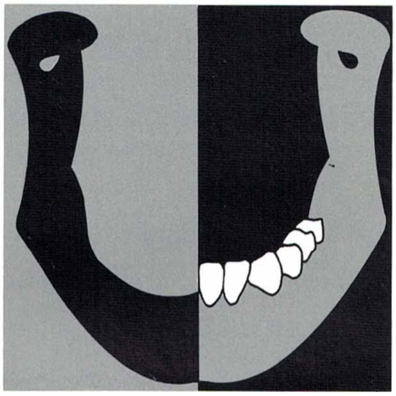
Mandibular Implants

A Dynamic Approach To Oral Implantology

Leonard I. Linkow



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These volumes are dedicated to my dearly beloved parents and beloved daughters, Robin and Sheree, whose love and support provided me with both comfort and strength.

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Knighted as "Sir" Dr. Leonard I. Linkow, by order of the Knights of Malta 1973.

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Foreword

Forty years is a long time in a man's life but a short time in history. The replacement of lost teeth in the bone with implants of foreign material has been tried for hundreds of years, but the final breakthrough of dental implants occurred with the first presentation of the subperiostal implants in the decade of 1940. There are mainly two reasons for this success. The first reason is the use of a suitable strong and inert material. Such a tissue tolerant material is Vitallium, developed for surgical implants, which made it possible to fabricate the first subperiostal dental implants. Another reason for success was the idea of distribution of force on the bone.

Bone is generally accepted as very sensitive, not only to chemical, but particularly to mechanical actions. The distribution of force to the bone, and the possible movements between the bone and the implant, are essential. The exact limits of these actions with implants are not known with the exception of what has been found from experiments disclosing that the natural tooth exhibits larger movements than an implant. It is essential to consider this last fact in connection with a bridge resting partially on natural roots, partially on implants. The implants without considering this fact will very easily be overloaded, resulting in loosening.

The above mentioned facts, in my opinion, have been considered to the upmost by Dr. Linkow. Step by step he has, from year to year, changed, very ingeniously, the design of his implants to satisfy these requirements. In titanium he has certainly found a most tissue tolerant material which is sufficiently strong. He has chosen a method of adapting his blade vents much closer to the bone than is possible with an implant resting on the surface of the bone. What also impressed me is the way Linkow, in suitable cases, has located the posterior implants to reduce the mastication force and the movements of the implant.

I should like to express my sincere congratulations, for the excellent results obtained, to the benefit of dentistry, and give all honor to the creator of the technique, and acknowledge further significant developments, such as the pterygoid and ramus implant systems.

Gustav Dahl, L.D.S., M.S.D.

Preface

When Dr. Linkow asked me to review his new book on Oral Implants I was complimented, of course, but somewhat dumbfounded. What could I contribute to a field about which I knew practically nothing? Yet the compliment of being asked plus a long standing family interest in dentistry encouraged me to comply with the request. My father, Dr. Ralph C. Cooley, of Houston was an outstanding and innovative dentist who specialized mostly in restorative dentistry for some 50 years. He would have been fascinated by the breadth of Dr. Linkow's knowledge of his subject.

After perusing the book it occurred to me that oral implantology was concerned with many of the same problems and obstacles which we encounter in developing a mechanical heart—namely those related to anatomical conditions, mechanical or functional requirements, choice of prosthetic materials, and rejection or infection. The rapid development of cardiovascular surgery during the past 25 years has been possible to an important extent because of prosthetic devices. Consequently, cardiac surgeons now have the capability of replacing virtually all of the cardiac components—the cardiac septa, the valves, the great vessels and even the conduction system by electronically controlled pacemakers. The technology which has developed in cardiac prostheses now supports a major industry in the health care delivery system. Improved devices appear almost daily and the future of partial cardiac replacement seems promising. Yet the one component which has not been successfully replaced is the myocardium or the basic pumping element of the heart. To accomplish this, the research team must develop a device as small, as efficient, as durable, and as adaptable to the physiological requirements as demonstrated by a most remarkable organ—the human heart. Perhaps the medical profession will necessarily be resigned to accepting a prosthesis which is quite inferior but at the same time useful for urgent situations or short term support. Nonetheless the beginnings of success were established by our team in 1969 when a two-staged cardiac transplantation was accomplished in a patient using an artificial heart in the first stage and three days later replacing it with a donor heart. The artificial heart maintained the patient's life for three days. But today, almost a decade later, the artificial heart has been improved and under similar desperate conditions could possibly maintain a patient's circulation not just 3 days but 3 weeks, 3 months or possibly longer.

Many of the problems facing further development of the artificial heart probably are shared by Dr. Linkow in "educating" the dental profession on dental implantology. He has pioneered and gained important experience which he now shares with his colleagues by producing this book. The longest journey must begin with a single step!

Denton A. Cooley, M.D.
Surgeon-in-Chief
Texas Heart Institute
Houston, Texas

Dr. Linkow is like all men of genius.

They are like thunderstorms — they go against the wind, they terrify people and they clear the air.

Dr. O. Krogsgaard-Jensen
President
Danish Academy of Oral Implantology

Introduction

My first two volumes, "Theories & Techniques of Oral Implantology", published by the C.V. Mosby Co., was a treatise of all the various disciplines of oral implantology. This included subperiosteal implants for completely edentulous mandibles as well as for unilateral situations occurring in severely atrophied mandibles. The many types of endosteal implants were thoroughly covered such as those of Formiggini, Peron Andres, Chercheve, Muratori, Tramonte, Lehmans, Sandhaus, and others, including my own self-tapping titanium vent-plant screws. Horizontal and verticals transfixations, transplants, re-implants, and endodontic endosteal stabilizers also were minutely described with accurate photos and detailed diagrams. Chapters were also included which illustrated the blade implant technique that I devised and pioneered.

With the advent of the endosteal wedge-shaped vented blade implant, implantology had marked an entirely new and profound dimension. Many colleagues who were skeptical regarding implants became more and more interested in this completely new and exciting system.

The eagerness and sincere wishes of so many of the dentists to whom I have lectured throughout most of the world, for a completely new book to be written by me exclusively on blade implants, had finally influenced me to pursue this new and unique volume.

All other types of implants in use prior to the blade were greatly limited in their usage, scope and success. Endosteal screw type implants depended on their depth in bone, their diameter, their inner and outer thread dimensions as well as the size of their vents, if any, for their retention. The tripodial pins for best results depended on their depth and degree of divergence from one another. The subperiosteal implants were only successful when placed over resorbed bone.

Lateral force breakdown usually occurred, especially in the completely edentulous maxillae and mandibles when screws and pins were the sole supports.

It was not until I began incising and reflecting the fibromucosal tissue to expose the underlying bone that I realized that the era of screw and pin implantology had to come to an end and would be replaced by something entirely different in shape, design and principle since many of our screws and pins were perforating the bone.

When teeth are extracted, the bone undergoes a dramatic change or remodeling. In time, the maxilla resorbs to a knife-edge ridge in a bucco-palatal direction, obliquely orientated from the horizontal plane, and the ridge resorbs to as thin as a few sheets of paper, but camouflaged by as much as 14 or 15 mm of fibromucosal tissue bucco-lingually and as much as 7 to 10 mm covering the residual bony crest. In the mandible, resorption often results in remodeling the mandible in a downward and flat direction leaving only the knife-like mylohoid ridge which has often been mistaken for the alveolar crest when covered by the mucoperiosteum. However, the mandibular periosteum is very thin, perhaps 1 to 2 mm.

From much experience I had come to realize that a new implant had to be designed that could readily be placed into these knife-edge ridges, shallow and oblique flaring ridges. An implant had to be designed that did not have to depend on its depth, diameter or degree of divergence to acquire retention. Instead, the implant had to be designed so that its mesio-distal diameter would give it its retention. An implant had to be designed where there were openings large enough to allow bone rather than merely fibrous tissue to grow through. An implant had to be so uniquely designed so that it could immediately withstand lateral as well as occlusal forces without requiring immediate stabilization. An implant had to be designed to be easily fitted into these knife-edge and shallow ridges and have a neck that could be bent to parallel the posts to one another. An implant had to be created that could easily be inserted by many dentists with the same degree of success. An implant also had to be designed to enable the researchers throughout the world to achieve the same histological results on animals as well as humans and on animal studies be able to keep them alive after removing their bone specimens. Thus was the creation of the Linkow wedge-shaped Endosteal Blade-Vents. I often parallel the designing of these various shaped blades with that of designing the nose cone of our space ships. Until the proper pitch and shape was created through much trial and error, the nose cone could never re-enter the earth's atmosphere without burning up. Similarly, until the new dimensional type blades were formed, too often the previous designed types of implants could never be inserted into the shallow, knife-edge ridges that exist in the atrophying maxillae and mandibles.

It was the very same teeth created by God that had been lost due to various aging and periodontal pathology because they could not tolerate the lateral forces brought to bear upon them. Therefore, after they were extracted and after remolding of the bone there remains even less bone than before, so why should implants be designed to recreate these lost roots? Something had to be designed to maximize the intrabony portion of the metal of the implant to the minimal amount of bone that is usually available in areas where the teeth were missing for various lengths of time. Most of the designs of the blades contact more bone on only one of their surfaces than most of the roots of teeth contact when in bone. Secondly, where the tooth root contacts bone only on its outer surface, the blade contacts bone on two of its broad surfaces. Thirdly, the blades have openings to allow for regeneration of bone, which gives it further retention and in most instances there is much more alveolar bone flanking the blade buccally and lingually than there exists around natural teeth and acts as stronger butresses against lateral force displacements.

Nature made a mistake in having a minimum amount of bone flanking our teeth in both jaws labially and buccally and a maximum amount of bone flanking the teeth lingually and palatally where the bone is least needed. Thus, when teeth are lost periodontally they are lost at the expense of the labial and buccal plates of bone, rarely from the palatal or lingual plates. To potentiate this occurrence all concavities existing in both jaws exist on the buccal and palatal sides bringing the bone even closer to the teeth labially and buccally. The blade being so thin bucco-lingually allows a maximum amount of bone to flank it buccally and labially especially when the blade is inserted nearer to the lingual.

This does not mean that all those patients who are completely edentulous require implants. Many people are perfectly satisfied with removable prostheses. However, there are three basic types of people today who can only function with implants.

The first category are those patients who cannot have well fitted removable appliances fabricated because of extreme anatomical and morphological conditions due to loss of bone, high muscle attachments, dehiscencies of the mental foramina and mandibular canals.

The second type of patients are those who psychologically cannot tolerate covering the entire palate with a conventional denture or a lower removable prosthesis with a lingual bar and clasps involving often innocent teeth on the other side of the arch.

Thirdly, there are those patients exhibiting enough bone and healthy tissue to function well with removable dentures who visit their dentists and demand that either they insert implants or refer them to someone who will insert the implants so they can have fixed rather than removable prostheses.

I have never attributed a failure of any implant to electrogalvanic action, metal transfer, or rejection, other than to an improperly designed and proper force distribution patterns can it be expected to stimulate the bone. The properly designed implant that is placed correctly into the bone can maintain the alveolar bone height and width through stimulation. This stimulation can be attained in at least two ways.

After the implant is inserted and some of the bone resorbs around its periphery as it did with the various metal screw type implants, it is replaced by fibrous connective tissue, mostly collagenous in nature. Since the tissue was already attached to the alveolar bone directly surrounding the implant, the innermost surfaces of the tissue would tenaciously bind around the threads and grow through the openings of the implant if the design exhibited these characteristics. Thus all occlusal forces brought to bear on the implant posts would be transmitted to areas of tension to the deeper portions of the implant via the pulling action of the fibers against the surrounding alveolar bone to which they are attached. These fibers pulling on the surrounding alveolar bone seemed to be all that was necessary to create a state of osteogenesis. It formed a mechanical suspensory type of ligament. Again, however, I must emphasize the fact that this only happened when the screw was correct and the widest portion of the screw which included all of the threads as well as the opened vents was buried well beyond the crestal bone. When these threads were too close to the crest, a V-shaped resorption of the surrounding crestal bone would occur since the pressure was greatest at the alveolar crest. Every movement of the implant laterally would cause excessive pressure at the crest since the wide threads were immediately contacting the bone in this area. Epithelial tissue would then replace the bone and prevent the more elastic fibrous tissue from adapting to that portion of the screw and finally the screw implant would loosen.

In the same manner when the open vents were placed too superficially to the crest, epithelial tissue would rapidly invaginate into them causing ultimate failure.

The tripodial pins failed for other reasons—mainly because the fibrous tissue that replaced the bone that resorbed around the pins could not tenaciously bind to them. Thus, the minute movements of the pins during mastication and swallowing became more excessive, since they slipped through the surrounding membrane cuffs. The membranes unfortunately could not be stretched and could not pull on the surrounding alveolar bone. The end result, as most qualified implantologists know, was an excessive amount of bone resorption camouflaged, however, by the thick buccal and palatal cortical bone flanking the medullary area.

It is my opinion that the bone can be stimulated in another manner. The wedge shape of the blade with the encapsulating fibrous tissue membrane can, through the intermittent pressure to the bone, cause a stimulating effect. Because the bone has a visco-elastic characteristic, the wedge can act as a minute hydraulic system, provided that a deep enough groove was made so that the blade could easily and gently be tapped into position without spreading the bone beyond its physiologic limits.

In 1971 I developed still another dimension in implantology which could very well have a great impact on dentistry. It replaces the maxillary subperiosteal implant designs for the totally and partially edentulous maxillae, which failed, because of their designs and eliminates these problems very efficiently. I call it the pterygoid extension implant, which was described in great detail in Volume I.

My latest five piece symphyseal-rami implant system replaces the mandibular subperiosteal implant in those situations where the mandibular canals and foramina are exposed. They will be thoroughly illustrated and described in this volume.

Implantology is a science but even more so, it is an art. When techniques and procedures are abused, failure can result. When executed by skilled, educated dentists with a thorough knowledge of the multi-discipline it must be considered the greatest advance in modern day dentistry.

An implantologist's attitudes toward morphology and prosthesis design differ from those of the dentist planning a conventional restoration. It is not a question of who is right or wrong, but of which method is used to compliment their techniques.

The totally or partially edentulous patient presents his case. The conventional prosthodontist selects a set of characteristic surface features, and designs his restoration to them. However, eliminating the alternatives does not produce The Only Solution; it is merely a convenient approach, based on frequently neglected observations in our field substantiated by clinical success and histological evidence.

Although the techniques demonstrated may seem difficult and radical, any skilled practitioner, given adequate guidance can learn to use implants to expand his therapeutic alternatives.

The following pages, which summarize some of the considerations involved in an implant procedure, are intended to stimulate the reader prior to reading the text. I look forward to sharing my enthusiasm with you.

Leonard I. Linkow

Morphology

The Mandible

Mandibular implant surgery tends to be easier than maxillary, primarily because mandibular morphology permits a wider choice of implant sites and more freedom in their use. The mandible has fewer anatomical landmarks potentially threatened by implant surgery or insertion. Further advantages over most typical maxillary interventions are provided by the denser bone typical of the mandible, and the characteristic reformation of a compact bony plate over both anterior and posterior edentulous sites. In the mandible gravity works with, not against, an implant seated on bone, as with the restoration. No matter how much of the residual dental arch remains, the shape of the mandibular body itself facilitates seating implants in a near-normal dental arch line or planning their posts in prosthodontically desirable positions.

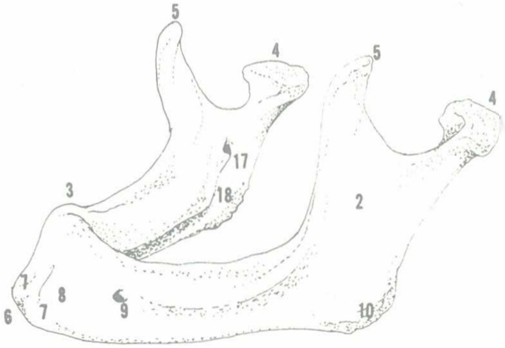
Because mandibular situations are less complicated, it is suggested that the inexperienced operator begin with them. However, remember that implant surgery follows a prosthodontic evaluation of the patient's needs, which may require restoring the maxillae first.

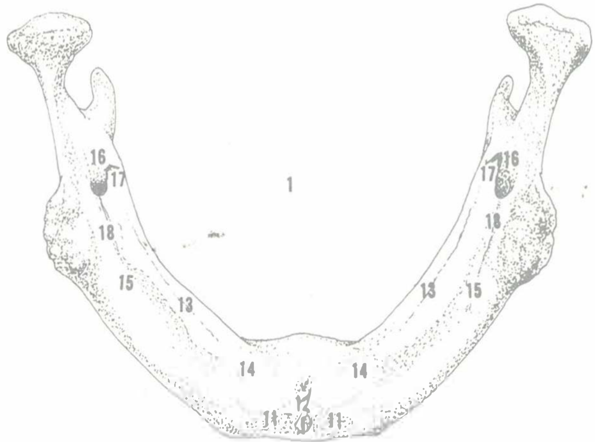
Morphology

As in the maxillae, implant surgery is directly related to mandibular morphology. The soft tissues must be incised and retracted to expose the implant site and, in some cases, to take impressions. The amount and shape of the bone in the proposed implant site will determine the type of implant and its insertion. Sometimes surgical modification of the hard or soft tissues is desirable to facilitate implant insertion or the seating of the restoration. Above all, the goal of implant surgery is the seating of stable abutments with a minimum of trauma. Implant surgery should be neither so complicated nor extensive that local nondental structures are threatened or prolonged healing periods are required. Simple, direct surgery based upon maximum utilization of local morphology is essential.

In most cases, the operative site is limited to the residual ridge, formed by a prominence or process of the mandible. The mandible is a strong, reinforced bone firmly fused at its midline, the symphasis menti. It is the only movable bone of the face. Its actions against the maxillae permit the mastication of solid foods and play a major role in speech formation. The mandible provides the skeletal framework for organs that participate in eating, swallowing and speaking. Among the most important of these, to the dentist, are the teeth.

The mandible consists of a horseshoe-shaped body (1), each free end of which ascends upward and backward at a sharp angle from the body as a mandibular ramus (2). The superior aspect of the body is the alveolar ridge (3), which varies in height, width, and inclination. Its lower border is thicker than the portions of the body, and smoothly rounded.





A ramus terminates as two processes: posteriorly, the condylar process (4), which lies in the glenoid fossa of the temporal bone and is separated from it by a meniscus (the temporomandibular joint); and anteriorly, the coronoid process (5), to which the temporal muscle is attached.

Numerous prominences and strongly reinforced areas that anchor muscles characterize the mandible, as do depressions that accommodate glands and muscles. On its outer surface, the mandible is thickest at the mental protuberance (6), or chin. This area is triangular in shape; its base projects bilaterally as the mental tubercles (7) and its ascending sides slope upward toward the dental arch. Within the curve of the slope is the mental fossa (8), pierced by a few small openings for blood vessels and nerves.

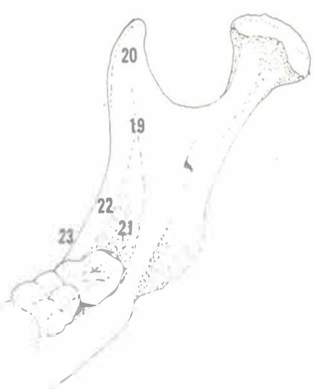
Below the dental arch, usually between the first and second pre-molars, is the mental foramen (9). Here the bulk of the mental vascular bundle passes out the mandibular canal into soft tissues. Lesser branches continue anteriorly within bone in the incisive canal. Whereas the mandibular canal is a distinct channel within the bone, the incisive canal diminishes, almost disappearing, as it nears the midline.

The mandibular angle (10), also a heavily reinforced area, is irregularly shaped and serves as an attachment site for the masseter and medial (internal) pterygoid muscles.

The inner surface of the mandible is highly irregular in shape, with numerous depressions and prominences. Anteriorly and inferiorly on each side of the midline is the digastric fossa (11), a shallow, elongated oval depression. Superior to the fossa, and closer to the midline, is the geniohyoid, or genial tubercle (12). This prominence may be a single, rather sharp prominence or, more commonly, two bilateral prominences. Occasionally the tubercle is divided into superior and inferior portions. When healthy teeth are present, this landmark is located below the apices of the incisors. After extensive bone resorption, the tubercle may be higher than the residual crest.

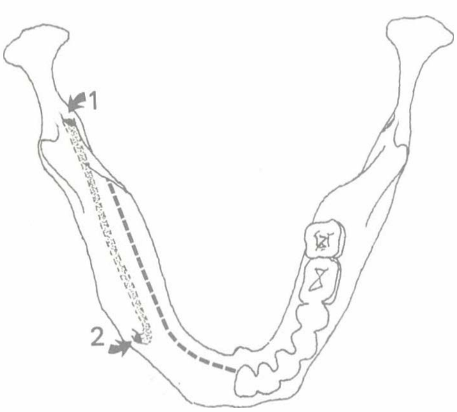
The mylohyoid line (13), originating in the third molar region and extending forward to terminate on the inner surface of the chin between the digastric fossa and the genial tubercle, is irregularly prominent. It is the crest of a pronounced ridge that juts bulkily from the body in most mandibles until at least the premolar area. Here it may begin to blend into the overall horseshoe shape of the body until its more anterior portion is indistinguishable, or it may continue as an obvious feature until it terminates between the digastric fossa and the genial tubercle. The mylohyoid line is the attachment site of the mylohyoid muscle, which forms the elastic floor of the mouth. The fossa above and below this line, or crest, are named for the glands that nest there: anteriorly and above, the sublingual fossa (14) for the sublingual gland; and posteriorly and below, the submaxillary fossa (15) for the submaxillary gland.

Almost centered on the internal surface of the ramus is the mandibular foramen (16), a wide opening that is the entrance to the mandibular canal. The anterior border of the opening may be modified and project backward over the foramen like a bony lip, the mandibular lingula (17). Sometimes the lingula is pronounced; other times it is almost indistinguishable. Extending downward from the foramen and slightly anteriorly is a narrow, sharply demarcated groove, the mylohoid groove (18), for the mylohyoid nerve.



The temporal crest (19) originates in the coronoid process (20) and becomes more pronounced as it descends toward the dental arch, where it abruptly turns almost horizontally forward and widens into a triangular shape, the retromolar triangle (21). Between this triangle and the anterior border of the ramus is the retromolar fossa (22), a depression advancing downward and forward between the alveolar process and the external oblique line, or ridge (23).

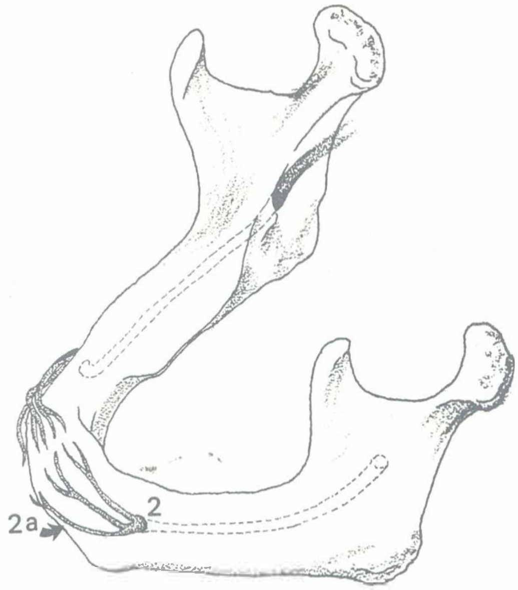
The preceeding index of mandibular landmarks is consistent with their presentation in most standard anatomy texts. However, identification relative to conventional location and function is not adequate. These features should be examined in terms of how they can be maximally untilized for implant procedures without subverting their normal anatomical roles.



Mandibular Canal (Inferior Dental Canal)

The major mandibular feature to be avoided during implant surgery or insertion is the mandibular canal, also called the inferior dental or inferior alveolar canal. This is a large, distinct channel in bone that runs through the ramus and body of the mandible from the mandibular foramen (1) on the medial surface of the ramus to the mental foramen (2) on the lateral surface of the body, usually in the premolar area.

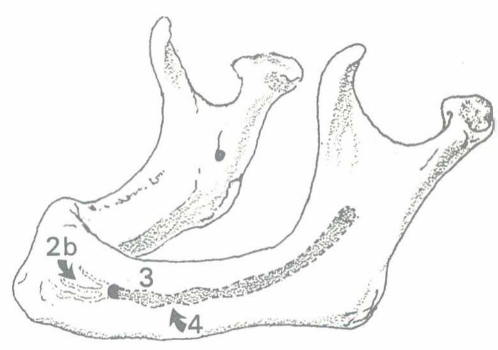
The mandibular canal contains the mandibular (inferior



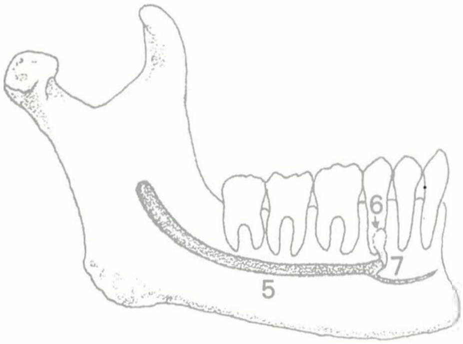
dental or alveolar) nerve, which supplies the bone and teeth up to the bicuspid region, where it bifurcates. The major portion of the nerve exits the mandibular body through the mental foramen and passes into and supplies the soft tissues of the chin and lower lip (2a). The smaller portion continues anteriorly within bone in the incisive canal toward the inferior aspect of the incisors (2b).

The fact that the mandibular canal bifurcates is often unclear radiographically. Nature being economical, the channels conducting the branches of the nerve are appropriate in size after bifurcation to the size of their respective neurovascular bundles. That portion arising from the mandibular canal and directed toward the mental foramen appears approximately the same size as the mandibular canal proper. The incisive canal is usually so much smaller in size than the mandibular canal, that the inferior dental neurovascular bundle appears to cease its course within bone at the mental foramen. In some cases, however, the incisive canal is quite distinct for a very short distance after the bifurcation. Then it rapidly narrows until it disappears near the midline.

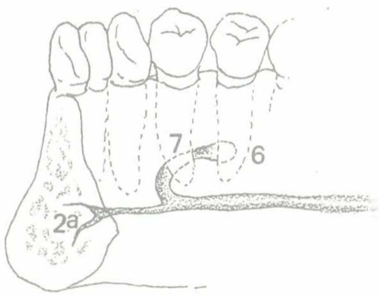
Typically the mandibular canal is uniform in width — about 3 mm. or less — from the mandibular foramen to the mental foramen. However, this dimension is often not consistent. Flared areas (3) may exist along the canal's course, or apparently compressed areas (4). These may be normal variations, and can usually be distinguished from pathological conditions by the presence of cortical bone at the canal margins, intact lamina dura in involved teeth and the absence of pain and other symptoms. Sometimes the difficulty in detecting an intact margin confuses the picture, and other diagnostic methods must be explored.



After entering the mandible at the mandibular foramen, the nerve descends rather steeply at first, sloping slightly anteriorly until it reaches the body of the mandible. Here it turns forward to pass toward the anterior portion of the bone and comes within the range of implant procedures. There are two basic positions of the canal to consider: its location in relation to the residual alveolar crest infero- superiorly, and its location laterally.

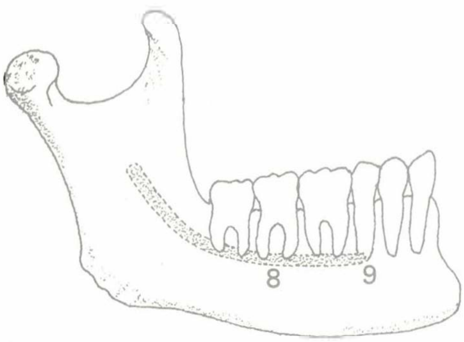


When normally healthy teeth in good occlusion are present, the position of the canal varies in relation to them. Most typically the canal lies immediately below the roots of the molars (5), with the distance between the canal and roots increasing as the canal progresses anteriorally. Where the canal bifurcates, usually in the region of the first premolar but sometimes slightly distally, it runs outward, upward, and sometimes backward to open at the mental foramen (6). Because this segment of the canal (7) distinctly departs from the horizontal pathway and conducts a branch of the nerve, some authors prefer naming it the mental canal.



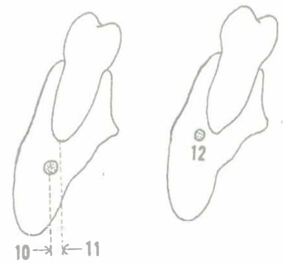
Because of the mental canal's oblique course, the mental foramen is often projected upon the apex of the second or, atypically the first premolar. The oblique course also gives the canal an almost U-shaped backward and upward sweep on some periapical projections.

In relation to the teeth, the canal in a few cases may lie well below their roots, closer to the inferior margin of the jaw than to the apicies of the roots. This occurs in persons who have a relatively high mandibular body combined with roots of moderate length. When the individual has a low mandibular body and long roots the canal appears to contact all molars and the second premolar. This situation is more common in children, whose mandibular body height has yet to increase by appositional growth at the alveolar crest accompanied by normal tooth eruption, than in a fully mature adult.

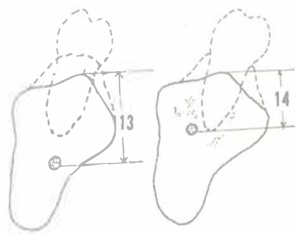


In some individuals the canal appears to be situated above the level of the molar apices (8) or, rarely, the bicuspid apicies (9). This is due to superimposition of the canal over the roots. Anatomically the canal (10) lies slightly buccal to the apices of the roots of the teeth (11). Thus a canal positioned high (12) on the mandibular body can appear to contact the teeth. Only very rarely are the roots of an abnormally inclined third molar in an atypically lingually offset alveolar process buccal to the canal.

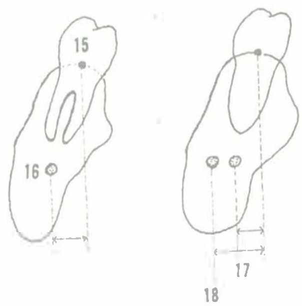
No matter where it lies in relation to the roots of the teeth, when teeth are lost the canal is higher on the mandibular body, closer to the alveolar crest. Tooth loss is always associated with bone loss, and bone loss is associated with an increasing proximity of an implant site to the mandibular canal. In terms of the amount of bone separating the alveolar crest from the mandibular canal after tooth loss, the individual whose canal lies well below (13) the roots of the teeth has an obvious advantage over one whose canal was so high (14) that it appeared superimposed over the roots. The more bone above the canal, the taller the bladevent body and consequently the greater the bone to implant contact.



In addition to a reduction in bone height between the alveolar crest and the mandibular canal, bone loss also leads to a shift in the relationship of the crest to the canal. Initially when teeth are present the crest (15) in the molar region is lingual to the canal (16), with the distance between the two points increasing as the canal courses forward. Variations in the initial distances are typical. The person with a thick mandibular body, usually a male, may have the canal only slightly buccal to the alveolar crest (17) or markedly buccal to the buccal surface of the roots (18), and therefore a "considerable" distance from the crest.

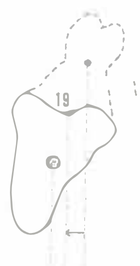


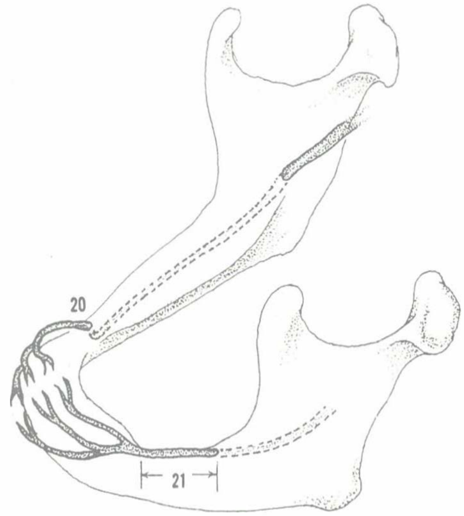
After tooth loss, the relationships between the crest and canal alter as the alveolar bone resorbs. In the mandible, particularly noteworthy in the molar region, the alveolar "crest" (19) eventually resorbs thus shifting bucally. This shift brings the crest and canal in closer vertical alignment. However, no matter how extensive the alveolar bone loss, occlusal radiographic studies of edentulous mandibles with a wire inserted in the canal and another laid over the center of the crest, do not reveal that the alveolar crest moves buccal to the mandibular canal. It always remains at least slightly lingual.

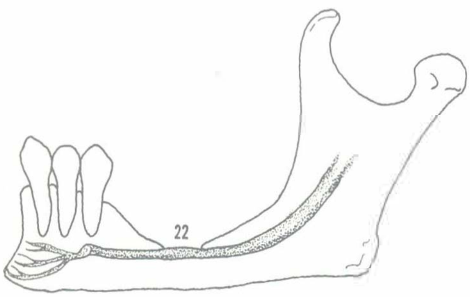


These relationships must be considered in making a bladevent channel. Angling a bladevent may avoid the canal, or moving lingually away from the crest and perhaps onto the mylohyoid ridge may prove more advantageous.

The mandibular canal is a normal anatomic space and, as such, has cortical layers of bone of varying thickness at its margins. These cortical layers and the canal itself produce a wide variety of appearances radiographically. Usually the canal appears as a narrow, dark ribbon with distinct white borders, but either the upper or lower border may be indistinct or not even apparent, or the canal may appear only faintly as a gray band. The mandibular canal is more accurately viewed in periapical projections, rather than in the panoramic radiographs that are otherwise so instructive to the implantologist. Therefore, periapical views are rec-







ommended when the operator is unsure of the canal's exact course in relation to the alveolar crest.

The bone between the cortical layers of the alveolar crest and the mandibular canal margin is spongy bone, and highly responsive to surface stress. Consequently, the bone separating the two points can be worn away. The canal then becomes a bony trough with its contents exposed to whatever pressures are applied to the surface of the ridge. The dehiscent situation is more common in the bicuspid region where the canal, as the mental canal, moves superiorally toward the crest and outward toward the foramen. A denture pressing on this area can be acutely painful and intolerable.

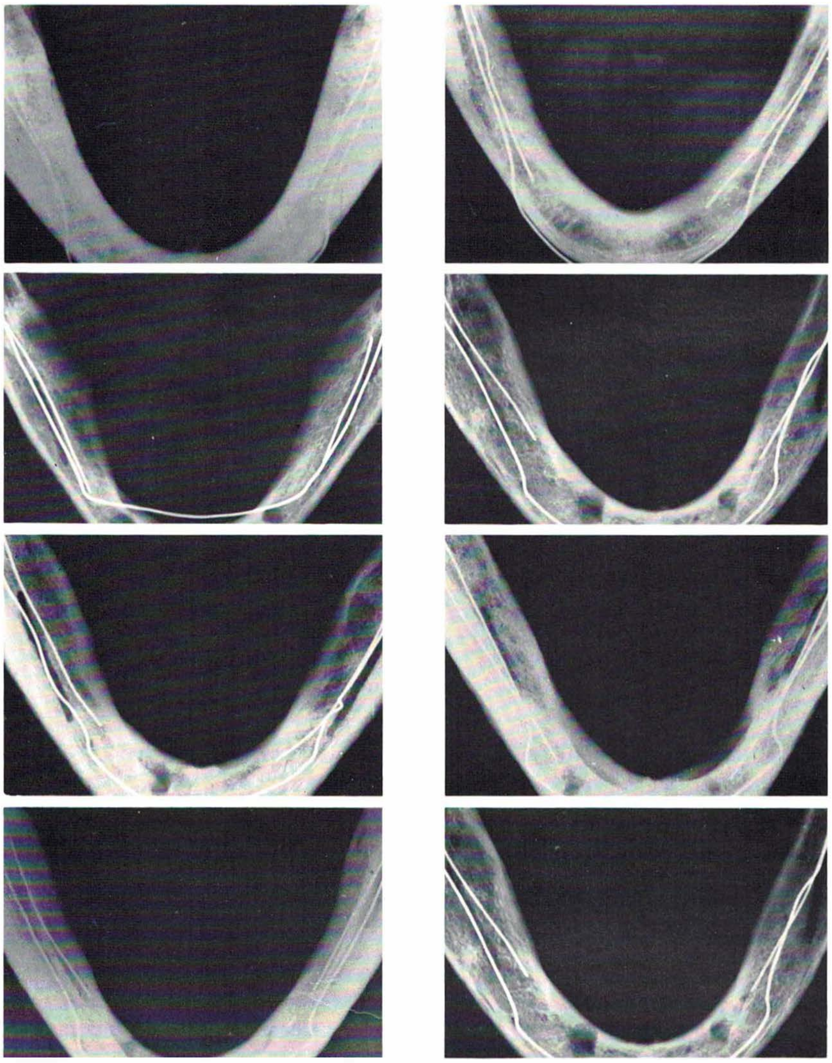
The neurovascular bundle can be locally dehiscent (20), or dehiscent along most of its entire length (21) in the mandibular body, from the bicuspid region through the molar region. A posterior dehiscency is less common than a mental nerve dehiscency, principally because the inferior dental nerve is further from the crest than the mental nerve is where it mounts superiorally to pass into the soft tissues. However, extensive periodontal disease, traumatic extraction of the molars or premolars, a poorly fitting denture that batters the ridge, or overerupted unopposed maxillary teeth can lead to a deep-dish picture of resorption in the more posterior edentulous areas. In an individual with a highly positioned canal, the likelihood of dishing producing a dehiscency is great (22).

When the mandibular or mental canal is dehiscent, the neurovascular bundle can be carefully deepened or repositioned. The original canal can be deepened with dental burs in partially or totally edentulous arches to seat a subperiosteal implant with its bars or struts on top of the ridge or a new canal can be made buccal to the original one in a totally edentulous mandible to insure a generous safety margin on the lingual side of the ridge for bladevent insertion.

The morphology of the blood vessels and nerves facilitates their repositioning. The blood vessels and nerves are ensheathed in a strong layer of connective tissue and form a distinct bundle. The size and elasticity of the neurovascular bundle make it easy to handle without tearing or otherwise harming it during surgical procedures.

Although the canal itself is considered the landmark, primarily because of the ease in identifying its course radiographically, it is the contents of this space and the possible effect on them from implant procedures that primarily concern the implantologist. Intruding into the canal with a bur during implant surgery can sever the blood vessels and nerve. Fracturing the upper border of the canal during implant insertion can drive bone chips into the contents or compress them, producing great pain if the accident remains undiagnosed. Seating a bladevent too close to the nerve sometimes produces pain or numbness in hypersensitive individuals. A subperiosteal implant pressing on an exposed nerve in any portion of the ridge will produce unfortunate results.

Any surgical procedure producing more or less permanent postsurgical pain is, of course, contraindicated. Or, if pain persists after healing, its cause should be remedied.

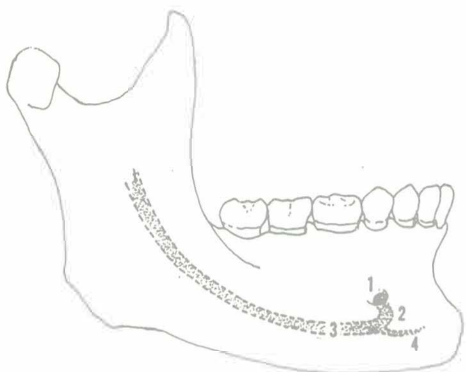


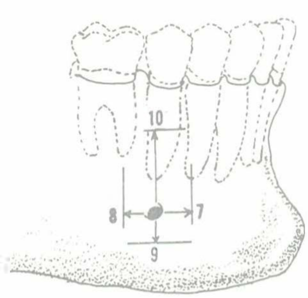
Occlusal films taken by the author on many mandibles that were wired through the entire length of the mandibular canals and by placing wires in the center of the existing residual crests, revealed, that the mandibular nerve in the body of the mandible is always slightly buccal to the center of the residual crest.

These results clearly indicate that in shallow ridges a blade can be inserted lingual to the existing crest and way beneath the mandibular canal, without causing a parasthesia providing that there is no submandibular fossa or just a slight concavity on the lingual side of the ridge.

If it occurs at all, parasthesia resulting from pressure on or damage to the mental nerve may disappear anytime from several weeks to several months, or never. When contemplating an implant procedure that might accidentally produce such a condition, the prospect should be carefully discussed with the patient. In my experience, most patients are willing to risk the chance in exchange for improved dental function and esthetic appearance. However, the operator's goal is to minimize risks by recognizing the course of the canal and anticipating variations in its structure or direction that might complicate otherwise simple, straightforward implant surgery or implant insertion.

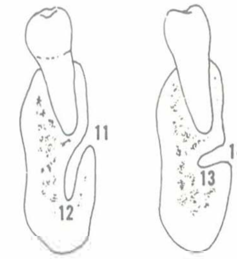
The Mental Foramen



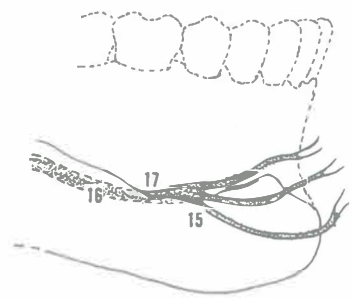


The mental foramen (1) is the opening through which the mental canal (2) releases its neurovascular bundle into the soft tissues to supply the lower lip and chin. The mental canal arises from the mandibular, or inferior dental or inferior alveolar, canal (3) where it bifurcates in the bicuspid region. The mental canal is usually the greater of the two branches. The other branch, the inferior incisal canal (4), continues anteriorly and inferiorly toward the midline within bone as a much less significant anatomical feature. Often by the incisor region the inferior incisal canal is indistinguishable radiographically. Sometimes, however, the incisal canal (5) is as large as the mandibular canal (6) for a very short distance after the bifurcation. This may be confusing radiographically, if the mental canal is not clearly depicted so that the bifurcation of the mandibular canal into two branches is obvious. Even if the inferior incisal canal does appear fat after the bifurcation, it rapidly tapers into the more typically thin size. Also it should be noted that after bifurcation, the branches diverge, with the incisal canal directed inferiorly.

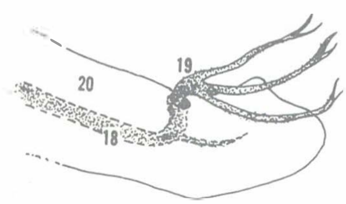
As the mental canal arises from the mandibular canal, it turns outward and slightly backward, terminating as the mental foramen at varying distances from the mandibular canal and from the alveolar crest. When teeth are present, the most common site for the foramen is at or immediately below the apex of the second bicuspid. However, in relation to the second bicuspid — its more common reference point — the foramen may appear mesial (7) or distal (8) to the root, and range in height on the mandibular body from well below (9) the apex of the root to almost half-way (10) up the root. Sometimes the foramen lies closer to the first bicuspid than to the second, again with its height at varying levels.



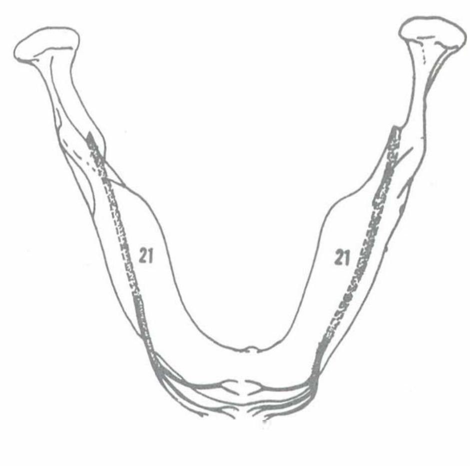
The foramen is higher than the mandibular canal, and it usually appears so radiographically. However, the distance of the mental foramen from the mandibular canal is difficult to determine from radiographs. It varies considerably, depending upon the precise location of the foramen (11) and the depth of the mandibular canal (12) within the mandibular body. Thus the length of the mental canal may range from a few millimeters to over one centimeter. The further the mandibular canal is from the labial surface of the mandible and the higher and more posterior the mental foramen is to the bifurcation, the longer the mental canal will be. And vice versa. Also, the mental canal (13) itself may be distinct radiographically because the shadow of the foramen (14) is superimposed.



When the site or jaw is edentulous, the alveolar crest becomes the most important reference point — particularly when implants are contemplated. Normally when the crest is high, the foramen is slighlty below an imaginary horizontal midline of the mandibular body. When the teeth are lost, ridge resorption moves the crest down toward the foramen. Extensive resorption may place the foramen (15) at the crest, with the mental canal — depending upon its course — dehiscent. If the mental canal rises only slightly superiorly from the mandibular canal, (16) its contents — and perhaps those of the mandibular canal — may be exposed (17). If the canal drops sharply down towards a deep mandibular canal (18), only that superior portion (19) near the foramen may be affected.



The variations in foramen and canal location are stressed to avoid diagnostic generalizations in terms of implants. For example, the superior location of the mental foramen — even with a partially dehiscent mental canal — does not necessarily contraindicate the use of bladevents posterior (20) to it. The mandibular canal itself may be a significant distance lower. Also in addition to bone above the canal, there may be adequate bone lingual to it (21) for a bladevent.



Normally the foramen lies within some mucosal tissue, and occasionally at the border of attached gingiva. When a good amount of bone exists in the area and the ridge is being exposed, it will probably not be necessary to expose the foramen. It will lie below the range of the contemplated implant insertion.

Extensive ridge resorption calling for the use of a subperiosteal implant will require exposing the foramen. This must be done with great care. After ridge resorption has lowered the crest and diminished the distinct contours of the alveolus, the foramen can usually be located by palpation. With its location by palpation coordinated radiographically, the soft tissues are incised and retracted (reflected).

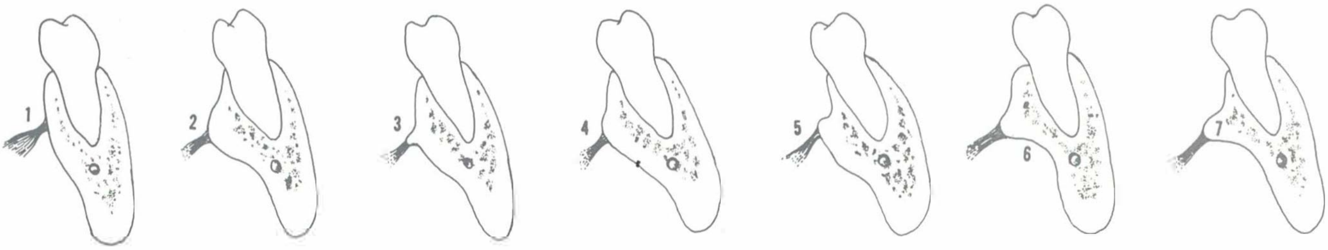
When bone resorption is extensive and the radiographs clearly indicate that the foramen is near the crest, the incision to reveal the ridge should be made lingual to the crest. As the scalpel passes the mental nerve on each side of the arch the incision can be made along the anterior crest, within the zone of attached gingiva, to avoid severing the neurovascular bundle.

The soft tissues should be reflected away from the crest with a blunt instrument, preferably a subperiosteal elevator, never separating from bone with a scalpel in this region. When a semilunar depression in bone is seen, the foramen has been reached. Great care must be used to probe around the tissues and free the neurovascular bundle. Because the bundle trifurcates as it leaves or soon after it leaves the foramen, all three branches must be freed. The neurovascular material is encased in elastic connective tissue, and will slip relatively freely within the tissues in which it is inserted. This gives a certain amount of freedom in handling the material.

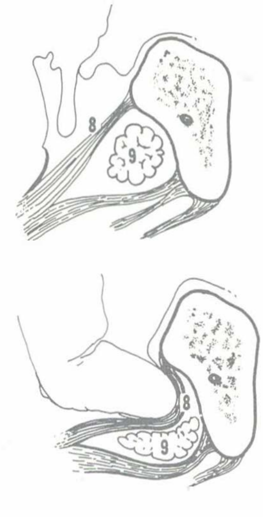
Because the foramen is an opening in bone and because the neurovascular bundle and its branches are distinct features, special attention must be paid to the area during impression-making procedures. All impression material packed into the foramen must be removed. It is very likely that impression material will creep under the neurovascular bundle and harden. The material must be freed under the bundle before removing the impression to avoid tearing the blood vessels and nerve.

The Mylohyoid Ridge

Mylohyoid muscle attachment begins low on the lingual side of the mental symphysis, between the digastric fossa and the genial tubercle, and gradually inclines diagonally along the mandibular body toward the ramus, ending at the third molar. In very few cases, bony reinforcement of the attachment site exists as a distinct ridge along the entire length of the site. In most cases, a notice-

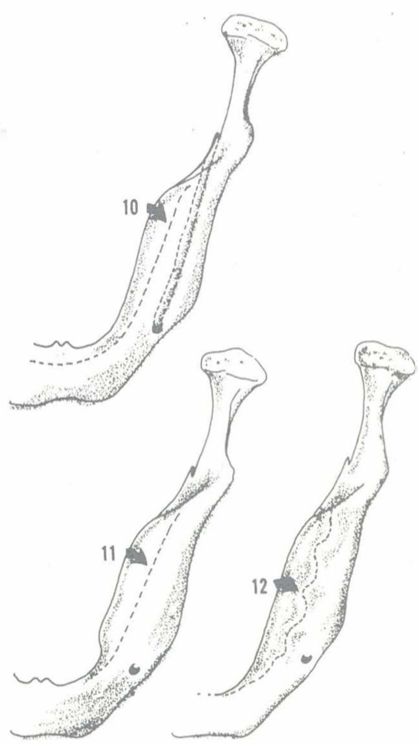


able prominence begins only in the bicuspid region, and becomes more obvious as it continues posteriorly. This prominence, the mylohyoid ridge, is almost continuous posteriorly with a ridge of bone that strengthens the coronoid process.



There are considerable differences in the shape and position of the mylohyoid ridge, and these differences affect implant potential. The ridge may range from a slight, smooth elevation (1) along its entire length, to a markedly bulky process with a smooth contour (2) or a sharply pointed crest (3). The ridge may be plump (4), or have concave walls superiorly (5), inferiorly (6), or both superiorly and inferiorly (7).

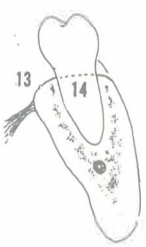
An unanticipated inferior concavity, or undercut, is particularly treacherous in implant surgery. Although exposing the entire implant site is mandatory in most other situations, tissue retraction to visualize the inferior limits of the ridge would require severing the tendonous attachment of the mylohyoid muscle to the ridge. Fortunately this is not necessary. The muscle (8) is a thin, flexible sheet and the tissues below it, including the submandibular (submaxillary) gland (9) are easily moved. To determine the shape of the mylohyoid ridge's lower border, the operator can palpate the inferior portion with his finger. The finger should probe the entire length of the intended implant site, because irregularity of contour and bulk are common. A nice plump bulge may abruptly become concave.



Viewed occlusally, the crest of the ridge also exhibits variability. The crest may form a smooth continuous line (10) that gradually blends into the overall horseshoe shape of the mandibular body; abruptly join the body in the bicuspid region (11); or be highly irregular along its entire length (12). The crest may also come to a relatively sharp point in some places, and be smoothly rounded and blunt in others.

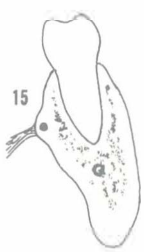
The density of the bone forming the mylohyoid ridge is also an important implant consideration. The amount of trabeculation is not necessarily related to the shape of the ridge. For example, in one individual a wide, bulky ridge may have very sparse, thin bone trabeculae; in another person the same shape ridge may have numerous dense ones. When the ridge is very bulky and heavily trabeculated, a dense shadow may appear on a radiograph. If the inferior margin of such a thickly trabeculated ridge abruptly ends, normal bone below the dense shadow can appear pathological in contrast — a diagnostic dilemma.

Fragility of the mylohyoid ridge should inspire extra caution in drilling an implant site. Too much pressure accidentally can drive the bur below the lower border of the ridge and into the submandibular fossa. It is also easier to fracture a more fragile ridge, either while inserting the implant or later through occlusal trauma. A bladevent also should not be seated close to the lingual border (crest) of a fragile ridge. Tension from muscle pull can fracture the thin wall of bone between the implant and the crest.

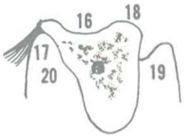


The position of the mylohyoid ridge on the body of the mandible also affects implant potential, in some cases because of its relationship to the residual alveolar ridge. For example, the mylohyoid ridge (13) may be almost level with the alveolar crest (14). In such a situation, after tooth loss tension from the mylohyoid muscle helps retard alveolar ridge resorption. The further the mylohyoid ridge from the alveolar crest, the less effective such stimulation for bone osteogenesis.

In a few cases, the mylohyoid ridge is located so low that it closely approaches the inferior margin of the mandibular body. This situation is more characteristic of the anterior portion of the mylohyoid ridge than the posterior. Furthermore, the mylohyoid ridge tends to become reduced and lower, less promising for implantation, where the mandibular canal moves labially and discharges the bulk of its contents through the mental foramen, leaving the alveolar ridge proper more favorable for implantation.



Typically in the molar region, the mylohyoid ridge and its crest (15) are level with the lower portion of the molar roots. As the alveolar ridge resorbs, the relationship between the alveolar crest and the mylohyoid ridge alters. Eventually the cancellous alveolar bone may resorb so extensively that the alveolar crest (16) lies below the mylohyoid ridge (17) and the external oblique ridge (18). At this stage, a conventional denture is difficult to fit because of the ridge's shape and the shallow buccal (19) and sublingual (20) vestibules. A poorly fitting denture irritates the soft vestibular tissues and mucoperiosteum, and often causes



resorption of both the mylohyoid and external oblique ridges by rocking against them. At this stage, oral surgery far more radical and extensive than implant surgery may be employed to fit the suffering patient with conventional masticatory replacements, when a sub-periosteal implant is the best solution.

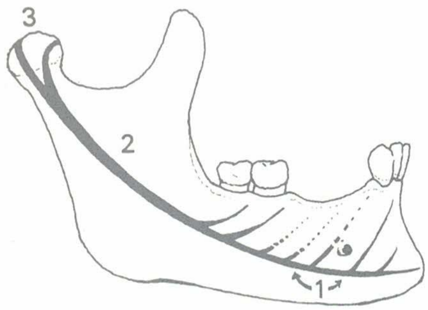
The mylohyoid ridge is principally used as an endosteal bladevent site when a bladevent cannot be used in the alveolar region due to proximity of the mandibular canal. Also, because a bladevent provides a stronger abutment than does a posterior unilateral subperiosteal implant, mylohyoid ridge implantation is attempted when a posterior unilateral site is opposed by strong natural teeth. In these situations the mylohyoid ridge's shape must permit inserting the bladevent without too closely approaching the mandibular canal, threatening a fracture, or penetrating the submandibular fossa.

Stress Adaptations

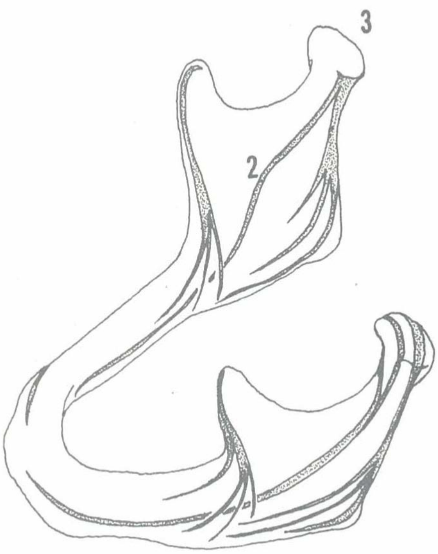
Mandibular and maxillary adaptations to mechanical stress are strikingly different. Whereas the maxillae are firmly fused to other bones of the upper face, the mandible is separate. It is the only movable bone of the face. This characteristic, and the fact that the mandible does most of the work during mastication, are reflected in morphological adaptations to pressure and tension.

The alveolar processes of the maxillary and mandibular jaws have responded to masticatory pressure in similar ways, at least initially. The alveolar bone surrounding the teeth in both arches is highly trabecular. Pressure on the teeth is transmitted as tension by the periodontal ligament, and the trabeculae are arranged along the lines of tension. They run horizontally in regular or irregular patterns between the teeth and toward the compact bone that forms the outer walls of the ridge, and extend beyond the apexes of the teeth in patterns that differ according to the arch and the tooth's position in the arch. The similarity in adaptive patterns around the teeth in both arches ends beyond the alveolus proper.

The posterior teeth in both arches have more alveolar bone laterally than do the anterior teeth, which may be covered by only a thin layer of compact bone. The amount of trabeculated bone and the thickness and regularity of the trabeculation reflect the amount, type, and direction of stress in that particular area of the dental arch.

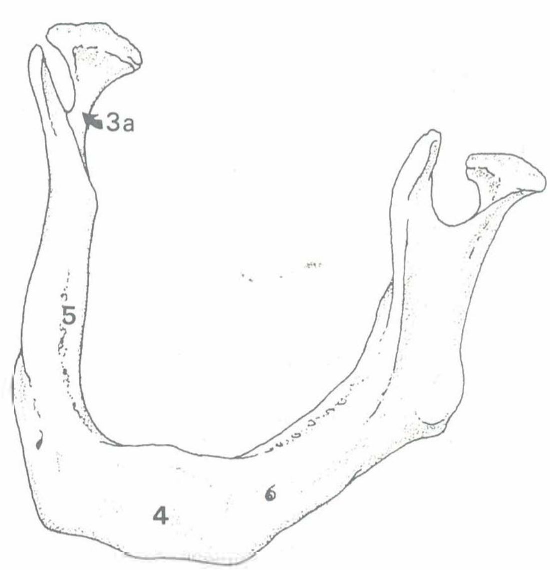


In the maxillae, masticatory pressures on the dental arch are dissipated by being deflected upward over strengthened pillars of bone and around pneumatic cavities. These function in much the same way as does an arch in the wall of a building. Certainly nature's upper facial accommodations for stress distribution equal in beauty and efficiency the Gothic cathedral's, with the additional bonus of serving functions other than mechanical as well.

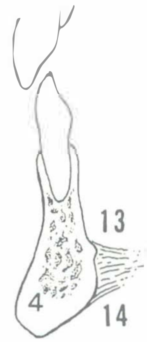


As a separate entity, the mandible must accommodate masticatory pressures within its body and relay them for dissipation. Thus alveolar trabecular bone is continuous with the cancellous bone that comprises the inner body of the mandible. Below the teeth, the trabeculae unite into a strong trajectory that leads force away from the dental arch. *This trajectory, the dental trajectory* (1), increases in strength and bulk as it runs posteriorly along the body of the mandible and ascends through the ramus (2) toward the condylar process (3) and the temporomandibular joint. Its strength is quite apparent on the inner surface of the ramus, where it forms a distinct ridge, called the ridge of the mandibular neck (3a).

At the condylar process some of the masticatory forces are transmitted to the base of the skull over the temporomandibular articulation. However, the mere fact that the stresses must pass through a resilient joint also serves to dissipate them. The power of masticatory pressure is amply demonstrated in those individuals who suffer sharp pains, headaches, and other discomforts as a result of temporomandibular joint dysfunction.



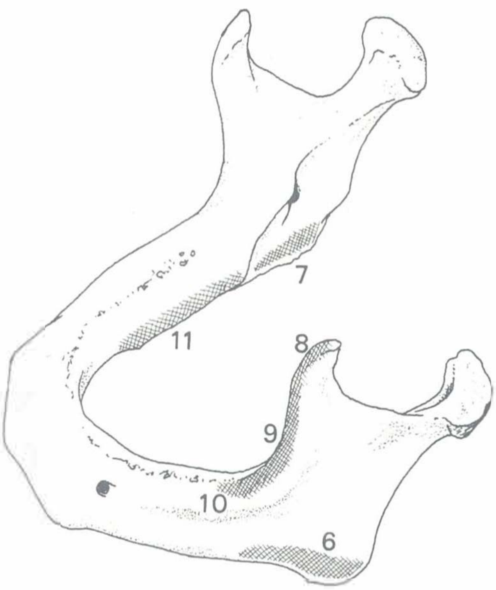
The mandible is also acted upon by forces not experienced in the maxillae, and its outer layers reflect this. Muscle attachments in the maxillae are weak; in the mandible they are unusually strong. The powerful muscles that open and close the mouth exert bending forces. Lateral thrusts of the mandible exert compressing forces. In response to these distorting influences, the mandible has a "shell" of thick cortical compact bone (4) around its entire surface. This reinforcement alone makes the lower alveolar process far stronger than its maxillary counterpart (5) in most areas.

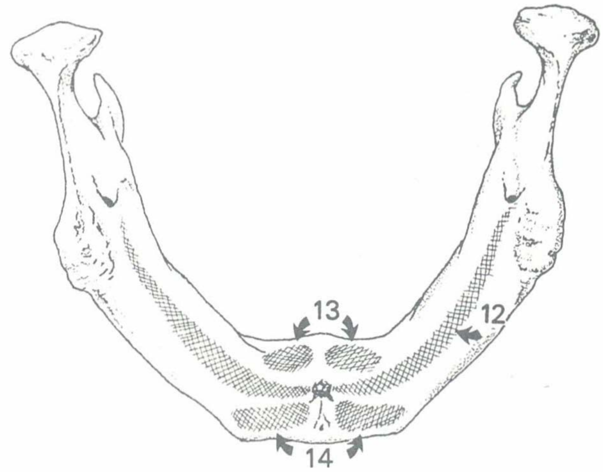


Muscle pull has encouraged the formation of distinct, bulky ridges, named masticatory muscle stress trajectories. There is increased deposition of bone on the mandibular angle, on its external surface by the action of the masseter (elevator) muscle (6), and on its internal by the internal pterygoid (elevator) muscle (7).

The deep tendon of the temporal (elevator) muscle, which is generally longer and more prominent than the superficial tendon, attaches at the coronoid process (8), and its tendonous insertion descends along the anterior edge of the ramus (9) to the temporal crest toward the alveolar process. The retromolar triangle is a continuation of the temporal crest that bifurcates around the alveolar process. Its buccal continuation, the external oblique ridge (10), is a particularly noteworthy bulwark against deformation.

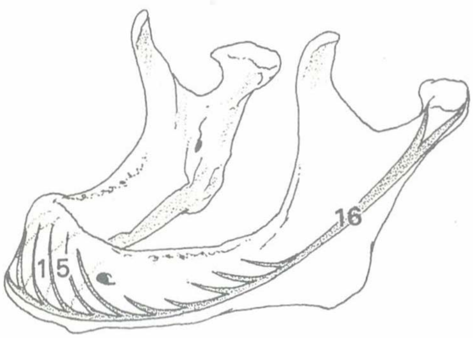
The mylohyoid (depressor) (11) muscle, which forms the floor of the oral cavity, attaches along the body of the mandible from near the midline to the third molar area. In most individuals,





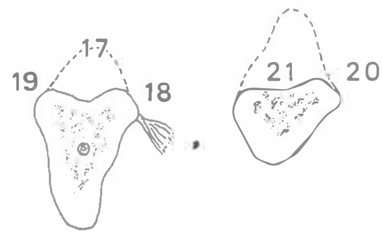
the muscle is associated with a strong, prominent ridge (12), which provides horizontal reinforcement against the bending tendencies of muscles attached to the chin.

The chin is subjected to stress by several muscles. The mylohyoid, geniohyoid (depressor) (13), and digastric (depressor) (14) muscles anchor in bone on the lower inner surface of the chin, near the midline. The two lateral pterygoid muscles pull the mandible inward. In response to these forces, the chin is reinforced by massive compact bone that forms the mental protuberance. Internally the trabeculae form tracts at right angles, making a cancellous bony network (15) that extends diagonally across the midline from the lower border of the mandible to the alveolar crest.



Between the trajectories and the compact cortical bone of the mandible, the cancellous bone is relatively free of stresses, and its trabeculae are thin, poorly organized, and the marrow spaces wide. An example important to the dentist exists in the angle of the jaw. The reasons being 1.) hematopoetic marrow is stored there. 2.) a deep submandibular fossa may add to the radiolucency. 3.) the size or diameter of the inferior alveolar canal may also contribute to the translucency. Formerly this was considered, and named, a "zone of weakness" (16) by implantologists. Here there are simply not enough bone trabeculae to engage post- or pin-type endosteal implants. These types of implants usually cannot be successfully stabilized because of the scarcity of solid bony contact. The bladevent implant, however, does contact adequate trabeculae because of its broad horizontal extension in bone. Thus of all the endosteal implant designs to date, the bladevent is the most effective in this particular area of the mandible. Even when the bladevent is used, however, the weakness and thinness of the bone trabeculae should be taken into account when making the implant socket and seating the implant.

Mandibular stress trajectories have been detailed because of their profound influence on implant potential. Unless the mandibular alveolar ridge is severely traumatized, it tends to resorb more slowly than does the maxillary ridge under similar conditions. Initially in most sites, particularly the posterior ones, the ridge is stronger than its maxillary counterpart due to the affects of nearby muscle attachments. When a tooth is lost, muscle pull tends to help maintain alveolar bone as the stresses are diverted toward trajectories. The strength of these trajectories is exemplified by the shape of a severely resorbed alveolar ridge. The alveolar crest (17) sinks between the mylohyoid (18) and the external oblique (19) ridges, which are maintained by muscle pull. Anteriorly in cases of extreme resorption, the genial tubercles (20) may be higher than the alveolar crest (21) proper.

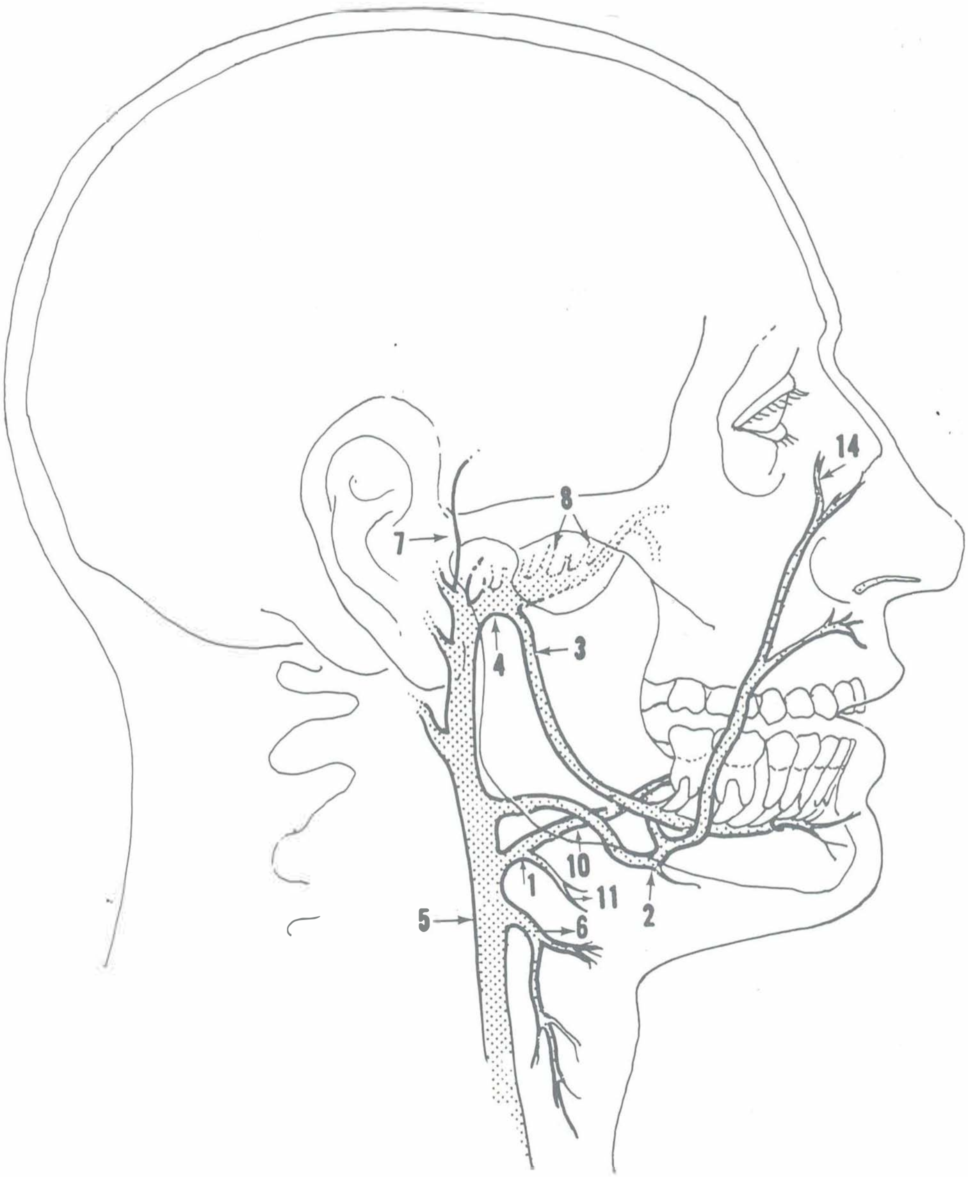


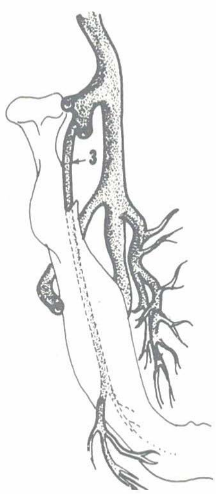
The changing relationships between the muscle-maintained ridges and the alveolar crest cause numerous problems in designing a stable conventional denture. With a convenient, mound-shaped ridge lost, the denture is difficult to stabilize. It can, and often does, batter the residual ridge into ulceration and resorption. Corrective surgery to reposition the muscle attachments and reshape the ridge may be the only solution when using a conventional appliance.

Implants offer alternatives. The implantologist can possibly utilize the muscle-maintained ridges as potential bladevent implant sites, depending upon the presence or absence of concavities and the location of the mandibular canal. The bladevent may be offset-lingually in the residual crest, but form a relationship to the maxillae that is nearer to natural than that possible with a conventional appliance. Because the alveolar crest tends to migrate outward posteriorly as the maxillary crest moves inward, offsetting a bladevent lingually may prove distinctly advantageous from a prosthodontic point of view.

When the cancellous alveolar bone has extensively resorbed in the mandible, the thick compact bone forming the mandibular "shell" remains. Furthermore, a generous layer of compact bone reforms over the crest. Compact bone is exceedingly stable; it does not resorb under surface pressure. This characteristic, plus the firm anchorage permitted by its distinct horse-shoe shape, make the mandible ideal for a subperiosteal implant.

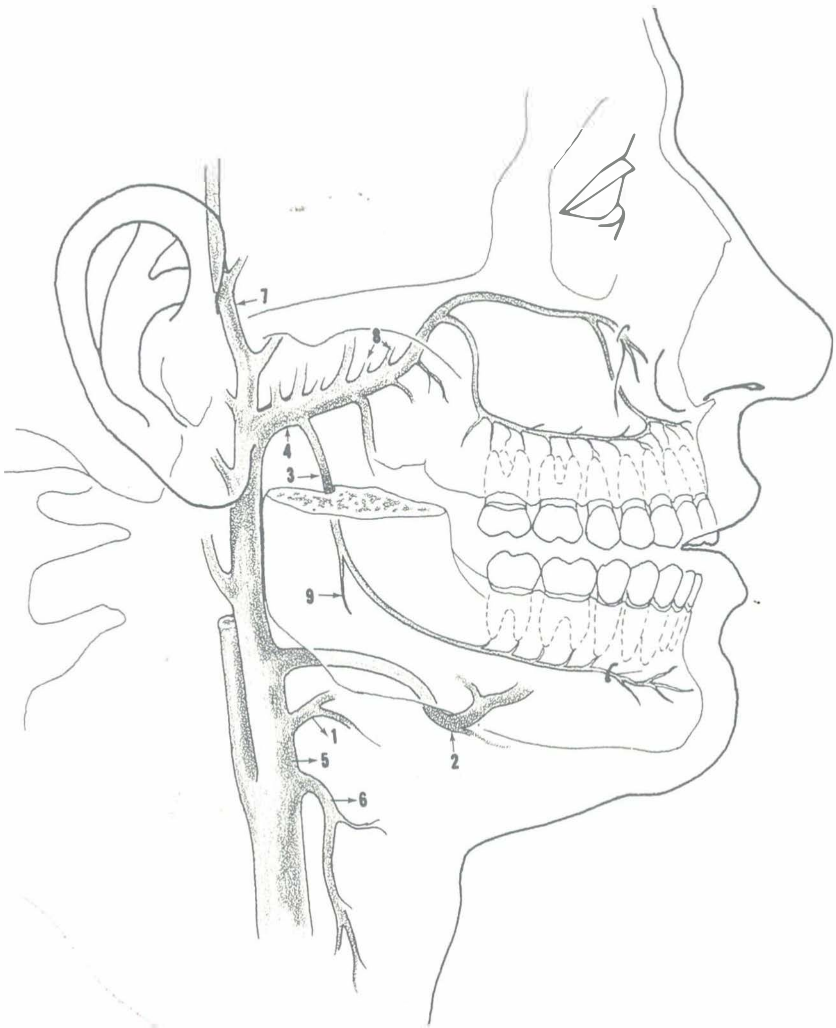
In summary, whereas maxillary adaptations to stress minimally retard the loss of a distinct bony dental arch, mandibular trajectories encourage the maintenance of the bony ridge. These factors help make the mandible a more favorable implant site.





Arteries

Three major arteries supply mandibular implant sites: the lingual (1), facial (2), and inferior alveolar (3) branch of the maxillary artery (4). The lingual and facial arteries arise directly from the external carotid artery (5), in the region of the mandible or just inferior to it, above the superior thyroid artery (6). The maxillary artery is formed as the external carotid bifurcates just



below the level of the mandibular neck within the parotid gland into the superficial temporal (7), and maxillary arteries. The common origin of the three arteries involved in most dental procedures is noteworthy in stemming a hemorrhage within the oral cavity when it cannot be stopped locally.

The origin of the inferior alveolar artery varies, depending upon the relationship of the maxillary artery to the pterygoid muscle. If the maxillary artery is superficial to the lateral pterygoid muscle, the inferior alveolar artery directly branches off the maxillary artery. However, if the main artery follows a deep course, it produces a branch which winds around the lower border of the lateral pterygoid muscle (8) and bifurcates into the posterior deep temporal artery and the inferior alveolar artery.

Almost at its point of origin the inferior alveolar artery turns almost vertically downward, usually closely following the lingual surface of the ramus. It enters the ramus at the mandibular foramen, and moves inferiorly and anteriorly together with the mandibular nerve within the mandibular canal. Just before entering the canal, the inferior alveolar artery produces the mylohyoid artery (9), which accompanies the mylohyoid nerve to the mylohyoid muscle, where it anastomoses with branches of the submental artery.

Two phases of implant surgery might threaten the inferior alveolar artery and one of its branches, the mental artery. When retracting the mucoperiosteal tissues to expose the ridge in the region of the mental foramen, great care must be taken not to perforate or tear the mental artery as it leaves the body of the mandible. A scalpel should never be used here. The subperiosteal elevator, used to push the periosteum and its overlying tissues away from the bone, should not be directed down at the neurovascular bundle but rather worked around it. As the instrument is worked toward the bundle, a semilunar circle will appear. This is the superior margin of the foramen. Because the neurovascular bundle is ensheathed by loose connective tissue, the mucoperiosteal tissues should slip along the vessels away from the bone, leaving the bundle safely intact.

Impression-taking can also damage the mental artery and its accompanying vessels as the operator tries to remove a set impression without checking to see if the impression material has crept under the neurovascular bundle. Pulling the artery in such a situation can bruise or tear it.

The more obvious danger to the inferior alveolar artery is drilling in the bone above the mandibular canal to create a seat for an endosteal bladevent. The sweep of the canal within bone must always be determined radiographically, and distances between the superior limit of the canal and the alveolar crest carefully noted. The mental foramen area may be confusing because of differences in the divergencies of the mandibular, incisive, and mental canals.

When the mandibular canal appears to closely approach the alveolar crest or be right at it, the incision to reveal the ridge should be made lingual to the crest, within the zone of attached gingiva. The canal tends to run buccal to the crest, and offsetting the incision lingually should avoid interference with its contents.

If the inferior alveolar artery is severed accidentally and local pressure is not sufficient to stop profuse bleeding, pressure must be applied above the mandibular foramen, where the artery enters the ramus. Copious or continuous bleeding must be stopped by ligating the artery.

As for the incisive artery, its branches are little larger than dental arteries. They are usually so small that severing them does not necessitate measures to stop blood flow.

The lingual artery may originate at the external carotid artery above the superior thyroid at the level of the greater horn of the hyoid bone, or it may arise from a short trunk — the linguofacial trunk — which it shares with the facial artery. The lingual artery runs almost horizontally forward. As it approaches the tongue, it sends a branch to the hyoid bone and its attached muscles.

As the inferior alveolar artery passes through the mandibular canal, it sends branches into the marrow spaces of the bone toward the alveolar process. Some of these supply the teeth, entering their root canals through the apical foramina, and others supply the interdental and interradicular septa. As these arteries ascend, many small branches arise at almost right angles and supply the periodontal ligaments and eventually the gingiva. In the gingiva these twigs anastamose with superficial branches of the arteries supplying the oral and vestibular mucosa, richly providing these tissues with blood.

Of particular importance here is the diminishment of blood to the mandible when teeth are lost. Upon the loss of a tooth, the arteries supplying its pulp and periodontal membrane are no longer functional. Nature being economical, these tend to resorb, leaving only those arteries that supply living bone cells and the gingiva. In comparison with the maxillae, with their numerous nondental functions, the body of the mandible may become relatively poorly supplied with blood. The denser areas, and they are many, are typically poorly supplied initially, in accordance with their more static state. Upon tooth loss, a major source of blood, the dental arteries, diminish. Thus compared with other bones, the superficial parts of the mandible are not so freely supplied with blood. As the alveolar ridge is exposed and subjected to surgical trauma, it may necrose, particularly if the inferior alveolar artery is injured during the procedure. Thus the contents of the mandibular canal — blood vessels and nerve — should be carefully attended during surgical procedures.

In the bicuspid region, the inferior alveolar artery bifurcates, sending the larger branch through the mental foramen into the chin as the mental artery. This artery provides oxygenated blood for the soft tissues of the chin, and anastamoses with branches of the inferior labial artery. Within bone, the smaller branch continues anteriorly toward the midline as the incisive artery. This artery produces numerous smaller branches which supply the incisors and pass out of the bone into the soft tissues through the incisive foramina. These incisive foramina are usually very distinct on dried specimens of the mandible.

Injury to the smaller twigs supplying the residual crest is usually uneventful. Blood quickly clots within the small severed artery, stopping the hemorrhage, and healing proceeds without undue delay. The exception to this might be in the patient with clotting difficulties, a tendency toward which the patient is probably aware and can reveal in a competent medical history prior to an implantation procedure.

Due to poor blood supply, healing may be slow in the mandible. The monitoring effects of blood on healing are less responsive in a poorly vascularized area than in a richly supplied one. Thus surgical procedures should avoid excessive trauma, and be rapid and efficient. Delays in closing the site should be avoided, and sutures should closely reapproximate the tissues.

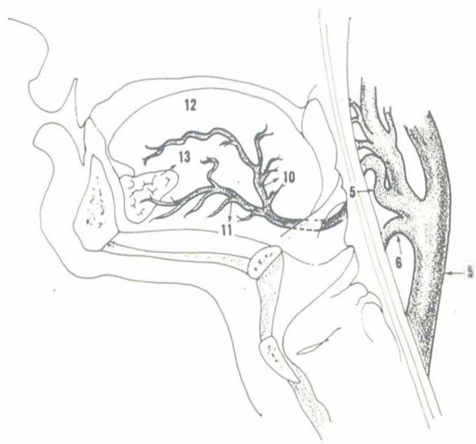
Before the lingual artery turns into the body of the tongue, it divides into two major branches: the deep lingual artery (10) and the sublingual artery (11). The deep lingual artery, the major continuation of the parent artery, runs upward into the body of the tongue (12) and passes forward in a tortuous course to the tip of the tongue, where one of its terminal branches anastamoses with its bilateral counterpart to form the acus raninus. In the more anterior portion of the tongue, the deep lingual artery lies very close to the inferior surface of the tongue. Its course through the tongue is characterized by numerous curves that flatten as the tongue elongates and changes position.

In the base of the tongue, the deep lingual artery gives off one or more branches that arise almost vertically to supply the dorsum of the tongue. These are the dorsal lingual arteries.

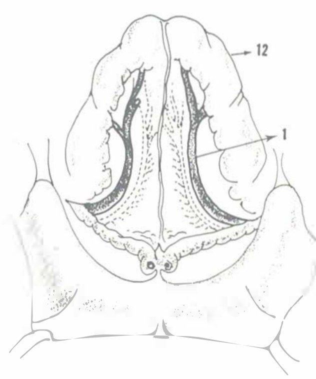
The sublingual artery courses along the floor of the mouth medial to the sublingual gland (13), which it supplies. More importantly to the implantologist, the sublingual artery supplies the mylohyoid muscle. Within the mylohyoid muscle, the sublingual artery anastamoses with branches of the submental artery, a branch of the facial artery.

In some cases, the major arterial supply to the sublingual regions derives not from that branch of the lingual artery called the sublingual artery, but from a branch of the submental artery. Typically the paths of the "true" sublingual and the submental arteries run almost parallel, the sublingual near the inner and upper surface of the mylohyoid muscle, and the submental on the outer and inferior surface of the muscle. These arteries freely anastamose, and a well developed connecting branch of either artery may perforate the muscle and assume the function of the other artery. This potential — replacement of the sublingual artery by one or more branches of the submental — occurs when the sublingual artery is small, insignificant, or absent, and is clinically significant. A sharp instrument or rotating disc may slip and cut the floor of the mouth, severing the artery.

If the accident occurs in the premolar or first molar region, there may be considerable bleeding. Local clamping, the first method of choice, is difficult, and the operator must stop the bleeding by ligating the artery feeding the injured artery. The lingual artery, which must be approached through the submandibular triangle — bounded by the lower border of the mandible and by the two bellies of the digastric muscle, usually feeds the injured sublingual artery. However, the operator should recognize that he may have severed a branch of the submental artery, and treat the situation accordingly.



The facial artery may originate separately from the external carotid artery or arise from a short trunk shared with the lingual artery, the linguofacial trunk. When it arises directly from the external carotid, the more typical situation, it arises just below the posterior belly of the digastric muscle, or slightly higher, in which case the muscle covers its origin. It runs obliquely upward and forward, entering the submandibular triangle where it is covered by the submandibular salivary gland. At or near the superior border of the gland, in the region of the mandibular angle, the artery turns sharply laterally, obliquely anteriorly, and slightly downward toward the angle of the mandible. Here, on the mandibular angle in front of the anterior border of the masseter muscle, the facial artery swings around the bone and upward into the soft tissues of the face. At this point the pulse can easily be felt.



As the facial artery ascends superiorly toward the corner of the mouth, lateral border of the nose, and inner corner of the eye, it follows a winding course that permits unimpeded blood flow as the lips and cheeks expand and move.

Near the corner of the eye, the facial artery terminates as the angular artery (14), anastamosing with branches of the opthalmic and frontal arteries.

The facial artery has numerous branches, which can be classified as cervical and facial branches. Of the two major cervical branches, the ascending palatine artery and the submental artery, the latter is more likely to be involved in mandibular implant procedures. The submental artery branches off the facial artery before the facial artery rounds the mandibular bony border and swings upward into the face. The main branch of the submental artery passes anteriorly with the mylohyoid nerve and supplies lymph nodes in the submandibular triangle, the anterior belly of the digastric muscle, and the mylohyoid muscle. Near the chin, a terminal branch of the submental artery curves sharply upward and anastamoses within the soft outer tissues of the face with branches of the inferior labial artery, another branch of the facial artery.

The submental artery is of particular interest because when it substitutes the sublingual artery proper, it can be accidentally severed during oral surgery. If the hemorrhage cannot be stopped locally, the operator must determine whether the "sublingual" artery is being supplied by the submental or the lingual artery. Either must be ligated, in the case of the submental artery by exposing the facial artery where it crosses the lower border of the mandible and following it posteriorly to where it gives rise to the submental artery in the region of the superior anterior portion of the submandibular gland.

In the majority of cases, the only other branch of the facial artery that might be injured during oral surgery or working with sharp implements or instruments in the mouth is that segment of the ascending facial artery running through the cheek at the level of the inferior vestibular fornix in the region of the first mandibular molar. If an instrument slips and cuts the cheek in this region, severing the facial artery, it may be necessary to stop bleeding where the artery swings around the lower border of the mandible in front of the masseter muscle. This focal point is fairly easy to locate by palpation. The patient clenches his jaw, making the masseter more prominent, and the dentist feels immediately in front of the muscle for the pulse, which is fairly strong. If compressing the vessel against the bone until clot formation begins is not sufficient, the area should be exposed for ligation of the artery.

Veins

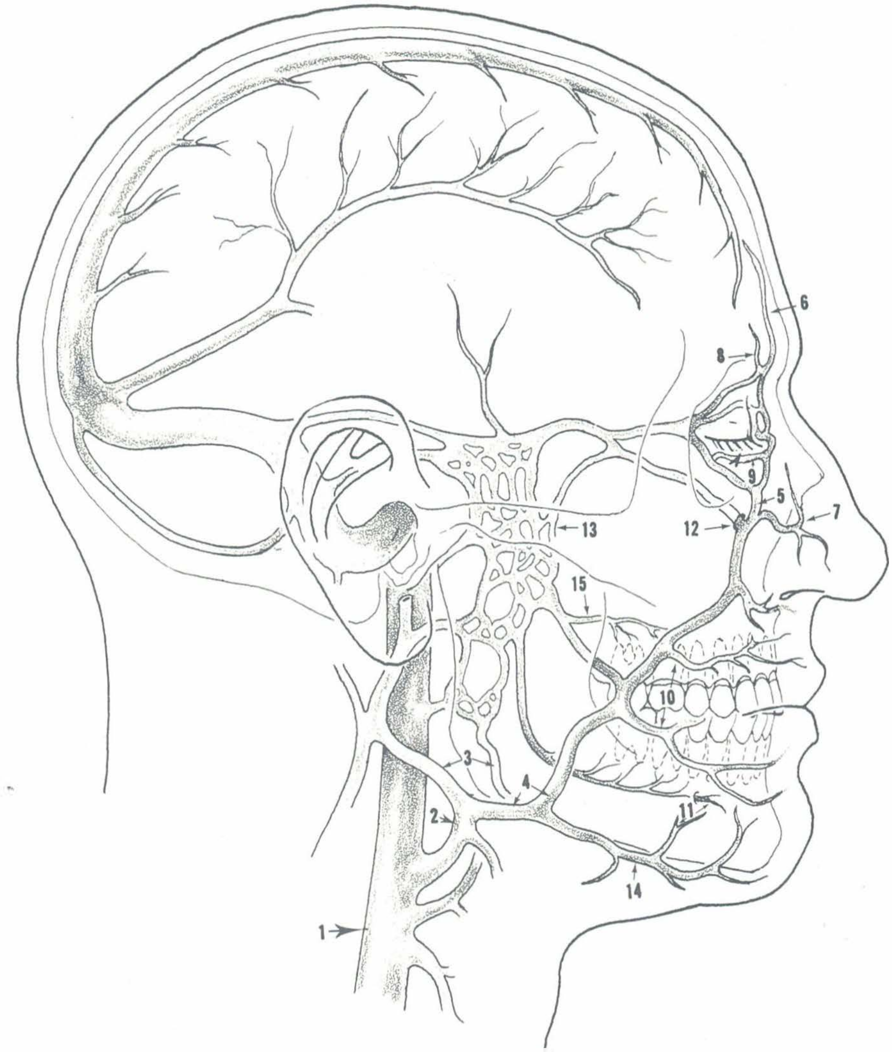
A knowledge of venous anatomy is important in implantology to minimize undesirable surgical consequences, including infection. Major vessels should be avoided during implant surgery. Efficient drainage of a surgical site, facilitated by intact vessels, minimizes swelling and promotes healing.

The blood can flow in any direction in facial and cranial veins because these vessels lack valves and many, particularly the intracranial, are modified into sinuses with rigid walls. Thus an infection originating in the oral cavity can spread rapidly along open pathways toward the brain with serious consequences. Infection is always a concern in dental procedures that interupt oral epithelium, as implant surgery surely does. However, practicing sanitary procedures familiar to all dentists minimizes the danger. Furthermore, efficient antibiotic therapy can retard or prevent undesirable consequences. As for the presence of the implant itself, a stable implant — endosteal or subperiosteal — has been shown repeatedly to have a tight elastic cuff similar to a false periodontal membrane around the posts protruding into the oral cavity. This cuff seals the site against microbial invasion and infection.

The venous pathways are highly irregular in the oral cavity and face. Generally each artery is accompanied by one or more veins which are closely associated with the artery. However, their pathways may diverge, and numerous anastamoses between veins may form a network of small veins that replaces more prominent single venous companions to an artery.

Eventually venous blood is drained from the head and neck almost entirely by the internal jugular vein (1). The internal jugular vein, the largest vein by far in the head and neck, merges with the subclavian vein in the upper part of the chest. These two form the innominate, or brachiocephalic, vein. The right and left innominate veins unite into the superior vena cava, which returns blood to the heart for recirculation.

Those veins forming the most direct pathways away from mandibular implant sites are the common facial (2) and the retromolar veins (3). The anterior facial vein (4), so called to distinguish it from its continuation below the mandibular angle —



the common facial vein, closely follows the facial artery. It originates as the angular vein (5) where the veins of the forehead (6), bridge of the nose (7), supraorbital rim (8), and lower eyelid (9) join.

From the inner corner of the eye, the facial vein descends in the soft tissues of the face toward the mandibular angle. Near the eye and nose the facial artery and vein lie close to one another. In the cheek, they diverge considerably, with the vein lying posteriorly and superficially to the artery. In this region the labial and cheek veins (10) join the facial vein. Several other venous branches, including the mental (11) and infraorbital veins (12), anastamose with the facial vein. One of the more significant, particularly in the spread of infection, is the deep facial vein (13), which courses below the zygomatic process and joins the pterygoid venous plexus, which empties into the retromolar vein.

The anterior facial vein turns under the mandible in front of the masseter and posterior and superior to the facial artery. Immediately after turning under, it receives the submental vein (14) and the palatine veins (15), which drain the tonsils. Then the anterior facial vein joins the retromolar vein, forming the common facial — or facial — vein. The common facial vein runs downward and backward a short distance, and usually anastamoses with the internal jugular vein at the level of the hyoid bone.

The retromolar vein is also known as the posterior facial vein because of its position in relation to the common and anterior facial veins. The retromolar vein receives blood from those regions supplied, in the main, by the maxillary and superficial temporal arteries. Important to note in dentistry, the retromolar vein drains the pterygoid venous plexus.

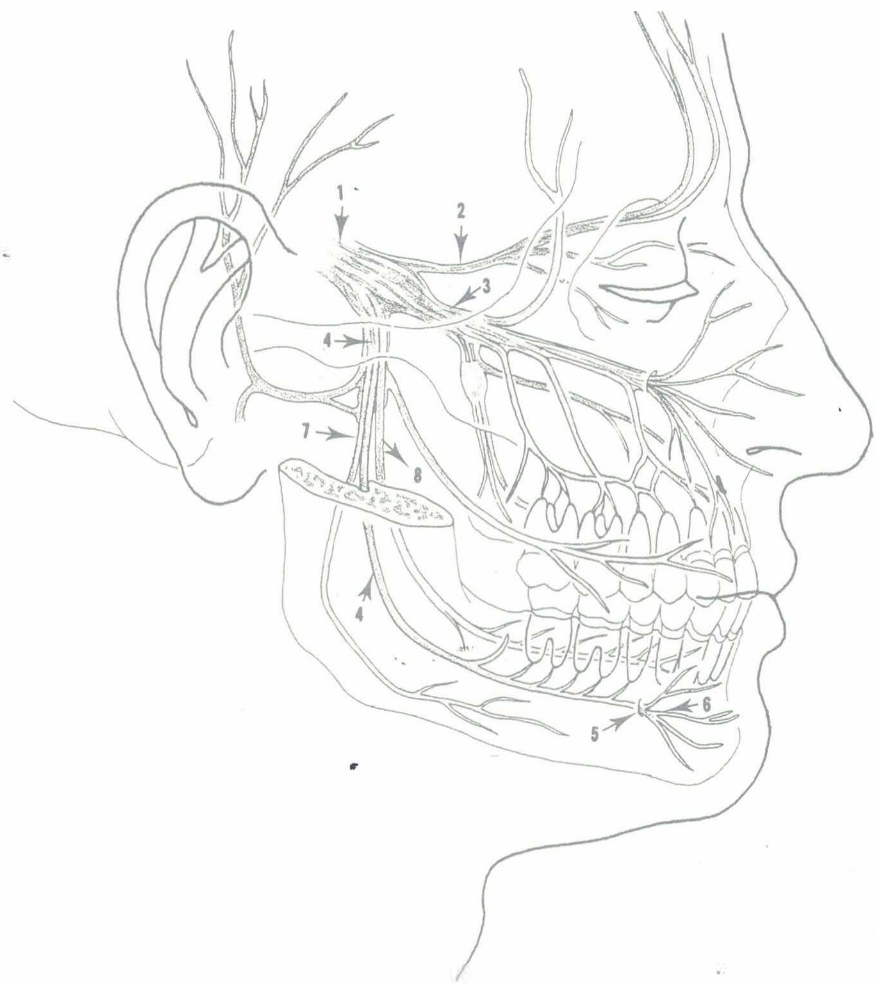
The pterygoid venous plexus can receive infected material directly from the posterior teeth or posterior implant sites of both arches by way of the alveolar network, or indirectly as the blood shunts or rushes backward and forward in veins associated with the more anterior portions of the maxillary and mandibular alveolar ridges and upper and lower lips. Once within the plexus, the infected material can drain into the retromolar vein or spread slowly upward into the cavernous sinus, possibly causing cavernous sinus thrombosis, if untreated.

Nerve Innervations

Of prime importance in the mandible is the pathway of the mandibular branch of the trigeminal nerve and its accompanying vessels. The trigeminal, or fifth cranial (1) nerve, is mainly responsible for the cutaneous supply of the face and scalp. In addition, it provides motor innervation for the muscles of mastication. The major portion is sensory and gives rise to three divisions: opthalmic (2), maxillary (3), and mandibular (4). In the lower part of the face on each side, a branch of the trigeminal nerve passes between the processes of the ramus and into the mandible on its inner surface via the mandibular foramen, which is marked by a spur of bone called the lingula.

In the body of the mandible the mandibular canal is located in the spongy cancellous bone. The canal does not have a definite wall. In the area of the molars, it divides into several accessory canals, supplying the teeth and chin with nerves and vessels. The mental foramen (5), which can be seen on the outer surface of the buccal surface of the mandible, is the termination point of the mandibular nerve, which passes through the foramen and continues on as the mental or inferior dental nerve (6), which supplies the anterior teeth and soft tissues in the area.

In an adult with all his teeth, the mandibular canal is approximately midway between the inferior and superior borders of the mandibular body. However, its position changes with age/or loss of teeth, and changes directly reflect what happens to the alveolar process.



The buccinator nerve (7) gives sensory supply to the cheeks and the buccinator muscle and sensation to the mucosa of the cheeks as far as the angle of the mouth.

The lingual nerve (8) runs downward and then forward to reach the ventral surface of the tongue, and supply sensation to the anterior two thirds of the tongue.

The mylohyoid nerve, branch of the inferior alveolar nerve, leaves the nerve near the mandibular foramen, and supplies the anterior belly of the digastric and mylohyoid muscle.

The lower portion of the parotid plexus of the facial nerve or the seventh cranial nerve supplies the sensation to those parts of the face such as the obicularis oris of the lower lip, the triangularis muscle and quadratus labi inferioris, resorius and also the muscle of the lower lip and chin.

Lymphatic Drainage of the Mandible

The lymphatic system is clinically significant because of its role in fighting infection. Lymph is a pale fluid consisting chiefly of blood plasma and white blood cells. The thin walled lymph vessels arise blindly in the intercellular spaces and follow a drainage pattern similar to that of the veins. The ducts are constricted at intervals, and these constrictions correspond to the semilunar valves within the vessels. The lymph is conducted through afferent channels to lymph nodes grouped at strategic locations along the veins. These nodes are often the first sites at which pathologic processes manifest themselves. Therefore a knowledge of these nodes is important in the recognition, diagnosis and therapy of infections and malignant tumors.

The lymph nodes of the head and neck consists of two anatomical groups: the superficial nodes and the deep nodes. Among the superficial nodes related to the mandible are the submandibular and the submental nodes. The submandibular nodes, 3-6 in number, are located beneath the body of the mandible, in the submandibular triangle on the submandibular gland. The submental nodes consist of 2-3 nodes located between the anterior bellies of the digastric muscles immediately beneath the mentis.

The deep cervical nodes consist of a superior group located beneath the sternocleidomastoid muscle at the level of the thyroid cartilage (Adams Apple) grouped around the internal jugular vein and an inferior cervical aggregation arranged near the brachial plexus and the subclavian vein in the posterior triangle of the neck.

The superior deep nodes receive afferents from the superficial nodes such as the submandibular and submental and their efferents drain partly into the inferior deep cervical nodes and partly into the jugular trunk in the inferior part of the neck. The latter, a collecting duct, joins the venous drainage at the junction of the internal jugular and subclavian veins on the right side and the thoracic duct on the left side of the neck.

The lymphatics of the gums drain mainly into submandibular nodes whose efferents reach the nodes of the superior deep cervical group. The central parts of the lower lip, tip of the tongue and anterior floor of the mouth drain primarily into the submandibular nodes. However, part of this drainage is also to a single node of the superior deep crevical group situated on the internal jugular vein at the level of the cricoid cartilage. This node, designated as "the principal node of the tongue" (jugulo-omohyoid node), is primarily involved in infection and malignancies of the tip of the tongue.

The lymph drainage of the dental pulp and periodontal ligament of the mandible follows in general the venous drainage of the alveolar canals. It is not possible to correlate a certain tooth with any special lymph node. Anterior teeth drain anteriorly through the mental foramina. However, the mandibular incisors drain directly into the submental nodes. The molars drain posteriorly through the mandibular canals. The premolars complicate the plan by draining both ways. The last molar can drain directly into the superior deep cervical nodes or through the mandibular canal into the submandibular nodes. A brief summary of the lymph drainage of the mandible is as follows:

The lymph from all mandibular teeth except the incisors first reaches the submandibular nodes. The incisors drain into the submental nodes and the last molars may drain directly into the superior deep cervical nodes. Afferents from the submandibular and submental nodes reach the superior deep cervical nodes, the efferents of which converge on the jugular trunk partly by way of the posterior deep cervical nodes. Ultimately the right and left jugular ducts which drain the head and neck join the venous system at the confluencies of the internal jugular and subclavian veins.

—*Ormond Mitchell, Ph.D.*

Preimplantation Surgery

Preimplantation Surgery

There is a basically different approach to restorative dentistry on the part of the implantologist and that of the conventional dentist. It is this difference that affects how tissues should be surgically prepared for the restoration.

The conventional restoration is seated over existing residual tissues. Hopefully, the soft tissues are tightly adapted to a well defined, regular arch. Corrective surgical procedures may be necessary to reshape the alveolar bone, improve the adaptation of the soft tissues over it, level interfering structures, reduce the amount of soft tissues, or more clearly define the crest including deepening the frenum and to alter neighboring structures. Also surgery is sometimes necessary to more easily accommodate the flanges of the restoration or to prepare the palate to accept a palatal bar, a horseshoe bar, or the palatal portion of a full removable denture. In summary, the conventional approach accepts the existing residual tissues or adapts them to better serve as a base for restorative dentition.

The implantologist looks at the residual tissues in terms of how he can use them to create a new base for restoration. The new base ideally will be more stable, more structurally distinct, and be restricted only to the alveolar crest. This prosthetic approach seeks to establish a series of firm vertical posts that lie in a relatively normal dental plane. These posts, not the residual tissues, will support the prosthesis.

Because an implant-supported restoration will not be tissue-borne, many of the problems arising from a tissue-bearing appliance are obviated, thus the implantologist can ignore a great many morphologic features that obstruct the proper fitting of a conventional denture. The implant-borne restoration will not impinge on a shallow sulcus or provoke a sensitive palatal condition—to name but a few impediments.

Usually more often in the maxillae than the mandible, excision or degloving of excessive soft tissue, generally in the tuberosity must be done when it interferes with the closure.

In the mandible sometimes the tissue covering a knife-edge becomes troublesome as a conventional denture presses on it. It makes implant insertion difficult, but it is alleviated by removing several millimeters of the spiny bone, thus widening and flattening the occlusal table, making it possible to insert blade implants. If a subperiosteal implant is the choice, then the tissue should be sutured closed, the denture relined and at least six months should elapse before initial surgery.

Most often, oral surgeons will do partial thickness flaps in order to reduce tissue to accommodate removable dentures. However, in implantology a full tissue flap should always be used to expose the bone without the periosteum attached, either for the direct insertion for a blade implant or for a direct bone impression for a subperiosteal implant. The tissue can always be degloved at the time the implant is inserted if the tissue interferes in anyway with the protruding implant post or the intermaxillary space that exists.

Alveoplasty

In most situations minor alveoplasty can be done at the time of implant insertion if an endosteal blade is employed. Removal of sharp bony spicules, retained roots, undercuts due to overhanging alveolar crests, etc., can be done, during the same visit the blades are inserted. One can go directly into the open sockets using socket blades or can avoid some of these areas. However, if a subperiosteal implant is used, grooves can be made in both cuspid, bicuspid, lateral or even central incisor areas across the crest labiolingually that just had the alveolectomy. These grooves should be from 3 to 4 mm. deep to support the crossover struts that will support the neck of the subperiosteal implant. Grooves should never be made across the posterior crest since it usually is much more resorbed than the anterior area which still contains alveolar bone. The anterior grooves therefore, bring the supporting struts closer to basal bone allowing an immediate subperiosteal implant to be accomplished. Sometimes these struts can be placed in an untouched area in between areas of alveolectomies or tooth extractions, allowing the implant to be done immediately. Also the supporting struts can be made to go directly to the base of open sockets. Sometimes it is necessary to wait from 6 months to a year for complete bone regeneration.

Knowing that there is a minute amount of bone resorption by merely reflecting the periosteal tissues away from the bone should make the implantologist extremely cautious regarding any unnecessary alveoplasty.

Since a fixed prosthesis rather than a removable one is the prosthesis of choice in most situations we must maintain as much bone as possible. Naturally replacing the lost bone with a removable conventional denture esthetically can hide many unnecessary evils such as resorption of the hard structures immediately after the teeth are removed. The resorption which continues throughout the life of the patient makes the periodic relining of the dentures necessary. We must reduce a knife-edge ridge in order to widen the ridge so that an implant may be inserted.

Whether or not we remove the excess mucoperiosteal tissue that still remains has to do with the overall esthetics. For example, how much was the intermaxillary space increased after the bone resorption? Does the maxillary ridge line up properly with the ridge of the mandible or is it in a severe class III position, etc?

Always try to envision making the groove in a knife-edge ridge slightly more toward the lingual side since the inner cortical plate is thicker than the outer one and thus the blade has more bone flanking it buccally or labially where it is needed. Since the maxillary arch becomes narrower as it resorbs, it often causes a cross-bite relationship with the lower resorbed arch which does not become narrower. Placing lower blades lingually often eliminates a class III relationship. Whereas when conventional dentures are done for these cases necessitating surgery in the mandible in order to prevent a cross-bite relationship, this is unnecessary with implants since the blades in the mandible can be placed along the lingual regions (so long as the posterior lingual areas are convex) to eliminate the crossbite caused by the narrowing of the maxillary arch.

Because the prosthesis over the implants is not tissue borne like a conventional denture, sore spots on the mucosa over the mylohyoid ridge-crest or the anterior ridge, external oblique, genial tubercles or symphyseal area do not occur, nor is there any pressure on exposed neurovascular bundles.

After alveolar bone resorption takes place, there is a general loss of the attached gingiva. In cases of advanced alveolar atrophy, it sometimes becomes necessary to create free gingival grafts, etc. to form more attached gingivae prior to insertion of the blades.

The formation of papillomatous mucosal hypertrophies in the labial and buccal flanges from poorly fitting dentures usually never occurs with implants.

Muscle attachments that, because of excessive resorption of the underlying bone become extremely superficial, must be reduced otherwise they will pull away the attached gingiva from the posts of the implants or even from any natural teeth that might be in the area.

The initial incision for blades and subperiosteal implants is called a full thickness flap. Clean and atraumatic surgery pushing and not pulling away the periosteum, submucosa and mucosa from the bone must be the rule of thumb. As the incision is made, the implantologist must feel for the bone as he slowly cuts firmly through the entire thickness of the soft tissues and "scratches" the bone. He should make one continuous incision rather than join incisions from one side to the other. At all times the scalpel should be scratching the bone, otherwise the tissues can be torn when they are reflected. The anatomy of the area must be well understood.

Using blunted periosteal elevators around the nerves and carefully reflecting and separating the tissues avoids problems, especially when expecting an exposure of the neurovascular bundles in the mandibular canal or mental foramen. Sometimes when making an incision over extremely thickened tissue covering an extreme knife-edge ridge, it becomes almost impossible to touch the alveolar crest all around in an edentulous arch. Therefore, you must stop. Reflect the tissue as best as you can and then use the scalpel again as you approach closer to the bone. Do not tear or stretch the tissues. In areas where there is practically no bone above the mandibular canal, be very cautious with the scalpel and extremely careful as the tissue is reflected in order to prevent perforation through the egg shell wall covering the canal. The flap must:

1. be large enough to provide adequate access to the surgical field

so that the direction and topography of the residual ridge becomes evident.

2. be large enough so that the blood supply is maintained.

3. be a full thickness mucoperiosteal flap.

4. hemostasis should be obtained and hematoma formation should be prevented as much as possible.

5. the flap should be sutured into place at the end of the blade insertions and immobilized wherever necessary.

6. If a bony defect is to be covered, the flap margins should rest on a solid bony base.

7. In cases where there is a near dehiscency of the mandibular canal and mental foramina or both, the incision must always be on the lingual side of the ridge.

The blood supply to a flap may be maintained either by incorporating an artery in the flap or by making the attached base of the flap larger than the free margin.

All the soft tissues must be handled carefully to avoid crushing, tearing or other trauma.

All pathologically involved teeth that cannot be saved by apicoetomies, infra-bony pocket removals, etc. should be extracted prior to implant insertions. Where two or more teeth are removed and are adjacent to each other a minimum of 4 to 6 months should elapse before implants are inserted.

When teeth are to remain as part of the implant prosthesis, but deep bony pockets exist, one or two procedures can be done. Either refer the patient to a periodontist before the implant surgery or remove the infra-bony pockets when the bone is exposed at the time of implant intervention.

A well balanced prefabricated fixed temporary acrylic splint should be carefully designed and processed prior to this appointment.

Whereas sometimes the preservation of the labial cortex at the expense of the inter-radicular medullary bone (according to Dean and Obergeiser) is needed for full denture procedures this never becomes necessary with implants. In implantology the canine eminences and the bucco-lingual thickness as well as alveolar height should remain ideally the same in the arch.

Alveoloplasties should only be done in those situations where, either because of an immediate extraction or an error in cutting away too much soft tissue so that the tissues can easily be sutured closed over the underlying bone.

It becomes extremely important to remove the labial and buccal crest undercuts that often exist in extreme knife-edge ridges so that a continuous groove can be made to its proper depth without perforating the labial cortex.

Whereas it often becomes necessary to remove tori when dentures are anticipated, it is absolutely unnecessary with blades.

Highly attached frenums, or scar tissue that prevent normal movements of the lips should be reduced prior to implant surgery.

Any excess hyperplasia should be removed.

Hyperplastic labial mucosal tissue (double-lip) from an ill fitting denture must be incised and removed prior to implant surgery.

A partial thickness flap is never done when inserting implants since they must all be beneath the mucoperiosteal tissues. A partial thickness flap is used when tissue grafts become necessary or it is necessary to reduce the tissue thickness.

In the region of the maxillary tuberosities where often the tissues are ten to fourteen mm. thick and even wider bucco-lingually it often becomes necessary to thin them out by degloving. Also, it is sometimes necessary when the excessive thickness in the area will interfere with a proper centric occlusion, especially when an implant post was inserted in a socket but was totally buried by thickened tissues. It is more desirable to lengthen the post by telescoping it rather than reducing the tissue.

Deepening the vestibular sulci in excessively flat ridges which is so often necessary for obtaining some sort of retention with conventional dentures presents very little problem when contemplating implants. Only when the muscle attachments fall directly beneath the implant posts or remaining teeth is it necessary to reduce the sulci.

Sometimes in an extremely wide mandible you can often circumvent rather than drill directly through one or two open sockets in order to immediately gain a maximum amount of the metal of the implant to the available bone.

By incising directly to the bony crest, the residual gingiva is not destroyed. Gingiva is destroyed when too much of the bone is resorbed.

In conditions when very little or no attached gingiva remains over the ridge and an implant is inserted, a tight attachment of the tissue around the post is not attained and either it will be necessary to scarify the tissue by making a number of deep accessory incisions or to bring in a tissue graft from the palate.

Through experience I have found much better and rapid healing in the maxilla than in the mandible. Pre-existing oroantral fistulas must be avoided both with the scalpel and with the implant itself. The sinus must first be irrigated thoroughly with saline or plain water, the polyps removed from its walls and sometimes a gold plate placed across the opening and sutured with surgical silk. The patient should be placed on an antibiotic. Implants must be avoided until the soft tissue healing has been completed. It is imperative that any implants to be inserted should be far enough away from the healed site in order to avoid any penetration of the bony walls of the sinus. (The pterygoid implant avoids these areas magnificently.)

Exostoses, although directly affecting a removable conventional denture since they exist in areas of the denture base such as on the lingual aspects of the posterior ridges in the mandible must be removed. With implants, however, these may remain since implants do not go into those areas.

In areas of fibrous hyperplasia it sometimes becomes necessary to remove the tissue before or during insertion of the blades, especially if it appears on the ridge crests. If hyperplasia was caused by an ill fitting denture, the denture should be relined with a soft tissue conditioner until the tissue "tones up" and possibly no surgery will be necessary.

The conservation of teeth has always been important. However, teeth that might be considered to a periodontist totally unsaveable making a case hopeless for fixed restorative dentistry does by no means contraindicate implants. For example, the lower six anterior teeth may have as little as 1/10th the bone remaining around their apices. However, below these apices there is usually a tremendous amount of dense bone to insert very well supported blades. It is the bone beneath the apices of the teeth that exists between them and the underlying vital structures that concerns the implantologist.

I used to try to save all loose teeth or periodontally involved teeth by apicoectomies, root resection, endodontic stabilizers with or without reimplantation of the teeth, removing at the same time any pockets. I do not often save them since the advent of blades.

An entire arch or mouth of periodontally involved teeth that are removed, once the bone has grown back, eliminates the periodontal condition. Usually insertion of four well-placed blades in the arch supported by a full arch fixed prosthesis prevents any future periodontal disease.

When teeth must be removed that are not too loose, they should be 'elevated' out using an elevator and rotating in a mesio-distal direction rather than a labio-lingual or bucco-palatal direction to maintain the labial and buccal plates of bone and all granulation tissue removed from the socket in order to allow new bone to form there. If granulation tissue is left, no bone will grow.

Conservation of the bone for future implants should be the prime purpose when extracting condemned teeth.

When sectioning multi-rooted teeth do not make a buccal flap nor remove any of the buccal cortex. Instead, from the occlusal portion section the roots with a dental bur (700) and carefully elevate each of the roots out mesio-distally or use a narrow beaked pliers.

Often, if that tooth were the terminal abutment and good bone support was present try to save the tooth with root canal and sometimes retrograde amalgams.

Overerupted maxillary molars (or any other teeth) either can be cut down to the C-E junction, root canal be done, some of the bone can be removed immediately superior to the C-E junction and then the root prepared for a full crown restoration thus making enough room available to allow implants to be inserted in the opposing jaw without opening the bite. In those conditions where it becomes impossible then the tooth has to be extracted, the alveolar bone leveled down and in about three months blades can be inserted in the maxilla as well as the mandible with enough inter-occlusal clearance to maintain a proper centric relationship.

Preserving the labial cortex at the expense of the medullary bone in order to collapse the labial cortex palatally, moulding it to the desired contour was fine for a conventional denture, but absolutely superfluous for implants. As much thickness of the bucco-lingual or labio-palatal bone as possible should be maintained before inserting blades to prevent fracturing the bone if it were too thin and to allow a maximum amount of remaining bone to flank the labial and palatal surfaces of the blades in order to act as buttresses of support against anterior and lateral thrusts of the tongue.

I agree where he says "if the immediate reduction of undercuts will result in a narrow V shaped ridge, then alveoplasty should be delayed 3 to 4 weeks until new bone fills the sockets". I feel that if we flatten the ridges in order to relieve the undercuts, then the occlusal table of the ridge usually becomes wider.

When an open socket remains between two teeth and only a single tooth blade can be inserted wait three months for the socket to fill in with bone before inserting the blade. In an open socket where neighboring teeth have been missing for some time a blade can be inserted through the socket and extended mesially and distally to it into good bone. If the buccal or lingual plates on one of them were destroyed insert the socket blade making sure, however, to bury the recessed shoulder to its proper depth beneath the most resorbed cortical plate. A curved groove around the socket could be made to place a blade into the bone providing the bucco-lingual thickness of the bone, labial or lingual to the socket was thick enough to avoid the socket.

In situations when an open socket exists and an implant is not used and a bridge is fabricated before the socket fills in with new bone, it is necessary to make sure that the pontic be made deeper and partially into the socket so that it will help compensate for shrinkage that will take place. When a number of sockets remain and the bridge is completed lengthen all of these pontics gingivally but wherever possible use soft cement only to hold the bridge and wait about six weeks before sending the bridge to the laboratory for reprocessing.

Overerupted teeth can be treated in the same manner as the upper molar. Retaining these teeth would become more necessary in those cases where poor ridges exist mesial and distal to it possibly preventing the insertion of blades. If excellent bone flanks the overerupted teeth and blades can be inserted it might be wiser to remove the teeth.

Only when an extremely excessive amount of labial bone exists is it necessary to reduce the thickness. Dean's method for implants would be the best since we are interested only in reducing the labial aspect and not the palatal. In those cases where anterior teeth exist with such extreme oblique axial inclinations than they might be extracted; a good part of the labial bone would "fall inward" and three months later the blades could be inserted with far less of an axial inclination than the original teeth had.

When the maxilla resorbs it resorbs in a bucco-palatal and labio palatal direction medially making the overall size of the maxilla narrower than that of the mandible (it also resorbs obliquely to a horizontal plane). A routine alveolectomy in order to widen the occlusal table might be more detrimental in considering the occlusal factor when opposing a sometimes wider arch of teeth. As we reduce the alveolar crest which was flaring in a buccal or lateral direction we are also narrowing it thus creating an unnecessary cross-bite.

Sometimes, however, in order to be able to insert the blades the knife-edged ridge must be removed. In situations such as these, it sometimes becomes necessary to fabricate a removable prosthesis locked to a Dolder or Andrews bar which splints the blades and produces proper occlusion.

Labial undercuts in extreme knife-edge ridges should be removed to prevent possible perforations of the bur as it nears the labial concavities existing beneath the undercuts. Removing these overhanging situations gives the operator a clearer view of the existing ridge and enables him to have less complications when making the grooves. Lingually, in the maxilla, undercuts usually do not exist except in the tuberosities which should be ignored. In areas where implants are not to be inserted but only the pontics undercuts also should be ignored.

Lateral palatal exostoses are left since they do not interfere with the blades or the fixed prosthesis. However, in those situations where the palatal tissue may have been torn during the reflection it may be necessary to shave down some or even all of these exostoses so that healing of the palatal tissues will not be retarded.

Gingival sulci, deep supra-bony or infra-bony pockets may be treated during the insertion of the implants. However, in those cases where many periodontally involved teeth with soft tissue exist, the perio should be completed before inplantation.

Hypertrophied frena and high muscle attachments can be reduced surgically, but other conditions such as submucosal hyperplasia of the tuberosities, hyperplasia of the palate, etc. should be avoided and can disappear with the removal of the conventional denture and replacement of a fixed bridge supported by blades.

Remove or reduce by degloving submucosal tissues of hypermobile gingiva before or at the time the implants are inserted since they make "sloppy" resealing.

Sulcoplasty is done to gain stability for a conventional denture. This is not needed with implants. However, sometimes a form of sulcoplasty is done to lower muscle attachments.

All grooves for blades should be done on the lingual or palatal side of the jaw to allow a maximum amount of labial and buccal bone to flank it, especially since most of the concavities exist on the labial and buccal surfaces of the mandible bringing the buccal surface of the bladevent even closer to these surfaces. Countersinking of the blade is often necessary, however, by reducing the bone on the lingual aspect of the crest which is interfering with proper seating of the blade, since the lingual aspect of the crest always contains more bone height than the labial aspect since teeth are mostly lost at the expense of the labial or buccal bone.

Sometimes extreme resorption of bone in the mandible involving its height and width, especially the anterior labial undercut area makes it necessary to use a method of subperiosteal tunneling using autogenous bone from either the posterior ridge or opposing ridge or from the medullary bone of one or both of the ileums of the patient and tunnelling it into the undercut areas or at the crest. A single vertical incision at the midline of the mandible is all that is needed while the tunneling is created to the left and right side of it in a horizontal direction. The incision is closed with a few sutures.

The patient should not wear a denture for at least three to six months to avoid any unnecessary mechanical irritation in the graft area. Antibiotics are prescribed. The graft area gradually becomes smooth by selective resorption and replacement of new bone occurs within six months. At that time the five piece symphyseal-rami implant system can be used successfully giving the patient a fixed prosthesis.

Surgical Hints

A. Handling of Soft Tissues

When performing surgical interventions of any sort one must have a complete understanding of the soft and hard tissues involved. This was clearly discussed and illustrated in the second and third chapters of my previously published book, "Theories and Techniques of Oral Implantology", C.V. Mosby Co., St. Louis, Missouri.

To include it in as few words as possible I will say the following:

1. An implant, whether it be a screw, pin or blade type should never be placed directly through the soft tissues and into the bone without first incising and reflecting the tissues to expose the under-

lying bone. Epithelial inclusions can occur deep into the artificial sockets if it were done without first exposing the bone. Also, the true crest of the bony ridge would often be misrepresented without first exposing.

2. All incisions through the soft tissues must be done with a sharp scalpel and must be clean and neat and must reach directly to the bone.

3. When making an incision around a completely edentulous arch, the operator should always try to make it continuous, starting from one side and continuing on to the other side. He should not try to make two half incisions that meet since often the incisions will not join each other accurately involving accessory incisions which could delay healing.

4. If the scalpel does not go completely through the periosteal tissues, these tissues will ultimately be torn during reflection which could lead to healing by secondary intention rather than primary intention causing a great deal of bone loss, unnecessary discomfort, and pain to the patient.

5. The incision must always be made at least one and a half to twice the length as the mesio-distal length of the blade that is to be used. A short incision will result in stretching, pulling and tearing the soft tissues in order to visualize enough bone for the placement of the implant. This can lead to post-operative swelling, edema and engorgement of the blood vessels as well as echymosis. By not reflecting the tissues enough, air from the handpiece while making the groove could possibly be trapped into this small flap resulting in an air embolism. By having a large reflection any air that is directed toward the flaps is more or less dissipated causing no problems.

6. Vertical incisions should be avoided whenever possible since they take a great deal longer to heal than horizontal incisions.

7. The periosteal elevator should be used as a "pusher" rather than a "puller". In other words, in order to cleanly separate the periosteum and fibrous connective tissues from the underlying bone, pushing firmly along the exposed bone will result in a much cleaner and less traumatic reflection of these tissues.

8. Certain areas should be carefully reflected when reflecting the tissue in the mental foramen areas as well as in dehiscent mandibular canals.

In the mandible, the incision should curve bucally just before it reaches the retromolar pad areas. Too often a great deal of pain results from too posterior an incision as well as trismus.

9. In situations where the mucoperiosteal tissues are extremely thick such as is often the case in the mandible where overretained periodontally teeth were finally removed degloving the tissues sometimes becomes necessary. With a sharp scalpel the submucosal tissues underlying the mucosal tissues in direct contact with the oral cavity are "scooped out" like one removes the grapefruit from its rind. With one hand the tissues are held firmly with a tissue forceps while underlying tissues are removed with a scalpel held in the other hand. Sometimes it becomes necessary to cut away the free ends of this excessively thickened tissue being sure to leave attached gingiva and not to cut beyond the muco-gingival junction.

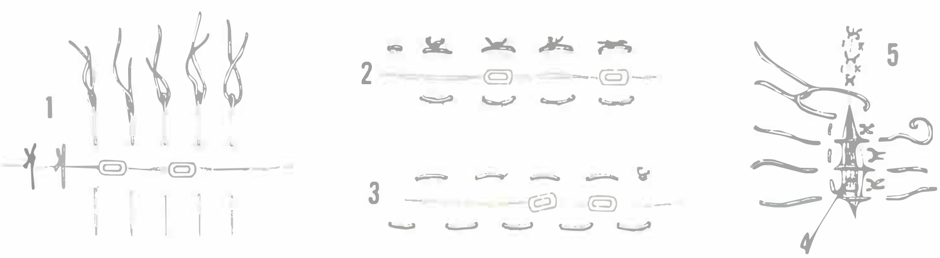
10. When the cut tissues are brought around the protruding implant post, if they become too "bunched" instead of incising them which might result in too much unnecessary removal of the tissue, a special tissue punch can be easily utilized which will accurately remove a small circular area of the tissue which conforms in size and shape to the protruding implant post.

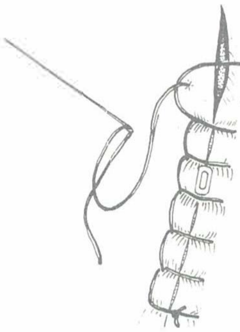
11. Clamping the soft tissues for any period of time should never be indicated at is will stop the circulating blood causing tissue necrosis which will greatly endanger proper and normal tissue healing.

12. Suturing the tissues closed should not follow the same pattern in all cases. It depends largely on the elasticity and mobility of the tissues at both sides of the incisions.

When the tissues are normal, simple surgical ties around the protruding posts as well as in between the posts are all that is necessary (1).

Sometimes, these sutures are fortified with mattress sutures around the posts (2), sometimes between the posts (3) and sometimes, when the tissues are severely scarred with little elasticity, they are first degloved (4) and then mattress sutures as well as

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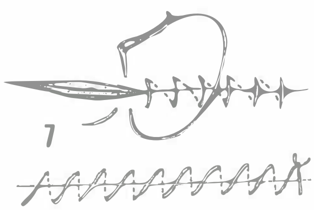
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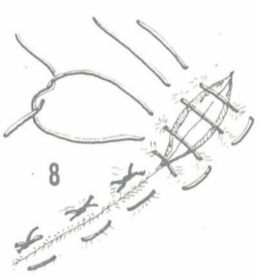
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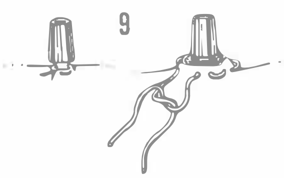
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surgical ties are used (5). Continuous suturing is preferred to close tissues after the insertion of a subperiosteal implant (6). Continuous over and under closing sutures are sometimes used for surface to surface contact of tissues (7). Interrupted mattress (Halsted) sutures are most often used for surface to surface contact (8). Purse string sutures are sometimes used around protruding implant abutments (9).

13. Placing a temporary prefabricated acrylic splint directly over the incised tissues, although often indicated to maintain esthetics and function for the patient can often cause undue problems. The tissue bearing surfaces of the splint should be relieved sufficiently so that it does not compress the sutured tissues. If not enough relief is obtained and if the tissues should become swollen from the operation, then the splint will cause constant pressure to the tissues resulting in severe pain duration which often delays healing.

Leaving the sutured tissues exposed immediately after surgery results in a most rapid and uneventful healing. It is not necessary to immediately splint the blade implants as was often the routine procedures required to stabilize the weaker screws and pin type implants. A properly inserted blade implant can easily support itself without the needed help of a splint. It will not loosen even during the catabolic stages of bone metabolism during the early stages prior to the rebuilding of the bone. If a splint is fabricated it must fit passively and very soft cement with vaseline is used so it can be withdrawn easily without harm to the implants.

14. Keep the patient on a soft diet for a few days. A diet including all essential vitamins and minerals will encourage uneventful healing. Warm saline mouth washes as well as oxygenated mouth washes are also indicated for quick healing. Ice packs used intermittently for the first few hours after surgery are also often advised on more complicated cases.

15. Healing of the soft tissues is also enhanced by the use of antibiotics, anti-inflammatory aids and analgesics.

16. The healed soft tissues must also be carefully handled — especially when taking impressions. As mentioned before, it is imperative not to leave any rubber base material underneath the posts of the blades after the impressions. Since the material contains a lead base it can destroy the underlying hard tissues as well as cause inflammation of the soft tissues.

B. Handling The Hard Tissues

1. Sharp rotary burs with sufficient coolants are imperative for

preparing the various grooves in the bone to accommodate the blade implants. Too often the carbide bur wears out after cutting only a few grooves. The result could overheat the bone by increased friction causing necrosis. Sometimes severe overheating may cause an osteitis or osteomyelitis. Thus, the 700 XL carbide bur must be changed after every two, three or four grooves. It is sometimes necessary to use two new burs for one groove.

2. The water spray should not only be directed from the handpiece attachment itself, but an additional water spray should be held and sprayed on the bur by an assistant.

Before inserting the implant, the groove should again be sprayed with a water syringe or with saline in order to remove all debris.

3. The bone should never be spread or compressed beyond its physiologic capacity. Bone has a viscoelastic characteristic and as long as it is not abused, it will spring back to its original shape and form.

If, for example the groove was not made deep enough so that the bone had to spread beyond its capacity to seat the blade to its proper depth, the bone will not be capable of springing back. The results end in loosening and loss of the implant with a sloughing off and sequestra of bone forming from the original implant site.

In certain areas in the same arch the bone radically differs. For example, in the anterior regions of the mandible as the bur approaches the symphysis while making a groove, the bone becomes denser and denser. The bone in this area does not have the same spring action as the remaining viscoelastic characteristics of the rest of the lower arch and that of the maxilla. Therefore, the bur must be changed more often or it can overheat the dense bone. Also, the blade must never be forced into the groove in this area since it could more easily spread the bone beyond its physiologic capacity. Since there is a limited blood supply in this dense area, recovery would be more difficult. If a bur should break and remain in the groove the easiest way to remove it would be to spin out the broken one with another bur.

Anterior Implantations

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Posterior Implantations

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Anterior Implantations

Introduction

For purposes of arch nomenclature, the anterior region is that portion of the dental arch anterior to both mental foramina. Because of the various shapes of the arches, the width between both mental foramina also seems to vary; for example, a wide anterior arch would seem to permit a longer span between each mental foramen than it would appear in a narrower arch. Strangely enough, however, after examining over two hundred mandibular dried specimens that distance between each mental foramen is almost the same, no matter how large or small the arch might be. It is approximately 50 mm.

Sometimes the mental foramina are not symetrically located in an arch which can be due to atypical arch shape or asymetry of the development and location of the foramin itself.

The only consequence this has is to alert the implantologist to be on the lookout for these asymmetrical situations so that he can avoid them. Often also two differently shaped implants might have to be utilized to properly adapt to the anterior asymetry that might exist.

Good Ridge

A good anterior ridge is wide labio-lingually with a slight concavity on the labial surface and deep with relatively dense bone.

The closer the ridge resembles the bone around a healthy natural tooth in its shape and character, the more ideal will the ridge be. However, once the teeth no longer exist in an arch, the bone trabeculae inside the arch become thinner, less numerous, and the overall dimensions of the arch are diminished.

A totally ideal ridge in an edentulous arch, however, is rare after being with no teeth for a good number of years. The cause of tooth loss and the effects of disuse and misuse have had time to take their toll. To assume, however, that the entire ridge of a totally edentulous arch exhibits the same bone all around—and that implantation in a totally edentulous ridge is always difficult, would be a mistake. Even if all the teeth were lost at the same time the internal and external portions of the bony arch would develop in different ways due to natural and artificially induced wear patterns as well as from the various types of forces placed upon it. Therefore, a completely edentulous mandibular ridge usually has a varying range of implant potential usually with more than adequate bone in the anterior portion.

In the anterior portion of a partially edentulous mandible with limited tooth loss, as for example in a young adult whose remaining teeth are still present and well attended, a good ridge is not unusual. The edentulous area may be the site of a recent extraction, with the healed socket receiving some osteogenic stimulation from the neighboring teeth in good occlusion.

The problems of a totally edentulous ridge differ slightly from those of a partially edentulous arch, even if the actual implant site is in the same position in both.

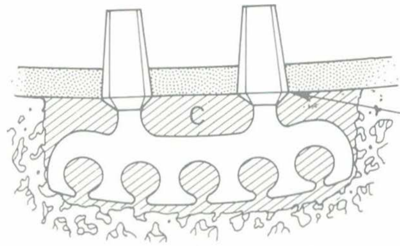
The purpose of this volume, however, is to explain specific concepts in detail, the totally edentulous arch situations are first presented to illustrate generalizations about a specific area. Partially edentulous situations tend to be modifications or elaborations of the basic surgical concepts and, therefore, are covered as addenda.

The Single Posted Bladevent

In any implant procedure, a balanced support for a fixed prosthesis is the goal.

Balanced support may be achieved in a totally edentulous arch by inserting four endosteal bladevents strategically around the arch. Ideally, the two posterior blades should have a double post and the two anterior blades a single abutment post. These posts should protrude at fairly symmetrical intervals, ideally, the anterior posts into the cuspid regions and the posterior posts into the bicuspid-molar areas. The six posts may arise from any combination of implants.

The following figures show various longitudinal sections, cross-sections, and clinical views of the bladevent implant.



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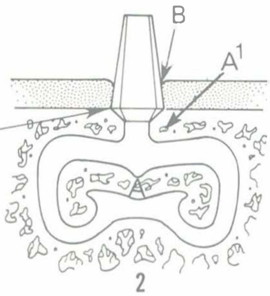

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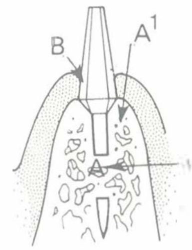

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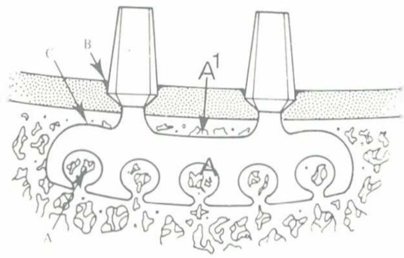
Figure 1, shows how deep and clear the groove should be made to accommodate the blade implant.

Figures 2, 3, 4, reveal how the osseous regeneration of bone takes place at the vent portion of the implant (A) and over the shoulders (A[1]). (B) shows how the muco-periosteal tissue adapts to the posts. (C) shows how the shoulder of the blade should be buried below the level of the alveolar crest, and (D) how the bottom of the post seats right on the bone.

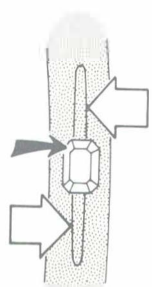


4

Figure 5, shows the cross-section of the blade implant, showing how the blade stabilizes itself against masticatory forces. The arrows show how it counteracts and prevents the implant from moving.

Figure 6, shows the parallelism of the posts to one another, which is very important for the final prosthesis.

These all lead to successful implantology.



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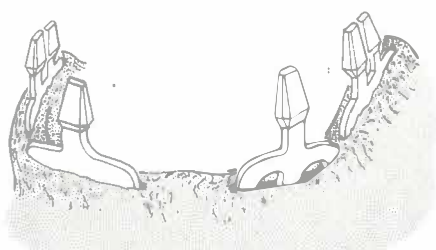
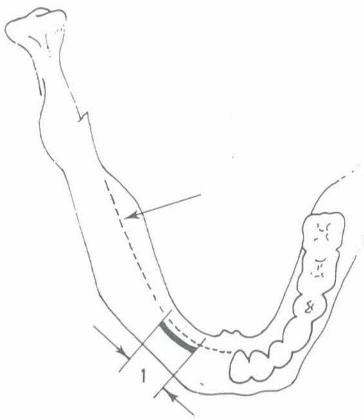
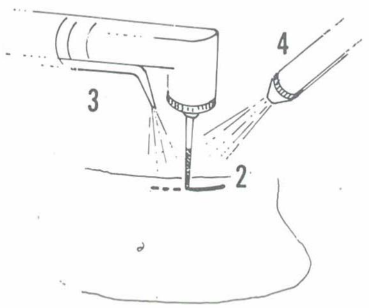


6

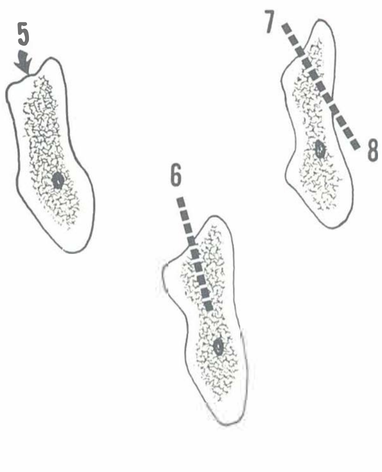
The mandibular anterior implant groove for a single posted bladevent is started about 2-3 mm. away from the midline (1), and follows the curvature of the arch posteriorly. A 700 XL bur is used in a contra-angle (2) Copious amounts of water (3) directly from the contra-angle and from a separate water syringe (4) are used to prevent burning of the bone.



Since the alveolar crest is the narrowest portion of the residual ridge, the groove entrance (5) should be centered on it or preferably lingual to it. Wherever possible, in the mandible, the bur should not be angled but the groove should be made closer to the lingual border routinely (6) in order to provide a generous amount of bone labially to resist anterior thrusts of the tongue, occlusal impact and eccentric anamolies. An implant seated in such a site has more bone support labially than does a natural incisor. This extra bone is greatly needed labially, which nature did not provide in the tooth-filled arch. This greater bulk of labial bone is effectively counterbalanced by the harder nature of the lingual bone.

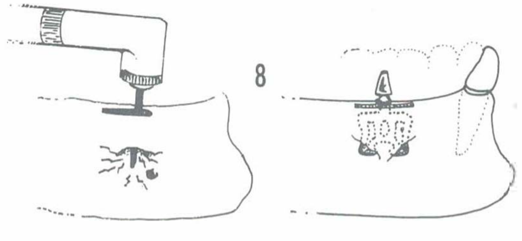


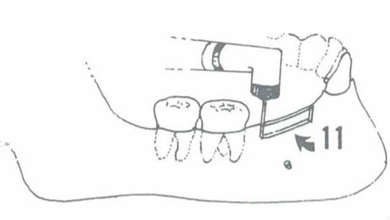
Caution: To avoid bending the post, the inexperienced operator may decide to angle the channel straight downward (7). This sometimes is unwise, depending upon the severity of the labial concavities as well as the lingual plate without angulating the bur slightly toward the labial might result in lingual perforation (8) of the bone by the blade and also ending up with a severe crossbite (9). Creating a groove more labially may cause a labial plate fracture near the shoulder of the blade where the labial portion of the ridge crest flanking the blade becomes extremely fragile (10). Thus, this straight upward angulation would also necessitate using a shallower implant, sacrificing the advantages of placing as deep-bodied an implant in the bone as is possible.

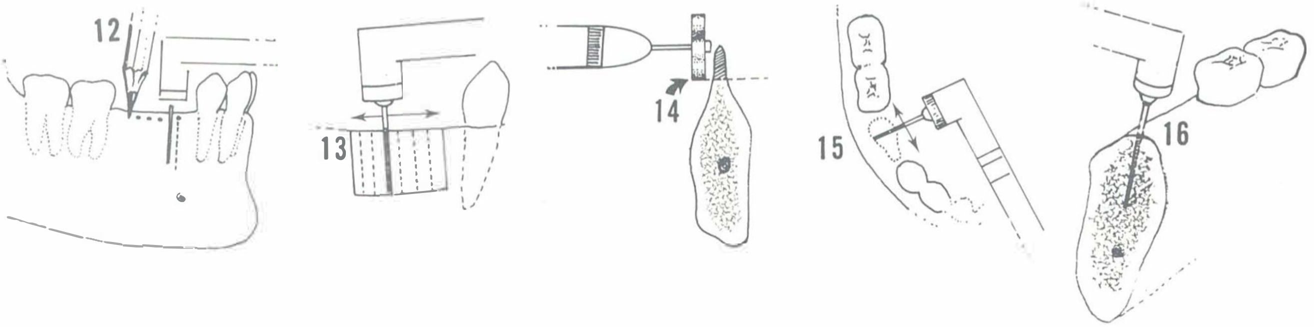


The groove required for the bladevent may be made in several ways. Many operators prefer to sweep the bur along the ridge (11), making a shallow groove first as a guide and gradually deepening the socket. This is a particularly sound approach in good bone.

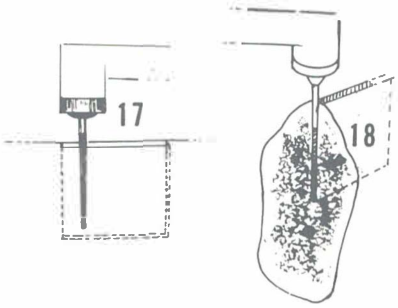
A relatively inexperienced operator might prefer to mark the implant site with an indelible pencil and then drill a series of holes



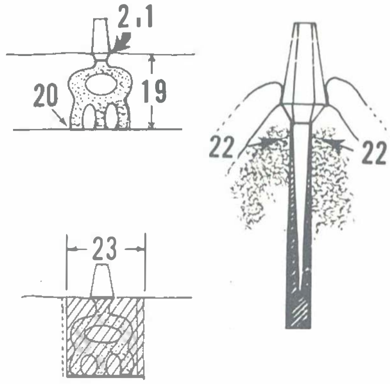




(12) along the marked line either to the entire depth of the socket or about half-way down. These holes are then connected with gradually deepening, running sweeps of the bur (13).



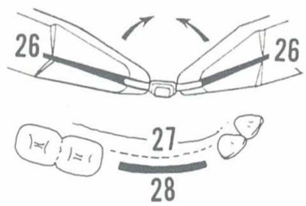
In a knife edge ridge, however, the groove approach is completely different. The knife edge ridge (14) is reduced with a round stone or the 700 XL bur in order to widen the occlusal table (15). With a 700 XL bur a deep hole is made anywhere along the widened ridge (16). The buried bur is then slightly lifted from its bony base in order to allow it to 'spin in the bone' (17) while buried in it. The groove is then created during which time the bur is totally buried in bone (18). Thus the labial and lingual bone flanking the buried bur helps to support and guide the bur as the operator creates the groove.



In good bone, the depth of the channel or socket (19) equals the height of the blade, from its leading edge (20) to the bottom of its post (21). The 700 XL bur, which is longer than the body of most blades is used to its entire depth. Often, the 700 XL bur must be substituted in maximum bone height to obtain the proper depth. If the channel is made deeper than necessary, there is little danger of the blade's sinking because its wedge shape (22) will brace it against the wall of the socket.

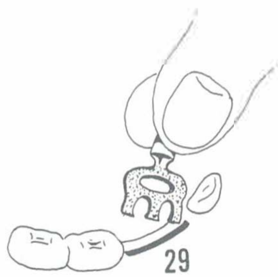
The socket should be no wider than the head of the bur. As injured bone cells whose processes have been disrupted by the drilling die, the socket will widen slightly. If the site has been properly prepared, the blade will not loosen. Also, the mechanical pressure on bone slightly stretched by a snugly fitting blade appears to hasten recovery of the site. A properly seated blade is tight upon insertion and should not loosen during the early catabolic changes.

When the socket appears finished, the bladevent is compared with it. The socket should be slightly longer than the bladevent on each end (23) or the same length, but not shorter. In many anterior cases, the implant socket curves to follow the arch (24). The straight bladevent (25) must be bent to fit it passively.



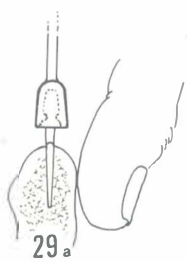
The cone socket pliers (26) are used to bend the bladevent until its curve (27) matches that of the socket (28).

Caution: A bladevent must fit its socket passively along the socket's entire length. Forcing a bladevent into strongly resistant bone will spread the socket walls beyond the bone's physiologic capacity, destroying bone cells and widening the socket.



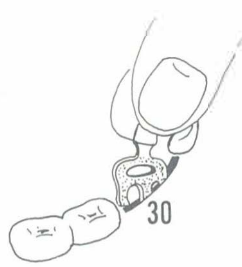
The correctly bent blade is inserted into the socket along the socket's axis (29). Anteriorly, this is relatively easy to do by hand. Posteriorly, a special carrying instrument is often necessary (29A). Manual pressure should be adequate to lodge the implant. If the implant slides in easily up to the bottom of its post, the socket is too wide. If the bladevent cannot be made tight in its socket by bending its body into an s-curve, the site must be abandoned.

The angle of bending is estimated, and the bladevent is withdrawn by hand (30) or with an implant remover (30A) Crown Socket Remover.

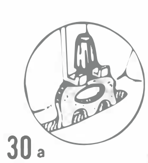


Caution: The implant never should be rocked (31) out of its socket!

Two cone socket pliers are used to bend the neck of the post (32) gradually to the proper angle. The post should not be worked back and forth innumerable times, trying for a good angle. Frequent bending will weaken even the strongest metal.



Caution: To bend the neck of the post, grasp the body of the bladevent perpendicular to its length where the neck meets the shoulder (33). Do not grasp the entire length of a curved blade (34) with the pliers. Such a grip would flatten the carefully created, accurate curvature.



Caution: The bladevent's neck should not be bent in the mouth with the bony walls of the socket used as a vise. This would crush living bone cells and possibly fracture the walls.

When all abutments are satisfactorily angled, the individual bladevents are ready for final seating.

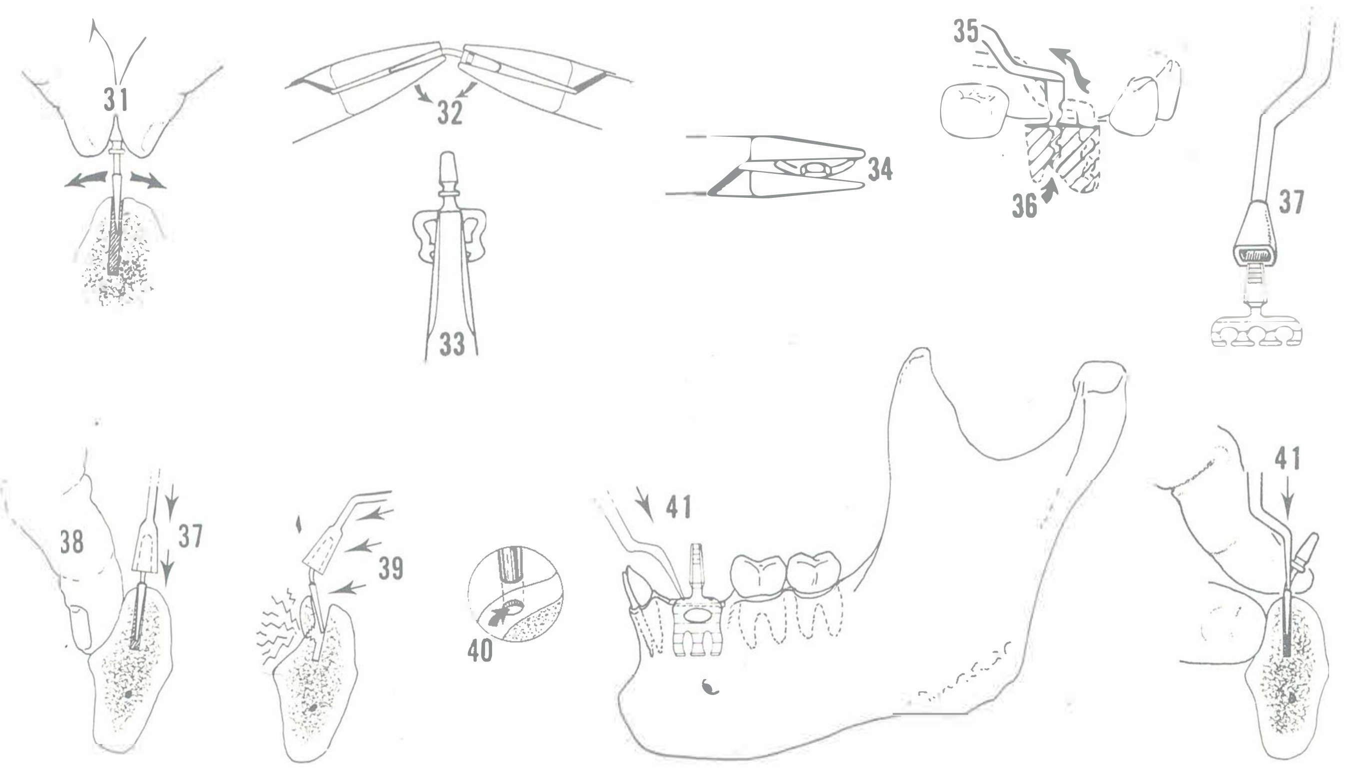
The socket is cleaned of debris with water and a special channel guide (35). This instrument is designed to help detect unevenly deep, improperly prepared sockets. If the tool pops up while passing it along the base of the socket, an obstruction (36) is indicated. This must be removed with the 700 XL bur to seat the blade evenly.

The sterilized implant is replaced. It must now be seated to its proper depth with some type of inserting instrument and a mallet. Because force should be directed along the axis of the socket, the final seating method must be carefully executed.

A single-headed inserting instrument (37) works very well indeed if the neck of the post is only slightly bent and the implant is correctly engaged in good bone. Even so, a finger is needed to brace the labial plate and support should always be given at the inferior border of the mandible with the palm (38).

Caution: If the post has been bent acutely away from the axis of the socket, the inserting instrument cannot be used on the post. The force against labial bone (39) might fracture it. In such a case, the implant's shoulders must receive the force. Most blade-vent designs have a small pit in each shoulder to secure a pointed seating instrument (a shoulder set point) (40). This is inserted in one shoulder and aligned with the axis of the socket (41).

An assistant's finger holds the unengaged shoulder to prevent its popping up. A sharp tap should sink the implant a short distance and then the instrument is alternated to the other shoulder.



Caution: Do not pound down one shoulder, then the other, or allow an unsupported implant to be rocked mesio-distally (42). Uneven, forceful seating injures the mesio-distal borders of the socket, and working the implant up and down widens the socket.

The sharp-pointed inserting instrument fits easily between the walls of the socket into the point on the blade shoulders, making it possible to sink the implant to its proper depth without traumatizing bone at the crest.

The implant is properly seated when the bottom of its post rests on the alveolar crest (43). It should resist being moved. Upon tapping the protruding post a sharp "thock" should be heard. A dull "thud" indicates a loose implant.

In summary, the better the ridge, the better the prognosis for a long-term, stable bladevent. Even in the best morphological situation, however, it is possible to make surgical errors because of over-confidence. Cautious surgery is essential in every situation, not just the most difficult.

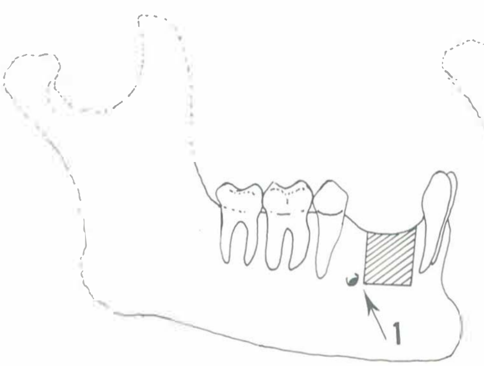
The Double-Posted Bladevent

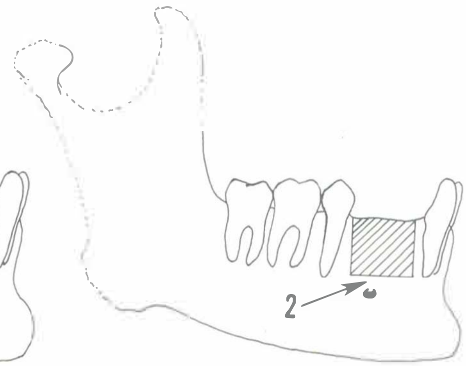
The double-posted bladevent provides two abutments in a single implant site. It is most commonly used in the posterior portion of the mandible to provide unusually strong support. It is often used anteriorly in between two periodontally involved cuspids or in anterior edentulous areas when only single posted implants can be inserted posteriorly.

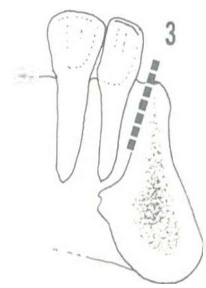
A double-posted bladevent is inserted in much the same manner as is a single-posted bladevent. However, a double-posted blade is from one-half to two times longer than a typical single-posted design. Correspondingly, its socket is longer and usually curves to follow the arch.

To provide maximum contact with bone, the largest implant of a suitable design should be selected. Its placement depends for the most part upon the location of the mental foramina as well as the height of bone above them and the amount of bone existing lingual to the nerve bundles.

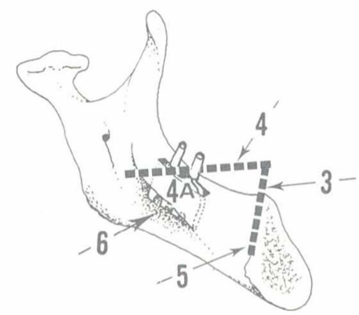
When the bone is thick labio-lingually, often the groove can start lingual to the mental foramina. Thus its posts could extend into the lateral incisor and first bicuspid regions. If the mental foramen is large or close to the ridge, the groove must remain mesial to it. The posts will then protrude into the central incisor and cuspid regions. The posterior extent of the socket must avoid the mental foramin (1). It may stop in front of the foramen, or—if the ridge is deep—extend over it, (2).





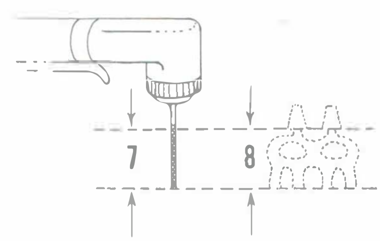


Frequently the angle of the ridge on the lingual side of the incisor region (3) is less than that in the region of the molar area (4) if it should exhibit a deep submandibular fossa (4A). This means that what may be an ideal inclination for the socket in the incisor region (5) threatens the lingual plate (6) in the molar region. The operator must scan the entire implant site *before* he begins drilling, and select the angle suitable to the entire site.



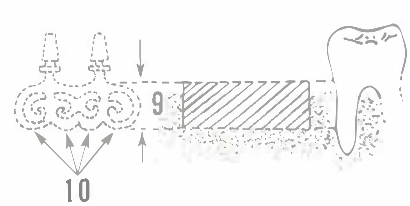
Caution: When drilling the groove, always maintain a continuous angle to the horizontal plane. Do not make a twisted socket. Adapting an implant to it is too difficult.

The socket is gradually deepened. In dense bone, the depth to be drilled (7) at least equals the height of the bladevent, measured to the bottom of its post (8).

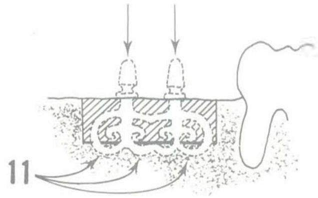


If the bone is particularly cancellous, the socket is made only as deep as the bladevent's shoulder or slightly less (9). The implant's leading edge (10) will break with little trauma the few fragile bony bridges under them leaving intact bone between the lowermost portion of the implant (11).

The bladevent is compared with the socket, and the amount of curvature (12) estimated. Two cone socket pliers (13) are used to bend the bladevent (14) until it fits the socket passively.



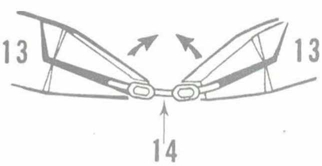
The leading edge of the bladevent should slip easily into the groove without binding on either end (15) of the socket. Again, it is better to gradually bend the implant to the correct curvature,



checking it with the curve of the socket, than to work the metal back and forth.

Manual pressure (16) should be adequate to lodge the implant one or two millimeters in the socket to check post alignments with other abutments. With pliers, the neck (17) of each post is bent gradually to the appropriate angle (18). After all post adjustments have been made, it is time for final seating.

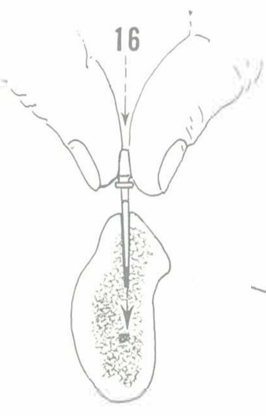
A double-headed seating instrument (19) is appropriate when the posts are either aligned or nearly aligned with the axis of the socket. The head fits over both posts, and aids in delivering simultaneous, equally distributed force to seat the implant. With an assistant's finger supporting the labial crest (20), the implant is tapped until the bottom of its posts sit on the alveolar crest.

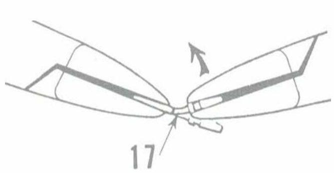


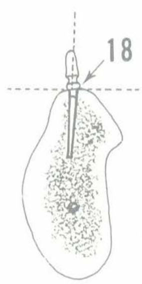
If the implant does not seat smoothly, or if one end requires more force to seat or will not seat at all (21), remove the implant and check the socket with the special channel curette (22). Make adjustments if necessary, and re-insert.

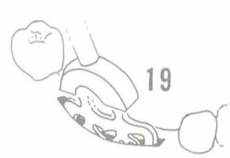
If the difficulty results from denser bone in one area, *do not widen* the socket in the denser area. Simply concentrate more force on the higher post with the single-head seating instrument (23), which may be used to level the implant, or alternate from post to post to completely sink it. If one shoulder still cannot be buried, the implant is removed and the groove in the area is deepened with a 700 XXL bur.

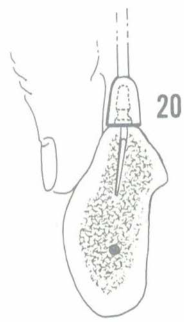
The shoulder set point instrument may be necessary when the implant is acutely angled. With a finger securing one post (24), the

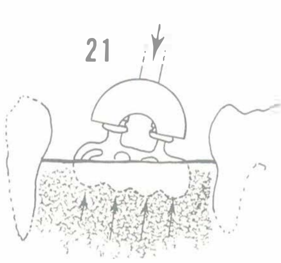


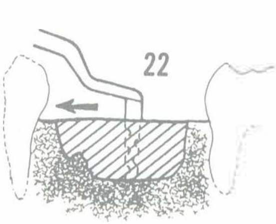


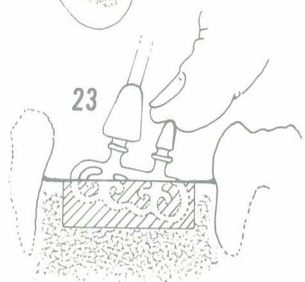


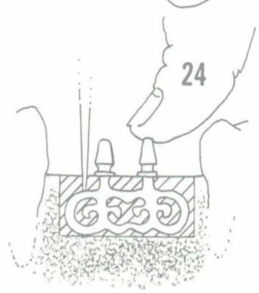










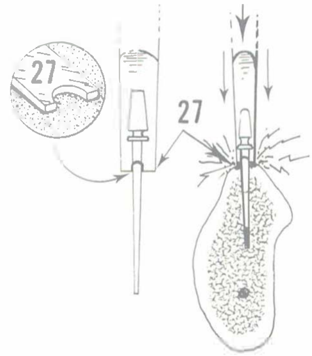


other side of the shoulder is tapped with the pointed seating instrument (25). The instrument is rotated from shoulder to shoulder until the bladevent is seated to its proper depth.

Caution: Continue securing (26) the untapped post even after the implant enters the crest. The implant should not rock in its site, and can be easily knocked above the crest if a finger does not trap it there.

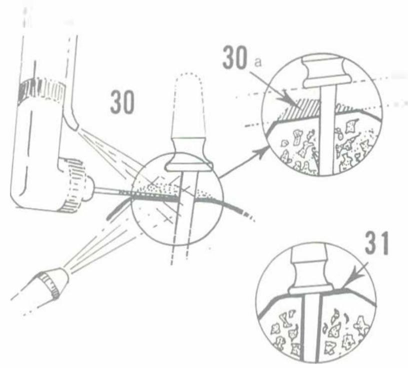
Caution: When using a modified, notched screwdriver (27) to insert a bladevent, do not approach the crest too closely with the implement. It can injure crestal bone, and should be substituted at this state with a pointed inserting tool.

Frequently when the posts have been acutely angled and the socket entrance is lingually offset, it is impossible to correctly seat the implant—with all faces of the bottom of a post resting on alveolar bone—without additional remodeling of the crest. The neck and part of the shoulder may be exposed labially (28), although lingually it contacts bone (28a).

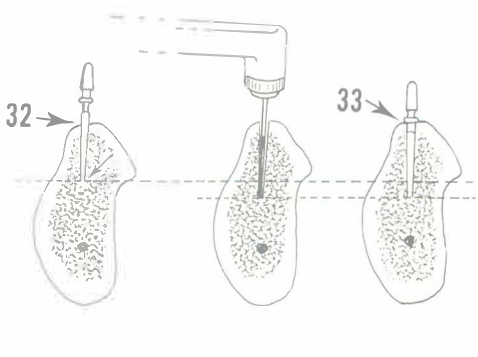


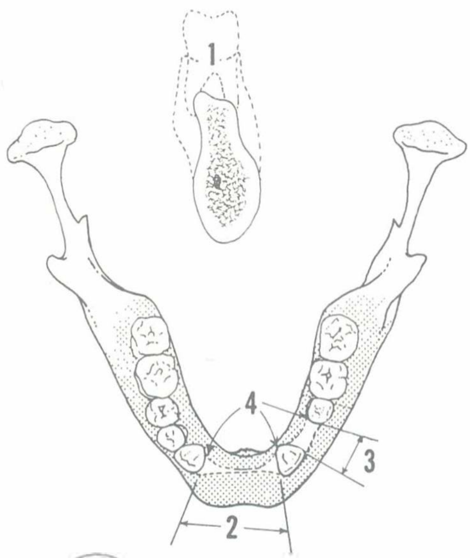
To properly seat the posts, it is necessary to countersink them; that is, to cut a depression in the higher—or lingual—side of the bone (29) just beneath the posts.

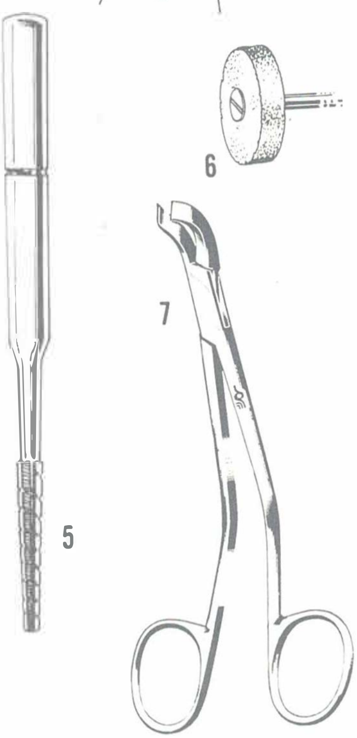
The 700 XL bur is used, with the water coolant particularly essential because of close proximity to the metal bladevent (30). Only that bone interfering with proper seating is removed (30A). This allows the buccal portion of the blade, shoulder and neck to be buried as deeply as the lingual side, thus giving the bladevent additional protection against tongue thrusts (31). It is neither necessary nor desirable to extensively reshape the crest to correctly seat the posts. Countersinking is adequate.

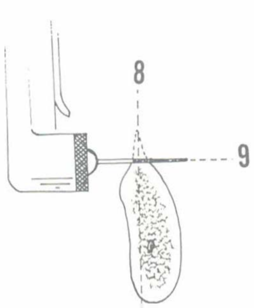


After removing bone for countersinking, the posts may not touch the crest (32) because the groove is now too shallow. The implant is removed, and the groove deepened to properly seat the implant (33).









Problem Ridge: Knife-Edge

The knife-edge ridge is often seen in the mandible particularly in a totally edentulous arch. The mandibular ridge resorbs downward and flat, leaving often the mylohyoid ridge as the highest portion of the arch. When some teeth remain, this narrowing tendency can be somewhat retarded in the edentulous span by osteogenic stimulation from teeth bordering the area. However, the longer the span, the less effective is such "borrowed" stimulation.

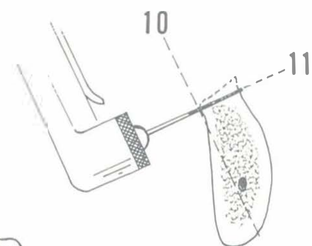
Although the ridge may have thinned and flattened considerably from its original dimension (1), the change is sometimes difficult to detect superficially. Typically the soft tissues in the mandible are extremely thin compared to the maxillary tissues. However, as thin as it is it still has a camouflaging effect over the underlying bone especially covering the mylohyoid ridge.

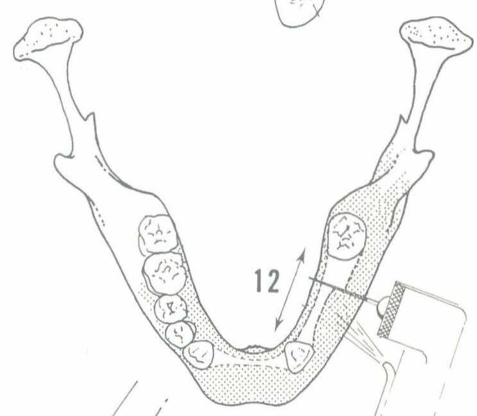
Radiographs still show a tall, bony ridge, but due to the loose attachment of the lingual tissues on the lingual side of the bone posteriorly with its gradual blending in with the floor of the mouth, it makes the mylohyoid ridge look like it is the true alveolar crest since it appears to be more buccally located than it truly is. Only reflection of the soft tissues reveals the true landscape.

The thinning of a totally edentulous ridge may have occurred around the entire arch, or be localized. When a limited edentulous span is involved, its narrowness is usually related to the span's position, its shape prior to tooth loss, its length, and tooth loss sequence. A longer span particularly anteriorly (2) tends to be narrower than a shorter span (3) due to more prolonged abuse. However, even in the longest span, the narrow ridge widens as it approaches teeth (4). In all situations the labial plate usually becomes more concave.

A bladevent must be introduced into a ridge at least 2.5 mm wide, approximately twice the width of the bladevent's shoulder. Most knife-edge ridges can be reduced, if need be, to the desired width with a 700 XL bur (5), a heatless stone (6), or a rongeurs (7).

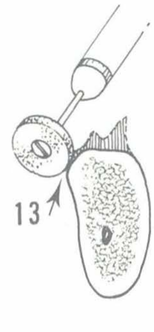
The crest is reduced perpendicular (8) to the vertical plane (9), to retain the labial plate and to avoid countersinking the posts—a process requiring great care because of ease in chipping the narrow, fragile wall of the socket. The crest can also be reduced perpendicular (10) to the inclination of the ridge (11) in those situations where there is extreme labial inclination of the anterior ridge. In this way the groove can be made more lingual and the neck be able to be acutely inclined labially without labial perforation. However, the necks will have to be greatly inclined thus making it necessary to countersink the posts on the labial side. Even reduction rather than spot reduction is often more practical for the totally edentulous knife-edge ridge. Even reduction permits better visualization of prospective implant sites and better access during surgery. Furthermore, almost the entire ridge will be occupied by the blades needed for adequate support. The ridge is gradually leveled by working around the entire arch (12) until adequately wide sites appear.



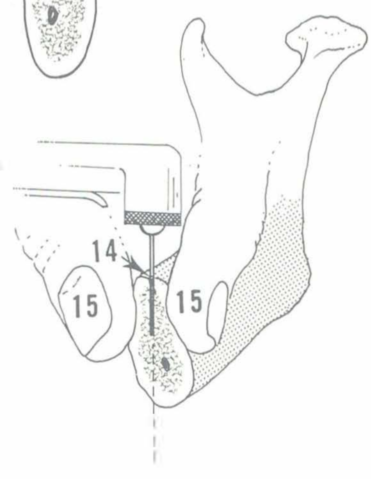


Caution: Although extensively reducing the ridge might produce a wider table, it also brings vital landmarks nearer the crest and limits the choice of implant. Reduce only enough to safely widen the ridge to accept the deepest-bodied bladevent appropriate to the site.

When an adequately wide table has been established, the sharp edge (13) of the ridge carefully may be rounded with a bur or stone to reduce trauma to the soft tissues that will overlie the altered bone.



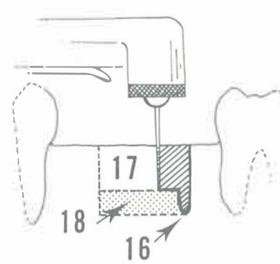
An atypical drilling technique is recommended in fragile knife-edge ridges to make the socket in as few steps as is possible. The 700 XL bur is centered on the reduced ridge (14) and the groove is made angled slightly toward the lingual to take advantage of harder lingual bone and to avoid the typical labial concavity. The operator places his fingers (15) on each side of the site. These will brace the ridge and feel the proximity of the running bur to the labial and lingual plates. The bur is driven straight down to the entire intended depth of the socket (16).

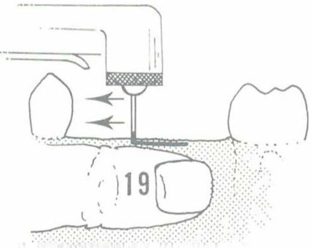


The bur is then slightly retracted (17) to back its shank slightly out of the bone, and then run inside the ridge, making the major portion of the socket and firmly establishing its direction in one sweep. One more pass of the bur, initiated at the original insertion site, is usually adequate to complete the socket (18). The finger (19) is kept on the ridge to sense the bur's progress.

Caution: Progress the bur evenly (20). Do not drag or advance (21) its tip. This will distort the socket's shape and very likely perforate the labial plate.

Caution: Running the bur back and forth in a narrow ridge, trying to gradually create the socket, increases the opportunity of over-enlarging the channel or fracturing or perforating the bone.

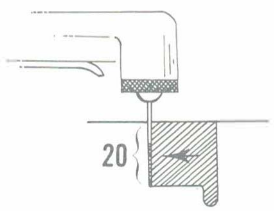




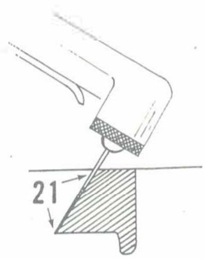
Caution: Whereas a shallow groove may be preferable in a *wide fragile* ridge, a completely drilled groove is essential in a narrow situation. The deep socket gives greater control over final seating of the implant, and prevents overspreading or fracturing the ridge.

When bending the blade to follow the groove, avoid tipping the implant into and out of the socket to see if it "fits." Bending may fracture the crest, and it may not be possible to deepen the socket below the fracture.

If fingers obscure the view of the operative site, use a carrying instrument (22) to compare the blade to its groove.



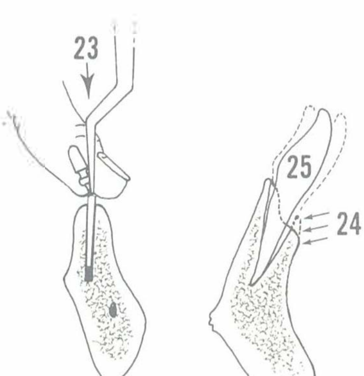
The correctly bent blade is inserted, and the angle of its post checked with those of other abutments. If it is not parallel it is removed, and pliers are used to bend the neck of its post to the correct angle. Again, try to establish the correct angle the first time out of the mouth. Avoid replacing and removing the blade. A slip in the angle of insertion or retraction is hazardous in a knife-edge ridge.



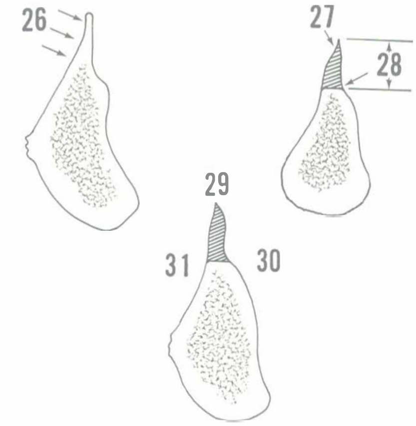
The prepared socket is checked for obstructions and gently cleaned. The implant is replaced and ready to be tapped home.

Final seating is cautiously executed in a narrow ridge situation. Even with fingers bracing the bone, off-center or unbalanced tapping can break the thin fragile wall of the socket. The pointed (shoulder-set) seating instrument is inadvisable for the first few taps because it can slip easily and chip the ridge. Therefore, an atypical procedure is followed—bending the post is delayed. The single-headed seating instrument is used on the unbent post to tap the implant almost completely to its proper depth. Then the implant is removed, its neck bent, and the implant is replaced. It is now seated deeper and is firmly held by bone. Thus secured, the shoulder-set point instrument (23) can be used to tap the implant home.

Both faces of the knife-edge ridge are supported by the fingers as the bladevent is tapped home. The plates will spread slightly as the bladevent is inserted, making the ridge wider than it was prior to implant insertion. Evidence so far indicates that the slight spreading does not exceed the physiological limits of bone. To the contrary, the spreading appears to stimulate more rapid bone regrowth.

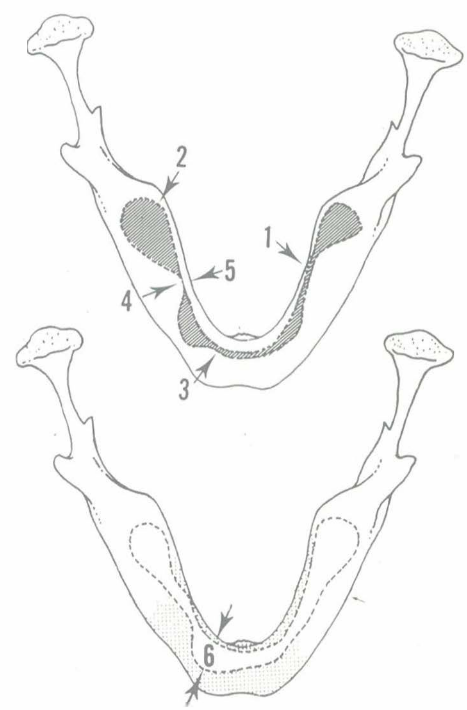


In the incisor areas particularly the labial plate of bone (24) may have almost entirely resorbed due to over-retained periodontally involved teeth (25). Consequently, when the teeth are lost, the remaining bone presents a peculiar picture. A knife-edge ridge exists, formed almost exclusively by the lingual plate of bone (26).



This sharp crest usually can be reduced to a favorable occlusal table. The amount of reduction depends upon the height of the ridge. When the ridge is shallow (27), the crest is reduced only until 3 mm of width is achieved (28). When the ridge is tall with good bone (29), it can be reduced until there is generous bone to flank the implant's shoulders labially (30) and lingually (31).

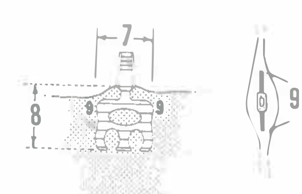
Problem Ridge: Uneven Width



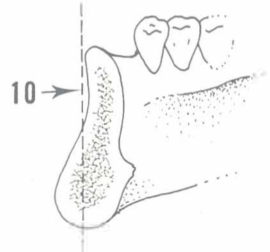
A totally edentulous ridge may range in width from a knife-edge portion (1) to a site almost as wide as one that would invest a healthy tooth (2). Bone loss—and consequently narrowing of the ridge—usually occurs primarily on the labial face (3), but it sometimes may also reduce on both faces (4,5). A greater tendency toward narrowness should be anticipated anteriorly because incisor and cuspid roots have narrower alveolae than posterior teeth. However, tooth loss sequence, time, and/or trauma can upset this pattern. Also, there usually remains more alveolar bone height anteriorly than posteriorly, as posteriorly the ridge tends to flatten out or even becomes concave leaving only the mylohyoid ridge to exhibit the highest dimension.

The same factors influence a partially edentulous arch. When more than one edentulous span exists, which is a common occurrence, the width of each may differ considerably. Longer spans, tend to be narrower and more irregular than shorter spans, for obvious reasons. The presence of some teeth helps divide the ridge into areas that can be evaluated separately and approached accordingly.

Adapting to a Limited, Wide Site: A generously flared anterior area (6) can usually accept any of several standard bladevents, the choice of which depends upon matching the mesio-distal length (7) of the implant and its height (8) to the available bone. Neither shoulder of the implant should approach too closely the narrowed portion of the ridge (9). A slip could fracture the plates, and bone dieback can weaken them.

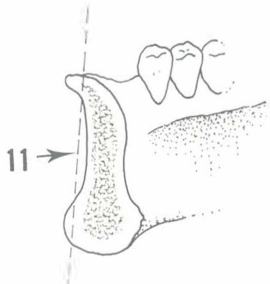


The area below the crest proper should be carefully examined for concavities and other flaws. The narrowed area should have



vertical (10) or diverging (11) mesio-distal dimensions, not converging (12) ones. An undetected convergency can mean penetrating the labial plate during drilling (13), or fracturing it during implant insertion (14). This is another reason why it is usually wise to make the groove slightly lingually (15).

In a wide, even ridge the socket and bladevent follow the curve of the dental arch. However, in an irregular ridge, it may be preferable to make the socket follow the swell of the wider area (16). This would be a particularly handy approach when the tip of the implant shoulders threaten to impinge (17) upon the labial or lingual plates. The slightly exaggerated curving could produce a safety margin in such a tight situation.

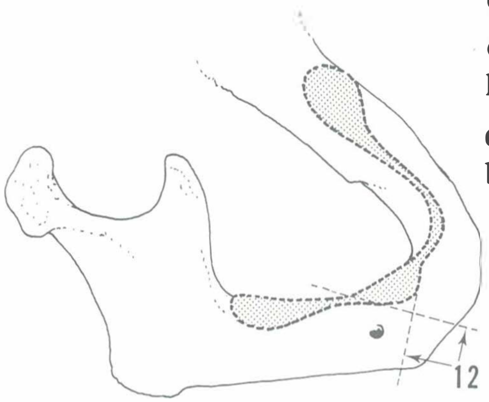


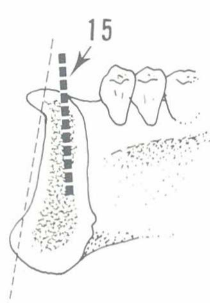
Caution: If the socket's curvature would bring the bladevent's shoulders almost flush against the labial (18) and lingual plates (19), a narrower, shorter bladevent design should be substituted and placed in center of ridge closer to the lingual side (20).

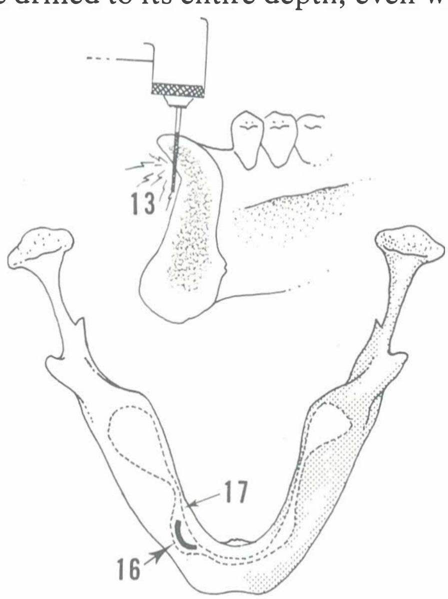
The bladevent is bent with two cone socket pliers to fit the socket passively, without binding or jamming at any point. It is inserted with manual pressure, and the angle of its post compared to those of other abutments. Perhaps curving the groove away from the ideal dental arch line has set the post off-center. This can be easily compensated in prosthesis design.

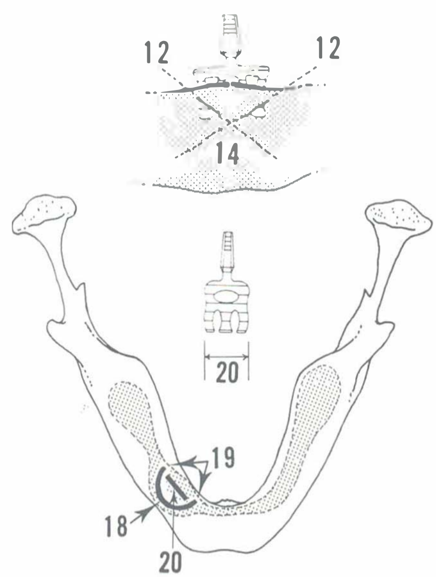
Caution: Trial insertions and removals of the implant should be kept to a minimum in problem ridges to avoid accidental fracturing.

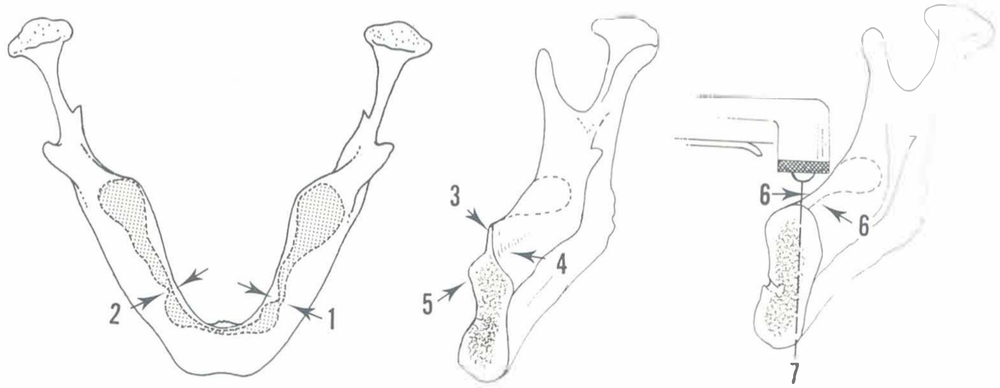
Caution: Also because of the fracturing potential, the socket should be drilled to its entire depth, even when the bone is porous.

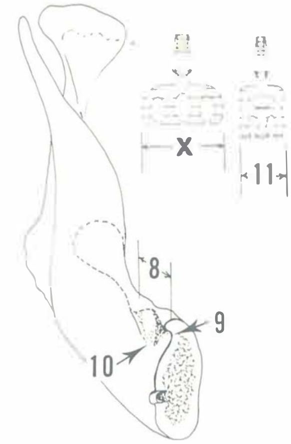






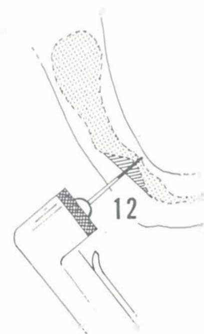






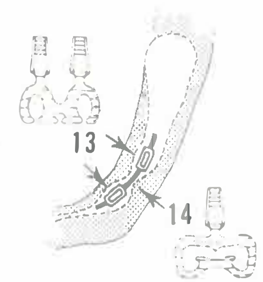
Dealing With a "Pinched Waist"

In some cases, the ridge may have a definite pinched area, or "waist." This feature may be labio-lingually centered in the ridge (1), or, more typically, offset lingually (2). The width of the waist and the shape of the bone above the crest and mesial and distal to the waist determine the implant approach.



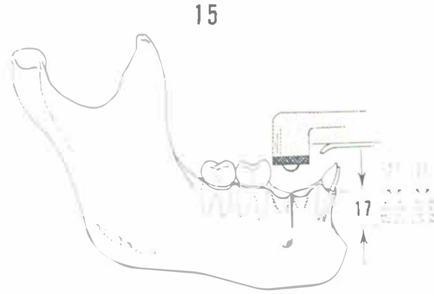
If the waist is less than 2.5 mm wide (3) and the deeper bone remains narrow (4) or is undercut (5), the ridge must be treated as two separate sites. No single bladevent can span the waist.

If the waist is at least 2.5 mm wide and there are no severe undercuts, the site is treated as a narrow ridge site. The guiding dimension is the width of the narrowest portion (6). The groove is centered in this, with the bur directed slightly lingually (7). The length of the groove—and of the bladevent—depends on the character of the mesial and distal portions of the ridge (8). Undercuts (9) or converging walls (10) may require using a mesio-distally shorter implant (11).

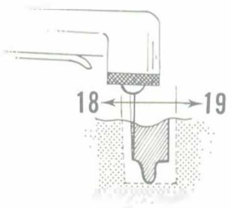


If the pinched waist is narrower than 2.5 mm, and a single implant site is desirable, it may be possible to reduce the waist (12) until the ridge is wide enough.

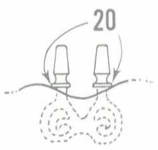
A double-posted bladevent is preferable for narrow-waist situations. A double-posted design places the abutments in stronger bone (13) where they share the forces brought to bear upon the site. The post of a single-posted blade would fall at or near the bone's weakest point, its narrow "waist" (14). Another advantage is provided by using the open-socket bladevent (15). Its recessed shoulder, falling in the narrowest area, (16) will allow the regrowth of a tall shelf of bone over the most fragile area.

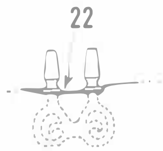


As in other precarious socket-making situations, the bur is sunk to its entire depth (17) to duplicate the depth of the bladevent, *Base to Shoulder*, being extremely conscious of landmark areas



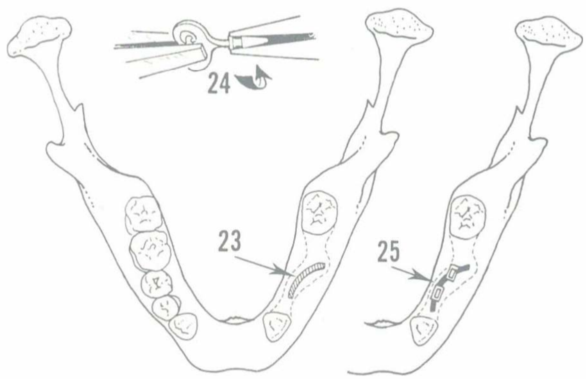
such as the mental foramen as in this illustration. Then its shank is backed out and the cutting portion is worked mesially into wider bone (18), then distally (19), or vice versa—operator's preference. Note that this approach is different. Whereas the socket in an evenly wide ridge is initiated at one end and worked toward the other, the groove here is initiated in the narrowest portion for greater control over its direction.

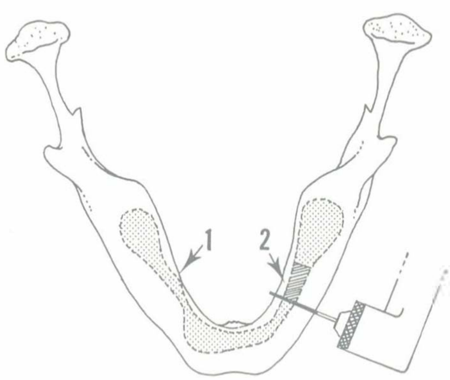




In many narrow-waist situations, particularly when remodeling of the crest is required, the implant cannot be correctly seated without countersinking the posts (20). Bone must be reshaped mesially and distally (21), to properly seat the implant with the bottom of both posts touching the crest (22).

Occasionally the shape of a pinched ridge may require curving the groove (23) counter to the curve of the dental arch. This is an exceedingly delicate situation. A short, shallow bladevent design must be used to avoid perforating the labial or lingual walls. The neck (24) of the implant should be twisted so that the post will follow the normal dental arch (25).

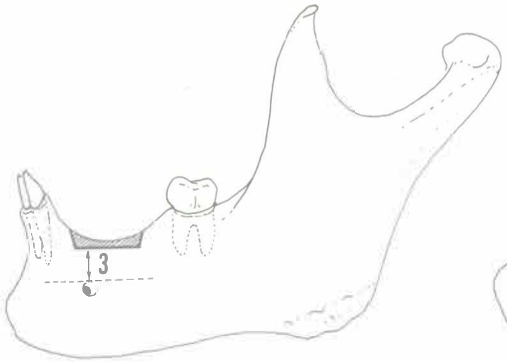


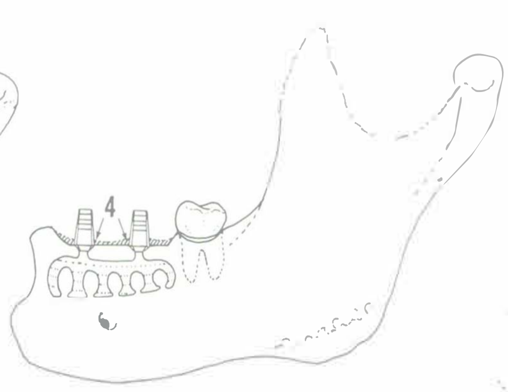


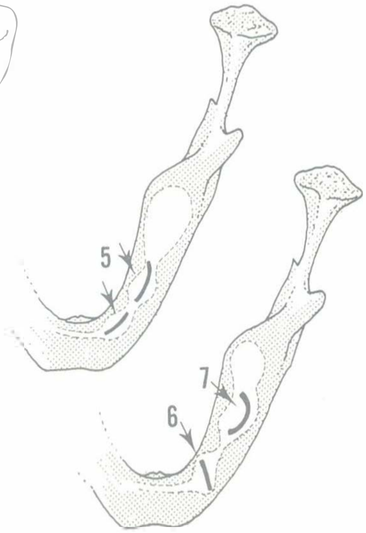
Finding Bone For Two Anterior Abutments

When two anterior abutments are needed and the crest has a relatively long "waist" (1), the approach, as usual, depends upon the morphology. If the ridge's walls diverge below the narrow crest and have no severe undercuts, the crest can be reduced to 2.5 mm wide (2) to prepare the ridge for a single or double-posted bladevent.

However, attempts to accommodate an implant design should be subservient to morphological considerations. Only a minimal

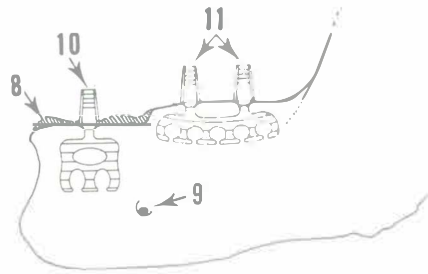






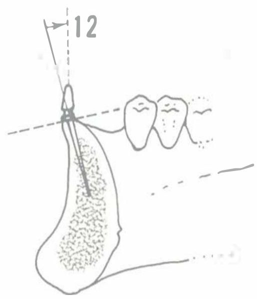
amount of bone should be removed. Reducing the alveolar ridge increases the proximity to anatomic landmarks (3).

The implant socket is created in the reduced crest, being closer to the lingual surface than the labial surface, if possible. Because of a double-posted bladevent's length, the socket will curve around the dental arch.



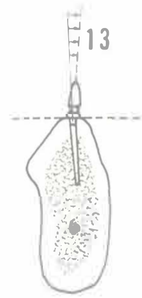
Caution: The bone above the mandibular canal may be more porous than that in the canine-incisor area. The socket should be drilled accordingly, being left slightly shallower in the porous area. When seating the bladevent balanced tapping is essential. The blade should not ride up and down in its socket. Both posts of the bladevent should be flush with the reduced crest (4).

Sometimes anteriorly, a narrow "waist" extending high on the ridge can divide the ridge into two implant sites. Because each site is separate, various "tricks" may be used to take better advantage of the remaining bone. The sockets may follow the dental arch (5); or, a groove may be angled (6) or curved (7) across the dental arch. Angling or curving a bladevent in a short space is recommended only for the experienced operator.

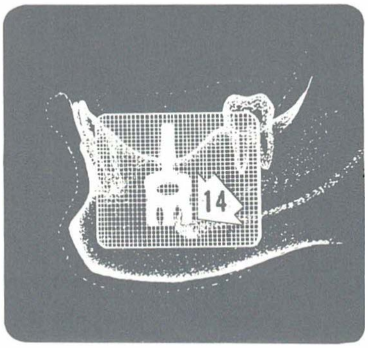


Sometimes it is possible to reduce (8) the more anterior site to extend a larger implant into the narrow waist. It is usually unwise to reduce the ridge too close to anatonacal landmarks of the mandible such as the mental foramen (9).

Caution: Do not improperly seat one implant in order to achieve even post height. Each implant must be buried up to the bottom of its post. Differences in post height (10), (11), can be easily compensated in the prosthesis.



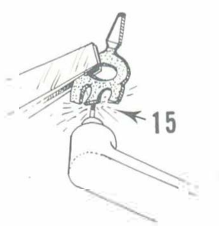
Because each socket should be angled most advantageously into its site, the implants may be seated at different angles. Their posts should be adjusted accordingly (12,13), so that each is

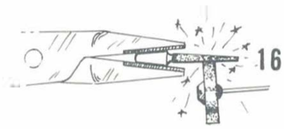


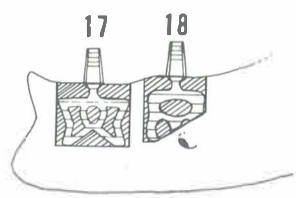
perpendicular to the occlusal plane and parallel to other abutments. Countersinking may be necessary in one site, but not in another.

When using two individual bladevents and the more posterior blade closely approaches the canal, it may be necessary to modify its distal edge as insurance against intruding into the canal. First the bladevent is compared to the radiographs, and the possibly intruding portion noted (14). This offending portion can be reduced with a 700 XL carbide bur (15). The altered segment is then trimmed to re-establish the wedge-shape on the leading edge of the implant (16). This wedge need not be as sharp as the manufactured one because of its proximity to the canal.

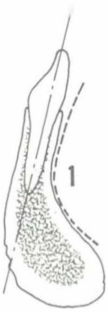
Bone porosity often differs in each site. Making each socket separately (17, 18) gives greater control over socket depth and implant insertion.

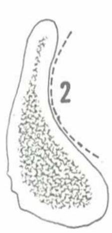






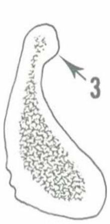
Problem Ridge: Undercuts (Severe Concavities)



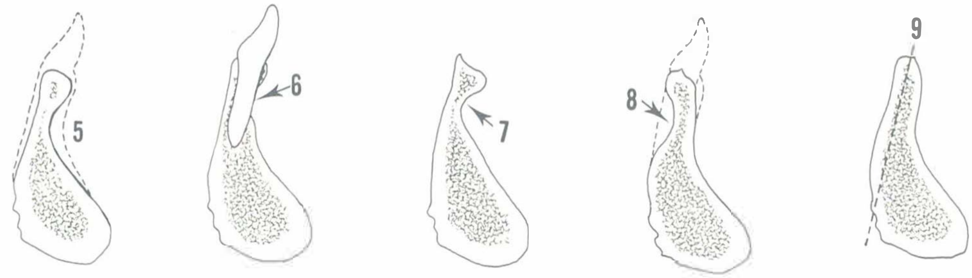


The shape of the ridge—from canine region to canine region—tends to be concave labially (1). This results from the normal inclination of the anterior teeth. As the ridge recedes after tooth loss, the concavity tends to become more pronounced (2). Perhaps crestal bone remains in the shape of a bulb-like knob (3).

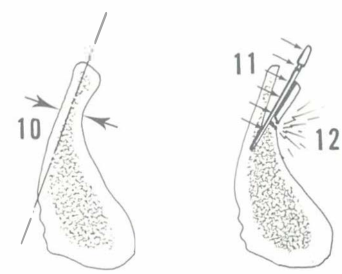
A concavity deepened by resorption reflects the history of the ridge. Because all teeth are not lost simultaneously by natural processes, the concavity is rarely a geometrically precise or balanced shape. A recently vacated left lateral incisor area may be much less concave (4) than its bilateral counterpart (5).



Furthermore, disease often induces a more exaggerated or an atypical resorption pattern. A fenestrated site (6) can leave a pronounced concavity (7), more precisely described as an "undercut". An abscess can cause a concavity which would not normally result from disuse atrophy, for example, on the lingual surface (8).



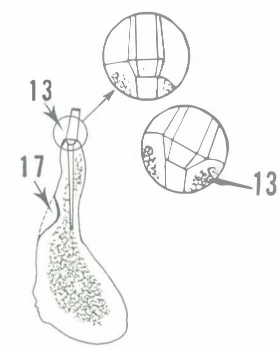
Caution: Remember that an implant candidate requires implants because of an abused, diseased, or neglected (a form of abuse) ridge. Problem ridges are more typical than atypical.



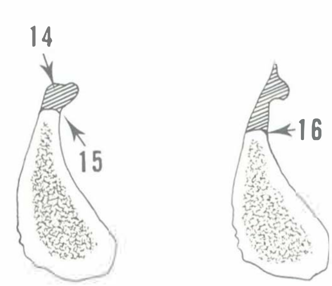
Concavities or undercuts are difficult to detect radiographically because they are aberrations in the labio/bucco shape of the ridge, rather than in its height. Only reflecting the tissues accurately reveals their presence and extent.

The deepness and length of the concavity and the resulting shape of the ridge around it influence the angle of the implant socket and its shape.

Ideally in a good ridge the groove is initiated slightly to the lingual of the center of the crest (9). However, when a concavity is present labially, it is imperative to use the concavity—the narrowest portion of the ridge—as the prime determinant in angling the groove. The groove should bisect the narrowest portion (10). This bisection should be potentiated by angling the socket into denser lingual bone, a desirable maneuver. Moving the socket labially (11) may cause the labial plate to fracture (12) during groove-making or implant-seating procedures, or later during mastication.

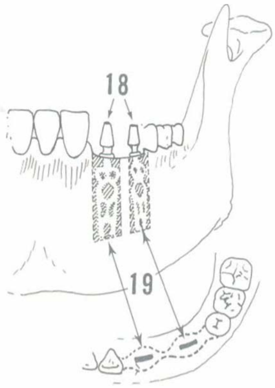


In most cases, angling the groove away from a concavity will mean that the neck of the bladevent must be acutely bent for proper alignment of the abutments, and the bone directly under the post on the lingual side of the ridge must be notched (13) to countersink the post so that the labial side of the blade is properly buried (13a).



Generally, a ridge with an undercut need not be reshaped. However, if a bony knob (14) at the crest complicates the access to the underlying narrow portion of the ridge (15), the knob can be removed, leaving the ridge at least 2.5 mm wide.

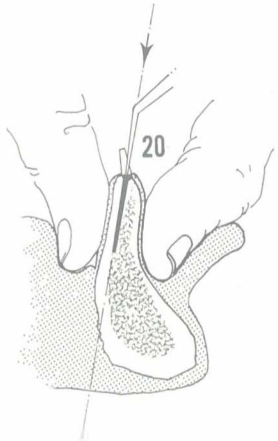
If there is enough bone below the undercut (16) and the concavity is very deep it may be advisable to reduce the ridge beyond the 2.5 mm minimum to a more generous dimension.

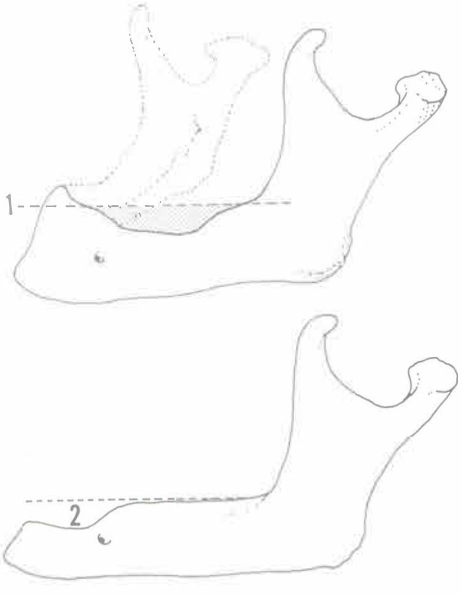


A lingual anterior undercut, which usually results from disease, is much rarer than a labial undercut. In such a situation, the socket axis should bisect the narrowest portion of the ridge (17), moving it more labially than is otherwise recommended.

Two narrow blades may be preferable to one wide double-posted design in an area with a deep or an irregular concavity. Each blade can be inserted to its best advantage (18,19). Two deep and narrow grooves might be the best options for each site.

No matter which option is selected, a thumb or finger bracing the concavity is recommended while drilling the socket and seating the implant (20). The area may not only be shallower, but also considerably weaker.



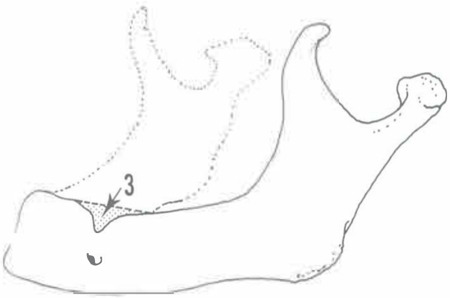


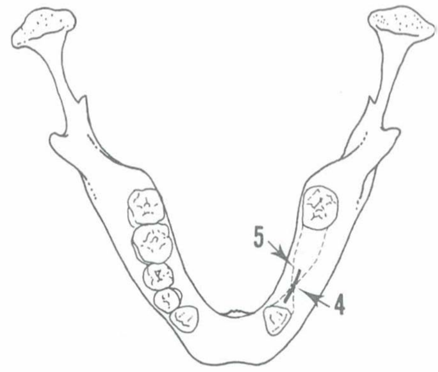
Problem Ridge: Uneven Height

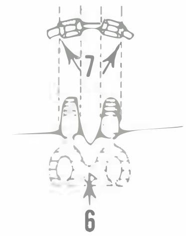
Variations in bone height are readily detected radiographically. Many prosthodontic problems arising from unequal height are more properly compensated in the prosthesis. Surgically the difficulties depend principally upon where adequate height and width remain, and the length of the edentulous span.

Usually the anterior ridge is at least as tall as the posterior, and in most cases it is taller (1). However, traumatic loss of the incisors or canines, or uneven distribution of masticatory forces can cause excessive labial resorption of the anterior portion of the mandible (2).

The loss of height may be limited to one area. For example, the vestiges of a single extraction site may produce a pronounced dip (3) in the crest. This feature is often accompanied by lateral recession of the walls of the socket, particularly the labial one

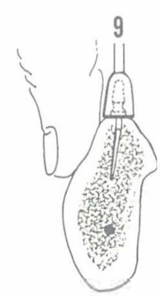


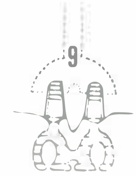




(4). If the site is prosthodontically desirable and not too narrow, the implant groove should be centered in the narrower area (5) and directed miso-distally into the wider area, treating the situation as a narrow ridge implantation.

An atypical design—the open-socket bladevent—is appropriate. The open-socket blade is inserted as is any other bladevent. The groove must follow the dental arch, and bisect the ridge at its narrowest point. The recessed shoulder (6) must be set beneath the dip in the ridge, firmly in bone. The design is double-posted, so that occlusal forces will be directed into the stronger bone on either side of the defect.

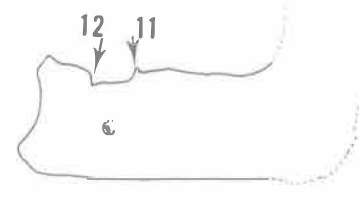




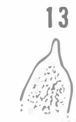
The posts must be bent (7) to the correct angle, and touch the crest on all faces. This usually means that countersinking (8) is necessary.

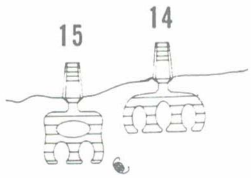
A double-headed seating instrument can be used to seat an open-socket bladevent in a slightly inclined socket (9). Or, if the socket has an exaggerated curve, a single-headed instrument can be rotated from post to post to gradually sink the implant. If the posts have been acutely bent away from the socket's inclination, the pointed seating instrument (10) may be used.

Sometimes a very rugged outline remains. This type of ridge may also be complicated by narrowness and undercuts. Small bony spurs (11) should be removed with a bur or rongeurs. The spurs tend to chip off or irritate replaced wounded soft tissues. An angular shelf or bone (12) should be reduced if it forms a narrow prominence (13) in or near the implant site. Such a fragile projection cannot be used as an implant site, and tends to fracture or otherwise interfere with implant insertion.



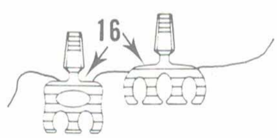
When only one abutment post is needed in the anterior mandibular area, any of several bladevent designs can be angled into the remaining bone. The chosen design is inserted according to the



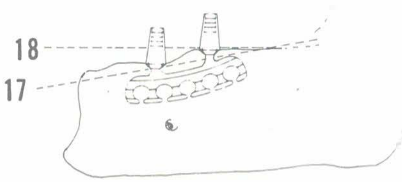


dictates of the site, with atypical bending and countersinking of the posts not unusual.

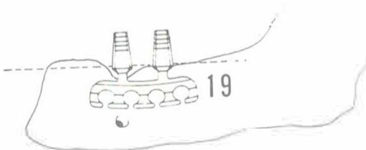
The need for two anterior abutments may be fulfilled more easily with two single blades than with one long double-posted blade. Two separate bladevents are often more practical, particularly when there are undercuts to avoid or when the ridge is narrow. Each blade may be set to its best advantage (14,15), usually without the extreme oblique angling or bending of their bodies often needed for a double-posted blade in the same situation. Exaggerated bending of the necks can also either be avoided with two blades, or at least perhaps limited to only one implant.



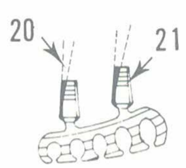
Caution: Avoid the temptation to insert the implants so that the posts are set at the same height. Differences in occlusal level are easily adjusted in the prosthesis. Improperly seating an implant (16) is the major cause of implant failure.



A double-posted implant is advisable only when there are no undercuts or other problems with the ridge. Seating the implant so that both its posts touch the crest of the ridge may set it oblique (17) to the occlusal plane (18).

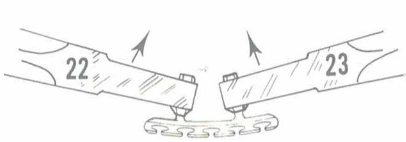


Caution: It is far more important to encase the shoulders firmly in bone than to position the implant parallel with the dental arch (19). The base of both posts must touch the crest.



The posts are adjusted after the socket has been prepared, and after the bladevent has been curved to fit the groove. If very acute angling is needed to adjust the posts, some adjustment can be done by grinding (20) outside the mouth to create a new taper (21). When exaggerated angling is predictable and if time permits, it might be more practical to order a custom-made bladevent with the posts already angled.

In most cases, the need for countersinking will become obvious as the implant approaches the crest. Countersinking is more easily accomplished with the implant in its socket.



Most adjustments in the necks of the posts should be made outside the mouth, prior to final seating. However, when a double-posted bladevent is used in firm bone, minor adjustments can be made in the mouth. After the implant has been almost seated to its proper depth—i.e., only the posts and their necks protrude above the crest—one cone socket pliers stabilizes one post for use as a brace (22), while another pliers adjusts the second post (23) by bending its neck, using the shoulder as the fulcrum.

Caution: Work cautiously with the pliers near the crest. A slip or pinch of the pliers can easily bruise or fracture bone.

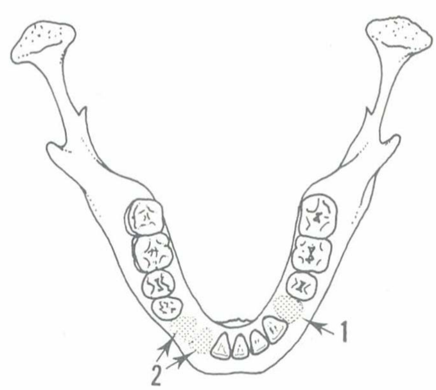
Any lack of parallelism of the posts after the implants are fully seated can be adjusted with the 700 XL bur without dislodging the implant. The post height can be shortened with the 700 XL bur or a heatless wheel—always with water. This type of paralleling should always be done immediately after the implant is inserted so as to allow for easy insertion and removal of a temporary splint, also to avoid having to do this procedure at a later time when the bone is undergoing catabolic changes which could cause dislodgement of the implant.

Problem Ridge: Limited Space

Space in which to work may be limited for two entirely different reasons. The presence of natural teeth may make it difficult to maneuver an implant into bone between the teeth and avoid the roots. In such a situation, the implantologist is usually working under relatively favorable conditions, i.e. in fair to good bone sites. The other reason is bad news: extensive resorption has left almost no ridge and nondental anatomic features may be threatened by implant procedures. Either situation—good or bad—requires versatility and ingenuity on the part of the operator.

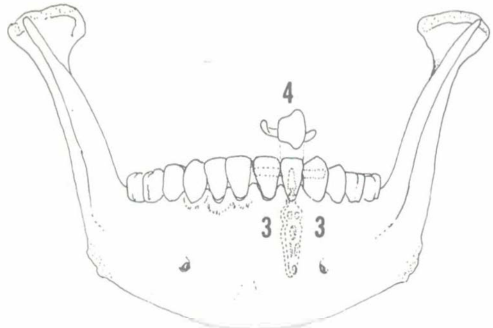
Single-Tooth Bladevents. The single-tooth bladevent differs in design and, in many ways, use from all other bladevents. It was designed to fit into a one-tooth edentulous span. Because the proximity of neighboring teeth limits its horizontal dimension, the implant must gain its mechanical advantage by vertical extension in bone. In this way the single-tooth implant is more like a natural anterior tooth than it is any other type of bladevent design. Its unusual height—slightly longer than a central incisor—limits its use in the mandible to areas in front of the mental foramen. Only here is the bone potentially deep enough to accept this tall design.

The single-tooth implant can be used when only one tooth in the entire arch is missing (1) or in a one-tooth span. Or in an arch with several other missing teeth (2). The condition of the remaining teeth and of the bone, as well as the location of the tooth loss, determine how the implant will be used.



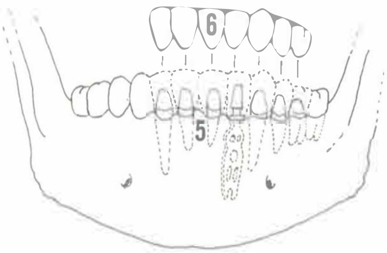
There are two basic, single-tooth implant situations. The first is to provide a base for a single-unit, fixed restoration that does not require sacrificing the crowns of neighboring teeth for its anchorage. This use most closely approaches the dream of "replacing a tooth with a tooth", a misleading ambition for several reasons extensively explained elsewhere.

The other use is to share and balance occlusal stresses on a multi-unit fixed prosthesis with other weaker abutments. Because dental disease leading to tooth loss usually affects more than one tooth, this latter use is by far the more common.

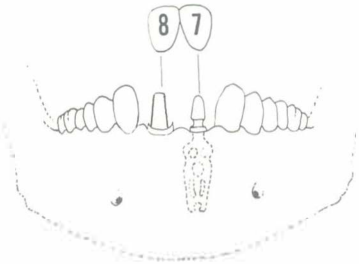


The criteria for both uses differ slightly, but both require that existing periodontal conditions around neighboring teeth be cured or stabilized before implantation.

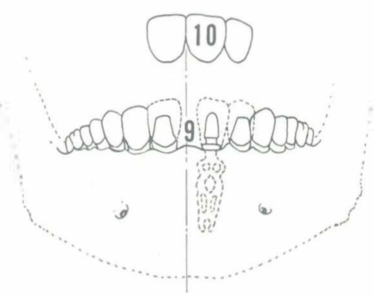
When a single-unit fixed restoration is desired, the teeth bordering the span must be healthy and firmly supported by bone (3). These teeth will be included with some form of stabilizing device for the implant, such as lingual extension rests (4) from the single crown or splinting. If the teeth have poor bone support (5), implantation is not necessarily contraindicated, but the single-unit fixed restoration is. The implant can be used to stabilize the loose teeth by providing more support in a multi-unit fixed bridge (6).



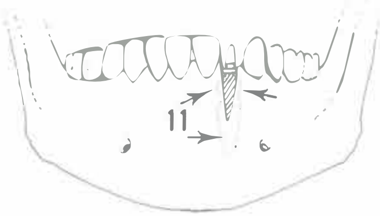
Esthetics also influence whether or not a single-unit restoration is advisable. It is more difficult to fashion a complimentary restoration for a single central incisor than to pleasingly restore both central incisors simultaneously—with one crown supported by an implant (7), and the other by the prepared remaining central incisor (8). A lateral incisor, with its bilateral counterpart three teeth away, poses fewer matching problems and would more easily give satisfactory results.



If a large diastema (9) existed before tooth loss, a single-unit restoration filling the gap would be awkward and unnatural looking. If the restoration were small and maintained the diastema, it would be very difficult to stabilize. It would be better to use the implant to anchor a two or three-unit fixed bridge, with two crowns closing the diastema (10).

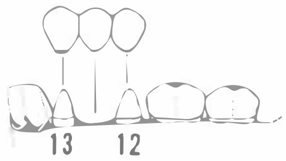


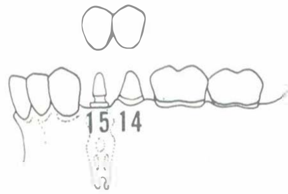
Bone in a state of flux is also an unwise implant site for a single-tooth restoration. Lateral extension rests from the single-unit or splinting do not provide as much stability as does inclusion in a multi-unit restoration. Therefore, if a single-unit restoration is contemplated in an extraction site, implantation should be postponed at lease three months to allow firm healing of the socket. Space should be maintained with a conventional appliance to prevent drifting or tipping. However, in those situations where the width of the single tooth implant can engage good bone mesial and distal to the socket and its length engage healthy bone beneath the socket floor, the implantation procedure may be undertaken immediately (11).



Caution: When a single-unit fixed restoration is used on a preteenager or a teenager, the parent also should be instructed about implant care. Both patient and parent should learn what promotes loosening and to recognize its symptoms. It would be unwise to rely upon the child to report back to the dentist to restabilize or replace the implant if it should loosen. The bone of a neglected implant site can eventually resorb so much that the substitute pontic would have to be unnaturally long to meet the ridge. This unattractive solution in the incisor region would make the patient and dentist very unhappy.

More commonly, the single-tooth implant is used to minimize the number of teeth to be included in a restoration or to provide additional balanced support between natural abutments for a multi-unit fixed prosthesis. For example, when a first bicuspid is missing, a conventional solution is a three-unit fixed bridge with the second bicuspid (12) and cuspid (13) as abutments. However, an implant can be used in the span, and a two-unit restoration fabricated for the second bicuspid (14) and for the implant (15). This is particularly desirable when the canine is esthetically perfect. In this type of situation, the bone must firmly encase the single natural abutment and be clear of the mental foramen.



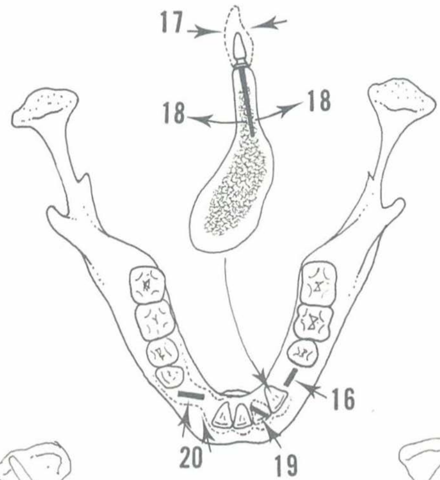


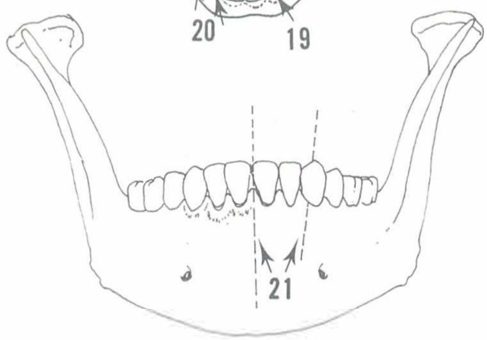
The methods for inserting a single-tooth implant, whether it be to support a single-unit restoration or for inclusion in a multi-unit restoration, are very much the same.

Because the single-tooth implant is atypically tall, the operator must reflect an unusual amount of tissue to visualize the ridge, particularly the labial surface. Undercuts may occur at any level on the ridge, and labial concavities are typical in anterior situations.

The exceptionally deep groove must be slightly lingual to the labio-lingual cortices at the narrowest diameter of the ridge, wherever it occurs. If the ridge is wide, the bur could also be angled toward the harder bone of the lingual plate.

The most desirable alignment for a single-tooth implant is along the arch line (16). Because of the extreme narrowness and increased length of the blade, its lever arm action is greatly increased (17) while the broader surface of the body of the blade is subject to lateral forces (18) which are the major cause of dislodgement. Sometimes there is insufficient space between the roots of the teeth

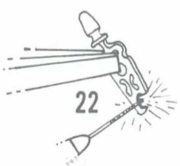




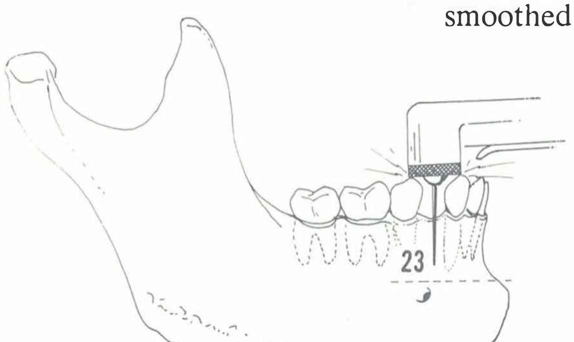
and the implant must be angled (19) to avoid impinging upon their periodontia. The implant socket may also be angled to avoid a flaw (20) in the ridge.

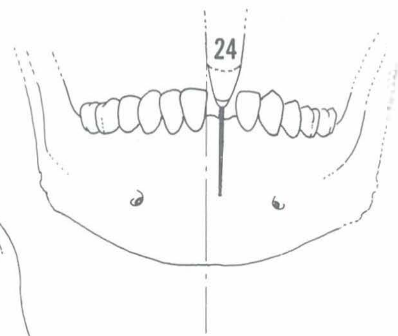
The 700 XXL bur is used to make the socket for this long implant. In particularly dense bone—which is usually seen in the canine area or in the symphyseal region (21)—more than one fresh bur may be needed. Some bone is so dense that reducing the implant's height (22) is preferable to intense, high-friction drilling. When the bone is very porous, a few millimeters should be left to be broken by the implant's legs as the implant is finally seated.

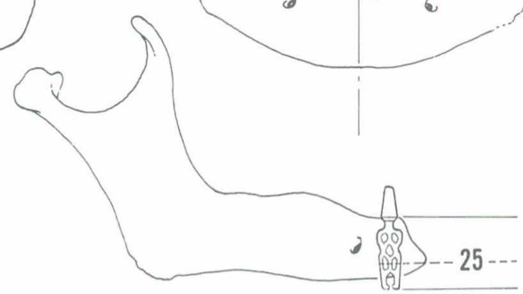
The teeth bordering the edentulous span may interfere with the head of the contra-angle, preventing the bur from reaching the desired depth (23). The bur can be locked further out of the contra-angle head; the standard contra-angle can be replaced with a pedo-headed contra-angle; or a straight handpiece (24) can be used to go between the teeth with a special bur to fit it. If neighboring teeth are to be prepared for full crowns, this can be done prior to starting the implant socket to make easier access for the implant groove.



Usually the bone between the crest of the ridge and the inferior floor of the symphyseal area is deep enough to accept the manufactured size of a single-tooth implant. However, excessive resorption, or reduction of a knife-edge ridge to make it better accommodate an implant, may make the ridge shorter than the implant (25). The implant can be shortened by cutting (22) a few millimeters off the legs. The altered legs should be retapered and smoothed (26).

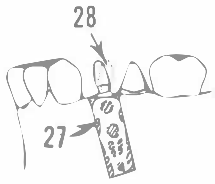






Caution: After any form of alveoplasty, the implant site must be re-evaluated to ensure that a previously selected implant design is still appropriate.

Before final seating, the implant is tried in its socket and the alignment of its post checked with that of the neighboring teeth (27). Often the neck (28) must be twisted so that the post will follow the arch line. This is particularly important in anterior sites for the construction of a natural-looking, non-bulky restoration.



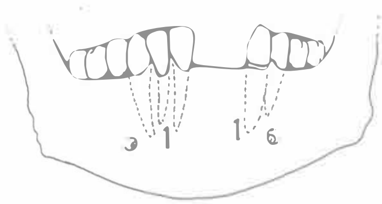
A single-headed inserting instrument is used with a finger supporting the labial plate. A few taps should sink the implant to its proper depth, with the bottom of its post touching the top of the ridge.

The single-tooth bladevent is the only bladevent design that must be immediately stabilized after insertion. The method of stabilization will depend upon its location, the condition of the neighboring teeth, and the type of final restoration.

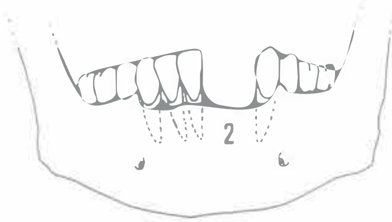
The single-tooth implant can serve an important function when a mandibular cuspid is missing by insuring osteogenic stimulation within the canine pillar. This column of bone allows the lip to remain symmetrical to its other side.

As the underlying bone shrinks in the canine pillar region, the lip drops in the area—a tendency noteworthy for its cosmetic implications. Thus an implant can provide more benefit than a conventional restoration whose prime functions are space maintenance and providing a chewing surface.

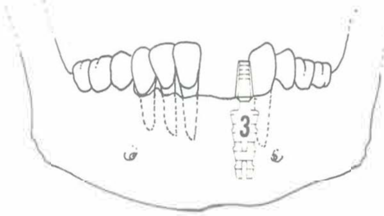
Anterior Tooth Replacements

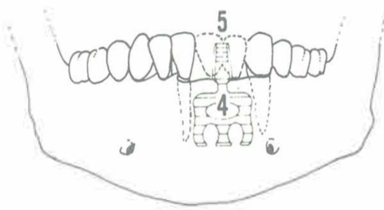


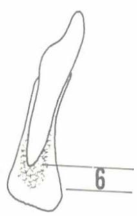
The decision to use an implant in a one or two-tooth anterior span depends primarily upon the condition of the remaining teeth and their supporting tissues. Neighboring teeth with good bone support (1) are usually adequate anchors for a prosthesis without the use of an implant. An implant might be considered to promote osteogenesis, but in such a short span the neighboring teeth usually provide adequate stimulation.

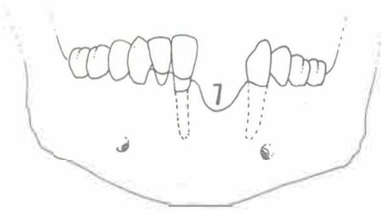


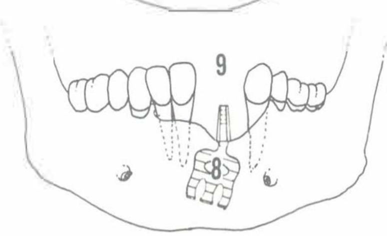
Frequently the cause of tooth loss affects neighboring teeth as well, and they are either unstable or in a precarious situation (2). In such cases an implant can provide additional support for a prosthesis. It may relieve the teeth of otherwise unbalanced occlusal forces and prevent the further deterioration of their situation. Bone











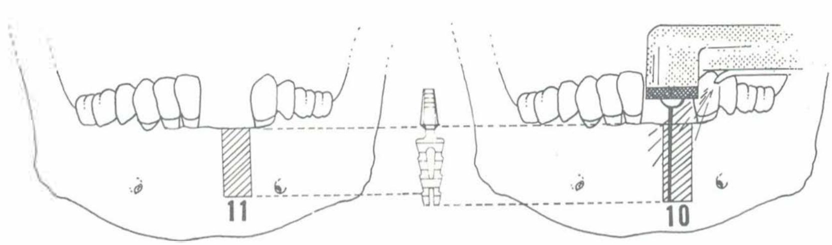
might benefit, around the teeth being saved from further trauma and around the implant receiving osteogenic stimulation.

The narrow, single-tooth bladevent (3) is usually the most appropriate design for an anterior two-tooth span. Whereas another narrow design (4) might fit into the span, its post would protrude interproximally (5), requiring the addition of unesthetic, unnatural bulk in the restoration. (Note: "Single-tooth" bladevent refers to a specific, atypical bladevent design so narrow that it can fit into a single-tooth anterior span. The term does *not* refer to the number of teeth to be replaced.)

Some individuals have very little bone (6) between the apex of the tooth and the inferior floor of the mandible. Thus when the tooth is lost, usually as a result of bone loss, there may be insufficient height to accept a standard single-tooth bladevent. Others may have lost an unusual amount of height (7) due to a traumatic extraction or some other factor. In such cases the implant's legs can be cut down to reduce the implant's height. Or, a shorter design can be angled (8) into the ridge and its neck bent to center (9) the post under the proposed restoration.

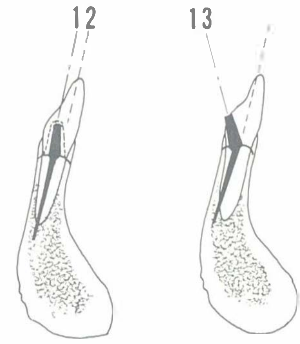
An implant socket between teeth is made according to the same surgical dictates as in a totally edentulous ridge. The socket is initiated slightly lingual to the center of the crest and inclined to leave more bulk on the labial side of the ridge.

Bone density will determine how deep the socket should be made. The socket should be drilled to its fullest depth (10) with a 700 XXL bur if the bone is dense. In a more porous ridge, 2-3 millimeters of bone may be left (11) to be interrupted by the legs of the implant. However, in the anterior mandibular arch the bone may progress from porous at the crest to very dense as the bur travels more inferiorly. Increasing resistance to the bur in deeper bone indicates this, and may necessitate using a fresh bur to avoid excessive friction. When the socket is acutely angled it is drilled to



its entire depth, even in porous bone, to facilitate insertion in difficult seating situations.

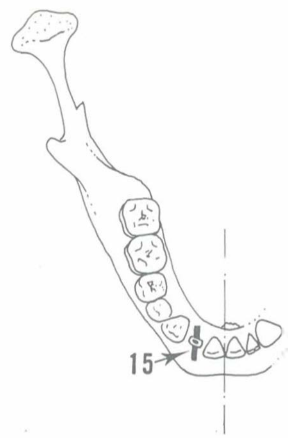
The implant is tried in the site, and the post's angulation compared with that of the teeth to be prepared and included in the restoration. The neck must be bent to parallel the post (12) with these teeth, not necessarily perpendicular (13) to the arch. If the socket is angled across the dental arch line, the neck must be twisted (14) to follow the arch (15).



The single-headed inserting instrument is used with the narrow, single-tooth implant. Because the post is parallel to prepared teeth in most short-span situations, it is not usually acutely angled. Therefore, it is relatively easy to direct the taps along the axis of the socket with the single-headed inserting instrument.

As normal operative precaution, gentle taps are appropriate. A supporting finger safeguards the labial plate, and both fingers should brace a narrow ridge or one in which the implant will closely approach either plate.

The implant is correctly seated when all faces of the bottom of the post meet the crest. Countersinking is usually unnecessary because the implant post is aligned with the teeth, and thus the axial inclination of the ridge.



However, in a few cases only the lingual face of the post may touch the crest, and a notch should be made in the lingual side of the crest to correctly seat the post. As the operator gains experience, he will be able to predict the necessity for countersinking and make the necessary socket adjustment with the implant in or out of the mouth, prior to tapping.

Caution: If the implant remains in its socket during countersinking, copious amounts of water must be used to keep the bone cool and prevent heat transfer from the metal implant.

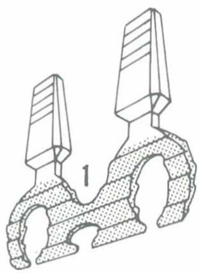
The single-tooth implant is the only bladevent design that should be immediately stabilized after insertion. The type of support will depend upon the condition of neighboring teeth.

Midline Implant

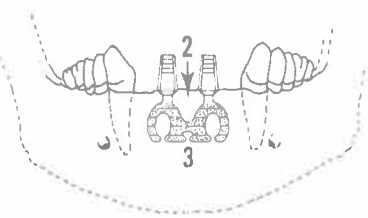
Usually the ridge is sufficiently wide and tall at the midline to accept a bladevent. The bone is extremely dense in this area requiring the operator to frequently change the cutting burs. The bone in this area also has less visco-elasticity than anywhere else in both arches along with a poorer blood supply. Thus, this bone could fracture more easily if the bladevent should be tapped too hard. In order to avoid this, the groove must be made extremely deep, constantly changing the 700 XXL bur and using copious amounts of water.

When contemplating crossing the midline with an implant, careful anterior peri-apical radiographic studies are essential, as well as full exposure of the bony ridge.

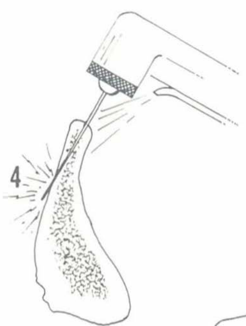
Sometimes artificial abutments are desirable in the midline area. Perhaps the bone in more distal, and prosthodontically desirable, sites is pinched or flawed. Or, only incisors are missing and the remaining teeth would benefit from some form of artificial anterior support.



Although a few designs fit the site, the open-socket bladevent offers several advantages. The recessed shoulder (1) allows a significant amount of bone to regrow as a shelf (2) over the central part of the implant (3), locking the implant securely in its site. This bonus feature often makes the open-socket design desirable in many situations other than a true open-socket situation. Postoperatively, bone always resorbs away from the crest as it heals, even if only slightly in the most successful implant situations. The bony shelf keeps a good protective barrier covering the recessed shoulder of this particular designed bladevent.



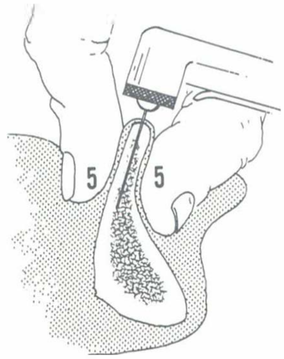
The open-socket blade's double posts also fall on each side of the midline under the central incisors. This is desirable in constructing a natural-looking prosthesis. It also gives more balanced, as well as additional, support than would a single-posted design.

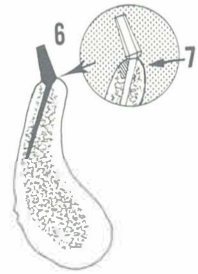


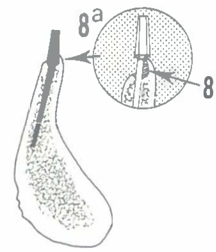
The socket must follow the arch, which necessitates curving it in the majority of cases. Occasionally, the ridge may have undergone extensive resorption which has flattened the sweep of the arch. Extra care must be taken to avoid fracturing or penetrating the labial or lingual plate, particularly at the ends of the socket (4) because of its extreme density. The thumb and finger should be placed (5) on labial and lingual aspect of the alveolous, to sense the bur's location.

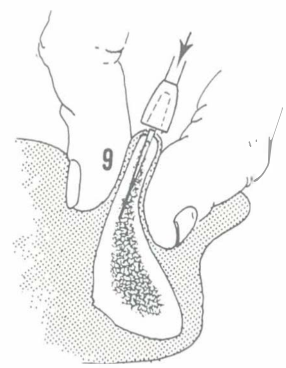
The bladevent itself must be curved to follow the groove, and be passively insertable. The posts must be parallel with the natural abutments to be included in the prosthesis.

Sometimes, in order to greatly reduce what could have been a severe overjet, the implant socket is created toward the labial plate and then countersunk lingually (6) in order to properly bury the



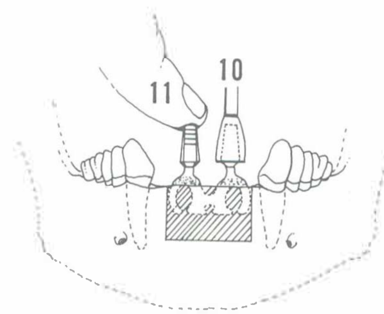






labial aspect of the neck and shoulder (7).

Occasionally, if it is desirable to flare out the posts at a greater angle the countersinking (8) might have to be accomplished by eliminating the interfering bone beneath the labio-gingival aspect of each post (8a). A supporting finger (9) is mandatory in this situation during tapping. Care must be taken not to let the denser bone in the center of the implant act as a fulcrum for see-sawing the implant as it is tapped to the proper depth. The double-headed inserting instrument usually prevents this. If the single-headed (10) or pointed seating instrument must be used, a finger is needed to hold down the untapped post (11).



Open-Socket Bladevent

As its name implies, originally the open-socket bladevent was designed for use immediately after an extraction. In such a situation, its recessed central shoulder should be buried at least 2-3 mm below the floor of the socket with its mesio-distal shoulders in the denser bone on each side of the socket and its posts touching the crest.

In cases of limited bone height, it is frequently necessary to postpone implantation until the socket remodels.

In some situations an open socket is not deep after extraction. For example, incisors so seriously periodontally involved that they can be "unscrewed" by hand may be immediately replaced by an open-socket bladevent. There is usually enough bone beneath the apices of these anterior teeth to bury the bladevent correctly.

In addition to its original purpose, the open-socket bladevent has come to have even wider applications. A ridge may be very uneven, with sharp walls. The open-socket bladevent is appropriate for this situation. The sharp walls may be retained to avoid countersinking the implant posts, although in many cases the sharp angles taper to less than 2.5 mm and must be remodeled.

When used in an even ridge with no dips or open sockets, the recessed shoulder allows a tall shelf of bone to regrow over it. The bony shelf is a bonus against tongue thrusts and other forces tending to cause lateral displacement.

Because the open-socket bladevent is a deep-bodied design, its use is more utilized in the mandible to anterior situations, although it is often used as posterior abutments where ample bone height exists.

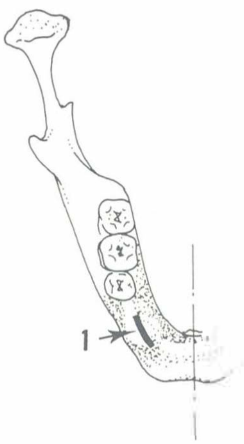
Canine Pillar Implants

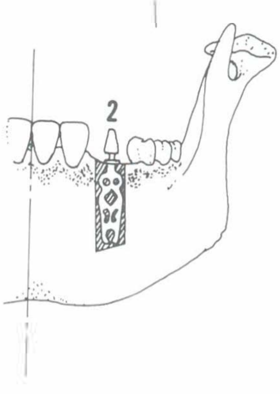
The canine pillar is a versatile site for the single-tooth implant. The pillar is a column of bone that tends to remain relatively substantial even after extensive bone loss elsewhere in the ridge.

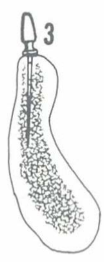
Although most patients have enough bone in this area to accept some type of bladevent, in a few cases the bone is so flawed or shallow that an endosteal implant is contraindicated. Resorption may have extensively flattened or deformed the ridge, or left a knife-edge ridge that cannot be reduced to accept a blade.

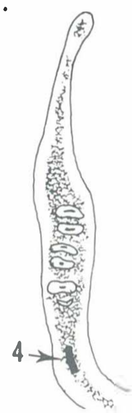
The shape of the bone at the crest determines how the socket will be made. Because the implant has narrow shoulders, it can be set in a very short space. Its socket can be aligned along the dental arch (1), with its face (2) following the arch line. Cross sections (3) and mid sagittal (4) cross-sections show that an implant set in this fashion has good bony resistance to lateral forces.

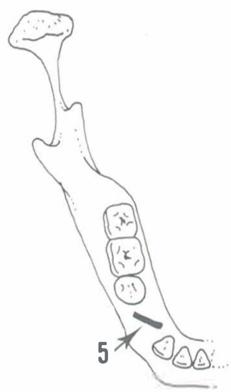
The implant site also can be angled across the arch (5), Profile (6), sagittal (7), and coronal (8) sections indicate adequate bony support in this position.

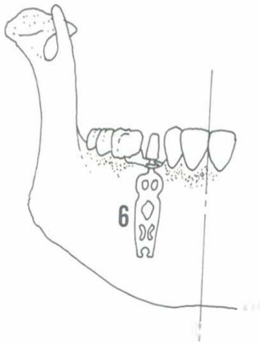


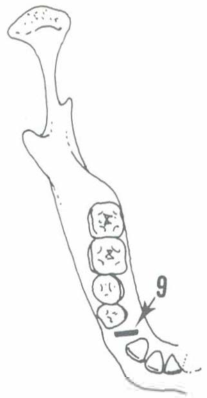




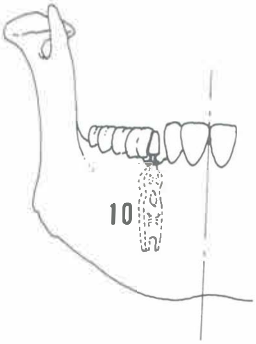








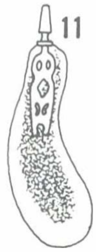
Even when the implant is set across the dental arch line (9), the sections (10, 11, 12) show secure encasement by bone.

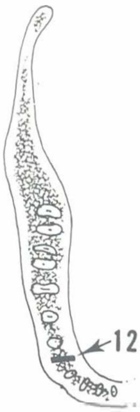


Seating the narrow single-tooth implant is unique in several ways. Because the post obscures the shoulders, the pointed seating instrument cannot be used on them. Thus, the force must always be directed on the post, a problem with an implant whose post has been acutely angled away from the socket's angle. In such a case, bending the post is delayed.

With a single-head seating instrument, the implant—with its post not yet bent—is driven almost all the way home.

Caution: The socket is always made to its full depth, even when the bone is porous, to minimize off-center seating problems.

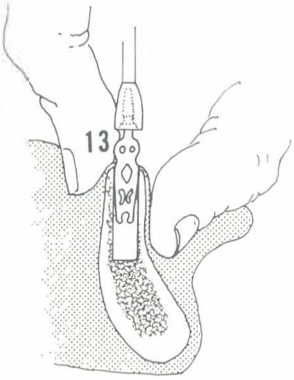




The implant is then removed and the neck is bent appropriately. When countersinking is necessary, it is accomplished prior to reinsertion, although in experienced hands it does not matter.

The implant is returned to its socket, and the single-headed seating instrument is used again to tap it home. Because the force is being directed against the labial plate by using the angled post, the labial plate should be supported.

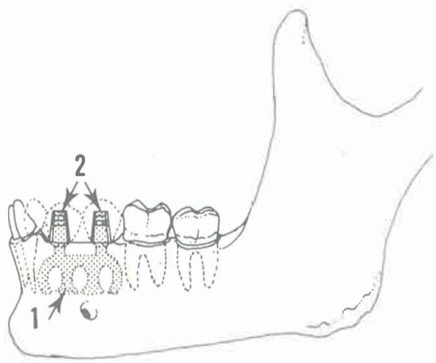
Caution: Because of the implant's narrowness, it is easy to create a "drag" (13) on the implant with a supporting finger. The fingers should not press the implant or inserting instrument during seating, except when used to prevent mesial or distal tipping of the implant.

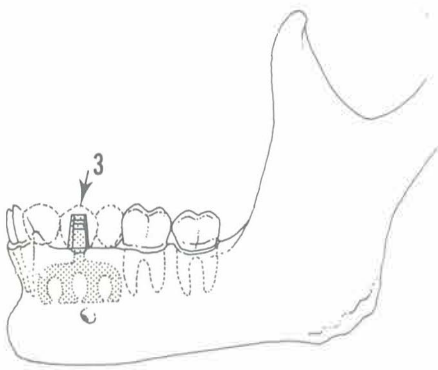


If the deeper bone is exceptionally dense, the legs of the implant can be shortened. The cut edges should be reground to a taper to facilitate insertion. When the post is only *slightly* misaligned after inserting, it may be trimmed in the mouth with a bur or stone (14) to be parallel with other abutments and perpendicular to the dental arch. Water (15) must be used continually to cool the post; metal is an excellent conductor of friction-induced heat.

Excessive trimming of the post in the mouth will reduce its height and/or width, and therefore its effectiveness as a support. Major alterations should be done outside the mouth prior to final seating. In most cases, the ability to bend or twist the neck of the post obviates the necessity for extensive remodeling of the post with burs.

Pre-Mental Foramina Bladevents

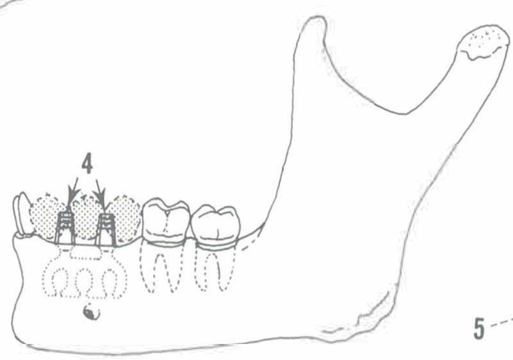


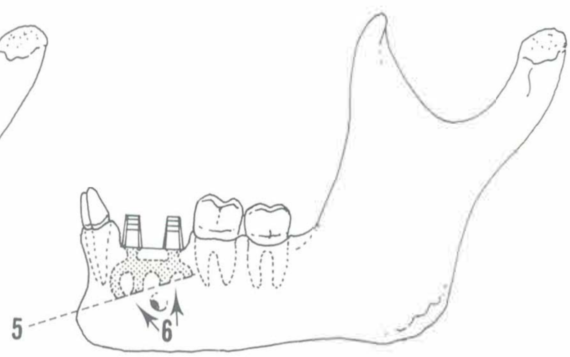


Here the reference is to that anterior site immediately in front of the foramen. In some partially edentulous cases, there may be enough bone above the foramen in the second bicuspid region to accept various designed bladevents (1). This bladevent comes in double-posted designs (2), the posts of which minimize occlusal stresses by sharing them, or single-posted designs (3). Because abutment posts ideally should be centered under the restoration, not all interproximally (4), the single-posted implant is sometimes prosthodontically more desirable than the double-posted in the anterior region.

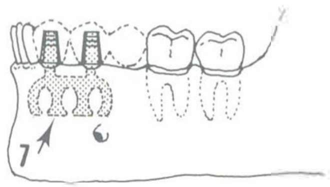
The decision to use a bladevent mesial to the mental foramen or above it depends upon several factors. The implant design must sometimes be made asymmetrical to avoid the mental foramen making it not as well-balanced as are symmetrical designs (5). Furthermore, bone bordering the mental foramen (6) is more fragile than that in the canine pillar region. Thus the shallow end of the bladevent with less surface for contacting bone is set in an area with fewer and thinner trabeculae.

When the choice exists, it is preferable to set a symmetrical design (7) more anteriorly in firmer bone anterior to the foramen





than to use a bladevent that is inserted directly over and lingual to the mental foramen.

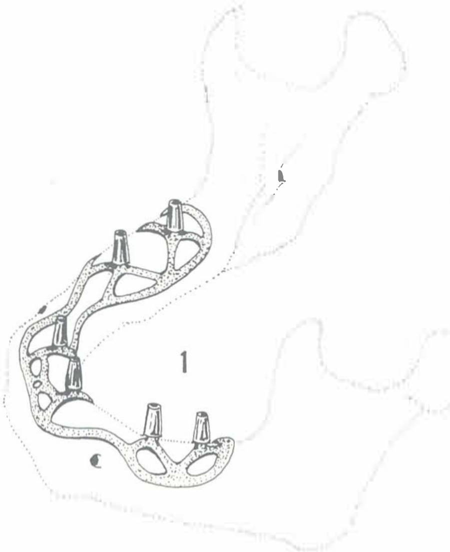


The main reasons for using a pre-mental foramen bladevent are the presence of a cuspid limiting space in front of the foramen; defects in more anterior sites that contraindicate their use as implant sites; and the desire to shorten the gap between anterior and posterior abutments.

A pre-foramen bladevent is not advisable for most posterior abutments unless the bridge includes stable anterior teeth and can be carried around the arch to include the opposite cuspid. The pontics should extend no further posteriorly from the bladevent abutment than the first molar.

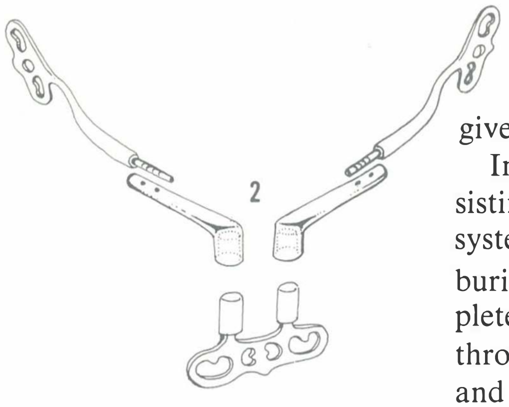
Caution: The groove made over the foramen area must be far enough on the lingual side of the ridge to prevent injury to the neurovascular bundle exiting the mental area as well as to avoid injury to the inferior alveolar nerve distal to the mental foramen.

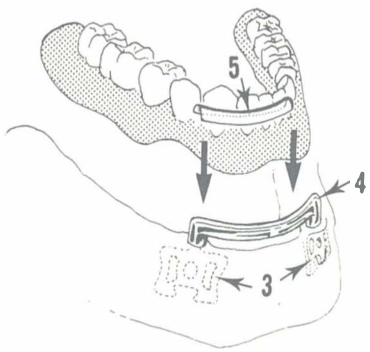
Anterior Support Only



When the only possible implant sites are anterior either a full lower subperiosteal implant can most readily be successfully used or the latest five piece rami-symphyseal implant system. This involves inserting an anterior blade as well as one blade into each ramus which immediately becomes attached with each other and to the anterior blade by virtue of hollow tubes and extension arms, thus making all elements form into a one-piece horseshoe. However, both of these systems will be illustrated in great detail later on in this text (1), (2).

To give added support to a denture in such situations, sometimes a bladevent is inserted in each cuspid area (3). The posts should be extremely short and joined together with a Dolder or Andrews type bar (4) for the support of the denture. The denture anteriorly should *not* fit tightly over the horizontal bar (5) as taking off and on as well as the eventual resorption in both posterior quadrants underneath the free end saddles could dislodge the implants. Either a gentle fit of acrylic over the bar would be desirable or Gerber, Ceka, or Lew attachments serve as excellent supports, (6), (7), (8). Also, the copings themselves that cover the implant posts can



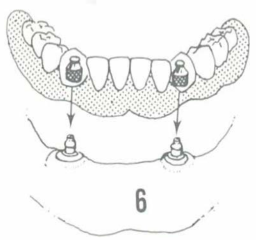


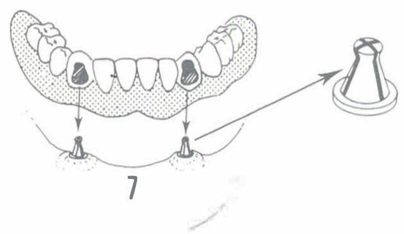
give a passive but definite form of stabilization of the denture.

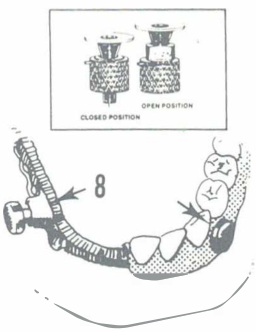
In these situations also, it is quite possible to use blades consisting of no necks and no posts, but exhibiting an internal screw system through part of its blade depth (9). These blades can be buried into each cuspid region (10) and the tissues sutured completely over them. Six months later, after dense bone has grown through the openings of the blades, the tissues are opened again, and the posts are screwed into the internal screw system of the blades (11), and procedures to complete the anterior denture support are accomplished (12).

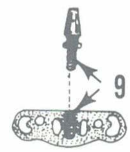
It is the authors belief, however, that in a totally edentulous arch, if a full arch prosthesis supported by at least three or four blades cannot be accomplished, one must be very uncertain as to long term success using only anterior implants.

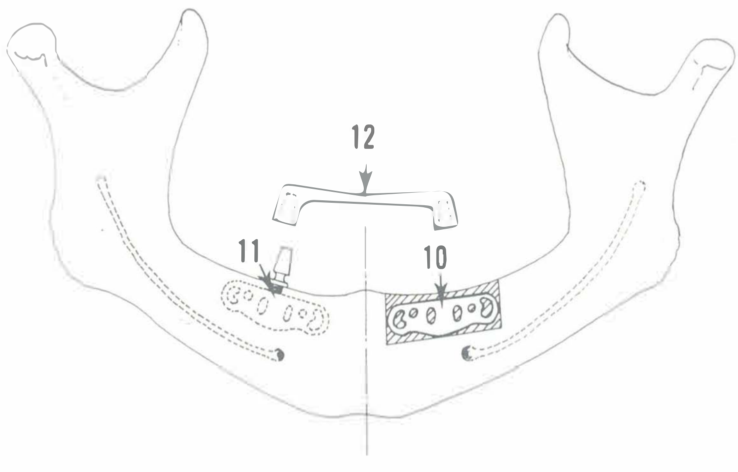
Sometimes also, an anterior subperiosteal implant using lingual fingers over the lingual surface of the mandible and extending the struts in both lateral directions just mesial to the mental amina, might work successfully. Naturally it is used to support a removable, rather than a fixed prosthesis.











Posterior Implantations

Introduction

Molars are commonly the first teeth lost from the mandible and the loss tends to progress anteriorly—tooth by tooth—accompanied by a reduction in ridge height unless the situation is stabilized and proper occlusal relationships re-established in both arches.

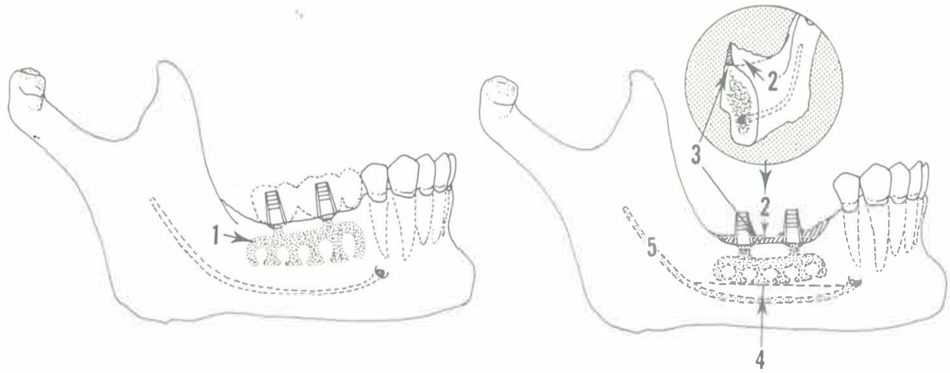
In the partially edentulous arch, a posterior implant not only provides support for a restoration, it also relieves stress on the anterior teeth used as abutments in a fixed partial prosthesis, prolonging their lives. Sturdy posterior support can minimize the number of anterior teeth included in the restoration, if a full arch prosthesis is neither necessary nor desirable.

As in any implant situation, the type of implant to be employed depends upon the amount and character of the remaining bone. It would be misleading to anticipate that the presence of sturdy anterior teeth in good occlusion implies minimal bone resorption posteriorly. Radiographs and observations of the revealed site are the only reliable means of accurately evaluating the potential implant site.

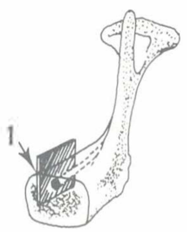
The posterior regions of a totally edentulous maxillary arch present the most challenging problems in implantology. Bone loss and fragility and proximity to the mandibular canal and mental nerve bundles are usually far more extensive when no teeth are present. However, current implant techniques provide several alternative implant approaches that are being used with increasing success in posterior mandibular situations. These include several bladevents specifically designed for shallow alveolar bone height, the sliding ramus or sliding cable implant and, to a more limited extent, the standard unilateral subperiosteal implant. When as many as six anterior teeth still exist, a universal subperiosteal implant spanning the entire arch rather than two individual unilateral subperiosteal implants is sometimes used.

Good Bone Above the Mandibular Canal

A good many patients present themselves with an adequate amount of bone above the mandibular canal, thus enabling one of the deeper bladevents to be inserted (1). Often, too, however, the ridge, even though tall, will be narrow or knife-edged (2). A knife-edge ridge must be reduced to obtain the minimal 2.5 width (3), consequently a shorter, or "shallowed" bladevent design must be substituted (4) in order to avoid the mandibular canal (5).

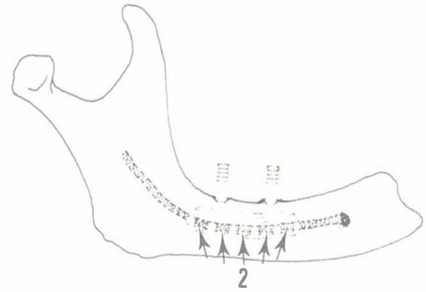


Very Little Bone Above the Canal



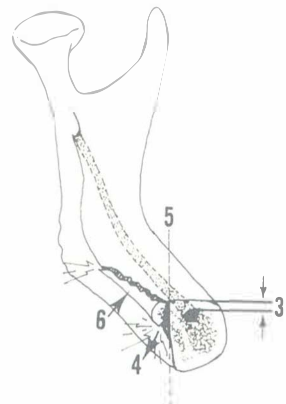
In those cases where there is a near exposure of the mandibular canal because of severe bone loss following tooth extractions, either blades or subperiosteal implants might be facilitated depending on several factors:

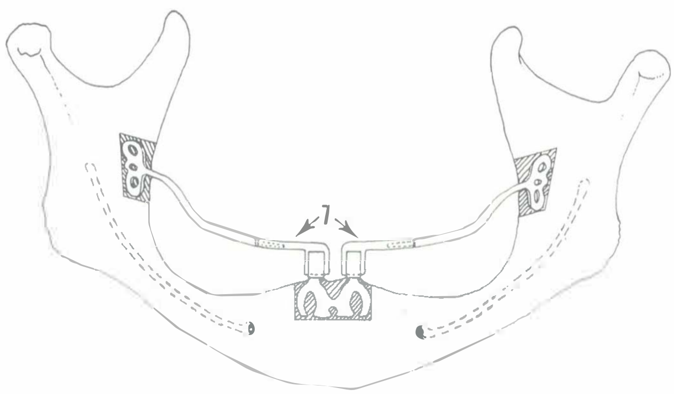
If the ridge posteriorly is wide buccolingually with no apparent undercut beneath the mylohyoid ridge (1), then a blade can be inserted lingual to the canal and much deeper than the canal depth with no fear of causing a paresthesia (2). Extensive studies by the author by placing wires through the mandibular canal from its inception at the mandibular foramen on the lingual surface of the ramus to its exit at the mental foramen and placing another wire over the center of the existing residual crest and then radiographing the mandible with occlusal films revealed in over two hundred specimens that the canal while in the body of the mandible is located several millimeters buccal to the center of the residual crest.



In those situations, however, where very little or no bone exists above the canal (3) and a severe undercut exists beneath the mylohyoid ridge, (4) trying to create a groove lingual to the canal may cause a perforation of the bur or bladevent itself (5) or result in fracturing off the mylohyoid ridge (6).

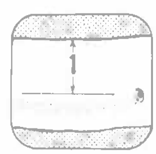
In extremely knife-edge ridges with little bone height above the canal and deep undercuts beneath the mylohyoid ridge (4) contraindicating bladevent insertions would be a wise choice. In these cases, the sliding cable or sliding ramus implant or the five piece symphyseal-rami system (7) shows great potential.



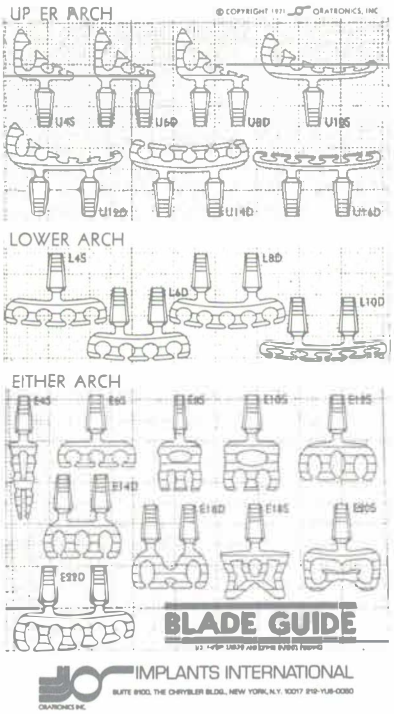


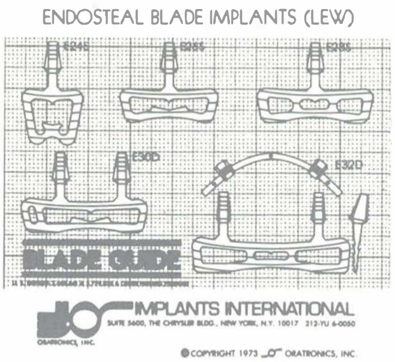
The Totally Edentulous Mandible

When a radiograph indicates that a good amount of bone (1) remains above the mandibular canal, appropriate designs are selected by placing the potential implants or a transparent sheet bearing implant outlines over the radiograph.* Most manufacturers supply special mandibular designs, shaped to accommodate most variations. A double-posted design is desirable, with the body of



* Implants International—N.Y.





the blade—from leading edge (2), to post bottom (3)—tall enough to fall just short of the canal (4). This provides two abutments in a single surgical site, and in prosthodontically desirable locations: the second bicuspid and the second molar.

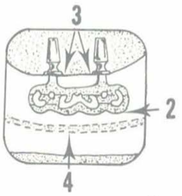
The groove is made slightly lingual to the crest (5), and wherever possible is made vertical to the horizontal plane (6). In a good ridge, the groove should not threaten the inferior alveolar nerve or mental bundle (7).

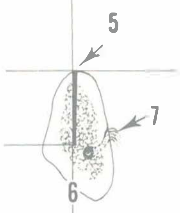
In some posterior areas, if the bone is porous, drilling a socket whose depth is less (8) than the bladevent measures from the bottom of its post to its leading edge (9) might be desirable. The legs of the bladevent will break the few remaining bony bridges as the implant is tapped to its proper depth.

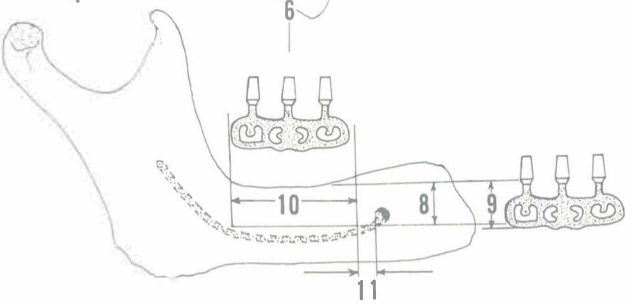
The groove is made slightly longer mesio-distally (10) than the length of the blade. Distally, it begins about 2 mm to 4 mm distal to the mental foramen (11) to avoid intruding beyond the posterior limits of the body of the mandible. In addition to providing a safety margin, the 2-4 mm limit helps position the implant far enough forward so that its posterior post will not interfere with the angle of the jaw where the bone sometimes is porous due to the storing up of hematopoetic marrow in the area, the enlargement of the canal and the area and deep submandibular fossaes that may exist. Also, the distal post of a double- or triple-posted blade will usually be in loose alveolar tissue rather than attached gingivale (12).

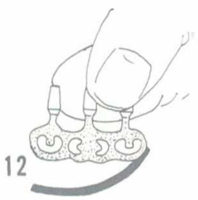
The bladevent is bent to fit passively within the groove, tried in it, and the proper alignment of the posts estimated. The bladevent is withdrawn, and the neck bent to parallel the posts with the other abutments and perpendicular to the dental arch.

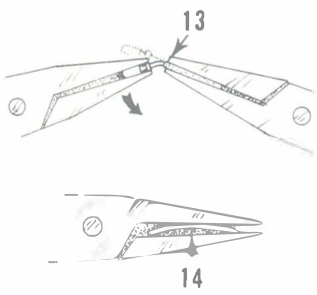
Caution: When bending the neck, grasp with the pliers only that portion of the bladevent's body directly under the post (13). Clamping the entire body (14) will straighten the carefully curved implant.



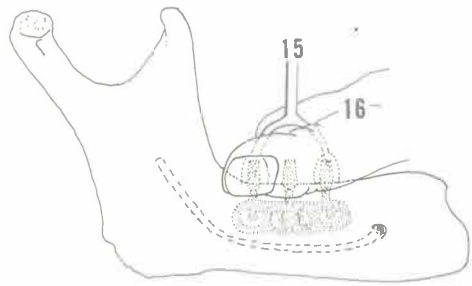








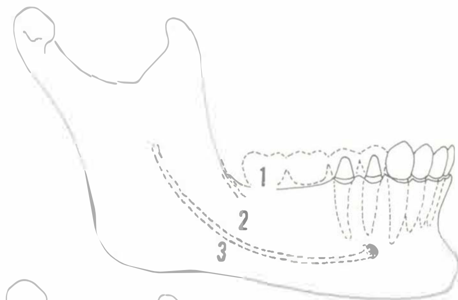
The bladevent is tapped into bone until the bottom of its posts meet the crest of the ridge. Frequently a double-headed inserting instrument (15) can be used in a good ridge: the bone is adequately dense and the socket angle not exaggerated. A finger on the buccal and lingual side (16) of the instrument will absorb some of the force while tapping the implant to its desired depth.



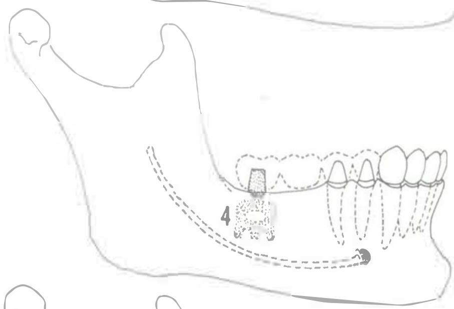
The pointed seating instrument can be used when the angle is more acute, but care must be taken not to let the cheek slip and dislodge the instrument during insertion.

The Partially Edentulous Mandible

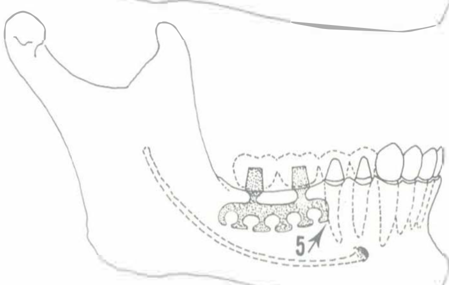
A two-molar span provides comfortable room for only one single-posted bladevent—with its post centered under the second molar (1) and the distal shoulder (2) approaching the angle of the jaw. In order to avoid the distal end of the blade from involving the mandibular nerve existing in the ramus (3) the disto-inferior border of the blade is cut and trimmed or a shorter blade is used both mesio-distally and superior-inferiorly (4).



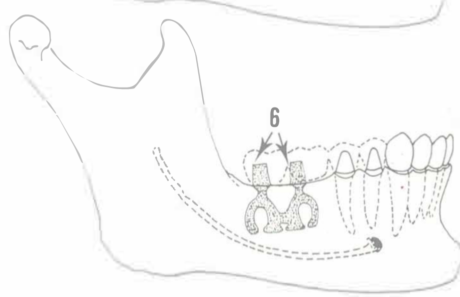
Occasionally, a double-posted bladevent can be used, but cautiously. The anterior shoulder of the implant should not intrude into the periodontium (5) of the second bicuspid. It should remain about 1 mm away.



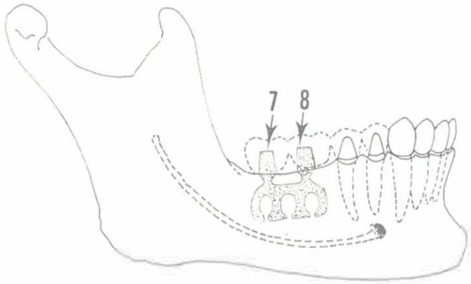
To avoid the periodontium, it may be possible in a long arch to move the implant posteriorly. Its posts may protrude into the distal position (6) of the naturally bulky crowns. However, being that the posts of the blades are so much narrower than natural prepared teeth there is usually enough clearance to establish proper esthetics and occlusion.

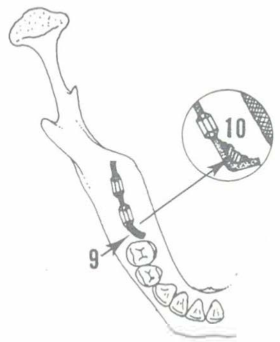


In some cases, a shorter, double-posted implant might be employed, with its distal post (7) centered in the second molar—which receives the most lateral pressure—and its proximal (8) offset posteriorly within the first molar.



If a two-post support would really prove superior in a short posterior span, two alternatives may be practical. Perhaps the ridge is wide enough to curve the proximal shoulder (9) of the implant away from the tooth, but only a truly experienced operator can coordinate the curve of both the socket and the implant so that the implant fits passively. Also, extreme bending to almost a right angle is not advisable. Bone dieback within the angle may create a weakened area around the proximal shoulder (10).

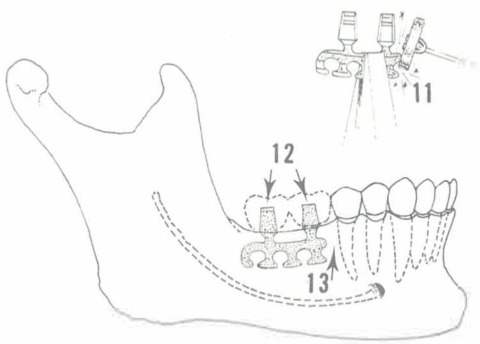




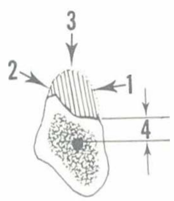
The more practical solution may be to reduce the length of the implant by removing an anterior leg. The cut edges must be smoothed and retapered (11). The posts of the remodeled implant can then easily be centered (12) under the crowns without intruding into the bicuspid's periodontium (13).

Generally, the more teeth missing, the greater the ridge problems although inserting posterior bladevents often become easier. The longer span often reflects more edentulous time, with its accompanying problems. When the molars and second bicuspids are missing, more bone will resorb in this area than would occur during the same period of time when only the molars were missing.

In posterior partially edentulous situations it may be necessary to reduce the post height of standard bladevents to assure occlusal clearance. The posts must be ground down until they no longer interfere with closure. This is done with a disk or stone, preferably outside the mouth prior to final seating, with the implant steadied by securing the post so that the neck is not overworked. The posts can also be reduced directly in the mouth immediately post insertion without fear of loosening or dislodging the bladevent, a feature unique to this implant.

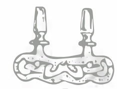


Problem Ridge: Shallow and Narrow



A shallow ridge is often a narrow ridge. The tendency in the posterior regions, as in the anterior, is for the buccal surface (1) to resorb more rapidly than do the lingual (2) or occlusal surfaces (3). Thus the typical resorption pattern is a thinning of the ridge at the expense of the labial and buccal surfaces, closely followed by a loss of height. However, whereas the anterior ridge loses height only from the crest, posteriorly the ridge becomes shallower as the crestal bone resorbs nearer to the canal (4).

The bone's condition, as well as the height of the ridge, helps determine the implant type. The totally edentulous posterior ridge is very likely to have fragile bone with widely space, narrow trabeculae. This characteristic may suggest using an apically closed bladevent (5), to give a better locking support rather than an open ended implant (6).



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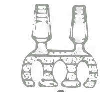
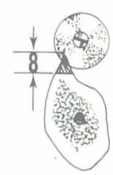


6

A bladevent's innate stability depends upon broad surface contact with bone and using the advantageous horizontal dimension. The shallow body of the shallowest type implants is a design disadvantage, and widely spaced, fragile trabeculae even further minimize the essential bone-implant contact.

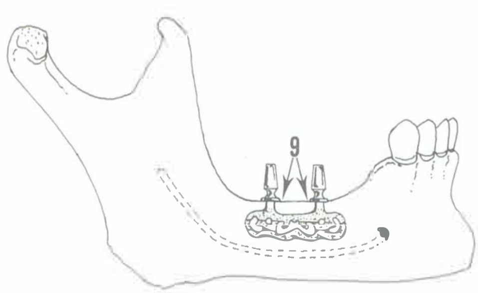
The shallow mandibular bladevent works most successfully in a dense bone, and is therefore more appropriate above the canal between stable teeth than in a totally edentulous site. It is not recommended as the posterior abutment for a unilateral bridge, although in some situations it can be used in conjunction with a full arch, fixed prosthesis.

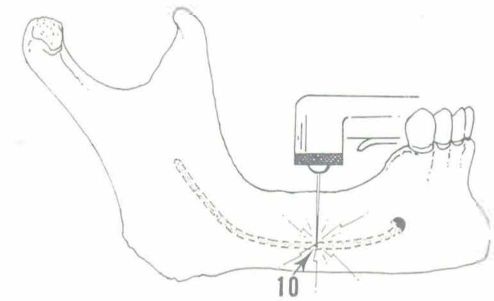
When a shallow bladevent design seems suitable in a posterior situation, the ridge must be at least 3.5 mm wide at its narrowest point (7). This is wider than for a similar anterior situation because of the greater lateral stress on posterior implants during chewing and grinding. When undercuts are present, the ridge usually must be remodeled (8). However, very careful estimates must be made when considering reducing a shallow posterior site. Too much reduction, and even the shallowest bladevent design will not fit. Bone above the canal is too precious for experimental reduction.

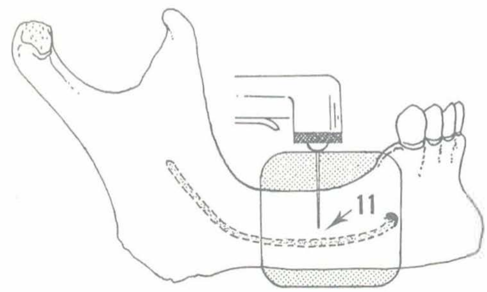


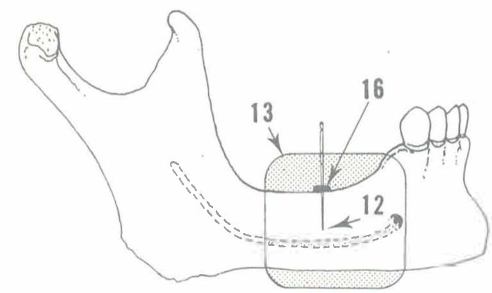
The special, shallow double-posted bladevent requires at least 7 mm of bone for properly deep insertion. Its shoulders must be buried in bone—with the bottoms of the posts touching the crest (9) for good retention.

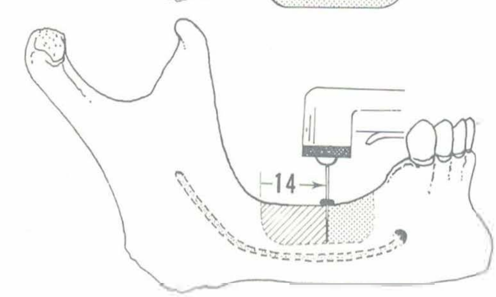
In a shallow implant site there is always the danger of penetrating the canal. Thus the 700 XL bur is used very cautiously. Typi-

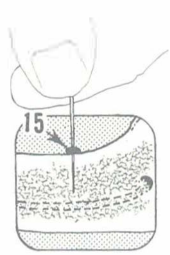












cally, the bone is fragile and offers little resistance. A heavy hand on the drill can easily punch through the superior wall of the canal (10), creating an almost positive paresthesia. It is advisable to radiograph the bur before it reaches its final depth in these situations (11).

The socket is usually not drilled to its maximum depth. Its height is less than the blade measures from the leading edge to the bottom of its post.

The groove made more lingually to leave more bone bulk buccally as resistance against lateral forces. Because the site is narrow and fragile, the implant socket should be made in as few steps as is possible, with fingers bracing the ridge.

Dealing with such a precarious situation, the operator is advised to take special precautionary steps. An estimate is made of how many millimeters the 700 XL bur can be sunk and avoid the canal, including a millimeter or so of safety margin. The bur (12) is used to this depth, left in the bone by disengaging it from the contra-angle, and a periapical radiograph (13) is taken. This is compared with the pre-operative panorex showing the extent of the mandibular canal. If the bur can be further inserted without too closely approaching the highest point of the canal, this is done. Then the bur is run along the ridge to create the socket in one sweep (14).

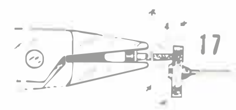
For additional safety, a rubber stop can be used to mark how far the bur can be sunk safely. This guide is particularly effective when sweeping along the crest to create the socket for a long blade. The depth of the bur in the groove can be determined radiographically. An intra-oral radiograph is taken of the bur with a metal "O" ring (15) slipped up the shank of the bur to the appropriate height. Or, the bur is sunk in the ridge, disengaged from contra-angle and radiographed for accuracy of position, with the metal stop (16) on the bur still in the ridge and a periapical film is taken.

A stop can be improvised by cutting a small length from a rubber band and slipping it over the bur.

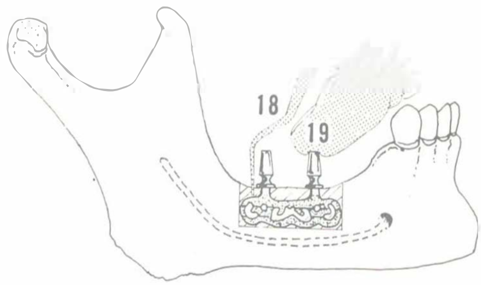
Caution: The socket-making technique consisting of drilling a series of holes along the ridge and then connecting them is not recommended for shallow ridges above the canal. Sinking the separate holes invites perforation of the canal or the labial plate.

Because the socket is long, it may be curved. If so, the bladevent must be bent to fit the socket passively, to slip into the groove without binding.

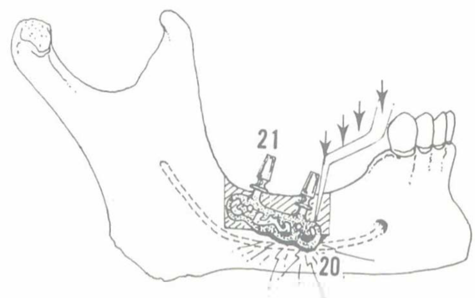
The posts are compared with the other abutment posts, and their occlusal angles estimated. The bladevent is withdrawn, and the posts bent appropriately, taking care not to distort the curve bent into the blade's body.



Many operators working near the canal prefer to blunt the leading edge (17) of the blade, so that if it should accidentally intrude into the canal, it will not pierce the nerve or arterial membrane. If the leading edge of the bladevent should intrude into the canal, it might only push the neurovascular bundle away from it without tearing or crushing it. However, this too, is not desirable.



Because the ridge has undergone considerable recession, the posts will probably be bent away from the axial inclination of the socket. The pointed seating instrument (18) should be used to sink the implant to its proper depth. A finger holds the post over the untapped shoulder to prevent the implant from being rocked up and down in its socket (19).



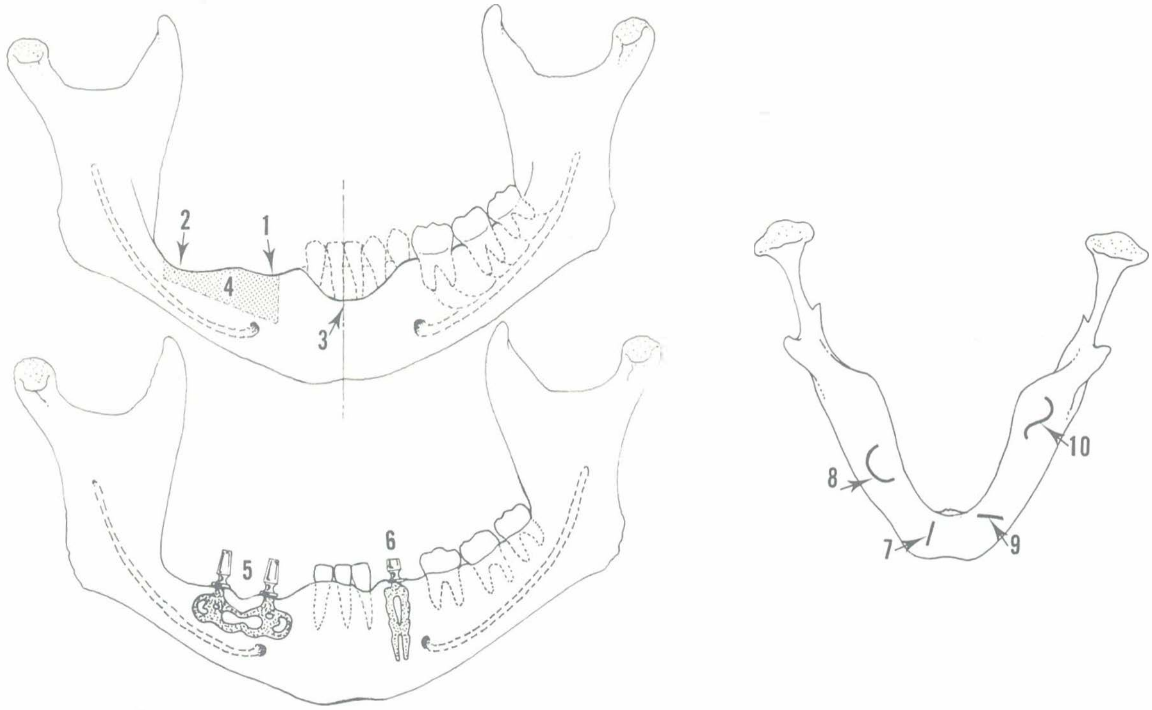
Caution: Gentle taps are essential. Hard whacks can break through the bone into the canal (20), as can neglecting to secure the distal post (21) with a finger.

The leading edge of the implant will break a few remaining bony bridges directly under the implant's legs as it is correctly seated. If the situation and amount of remaining bone were correctly appraised, the bladevent should be secured in the small amount of bone remaining above the canal.

Problem Ridge: Irregular Alveolar Crest

In an adult who lost numerous teeth in the arch, especially due to over-retained periodontally involved teeth, thus causing extreme resorbtion of the labial and buccal plates of bone, the ridge is left with numerous uneven concavities and loss of bone. The alveolar crest height may therefore drop down anteriorly (1), posteriorly (2), or in the middle (3).

The goal in selecting an implant is to place as much implant in bone as possible. Thus many designed implants both in height and width as well as single posted or double posted varieties must be used to give the maximum amount of metal to the minimum amount of bone that exists as well as proper interspacial arrangements of

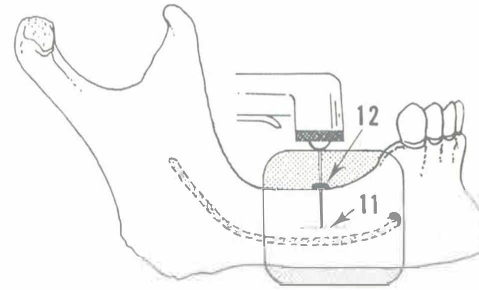


their protruding posts for proper occlusion with the opposing arch of teeth.

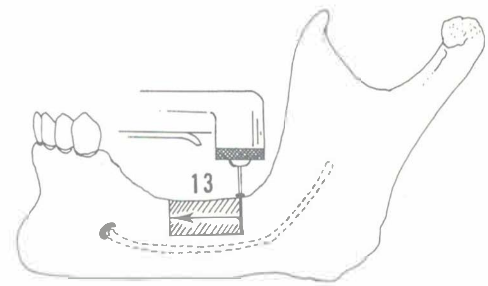
In these atypical situations avoiding the canals and mental bundles as well as perforating into cortical undercuts should be the prime concern of the implantologist. Therefore many combinations for a specific case may exist. For example, insertion of some of the blades directly into the most resorbed areas of the ridge in order to avoid the canal or mental foramen may be a wise choice (4). Other times, the introduction of the specially designed socket blade into the shallower area with both of its posts resting on the more adequate alveolar bone mesial and distal to the resorbed area would be the choice (5). Insertion of a narrower blade in between the areas of bone resorbtion may also be a necessary step for some operators (6). Making grooves labio-lingually in between the areas of resorbtion (7) or even curving the groove (8) or creating a groove in a transverse-oblique direction (9) may be the most advantageous approach for a particular situation. Sometimes, but more rarely however, an asymetrically shaped groove and bladevent might have to be used (10).

Balanced inserting is essential to keep any bladevent design from being rocked in its socket and unnecessarily destroying bone. The asymetrical shape of these implants must be compensated by atypical variations in making the socket.

When, for example, the deeper end of the blade is distal, the bone tends to be firmer than the shallow more mesial bone. To create a more balanced "feel", during seating, the deeper end is drilled to its entire depth, thus removing the resistance in front of the leading edge. The shallow portion of the socket may not be drilled to its entire depth in order to leave greater resistance there.



In drilling the socket, the shallowest part of the ridge should be the guiding dimension. Its exact depth is determined from radiographs, then about 2-3 mm are subtracted as a safety margin. The resulting measurement is noted (11) and—if so desired—marked on the bur with a rubber stop (12).



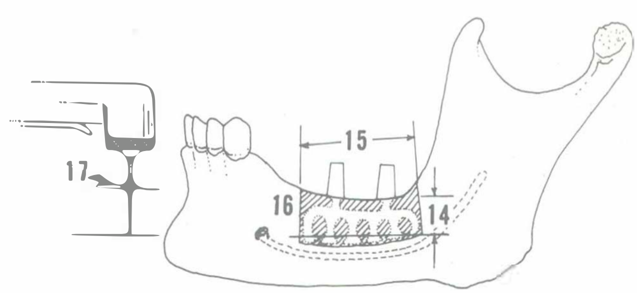
The socket can be started at the most distal point, at least 3-4 mm in front of the angle of the jaw, and the bur run forward in a continuous sweep (13). The stop on the bur always keeps it above the shallowest portion of the mandibular canal, and working from back to front permits clear visualization of the operative site. Little resistance to the bur should be anticipated in the shallow zone.

In questionable situations, the socket should be started in the shallowest portion of the site, even if this is the more anterior point.

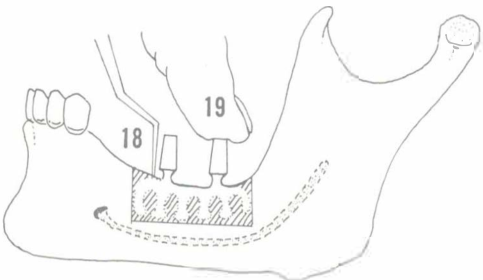
A shallow socket (14) is made slightly longer than the mesiodistal length of the bladevent (15). Then adjustments are made to accommodate the deeper end of the implant (16). The stop (17) on the bur is adjusted for the deepest part of the implant. The bur is sunk to the marker in the appropriate portion of the socket, and then started toward the shallower end—gradually being retracted. A few millimeters from the shallow end of the socket, roughly where the more posterior post will be set. The bur should run free in the previously drilled shallow groove.

The implant is bent to follow the curve of the groove and inserted with manual pressure to determine the proper angulation of the posts. The implant is withdrawn, post adjustments made, and reinserted in a cleansed socket.

The implant is finally seated by tapping it to the correct depth. Care must be taken to keep the shoulders level with the occlusal



plane. The deeper end is tapped first (18), with a finger on the shallow end's post to prevent it from popping up (19).

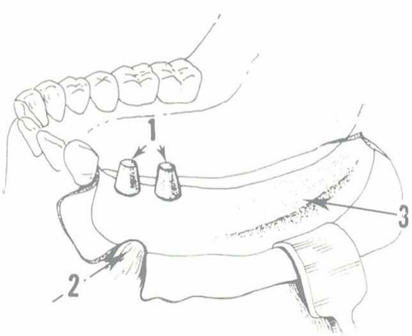


Caution: Special attention should be paid when tapping the shallower end to avoid knocking the implant into the canal.

Problem Ridge: Unilateral Subperiosteal Implant

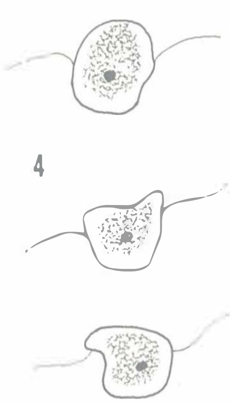
When less than seven mm. of bone separates the mandibular nerve from the alveolar crest, and a deep submandibular fossa exists preventing the utilization of an endosteal bladevent, either the unilateral or universal subperiosteal implant procedure can be introduced, depending upon how many remaining teeth are left in the arch and whether the arch is unilaterally posteriorly edentulous or bilaterally posteriorly edentulous.

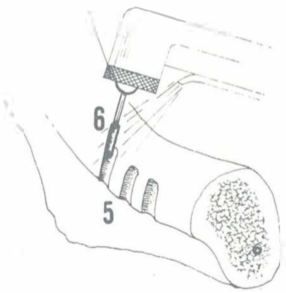
If it is only unilaterally edentulous then a unilateral rather than a universal subperiosteal implant would be the choice if it is to be done at all. When edentulous areas appear in both posterior quadrants, it is preferable to fabricate a universal subperiosteal implant thus taking advantage of a full arch implant support which includes the symphysis and genial tubercles rather than not to include these areas thus contributing to increased overall retention of the implant.

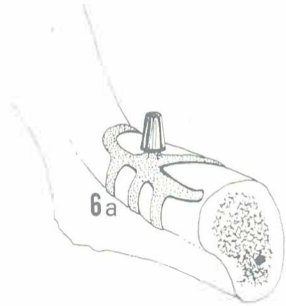


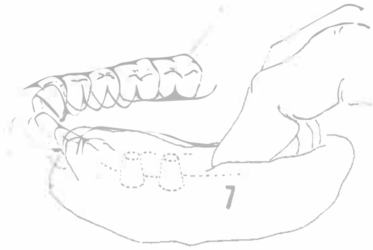
The following technique is prescribed for the unilateral subperiosteal implant:

The anterior abutment teeth that are to be the anterior supports of the fixed prosthesis should first be prepared (1). An incision is made from the retromolar pad area to the disto-proximal surface of the nearest anterior abutment tooth and should continue buccally and lingually along the gingival attachments of at least two of these anterior abutments and reflecting these tissues downward to expose clearly the neuro-vascular bundle of nerves exiting the mental foramen (2), the external oblique ridge (3), and should include some of the bone near the inferior border of the mandible anterior to the foramen, but above the most bulbous portion of the bone. Lingually, the tissue should be reflected further downward as it approaches the anterior tooth abutments and should be reflected below the mylohoid ridge, the depth being determined by the height of the ridge and the flare and extent of the lingual concavity (4). With a #558 fissure bur anywhere from

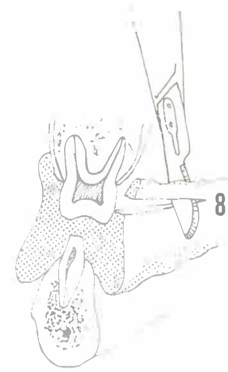




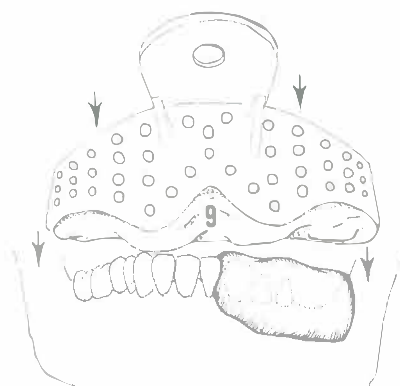


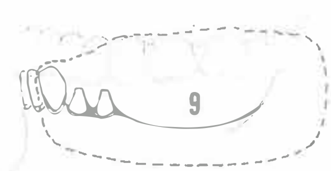


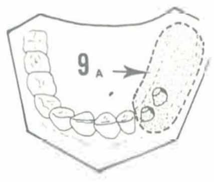
two to four notches are made below the mylohyoid ridge (5). The length of these grooves are dictated by the overall contour, slope and amount of undercut that exists beneath the mylohyoid ridge. The width and depth of these grooves should be no wider than 2mm and no deeper than three quarters of a mm respectively. The sharp line angles of the grooves are smoothed away with a tapered diamond stone (6). These grooves serve as a two-fold purpose; for immediate retention and seating of the implant, so that the lingual fingers of the implant fit flush with the bone therefore, the thin friable lingual tissues are not stretched nor interfered with, once the implant is seated and the tissues sutured closed (6a).

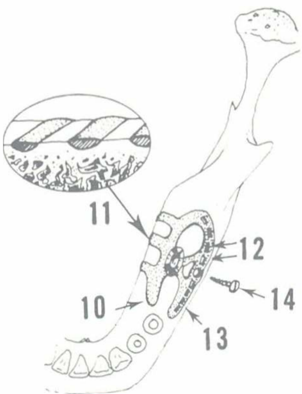


With a mix of heavy silicone, the material is moulded over the entire exposed area of the bone, making sure to include the external oblique ridge, the mental nerve area, the inferior border of the bone anterior to it, most of the lingual border of the mandible, and at least two or more anterior teeth. The patient's jaw is brought into a centric relationship and the patient is told not to move his teeth or open his mouth during which time the operator moulds the material accurately to the bony topography (7). Some of the excess flash of the material flanking the lingual and buccal surfaces of the upper teeth is then removed with a scalpel, being sure to keep the impression in place during this procedure (8). This enables the operator to then take a full lower elastic or stone impression of the remaining teeth of the lower jaw, including the silicone impression of the partially edentulous area. It is now preferred by the author, to use a rubber impression, using a prefabricated Omnivac tray. This tray is fabricated from a previous direct bone impression, using either silicone or rubber base material. With this rubber impression inside the Omnivac tray, and fitted over the partially edentulous bony quadrant, the author, then picks it up with a full mouth lower impression, using again, rubber base material (9). The entire model is poured in stone and carefully the elastic or plaster impression is separated from the

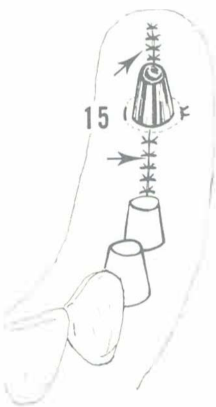


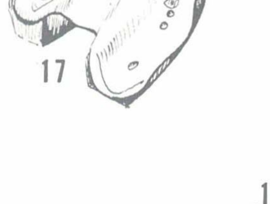


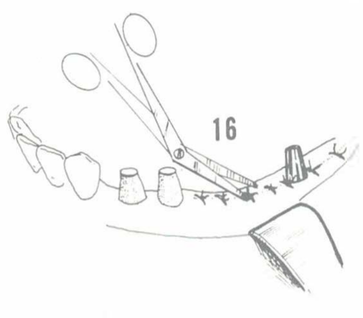


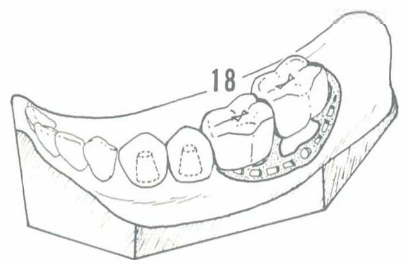


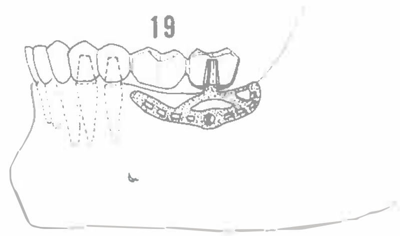
stone model, but the silicone impression is left in place in order to establish the bite relationships (9A) with the stone model representing the upper arch of teeth. The implant is designed and cast in a surgical metal. The design is such, that it does not cross over the alveolar crest anteriorly, near the remaining teeth, where there usually exists alveolar bone from the intermittant stretching of the periodontal membrane at the disto-proximal surface of the tooth nearest the edentulous area (10). Lingually, the grooves give stability to the implant and resist the lateral thrusts of the tongue from pushing or lifting the implant buccally and off the ridge (11). Buccally, it contains a fenestrated buccal peripheral strut along the external oblique ridge, which allows for the mucoperiosteal tissues to re-attach to the bone in between the struts, also being that it is broader than the usual sized solid strut it resists "settling" of the implant (12). The strut becomes solid and narrower as it circumvents the mental foramen and remains solid along the inferior border of the mandible above the undercut area. At the second surgical visit, either the same day, next day, or preferably three to four weeks later, the tissues are once again reflected and the implant is seated into place (13). Sometimes it is necessary to use a stabilizing screw through a specially designed inset, made through the buccal peripheral strut and into the bone in the external oblique ridge (14). The tissues are sutured closed (15). Five to seven days later, the sutures are removed (16). When the tissues are thoroughly healed, a full mouth elastic impression is taken (17), and the final fixed prosthesis is fabricated on the model (18), and cemented into correct position (19).

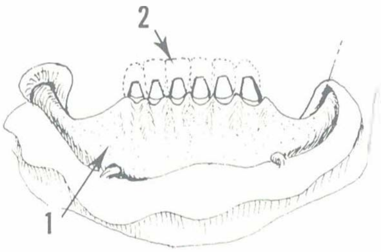


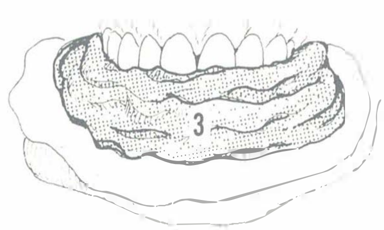


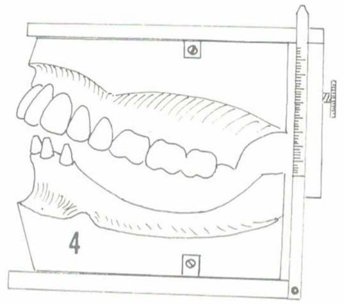








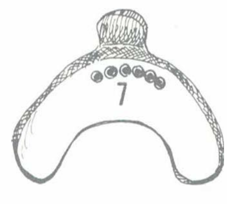


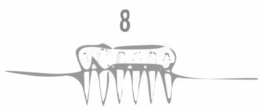


The Universal Subperiosteal Implant

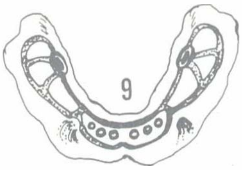
Similarly, the technique for this procedure is similar to that of the unilateral procedure with several differences.

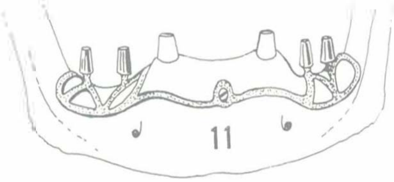
The reflection of the tissues are done on both sides of the arch instead of one. Also, and more important is that the tissues in the areas of the remaining anterior teeth must all be reflected downward to expose the entire symphysis and genial tubercles (1). Before the impression can be taken all the remaining teeth should be prepared for full crown restorations (2). This can be accomplished prior to or after the tissues are reflected. It is important, however, to be absolutely careful when separating the gingival tissues from the necks of the teeth so that minimal tissues are destroyed. With the entire mandible exposed and the teeth prepared a full mouth silicone impression is taken and the material moulded in the same manner as when taking the impression in a unilateral site. The interocclusal records of centric relationship is taken at the same time and with the same material (3). If a tray is preferred then the silicone impression is removed from the mouth, the stone model poured into it and the upper stone model set into the opposite side of the silicone impression and models are articulated (4). A thin acrylic tray is cold-cured directly over the accurate stone model (5) and can then be used as a tray for a rubber base impression material directly over the bone (6). Or, as I now more often do, an Omnivac tray is fabricated from the stone model, and used to support the rubber base impression. Making a prefabricated tray (7) from an impression of the soft tissues to be then used for taking the bone impression, is never accurate enough and too many adjustments of the tray must be done.

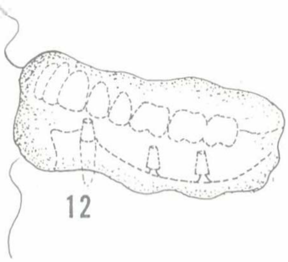


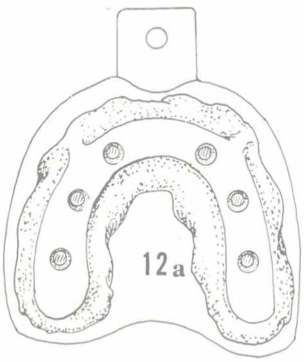


The tissues are sutured together and a temporary acrylic splint is carefully fitted over the prepared abutment teeth (8). Most of





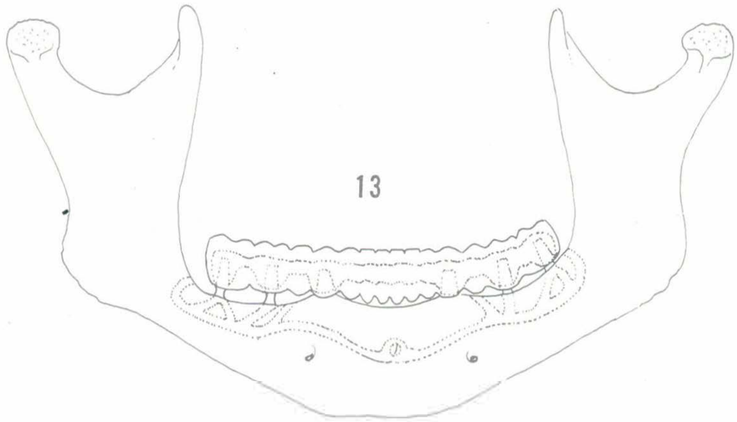


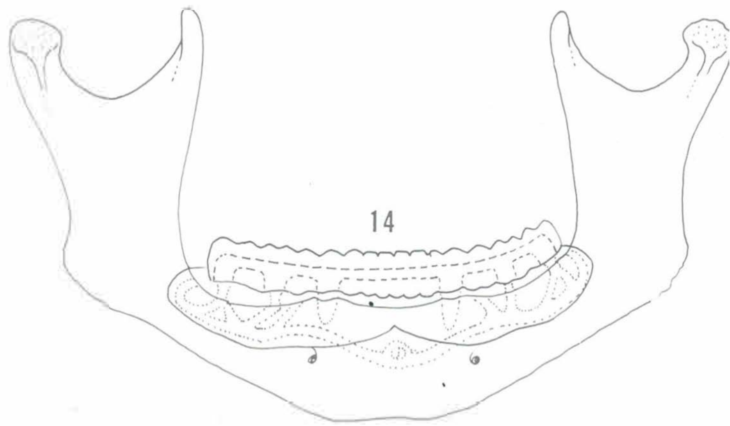


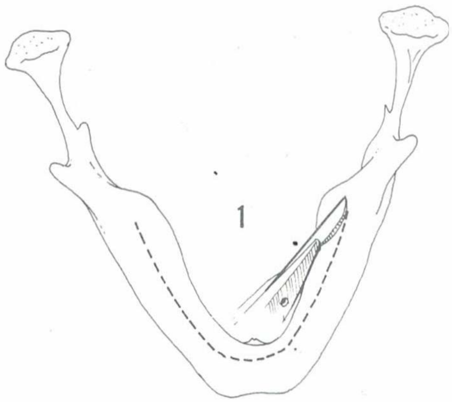
the post-operative sensitivity in the procedure, is from the tissues and bone in the areas of the teeth. At the next surgical visit, the flapping back of the tissues is again accomplished, the implant is seated (9), and the tissues are sutured together (10). The anterior teeth are completely ignored in designing the universal subperiosteal implant. It is designed exactly as is a subperiosteal implant for a totally edentulous mandible with one or two exceptions.

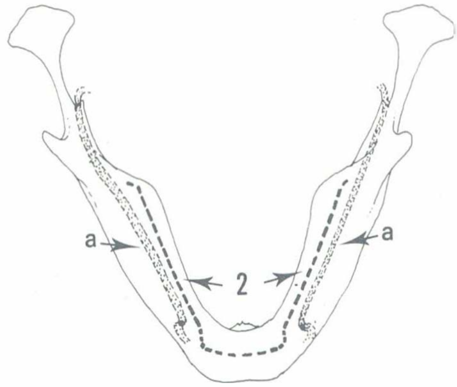
Depending on how many teeth remain present, the universal subperiosteal implant may only contain two posterior posts, one on each side of the arch, or in those situations where only cuspids exist, four posts are designed in the implant framework, the anterior ones, however, being in the area of the bicuspids rather than in their usual cuspid area. (fig. 11)

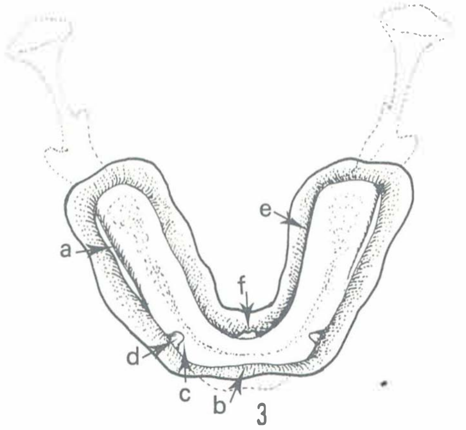
A time lapse of at least three weeks should take place after the implant had been inserted before an impression is taken. This delay in time is primarily so that the gingival tissues around the remaining teeth have sufficient time to heal. The teeth should be reprepared to form new finishing lines to make sure they go well underneath the sometimes receded gingival tissues, and the elastic impression, and bite registration are taken (12), (12a). The final restoration in these situations can be a full arch fixed bridge (13) or a removable prosthesis that fits over soldered copings and a continuous connecting Dolder bar (14), with or without the various types of attachments such as inter-coronal (I-C) attachments, internal clips, Ceka or Gerber or Lew.



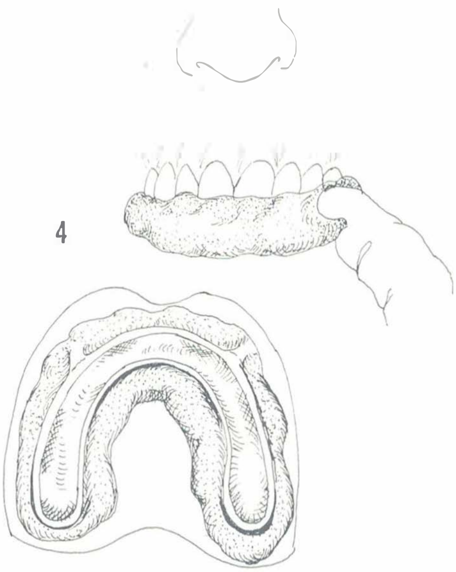






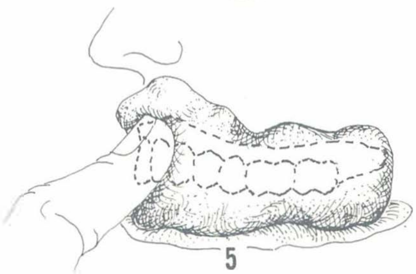


The Subperiosteal Implant For The Totally Edentulous Mandible

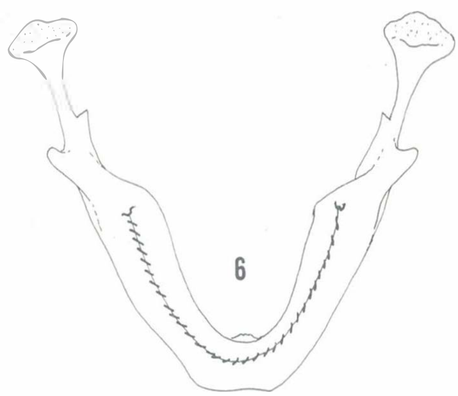


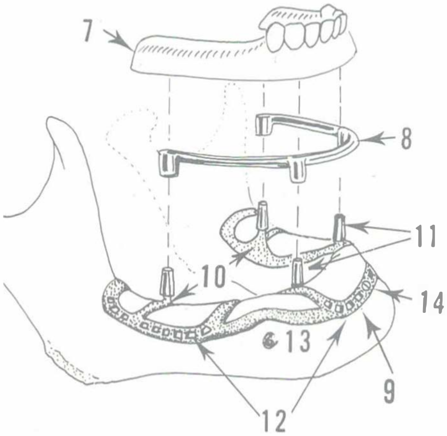
When not enough bone exists in the edentulous mandible for the insertion of four endosteal blade-vent implants, the full subperiosteal implant is the implant choice.

An incision is made from the retromolar pad area on one side of the arch and should continue along the tissue covering the residual crest to the retromolar pad area on the other side (1). In those cases where dehiscence of some or all of the inferior alveolar nerve is expected[a] then this incision must be carried out lingually along the entire region mesial to both mental foramina (2). With a broad periosteal elevator the tissues are pushed away from, rather than pulled away from the bone, exposing the external oblique ridges,[a] symphysis,[b] mental foramina[c] and their corresponding neuro-vascular bundles,[d] mylohyoid ridges,[e] and all the bone on the lingual anterior surface of the mandible including the genial tubercles[f] (3).



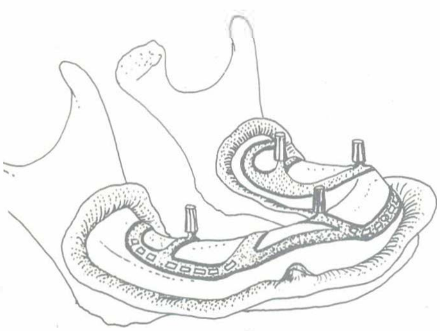
The impression is taken either without a tray using heavy silicone or with an Omnivac tray fabricated from an original heavy silicone impression (4) taken of the bone and then used for the support of a rubber base impression, (as described in the previous technique) (4). An interocclusal record of centric relationship is taken with the patient's existing maxillary denture in his mouth, for the fabrication of the temporary acrylic stent (5), and an impression of the upper denture is also taken. The tissues are sutured together, usually with interrupted sutures (6). Five to seven days later, the sutures are removed and ideally three to six weeks after their removal, the implant is inserted. At the same time the implant is fabricated, the metal superstructure as well as





the acrylic temporary stent is also completed (7). An upper impression for a new denture is usually done just prior to the first surgery, as the teeth made for subperiosteal implants are always acrylic with zero degree inclined planes.

The subperiosteal implant framework should be no more than half a mm in overall thickness. It contains usually four protruding posts, or if the framework is extremely flat because of the bony topography, a horizontal bar (8) is sometimes included instead of the posts to give more support and stability to the substructure framework (9). Whether it be a bar or four posts, the two posterior posts always arise from a neck which extends from the mylohyoid strut (10), since this is the only area posteriorly where there exists attached gingiva. Anteriorly, the two posts protrude slightly to the lingual side of the residual crest (11). Both buccal peripheral struts contain perforations approximately two mm square (12), and continue anteriorly over and circumventing the mental foramina as a narrow single strut (13) to continue on as a fenestrated strut again in the symphyseal region (14).



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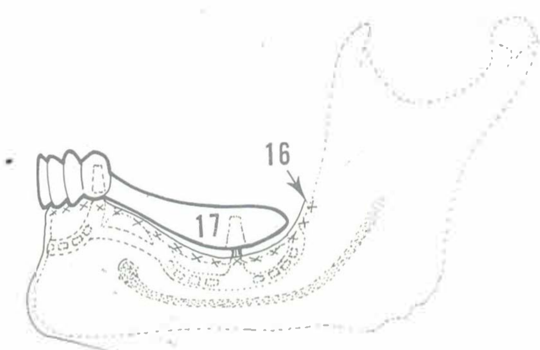
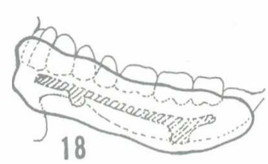
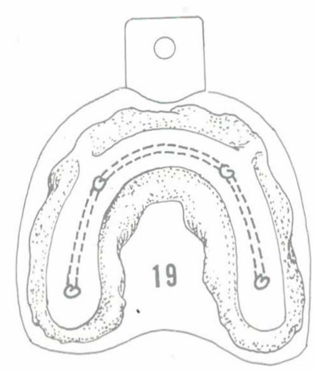
At the second surgical visit the tissues are incised, reflected and the implant is inserted (15). The tissues are sutured over the framework of the implant (16) and the temporary acrylic stent with its two posterior geometric acrylic planes of occlusion is seated over the protruding posts (17). The denture should be implant borne only, and impingements on the tissues should be relieved. The occlusion is carefully checked. One week later the sutures are removed. When the tissues have healed sufficiently, the metal superstructure is fitted over the protruding posts, the wax up of the new denture is fitted over the maxillary tissues and an inter-occlusal record of centric relationship is taken (18). The upper denture wax up is removed with the bite registration and







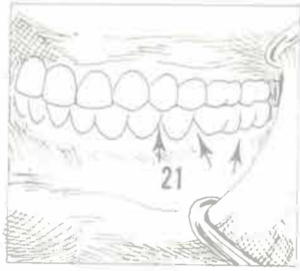
then the lower alginate impression is taken, making sure to mould enough of the impression cream beneath the bar to include an accurate account of the underlying soft tissues. When the impression hardens, it is removed making sure it picks up the metal superstructure. If this was done correctly, the inside of the impression should only show the four clasps, and not the bar which should be completely buried (19).

The final models are poured and articulated. Several thicknesses of tin foil are moulded over the mandibular model, so the base of the denture will not be tissue bearing (20).

Both waxed up dentures are fitted in the mouth and final adjustments of esthetics, vertical dimension and centric relationship are made.

The dentures are processed and fitted. All minor adjustments are made (21).

In those situations, where, due to a dehiscency or near dehiscency of the mental nerve bundles, the buccal peripheral strut must be brought very close to the lingual strut, or become continuous with it, in order to strengthen this weakened area, a continuous Dolder or Andrews type bar is processed directly with the implant framework, rather than the usual four posts(22).



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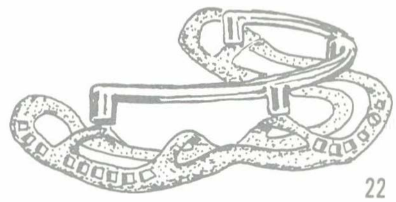

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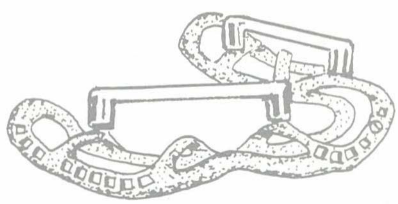

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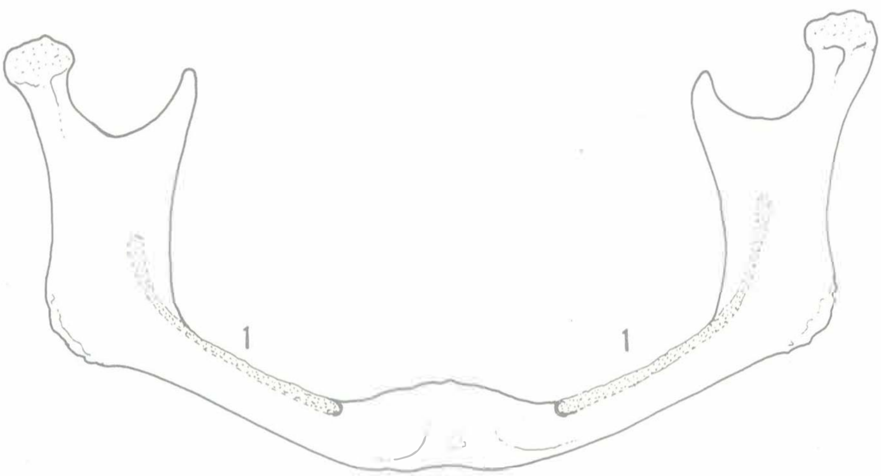
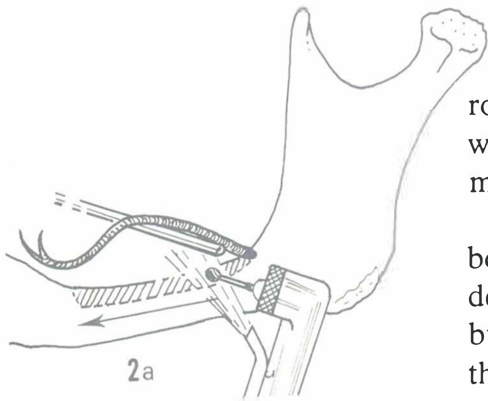
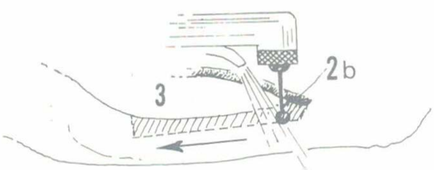


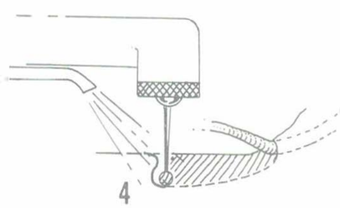
A technique previously described by the author in preparing the bone for a subperiosteal implant when either or both of the inferior nerves are dehiscent and the mental foramina have been totally destroyed because of vertical resorption will be briefly discussed (1). Lifting up the inferior nerve bundle gently with a

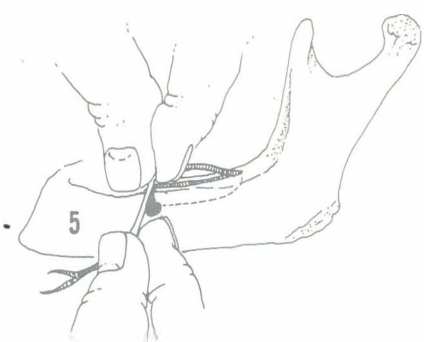


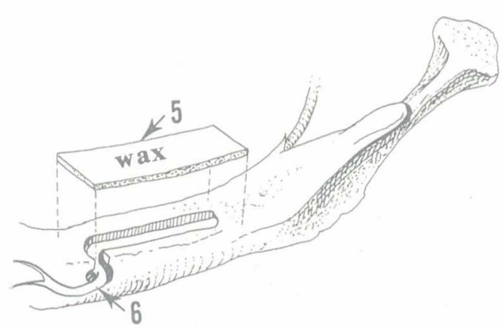
rounded instrument and using a #6 round bur in a contra-angle with a sufficient water spray, channels the bone along the existing mandibular canal floor to deepen it several mms (2).[ab]

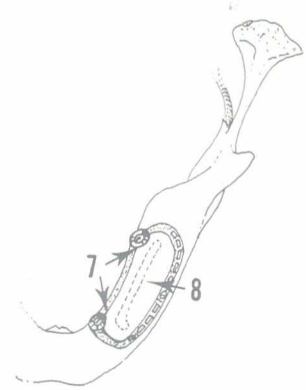
The depth of the floor is dependent upon the total amount of bone in the body of the mandible. If the canal is channeled too deep it could cause a mechanical fracture. With a #557 fissure bur, a vertical groove is made from the most superior portion of the cortical plate, in the area where the original foramen existed to about two or three mm inferiorly (3). With a #4 or #6 round bur, at the base of the vertical groove, a round keyhole style window is cut into the buccal cortex (4). The mental nerve is carefully stretched with the thumb and forefinger of each hand, so that it can slip through the narrower vertical groove and then left to exit out of the larger round window representing the mental foramen (5). Soft wax is placed over the entire length of the artificial mandibular canal so that an impression can be taken without involving the underlying nerve (6). The subperiosteal implant is designed uniquely, so that there are no secondary struts crossing over the exposed mandibular nerve (7). Healing is often uneventful and many cases have been done in this manner (8). However, if the patient did not already complain of a paresthesia due to pressure from the original conventional denture pressing on the exposed nerves, a warning should be given to them over the possibility of a paresthesia, that could be brought about from the handling of the nerve bundles during this operation.

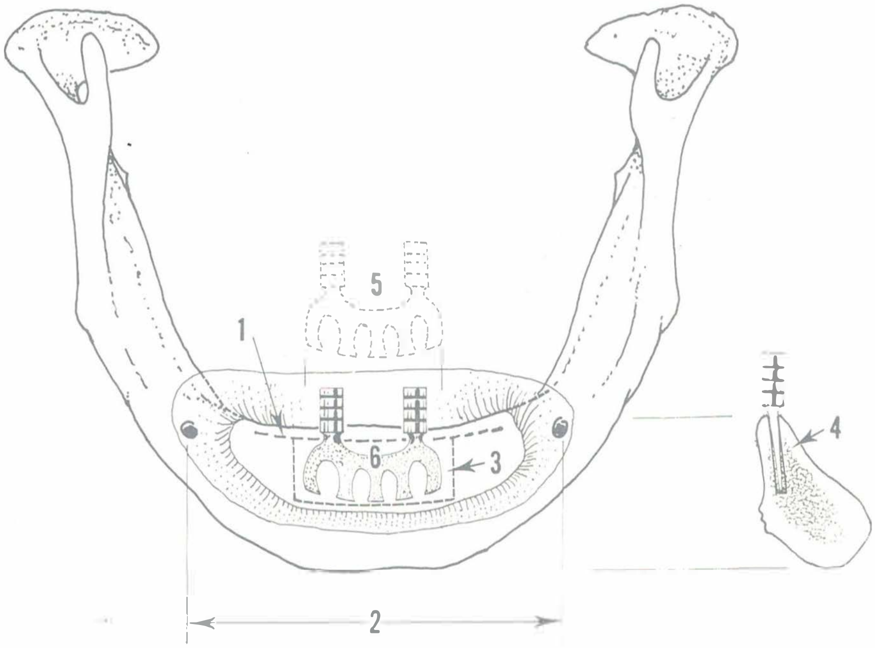










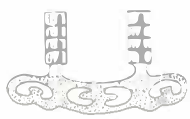


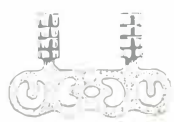
The Five Piece Symphyseal-Ramus Implant System

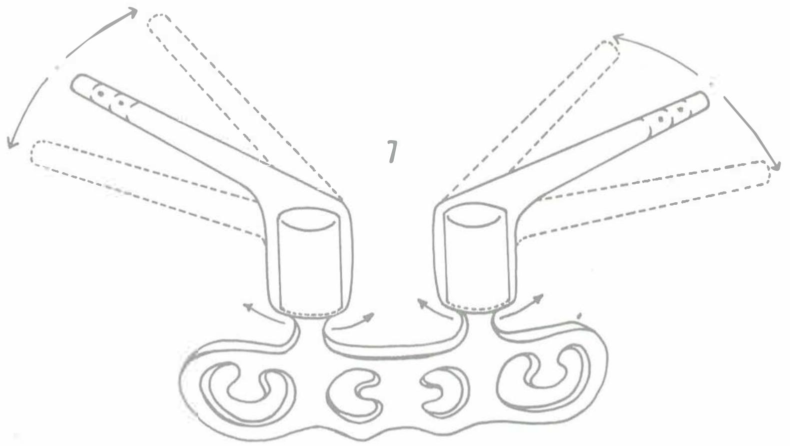
In situations occurring such as the one just described when there is near dehiscency or complete or partial dehiscency of the mandibular canal or canals bilaterally, a newer technique has been developed by the author that is far more practical, simpler in surgical procedure and with far better results. As long as there is enough bone anteriorly in the symphyseal region and there usually is, to insert an endosteal blade, the rest of the surgical procedure should present very little problem, if any, since there is always more than sufficient amount of bone existing in the ramus.

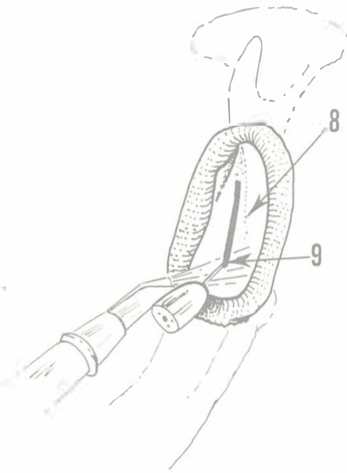
The procedure is as follows:

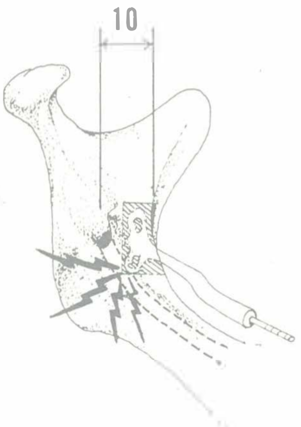
An incision is made anteriorly over the soft tissue crest to about two or three mm short on each side of the mental nerve bundles and the tissues reflected (1). It has been found from examining more than two hundred mandibles that the mental foramina average out to be about 50 mm. from each other, regardless of the size of the mandible (2). With a #700 XL fissure bur the groove is made for the specially designed blade (3). The groove should be nearer to the lingual side of the crest so that a maximum amount of bone will flank the implant labially where it is needed (4). The properly designed blade is fitted over the groove (5), and tapped into its proper position in the bone (6). The copings with their extension arms are tried over the round posts of the blade-vent just



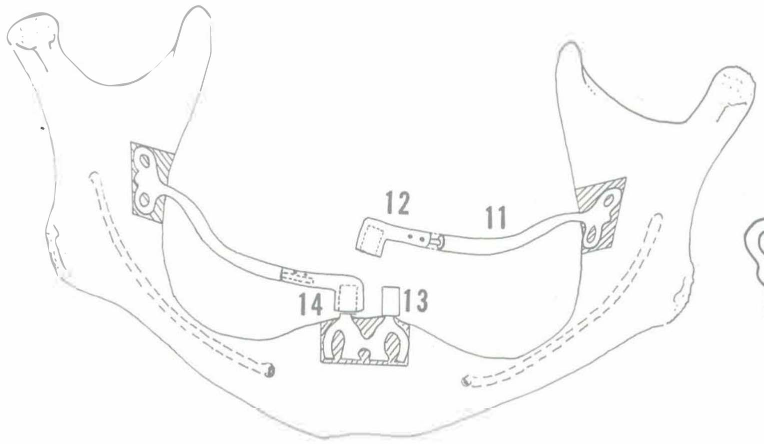








to test the swiveling effect (7). Palpating the soft tissues covering the anterior surface of the right ramus, an incision is made starting from almost the base of the coronoid process and extending it downward for about 15 mm. The incision should run nearer to the buccal side of the ramus than the lingual side. The tissues are reflected exposing the anterior face of the ramus (8). With a specially bayonet designed contra-angle and using a #700 XL fissure bur with a sufficient water spray, a thin groove is made just lingual to the buccal cortex. The groove should start superiorly above but dramatically buccal to the mandibular foramen, and should go downward so that its inferior portion still remains high in the ramus whenever possible (9). Since the depth of the groove is as deep as the blade portion of the ramus implant, if the groove is not made high enough on the ramus, even though it is quite buccal to the lingual surface of the ramus, where the nerve runs, it is possible that the inferior apical angle of the blade could injure the canal as it descends down the ramus (10). The ramus blade with its anterior extension arm is tapped into the groove so that the shoulders and neck of the blade are partially buried in the ramus. However, it is important at this time to tap it in so that the horizontal arm is tipping upward away from the occlusal plane (11). The anterior coping with its distal horizontal extension tube, is then placed into the horizontal extension arm of the ramus implant (12). The anterior component gently slides in and out of the ramus extension arm so that the anterior coping extends over the corresponding rounded anterior blade posts (13). Carefully, the horizontal extension arm is gently tapped downward toward the plane of occlusion while the anterior component is continuously guided over the ramus extension arm until the anterior coping

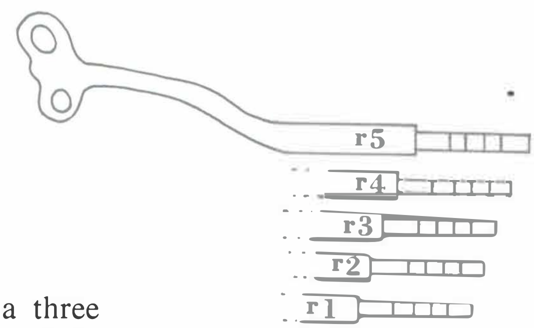


snaps over the post of the bladevent (14). Immediately a three dimensional locking effect takes place and neither the ramus blade nor the symphyseal blade or anterior component (right angled hollow tube fitting) and extension arm can be moved in any direction. The anterior component must fit *passively* over the corresponding symphyseal blade post, and the horizontal portion of the anterior component must form a butt joint with the ramus extension arm. In order for this to be properly accomplished, I have designed the ramus extension arms with five different lengths, (15). In order to be certain that the hollow tube of the anterior component fits passively over its corresponding symphyseal blade posts, several bends of the ramus horizontal extension arm might have to be done. Being that this implant system is manufactured of pure titanium, it is easily bendable and malleable with no deleterious effects. Caution however, should be followed, not to overbend the metal and to bend only with titanium tipped bending pliers, to avoid contamination. Also, if any adjustments are to be made requiring power instruments, stones only, rather than metal burs, should be used in order to avoid metallic contamination.

When the anterior coping is obliquely tipped toward the mesial of the corresponding post (16), the horizontal extension arm or the narrow portion of the extension arm must be slightly bent in a downward position to create a passive fit (17).

When the anterior coping is obliquely tipped toward the buccal of the symphyseal blade post (18), the extension arm must be bent toward the lingual.

Similarly, when the anterior coping is obliquely tipped toward the lingual of the symphyseal blade post, the ramus extension arm must be bent toward the buccal (19).



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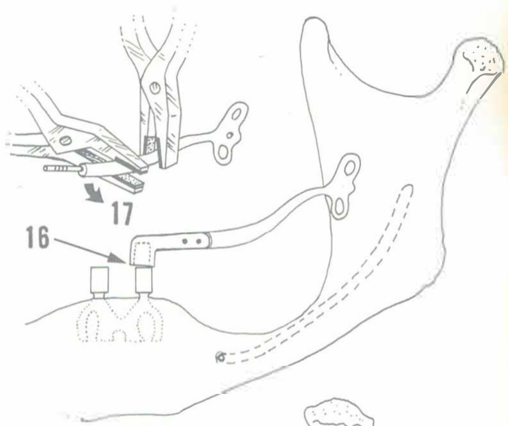
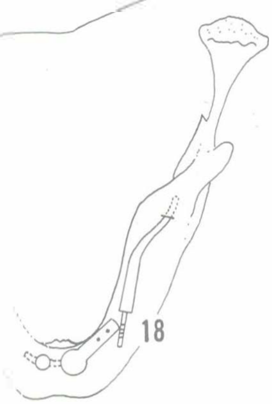
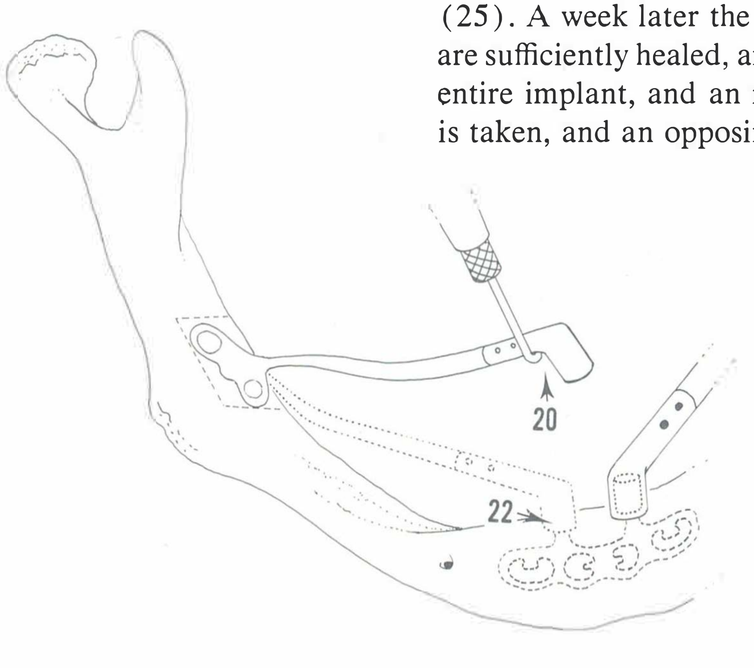


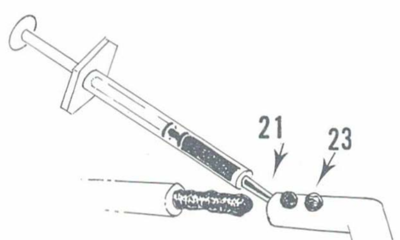


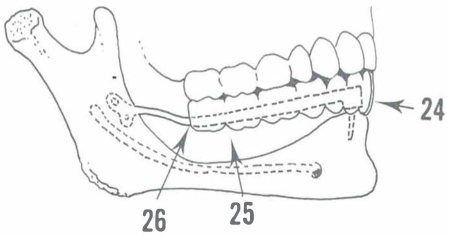
* *It is imperative that no bending takes place while the ramus mi-plant is in the mouth.*

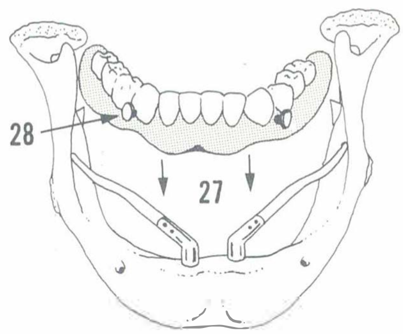
The coping is then carefully tapped off of the bladevent post, thereby, once again tipping the ramus horizontal extension arm upward away from the occlusal plane (20). This is done so the extension arm can disengage from the anterior component, so they can be cemented firmly into position. The extension arm and anterior component as well as the bladevent post are thoroughly dried, and with a special plastic tuberculin syringe, a loose mix of Duralay acrylic cement is expressed into both ends of the anterior component blade post and extension arm, tube and coping (21). The anterior component slides over the ramus extension arm and the entire mechanism is guided downward until once again the anterior coping fits snugly over the rounded post of the symphyseal bladevent (22). Two holes at the surface of the tube allows for excess amount to "ooze" out, thus preventing air pockets within the cement itself (23).

The same procedure is carried out on the opposite side of the arch. The tissues are sutured closed, although often I now do not suture the tissues in the ramus area, thus allowing them to fall properly into place, and a temporary fixed splint (24), created from an Omnivac machine is fabricated, or the patient's original denture is severely hollowed out and relined with a hard or soft acrylic, making sure it does not lock beneath the horizontal bar (25). A week later the sutures are removed, and when the tissues are sufficiently healed, an alginate impression is taken to include the entire implant, and an interocclusal record of centric relationship is taken, and an opposing jaw alginate impression to complete the







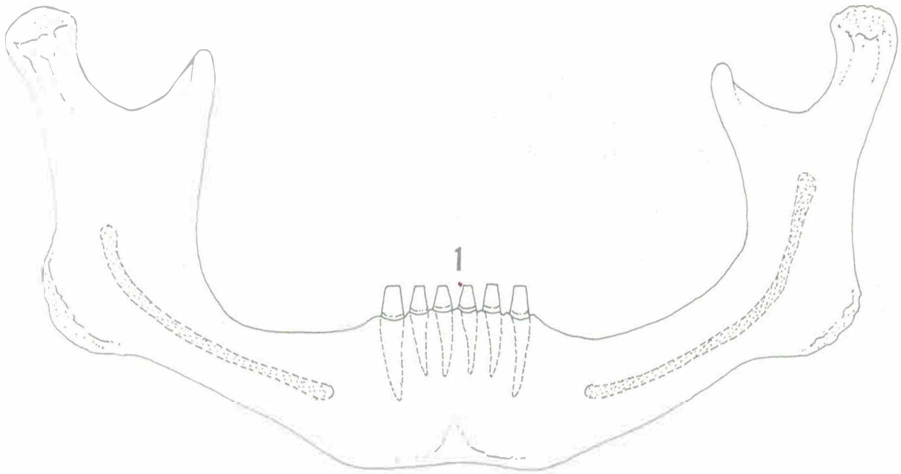


prosthesis, which is either an all acrylic splint cemented permanently over the implant system with Duralay acrylic (26), or a denture is cemented permanently into position (27). Being that neither prosthesis comes in contact with underlying soft tissues, but instead, remain a considerable distance away, they both act as sanitary bridges. However, often the prosthesis is now designed with various types of passive attachments, to allow extremely excellent retention and yet remain removable (28).

The various sizes, shapes and lengths of the symphyseal blades, anterior and posterior components were brought about from careful measurements of 80 mandibles.

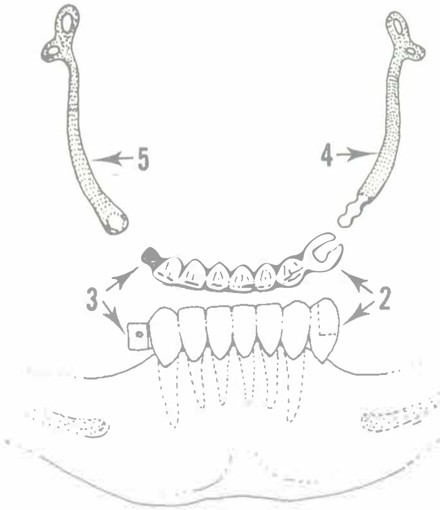
The Sliding Cable-Ramus Implant

Using the basic principles of the five piece system, another system was developed by the author that can solve practically every single problem that exists in the posterior edentulous mandibular body due to insufficient bone. This lack of bone can have been recently created such as by the extraction of teeth, the removal of a failing blade or other type of implant, as well as from the removal of the distal portion of a subperiosteal implant leaving the anterior portion intact. This technique can be accomplished simultaneously on both sides of the arch or unilaterally only depending upon the ensuing situation. However, anteriorly there must exist at least one or more well supported teeth or a well functioning anterior subperiosteal implant.



The procedure is as follows:

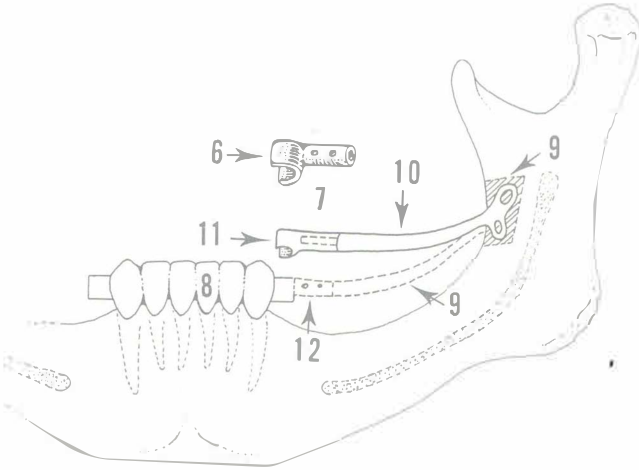
Technique #1:

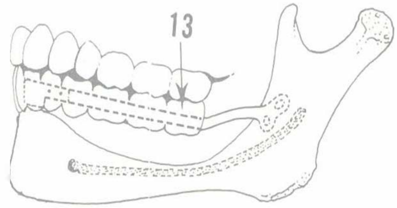


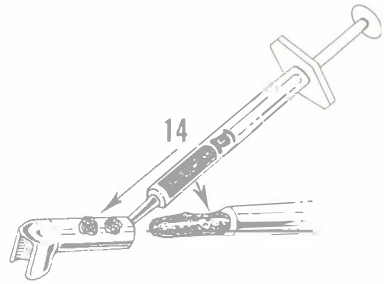
The anterior teeth are prepared for full crown restorations and impressions are taken for the fabrication of a completed fixed bridge (1). Extending distally from the last abutment on each side is a cantilevered pontic large enough to create a "figure eight" lock inside of it (2). If one prefers a telescoping effect, then extending from the last abutment on each side can be a smooth surface pontic with a horizontal hole that extends from the buccal surface to the lingual surface to accept a horizontal transfixation pin (3). However, it has been the author's experience to use telescopic copings, without the locking mechanism. The bridge is fitted into place and checked for marginal adaptations, overall fit, contour and occlusion. Originally it was then sent back to the laboratory and direct wax ups were made inside the female figure eight locks, or a wax up was made over the cantilevered pontic, and a casting of either the male figure eight attachment or the telescopic coping with the extension arm and ramus blade (4-5) was cast. Today, however, with my prefabricated hollow tubes, the technique becomes simplified. A casting is made to fit over the cantilevered pontic and is soldered to one of the prefabricated hollow tubes (6). The properly sized ramus implant (1-5) is then used to engage the ramus groove and anterior hollow tube component (7).

The technique is as follows:

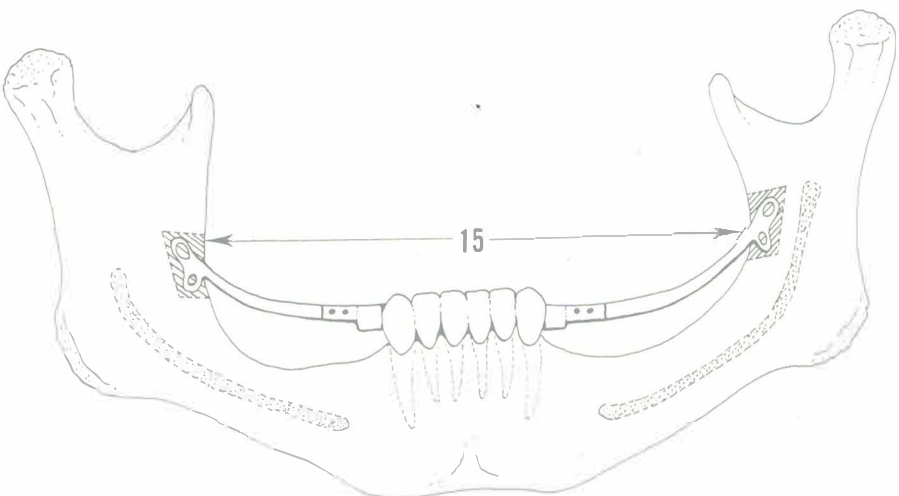
The anterior bridge is cemented over the anterior abutments (8). The tissues covering the superior anterior surface of the ramus on one side of the arch is incised on its buccal portion, and reflected and the groove is made in the same manner as when

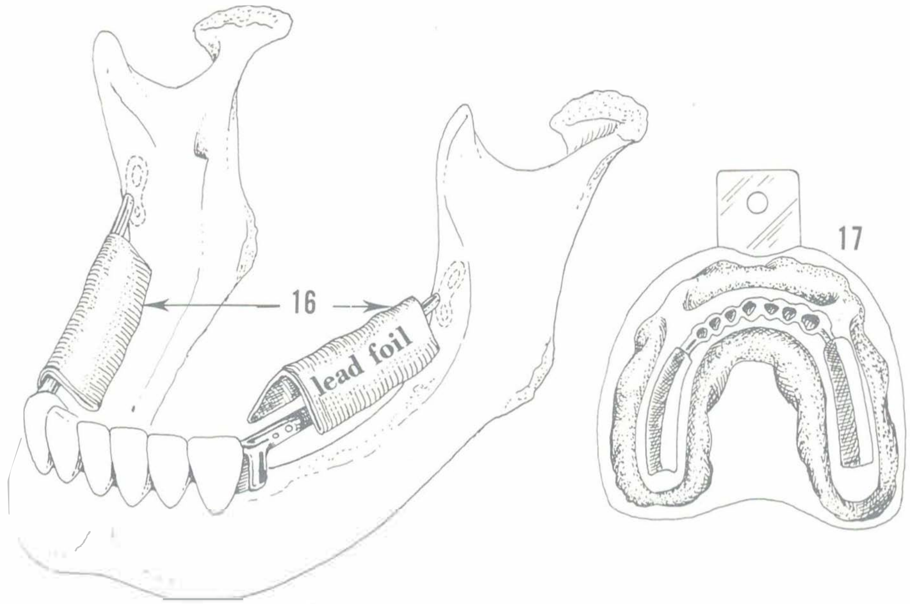






made for the R^2S[5] system. The ramus blade with its solid anterior horizontal extension arm is tapped into the ramus groove (9), so that the arm is oblique to the occlusal plane (10). The anterior component consisting of the telescopic coping and distally extended hollow tube is slid over the horizontal arm (11). It is made to slide rather easily along the extension arm. The extension arm is carefully tapped or pushed downward, working the "cable car" mesially and distally until it snaps into or over the pontic, depending on which type of attachment was used (12). The horizontal arm should line up properly with the opposing jaw and should



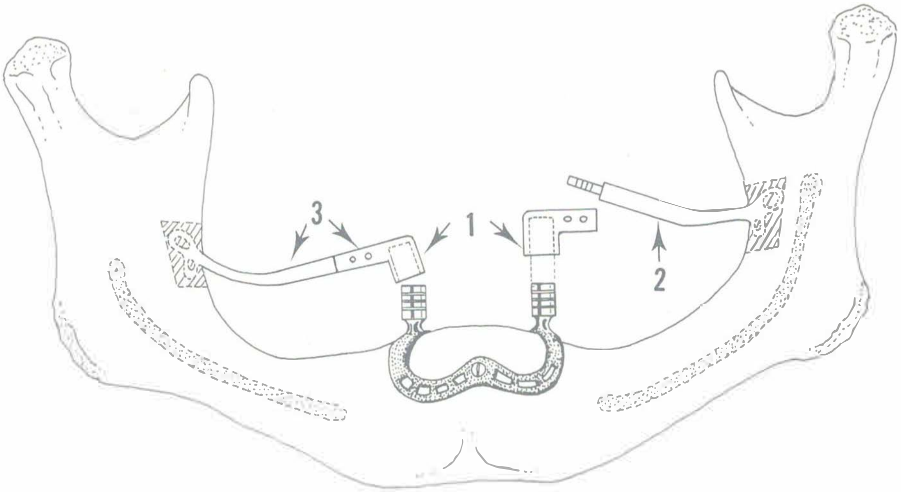


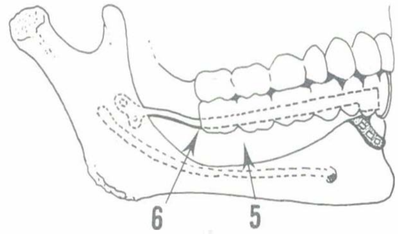
spare several mm. for the fixed superstructure (13). Carefully, the telescopic coping is tapped occlusally away from the cantilevered pontic enough, so that it can completely disengage the pontic, and horizontal arm, so that cement can be added, and it once again can be locked into position (14, 15). The procedure is repeated on the other side and the tissues are sutured closed. When sufficient healing has taken place, an impression for both posterior fixed bridges are accomplished, using always an elastic type of impression. Sometimes lead foils (from periapical radiographs) are used by folding them over the horizontal arms, and allowing the foil to touch the underlying gingival tissues, thus blocking out the undercut areas beneath the horizontal arms, and the impression is taken with them in place (16, 17).

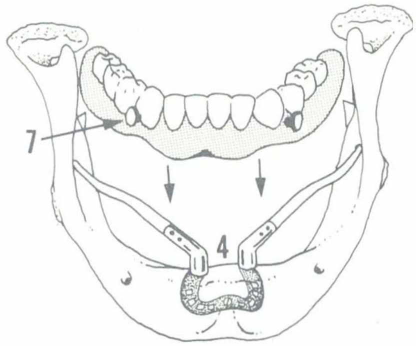
Technique #2:

When the anterior portion of a subperiosteal implant remains and a denture prosthesis is contemplated, the following procedure is followed:

An impression of each post is taken and a telescopic coping with a horizontal hollow tube is cast (1). The ramus blade is tapped into its groove made on the buccal side of the ramus, so that its horizontal arm is tipping upward (2). The telescopic coping with its distally extended hollow tube is fitted over the posterior extension arm (3), and the arm is manipulated downward while the coping slides along the horizontal bar until it snaps into place over the corresponding subperiosteal implant post. The other side is done in the same manner and cementing procedure is also followed as previously described (4). Either, an all acrylic splint is fabricated and cemented permanently (5), or a denture





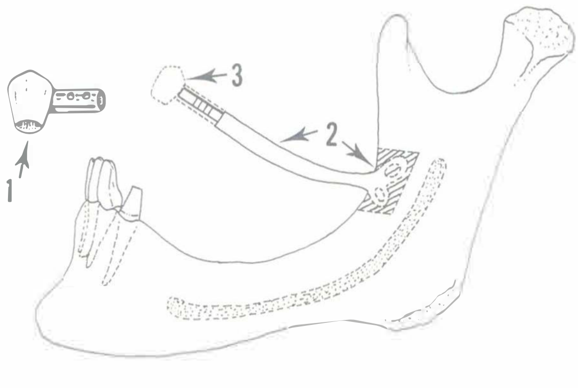


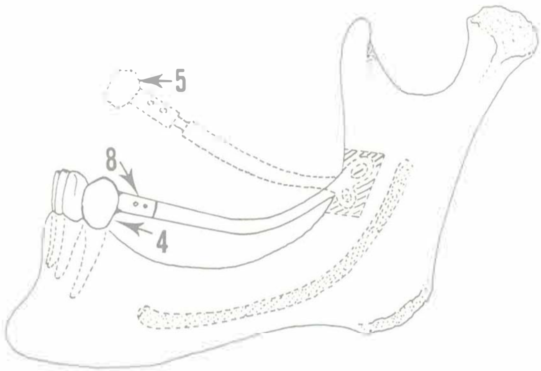
type superstructure is fabricated and cemented over the bar (6), or fabricated with attachments to remain as a removable appliance (Dolder, Ceka, Lew, and clip attachments (7)). It is imperative, however, that there is a passive fit of coping to post.

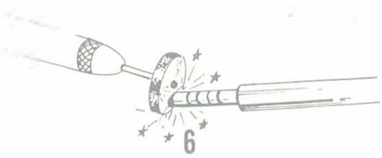
Technique #3:

For the Single Anterior Abutment Tooth:

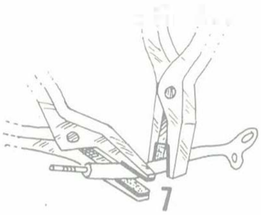
The tooth is prepared for a full crown restoration and the prefabricated hollow tube is soldered to the disto-proximal surface of the finished crowns, and extends about five mm. distally and horizontal to the occlusal plane, leaving several mm. above it for the fixed prosthesis (1). The ramus implant is tapped into its proper groove with its horizontal arm extending slightly upward (2). The anterior component is placed over the arm (3) and carefully, the arm is tapped or pushed downward until the crown seats firmly and exactly over the prepared abutment tooth

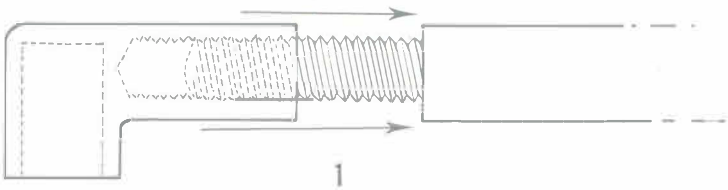






(4). Immediately the overall stabilization of the crown, bar and ramus implant is appreciated. The bar is then tapped upward to release the crown totally from the tooth, so that its distal tube can slide off the solid horizontal bar (5). Sometimes, it becomes necessary to shorten the bar if it interferes with proper seating of the crown, by cutting off some of its anterior extension (6). Sometimes also, it may be necessary to bend the bar slightly to create a more passive fit of the crown over the tooth preparation (7). When everything is accomplished, the crown and tooth are thoroughly dried and sterilized, zinc oxyphosphate cement placed inside the crown, and a loose mix of Duralay acrylic is placed inside the tube. The tube is then fitted back over the horizontal extension arm of the ramus implant, and it is skillfully tapped downward until the crown fits snugly over the abutment tooth (8). When it hardens, the excess cement is trimmed and sutures are used to close the wound. Very often, I no longer use sutures in the ramus area, so that the loosely arranged tissues in the area join together to their own advantage. A week later, the sutures are removed and procedures are followed to complete the fixed bridge.





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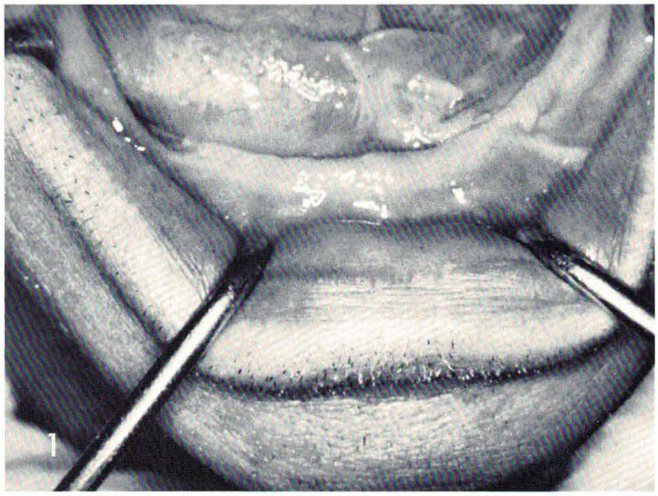
Technique #4:

Threaded Components:

The lastest modification to strengthen the connecting points between the anterior and posterior components of the ramus implant now includes an internally threaded hollow horizontal tube, that screws directly over the threaded anterior portion of the ramus implant (1). This eliminates the need for cementation between the anterior and posterior components, and creates a positive metal to metal connection.

New Linkow Ramus Systems

Combination of unilateral sliding cable (ramus implant) with blade implants



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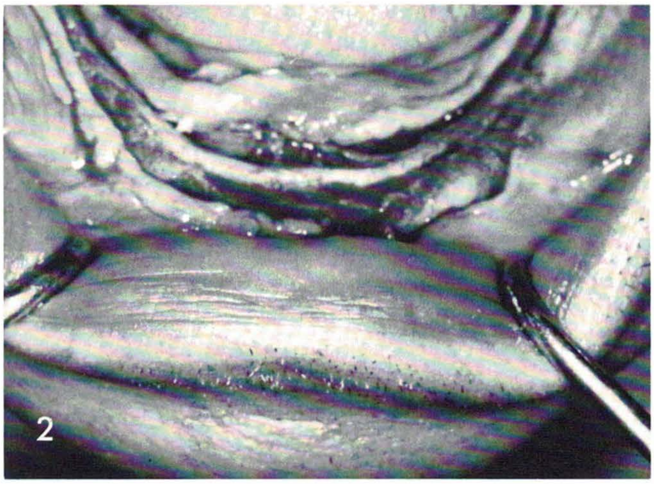

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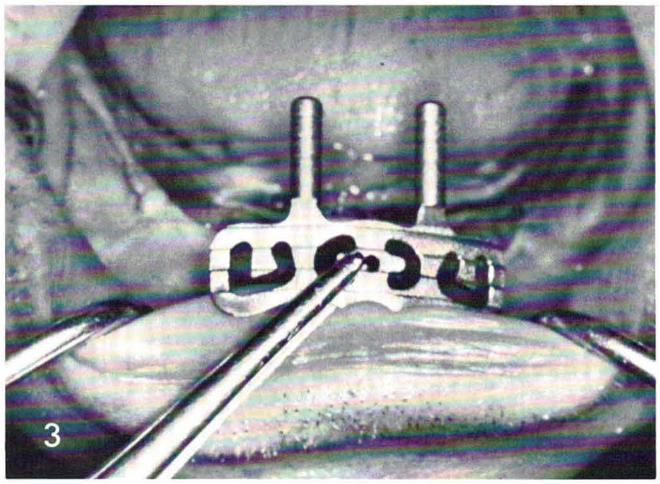
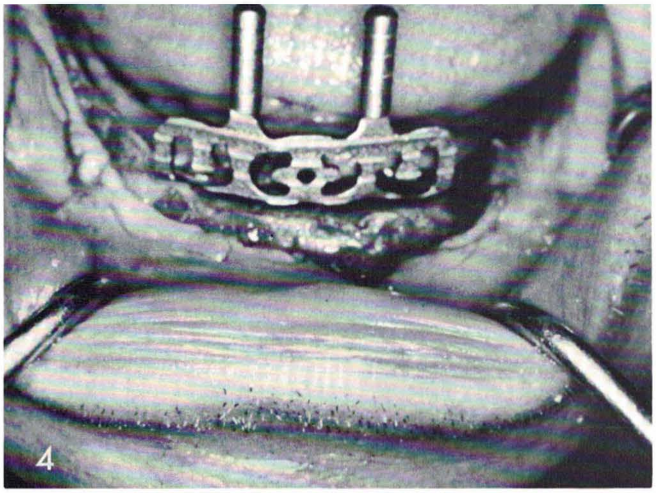


3

In a totally edentulous mandible, when enough bone exists all over, except on one posterior side preventing an endosteal blade to be inserted, the author does the following:

An incision is made around the entire arch, not necessarily on the side lacking bone, fig. 1, 2. A symphyseal blade is inserted, fig. 3, 4, 5. It must have the rounded posts so at the very first visit a connection between the ramus blade and the corresponding post can be accomplished. Posteriorly, on the left side where sufficient bone existed, a double posted endosteal blade was inserted, fig. 6, 7, 8. The tissues were sutured closed, fig. 9.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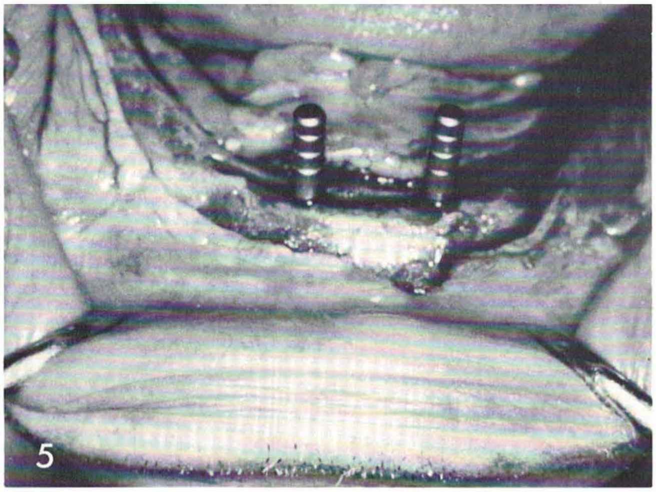
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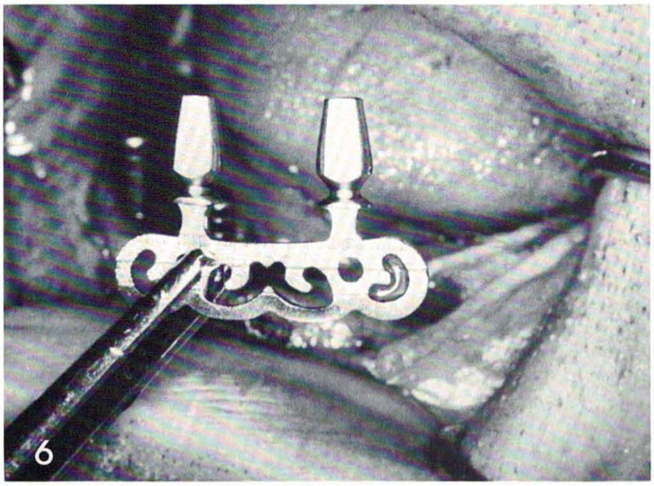
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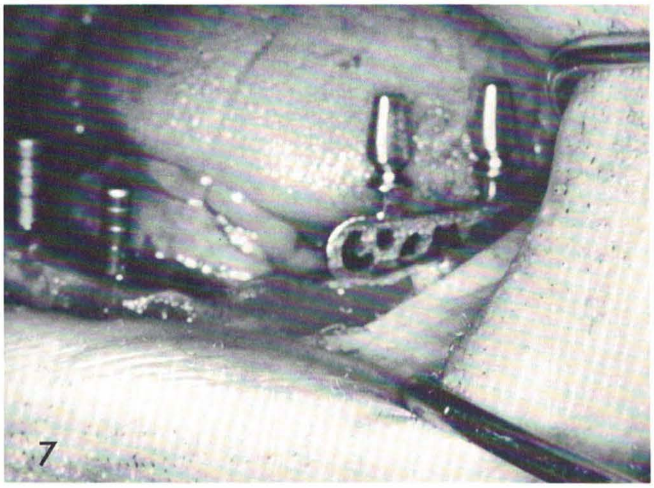
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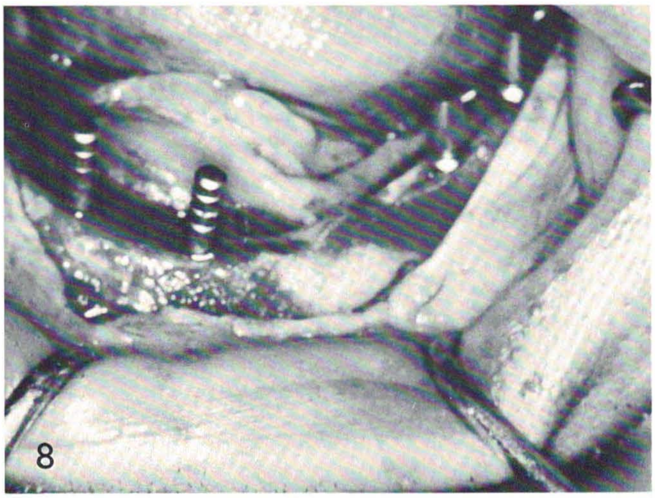
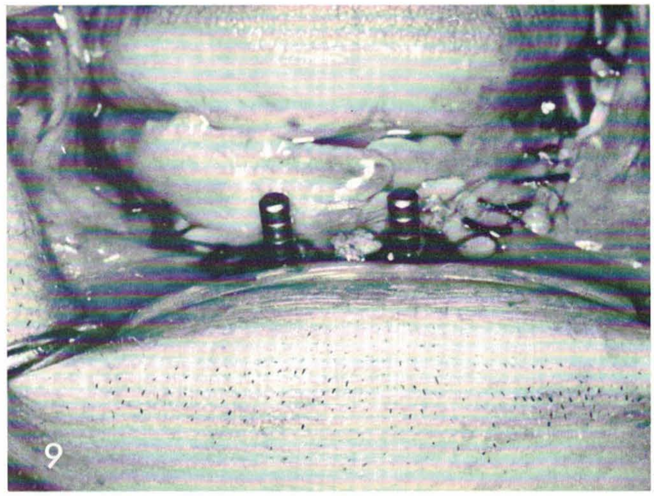
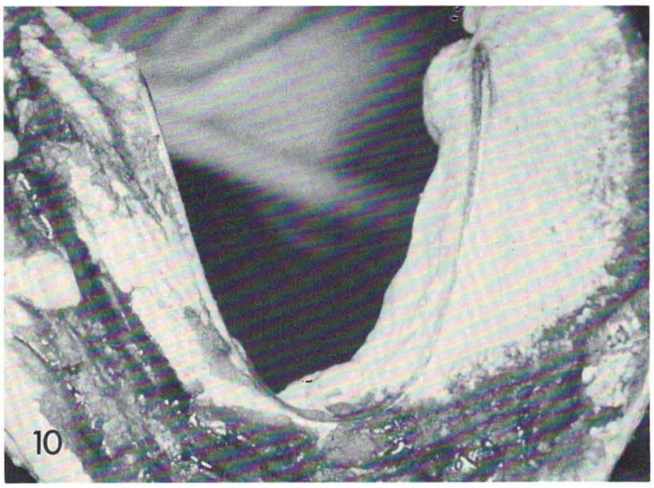
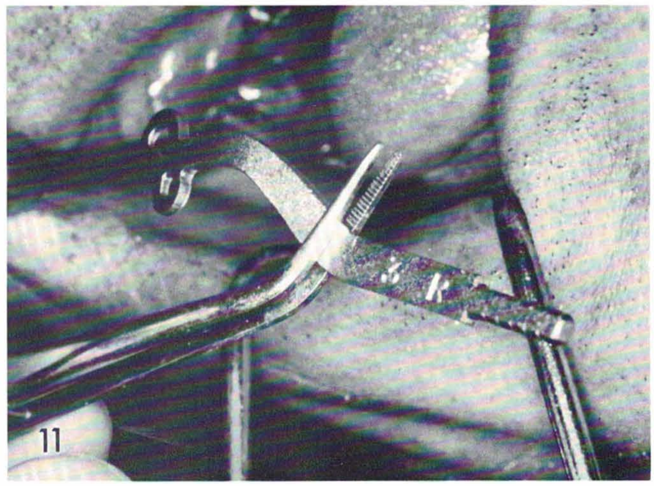


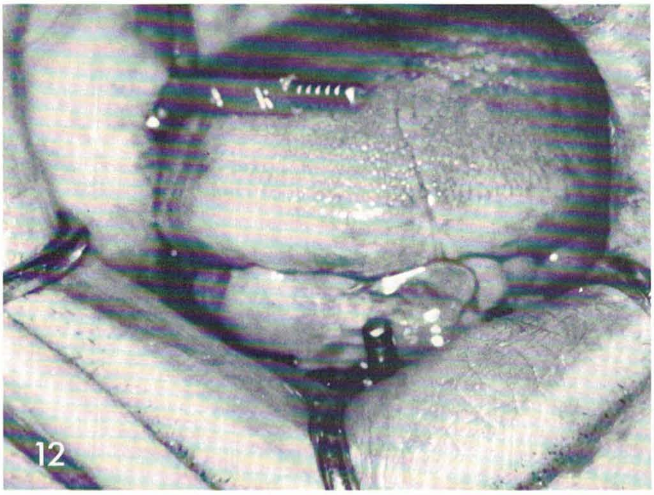


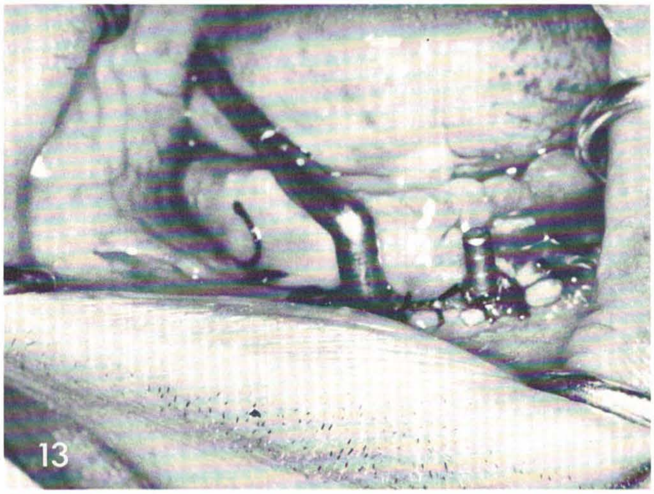


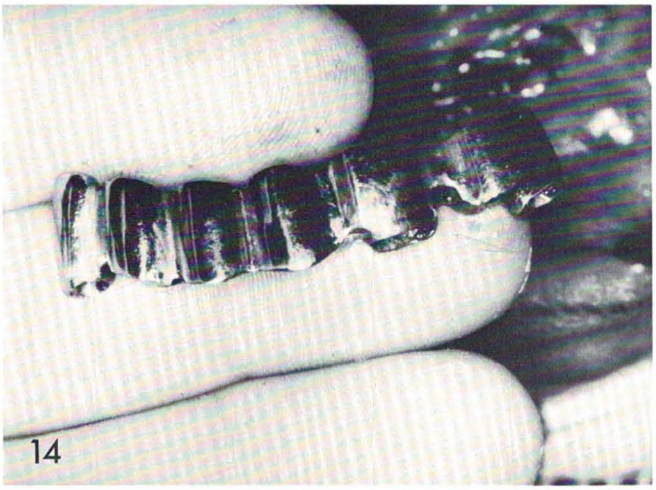


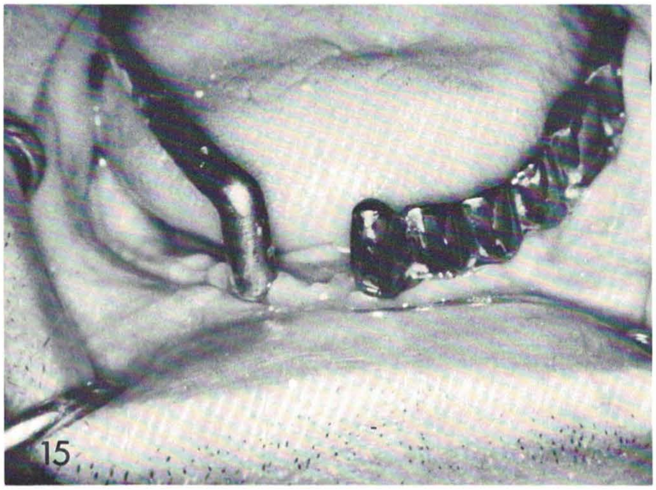
Immediately an impression was taken, primarily to fabricate a one piece casting which would include the left anterior symphyseal blade and the two posts of the left posterior endosteal blade, fig. 10.

The right ramus blade was then inserted into a previously grooved ramus, and the components cemented to each other, fig. 11, 12, 13. From the impression taken shortly before the

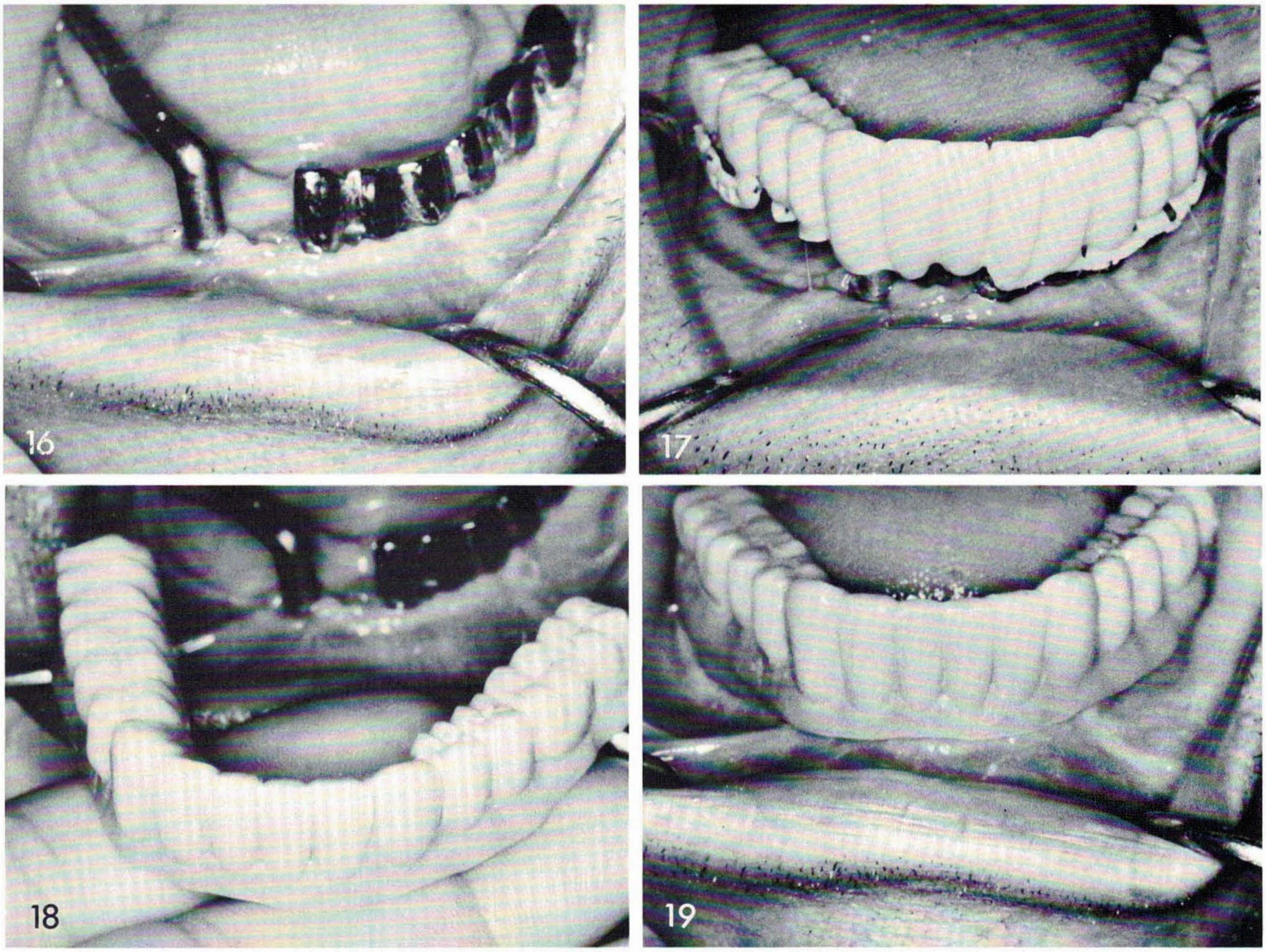








ramus implant was inserted, several hours later the casting was completed and cemented into position, thus locking the ramus half of the symphyseal blade to the left side in a full arch fashion, fig. 14, 15.



Approximately three weeks later, the tissues were all healed, fig. 16, and the final prosthesis, all porcelain, including the saddle area, was fitted and cemented, fig. 17, 18, 19.

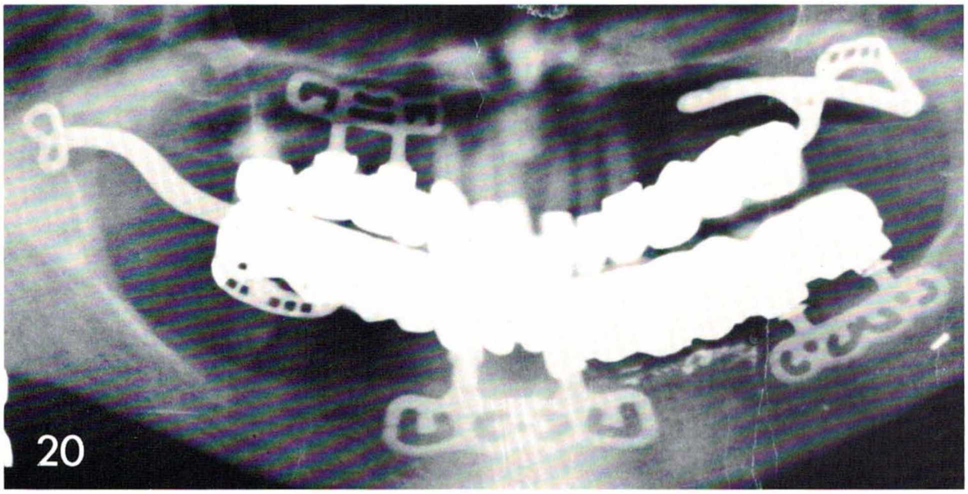
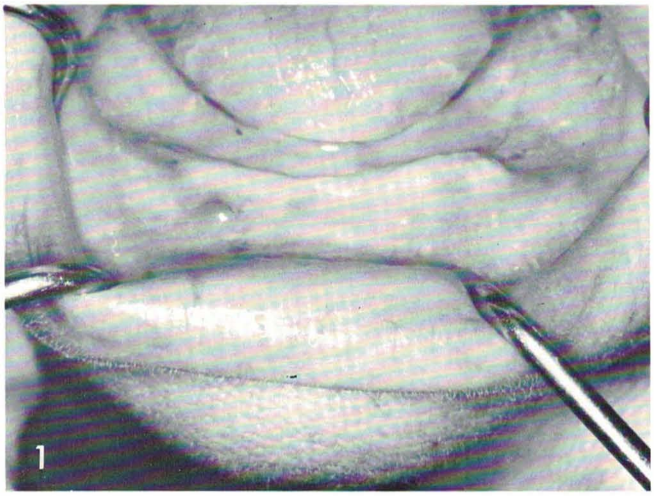
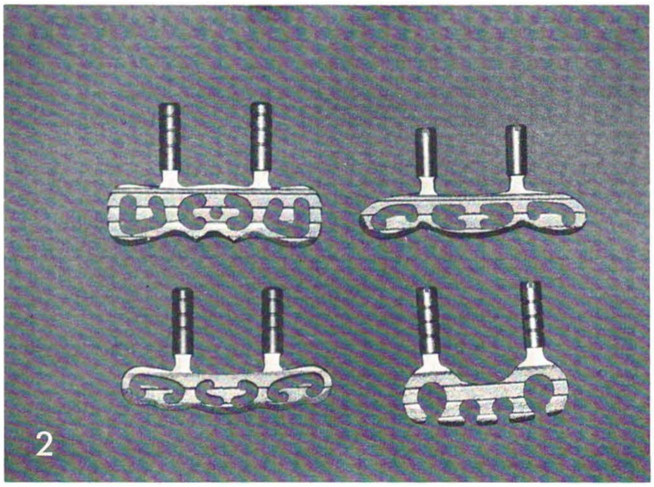


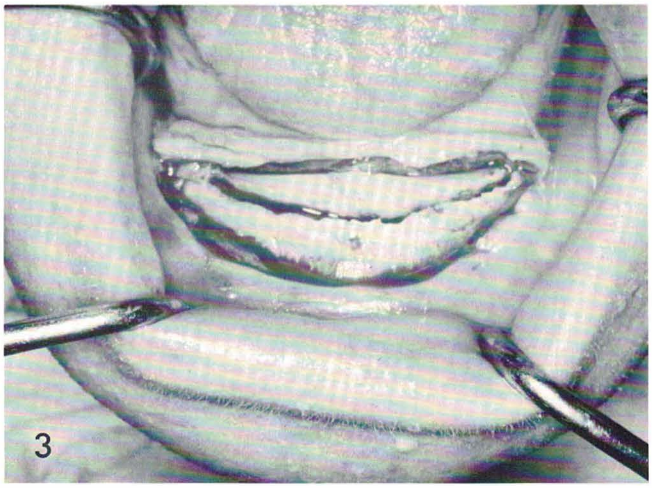
Fig. 20, shows the panex of the completed case.

The great advantage of this technique, is that it was able to be accomplished in one visit, instead of two, since pre-fabricated symphyseal blades and anterior hollow tube components were used.

Latest Linkow 5 piece total symphyseal-ramus system: $R^2S^{(5)}$





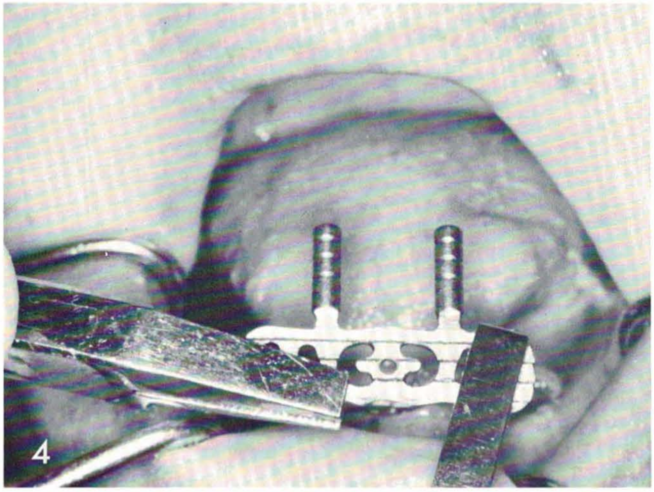


The typical implant candidate for a five piece symphyseal-ramus system, $R^2S^{(5)}$, is the one who exhibits adequate bone in the symphyseal region with little or no bone in both posterior quadrants. In fact many of these cases include exposures or dehiscencies of one or both inferior alveolar nerves. (Fig. 1).

The proper blade is selected for it's length and depth (Fig. 2). An anterior incision is made and the appropriate bone groove is created. (Fig. 3).

The symphyseal blade is then bent to passively fit the curved groove (Figs. 4 & 5).

It is then carefully tapped into it's proper position (Figs. 6 and 7) and sutured (Fig. 8).



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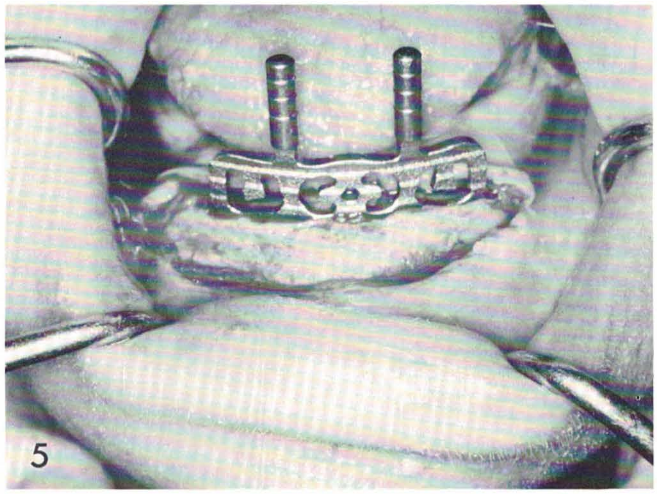

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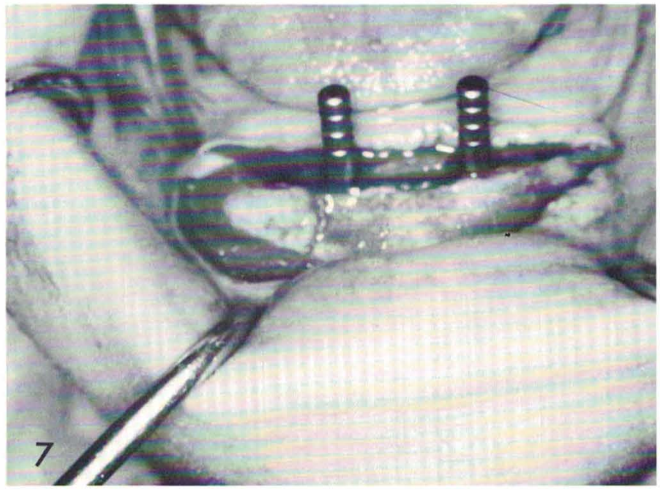

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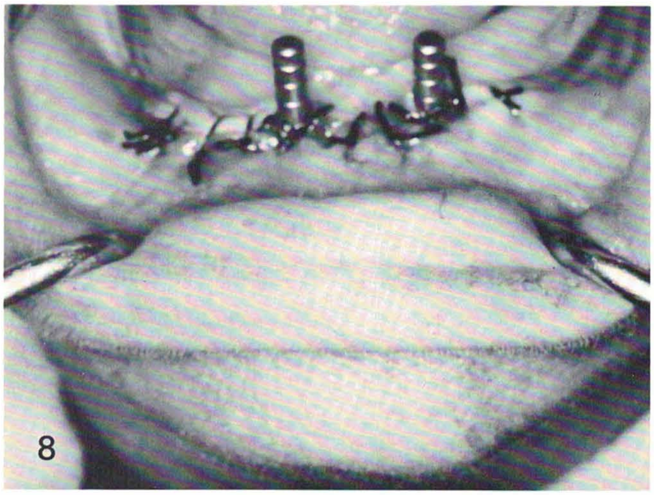

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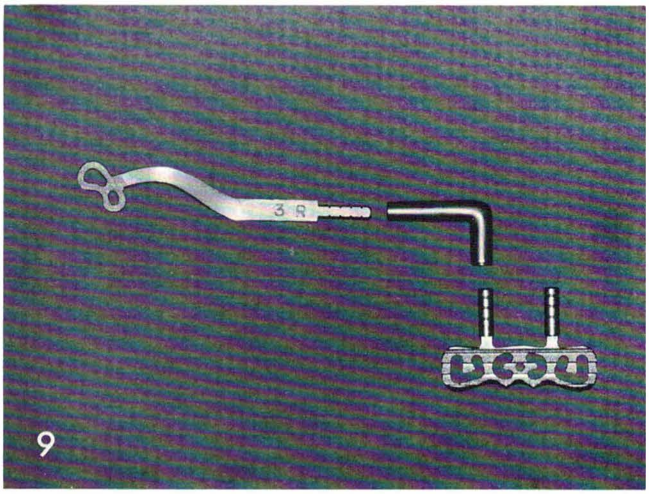

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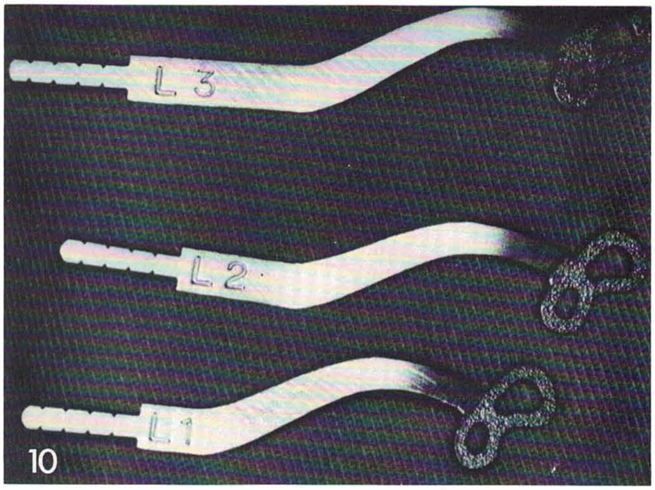

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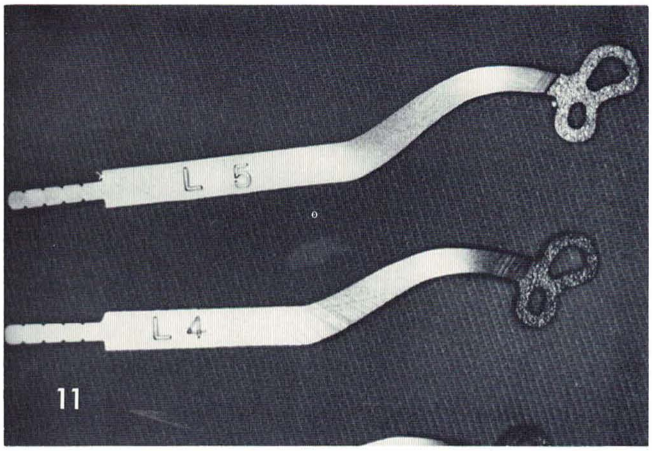

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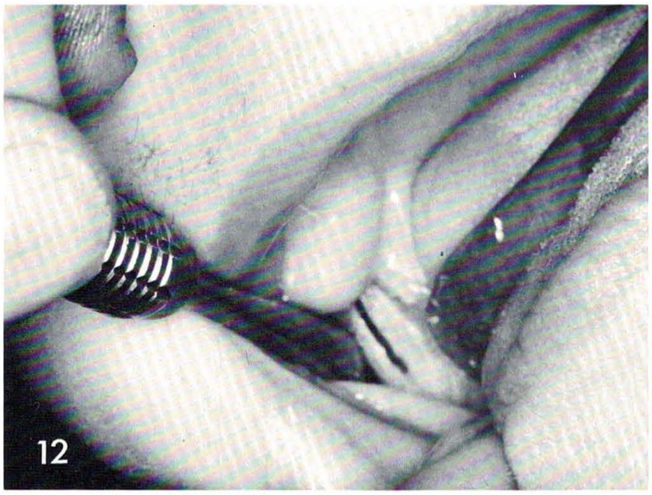
Figure 9 shows the armamentarium of the unassembled system which includes the symphyseal blade, the ramus blade and the connecting tube (a vertical-horizontal hollow tube).

Figures 10 and 11 illustrates the titanium ramus blades. They are fabricated in five different lengths. Separate sets are used and are designed for each side of the mandible.

This newest five piece ramus system has been coordinated to exact measurements, shapes and sizes that were determined from measuring eighty dried mandibles.

Each entire set consists of four symphyseal blades of different sizes, depths and shapes, at least two connecting tubes and ten ramus blades, five for each side of the arch. Varying lengths are marked directly on the titanium ramus blades.



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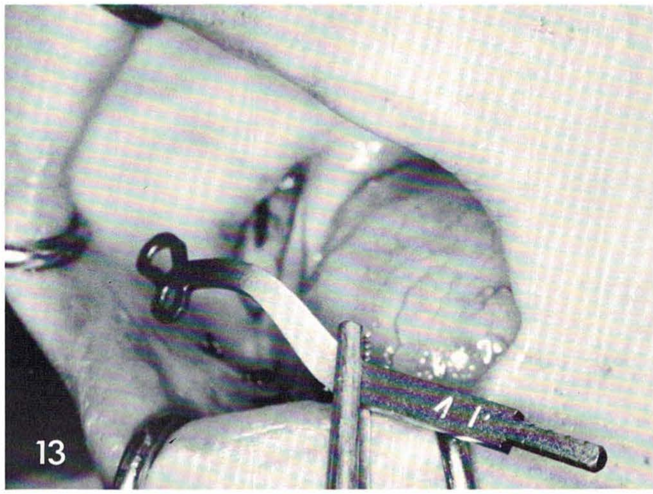

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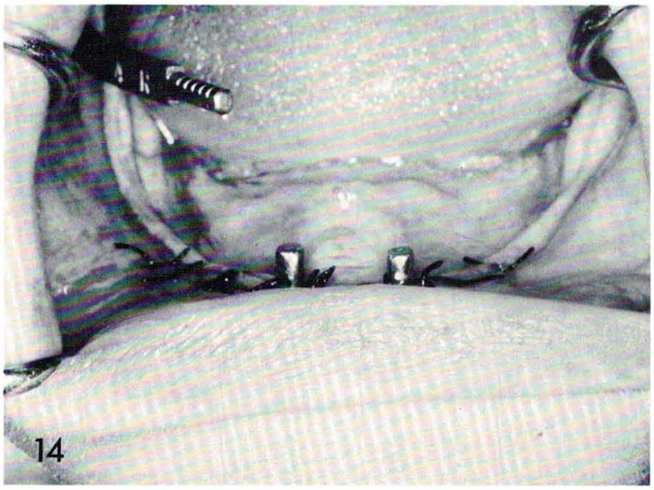

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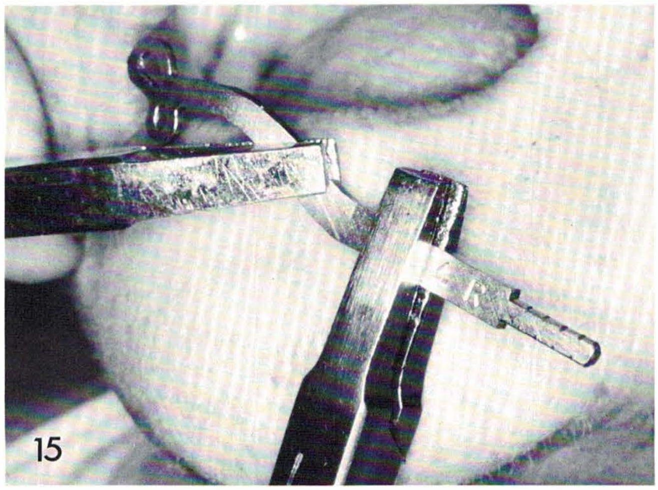

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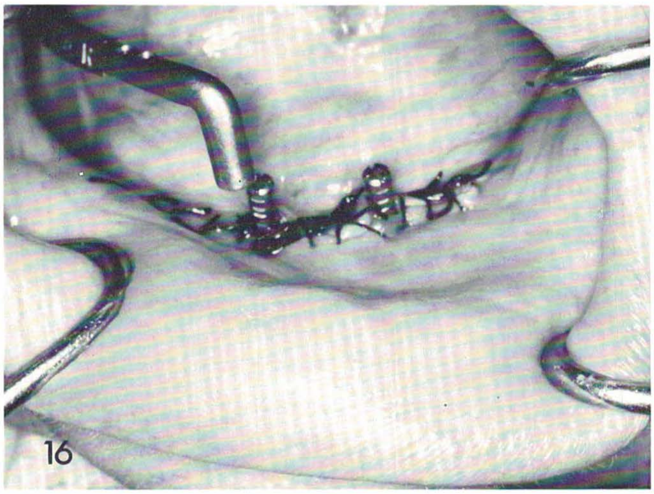
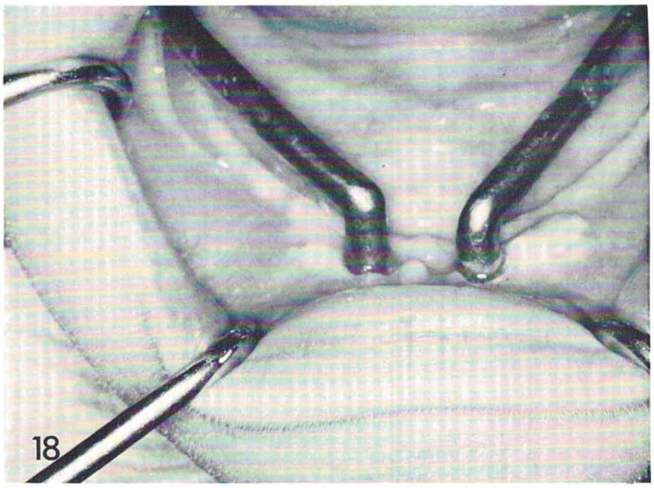
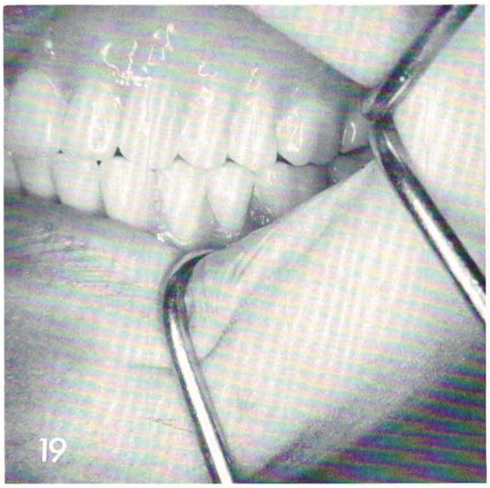
The right ramus is exposed by incising at least 15 mm of tissue covering the antero-buccal line angle of the ramus, starting approximately five mm below the base of the coronoid process and continuing downward near the buccal surface of the anterior border of the ramus.

The groove is then carefully made with a 700 fissure bur in either a straight or a bayonet type handpiece. The groove should be close to the buccal peripheral border of the ramus but not close enough so as to encourage a possible perforation of the bur through the often concave surface that exists on the buccal surface of the ramus. The groove must be nearly as deep as the blade and 2 mm of it's necks and must be exactly the same length of the blade or slightly shorter, but not longer. In this manner, the blade can first be tapped into the groove from it's superior portion and then tapped downward so that the inferior portion can be tapped into uncut bone (Figs. 12, 13 & 14). Wherever necessary the blade is removed and the horizontal arm of the blade is bent to allow for complete passivity of its fit over the symphyseal blade post (Figs. 15 & 16).







The same procedure is then carried out on the opposite side of the arch (Fig. 17).

Figure 18 shows an eight week post-operative clinical view of the healed tissue and the five piece system locked into proper passive position.

Figure 19 illustrates the completed case.

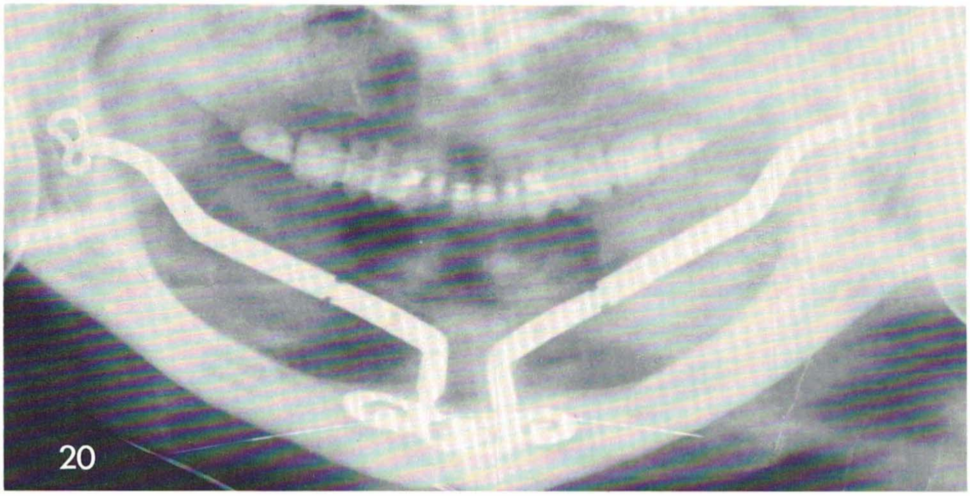
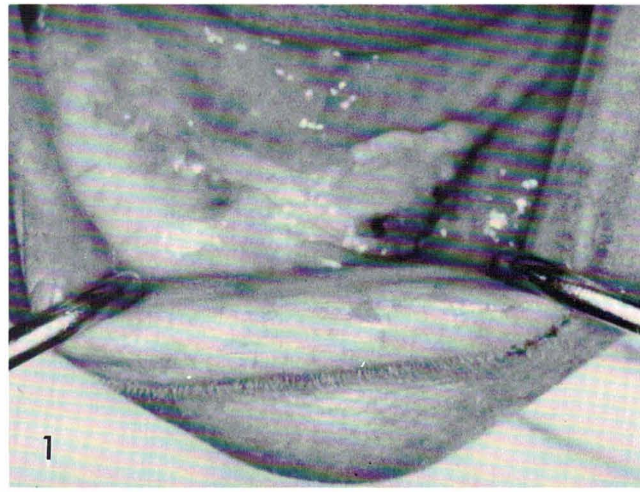
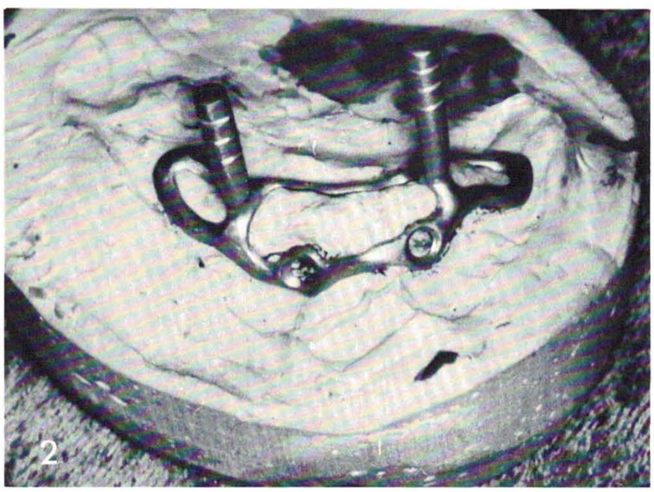
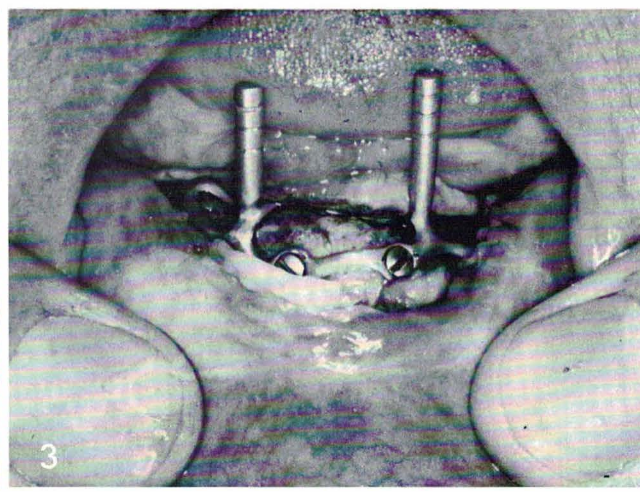


Figure 20 shows the post-operative x-ray. It demonstrates the tripodial effect, utilizing the horizontal bone in the symphyseal region and the vertical bone in the ramus regions.

Linkow 5 piece ramus system with anterior subperiosteal

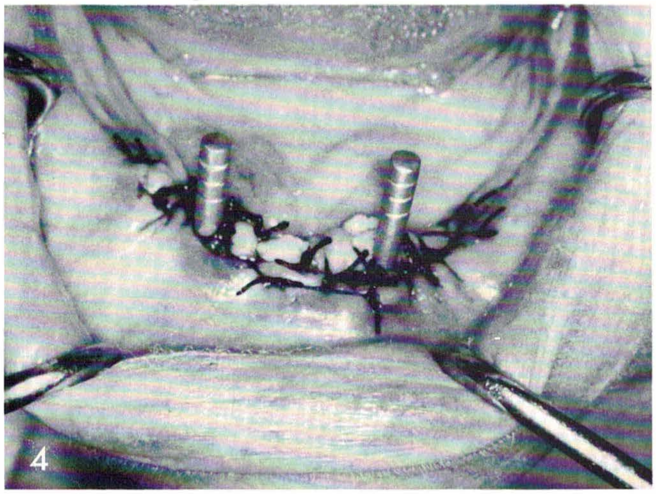






When not enough bone exists in the symphyseal area, (Fig. 1) prohibiting an anterior blade to be inserted there, for fear of perforating the inferior border of the mandible or fracturing the bone itself, an incision and impression for an anterior partial subperiosteal implant is done (Fig. 2). The posts, however, of the subperiosteal casting are fabricated to fit the prefabricated hollowed out anterior connecting tube copings. The cast subperiosteal implant is then fitted over the exposed bone and with two small Vitallium screws, it is screwed into place, (Fig. 3) and sutured (Fig. 4). The posts are shortened if necessary.

The anterior components are once again tried over the shortened posts and are adjusted, so that they fit to the gingiva and swing buccally and lingually with no resistance from the underlying posts. The right ramus groove is then made, (Fig. 5). The various sized ramus components are fitted into the groove, until the proper size coordinates most closely with the anterior symphyseal blade post of its corresponding size, (Figs. 6, 7, & 8). The procedure is repeated on the left side, (Fig. 9).



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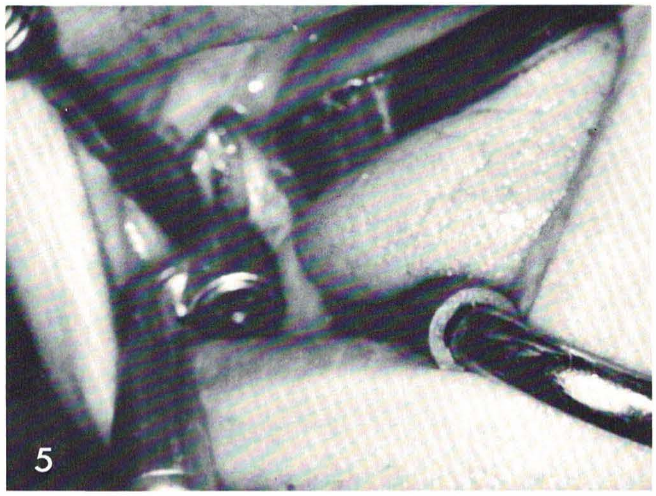

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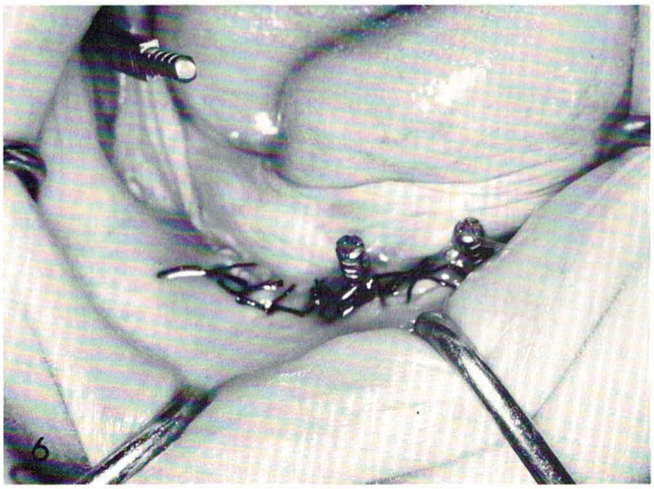

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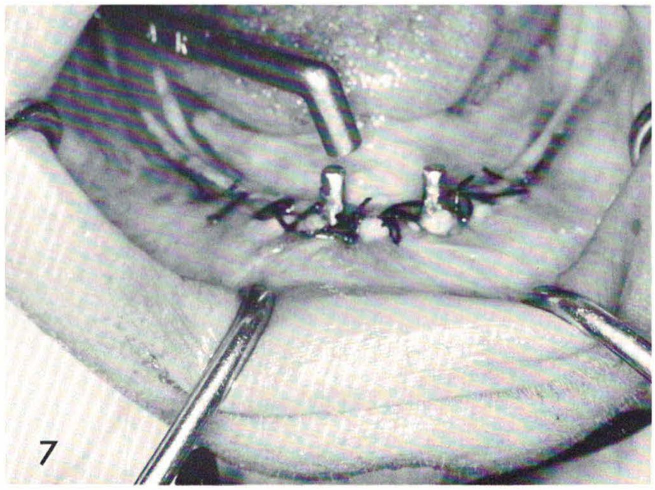

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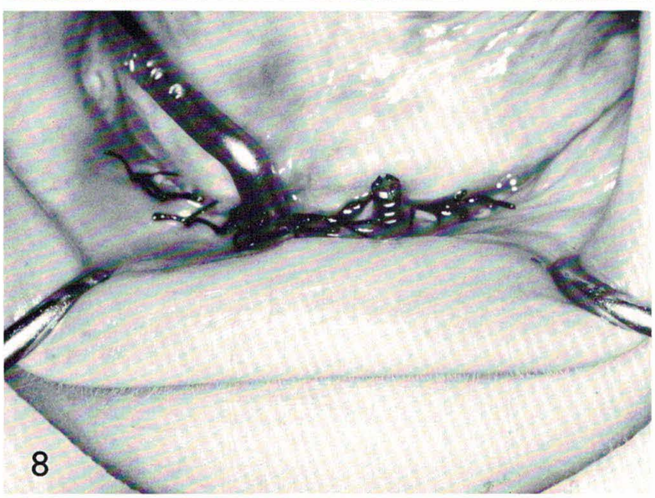

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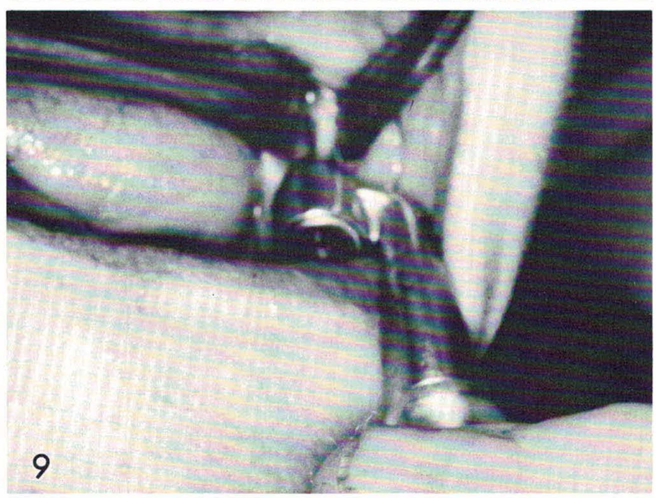

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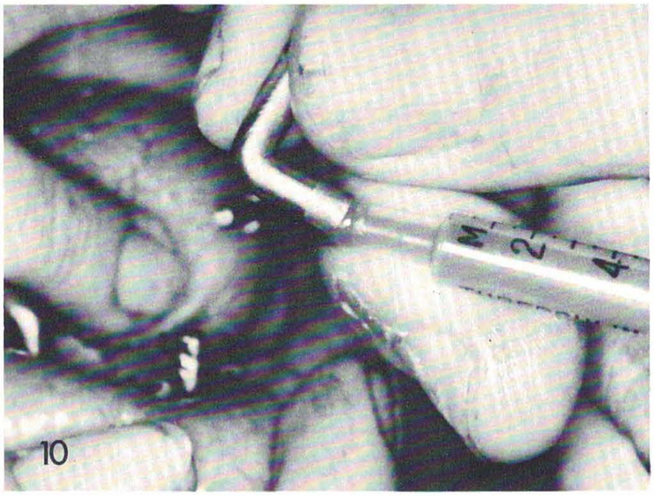
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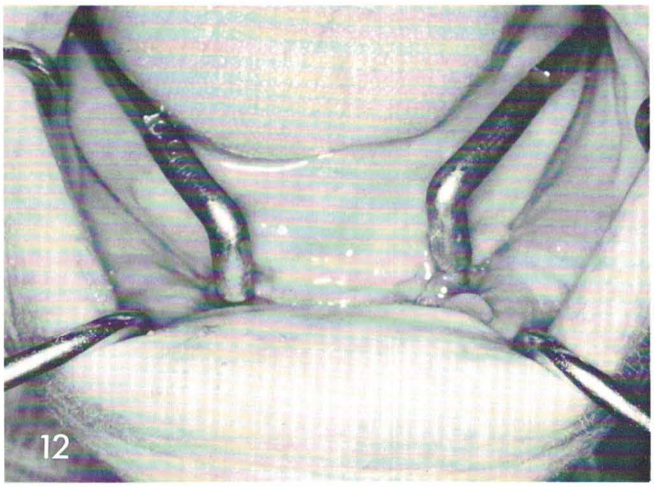
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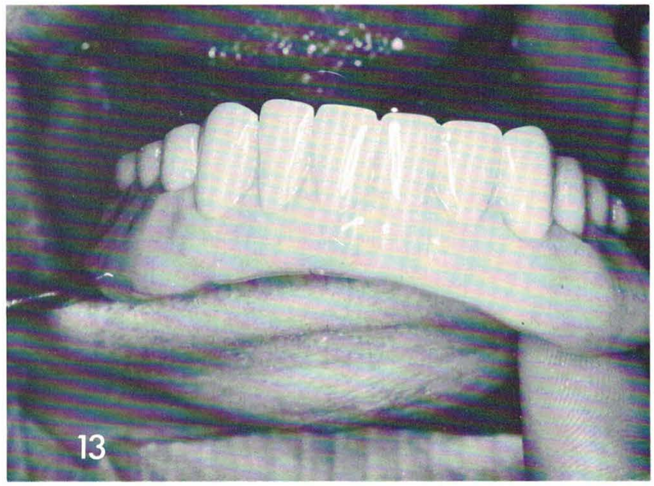
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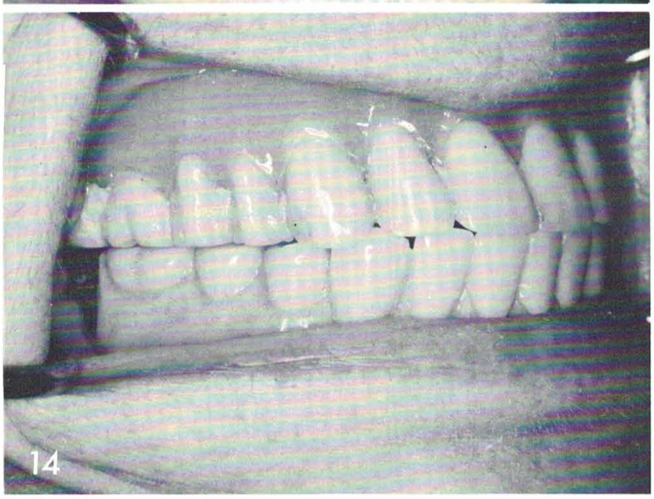
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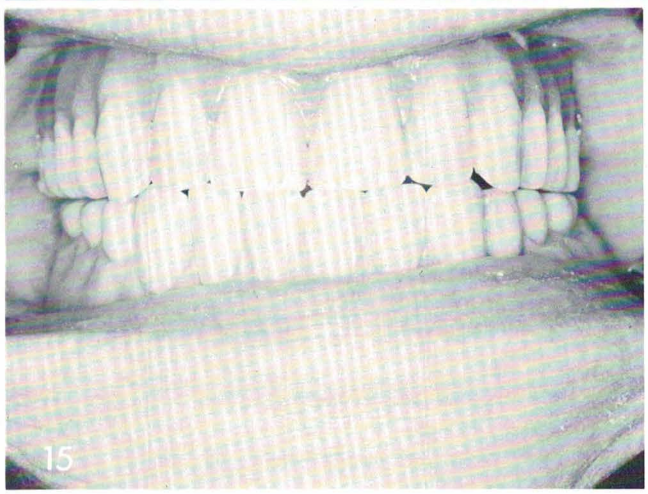
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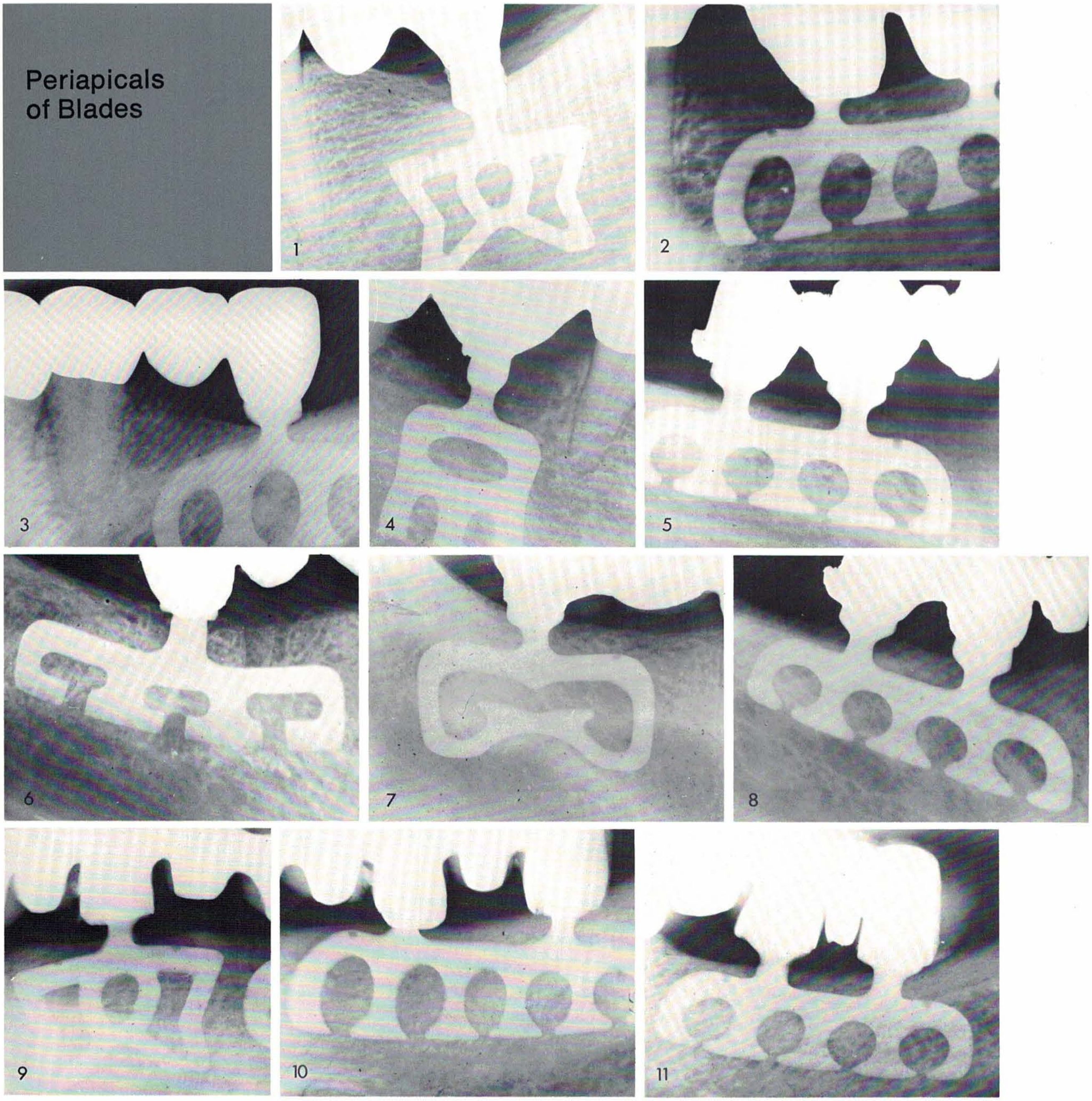
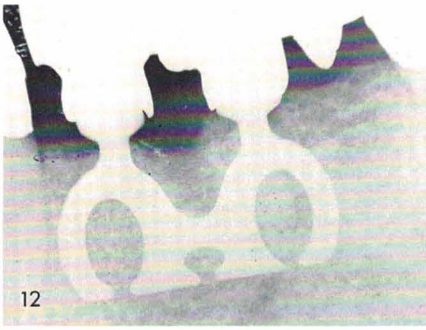
Case Studies

Periapicals of Blades



Mandibular bladevents, when inserted correctly and to their proper depth, have certainly proved to have a predictable prognosis.

Figures 1 through 34 show post-operative periapical radiographs of numerous bladevents that have been functioning from two to ten and one half years.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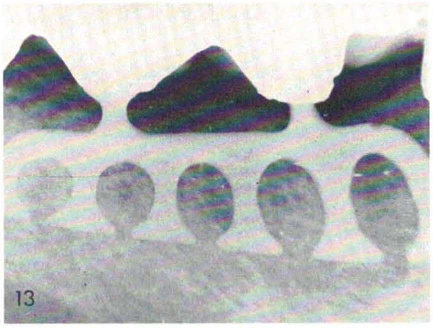
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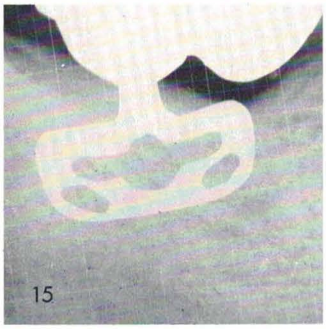
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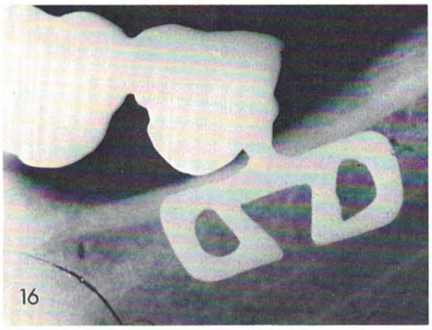
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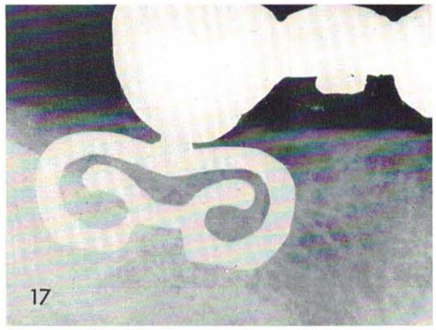
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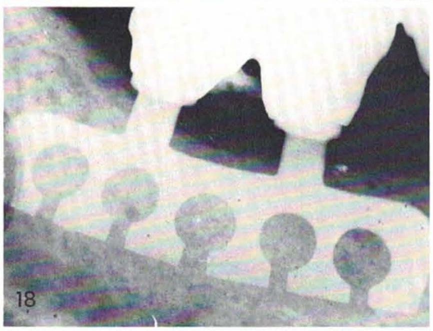
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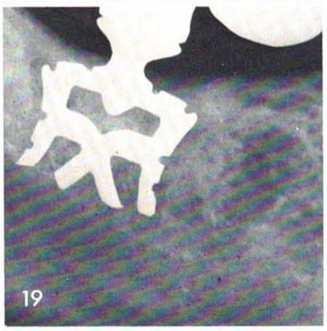
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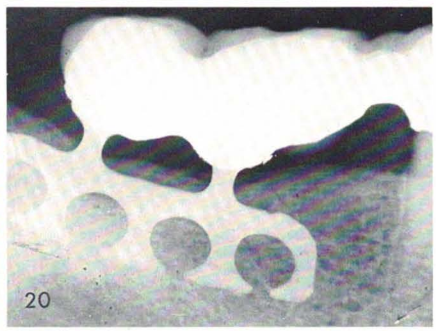
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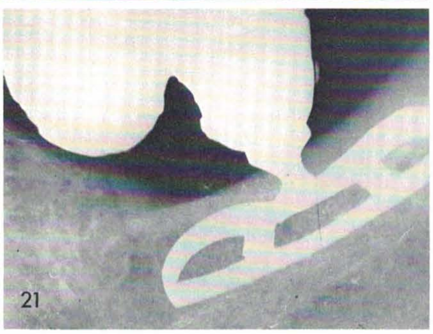
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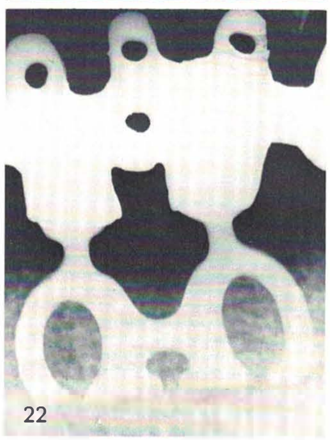
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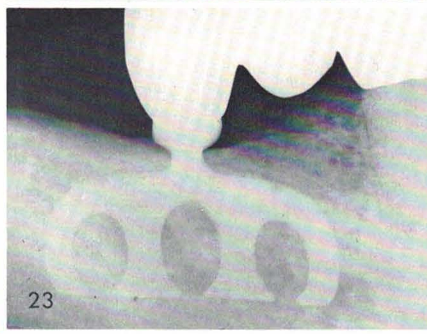
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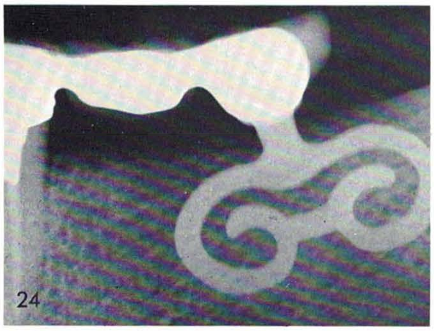
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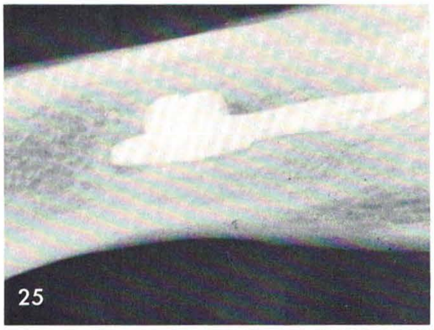
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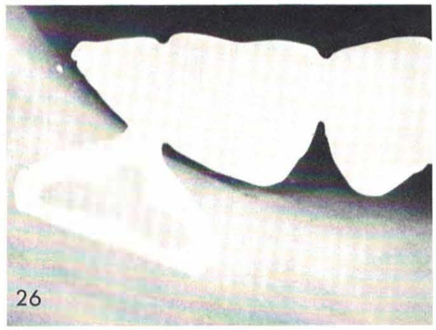
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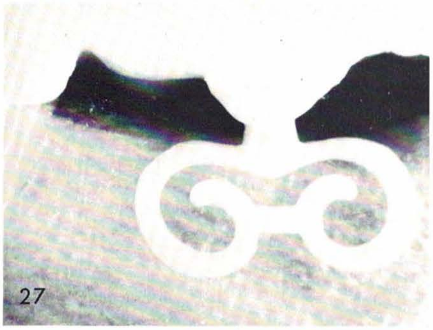
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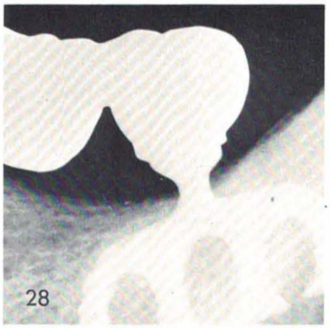
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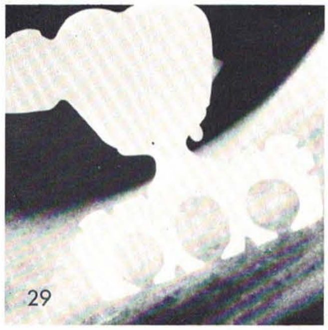
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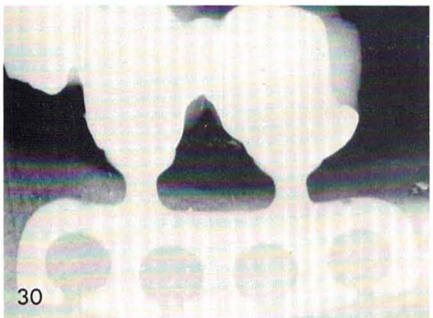
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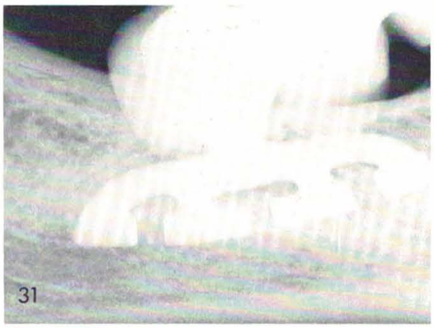
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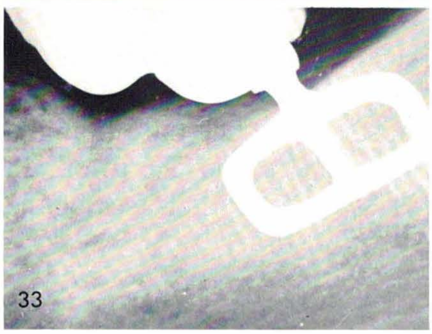
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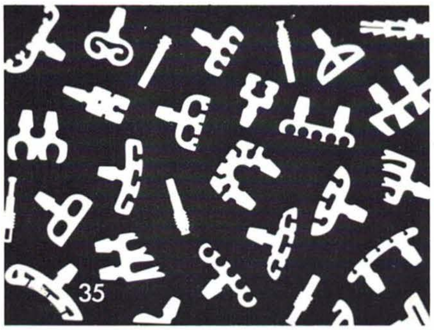
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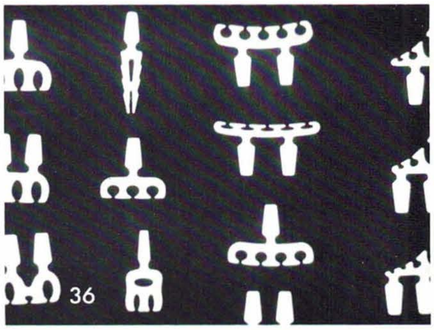
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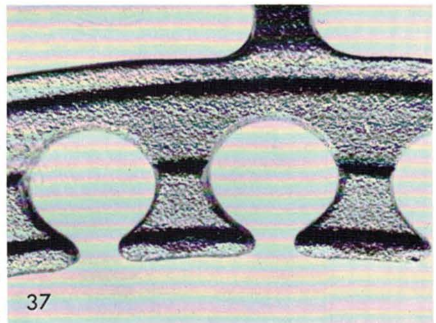
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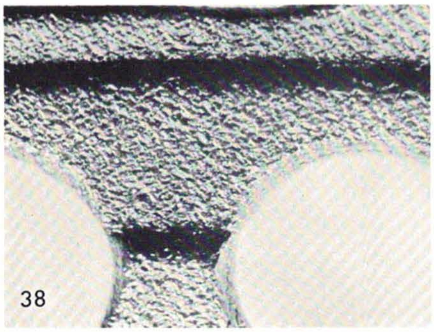
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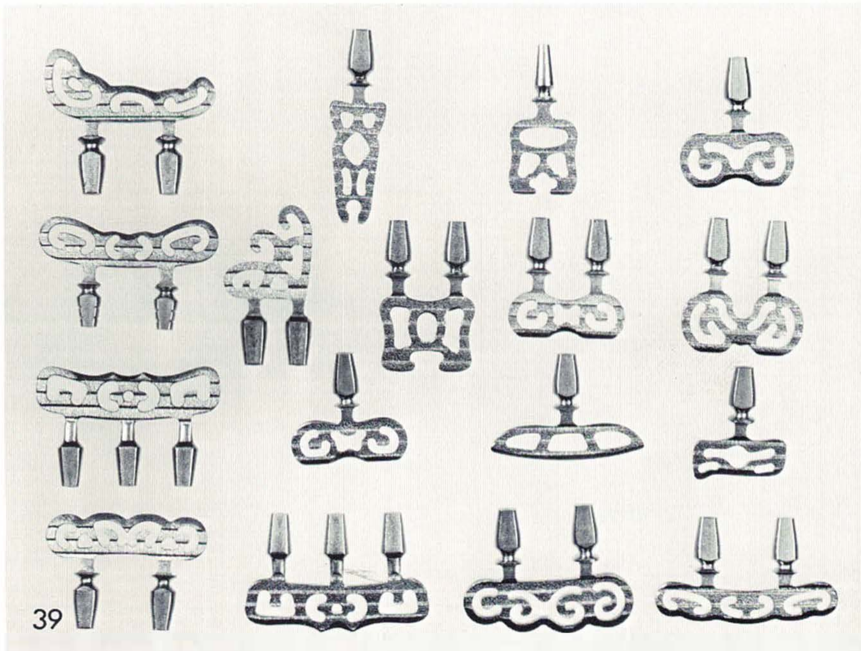
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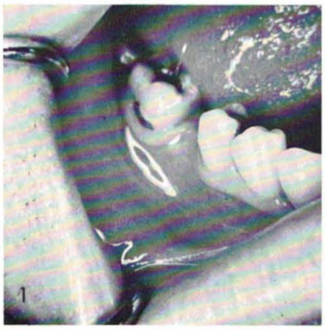
Figures 35 and 36 show blades that were x-rayed from a special radiographic and fluoroscopic x-ray machine showing there are no flaws.

Figures 37 and 38 show a higher magnification of the interface surface of the pure titanium blades. The surfaces are magnificently textured with a homogenous roughened surface to obtain a closer physiological relationship between the surrounding soft tissues and the interfaces of the blades.

Figure 39 shows some of the newer designed blades.

Single Tooth Implants



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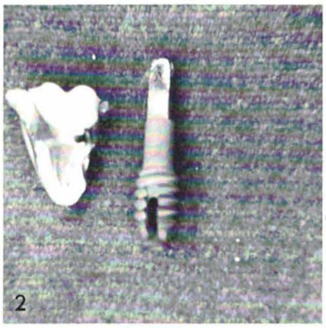

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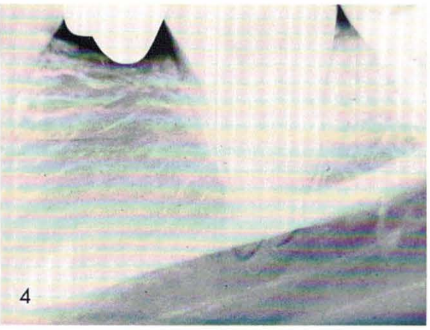

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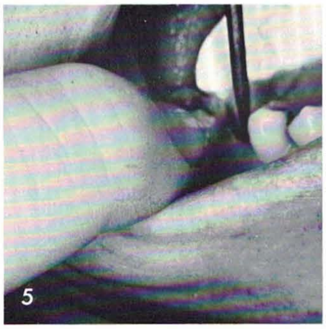

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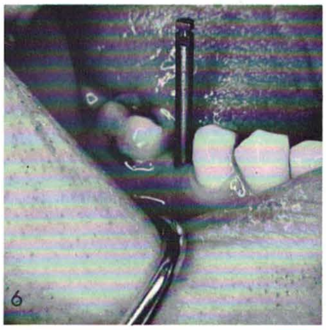

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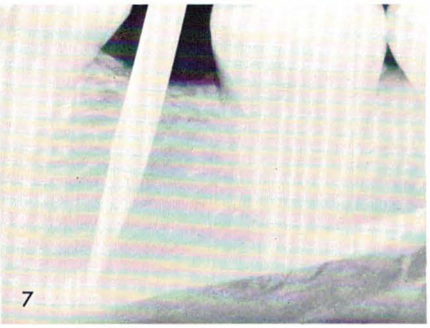

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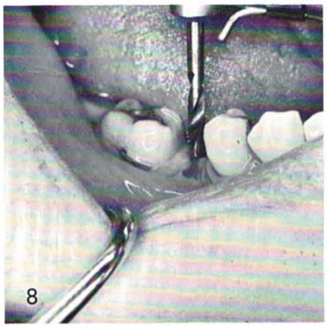

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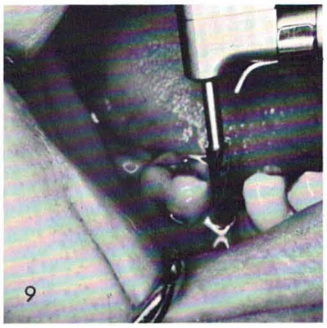

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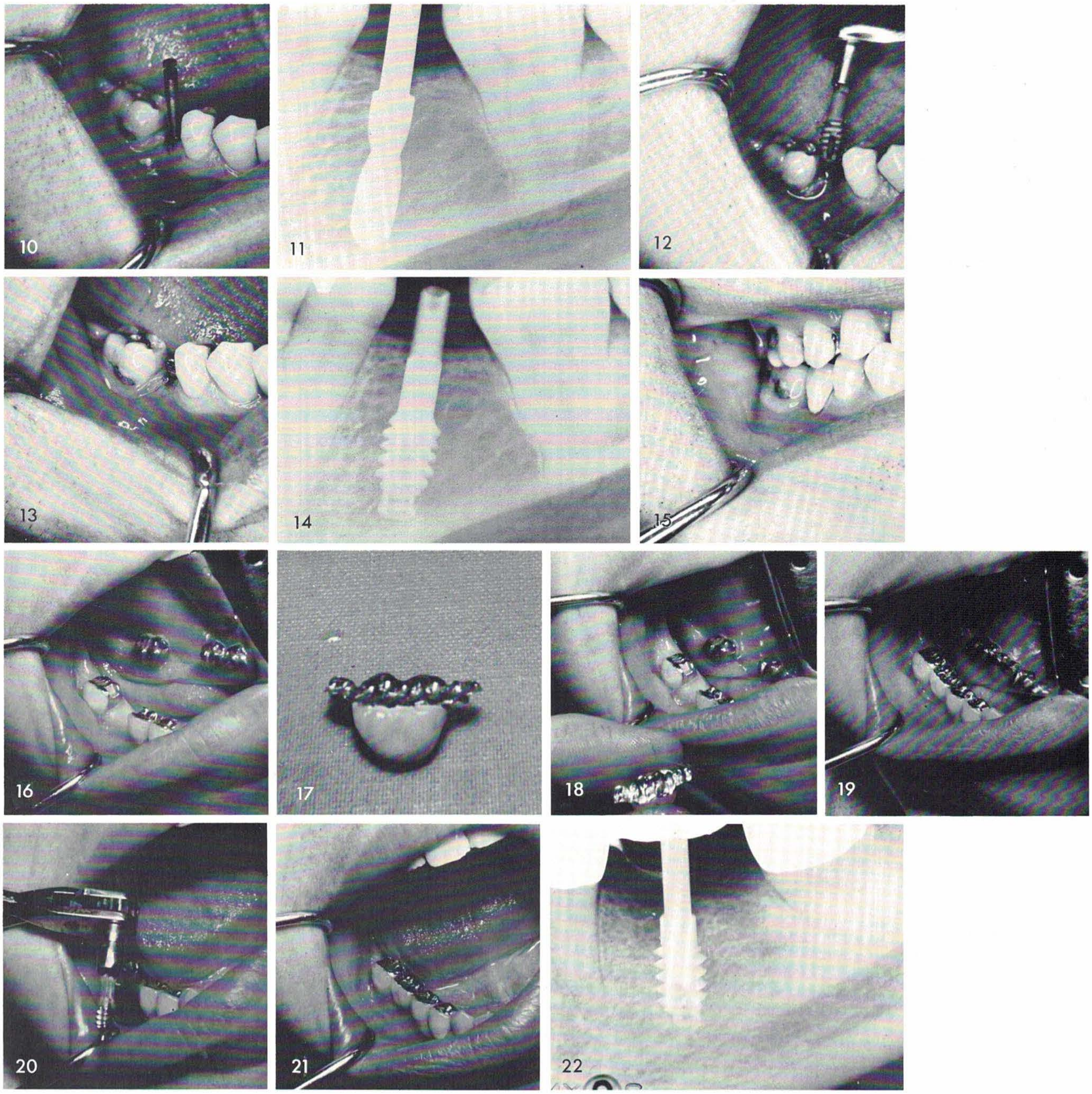
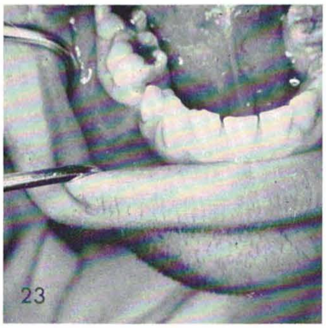
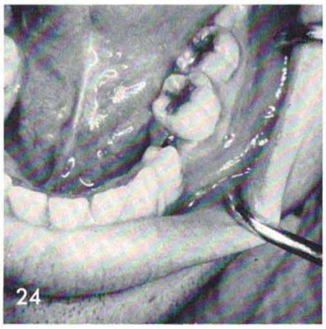
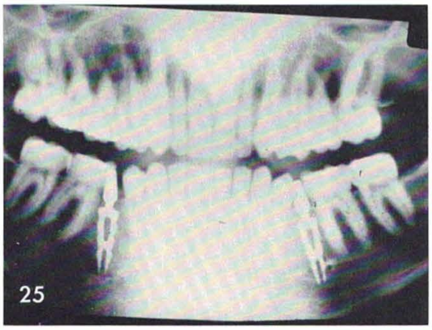
In posterior quadrants when only a single tooth was missing, fig. 1, the author originally used the Linkow "vent-plants" with a considerable amount of success. To prevent the screw implant from loosening during the early catabolic stages of bone metabolism the crown was fabricated prior to implant insertion. The crown always included a deep mesial and distal occlusal rest or lingual clasps to help stabilize it. Figure 2 shows the prefabricated crown and vent-plant imploded with aluminum oxide. The crown was then fitted into position and ground into proper occlusion prior to the insertion of the implant, fig. 3, and radiographed, fig. 4. Figures 5, 6, 7 show the preparation of the socket with an entering type bur. Figures 8-11 show the drilling into the bone with various sized bone burs to widen it just slightly smaller in diameter than the vent-plant, fig. 12, which made its own threading into the bone as it was of a self-tapping type. Figures 13 and 14 show the vent-plant in its proper position in the bone and the final periapical film showing its actual depth. The crown was then immediately cemented over the implant for immediate stabilization, fig. 15.

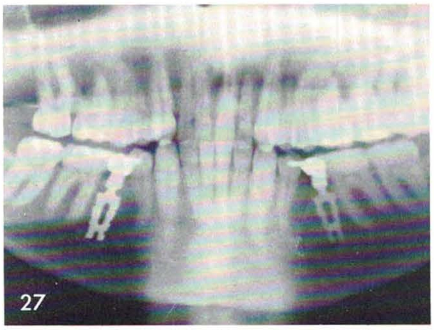


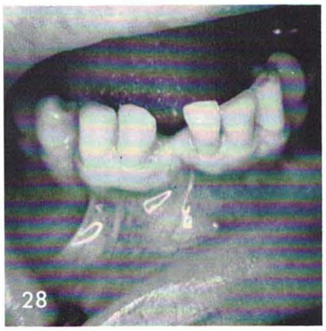
When existing bridgework is present, it becomes easier to prepare deep rest seats into the gold work, fig. 16. In this particular situation the solder joints broke on both sides of an existing pontic thus creating the space. An impression of the edentulous space and the rest seats were taken and a prefabricated crown with two deep rests was fabricated, fig. 17, and fitted into position, figs. 18, 19. With a hand ratchet the vent-plant (here seen with a Dacron sleeve) fig. 20, was screwed into position. Figs. 21 and 22 show the final cementation of the crown and post-operative periapical film.

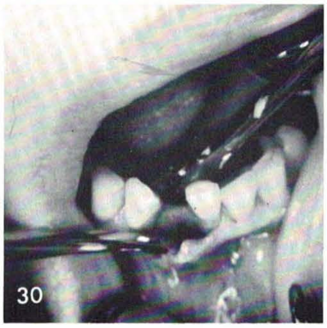


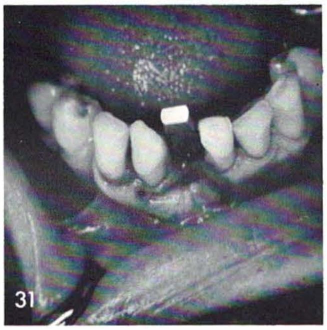


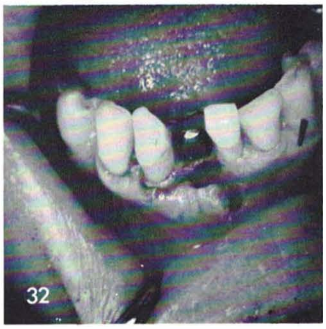












With the advent of the endosteal bladevent implants most screws and pin type implants disappeared from the implant scene. Fig. 23 shows the edentulous areas and figs. 24, 25 the healed, bladevents and x-ray respectively. Fig. 26 shows a five and one half year post-operative clinical view of the two bicuspid crowns with lingual extensions to resist lateral thrusts of the tongue and fig. 27 shows a five and one half year panoramic x-ray showing no bone loss.

A single anterior missing mandibular tooth usually allows a very deep single bladevent to be inserted since there are no vital areas to be concerned about. Figs. 28 and 29 show the edentulous area and the one tooth removable prosthesis the patient had to cope with. The tissues were incised and reflected, fig. 30, and the bladevent was tapped into a prepared groove, figs. 31, 32, and the tissues sutured closed, fig. 33. Fig. 34 shows the healed tissue around the blade and figs. 35 and 36 show the final cementation of the single crown with lingual rests.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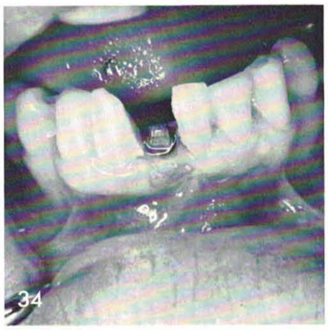
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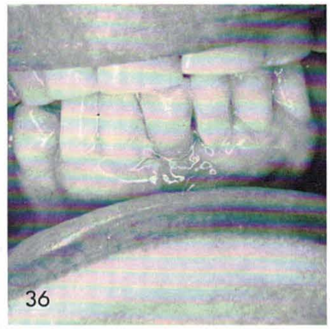
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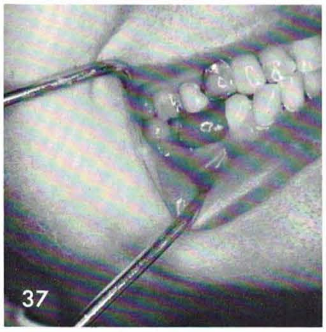
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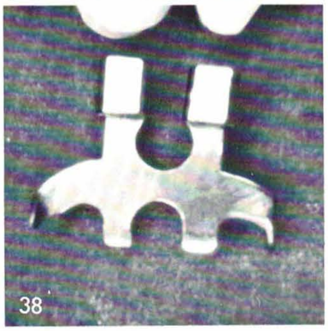
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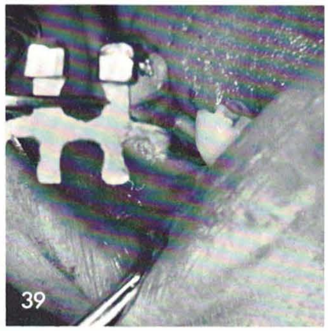
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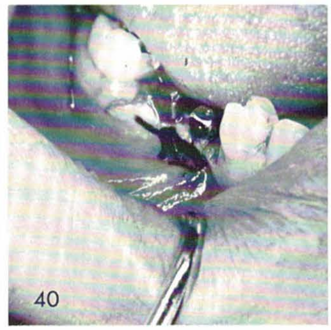
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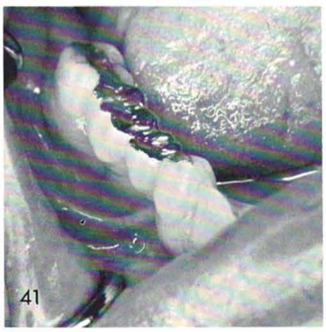
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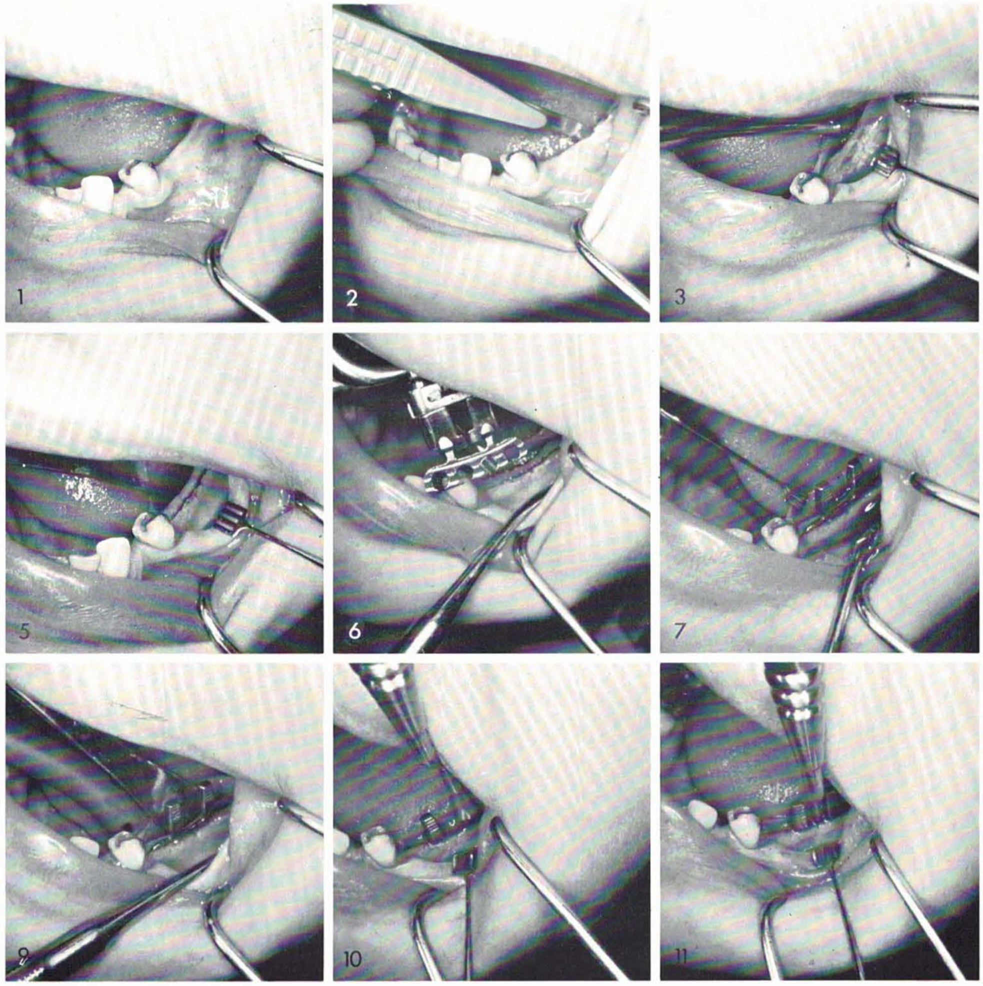
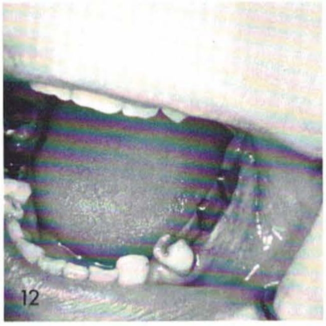
Sometimes in very wide ridges where two teeth instead of only one were missing, fig. 37, a groove was made into the bone with a mesial and distal accessory groove that curved at opposite angles buccally and lingually to the main groove. A specially designed double posted bladevent with the proper buccal and lingual bends was used, fig. 38, and fitted into the "atypical" groove, figs. 39, 40. A two unit veneer bridge with a mesial and distal rest seat was then cemented with hard cement, fig. 41, and a post operative radiograph taken, fig. 42.

Blade Technique



A patient with a unilateral posterior edentulous area presents herself, fig. 1. With a #15 disposable scalpel, the incision is made and the tissues are reflected to expose the underlying bone, figs. 2, 3.

With a #700 XL fissure bur with a water spray the groove is made, figs. 4 & 5. The blade is carried to the groove and the body of the blade is adjusted to fit into the groove passively, figs. 6 & 7. With the inserting instrument the blade is tapped until a solid sound is heard, figs. 8 & 9. Sometimes if the blade is not buried deeply enough a single headed inserting instrument can rock the implant into position, fig. 10. Sometimes, also, it is necessary to use the shoulder set point instrument, fig. 11, until the implant is properly buried, fig. 12. A tissue punch sometimes is used to prevent "crimping" of the soft tissues around the blade posts when suturing, figs. 13, 14.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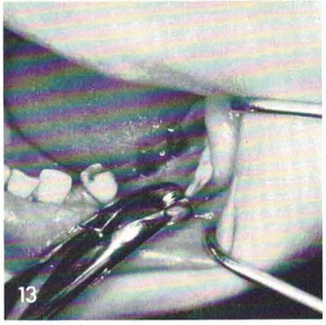
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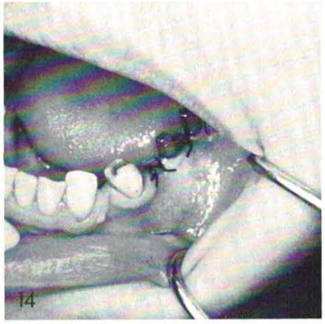
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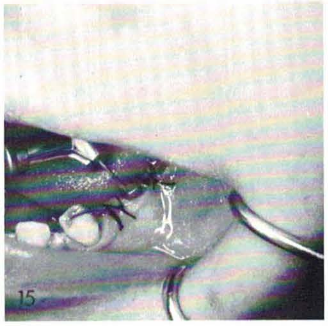
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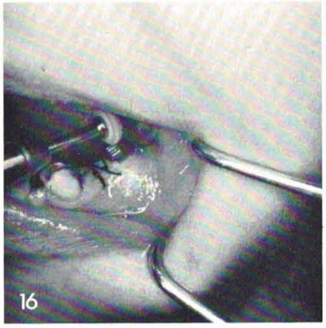
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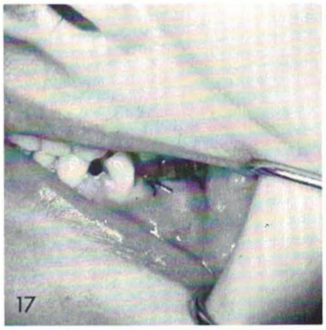
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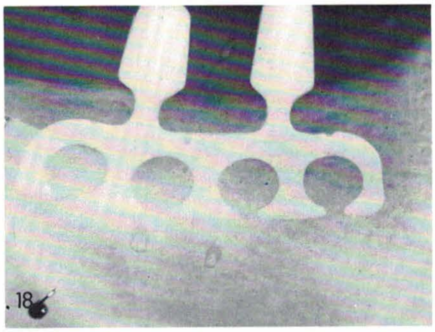
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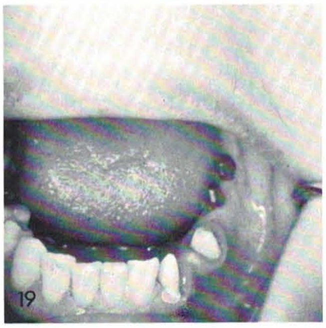
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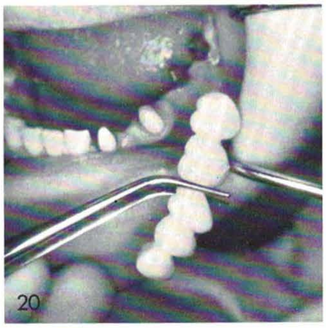
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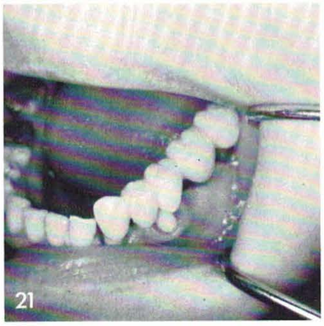
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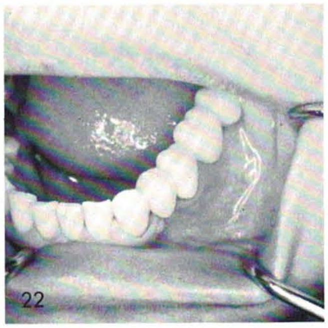
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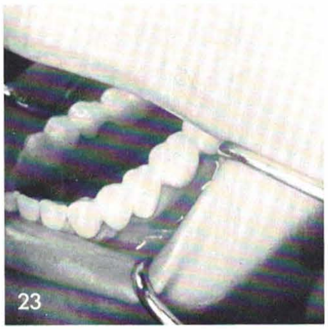
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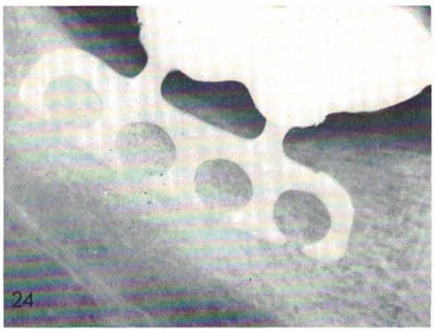
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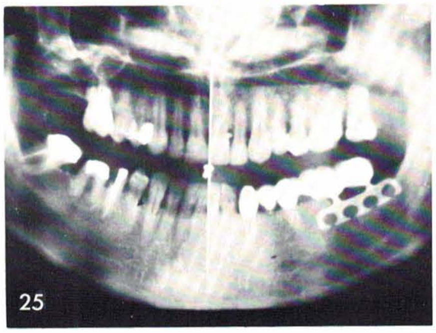
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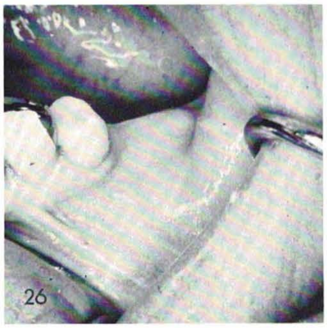
Before the patient is dismissed, be certain to remove enough of the occlusal surfaces of the blade posts as possible to allow enough room for the fixed prosthesis, fig. 15. Be certain to smooth off all line angles of the posts with a rubber wheel so that the tongue will not be injured, figs. 16, 17.

An immediate post operative periapical x-ray is taken, fig. 18.

Healing is uneventful, fig. 19, and steps are taken to complete the fixed prosthesis, fig. 20. It must not be forced into position, fig. 21, but rather it must fit passively, fig. 22, and the lingual and buccal embrasures must be wide for proper oral hygiene, fig. 23.

X-rays of the bridge and implant in place are then taken, figs. 24, 25.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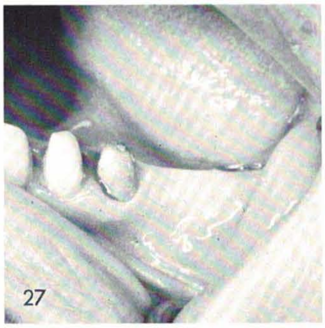
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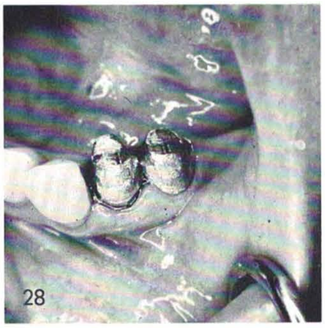
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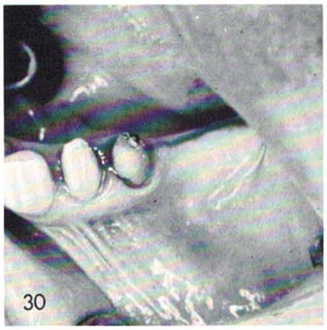
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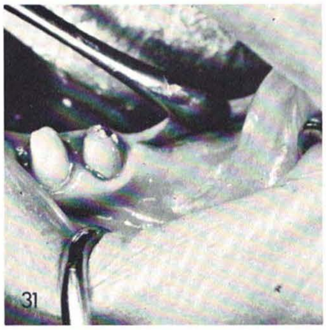
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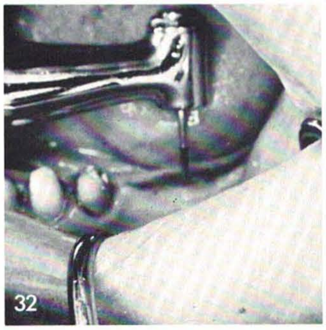
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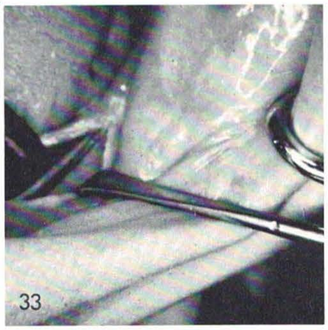
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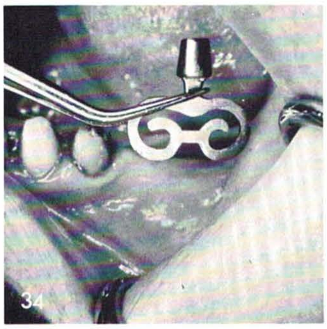
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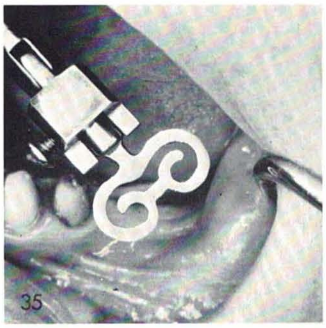
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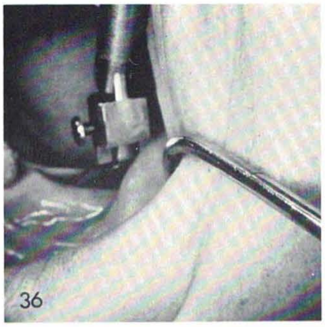
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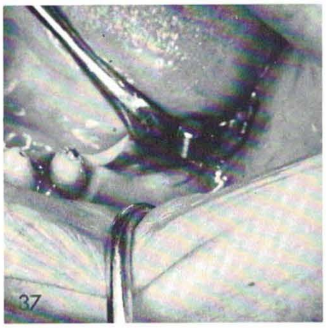
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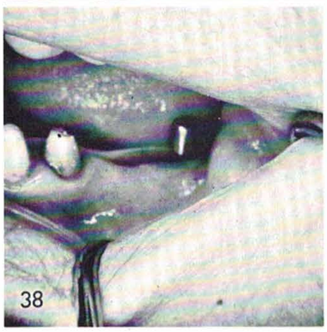
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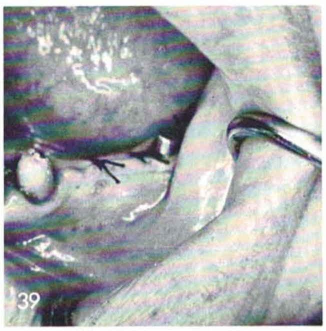
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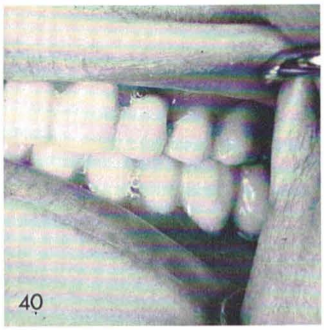
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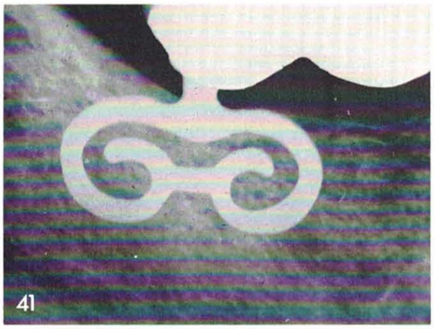
For beginners, however, before the implant is inserted, the natural teeth abutments that will act as the anterior supports must be prepared and the castings fabricated, figs. 26, 27, 28, so that there will be a minimum amount of time elapsing from the moment the implant is inserted until the final prosthesis is cemented—3 to 6 weeks is ideal.

The incision is made, figs. 29, 30, and the tissues retracted, fig. 31.

The groove is made with the #700 XL bur, figs. 32 & 33. The bladevent is fitted into the groove, figs. 34, 35, 36, and tapped to its proper depth, figs. 37, 38.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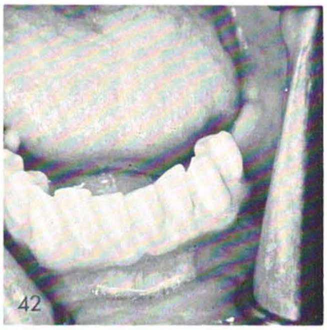
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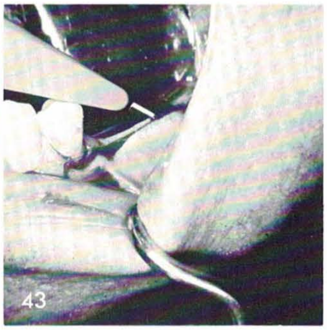
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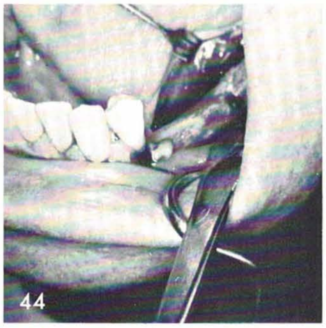
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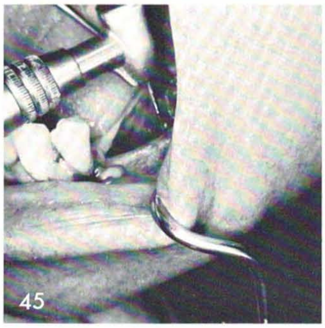
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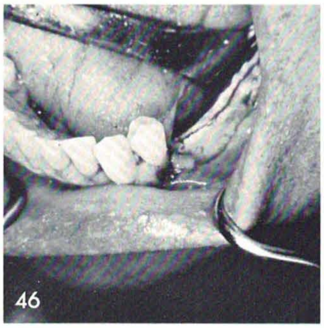
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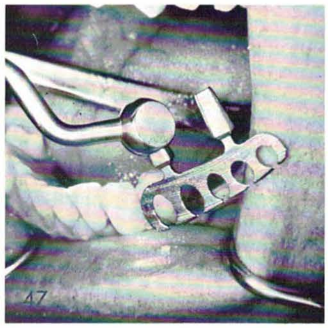
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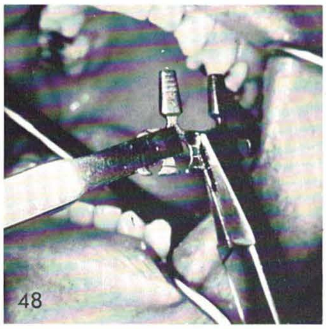
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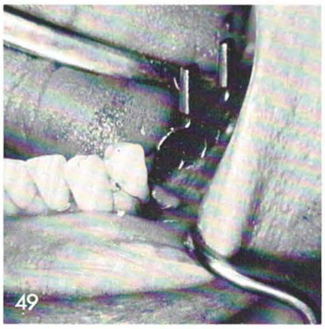
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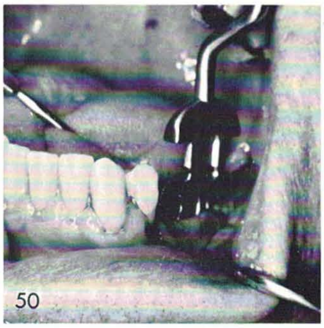
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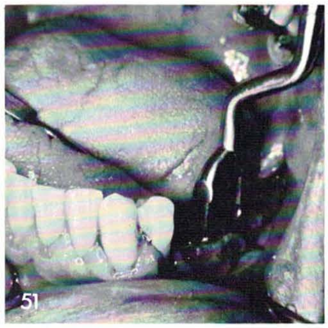
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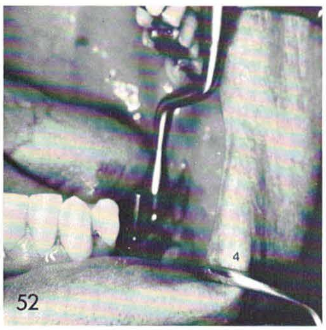
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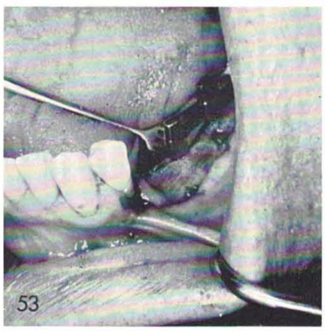
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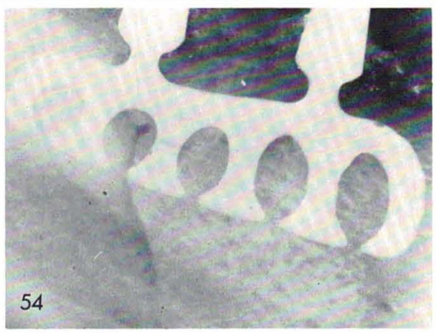
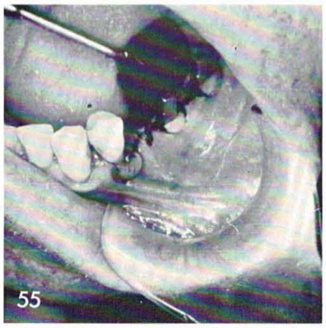
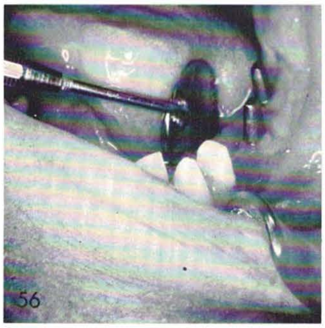

54

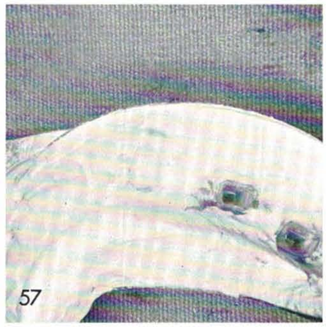
The tissues are sutured, fig. 39. The final prosthesis is cemented after healing, fig. 40, and a periapical radiograph is taken, fig. 41.

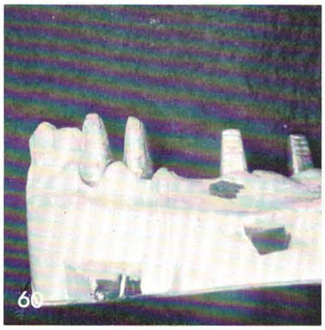
In extremely knife edge ridges, care must be taken in incising and reflecting the tissues, figs. 42, 43, 44. Even more care must be made in making the groove, being careful not to perforate the lingual or buccal plate of bone, figs. 45, 46.

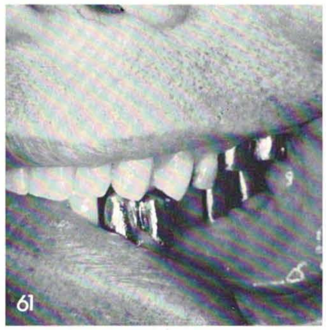
The insertion and tapping of the blade is extremely important and must be done with tender care to prevent fracturing the bone flanking the groove, figs. 47, 48, 49, 50, 51, 52, 53. An x-ray is taken, fig. 54. The tissues are sutured closed, fig. 55.

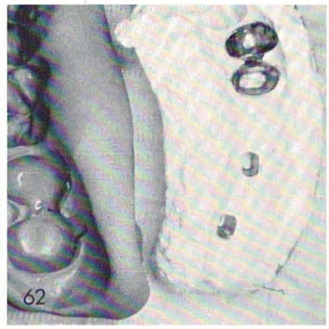


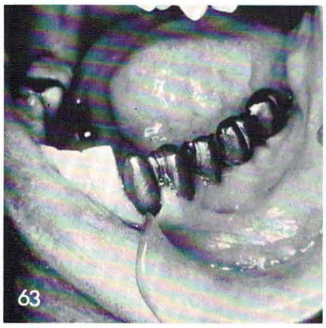


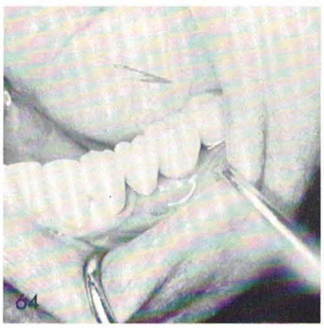


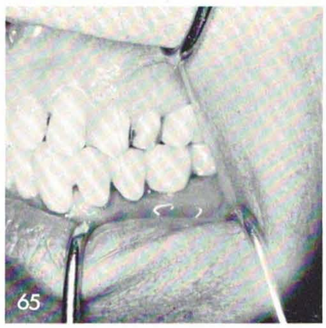


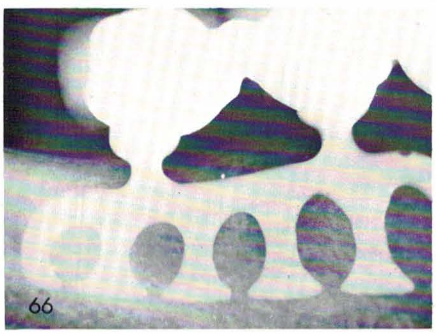






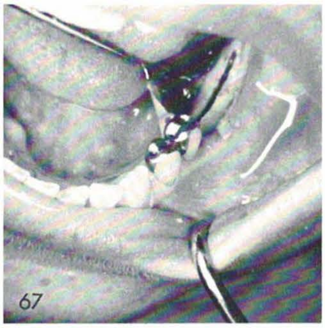






After healing, fig. 56, plastic copings (manufactured to fit over the blade posts) are often used and picked up with a plaster impression, fig. 57, and manufactured die pins are placed inside them, figs. 58, 59, and the master model is poured, fig. 60.

Gold copings are fitted over the natural teeth abutments and the implant abutments, fig. 61, and an interocclusal record of centric relationship and a plaster index are taken, fig. 62. The soldered castings are fitted in the mouth, fig. 63, and the completed bridge is fabricated and cemented into position, figs. 64, 65. Final x-rays show the implant, fig. 66.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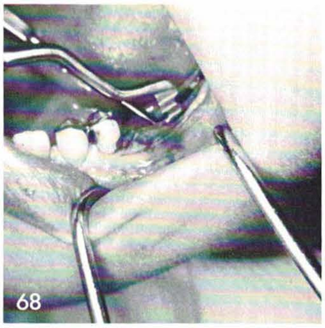
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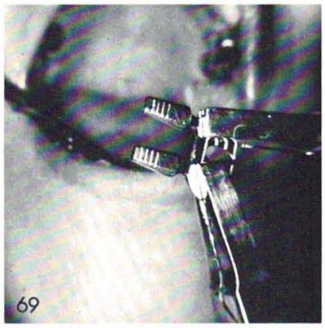
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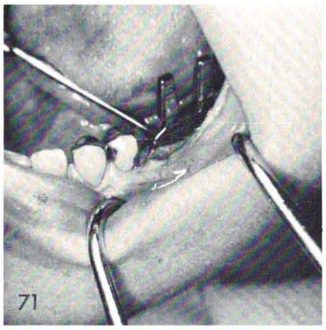
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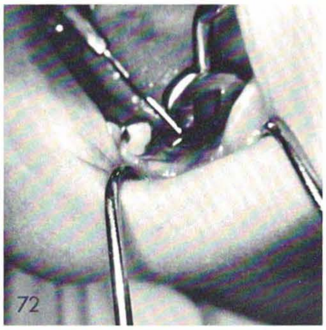
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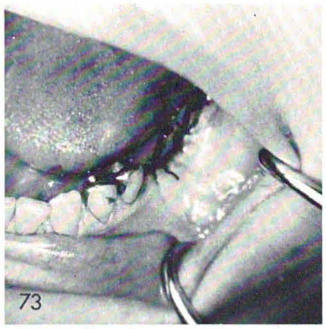
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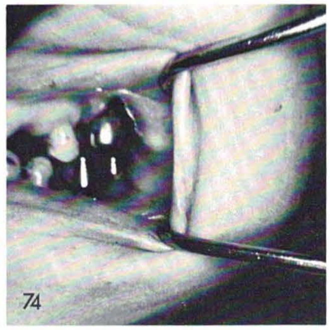
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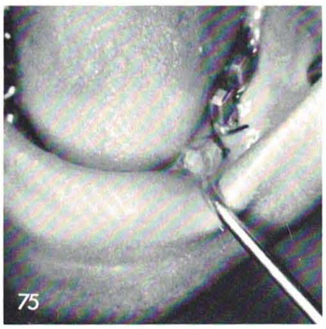
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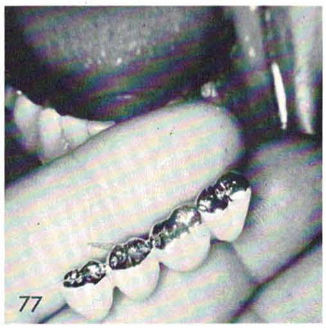
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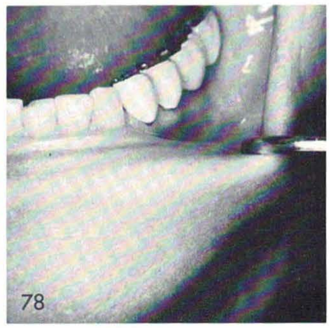
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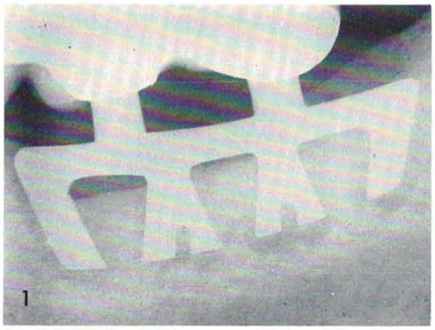
79

Another case shows how clean and concise the groove must be, fig. 67. A special depth guage instrument is used to check the entire depth of the groove, fig. 68. The properly designed and sized blade is bent with two titanium tipped pliers so that it will fit passively into the groove, fig. 69. It is carried with a carrying instrument, figs. 70, 71, to the groove, and tapped into position, fig. 72, and then sutured, fig. 73. The interocclusal clearance is carefully checked before sending the patient home, fig. 74. Sometimes, at the same visit plastic copings are inserted over the posts, fig. 75, to more rapidly fabricate the final prosthesis. After sufficient healing, fig. 76, the completed partial bridge is cemented in position, fig. 77, 78, and a final x-ray is taken, fig. 79.

Unilateral and Bilateral Blades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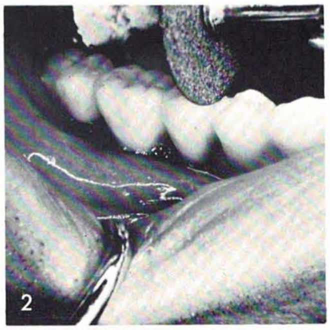
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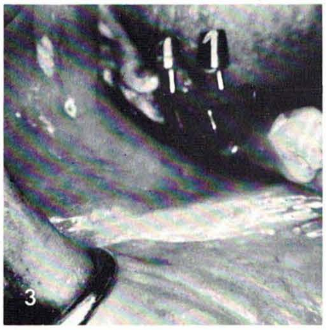
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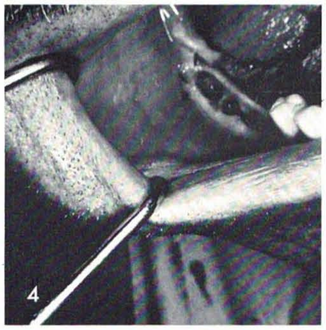
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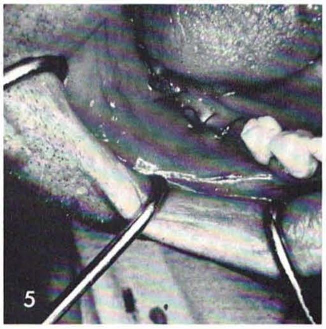
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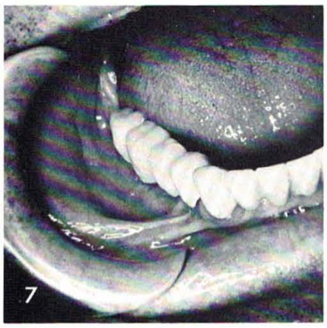
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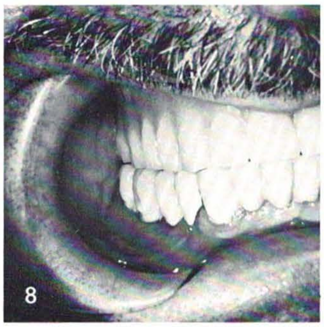
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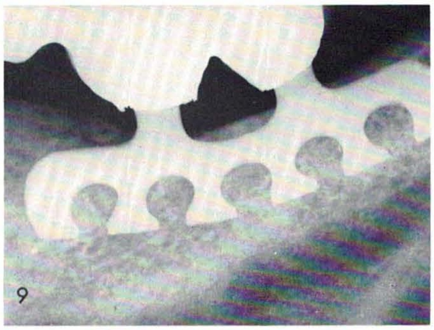
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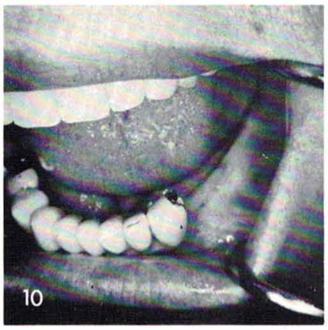
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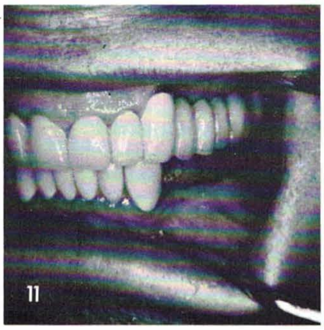
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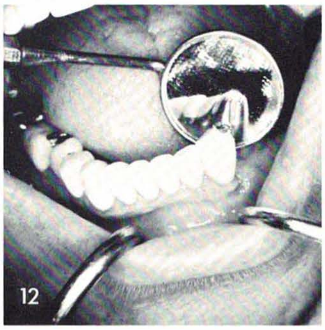
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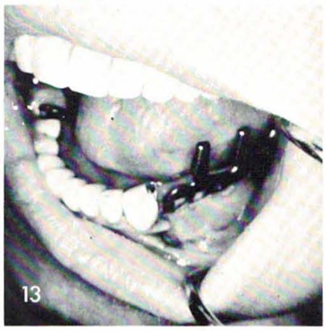
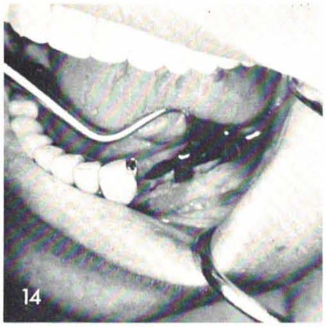

13

When a bladevent is failing, fig. 1, the bridge can be usually disked off, allowing a cantilevered pontic, fig. 2, to remain attached to the anterior portion of the prosthesis. The failing implant is removed, fig. 3, and the socket is thoroughly cleansed of all granulation tissue, fig. 4, and the tissues are sutured closed, fig. 5. Three to six months later after the sockets fill in with new bone, another bladevent is inserted, the cantilevered pontic is prepared for a telescopic coping and a new fixed prosthesis is fabricated, fig. 6, and cemented, figs. 7, 8. A post-operative radiograph reveals the second implant in the original implant site, fig. 9.



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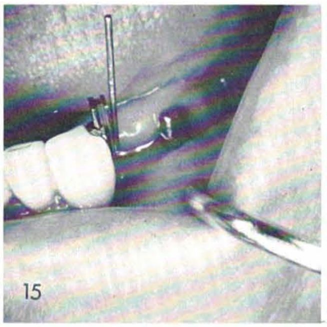

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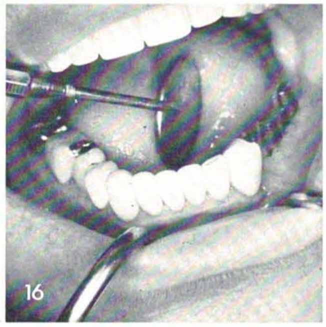

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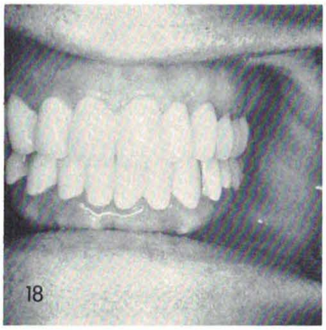

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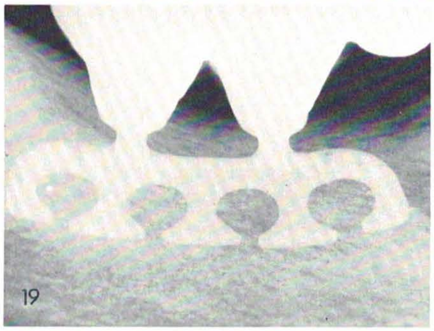

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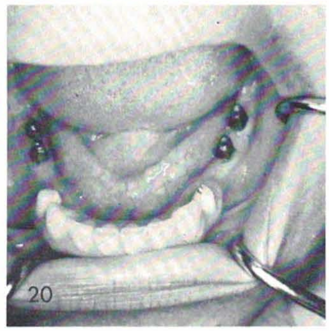

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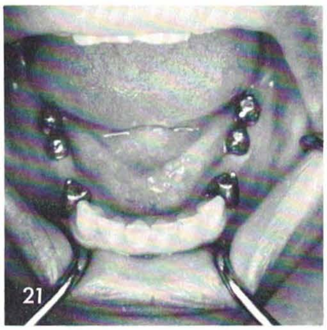

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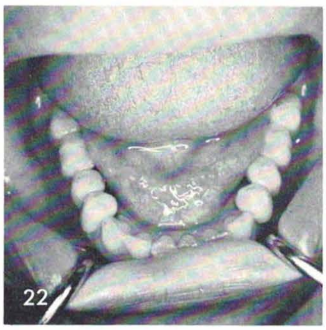

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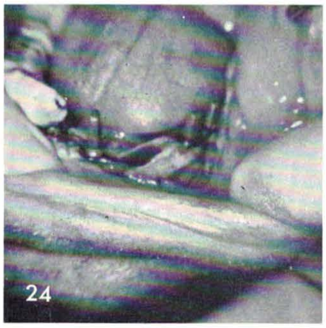
23

Very often, patients who were wearing precision attachments, figs. 10, 11, 12, chose a blade implant, figs. 13, 14, with either the existing male attachment from the original removable denture or as in this case, a new one, since the original one broke, fig. 15, to be used as the anterior support for a fixed bridge not involving the original anterior bridgework. The male attachment was adjusted in height, plastic copings were inserted over the blade posts, fig. 16, and picked up with a plaster index, fig. 17. The final unilateral fixed prosthesis was then cemented into position using the male precision attachment anteriorly and the double posted blade posteriorly to support the fixed rather than removable prosthesis, fig. 18. Fig. 19 shows the post-operative radiograph.

When the bone supporting the natural teeth is excellent as well as the bone in the edentulous areas, and the edentulous span is not too long, then only, a single tooth is necessary to act as the anterior support for a double posted blade, fig. 20. Individual castings are sometimes fabricated, fig. 21, prior to final completion of the bridgework, fig. 22. Fig. 23 shows the final panoramic x-ray.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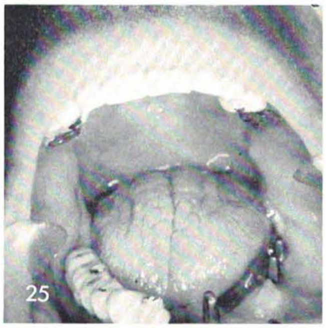
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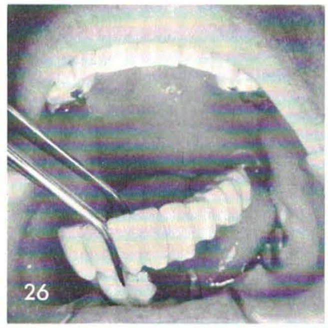
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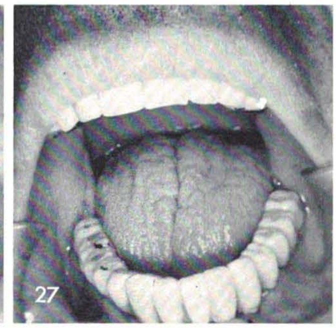
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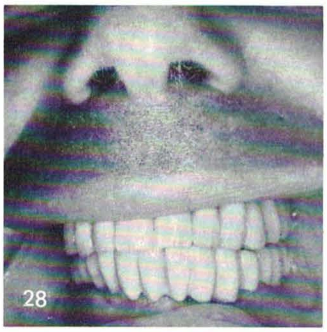
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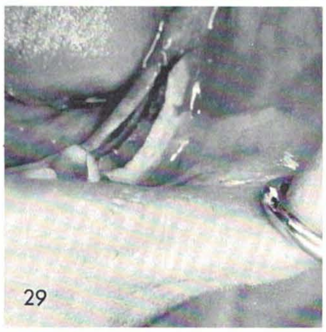
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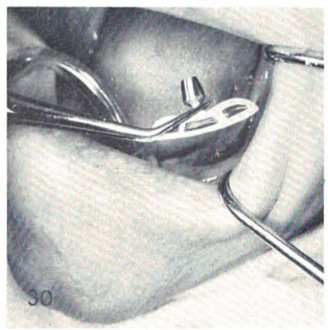
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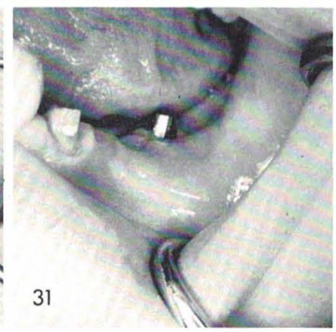
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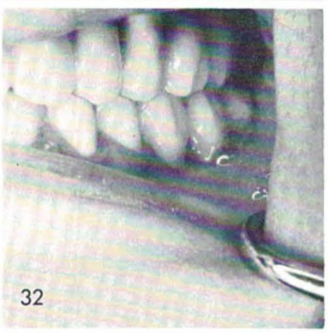
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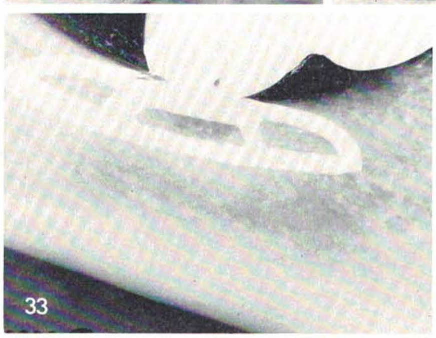
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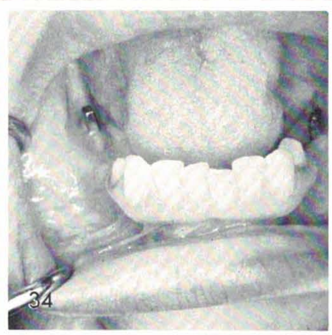
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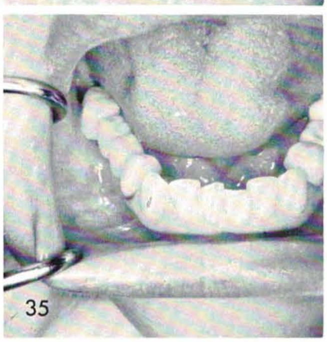
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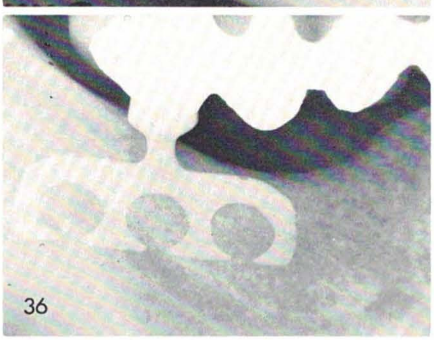
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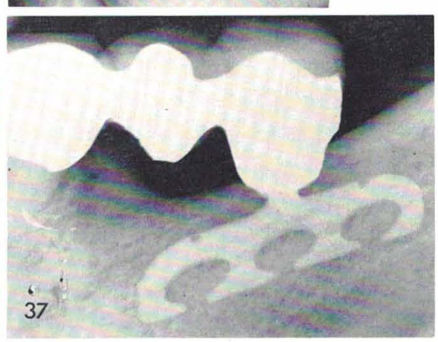
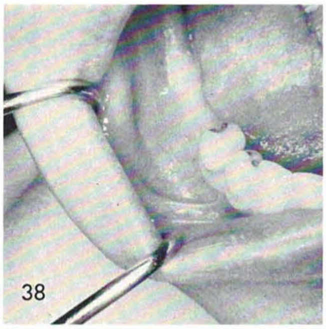
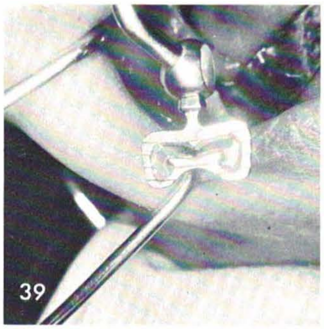
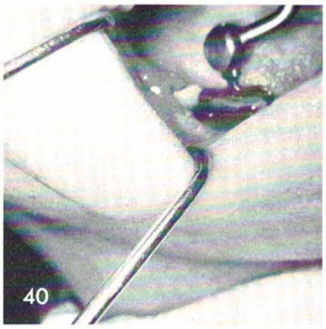
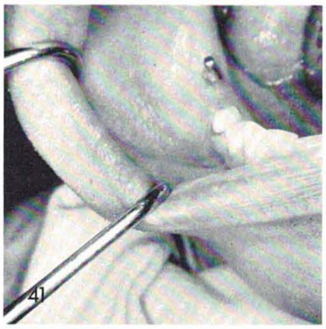

37

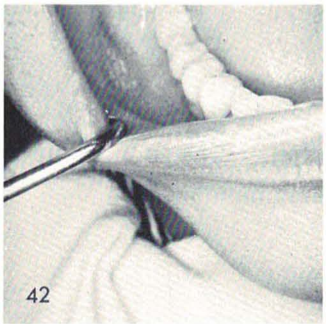
Saving an already functioning prosthesis where some of the abutment teeth had to be extracted is often possible by preparing the remaining cantilevered pontic for a telescopic coping, inserting the implants, figs. 24, 25, and completing the bridge, figs. 26, 27, 28. In grooving a ridge that is shallow and knife edged, great care must be taken not to fracture or perforate the bone nor to penetrate the canal, fig. 29. A very shallow blade that has a long mesio-distal length is used, fig. 30, to give adequate support against lateral thrusts of the tongue. After healing, fig. 31, the final prosthesis is cemented, fig. 32, and a final periapical x-ray is taken, fig. 33.

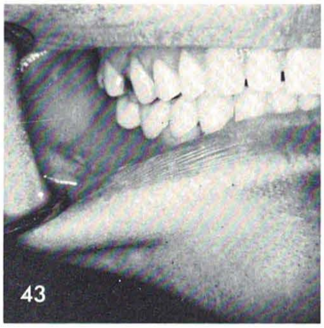


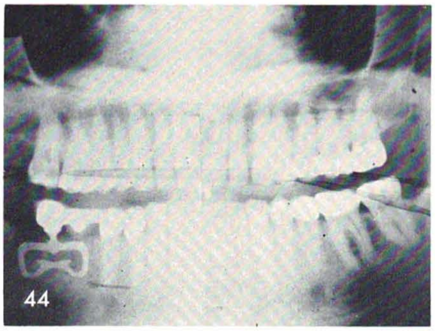


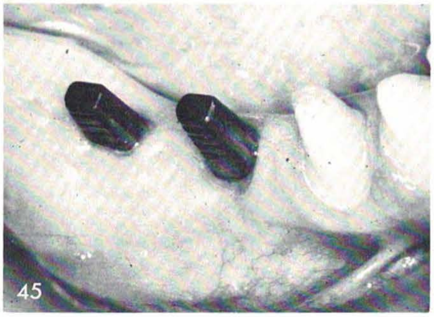


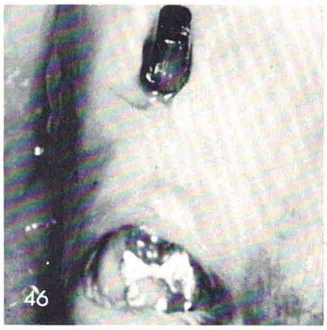


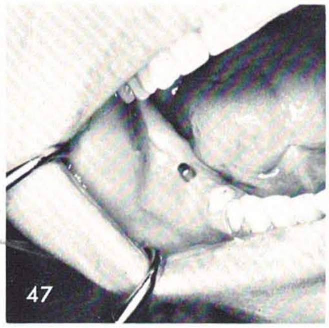












Sometimes also, in short spans that have knife edge ridges we are able to place into the bone smaller type bladevents, fig. 34, which serve well in supporting two unilateral fixed bridges, fig. 35. The radiographs show the well placed blades, figs. 36, 37.

Most often, however, two anterior abutment teeth are used, rather than one for anterior support for a fixed bridge, figs. 38 through 43. A panoramic x-ray shows the completed case, fig. 44.

Parallelism of the blade posts with the anterior abutment teeth is necessary for passive insertion of a fixed partial prosthesis, figs. 45, 46.

In order to acquire the proper inter-occlusal relationship with the opposing teeth, it must be decided whether a double posted blade or, as in this case, a single posted bladevent, should be used, fig. 47.

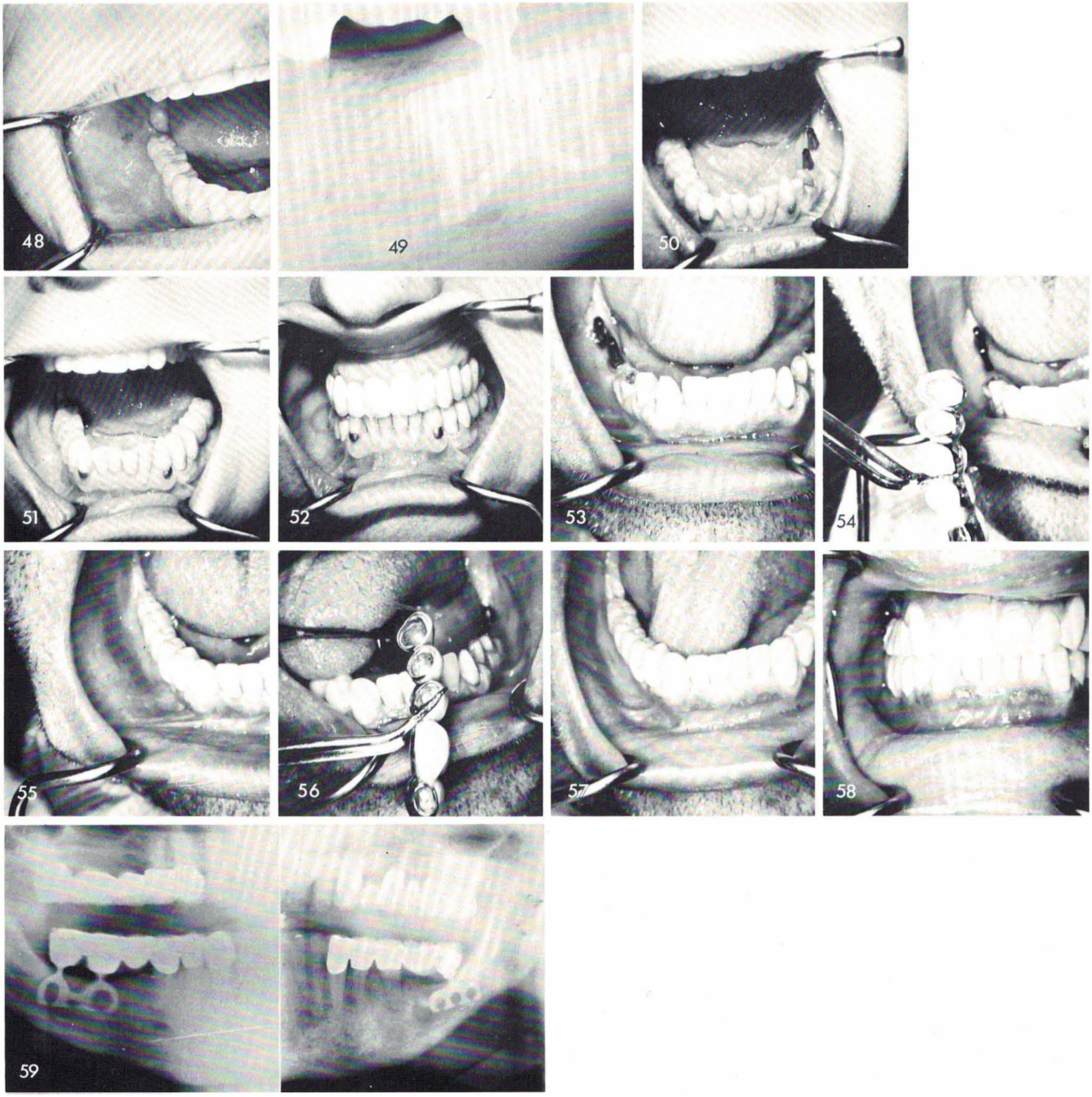
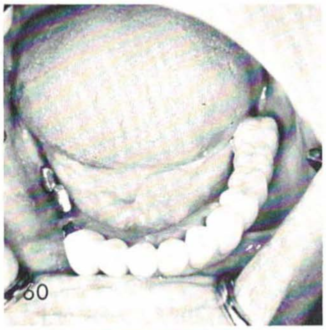


Fig. 48 shows the completed case and fig. 49 shows the post-operative x-ray.

This case required a double posted bladevent, fig. 50, in order to obtain proper occlusion with the opposing teeth, fig. 51, 52.

Very often it is necessary, due to esthetics, or slightly weaker bone support, to use three anterior tooth abutments rather than one or two for a long term success, fig. 53. The completed partial fixed bridges are fitted and cemented into proper position, figs. 54 through 58. A final panoramic x-ray shows both posterior blades to be below the canal. However, being that the grooves were made well on the lingual side of the ridge, no parasthesias can be expected, fig. 59.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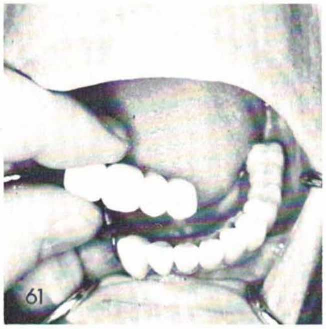
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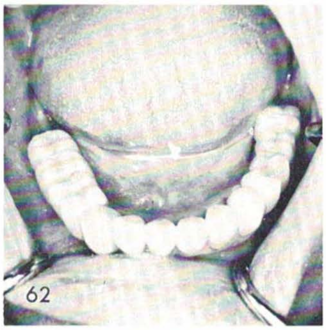
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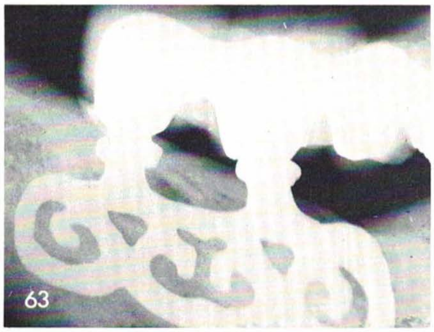
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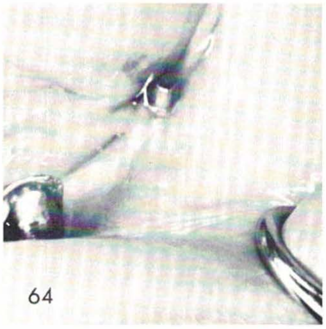
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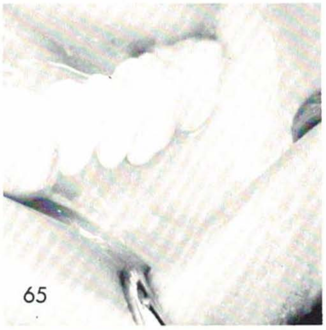
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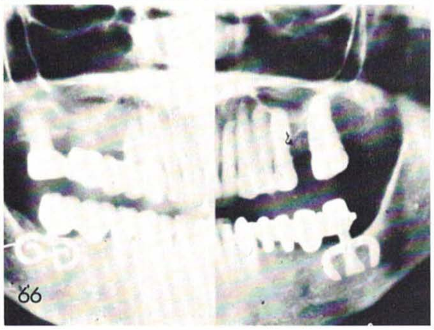
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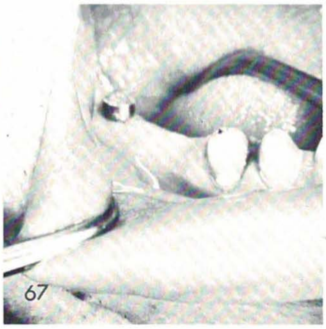
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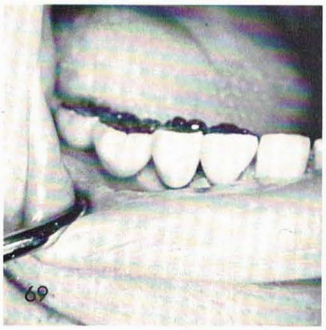
68

A three quarter fixed prosthesis was fabricated for this patient with a cantilevered pontic extending distally from the right cuspid crown. The bridge was cemented permanently while the sockets from two extracted teeth on the right side had three months to heal. A double posted blade was then tapped into a groove made in the healed bone, fig. 60, and a four unit fixed prosthesis was cemented into position using the cantilevered pontic as anterior support, figs. 61, 62. Doing it in this manner allows the bladevent to resist bucco-lingual movements far greater than if an isolated unilateral fixed bridge were to be made. Fig. 63, shows the final x-ray.

Occasionally, when excellent bone support exists both in the edentulous area and around a remaining cuspid tooth, even though the span is greater than usual, a blade can be used as posterior support, fig. 64, with just the cuspid for support anteriorly. With bladevents in the mandible the type of restoration makes no difference as to the overall success. Here is seen a porcelain-fused-to-metal fixed bridge, fig. 65, but gold veneer crowns or acrylic over gold crowns can also be used successfully. A final panoramic x-ray shows this case, fig. 66. Another case shows a single posted blade with two anterior abutments, fig. 67. However, a four unit acrylic veneer bridge was processed with gold occlusals, figs. 68, 69. Fig. 70 shows the final x-ray.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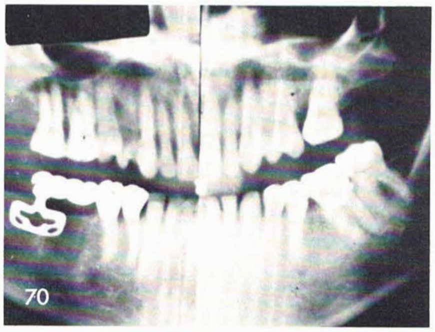
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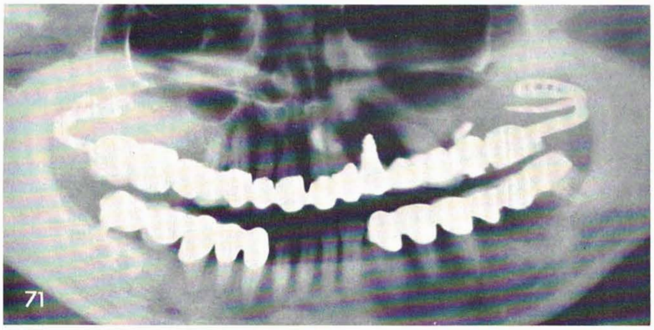
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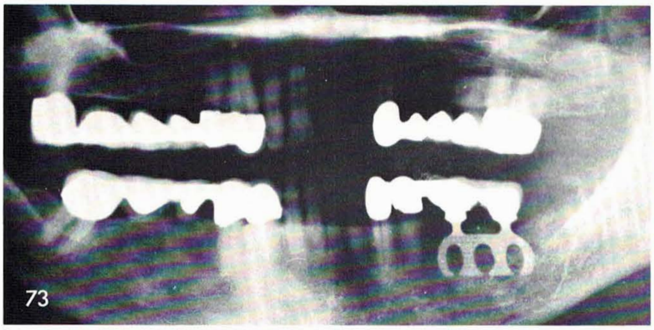
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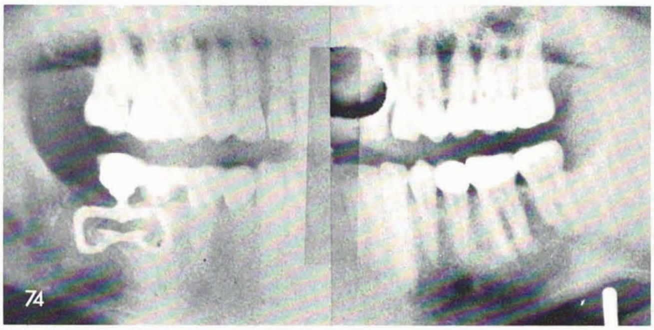
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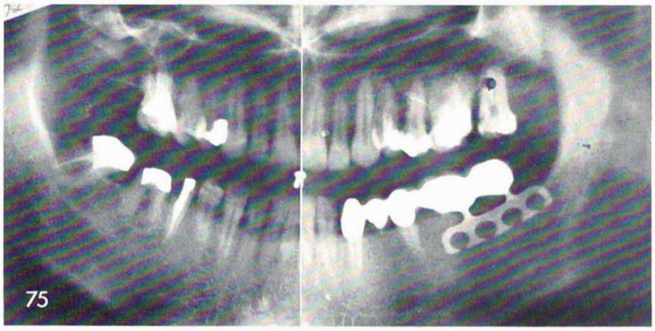
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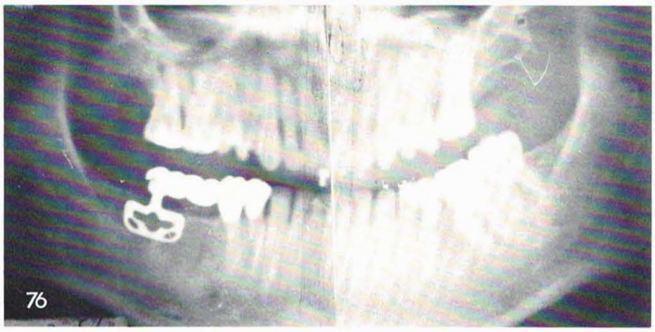
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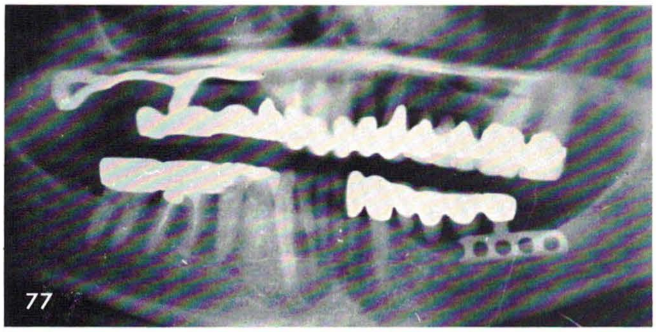
Fig. 71 through 86 show completed x-rays of unilateral and bilateral bridges and posterior blade supports.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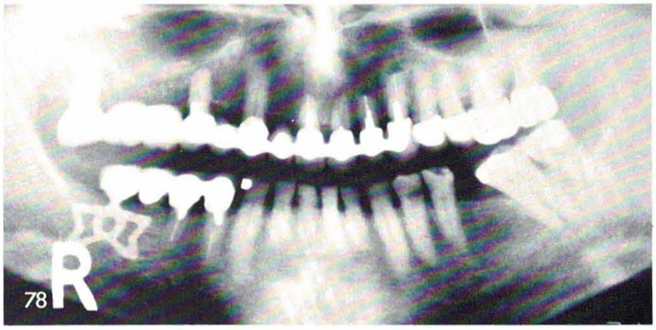
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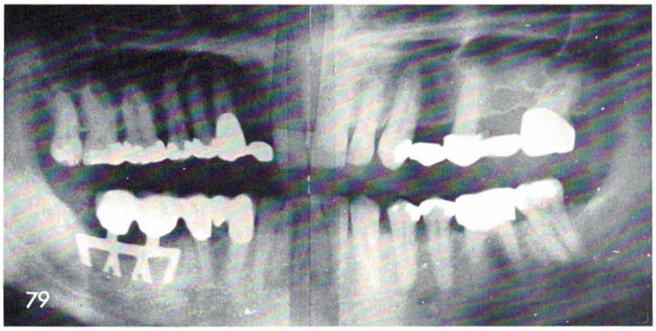
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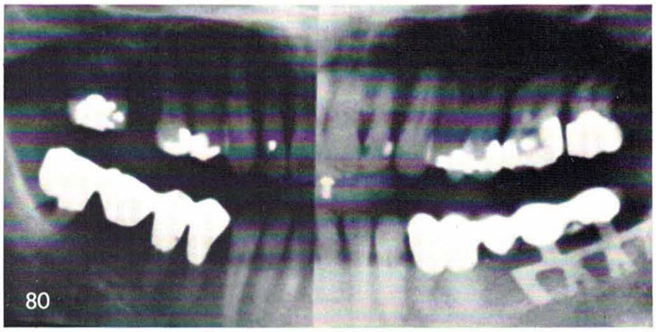
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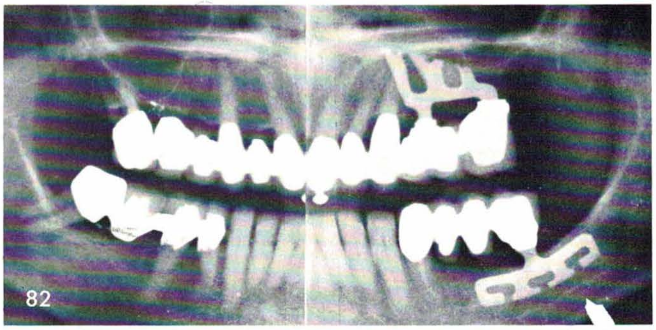
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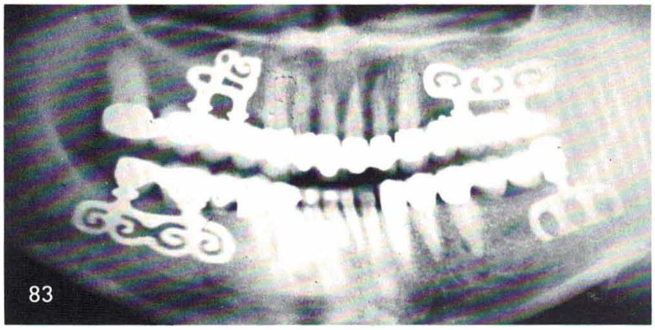
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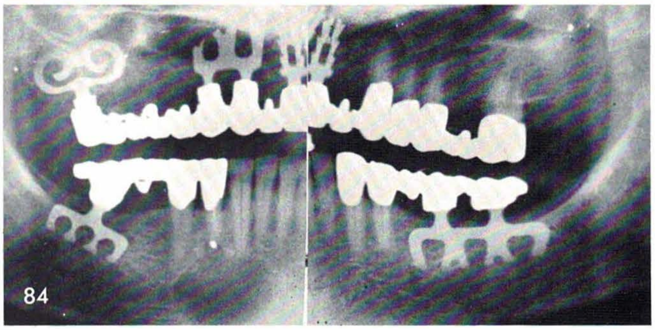
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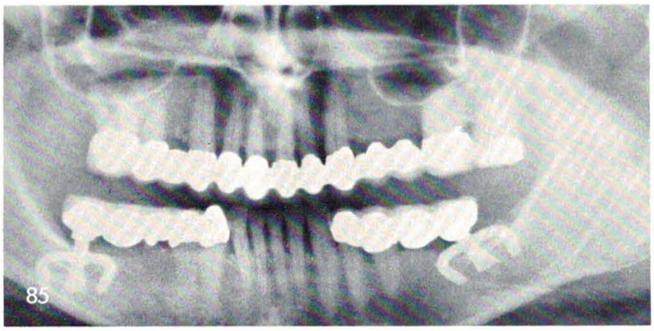
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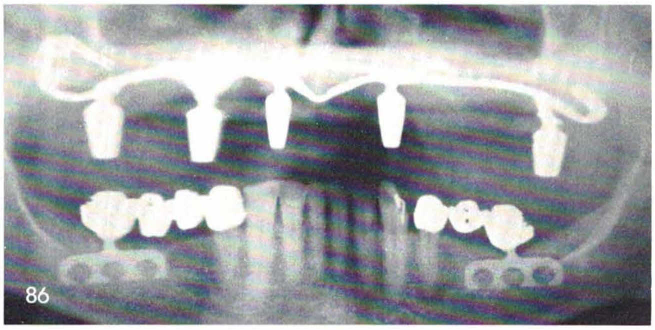
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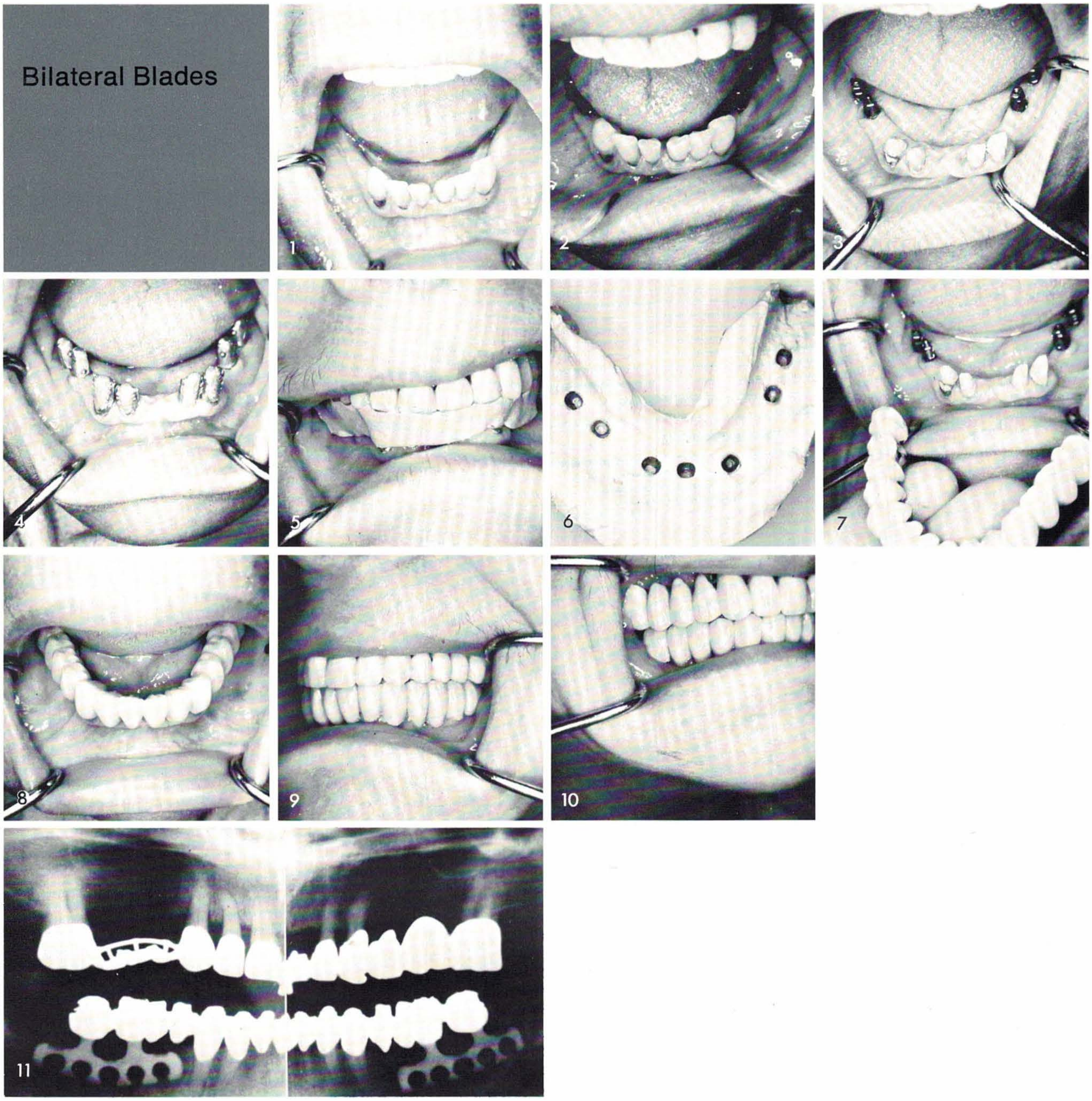
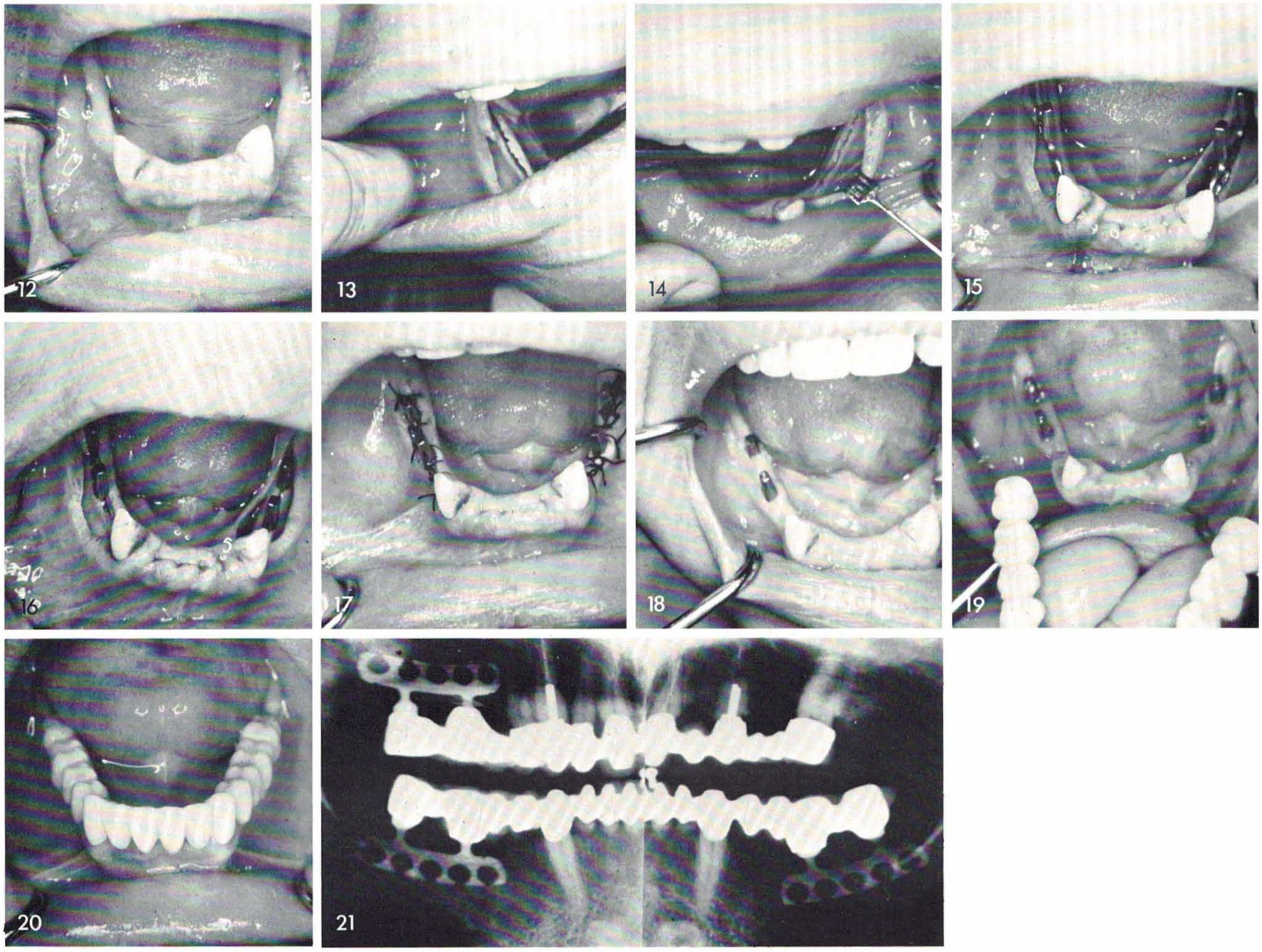
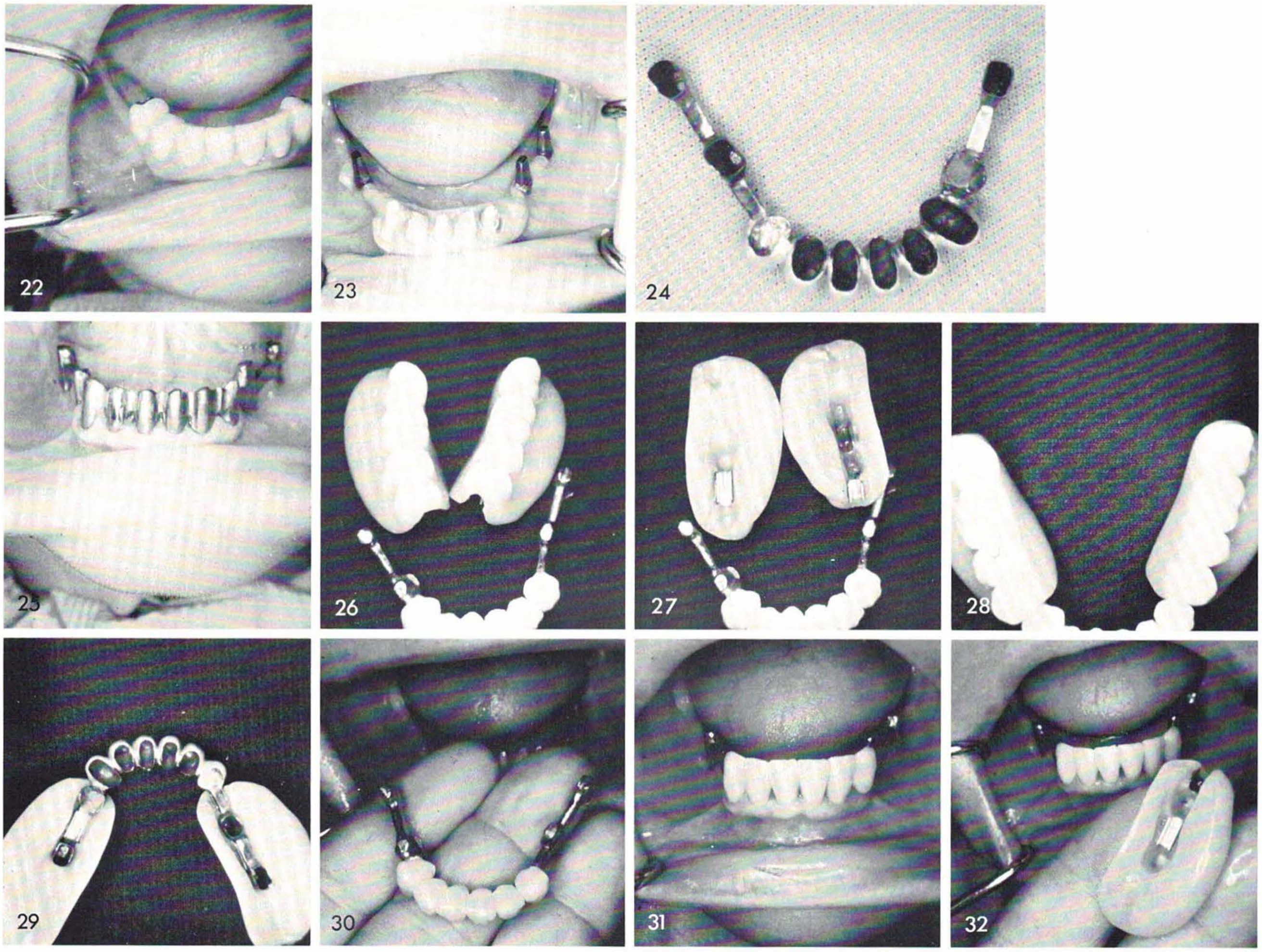
Bilateral Blades



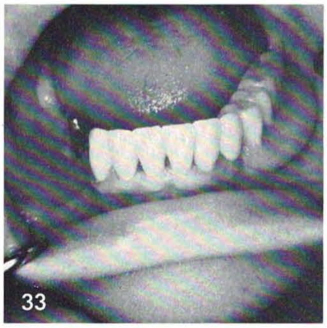
Often in bilateral posterior edentulous situations bilateral splinting becomes necessary. This case shows six remaining teeth with both central incisors being extremely loose, fig. 1. Fig. 2 shows the healed tissues around each double posted bladevent. The teeth were prepared for full coverage and both central incisors were removed, fig. 3. Castings were fitted, fig. 4, an interocclusal record of centric relationship was taken with Citricon, fig. 5, and the copings were picked up with a plaster index, fig. 6. The full arch fixed restoration was fitted and cemented into place, figs. 7, 8, 9, 10. A panoramic x-ray is taken post operatively, fig. 11.



When two cuspids are the only teeth remaining, a full arch restoration is usually obtainable providing the cuspids are well supported by bone, fig. 12. The grooves were made in knife edge ridges on both sides of the arch, figs. 13, 14; the blades were made to fit passively into the grooves, fig. 15, and carefully tapped to their proper depth, fig. 16. The tissues were closed with 000 silk sutures, fig. 17. Within ten days uneventful healing occurred, fig. 18. The teeth were then prepared and the bridge was completed, fig. 19, and cemented, fig. 20. Fig. 21 shows final x-ray.



This young female patient with five remaining teeth and two cantilevered pontics, one on each side, had a problem of facial esthetics, fig. 22. Both of her cheeks fell in drastically giving her a "Dracula" type of look. She also could not psychologically cope with her removable prosthesis. The remaining anterior teeth were prepared and a bladevent was implanted on both sides of the arch, fig. 23. A one piece casting was made to join the implants with the teeth, figs. 24, 25. The anterior portion was processed with porcelain restorations and two unilateral denture splints were made to snap over the horizontal bar and be implant borne only, figs. 26, 27, 28, 29.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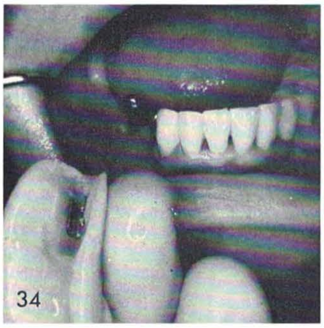
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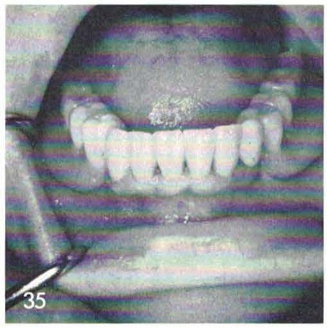
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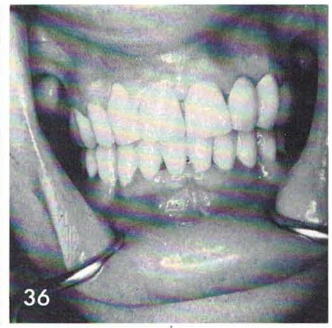
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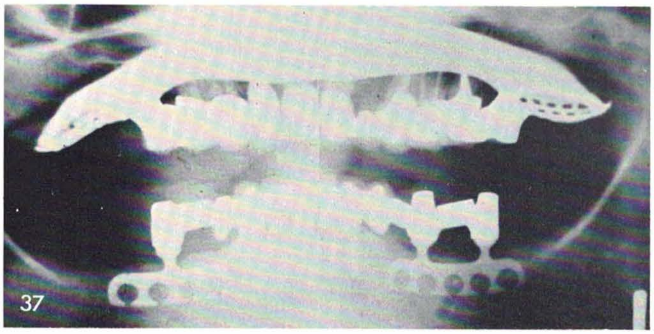
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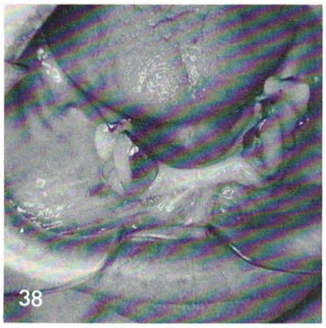
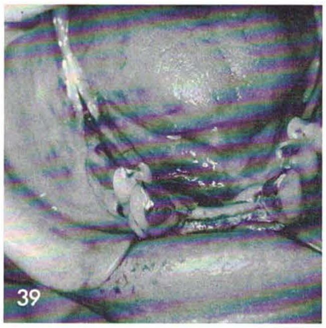
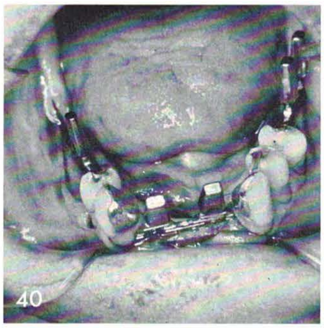
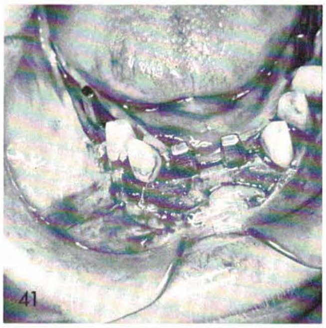
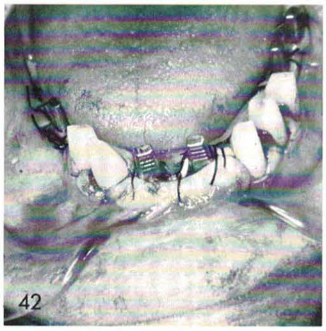
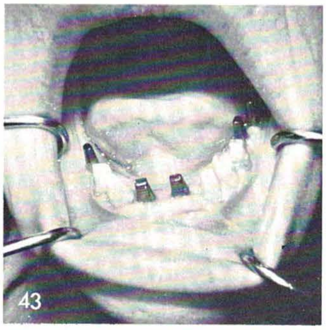
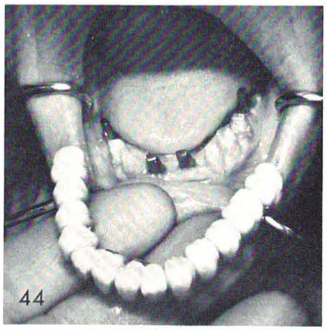
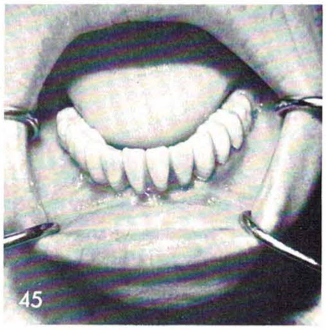
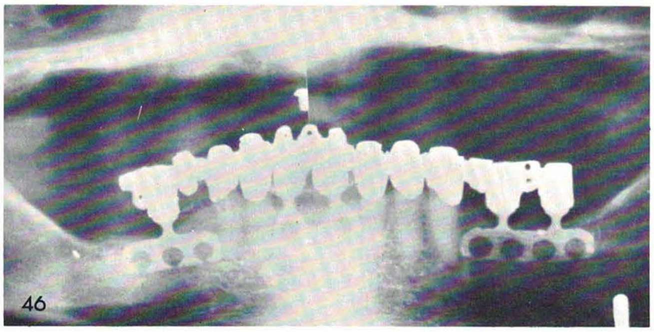
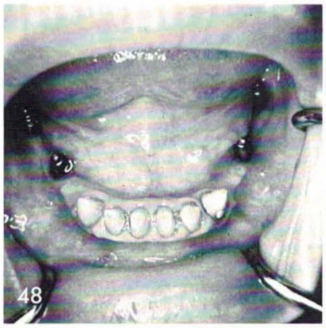
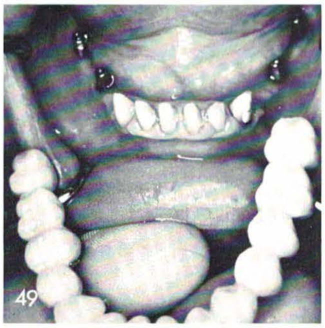
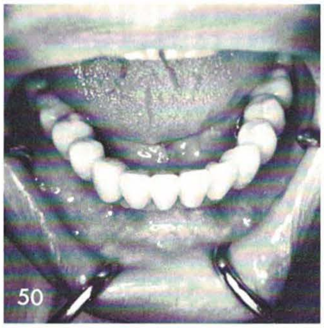
The buccal flanges were made extremely bulky to fill out the "shrunken" cheeks. The full arch restoration was cemented, figs. 30, 31, and each individual "snap-on" partial restoration was fitted to place, figs. 32, 33, 34, 35, 36. Thus, full arch splinting was obtained, the psychological problems of the patient were eliminated and the cheek problem was solved. Fig. 37 shows the post-operative x-ray.

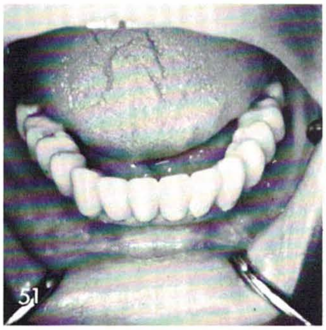










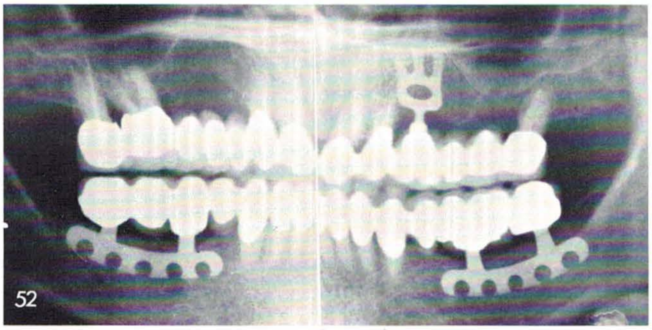
When all four anterior teeth are missing as well as the two posterior quadrants, fig. 38, often a specially designed blade is implanted anteriorly between both cuspids. The tissues are incised and reflected to expose the bone and grooves are made, fig. 39. The blades are inserted, fig. 40, and tapped to their proper depths, fig. 41, and sutured, fig. 42. After healing, fig. 43, the bridge is completed, figs. 44, 45. A final x-ray shows the completed case, fig. 46.

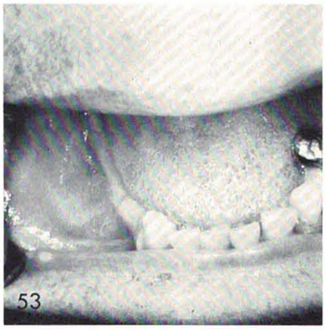


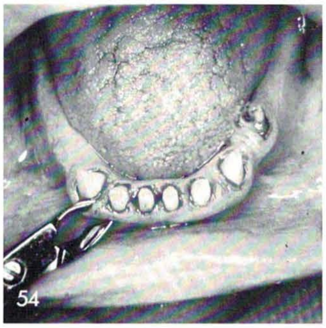


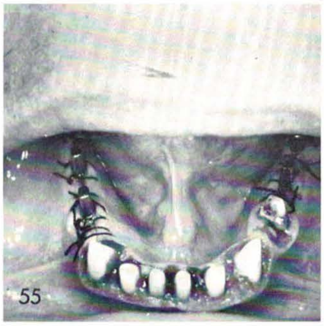


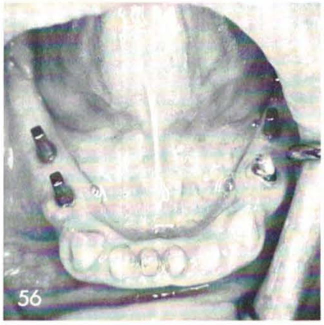


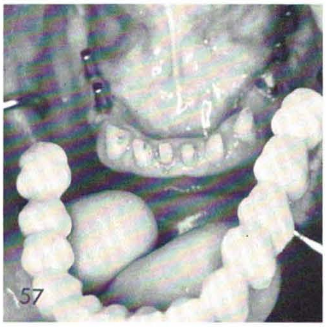


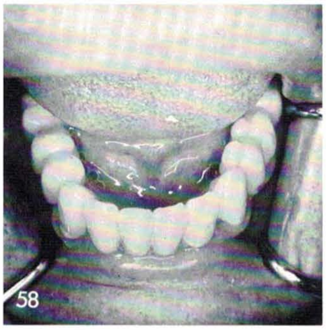


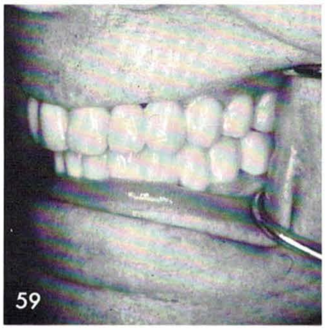


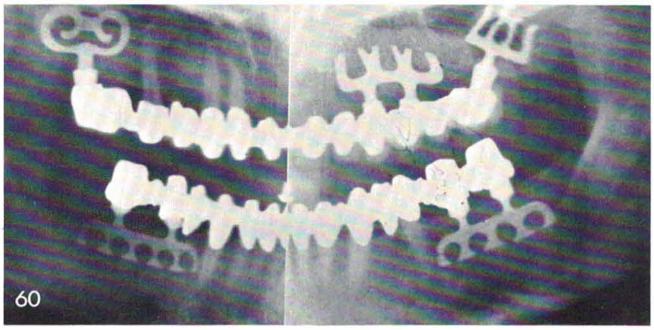






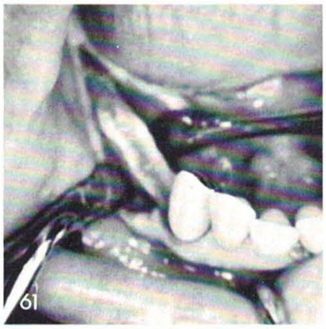


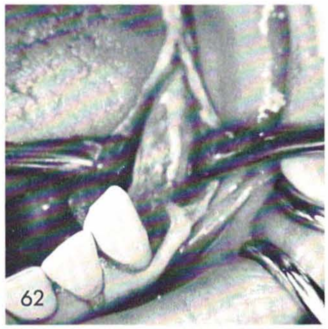


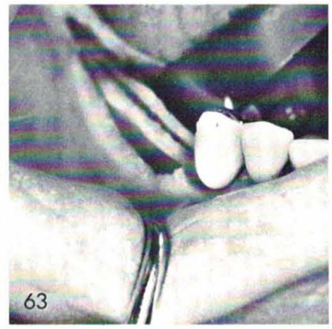


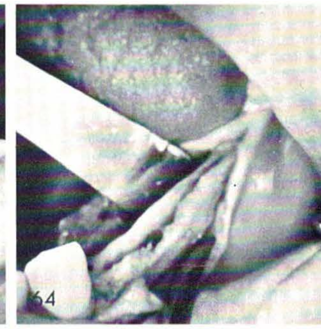
Very often six remaining periodontally involved teeth can all remain, with the use of implants, fig. 48. In this manner, with the aid of full arch splinting the only way the anterior teeth can loosen is by "exfoliating" the posterior bladevents, figs. 49, 50, 51. A removable prosthesis will rapidly destroy the remaining anterior teeth. Fig. 52 shows the final x-ray.

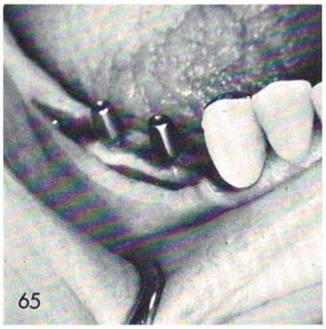
Even with knife edge ridges, fig. 53, and teeth with soft tissue involvements, fig. 54, the patients can acquire complete satisfaction with properly inserted bladevents, figs. 55, 56, and properly fitting and designed fixed restorations, figs. 57, 58, 59. The final x-ray reveals this, fig. 60.

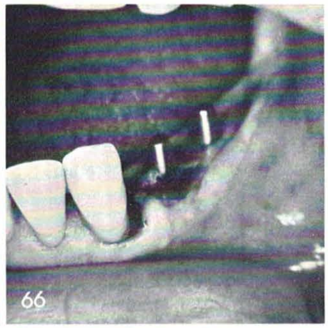


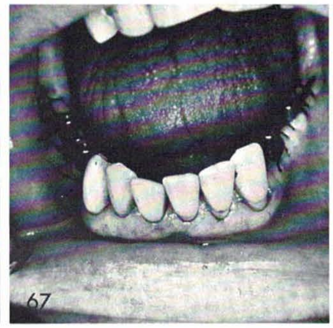


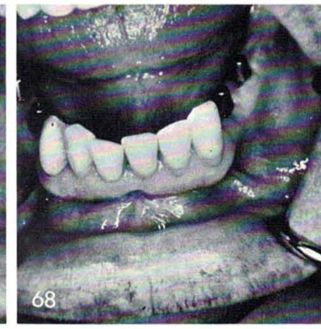


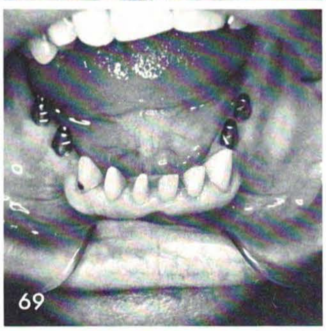


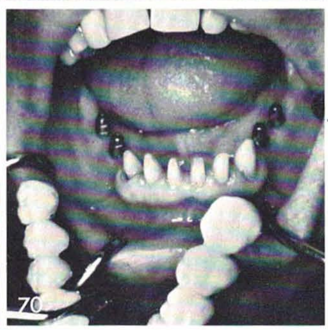


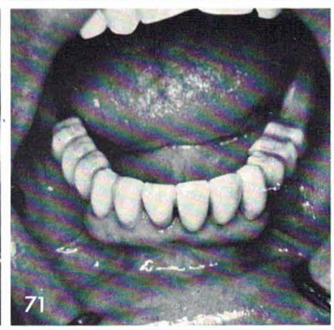


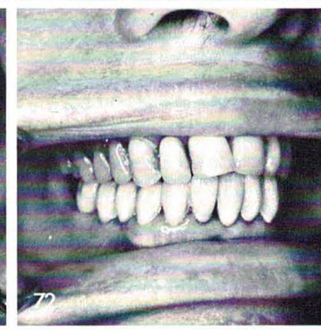


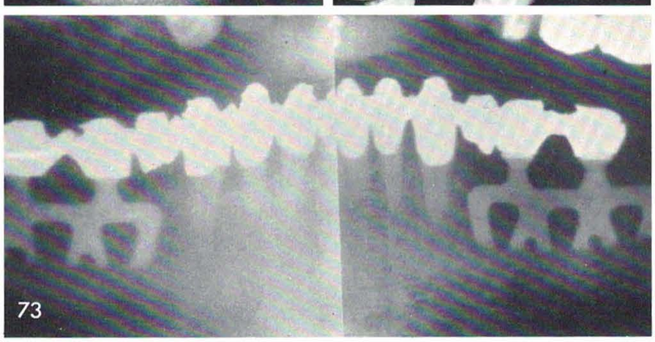




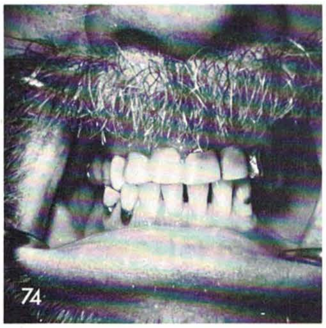


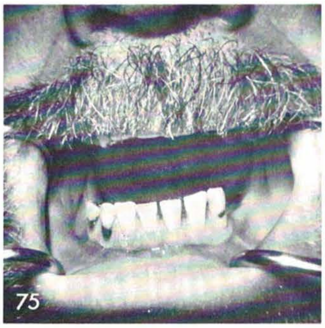


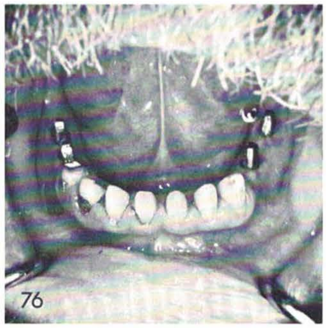


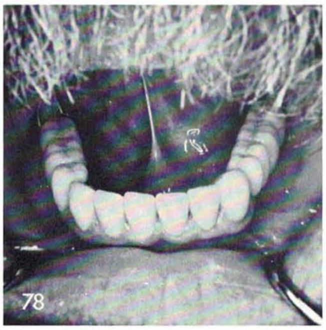


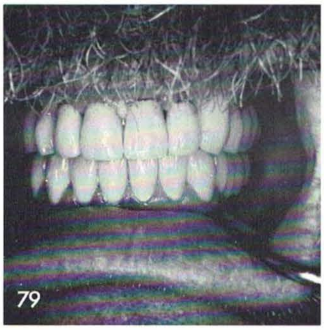
More than often severe undercuts exist both lingually and buccally in the areas where implants are to be inserted, figs. 61, 62. Extreme care must be taken not to perforate these undercut areas, figs. 63, 64, so that the blades will not encroach upon these narrower surface areas, figs. 65, 66. Careful suturing is done, fig. 67. Healing as usual, is uneventful, fig. 68. The teeth are then prepared, fig. 69, and the full arch fixed prosthesis is then completed, figs. 70, 71, 72. The final x-ray, fig. 73.

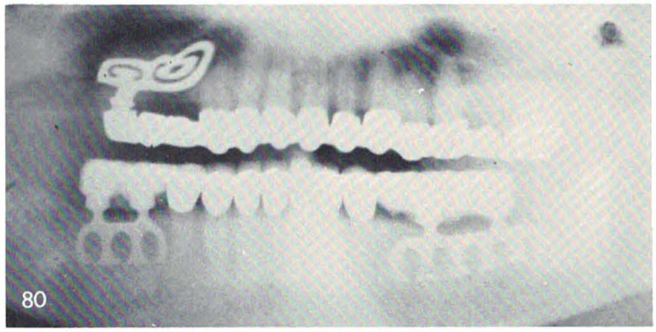




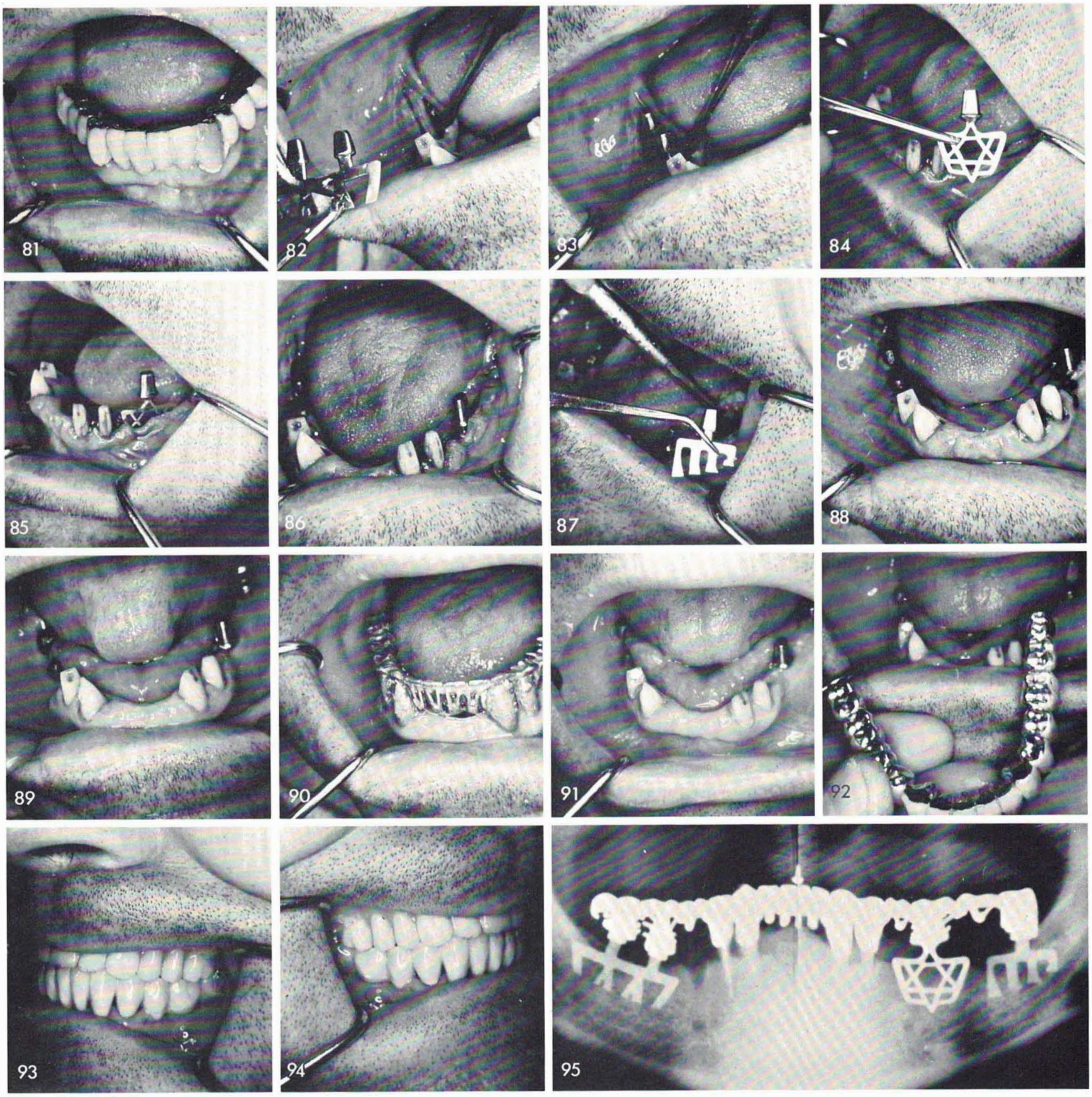






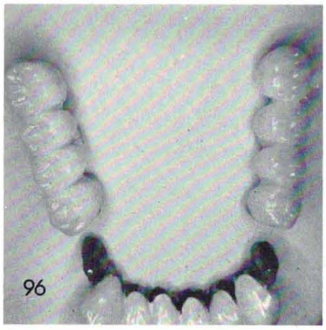


A patient may be motivated towards implants with the prime goal of improving the original esthetics as was the reason for this patient presenting himself, figs. 74, 75, 76. A full arch porcelain-baked-to-metal restoration was then fitted and cemented, figs. 77, 78, 79. A final x-ray, fig. 80.



Quite often, patients, previous to implant work, neglected their teeth and practiced poor oral hygiene, fig. 81. Besides being so neglectful this man was an athiest, so I decided to put a little religion into his soul.

Grooves were made and the various designed bladevents were implanted into the bone, one of the implants, being a Vitallium "Star of David", figs. 82, 83, 84, 85, 86, 87, 88. Several weeks later after the tissues were thoroughly healed, fig. 89, the soldered castings were fitted, fig. 90. By the fourth week the tissues looked well clinically and the blades were firm inside the bone, fig. 91, and the finished prosthesis was cemented, figs. 92, 93, 94. A final x-ray was taken, fig. 95.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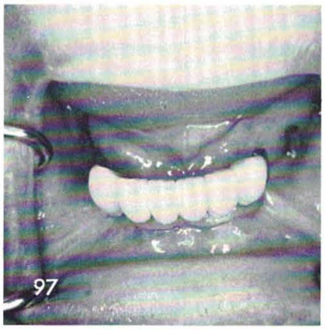
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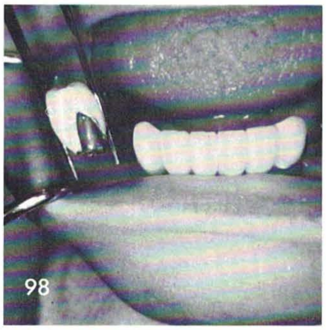
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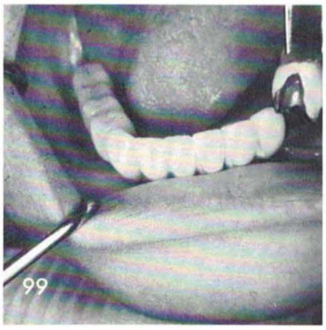
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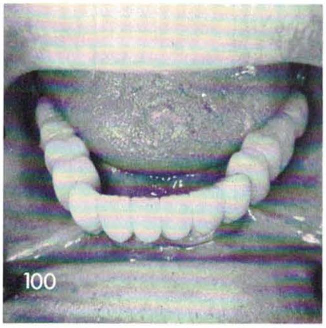
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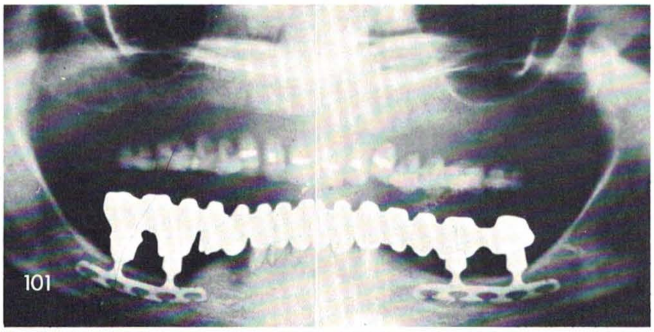
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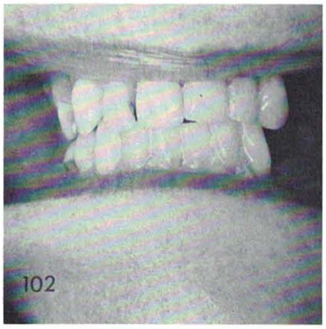
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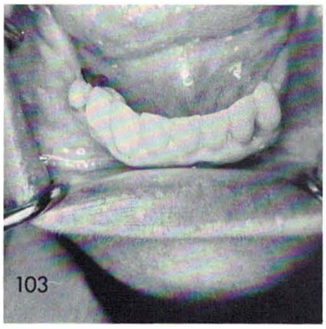
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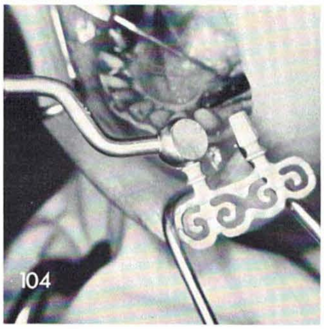
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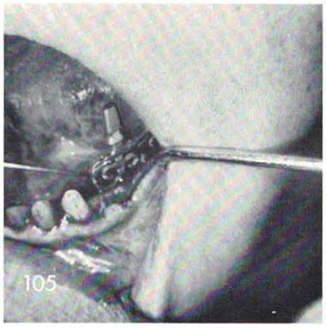
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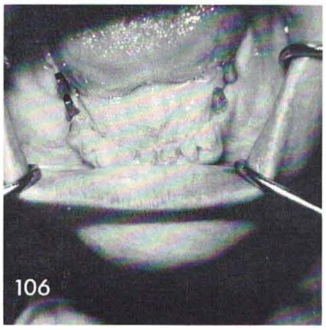
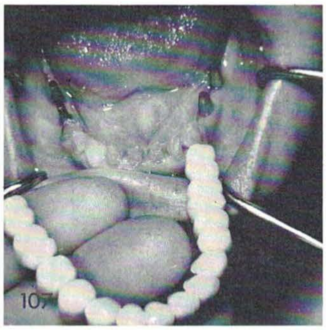

106

When the anterior teeth flare out too much preventing paralleling them with the posterior posts of implants, the bridgework can be done in three quadrants rather than one. Cantilevered pontics are included in the anterior portion and are made to sit vertical to the horizontal plane in order to facilitate paralleling the blade posts to them, figs. 96, 97. The anterior portion of both unilateral superstructures contain telescopic crowns which are cemented directly over the pontics thus creating the same effect as if the restoration was a full arch splint, figs. 98, 99, 100. A final x-ray, fig. 101.

A pre-operative photograph of another case, fig. 102. With this case, fig. 103, some of my newer designed blades were used, figs. 104, 105, 106. A porcelain full arch restoration was the prosthesis of choice, figs. 107, 108. The completed x-ray, fig. 109.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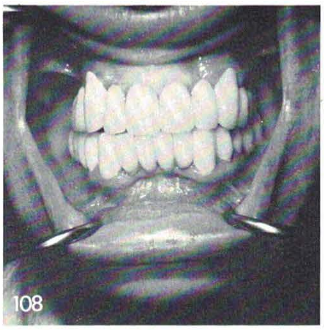
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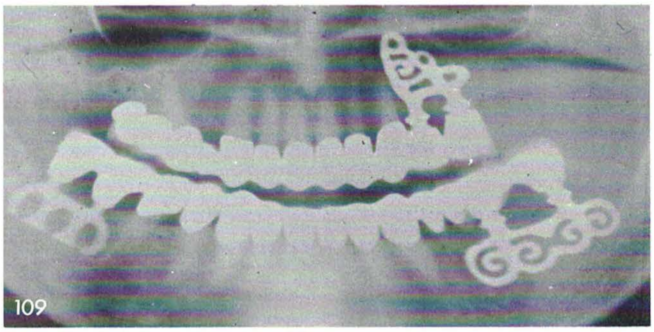
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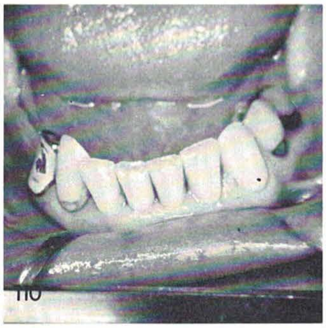
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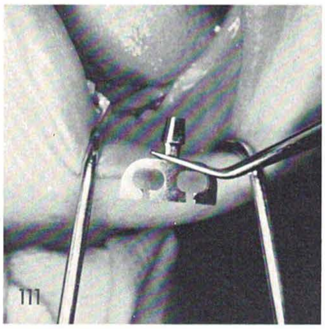
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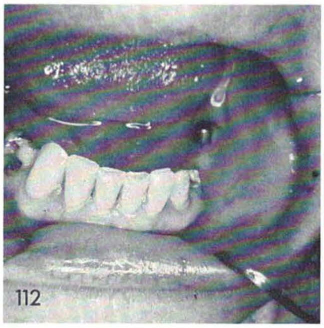
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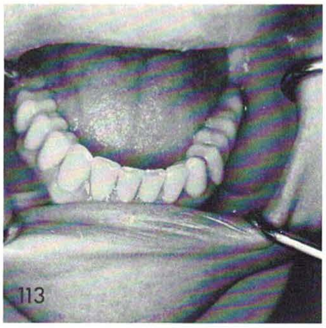
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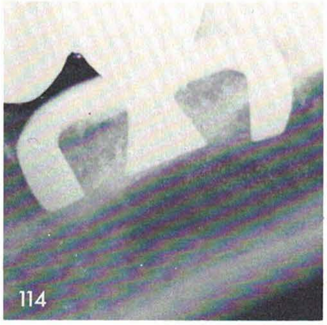
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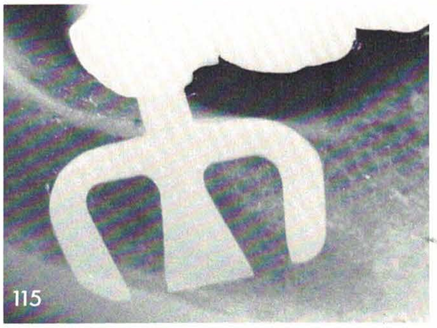
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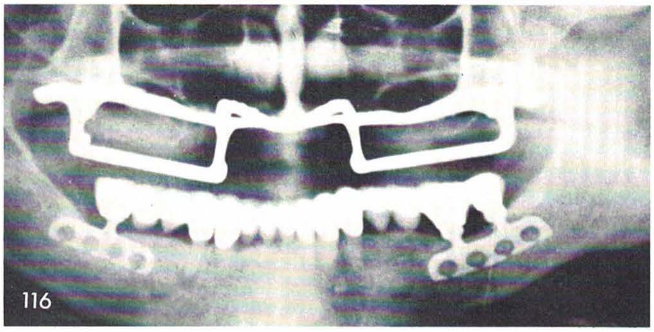
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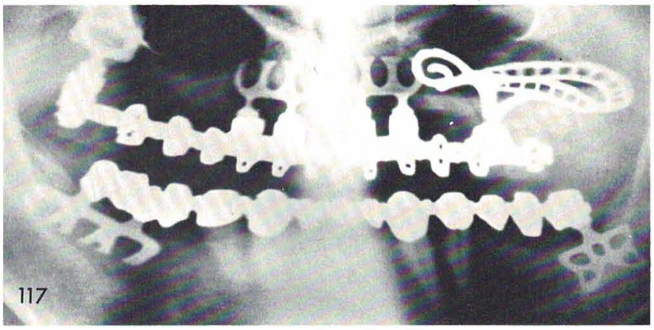
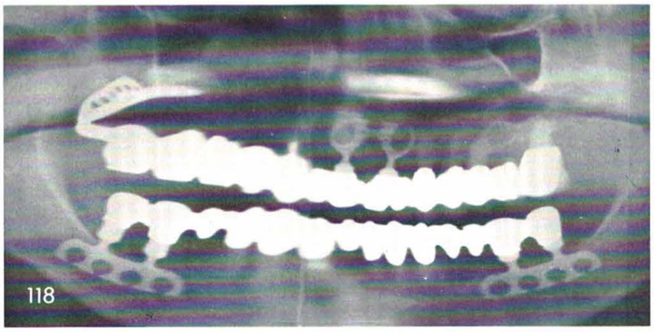

117

One of my earliest cases of blades is seen here, fig. 110. The early designed blades were inserted, figs. 111, 112, and the final restorations cemented into proper position, fig. 113. Periapical post-operative films show the excellent results. These were ten and one half year post-operative x-rays, figs. 114, 115. Fig 116 through 147 shows final x-rays of unilateral and bilateral posterior blades.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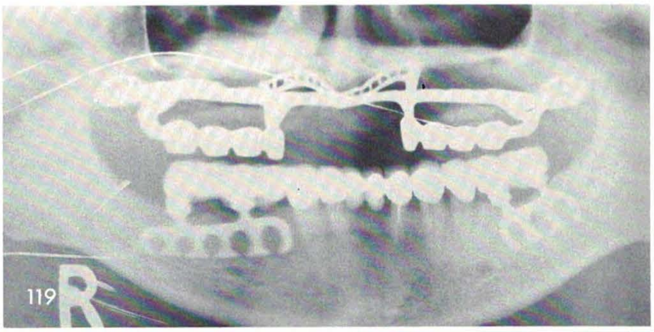
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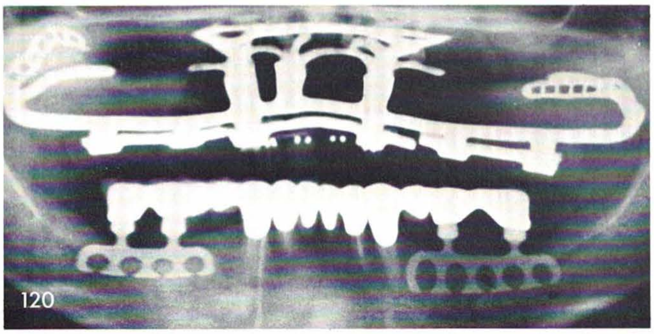
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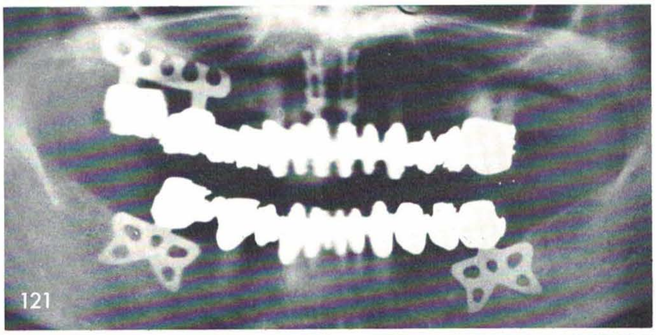
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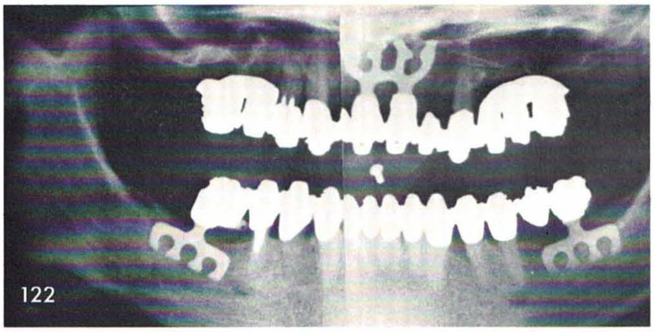
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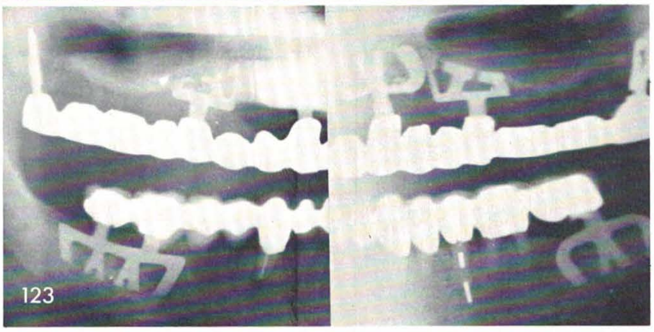
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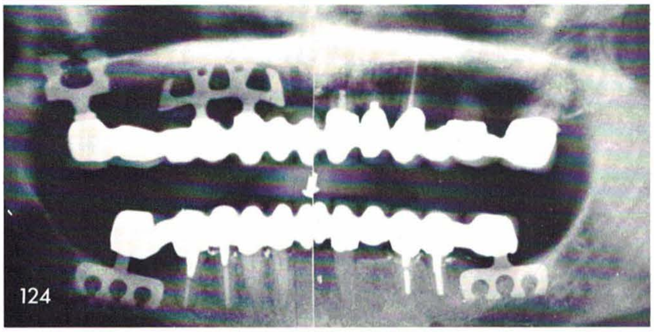
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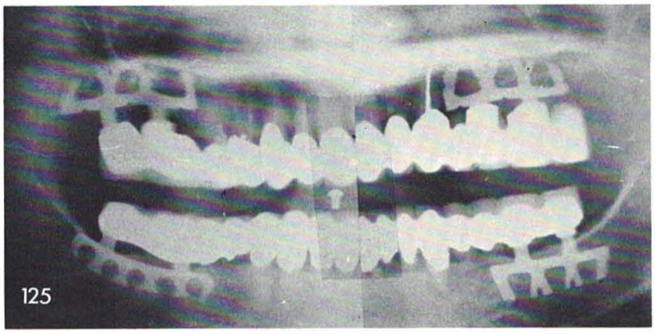
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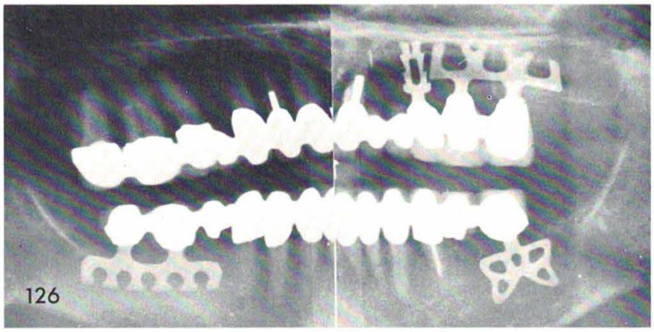
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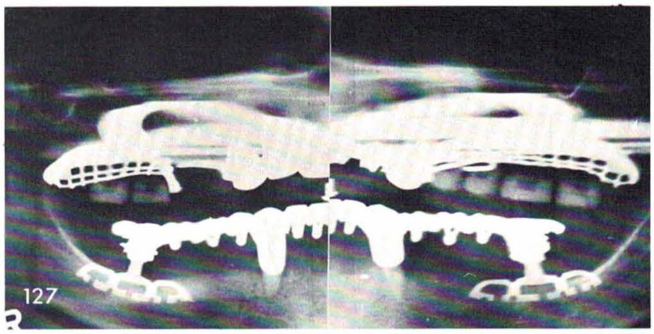
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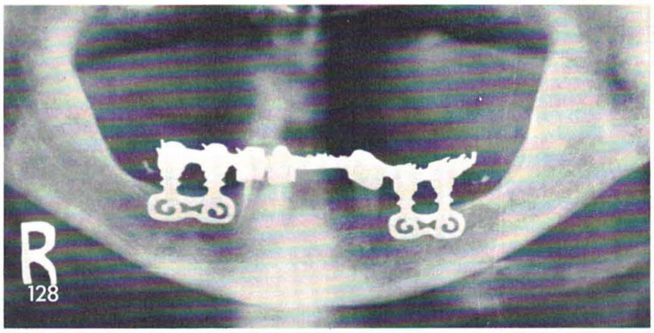

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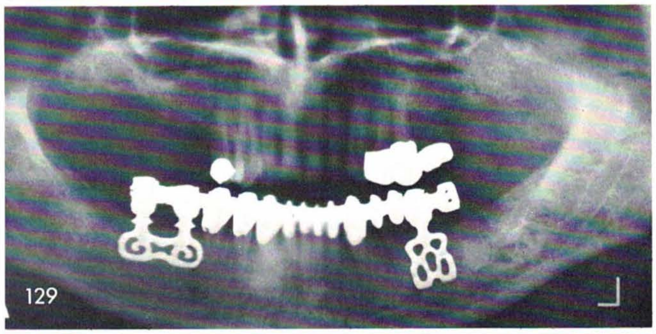
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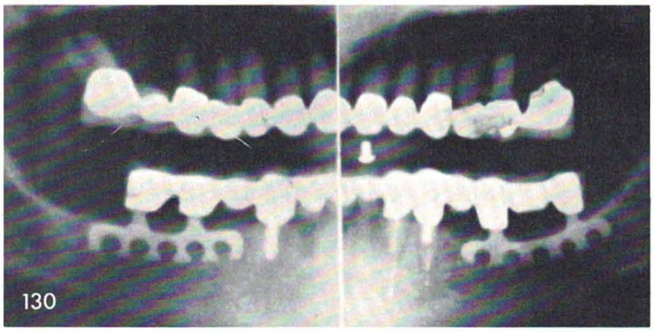
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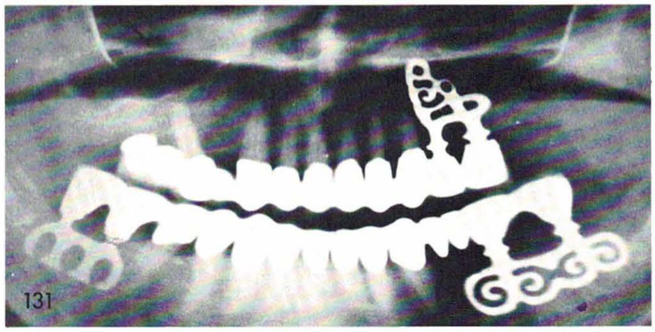
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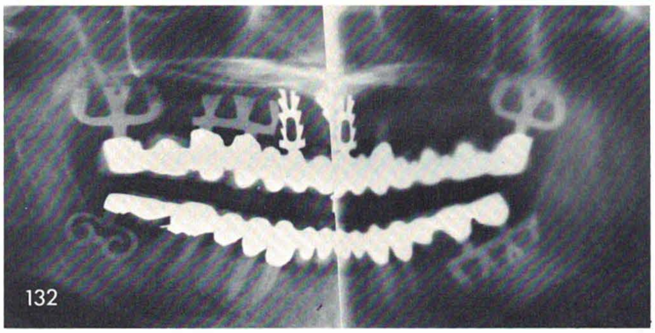
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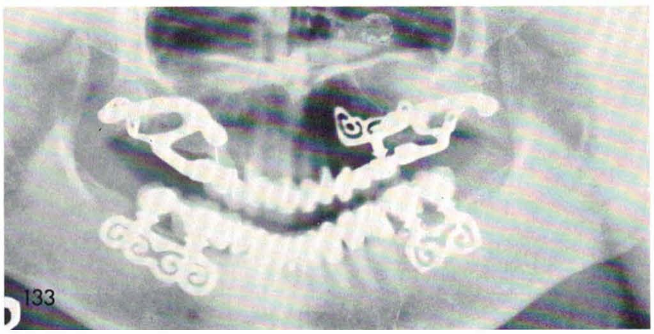
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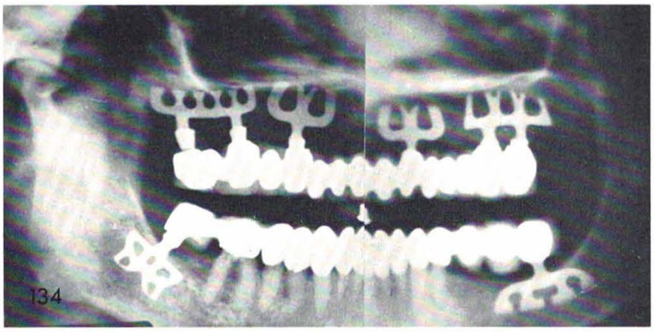
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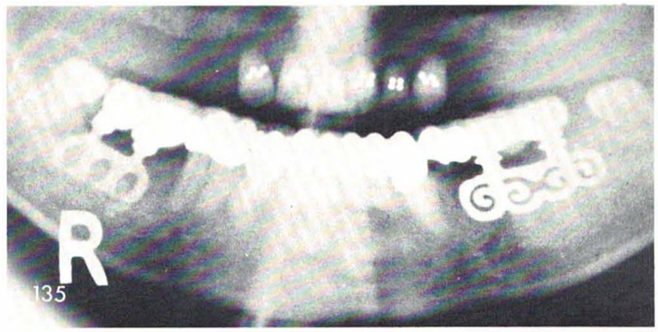

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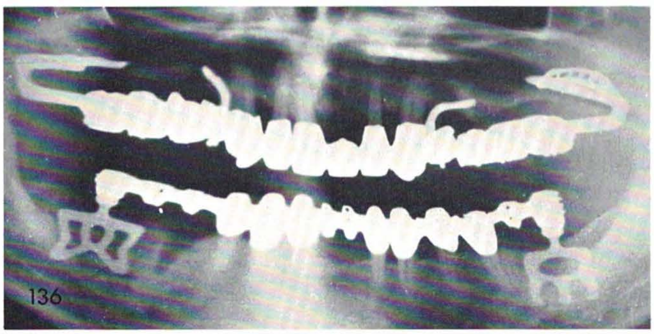
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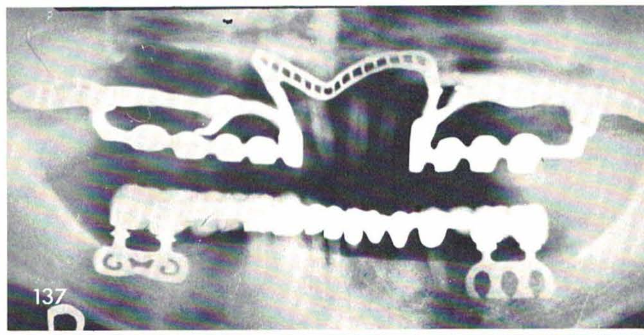
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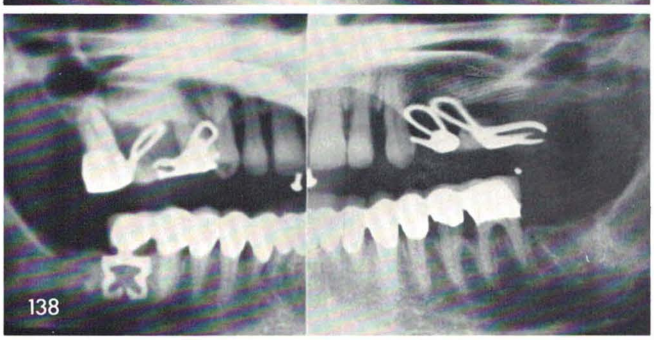
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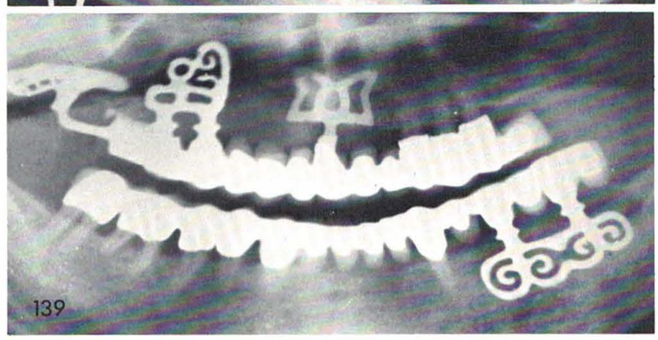
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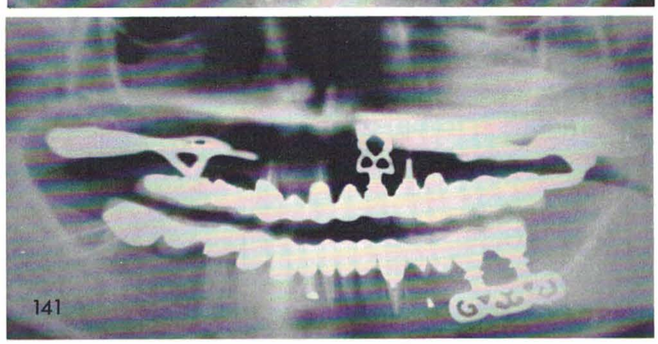
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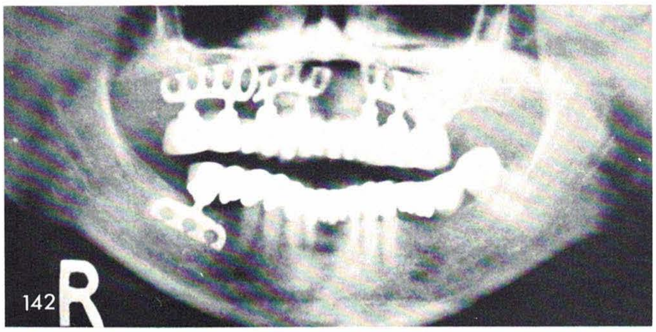
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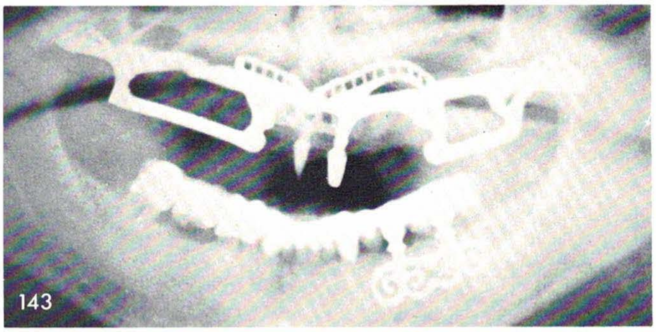
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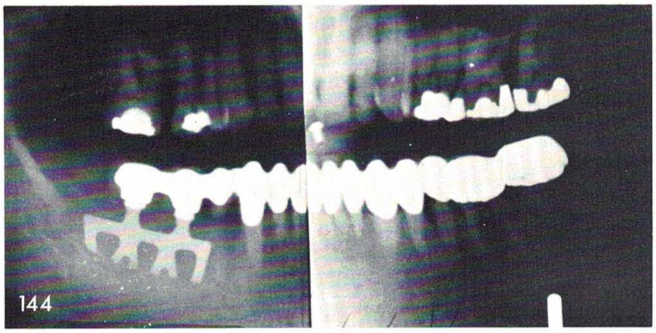
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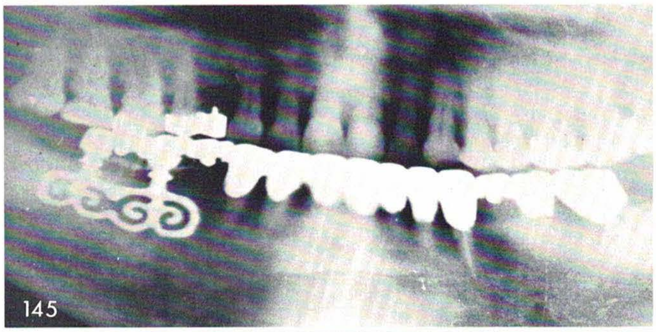
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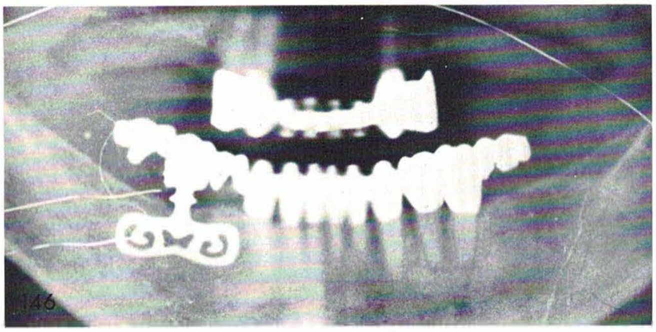
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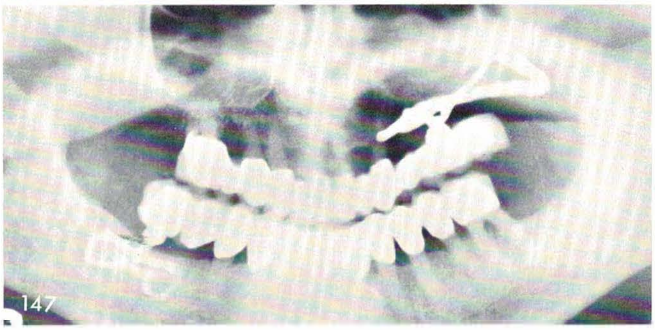
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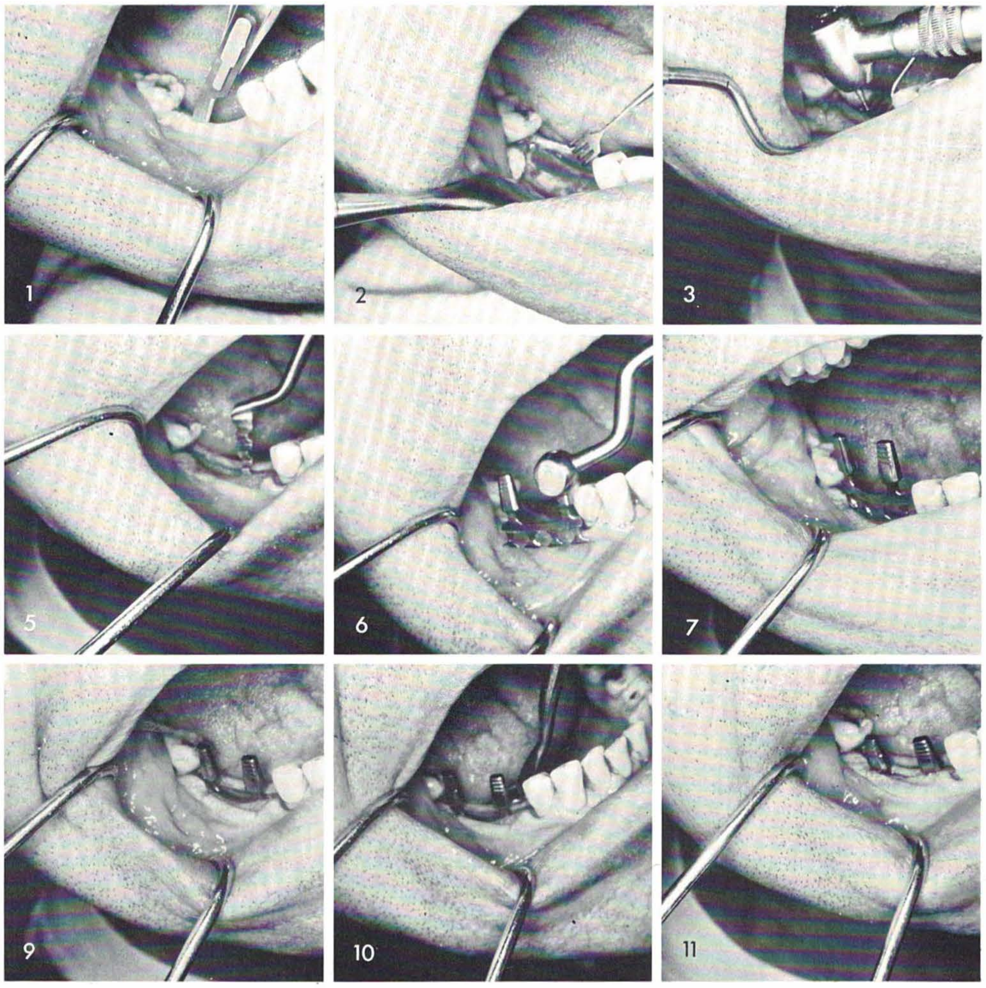
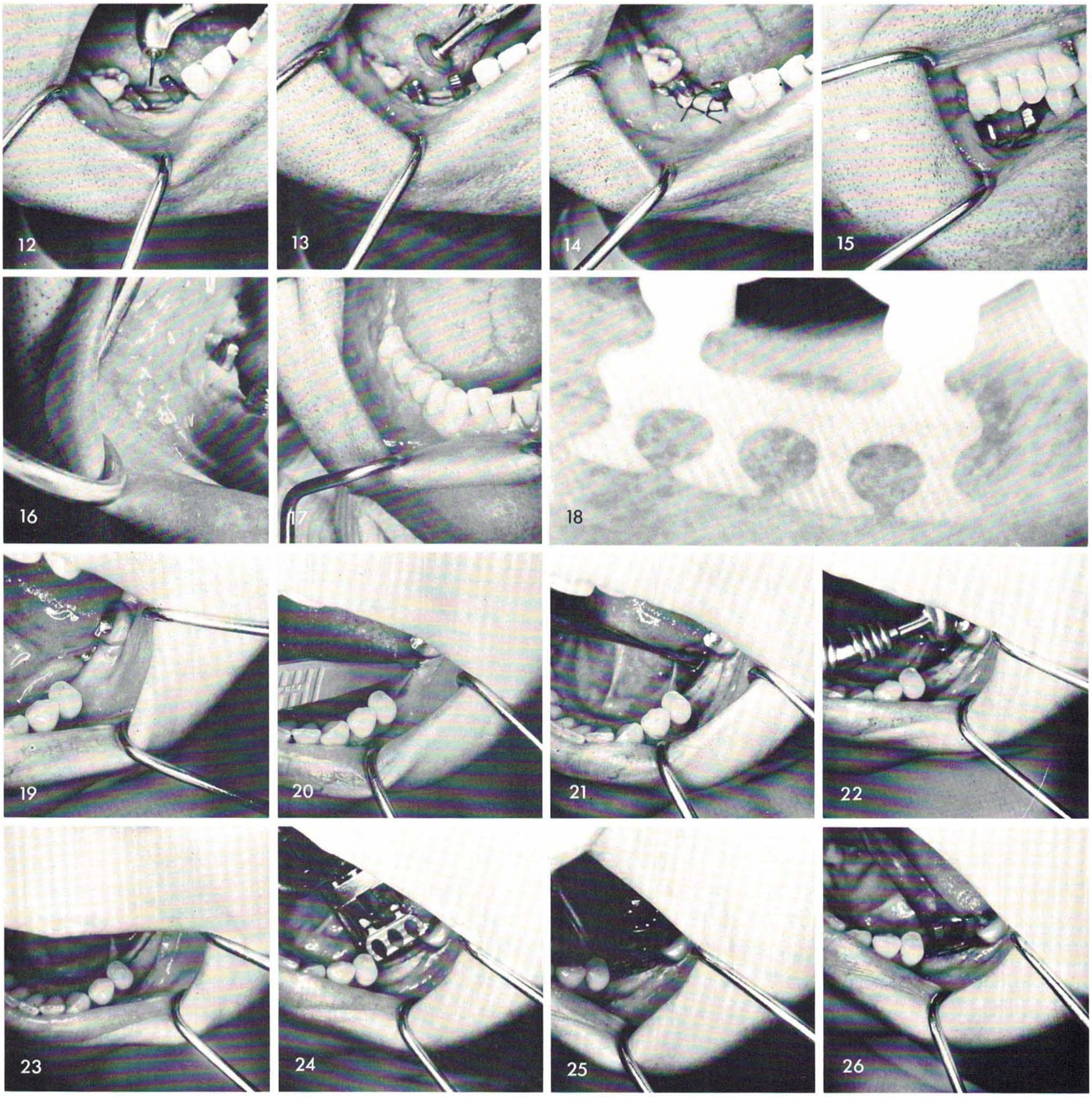
Intratooth Blades

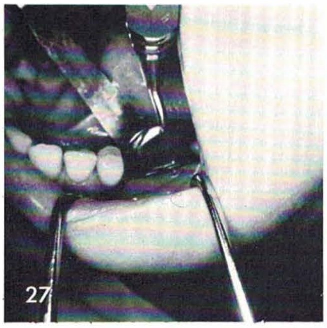


The length of the incision in an intratooth situation is dictated by the teeth approximating the incision on its mesial and distal side. Fig. 1. The tissues are reflected, fig. 2, and the groove is made, figs. 3, 4. A specially designed instrument is sometimes used to check the overall depth of the groove, fig. 5. A blade that was shortened on each side so that it still remained symmetrical and can be fitted into the narrower space was done and carried, fig. 6, into the groove, fig. 7. The body of the blade was bent to fit passively into the curved groove. With a double headed tapping instrument, fig. 8, the blade was tapped until resistance was felt, fig. 9. Being that it was not buried deeply enough a special blade removing instrument is used to tap the blade out of the bone, fig. 10. After using a long 700 XXL bur to deepen the groove, the blade was able to be tapped to its proper depth, fig. 11.



The blade posts are ground down occlusally, fig. 12, and smoothed off with a rubber wheel, fig. 13. The tissues are sutured closed, fig. 14, and the interocclusal clearance is carefully checked, fig. 15. After healing, fig. 16, the fixed bridge is cemented in permanently, fig. 17. A periapical film shows the intra-tooth blade, fig. 18.

Sometimes there is adequate bone height to insert a deep implant in between two teeth. The tissues are incised, reflected and the groove is made, figs. 19, 20, 21, 22, 23. The deeper implant, usually a double headed one, is inserted into the bone, figs. 24, 25, 26. The various instru-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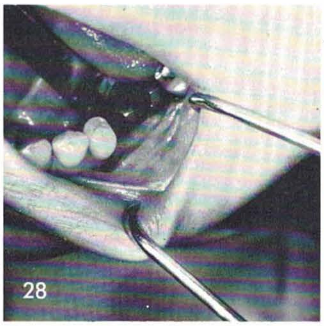
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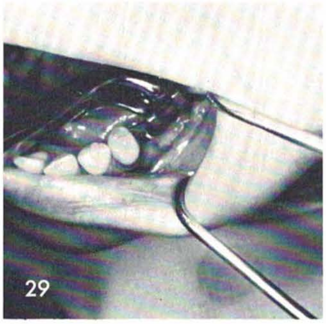
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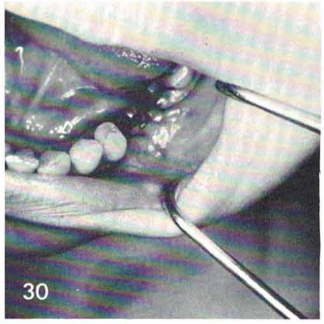
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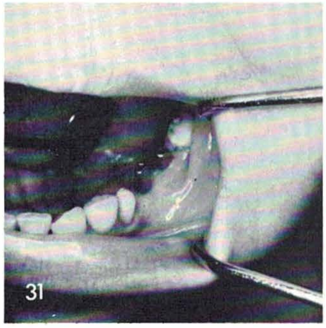
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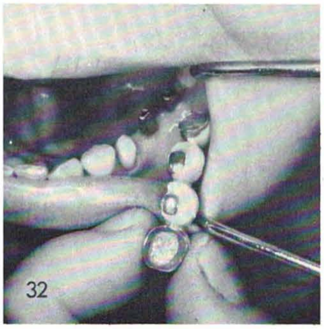
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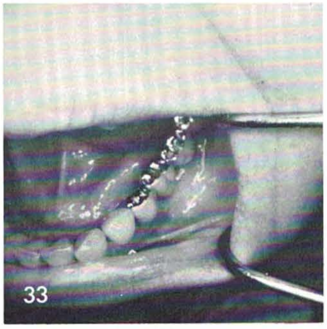
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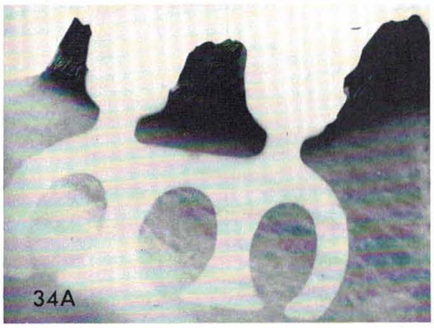
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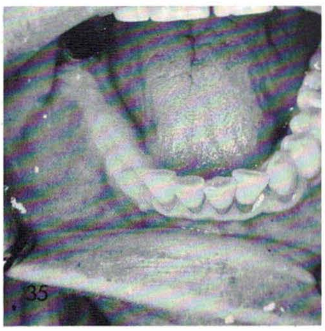
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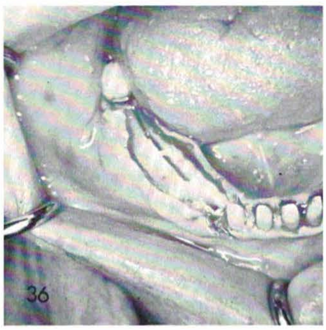
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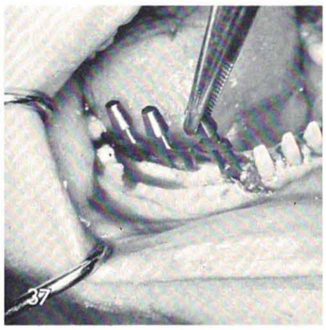
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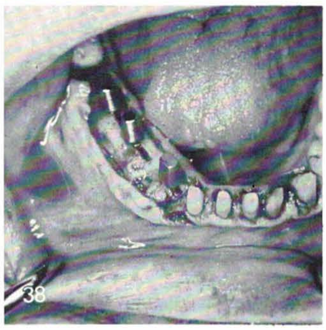
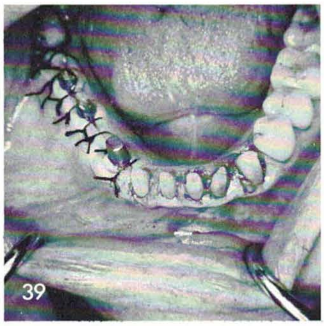

38

ments are then used for proper anchoring of the bladevents, figs. 27, 28. A tissue punch is sometimes used, fig. 29, to eliminate crimping of the tissues when sutured, fig. 30. After healing, fig. 31, the four unit acrylic veneer bridge was fitted and cemented, figs. 32, 33. Films show the finished case, figs. 34A, 34B.

In long intra-tooth edentulous spans often two blades are utilized, fig. 35. Two grooves are made, one for a vertical blade in the cuspid area to prevent the cuspid eminence from collapsing in time and one horizontal groove for a long double posted blade, fig. 36. The two blades are inserted into the grooves and tapped into the bone, figs. 37, 38. The tissues are sutured, fig. 39.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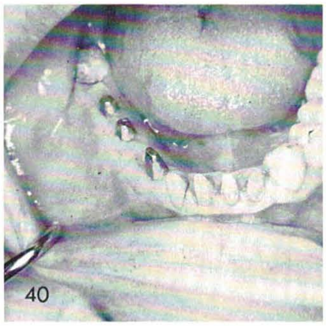
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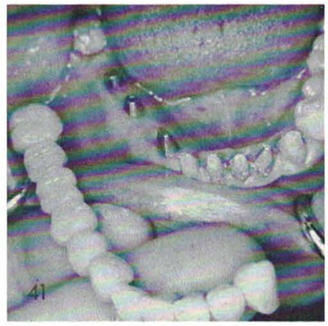
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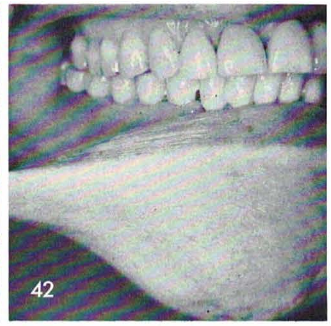
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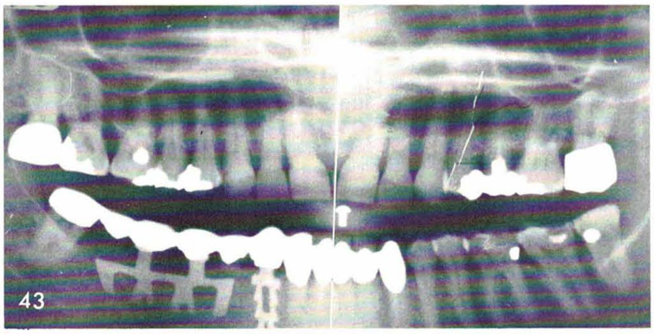
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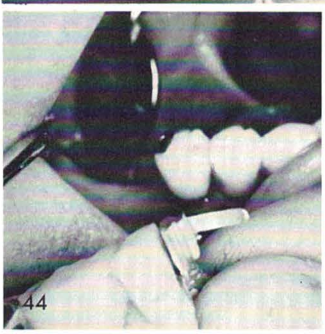
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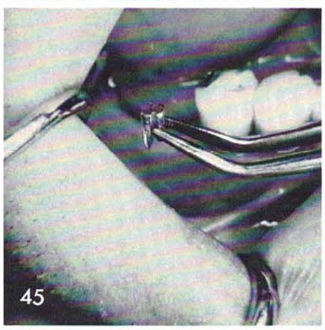
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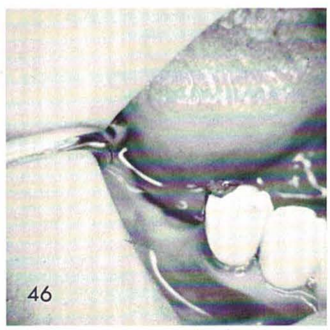
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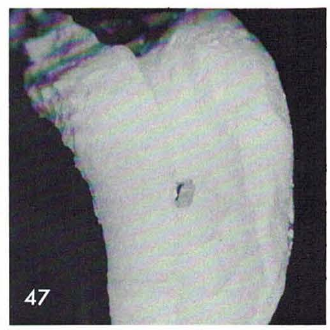
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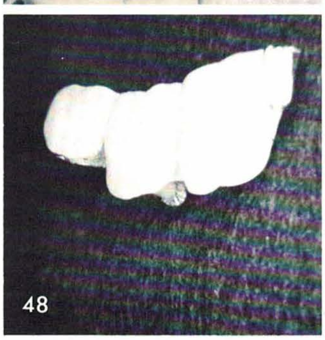
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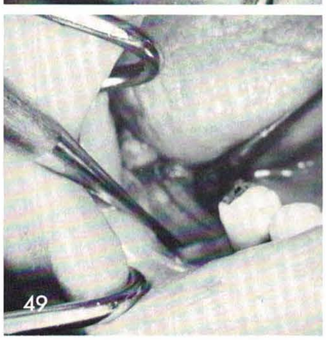
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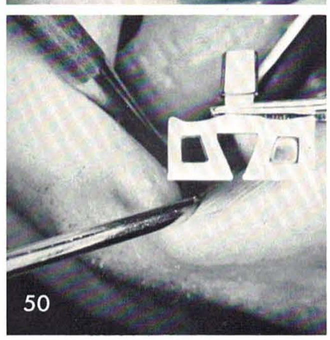
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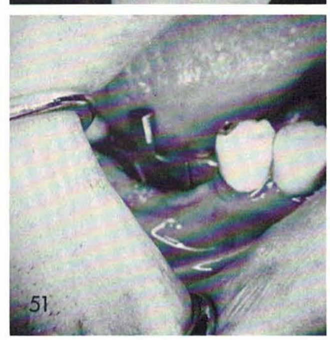
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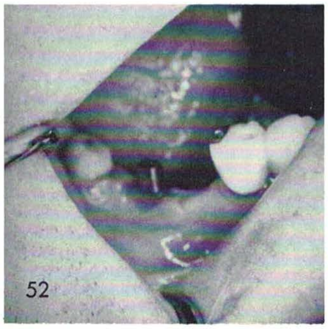
The blades are tapered to allow for proper contour of the final restoration, fig. 40, which is fitted and cemented, figs. 41, 42. A final x-ray shows the completed case, fig. 43.

Improvising often can result in less complications for the patient and dentist as well as saving the patient a great financial burden by not having to redo an entire restoration. In this situation, the male attachment was removed from an existing Nesbit bridge, fig. 44, and used as the anterior abutment, figs. 45, 46, for a prefabricated bridge by picking it up with a posterior crown with a plaster index, figs. 47, 48. A groove is made in the same manner as usual, fig. 49, so that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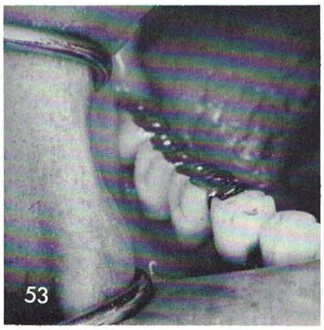
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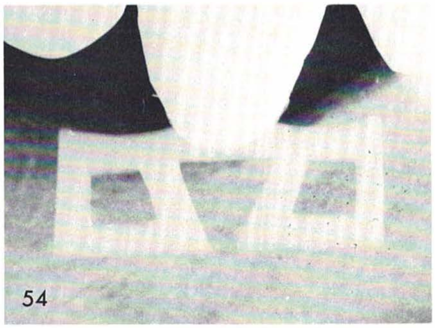
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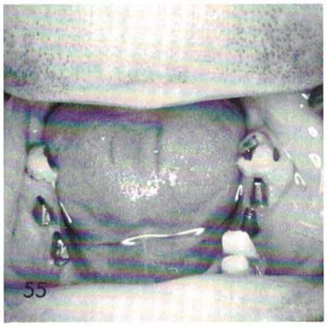
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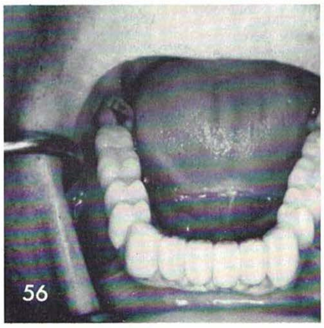
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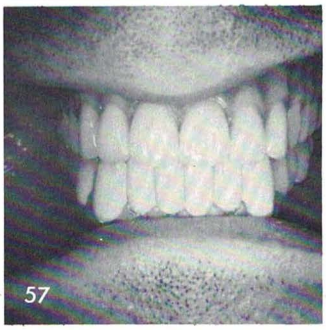
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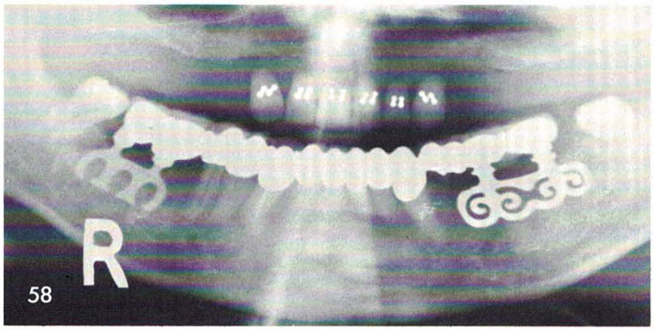

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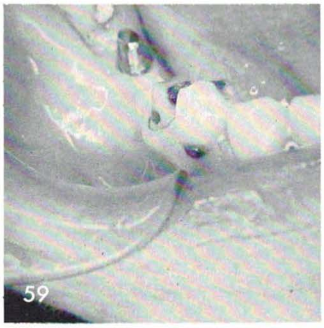
the blade, when tapped into position, figs. 50, 51, 52, will have its head fit directly into the hole made in the prefabricated bridge, fig. 53. A post-operative periapical film, fig. 54.

There are times when even though the blades are in between teeth mesially and distally, due to excessive tipping of the posterior teeth, the blades are not splinted to them, fig. 55. The final restorations are supported anteriorly with natural teeth and posteriorly by the blades, figs. 56, 57, 58.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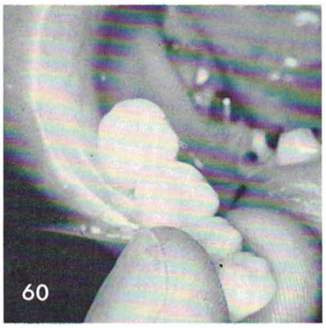
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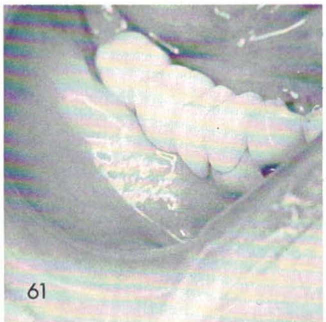
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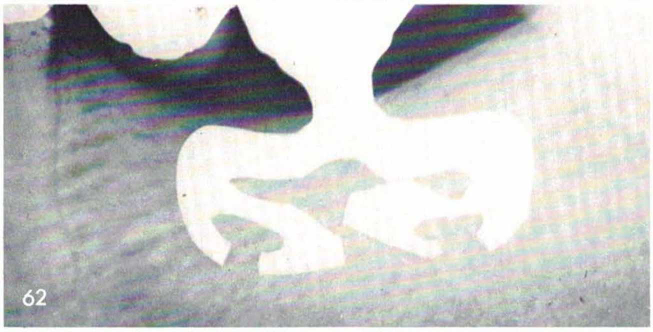
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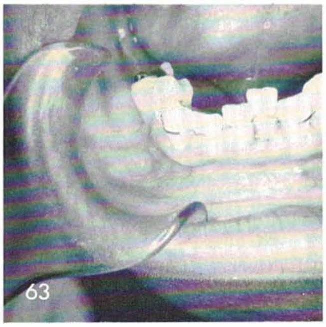
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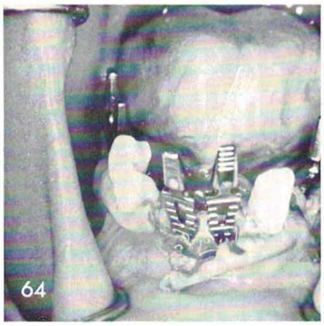
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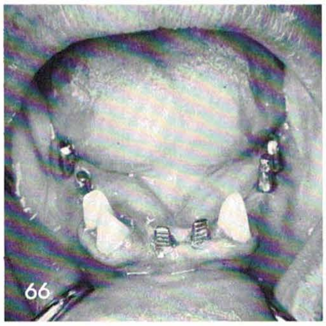
65

Wherever abutment teeth must be helped by further support other than the fixed bridge itself intra-tooth bladevents serve the purpose exquisitely, figs. 59, 60, 61. Notice in this nine year post-operative film that the originally broken blade (because of probably too shallow a groove and too hard tapping) caused no further bone damage, fig. 62.

Periodontally involved teeth that were over retained with wiring are often removed completely with immediate insertions of blades. These can go much deeper into the great depth of bone that exists in the symphyseal region than were the original teeth, thus aiding in the overall retention of the remaining weak teeth, figs. 63, 64, 65.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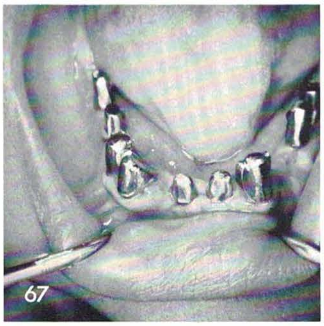
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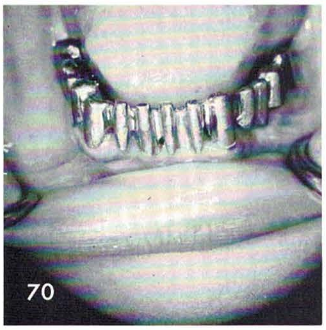
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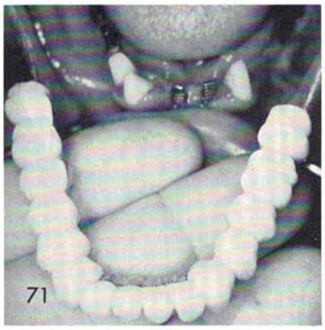
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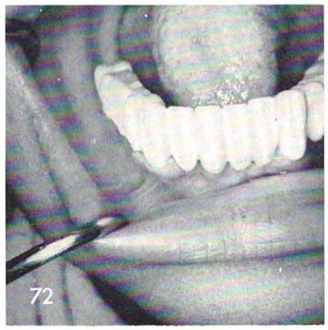
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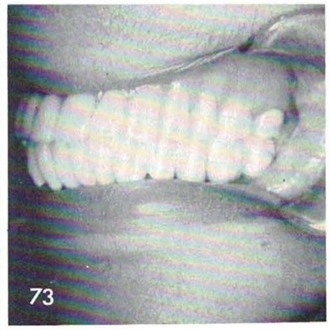
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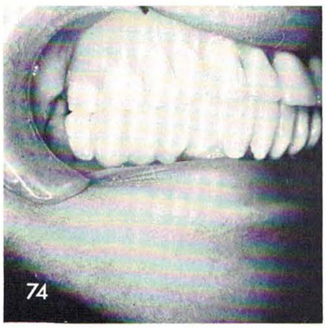
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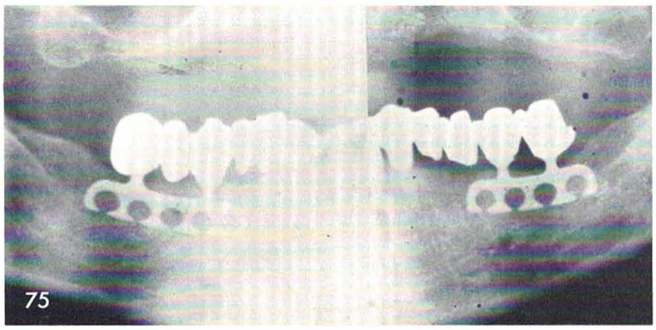
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Blades are also inserted in both posterior quadrants, fig. 66. Castings can be individually seated over the teeth and implant posts, figs. 67, 68, and an interocclusal record of centric relationship is taken and a plaster index which picks up the copings, fig. 69, for final soldering, fig. 70. A full arch fixed bridge is cemented with hard cement, figs. 71, 72, 73, 74. The finished case, fig. 75.


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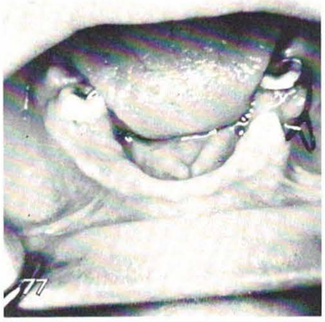
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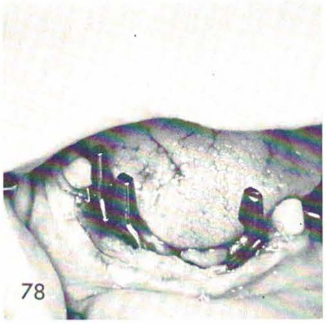
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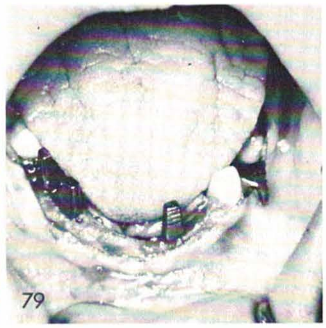
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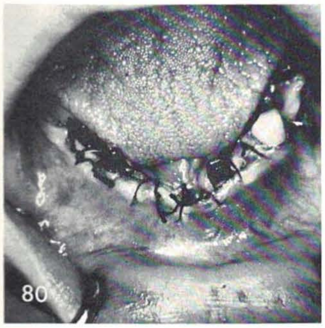
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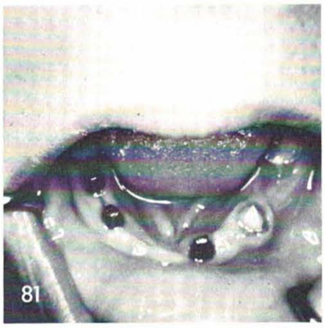
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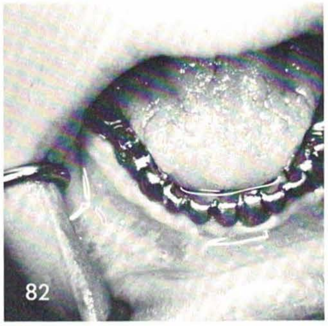
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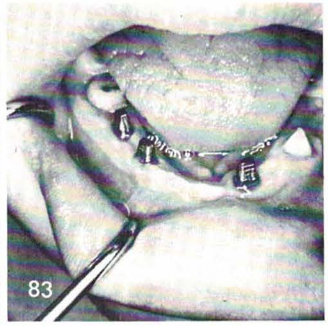
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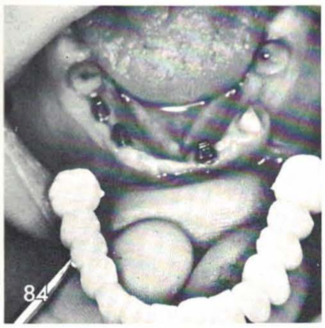
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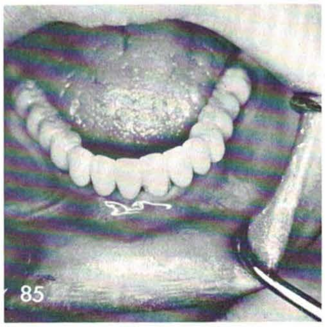
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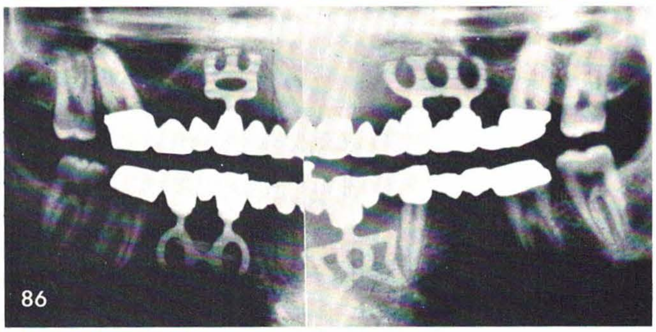
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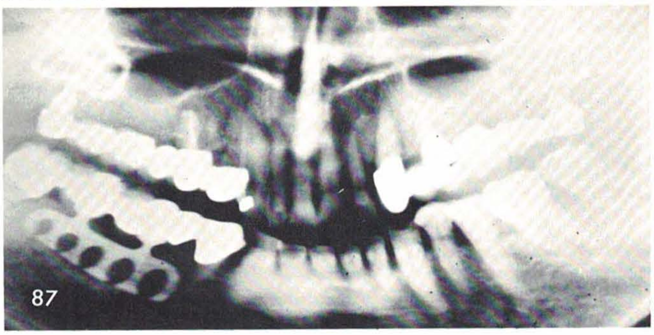
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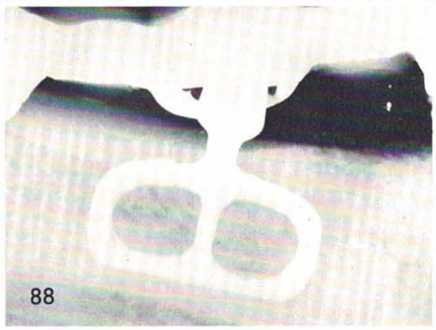
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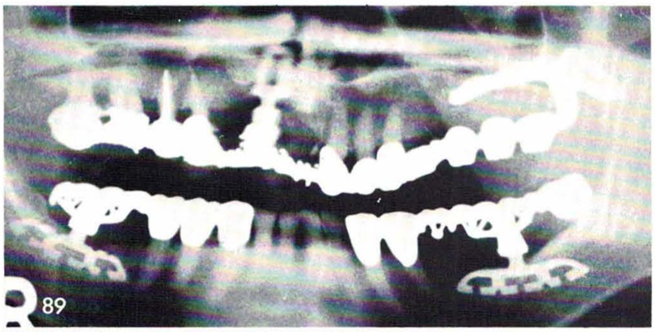
A case of partial anodontia with extremely knife-edged ridges, fig. 76, 77, needed the support of two intra-tooth blades, fig. 78, that were carefully tapped into proper position by first widening the pyramidal shaped knife-edged ridge by removing several milimeters of bone at the crest, thus widening the occlusal table, fig. 79. The tissues were then sutured together, fig. 80. After tissue healing, fig. 81, impressions were taken for individual gold copings, fig. 82. One week later, the case was completed, figs. 83, 84, 85. The post-operative x-ray shows the entire case. It also reveals that the twelve year molars did not have to be involved for added support, fig. 86.

Fig. 87 through 102 shows other cases using intra-tooth bladevents.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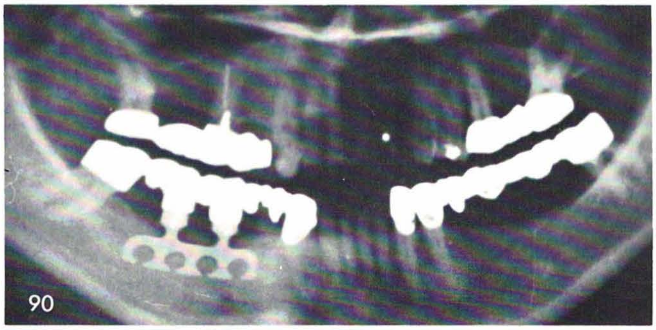
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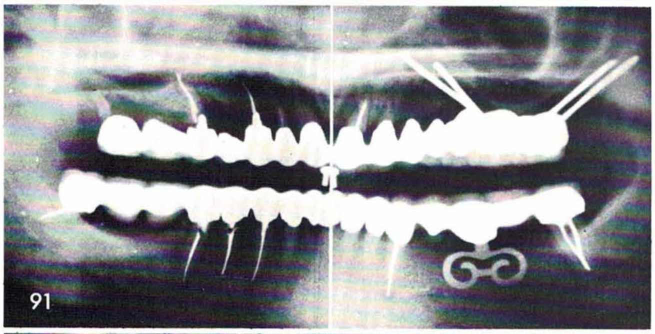
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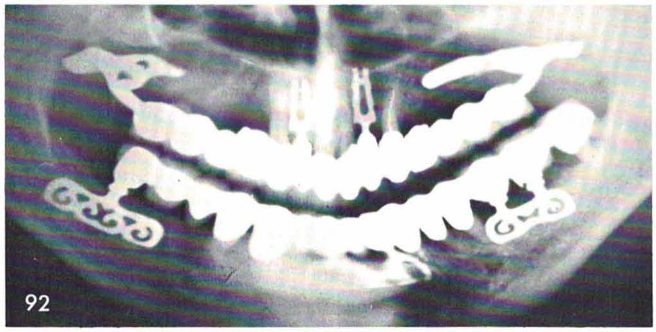
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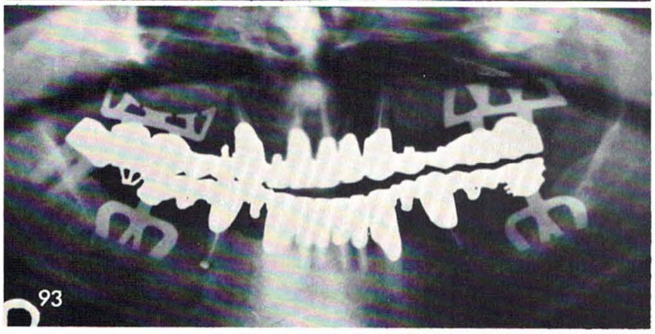
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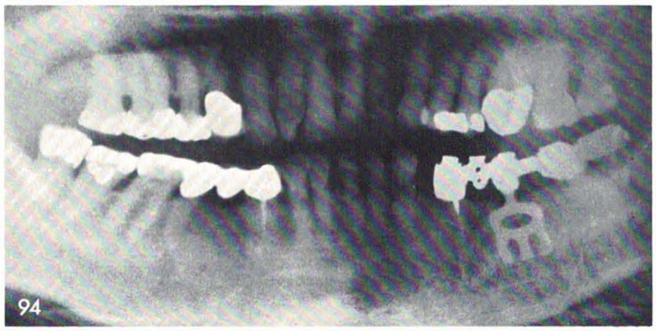
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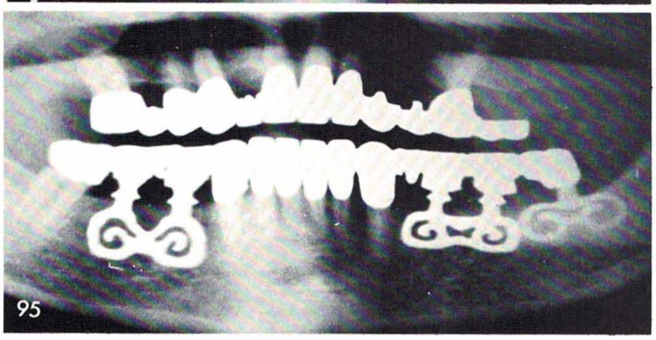
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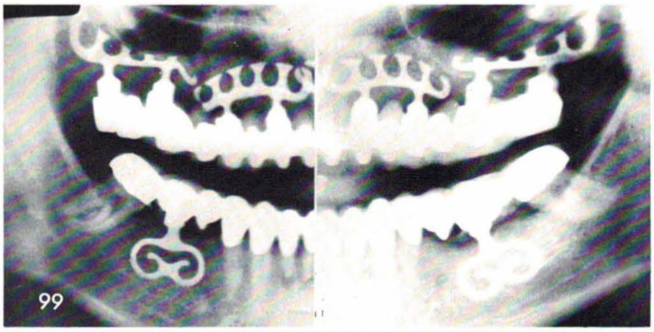
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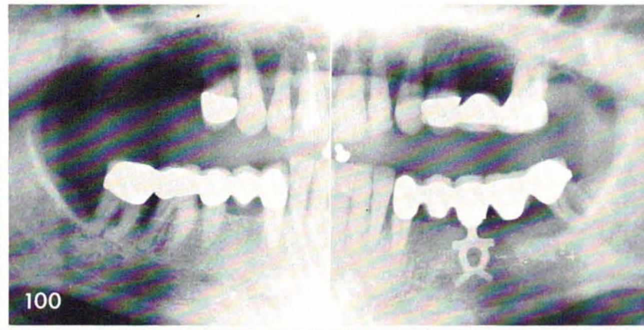
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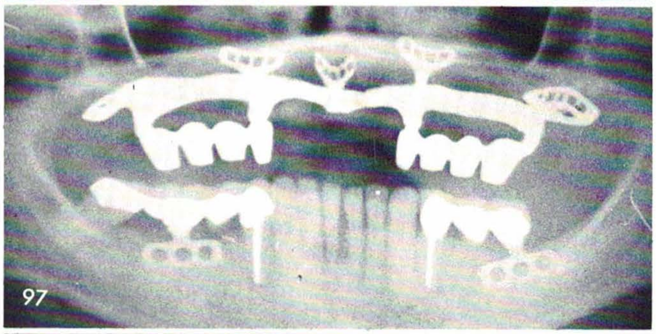
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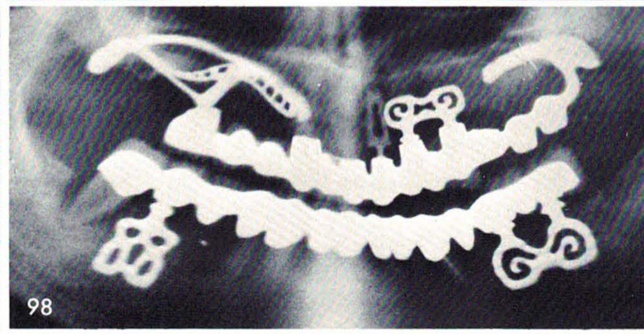
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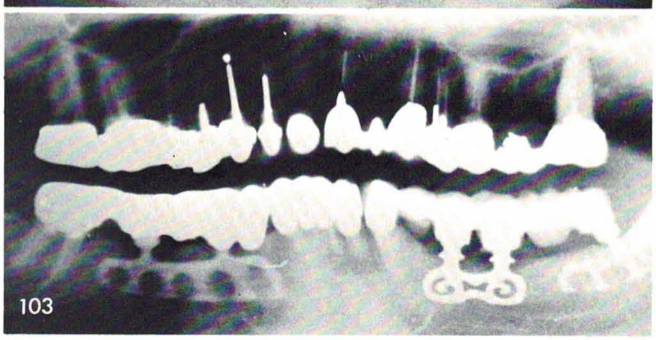
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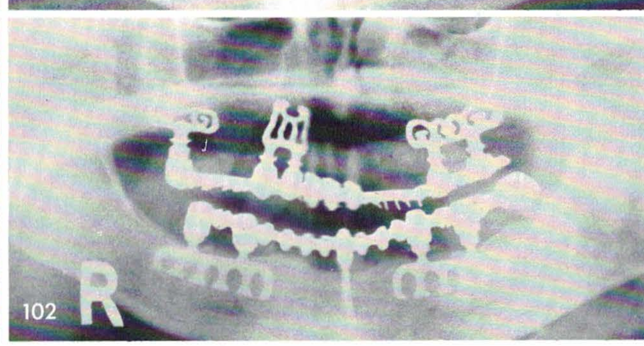

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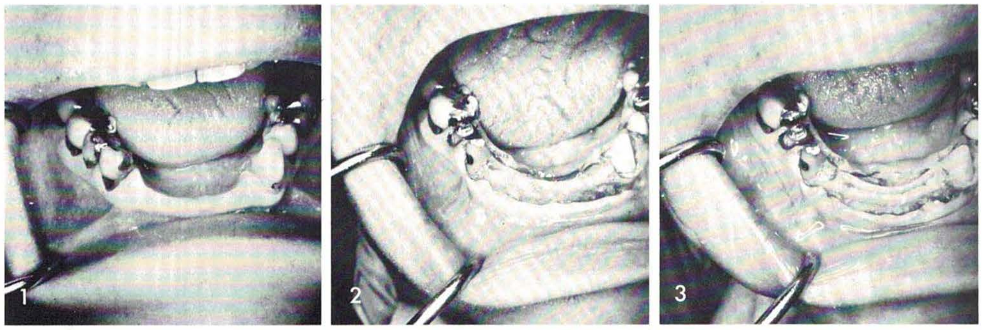
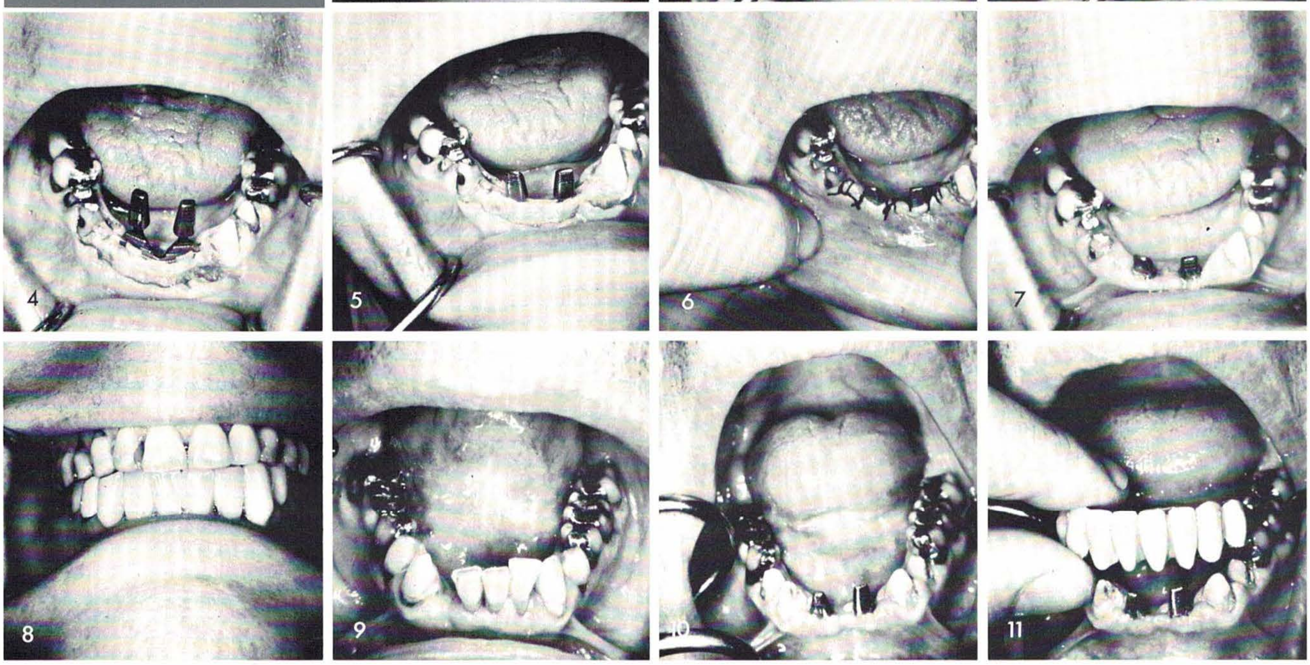
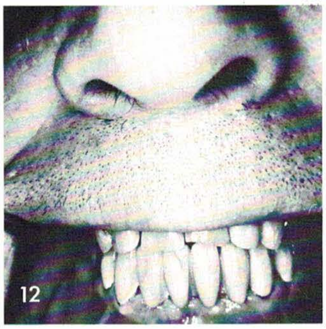
Midline Blades





Occasionally a patient presents himself with only the anterior quadrant of teeth missing and strong posterior teeth remaining, fig. 1. Usually in these situations the teeth were extracted instead of restored with root canal therapy and full coverage because of poor dentistry or the patient's inability to pay for a more expensive restoration at that time. The incision and reflection of the soft tissues is accomplished, fig. 2, prior to grooving the bone and preparing the teeth, fig. 3. The midline blade is inserted and tapped to its proper depth, figs. 4, 5, and sutured, fig. 6. After healing, fig. 7, the final partial fixed bridge is cemented with hard cement using a few abutments on each side, fig. 8.

In similar anterior bridgework situations, requiring midline implants immediately after the four or as in this case, three, anterior periodontally involved incisors had to be removed, the results can be the same, figs. 9, 10, 11, 12. A periapical film of the midline blade, fig. 13.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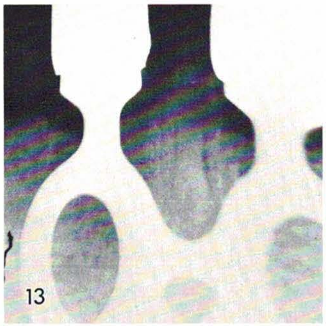
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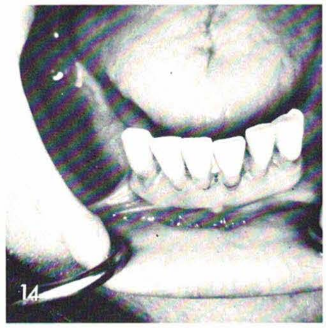
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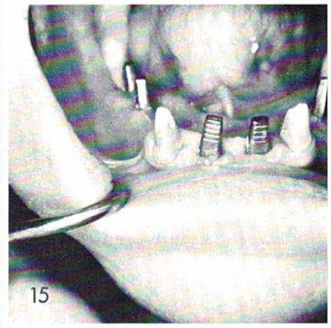
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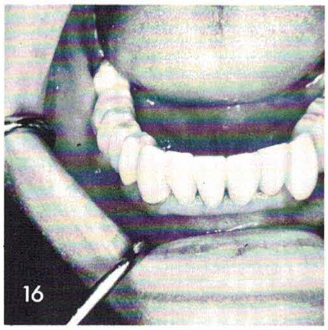
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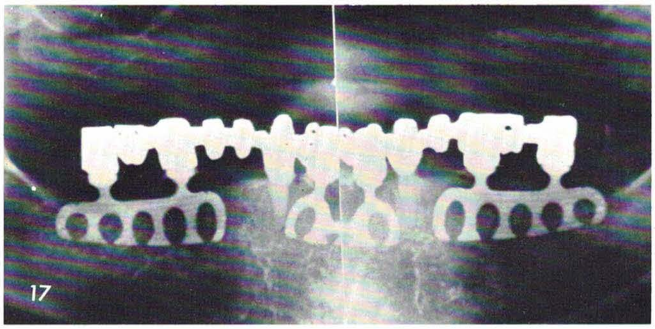
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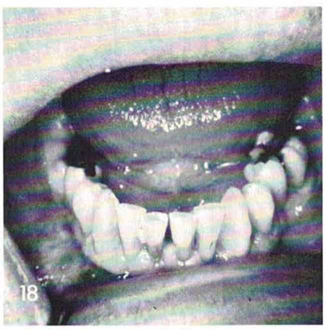
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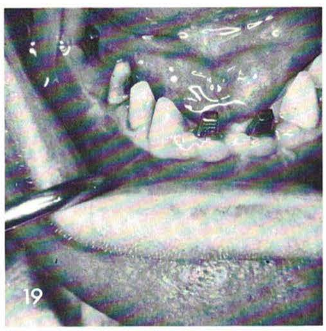
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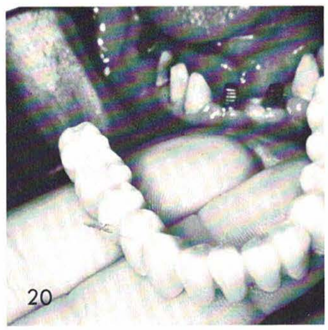
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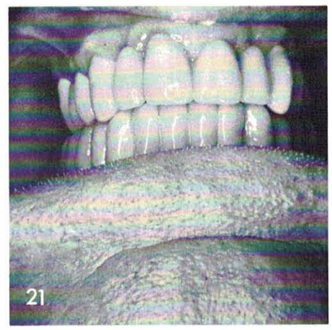
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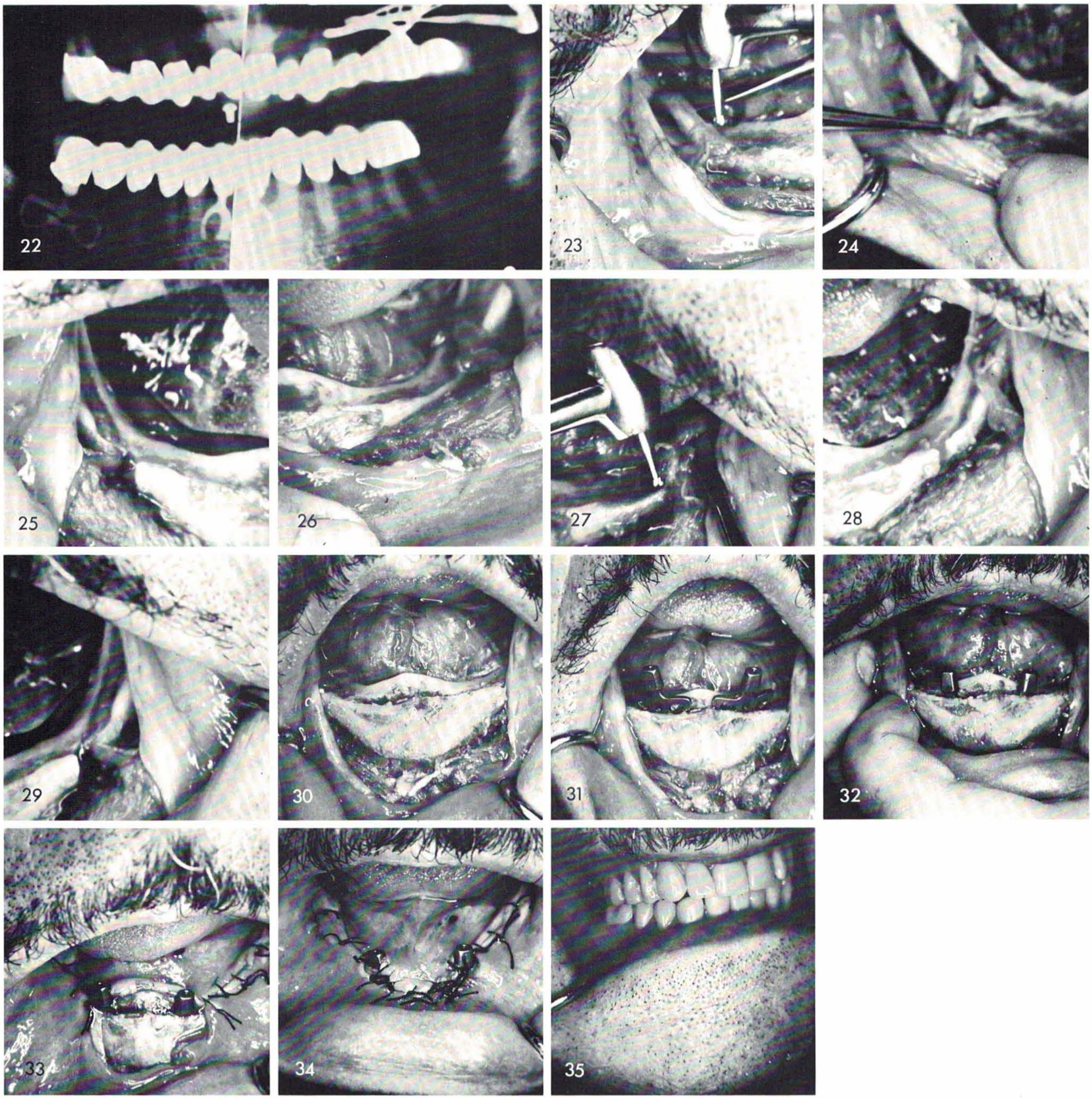
Midline blades are most often used in the form of a "socket blade" in between two cuspids immediately after the four periodontally involved incisor teeth are removed. Posteriorly, blades are also inserted in the edentulous areas, figs. 14, 15. A final acrylic over gold full arch fixed prosthesis was the material of choice, fig. 16. A final x-ray, fig. 17.

Similarly, a socket blade is inserted between both cuspids after the incisor teeth are removed and only one posterior blade is needed in the right posterior edentulous area, figs. 18, 19. The porcelain bridge is cemented as soon as possible, figs. 20, 21. An x-ray shows the completed case, fig. 22.



At times, due to extreme resorption of the posterior edentulous areas of bone the inferior alveolar nerves and the mental bundles are totally exposed, fig. 23. With a round bur, the author has often created his own inferior alveolar canal and mental foramen, fig. 24, into which the inferior alveolar nerve and mental branch were placed into, fig. 25.

The same is repeated on the other side of the arch, figs. 26, 27, 28, 29. Anteriorly where there still remains sufficient bone a groove is made, fig. 30, to allow the bladevents, fig. 31, to be tapped properly into the bone, fig. 32. The tissues are then sutured closed, figs. 33, 34, and a snap-on removable denture is fabricated, supported by the anterior blades, fig. 35.

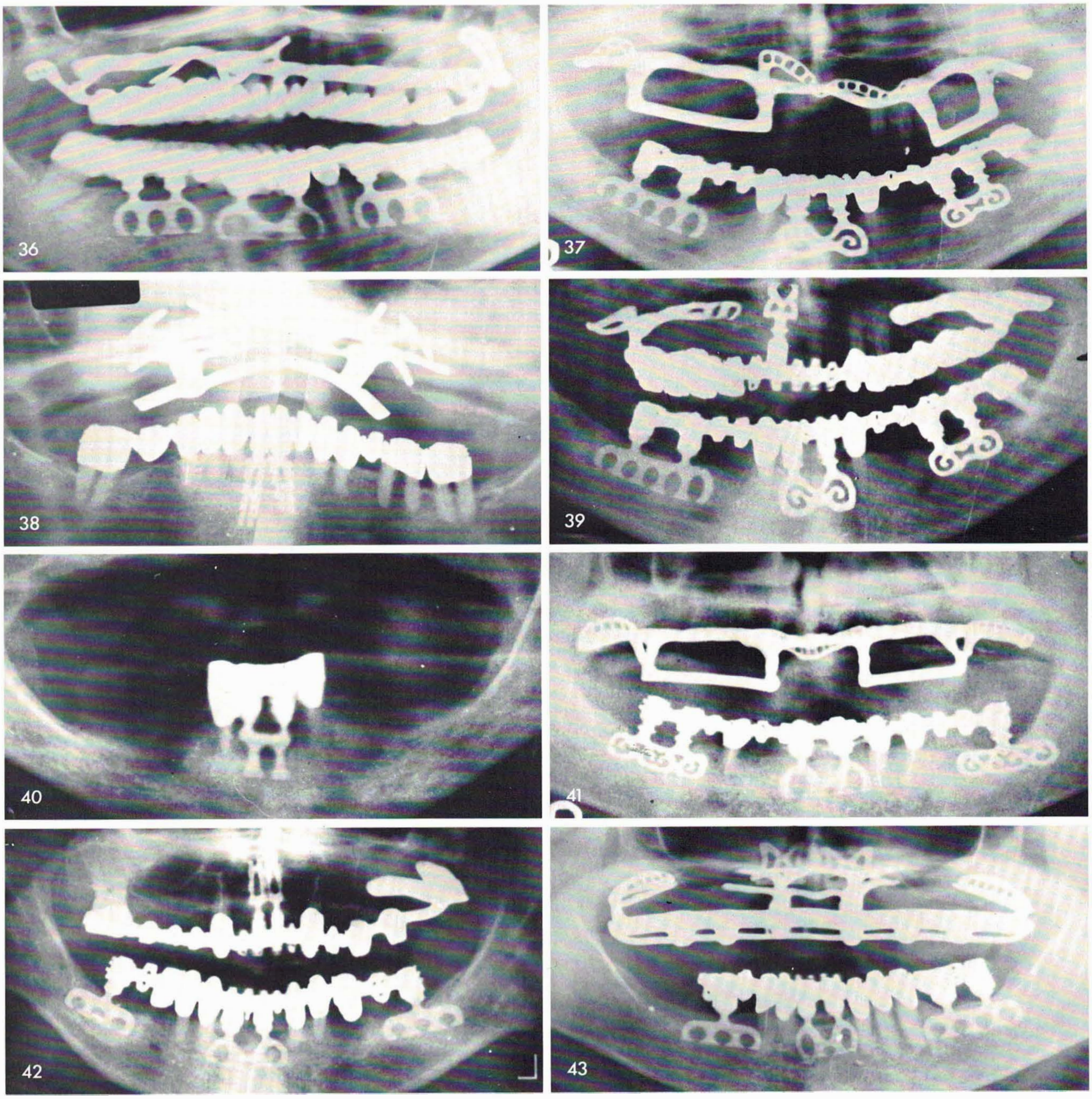
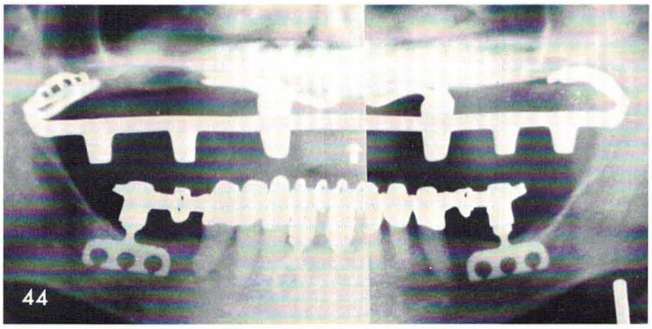


Fig. 36 through 45 shows x-rays of other mid-line cases.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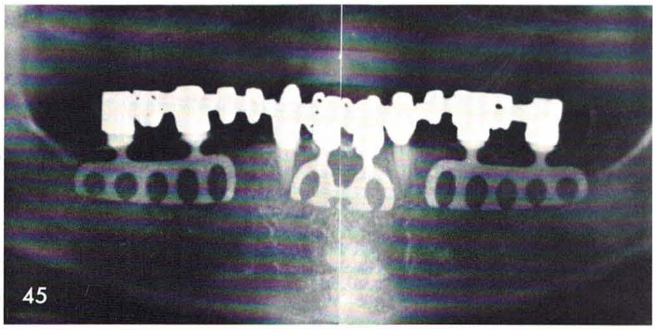
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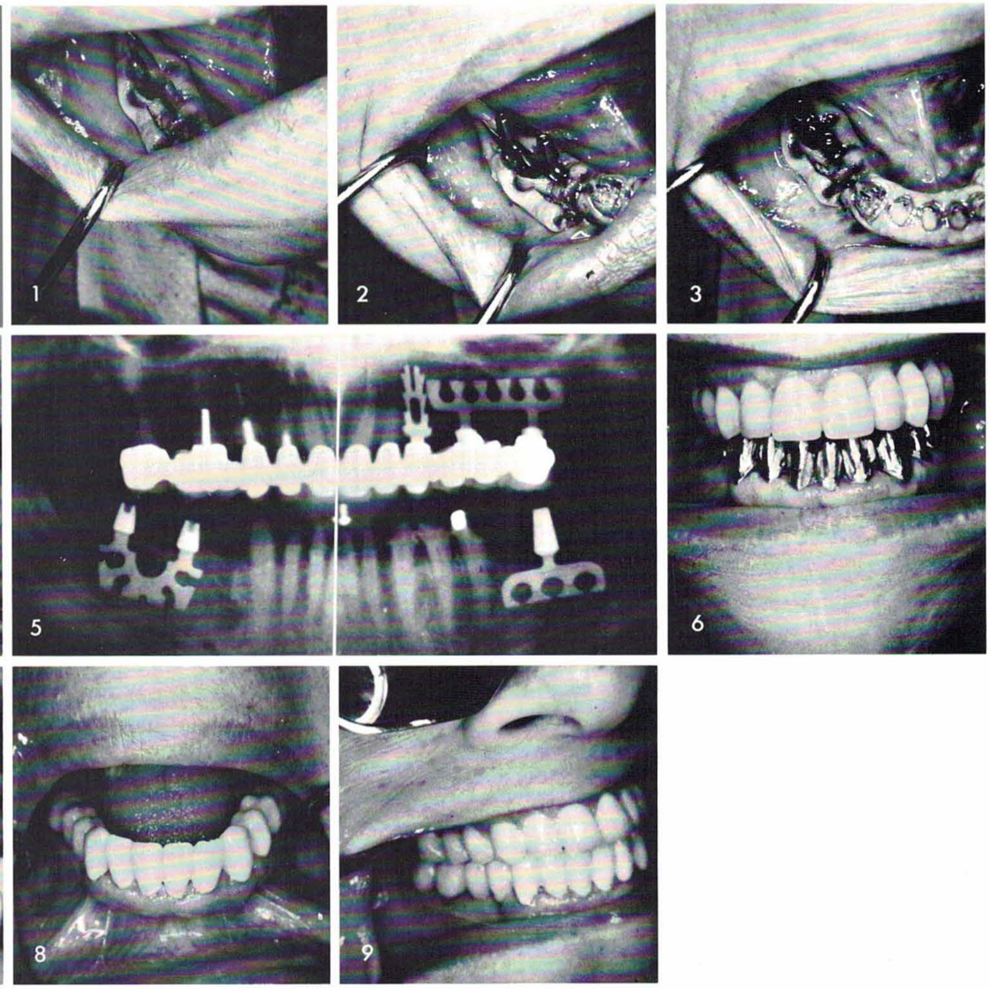
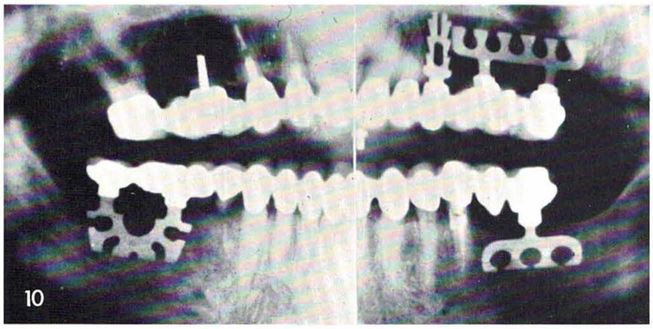
Posterior Socket Blades



As long as there is healed bone mesially and distally that flanks a socket created from an extracted tooth, screw type implants or vitreous carbon implants or a bladevent implant can be immediately inserted, fig. 1. The "socket" bladevent must, however, be tapped in such a manner that the recessed shoulder is at least 2 mm. below the lowest cortical plate that exists which is usually the buccal and both posts must rest on the alveolar crest mesial and distal to the socket, figs. 2, 3. In this manner bone will definitely grow over the shoulder of the blade and the soft tissues will heal uneventfully, fig. 4. An immediate x-ray shows the socket blade properly inserted, fig. 5. Castings are fabricated, fig. 6, and the completed prosthesis is completed and cemented, figs. 7, 8, 9. A final x-ray, fig. 10.



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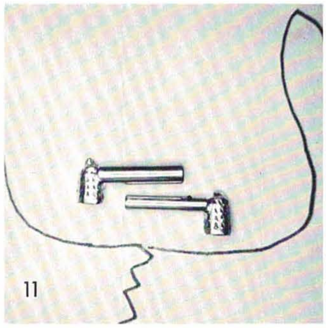

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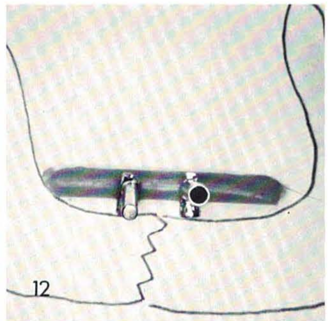

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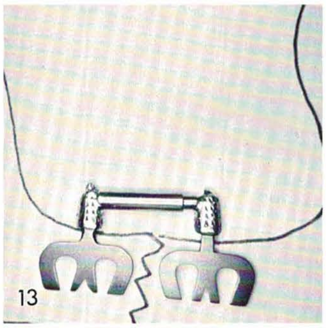

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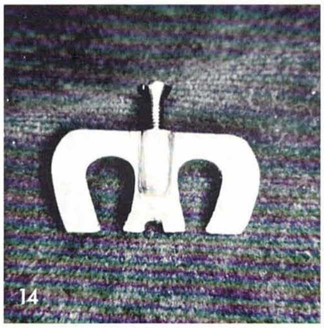

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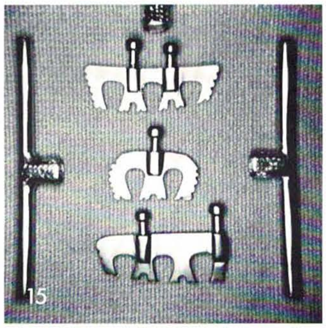

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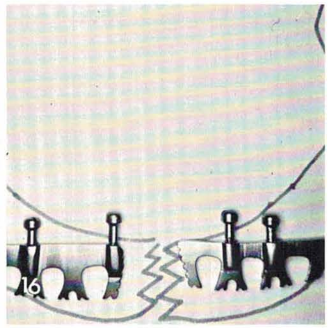

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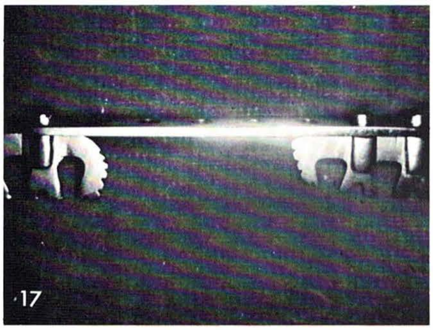

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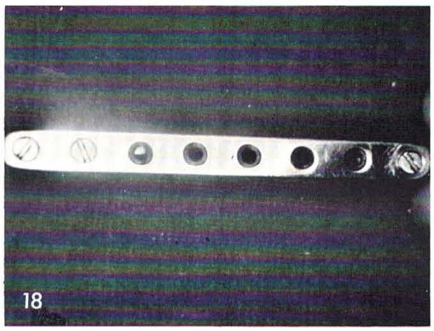

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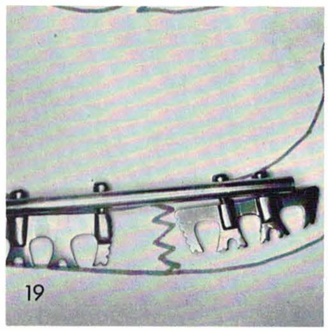
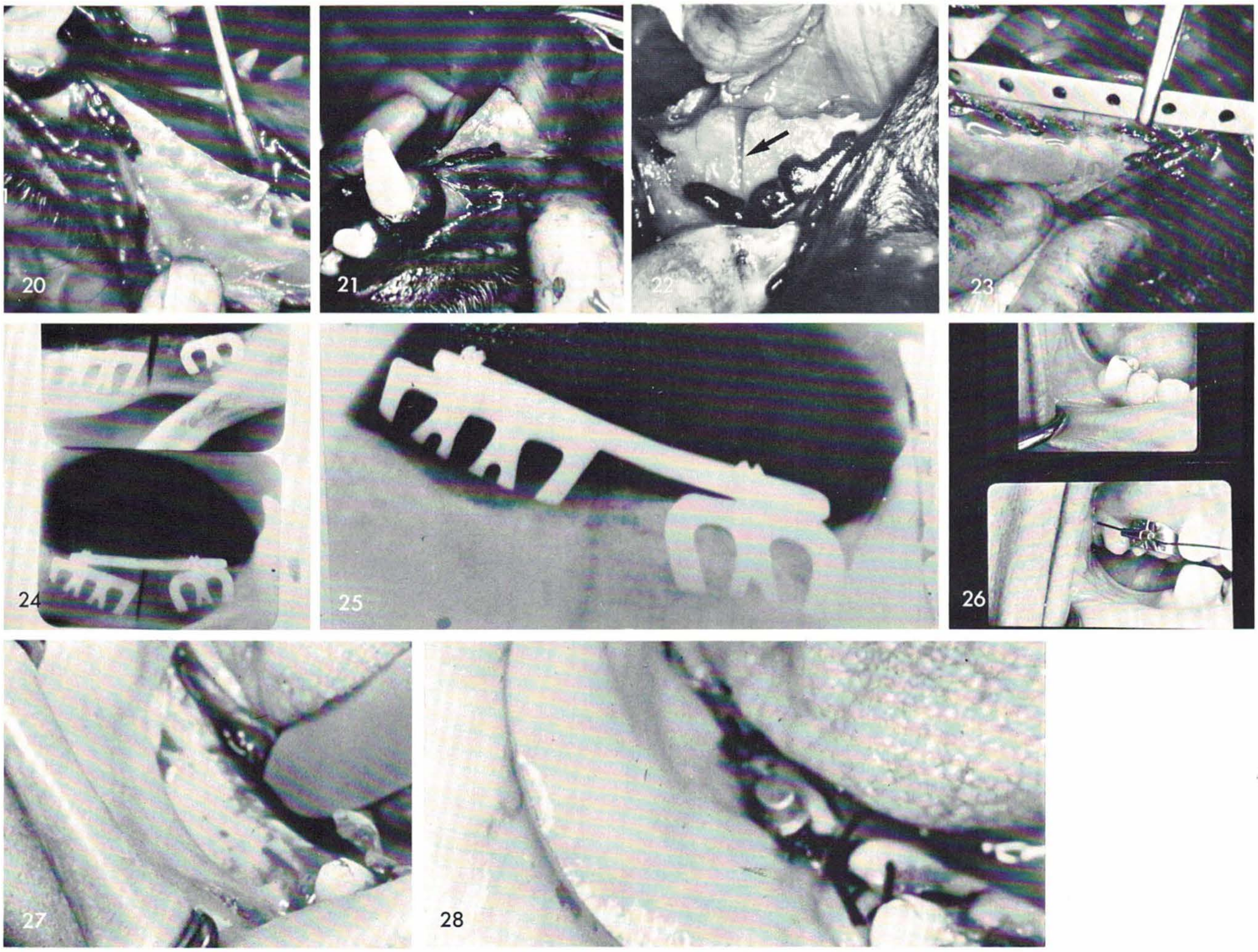


19

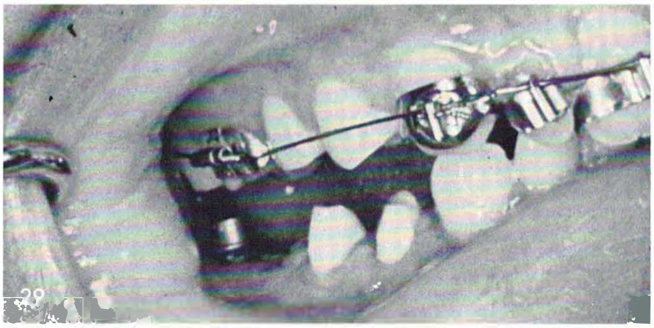
For symphyseal fractures in the midline area, the author had devised special copings, one with a solid round shaft, the other with a larger hollow tube, figs. 11, 12. By inserting a blade on each side of the fracture and immediately cementing the copings over the blade posts and cementing the solid shaft into the hollow tube after reducing the fracture, stabilization of the fracture is accomplished and the patient can open and close their mouth during the healing rather than having to drink through a straw for six to eight weeks with inter-maxillary wiring, fig. 13. I prefer, however, to use four blades in these situations.

The author had also devised blades with a hollow threaded body instead of a neck and post, figs. 14, 15, 16, which stabilize the fracture with orthopedic plates being screwed into the hollow threaded tubes of the blades, figs. 17, 18, 19.



A special case where the jaw of a dog was purposely fractured with a saw is seen in figs. 20, 21, 22.

Blades were inserted mesially and distal to the fracture and an orthopedic bar was used to splint the blades together, fig. 23. Various x-ray films show the immediate fracture, and the splinting of both blades, fig. 24. Eight weeks later a complete bony union had taken place even though one of the blades jarred loose, fig. 25. All during this time the dog was not restricted from normal chewing.



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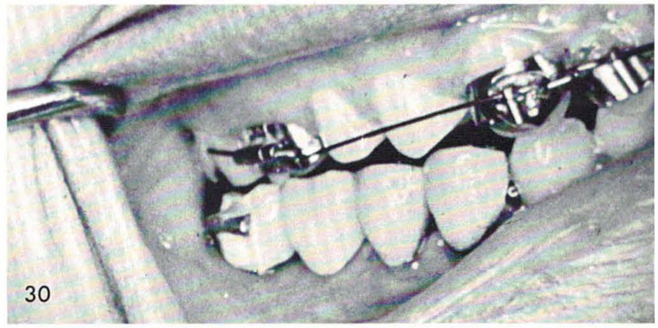

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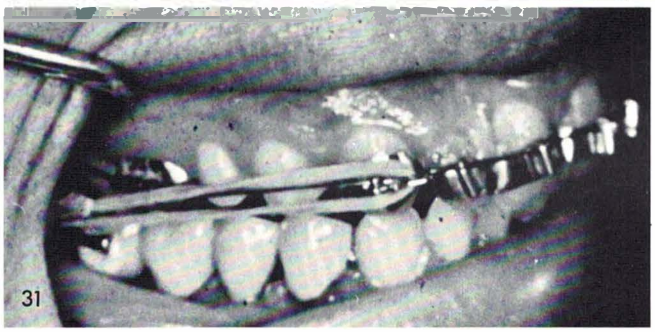
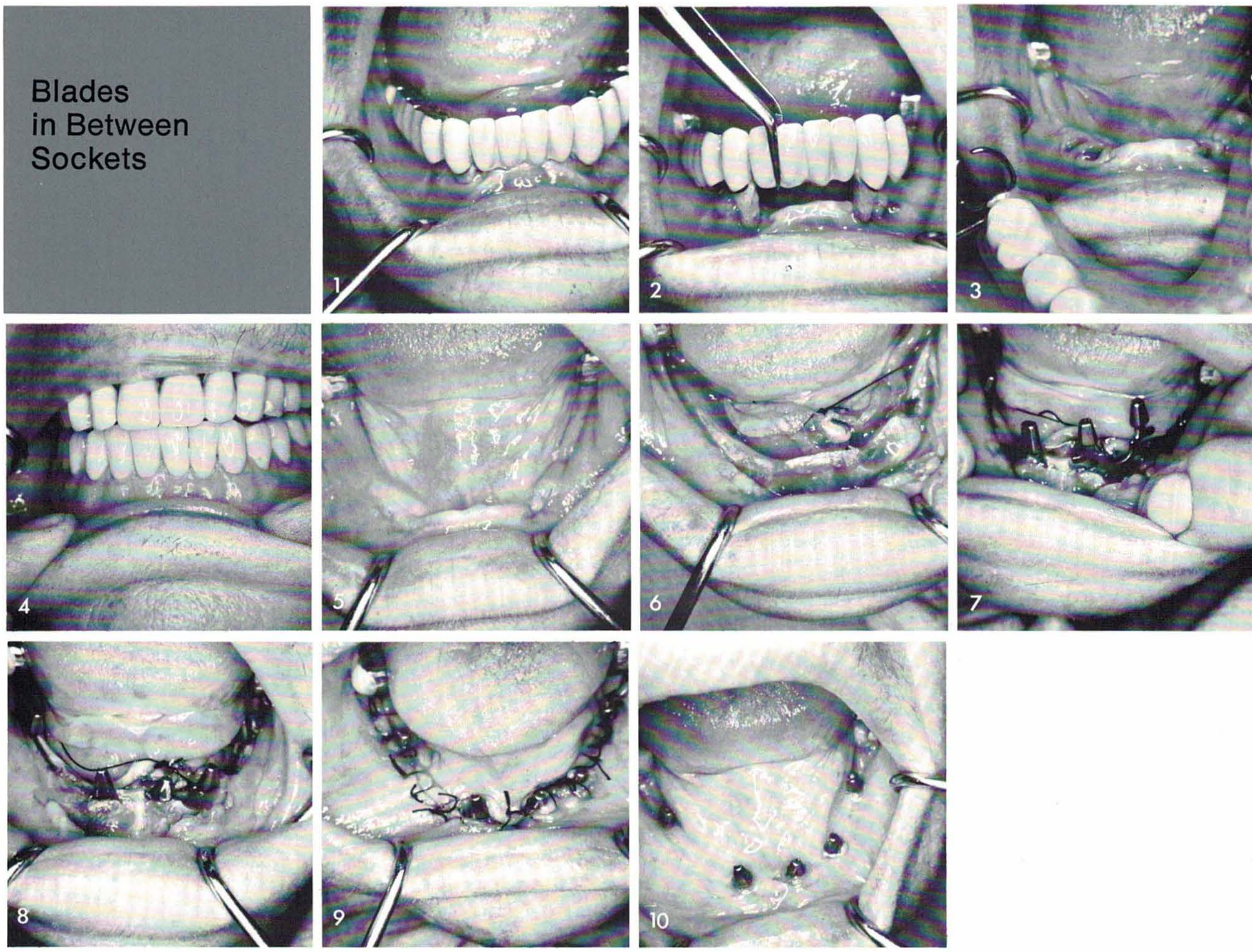


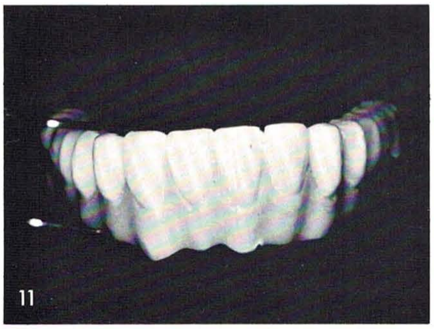
31

In orthodontics, also, bladevents have played an important role. In this particular case of a Class II division II malocclusion, blades were used on both posterior edentulous quadrants for the use of intermaxillary rubber bands, since the patient, who was an adult, refused to wear an extra-oral anchorage support, figs. 26, 27, 28, 29, 30, 31.

Blades in Between Sockets



In this particular case the loose teeth were able to be removed from their sockets by merely pulling out the original prosthesis, figs. 1, 2. An immediate removable partial denture was constructed until three months passed by for complete bony fill in of the sockets, figs. 3, 4. After three months went by, fig. 5, the tissues were incised and reflected, fig. 6, and blades were inserted in between the remaining sockets and directly into some of the sockets as seen by the socket blade in the left cuspid area, figs. 7, 8. The tissues were sutured closed, fig. 9. Two weeks later the tissues were completely healed, fig. 10. A specially designed full arch fixed prosthesis was processed. Being that so much vertical bone loss took place a false gum line had to be included in the design, fig. 11. This gum line, however, ended exactly where a natural crown would usually end at the gingival margins of the blade posts. The bridge was then cemented permanently into position, figs. 12, 13, 14, 15. A post-operative x-ray of this case, fig. 16.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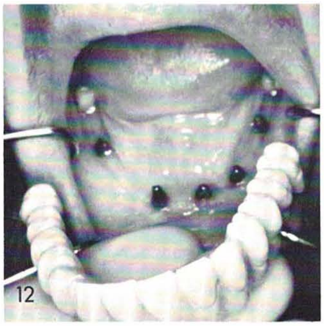
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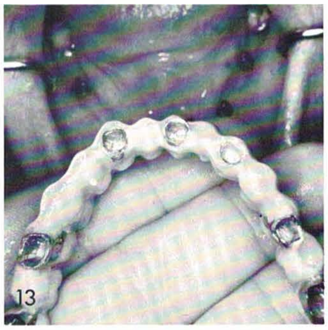
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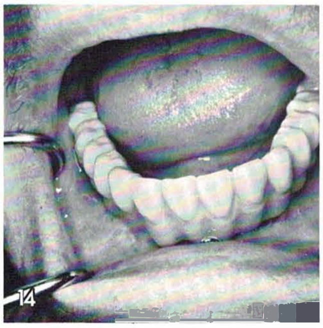
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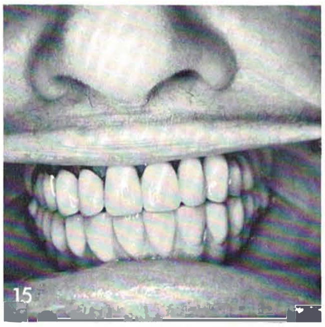
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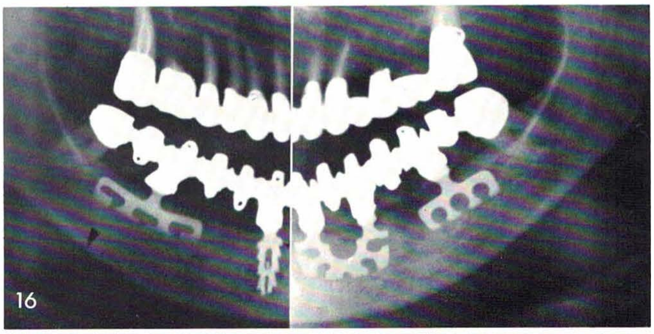
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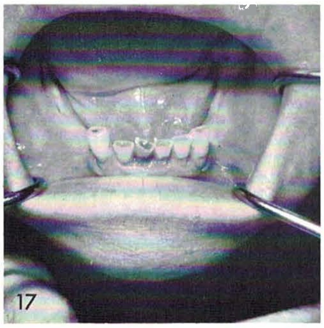
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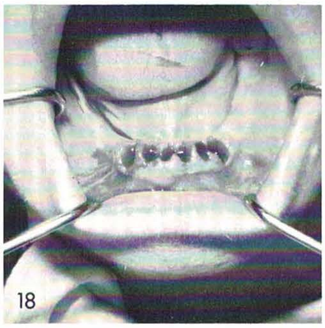
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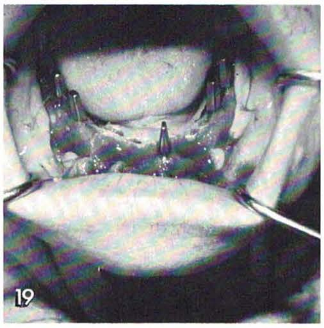
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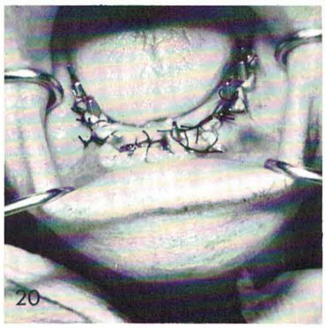
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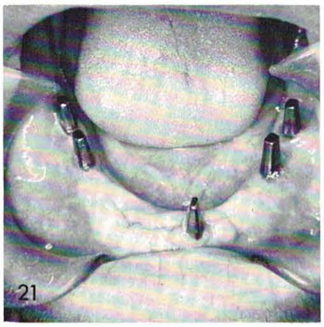
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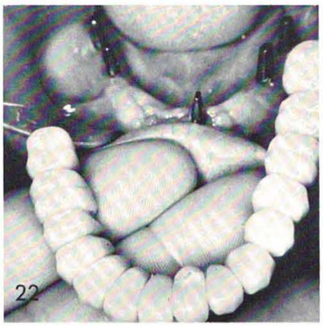
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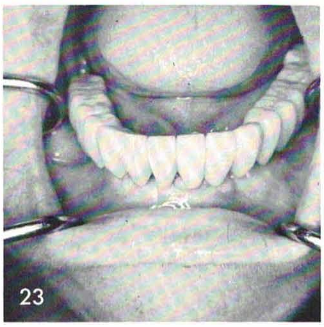
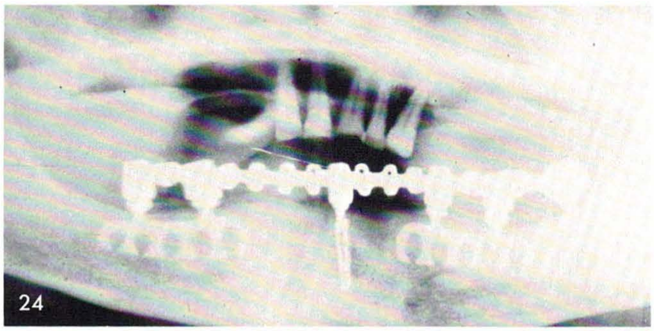

23

Extremely loose teeth must be extracted, figs. 17, 18. Whenever the sockets are too deep to insert blades a labio-lingual blade can be inserted in a labio-lingual direction directly into the intra-septal bone in between the sockets, fig. 19. After the tissues are sutured, fig. 20, and healing takes place, fig. 21, the completed prosthesis is fabricated and cemented into position, figs. 22, 23. A final x-ray shows the finished case, fig. 24.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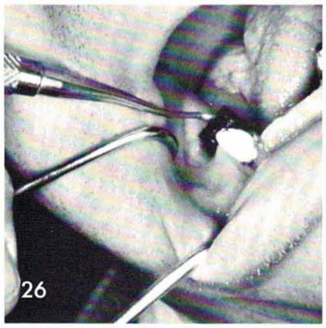
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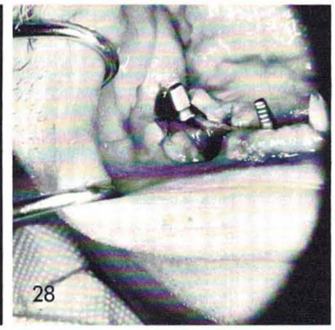
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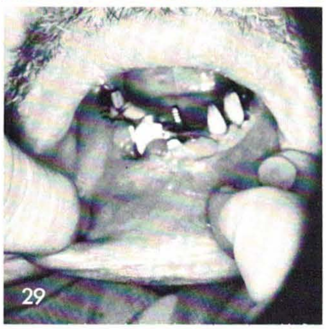
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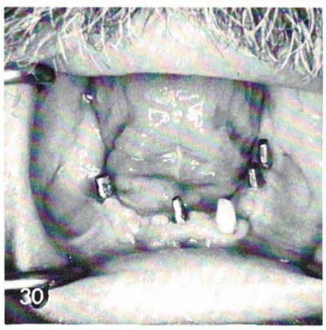
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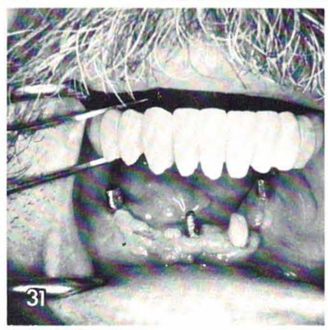
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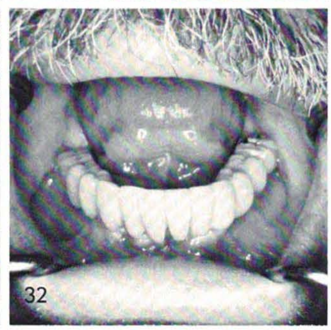
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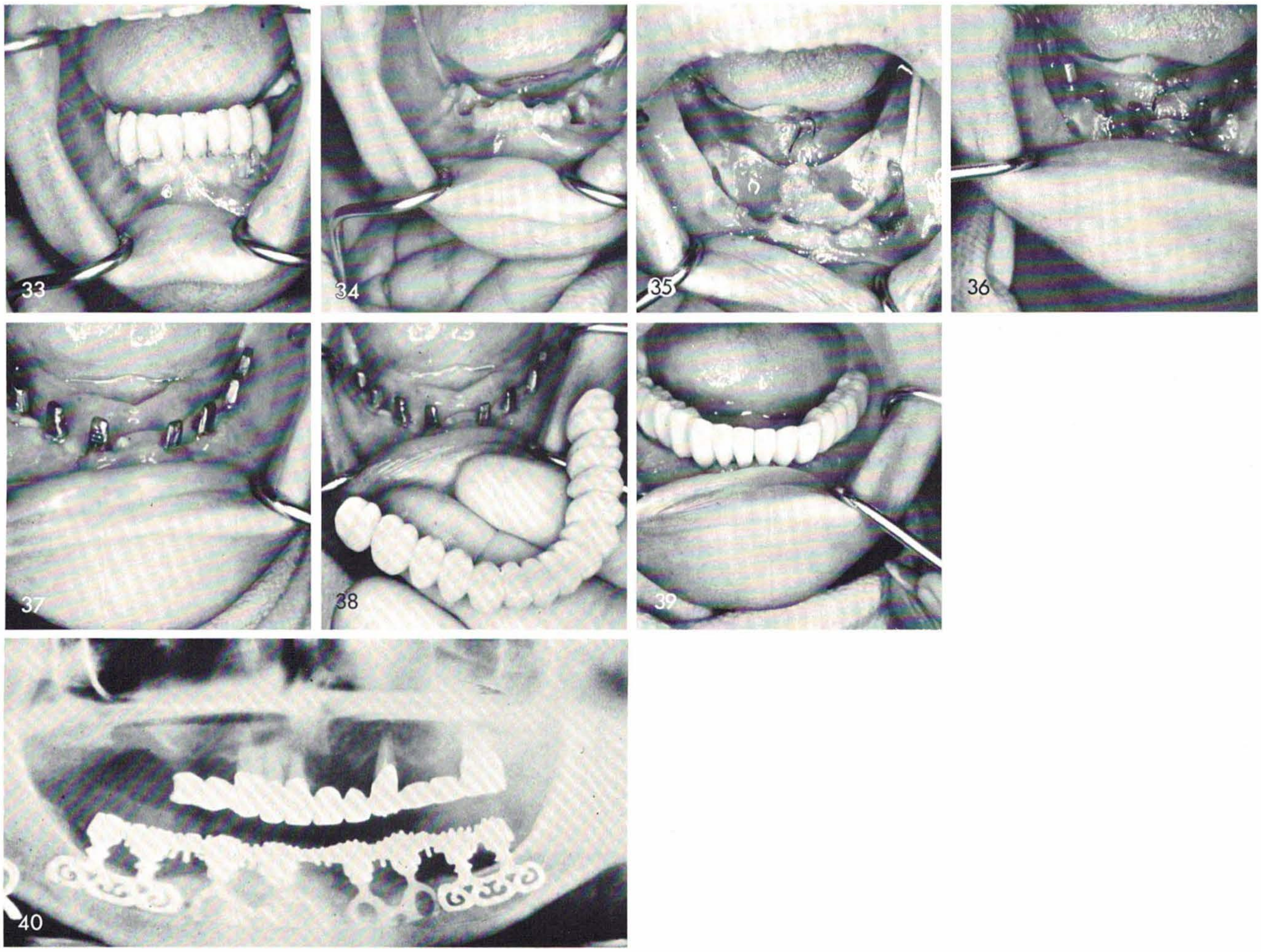
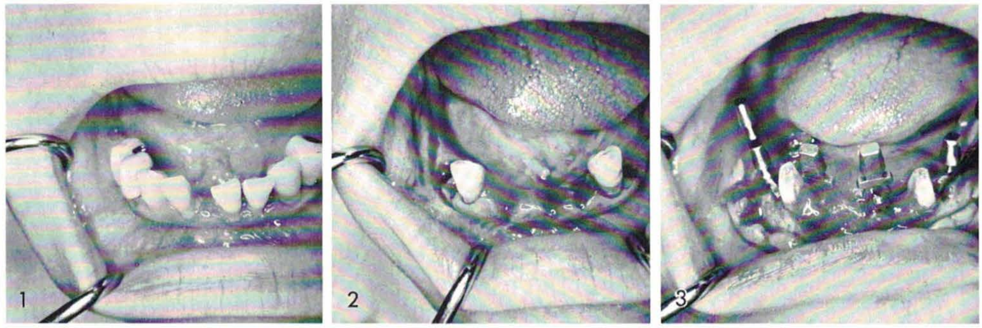
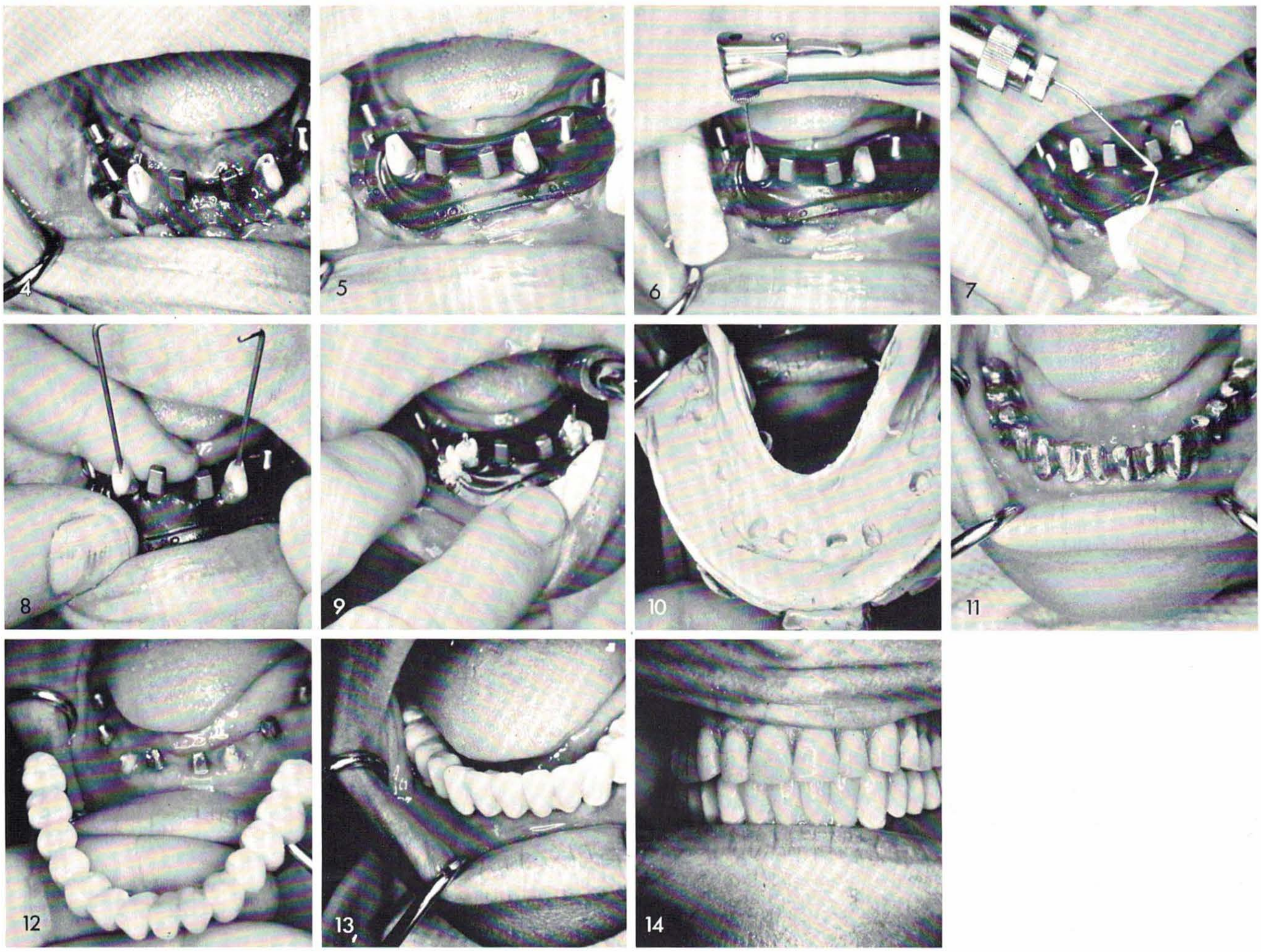
The next case shows a loose right cuspid and a failing vitreous carbon implant that was able to be lifted out of its socket with two fingers, figs. 25, 26. The massive amount of bone loss from both the over-retained tooth and the failing implant invaded a good portion of the labial and buccal plates of bone respectively, fig. 27. Bladevents were inserted mesially and distally to the sockets, fig. 28. Sterile plaster of Paris was used to fill up the socket to prevent epithelial invagination and increase rapid osseous regeneration, fig. 29. Healing was uneventful, fig. 30, and the acrylic over gold full arch fixed prosthesis was fitted and cemented, figs. 31, 32.



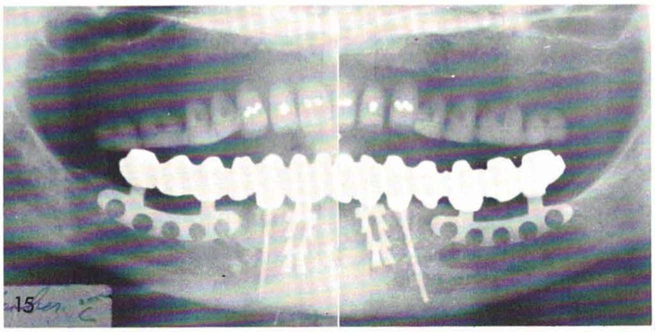
A severely periodontally involved mouth is seen in fig. 33. The remaining teeth were extracted, fig. 34, and the tissues were reflected and the sockets thoroughly enucleated of all granulation tissue, fig. 35. Notice also both mental nerve bundles. A double posted socket blade was inserted deeply into each socket to the left and right of the midline and regular type blades were inserted posteriorly, fig. 36. After sufficient healing of the soft tissues, fig. 37, the prosthesis was completed and cemented, figs. 38, 39. A post-operative x-ray, fig. 40.

Endodontic Stabilizers





In cases where only two periodontally remaining cuspids are to be used for support for a fixed prosthesis, figs. 1, 2, besides further support from blades inserted anteriorly and posteriorly to the cuspids, figs. 3, 4, a specially designed partial rubber dam, fig. 5, is often used during the cleansing out of the canals of the teeth and insertion of endodontic stabilizers, figs. 6, 7, 8, 9. After sufficient healing an elastic impression can be taken, fig. 10, to facilitate the final bridgework, figs. 11, 12, 13, 14. A seven and one half year old x-ray shows the results, fig. 15.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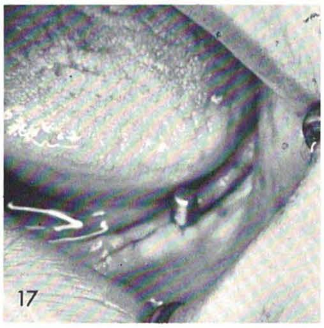
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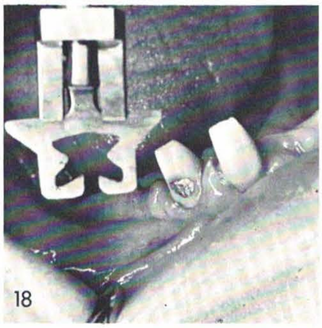
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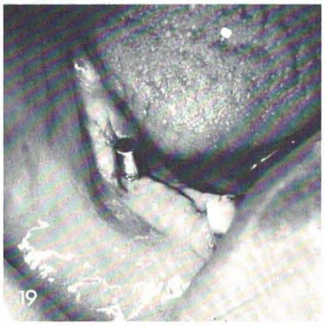
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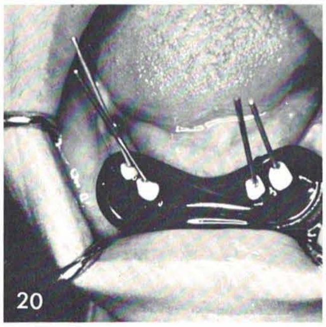
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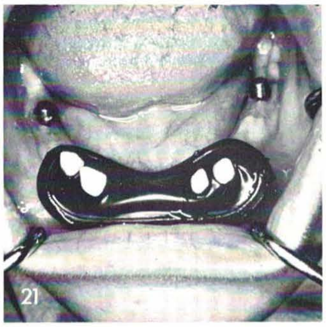
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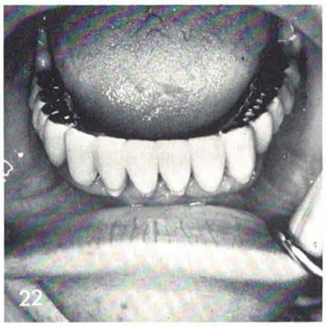
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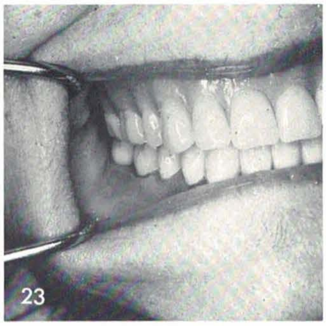
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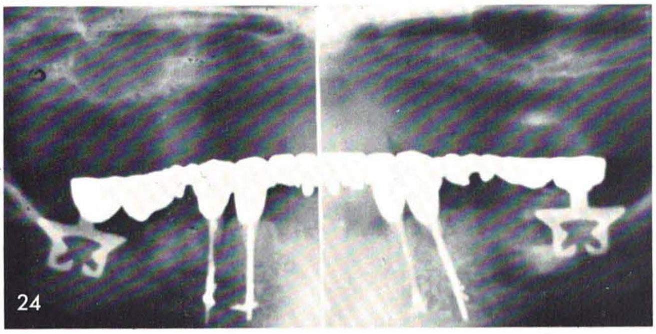
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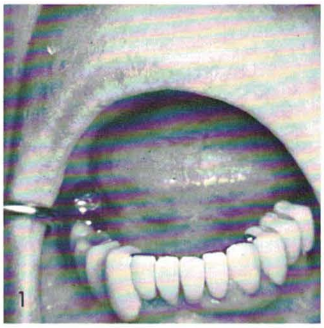
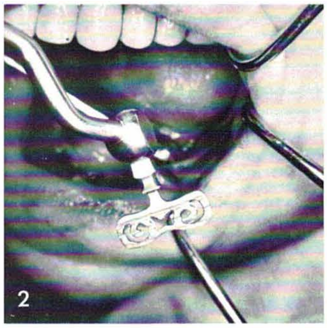
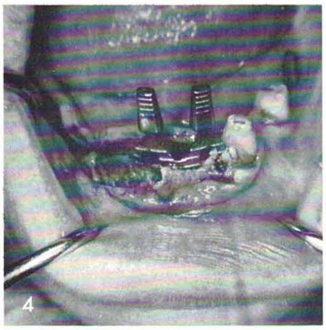
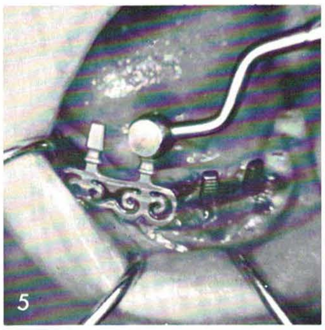
Similarly, other cases involving knife edge ridges posteriorly can still accept blades, figs. 16, 17, 18, 19. Anteriorly, without the use of midline blades, lengthening of the roots of the remaining teeth mechanically with the introduction of endodontic stabilizers helps to further the overall support of the entire prosthesis, figs. 20, 21. The completed prosthesis in place, figs. 22, 23, and the post-operative x-ray, fig. 24.

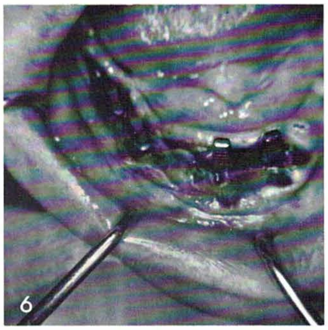
Miscellaneous Situations

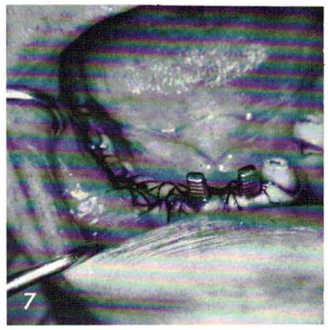


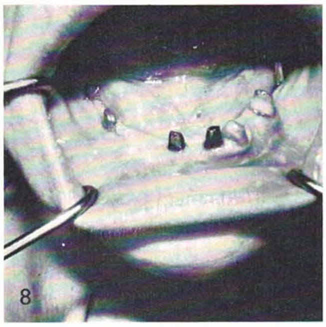


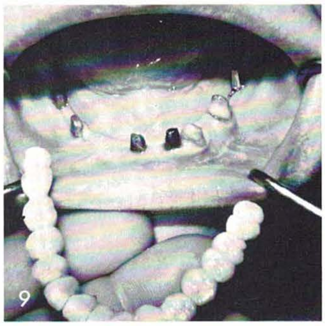


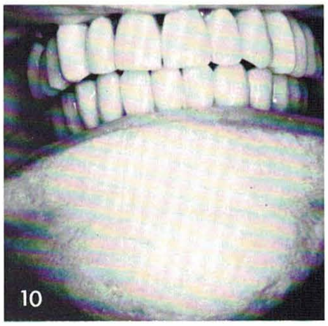


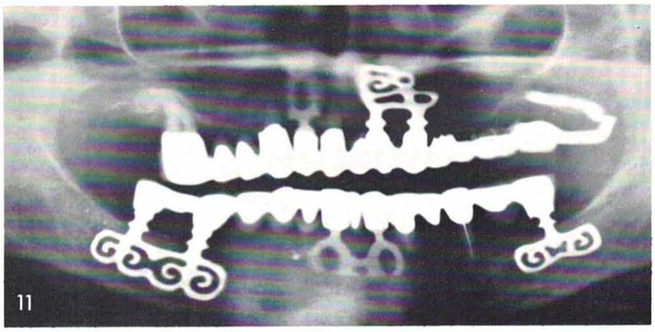




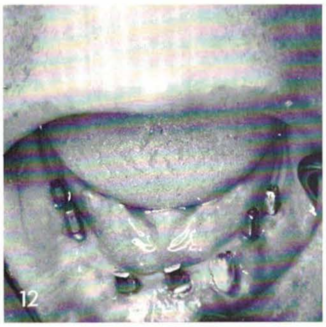








A failing full arch fixed prosthesis required its removal, fig. 1. With only two teeth worthwhile to save, bladevents were inserted into pre-determined grooves around the arch, figs. 2, 3, 4, 5, 6, and the tissues were closed with triple 0 silk sutures, fig. 7. The healing was rapid and uneventful, fig. 8. A full arch porcelain-baked-to-metal restoration was cemented into position, figs. 9, 10. A post-operative x-ray, fig. 11.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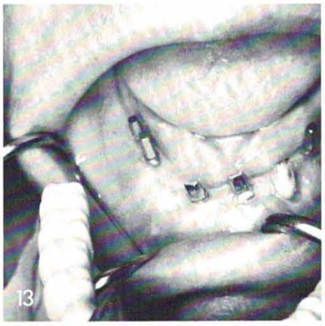
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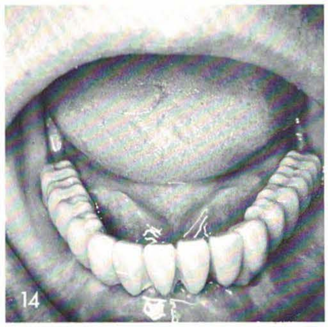
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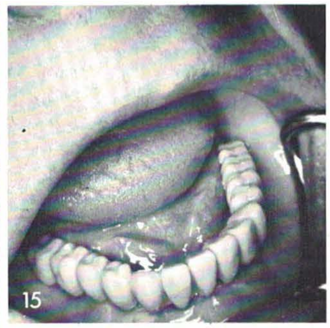
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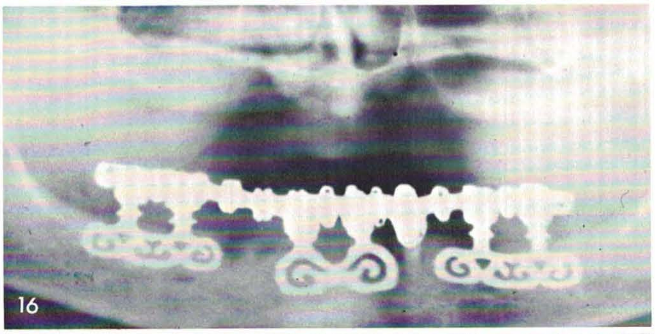
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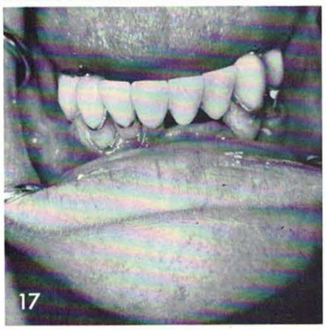
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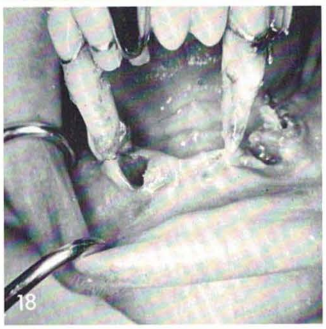
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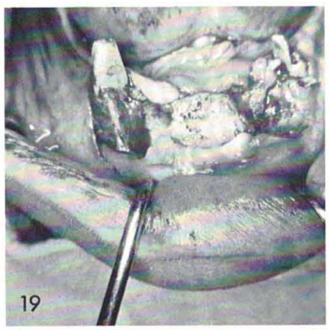
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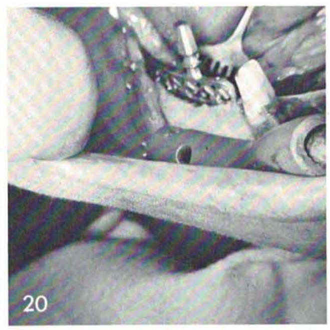
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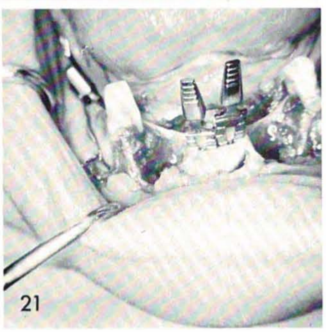
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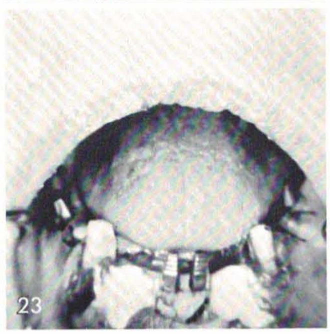
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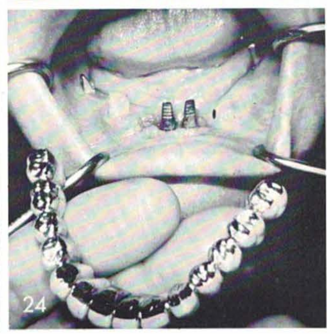
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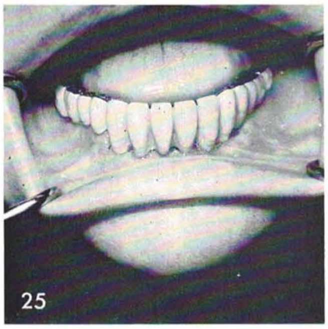
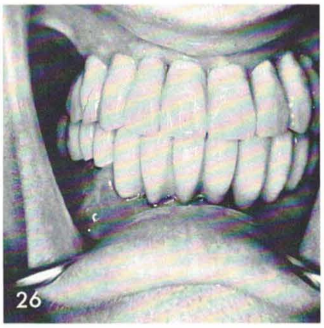
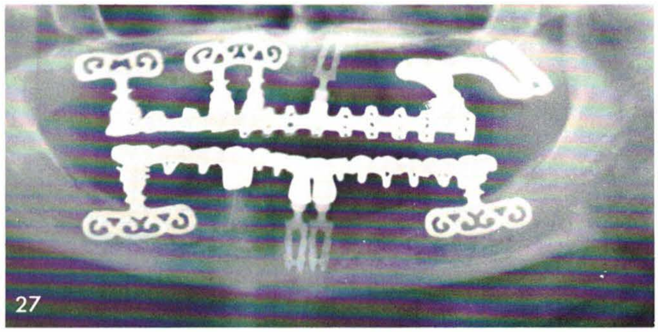
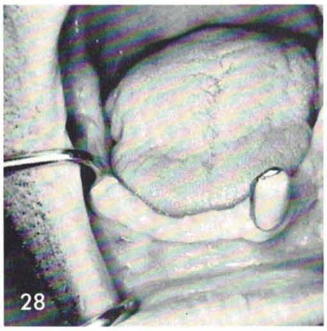
With only one tooth remaining, blades should be inserted around the arch with as much symmetry as possible, fig. 12, to give better support to the fixed prosthesis, figs. 13, 14, 15. A post-operative x-ray, fig. 16.

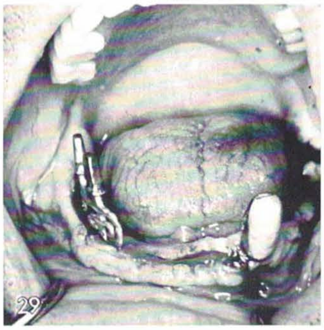
Severely periodontally involved teeth can often be removed by hand with the bridgework still attached and intact, figs. 17, 18. Over-retained periodontally involved teeth involve the labial rather than the lingual plate of bone as is clearly seen in fig. 19. Blades are inserted posteriorly and anteriorly to the remaining two abutments, figs. 20, 21, 22, and sterile plaster of Paris is carefully placed inside the sockets, fig. 23. Healing is excellent except that it was later decided

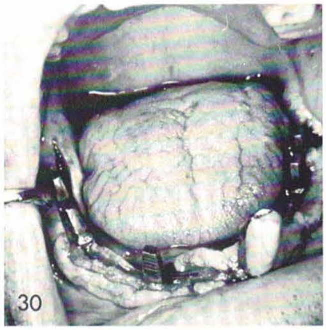


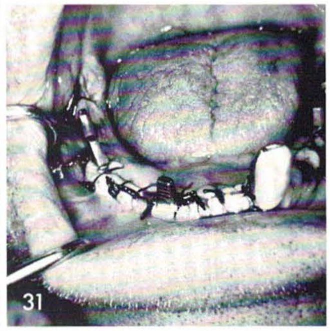


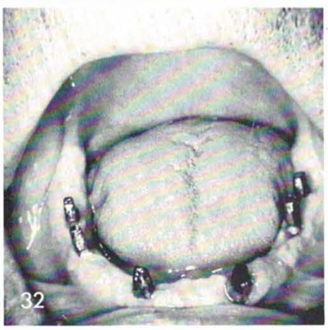


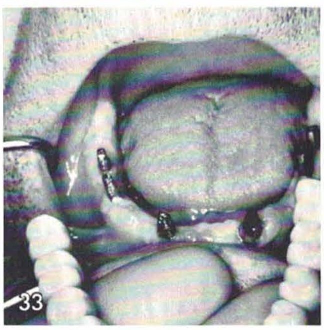


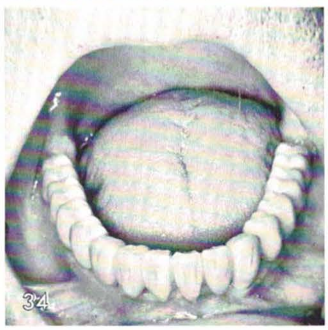


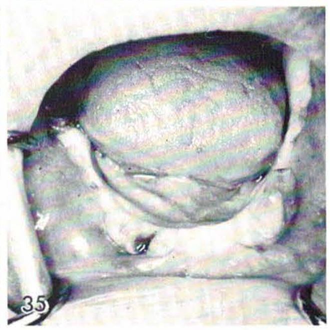


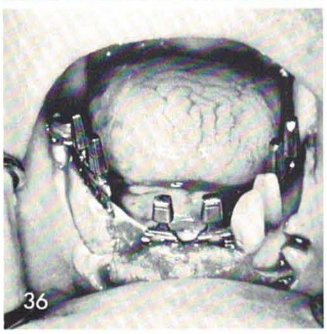


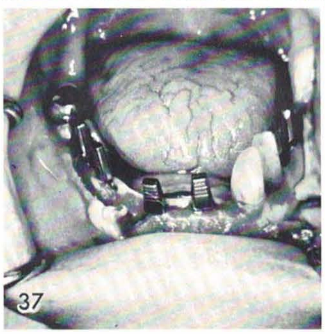


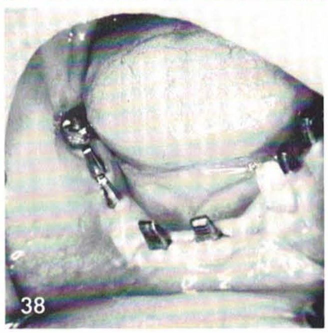


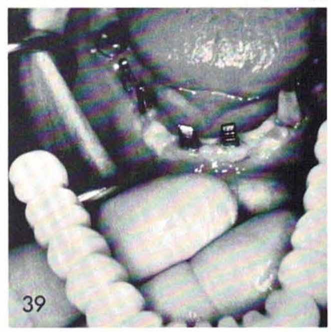






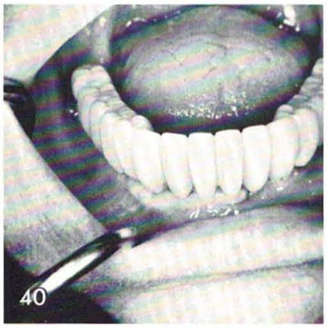






to remove the remaining left tooth, fig. 24, and the prosthesis was cemented, figs. 25, 26. A final x-ray shows the healing of bone inside the large sockets, fig. 27.

Even in knife edge ridges with only a single tooth remaining, fig. 28, blades can often solve the problems, figs. 29, 30, 31. After healing and preparation of the remaining left cuspid for a full crown restoration, fig. 32, the fabricated prosthesis is adjusted and cemented, figs. 33, 34. A long span existed between the two teeth on the left and the third molar on the right side of the arch, fig. 35. Blades were inserted, figs. 36, 37, and during the healing it was decided to remove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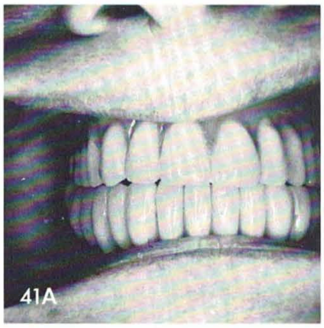
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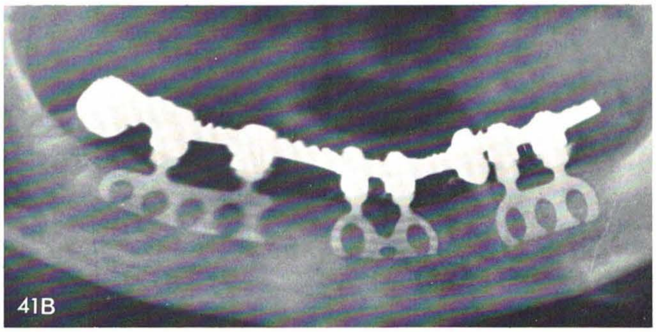
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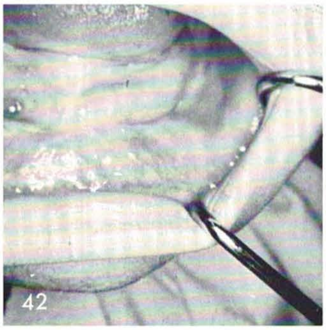
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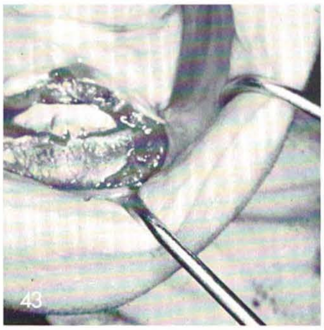
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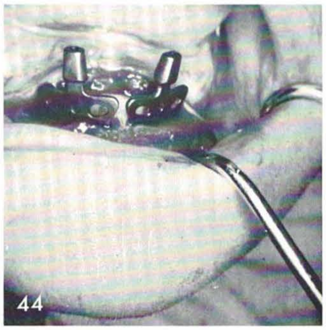
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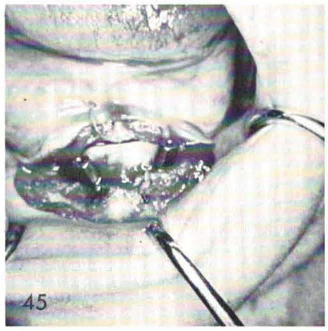
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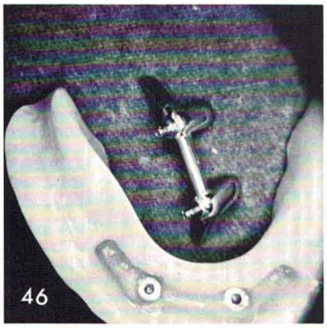
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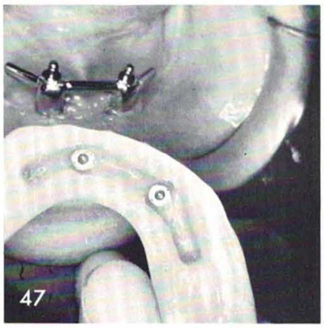
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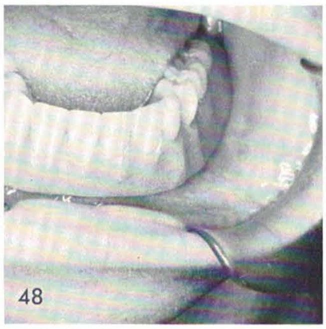
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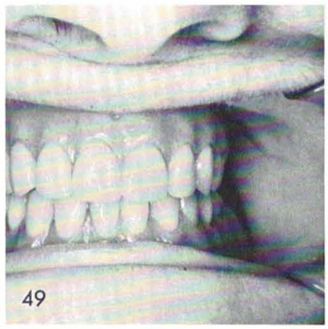
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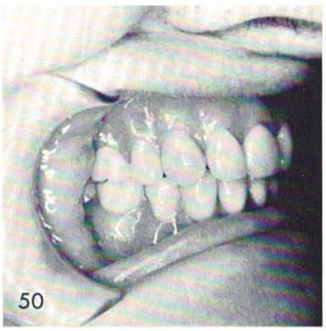
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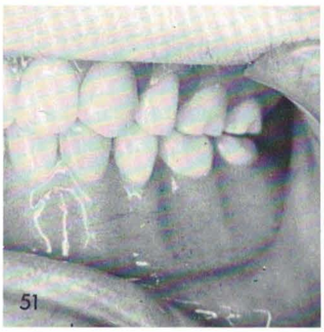
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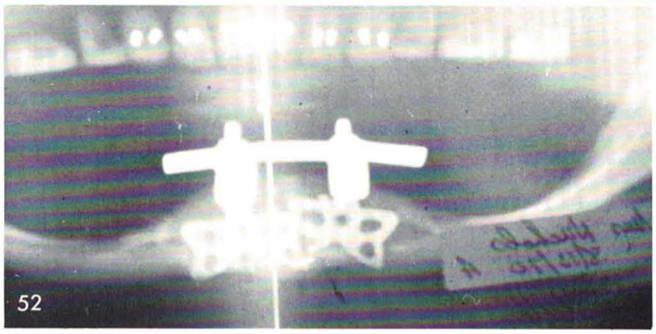
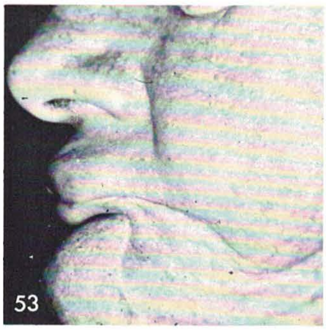

52

the periodontally involved left cuspid, fig. 38. Another full arch fixed restoration was inserted and cemented, figs. 39, 40, 41A, 41B.

Sometimes, but not too often, in a totally edentulous mandible, fig. 42, the insertion of two anterior blades, figs. 43, 44, 45, can be enough to stabilize a denture, especially when no bone exists posteriorly. Splinting the blades to each other with a Dolder bar with resilient Gerber attachments, figs. 46, 47, to take the pressure off of the implants, can sometimes serve the purpose, figs. 48, 49, 50, 51. A post-operative x-ray of the case, fig. 52.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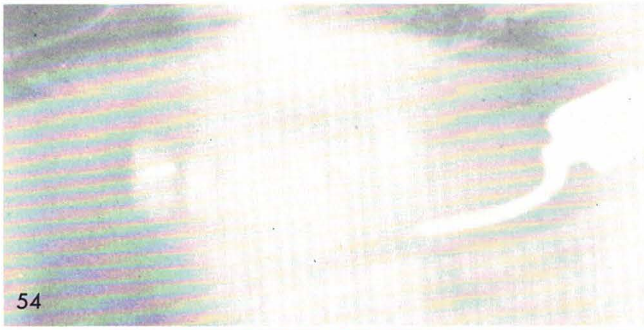
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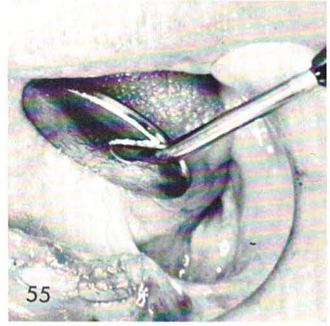
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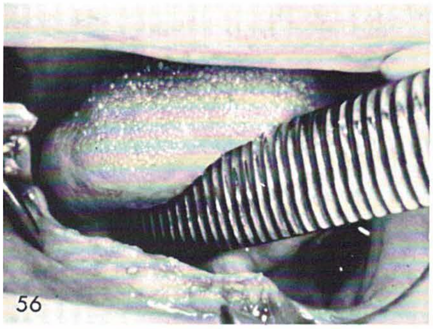
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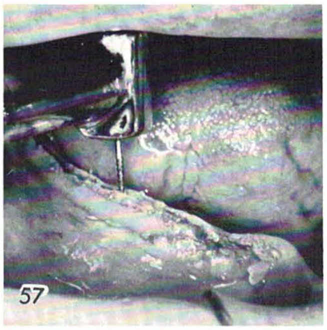
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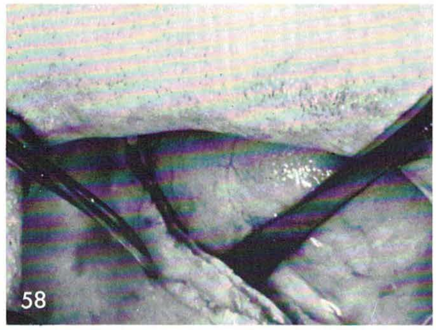
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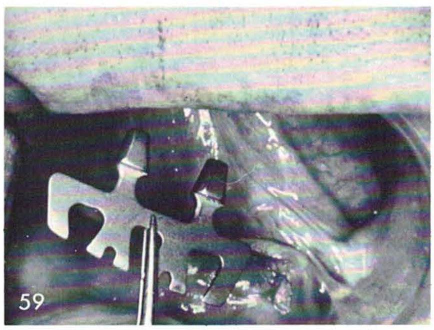
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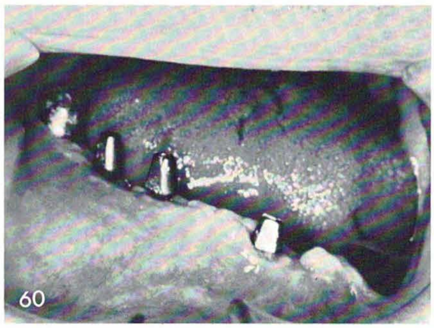
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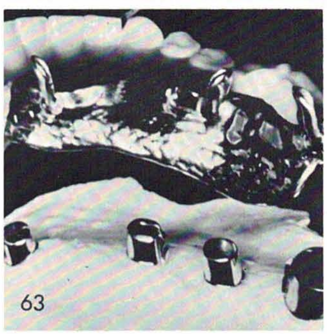
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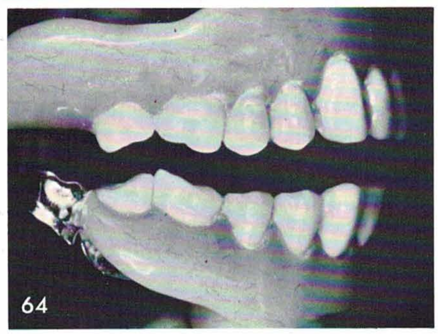
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A patient with the entire left body and ramus of the mandible removed was helped considerably for several years before he deceased, fig. 53. A single molar tooth remained on his right side, fig. 54. The tissue was incised and reflected, figs. 55, 56, and a long groove was made along the entire length of the remaining half of the mandible, figs. 57, 58. Blades were carefully placed into the deepened socket, fig. 59. The tissues healed remarkably well, fig. 60. Notice the gold telescopic coping over the remaining molar tooth. Fig. 61 shows a periapical film revealing both blades. Copper bands festooned, shaped and filled with rubber material, fig. 62, were used in conjunction with a full arch rubber impression inside a tray to facilitate the laboratory procedures

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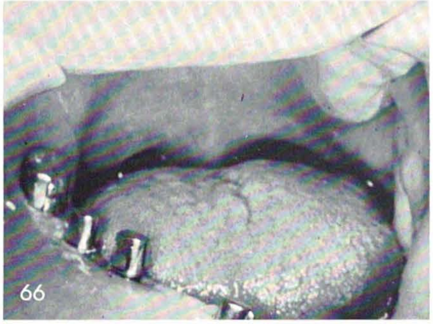

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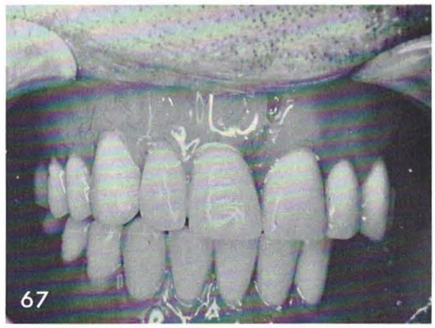

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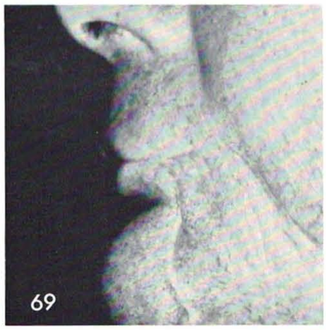

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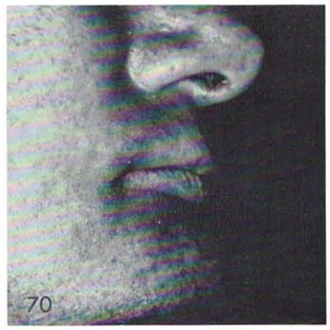

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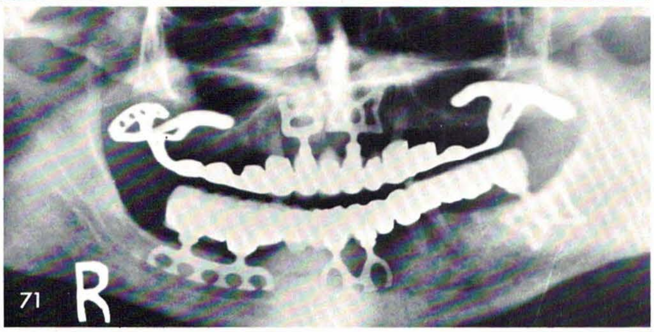

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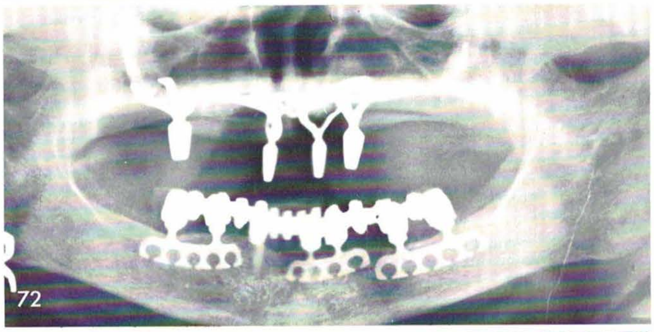

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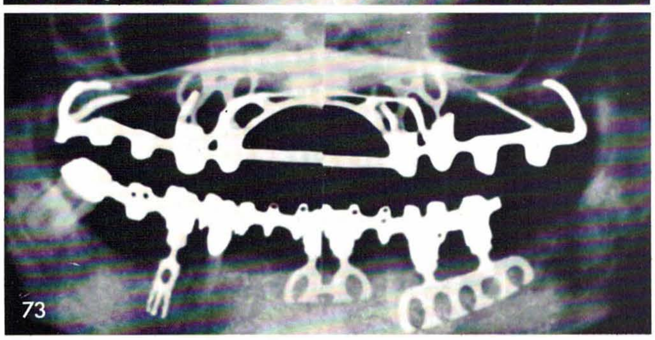

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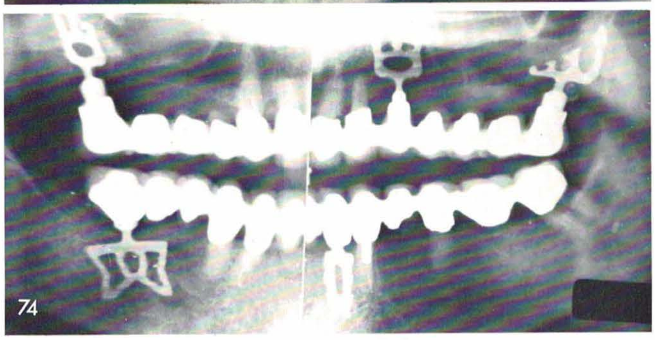
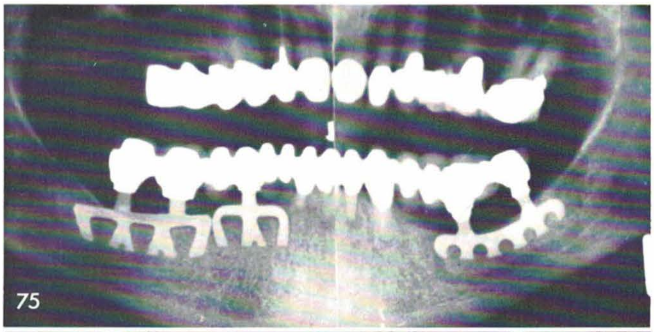


74

which included a gold coping mesostructure with special built-in attachments for a removable prosthesis with passive type swing-lock attachments, figs. 63, 64. The missing left side of the mandible was filled up with a bulbous type extension off of the left side of the removable prosthesis, fig. 65. The gold copings were cemented over the implant posts and over the telescopic coping covering the molar tooth, fig. 66, and the prosthesis placed over them, fig. 67. Fig. 68 shows a post-operative x-ray.

The left side of the face with restoration, fig. 69. The right side, fig. 70.

Figs. 71 through 81 show other atypical cases.



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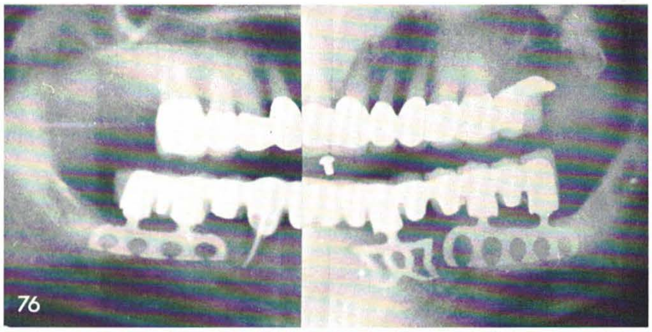

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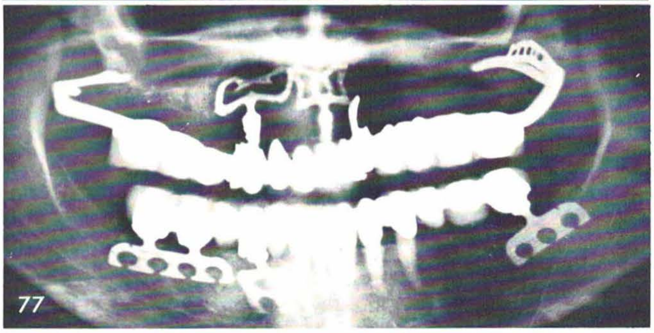

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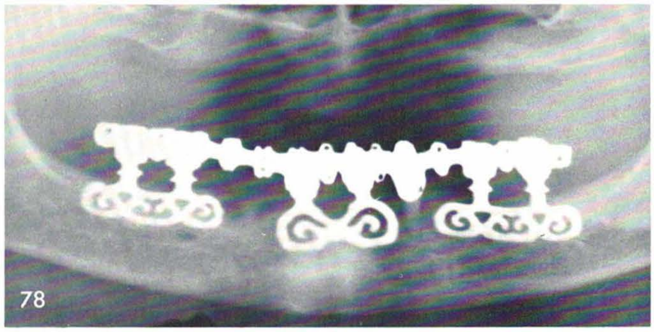

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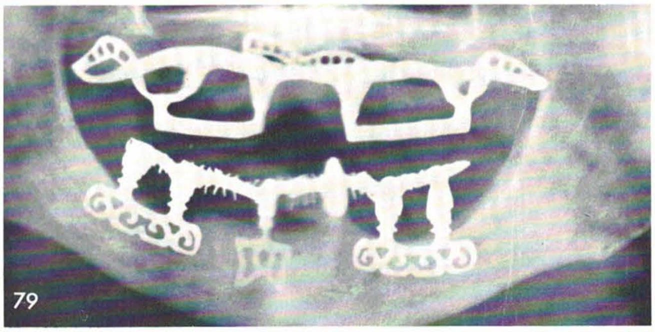

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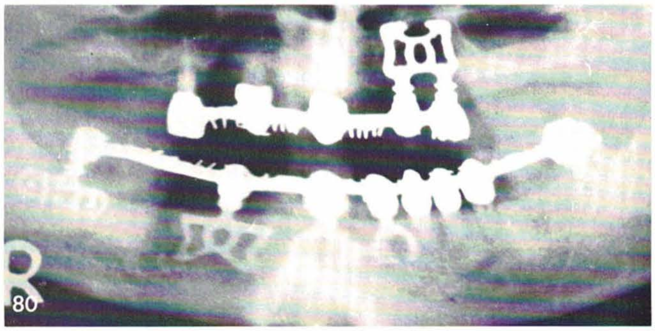

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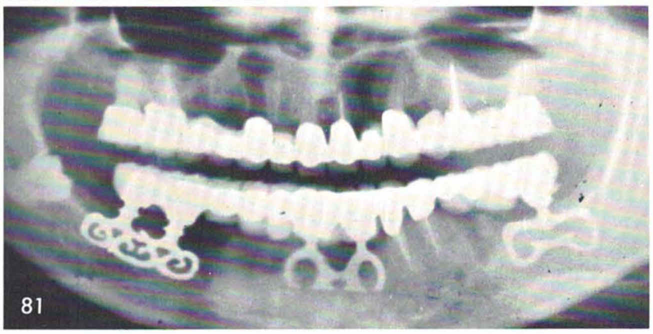
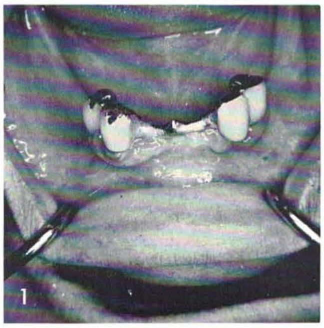
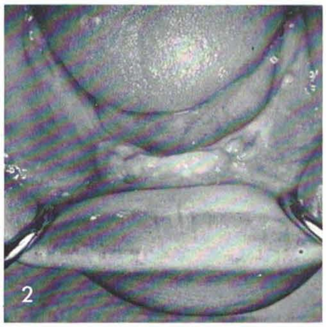
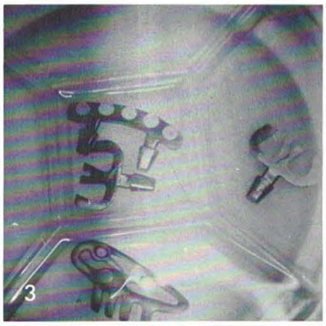
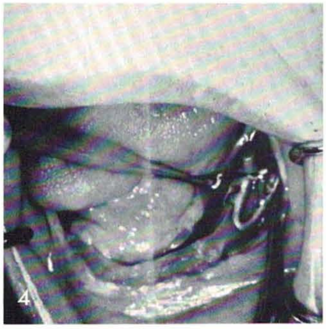
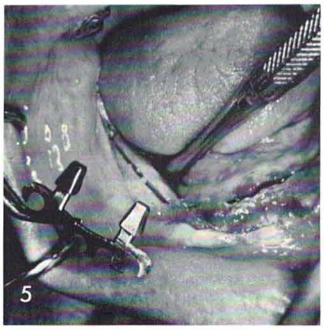
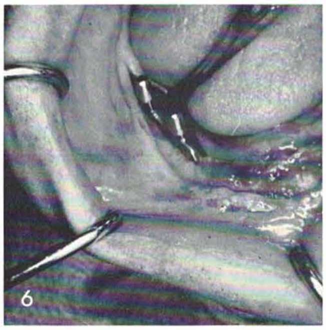
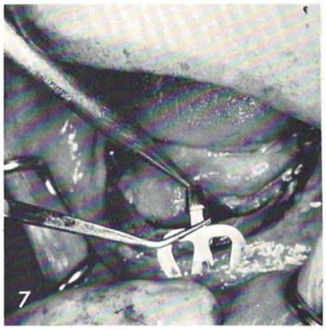
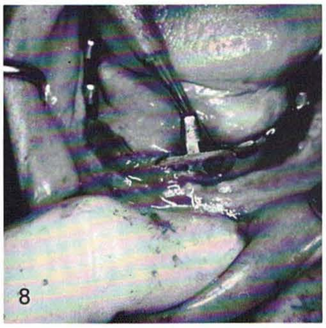
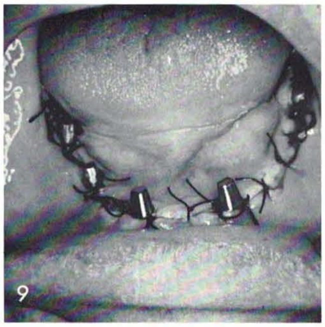
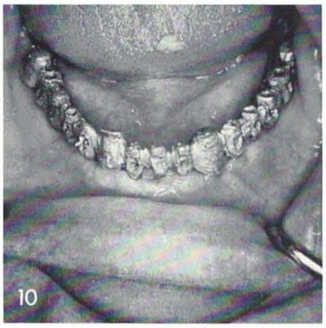
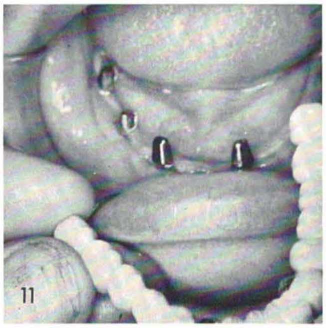
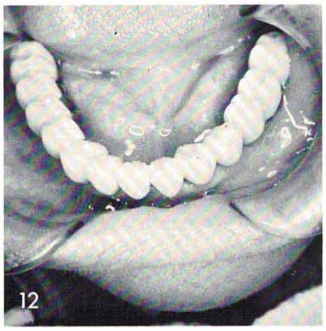
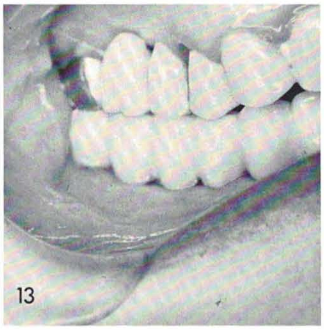
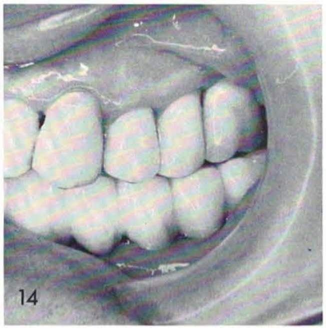
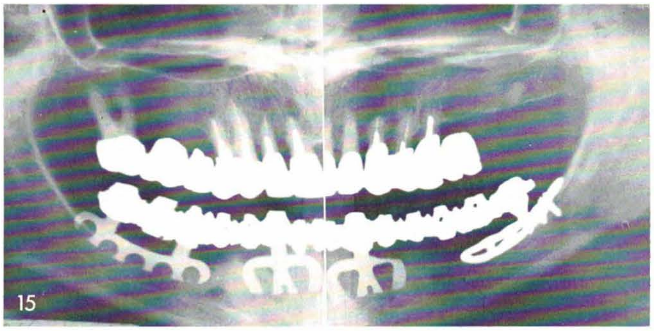


81

Combinations of Blades and Subperiosteals

In this situation all remaining teeth had to be extracted, figs. 1, 2. A partial bone impression on the left posterior quadrant was taken for a unilateral subperiosteal implant since not enough bone existed in that area for a blade. Fig. 3 shows the subperiosteal implant and the desired blades that were to be used. The subperiosteal implant is always tried in before the blades are inserted to make sure of its proper fit, fig. 4. Grooves were then made into the crestal bone for the insertion of three blades, and the tissues were sutured together, figs. 5, 6, 7, 8, 9. Soldered gold copings were fitted over the implants, fig. 10. By the fourth week, the prosthesis was ready for cementation, figs. 11, 12, 13, 14. This is an eight and one half year post operative x-ray, fig. 15.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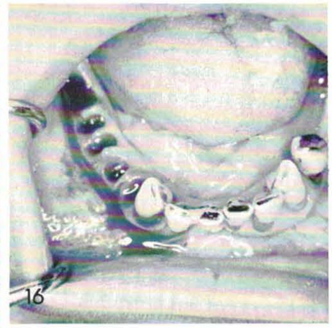
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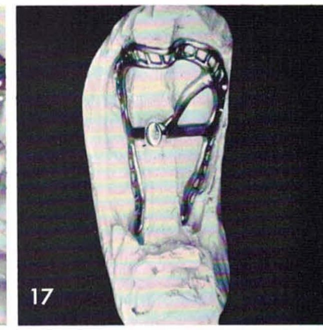
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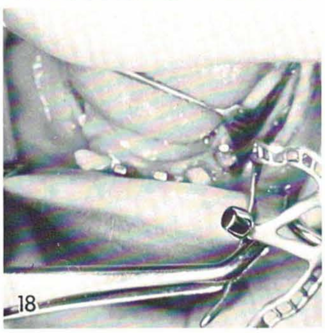
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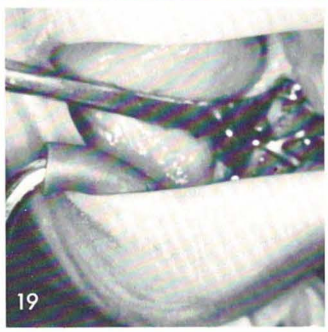
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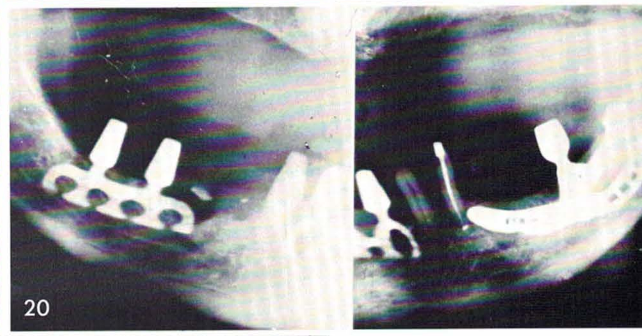
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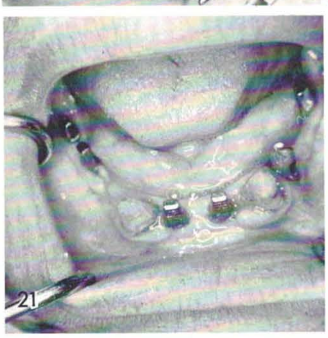
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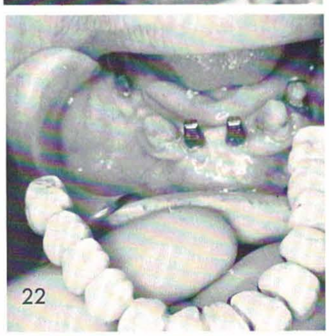
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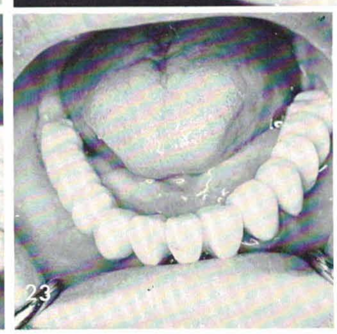
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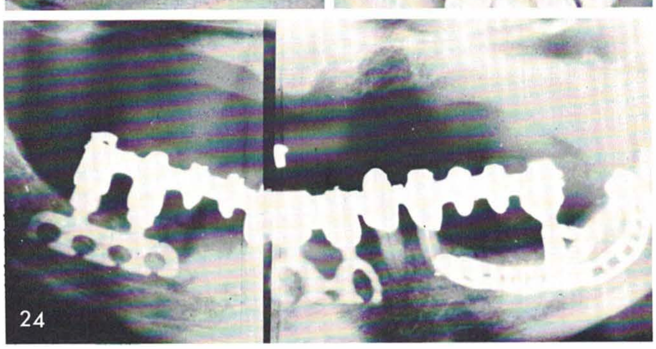
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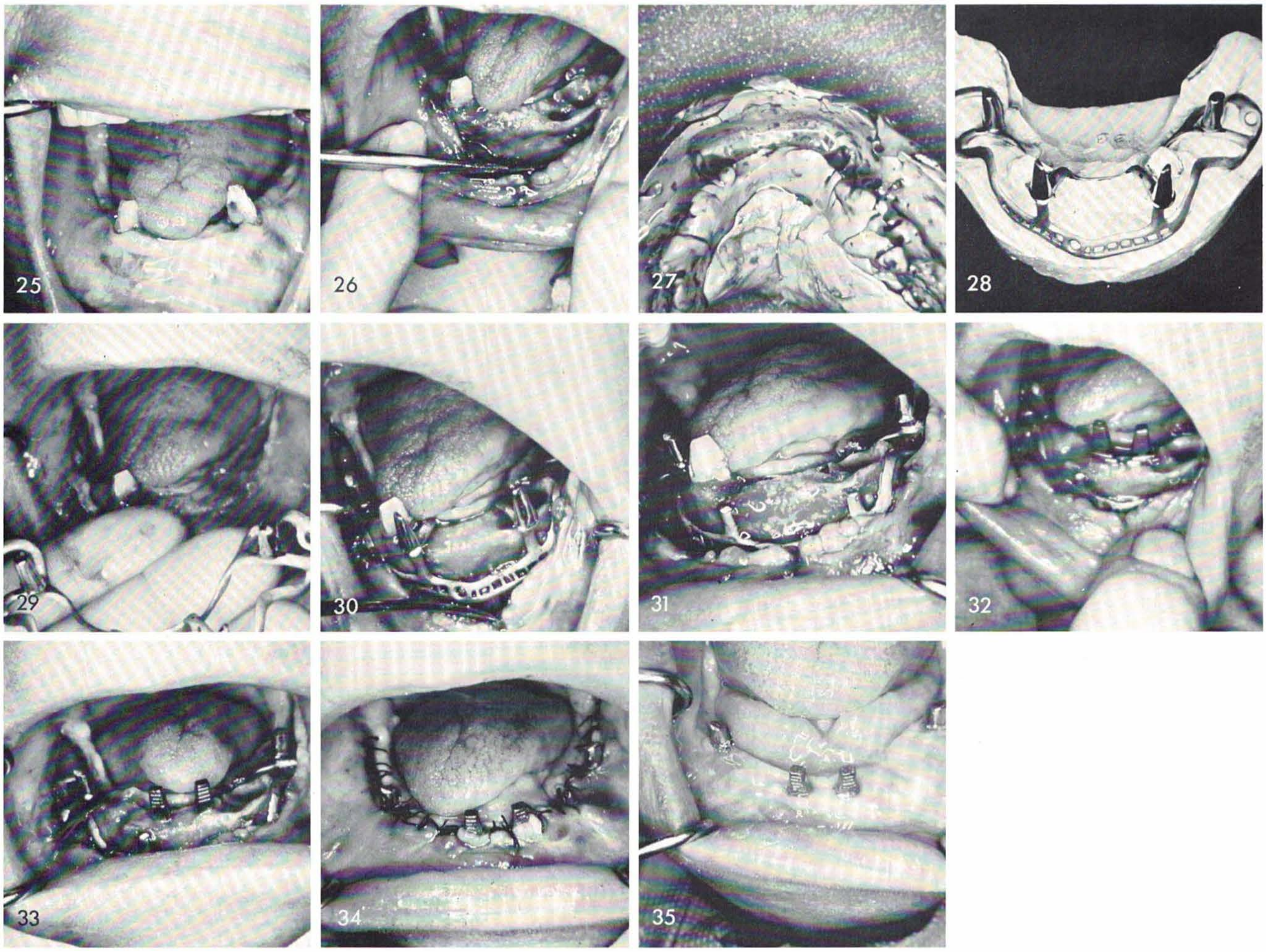
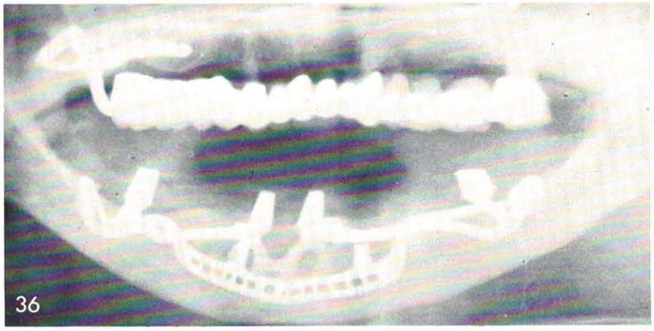
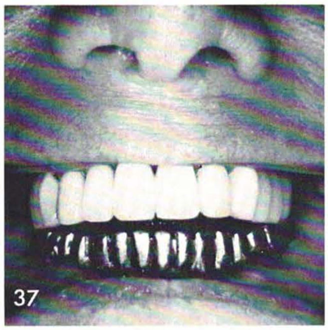
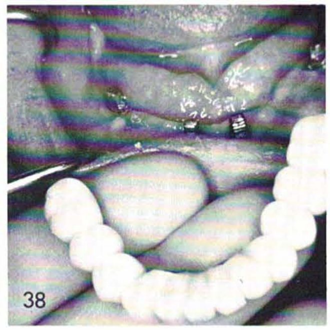
When some teeth are present it is not that imperative to first be certain that the subperiosteal implant must fit as some of the remaining teeth can be utilized to help support the bladevents and give the patient a temporary plane of occlusion, fig. 16. The impression for the subperiosteal implant can be taken at the same time the bladevents are inserted, figs. 17, 18, 19, 20. After healing, fig. 21, the acrylic over gold restoration is cemented, figs. 22, 23. A final x-ray, fig. 24.

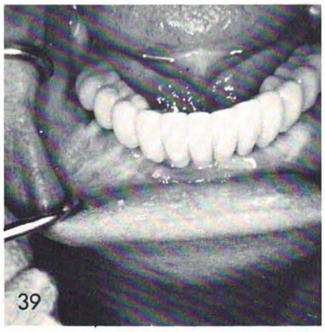


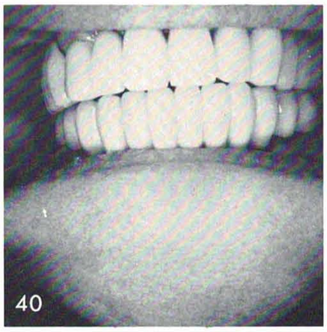
In this situation, the patient had only two remaining teeth, fig. 25, of which one was later removed. She also had a severe overbite and overjet which I thought could be greatly reduced by designing the anterior posts of a universal subperiosteal implant to rest extremely in a labial position. The tissues were incised and retracted as well as the left loose cuspid extracted and an impression for the universal type subperiosteal implant was taken, figs. 26, 27. Fig. 28 shows the anterior posts on the labial edge of the ridge, which when inserted over the bone, figs. 29, 30, made it impossible to suture the tissues closed. By removing both anterior posts and their secondary supporting struts, still leaving the entire implant in one piece, thus not reducing its overall retention, fig. 31, a double-posted bladevent was inserted in the anterior quadrant, figs. 32, 33, and the tissues were sutured together, fig. 34. Healing was excellent, fig. 35. The x-ray shows

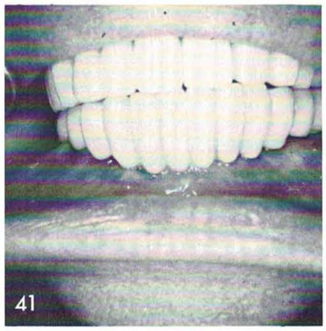


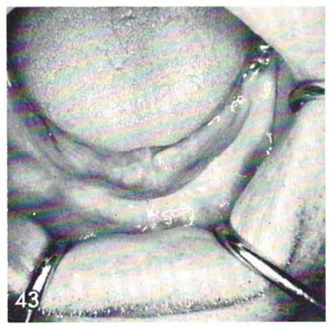


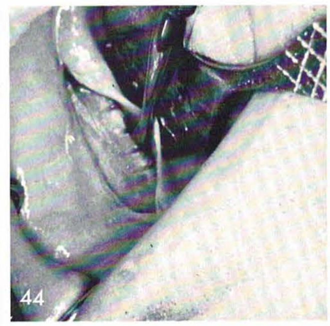


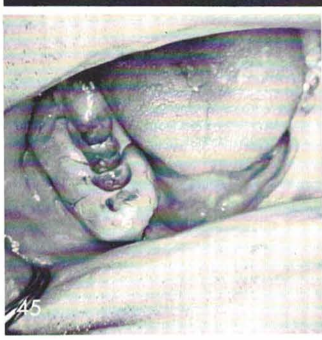


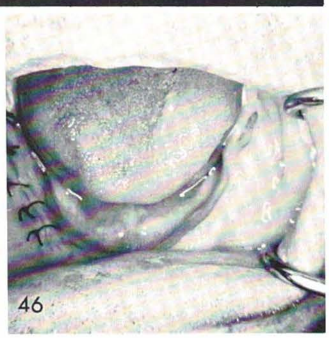


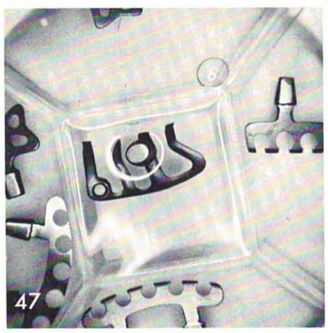


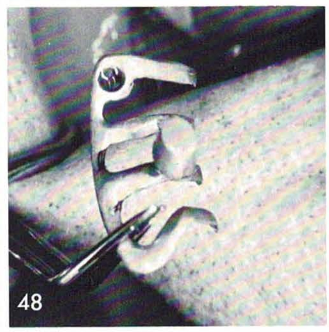






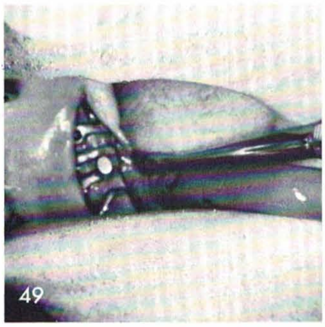


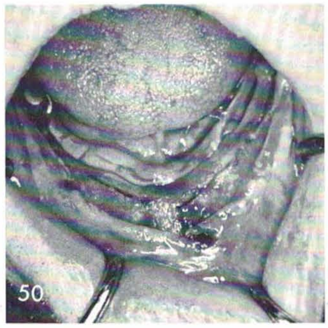


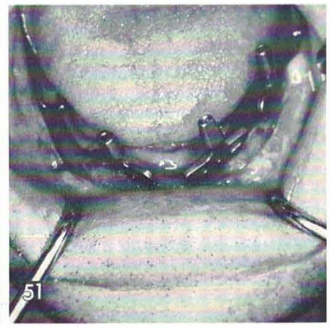


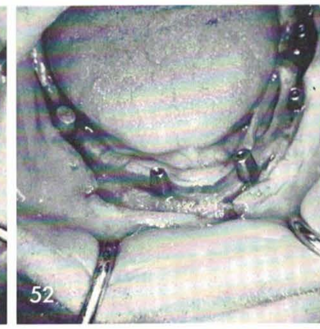
the subperiosteal implant and anterior blade, fig. 36. Castings are fitted, fig. 37, and the completed prosthesis is cemented with hard cement, figs. 38, 39, and the overjet and overbite were still greatly reduced, figs. 40, 41. The post-operative x-ray, fig. 42.

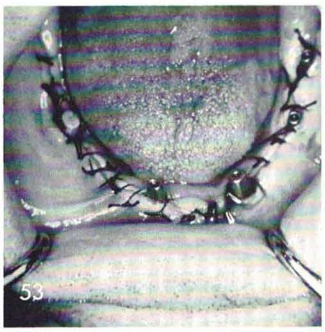
In a totally edentulous situation, fig. 43, it is most important to first prepare the lingual side of the mylohyoid ridge with several shallow grooves and take an impression and bite (Input) for a unilateral subperiosteal implant, figs. 44, 45. The tissues are then closed, fig. 46. At the next visit the sterilized implants, fig. 47, are ready to be fitted and inserted. The unilateral subperiosteal implant must first be tried in, fig. 48, because a full arch temporary splint is much better

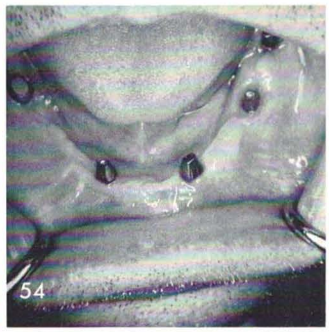


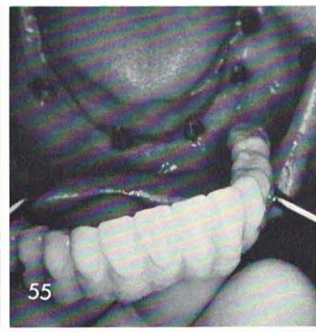


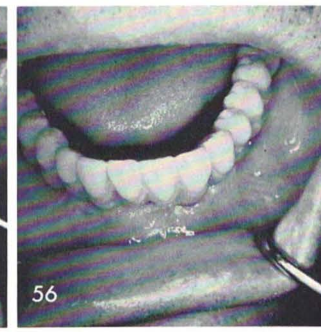


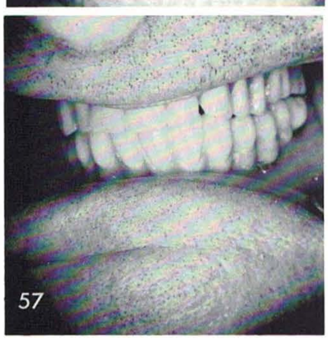


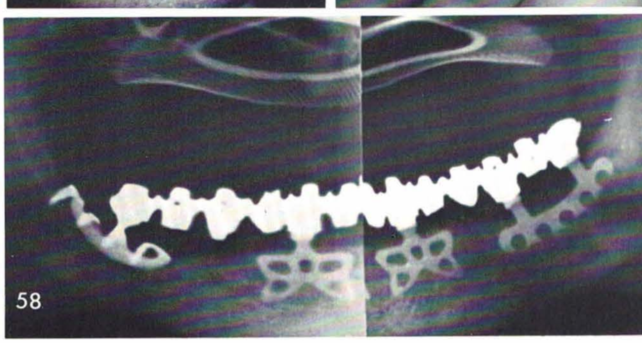




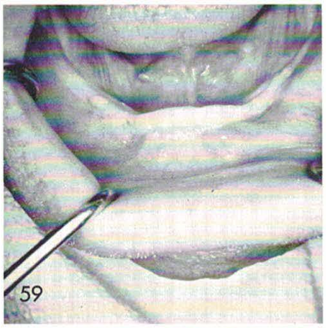








than a partial full arch splint in a totally edentulous mandible. If for some reason the subperiosteal did not fit the three blades were still inserted. The fit, however, was exact, fig. 49. Grooves were then made symmetrically to one another and to the subperiosteal implant, fig. 50, and the blades were inserted, figs. 51, 52, and the tissues closed, fig. 53. Healing again shows to be excellent even with the Vitallium subperiosteal implant and the titanium bladevents, fig. 54. Because of vertical bone loss anteriorly the finished restoration contained a pink gingival portion which ended at the gingival portion of the blades and did not overlap the soft tissues, figs. 55, 56, 57. The post-operative x-ray, fig. 58.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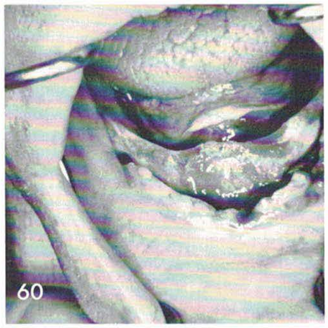
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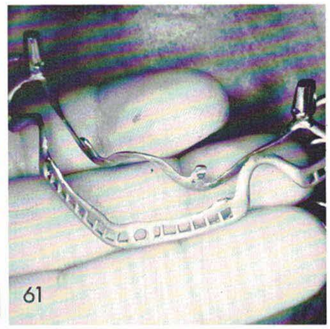
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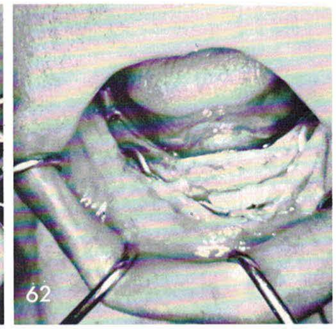
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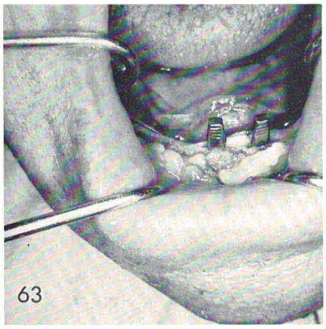
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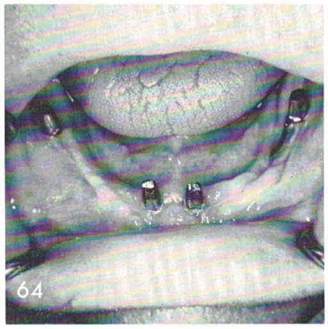
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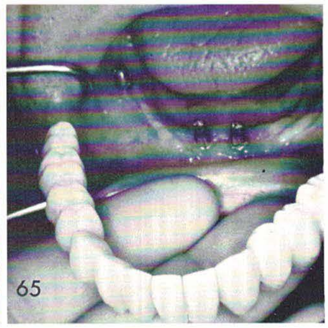
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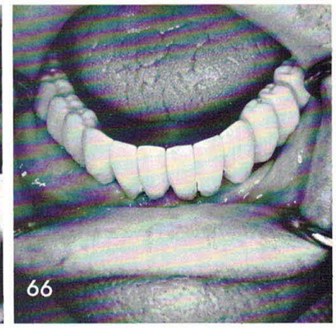
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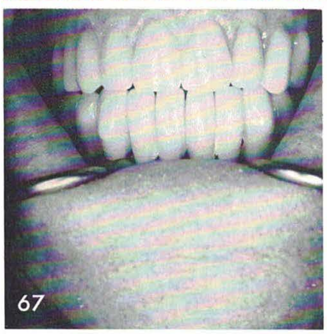
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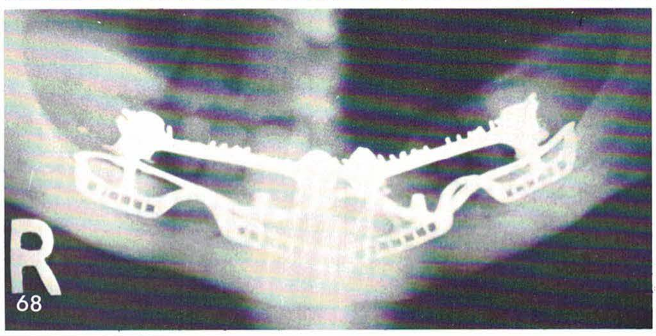

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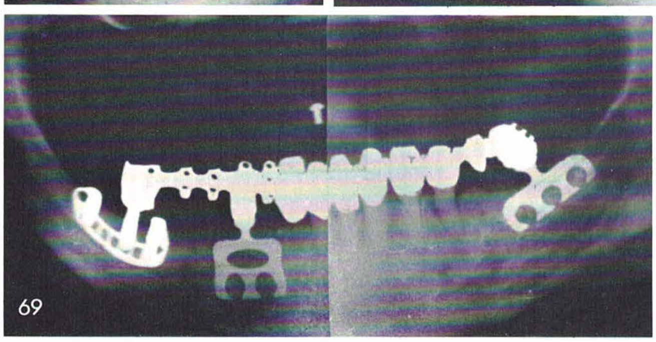
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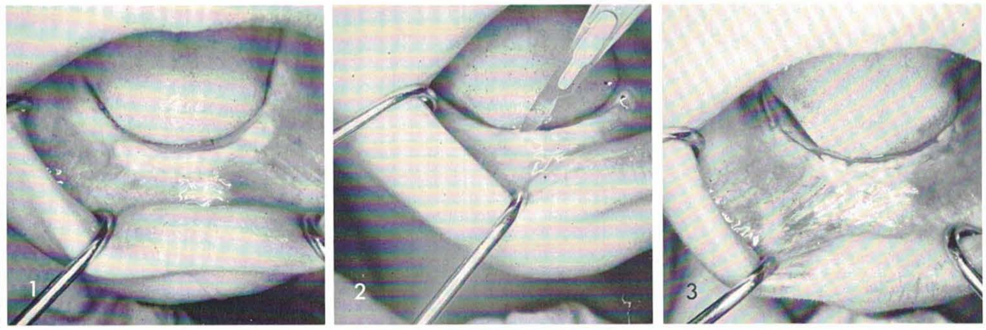
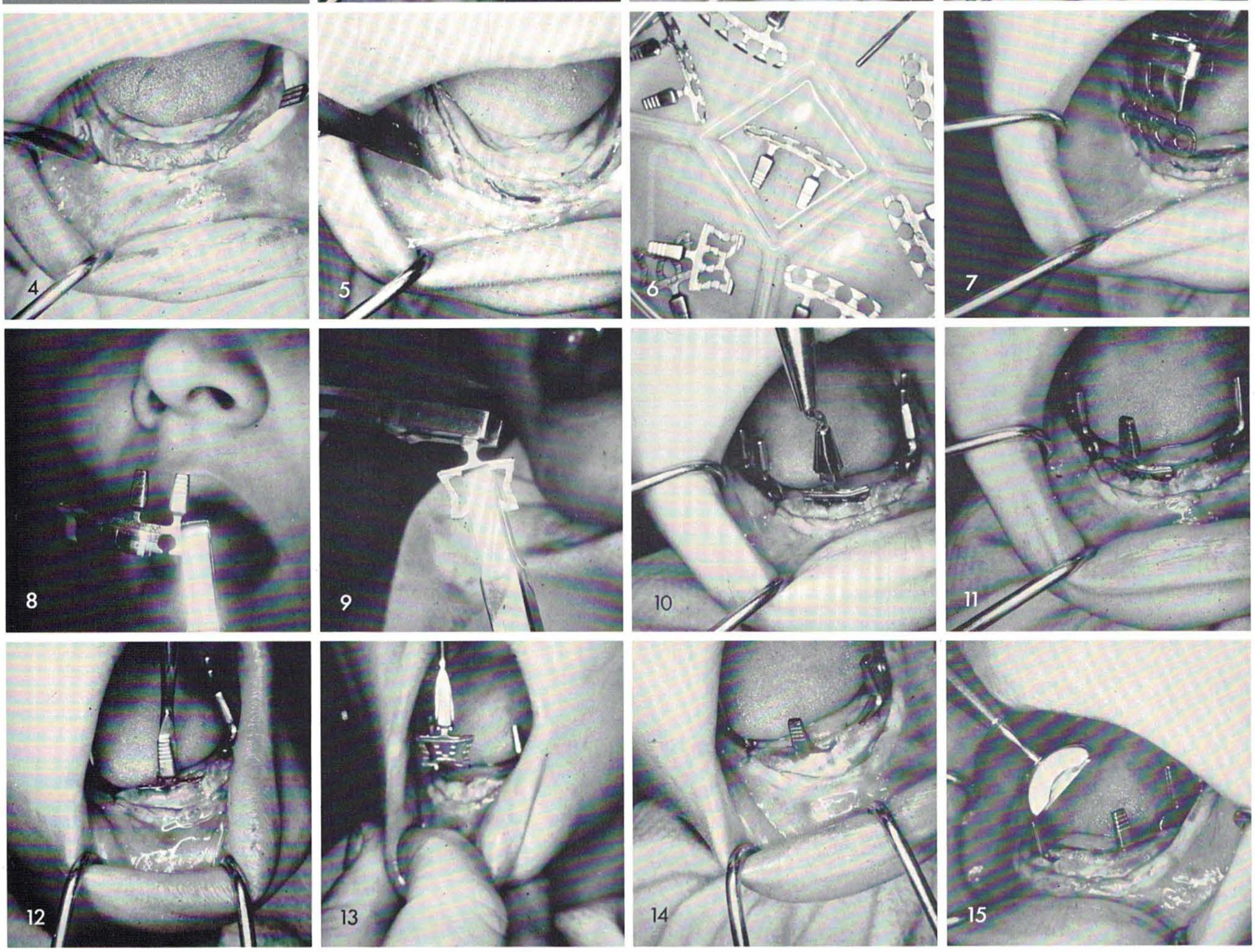
Sometimes also, in a totally edentulous mandible, fig. 59, prepared for a full subperiosteal implant, fig. 60, because of a poor fit anteriorly, those struts were removed from the implant, fig. 61. The implant still in one piece fitting around the arch does not lose any of its overall retention, fig. 62. To give necessary support for the fixed bridge a double posted blade is inserted anteriorly, fig. 63. After healing of the soft tissues, fig. 64, the completed prosthesis is ready for cementation, figs. 65, 66, 67. A final x-ray, fig. 68.

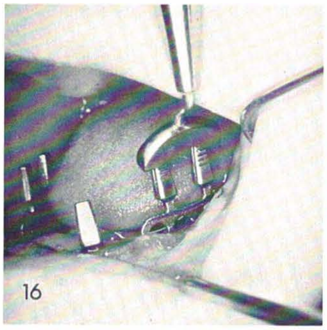
Fig. 69 shows a combination of natural teeth, blades and a uni-lateral subperiosteal implant.

The Totally Edentulous Mandible Using Blades





There are hundreds of thousands of people who can be helped by the introduction of three or four blades into a totally edentulous mandible to support a full arch fixed prosthesis. Fig. 1 shows a clinical view of a totally edentulous young lady in her early twenties. With a #15 disposable scalpel, fig. 2, the incision is made, fig. 3, and the tissues are reflected to expose the bone, fig. 4. Grooves are carefully made, fig. 5, and the various designed blades, fig. 6, are placed, bent, and tapped into the bone, figs. 7, 8, 9, 10, 11. If the grooves were not made deep enough the implants cannot be properly seated so they must be tapped out of the bone with an implant removing instrument, figs. 12, 13. The grooves are made deeper with a longer bur so that the blades can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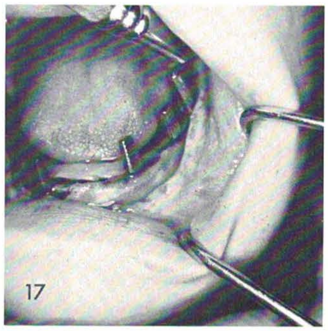
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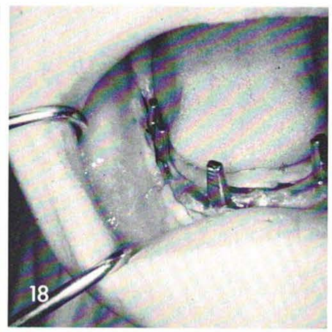
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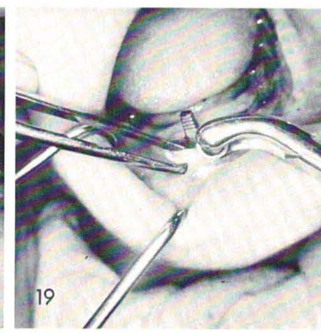
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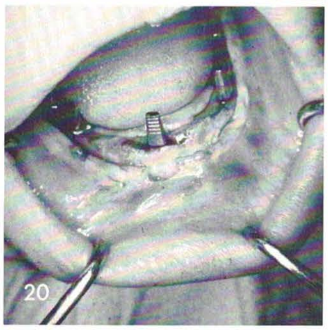
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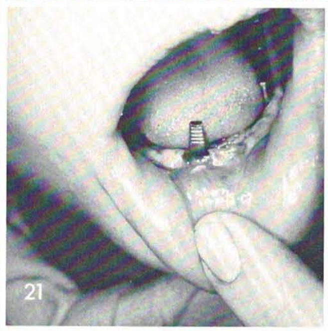
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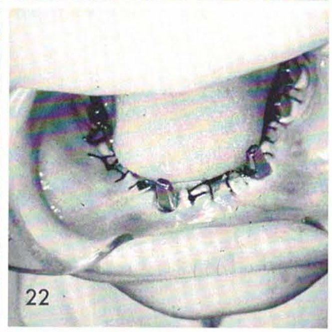
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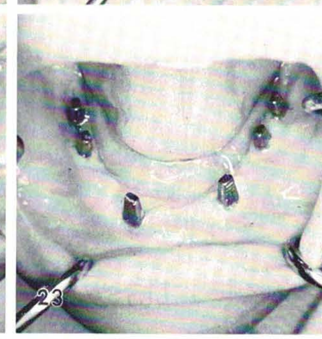
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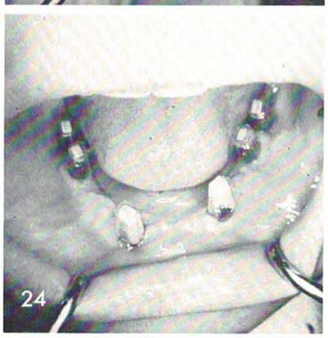
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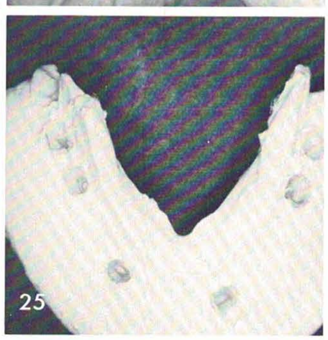
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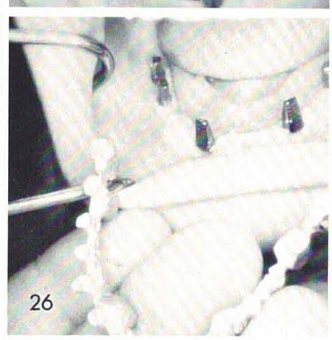
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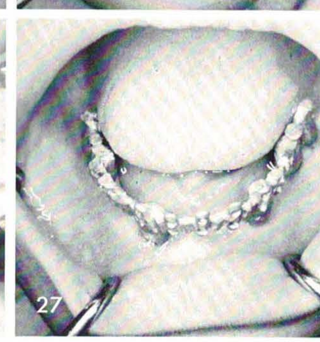
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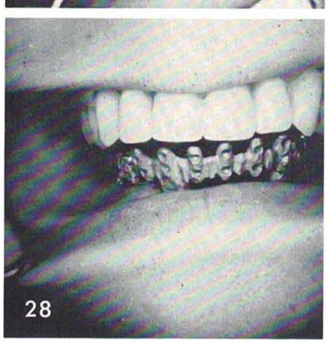
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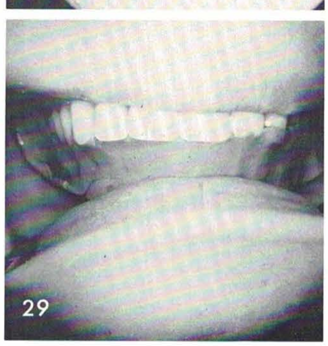
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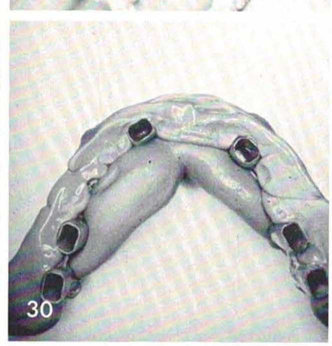
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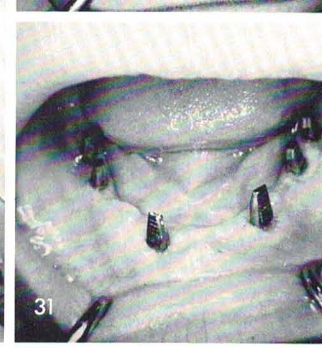
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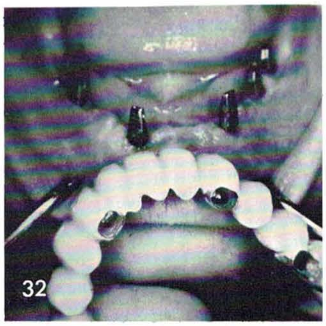
be tapped to their proper depth, figs. 14, 15, 16, 17, 18. A tissue punch is sometimes used when too much tissue exists near a blade post, figs. 19, 20. In this manner, when the tissue is approximating the implant post, it makes for easier suturing and neater adaptation of the tissues themselves, figs. 21, 22. Healing is rapid and usually uneventful, fig. 23. Often, if the posts did not have to be ground down for paralleling, prefabricated plastic copings are fitted over the posts, fig. 24, and picked up with a plaster impression, fig. 25, for construction of the gold framework, in this case for acrylic teeth, figs. 26, 27, 28. An interocclusal record of centric relationship is taken with a heavy silicone material (Input), figs. 29, 30. At the last visit the healed tissues,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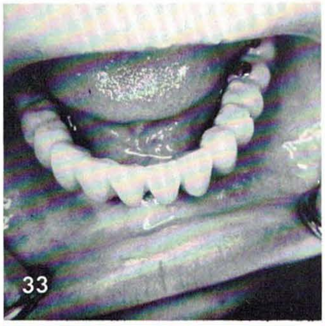
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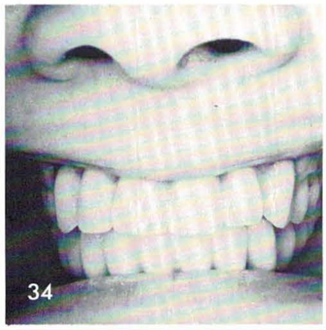
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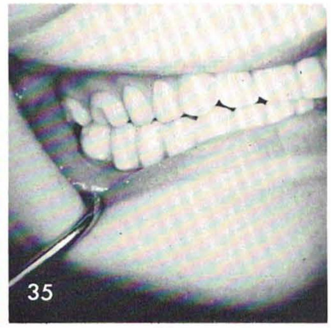
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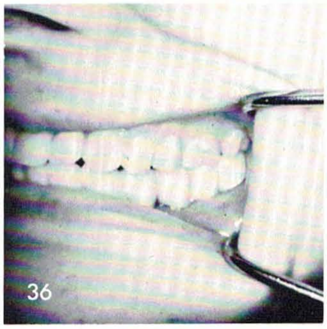
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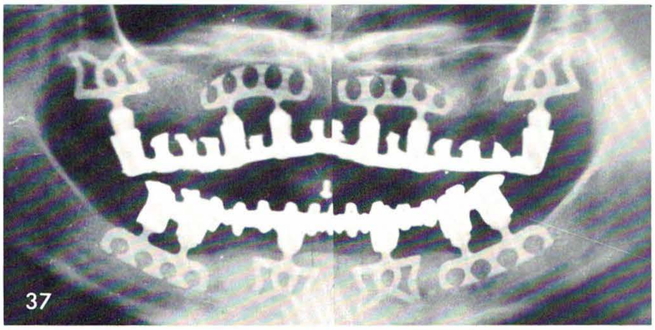
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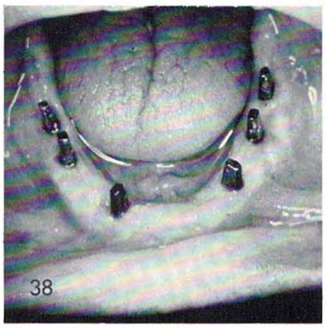
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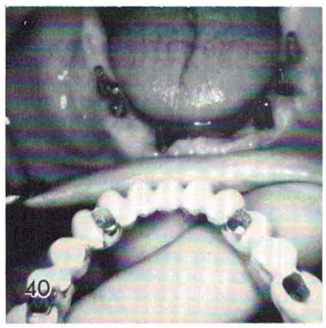
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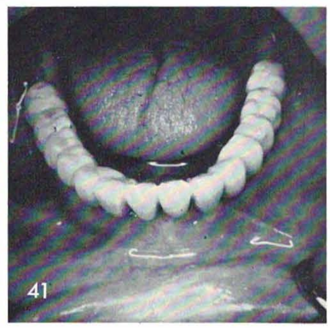
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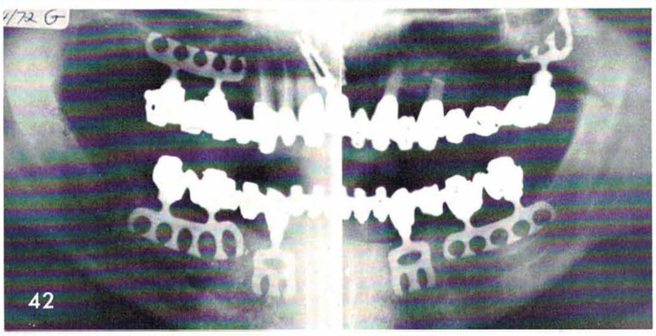
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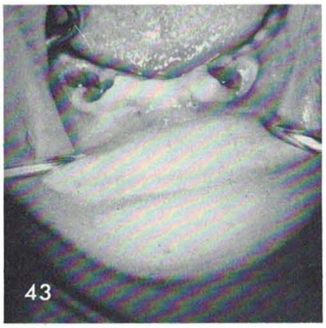
fig. 31, are ready to accept the full arch fixed restoration, figs. 32, 33, 34, 35, 36. A final x-ray, fig. 37. The case is extremely successful after seven and one half years.

The blade posts should be symmetrically placed whenever possible. This case also reveals the two cuspid blade posts to be narrow mesio-distally to allow for better esthetics, fig. 38. Notice also, how far out labially the anterior teeth must often be made to prevent the lips from falling in, fig. 39. Figs. 40 and 41 show the cementation of the restoration. Fig. 42 shows the post-operative x-ray.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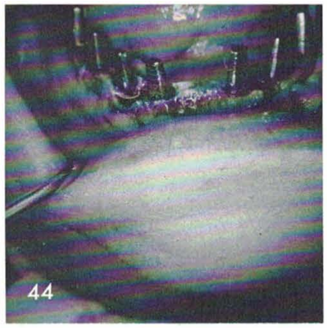
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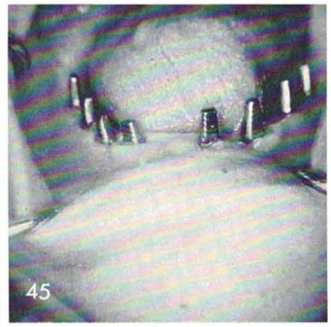
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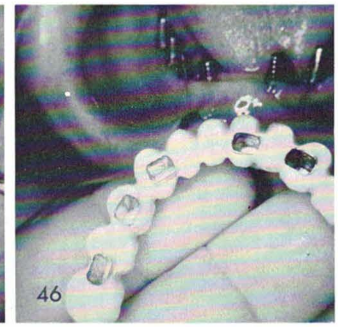
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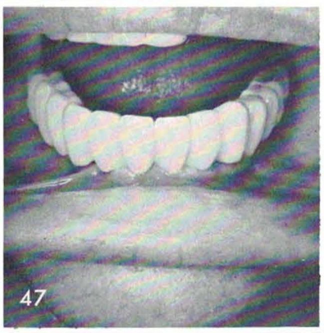
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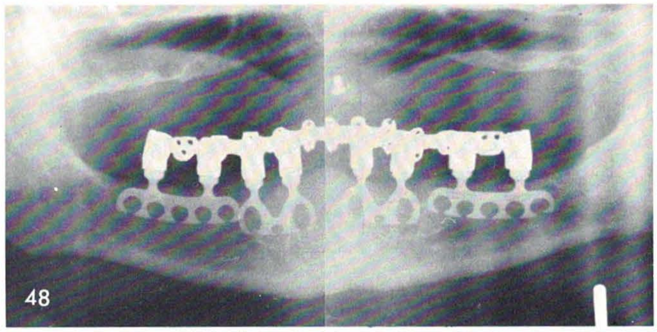
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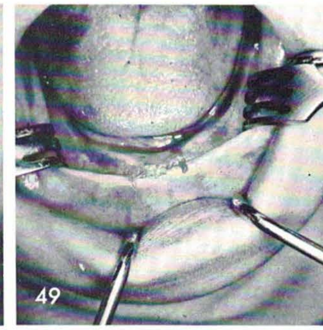
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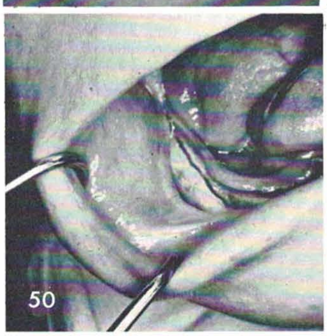
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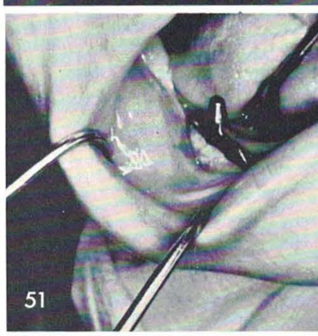
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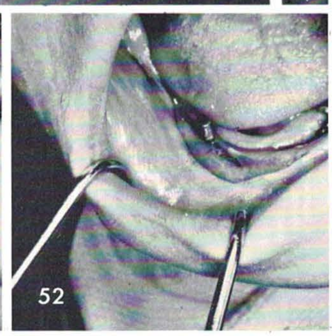
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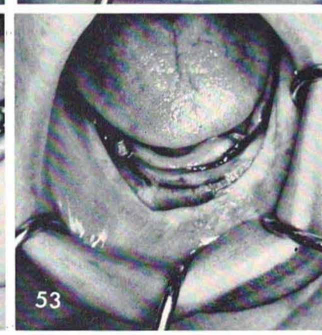
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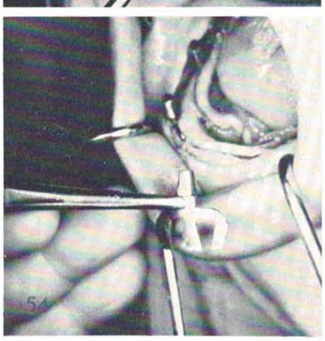
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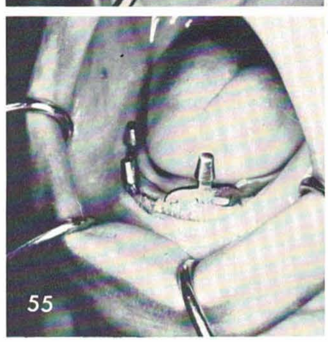
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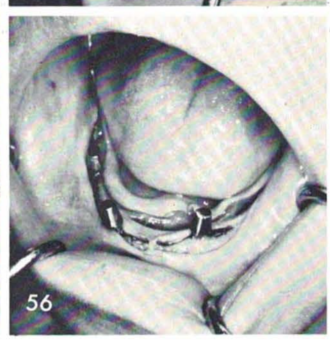
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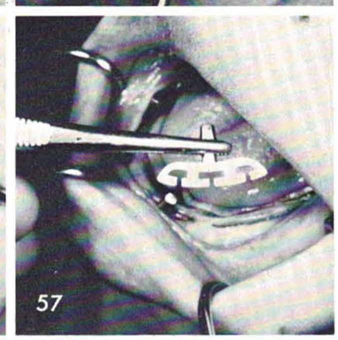
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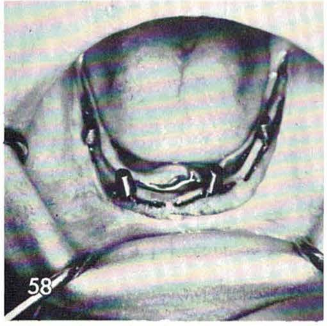
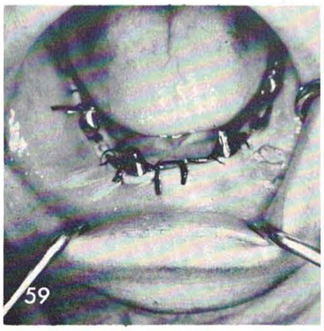
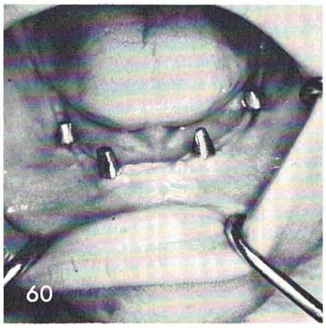
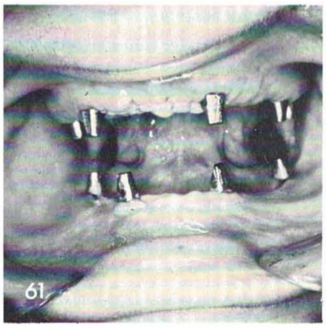
In a totally edentulous mandible with fresh sockets, fig. 43, double posted "socket blades" with their recessed shoulders work extremely well as long as they are buried properly. Fig. 44 shows the socket blades and posterior blades. Healing over the sockets is just as excellent as in the ones away from the sockets, fig. 45. The finished restoration is then ready for cementation, figs. 46, 47. The x-ray, fig. 48.

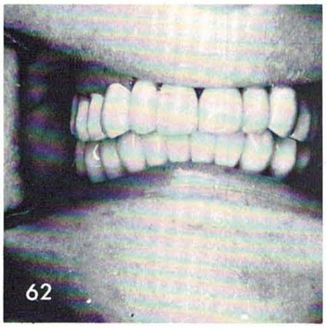
Where shallow bone exists posteriorly, fig. 49, grooves are made to allow the insertion of shallow blades, figs. 50, 51, 52. The remaining grooves are then made to support the two anterior cuspid blades, figs. 53, 54, 55, 56, and the more shallower left posterior blade, figs. 57,

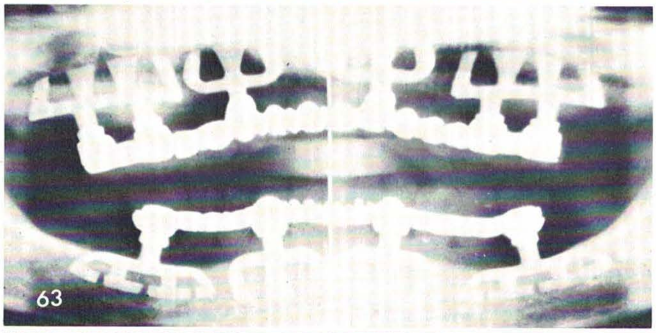


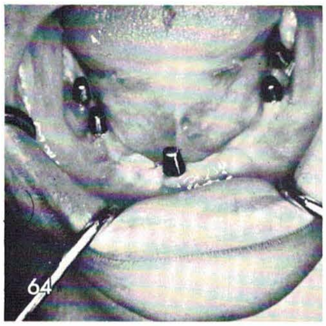


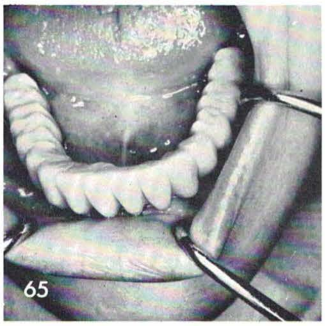


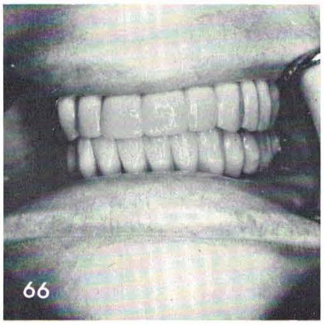


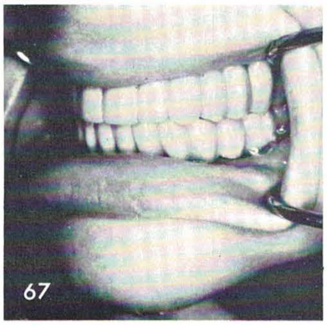






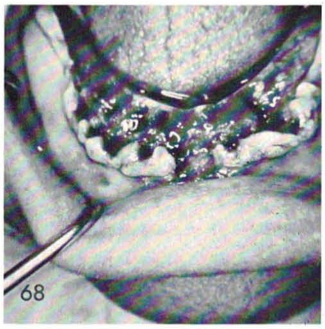






58. The tissues are sutured and immediately after the posts are made parallel to each other, fig. 59. Healing is rapid, figs. 60, 61, and the final prosthesis has been functioning at this date for nearly nine years, fig. 62. The x-ray was an eight year post-operative view, fig. 63.

Many cases have been done with only three blades, the anterior one usually avoiding a deep unhealed socket area or merely an area not having enough bone, fig. 64. The three blades often support the full arch fixed prosthesis as well as four, figs. 65, 66, 67.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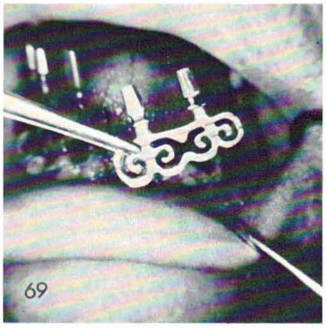
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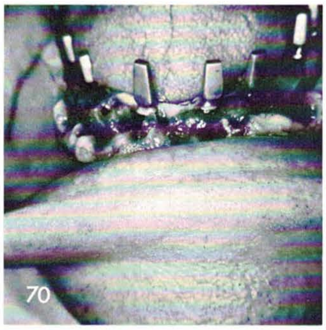
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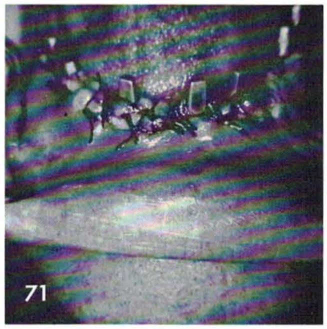
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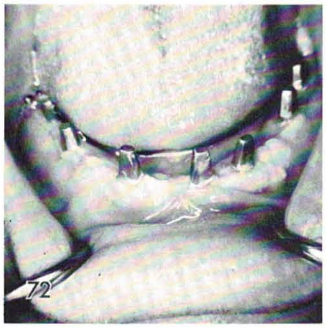
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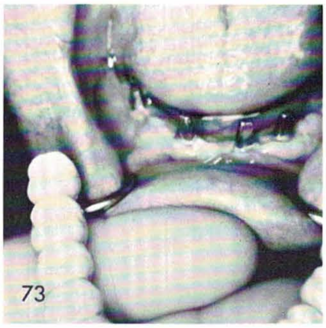
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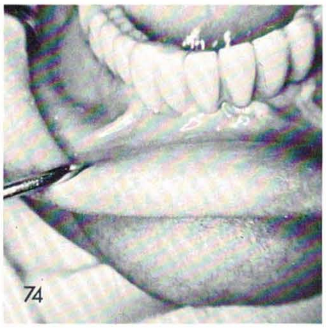
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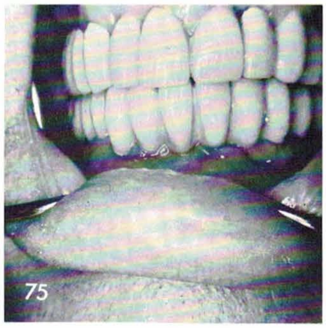
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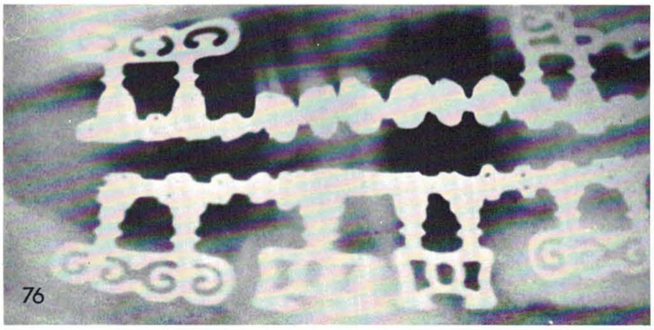
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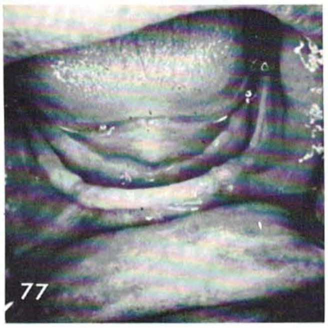
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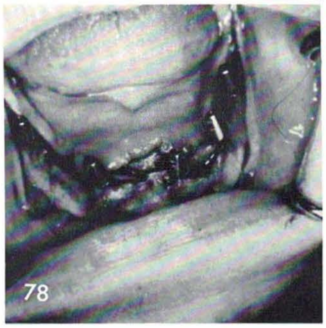
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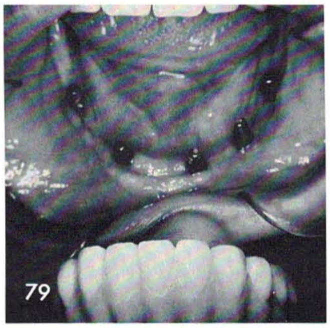
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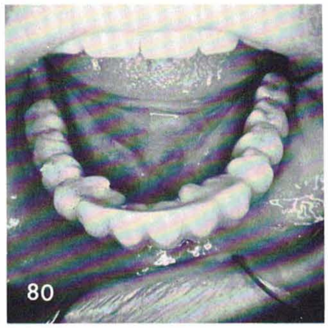
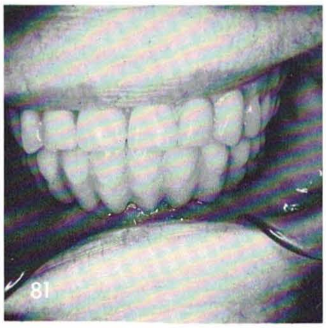
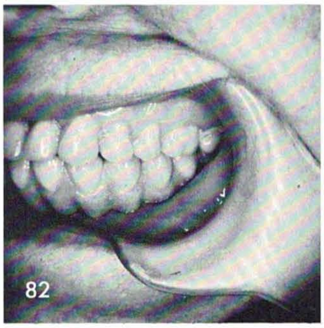

80

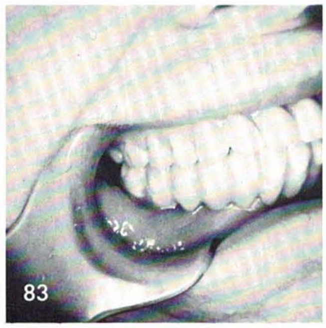
In this edentulous mandible with several fresh sockets, fig. 68, some of my newer designed implants were used, figs. 69, 70, 71, 72, to support a full arch fixed prosthesis, figs. 73, 74, 75. The post-operative x-ray, fig. 76.

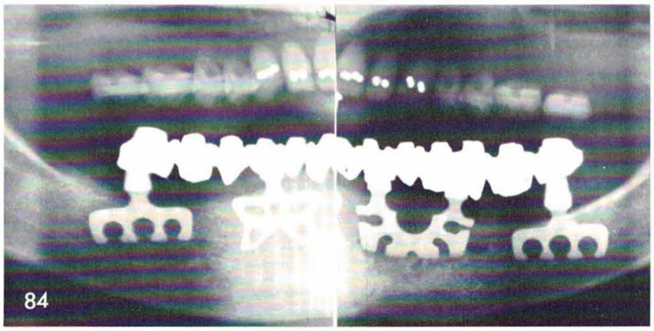
Even in a totally edentulous mandible that exhibits a knife-edge ridge and shallow ridge, fig. 77, blades can usually be satisfactory, fig. 78.

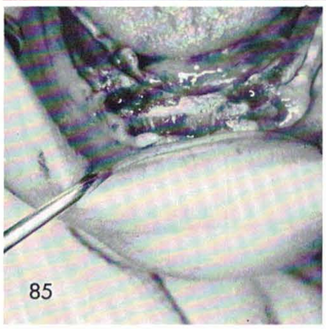
Because of the severe vertical bone loss the fixed prosthesis was fabricated with an extremely long pink gingival portion both anteriorly and posteriorly, fig. 79. In this manner the vertical dimension was maintained and the teeth did not look so long and grotesque, figs. 80, 81, 82, 83.

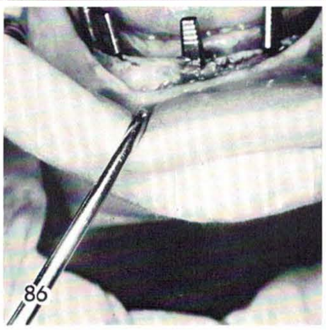


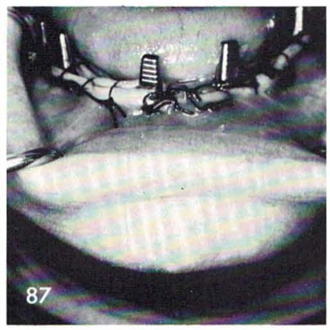


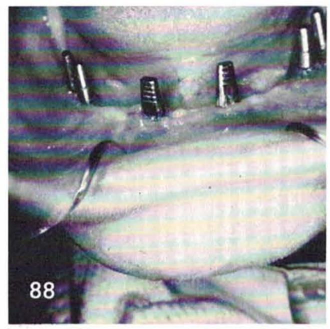


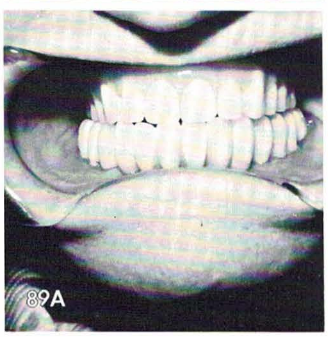












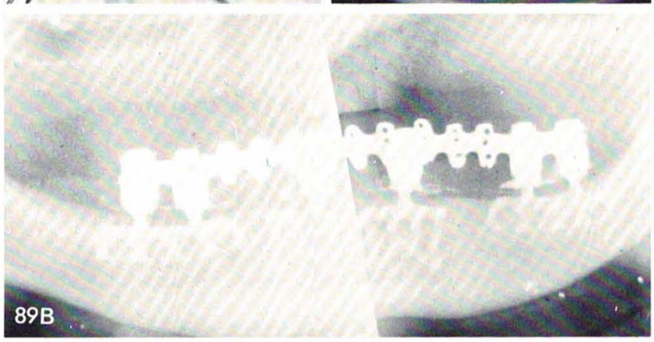
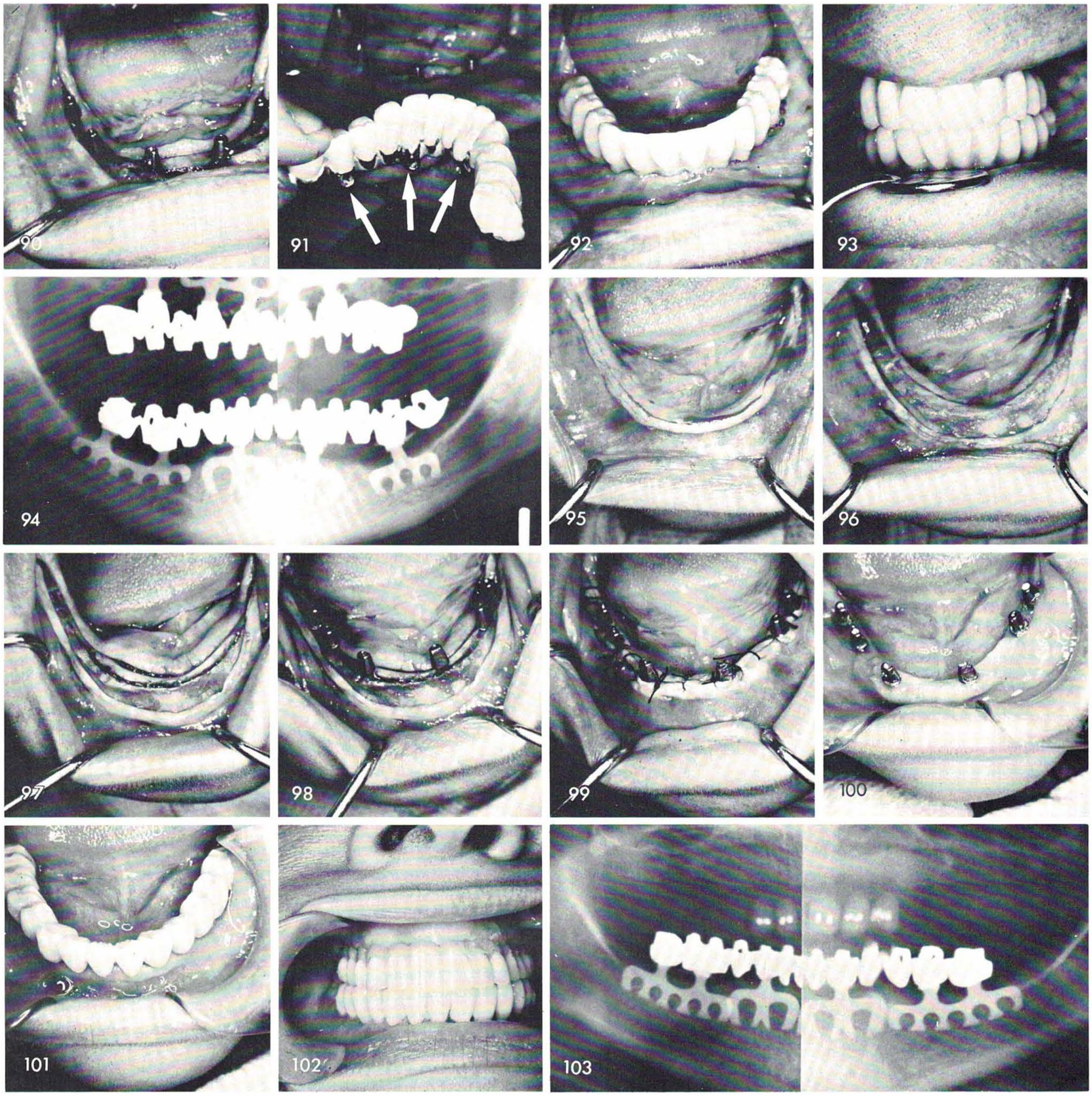


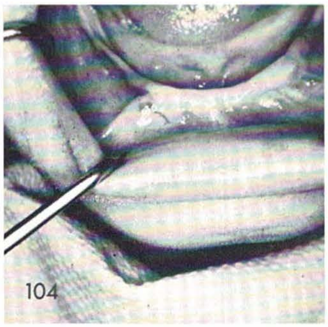
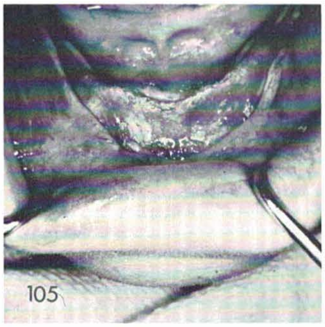
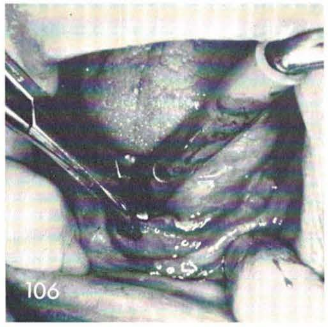
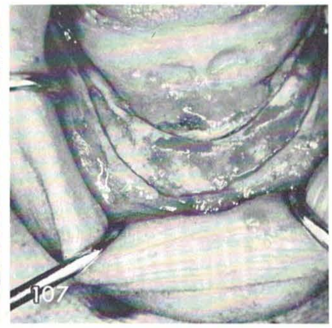
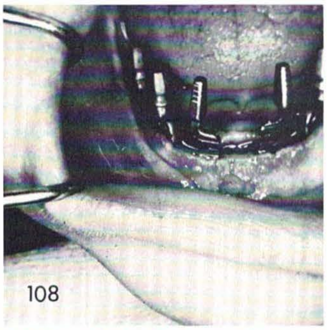
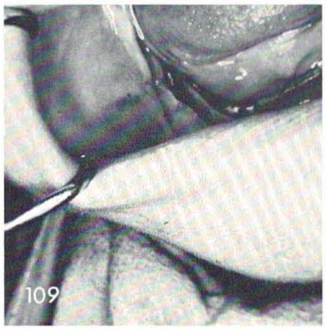
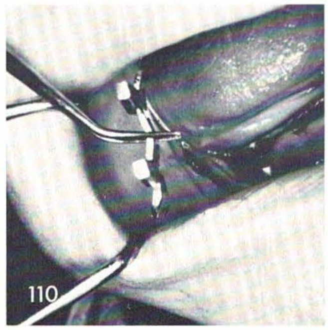
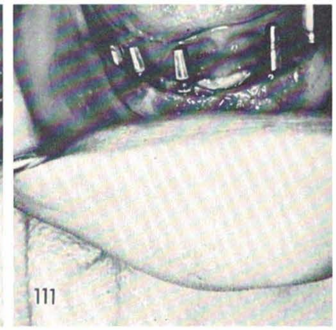
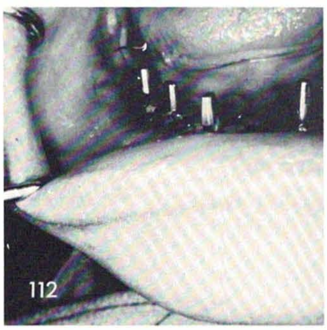
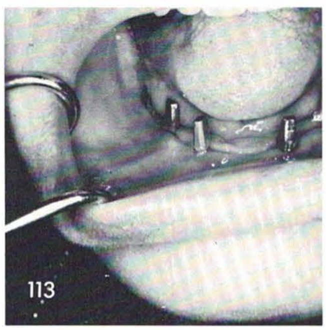
Fig. 84 post-operative x-ray.

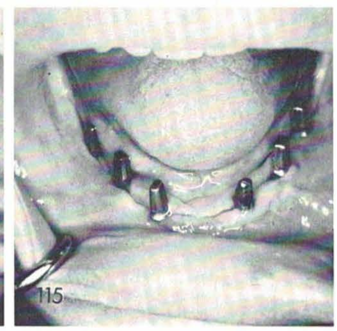
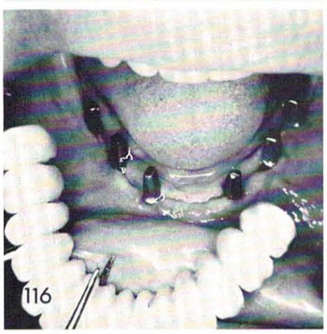
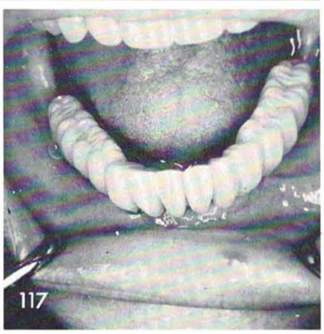
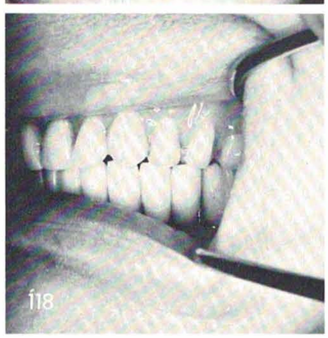
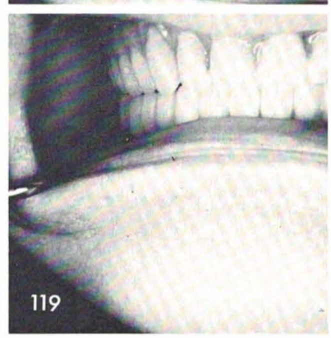
On cases where muscular attachments are too high they should be relieved making sure there exists a fairly thick band of attached gingivae around the posts of each bladevent, figs. 85, 86. Suturing is accomplished with simple surgical ties and mattress sutures wherever necessary, fig. 87. With the lowered muscle attachments healing becomes simple, fig. 88, and there is chance for success. Fig. 89A & 89B show post-operative results.



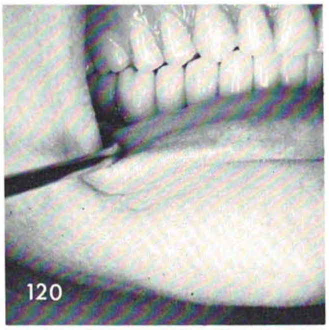
Some of my earlier designed blades had horizontal threading through the posts, fig. 90, to allow for "screwing in" of the prosthesis without the use of cement, figs. 91, 92, 93. However discoloration of the underlying metal developed as well as cases of halatosis occurred causing me to drop this system. Final x-ray, fig. 94.

Sometimes in totally edentulous cases, figs. 95, 96, a continuous groove rather than interrupted grooves are created, fig. 97, making it a bit easier to line up the blade posts with the opposing teeth, fig. 98. After suturing, fig. 99, and healing, fig. 100, the restoration is cemented, figs. 101, 102. The post-operative x-ray, fig. 103.

One must be extremely cautious when inserting four blades in a knife edge ridge, figs. 104, 105. In order to widen the occlusal table a bone rongeur is first used, fig. 106, followed by a rotary stone or fissure bur, fig. 107. The blades are then lined up in the grooves, fig. 108, and tapped to their proper depth. Because of failure to remove the right posterior blade and make the groove deeper I spread out the bone with the post of the implant that also became buried, fig. 109. I quickly removed it and using another blade and bending it like a "snake", fig. 110, I was able to re-insert it successfully, fig. 111. After suturing, fig. 112, healing was accomplished, although much slower in the right posterior area, fig. 113. A gold substructure was fitted, fig. 114.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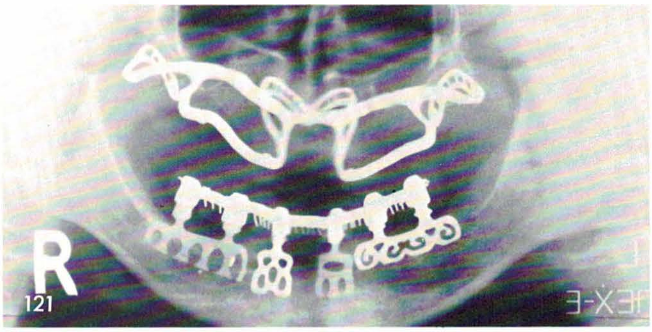
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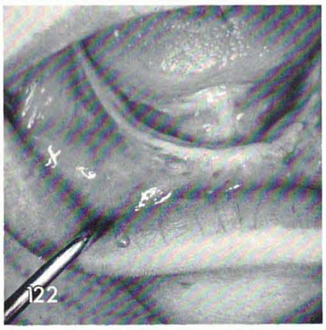
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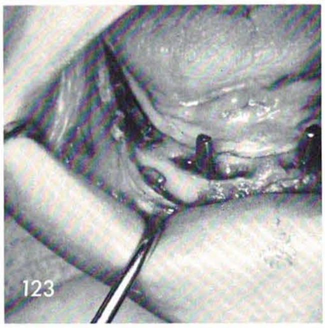
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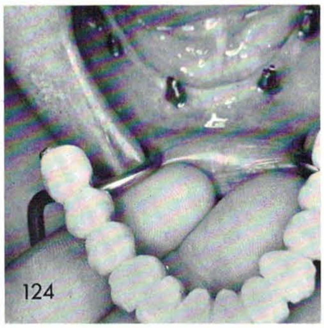
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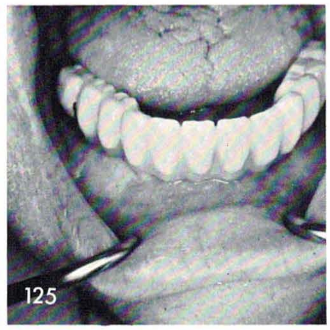
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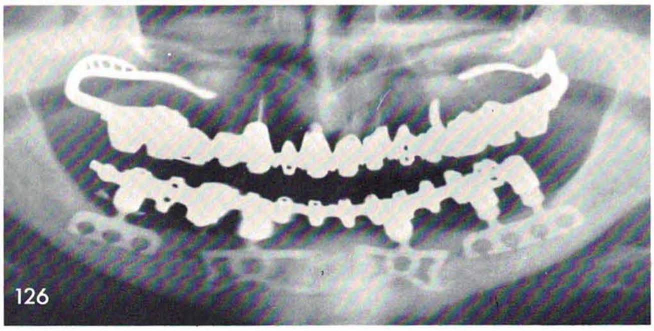
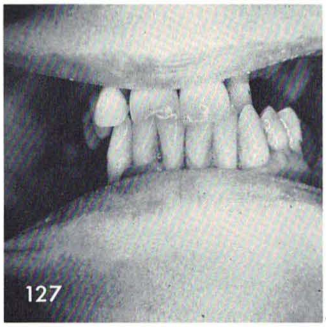

126

Six weeks post-operatively the tissues were very much healed, fig. 115, and the prosthesis was cemented, figs. 116, 117, 118, 119, 120. The x-ray, fig. 121.

Many times the clinical picture, fig. 122, does not show areas of bone that had never filled in from extractions many years before of periodontally involved teeth. Therefore, as the grooves are made into these areas they must be cleared of granular material. This necessitates making the grooves wider and bending the body of the blades in various directions to accommodate this situation, fig. 123. Healing again will usually be uneventful, fig. 124, allowing an esthetically functioning fixed restoration to remain in a healthy environment, fig. 125. The post-operative x-ray, fig. 126.



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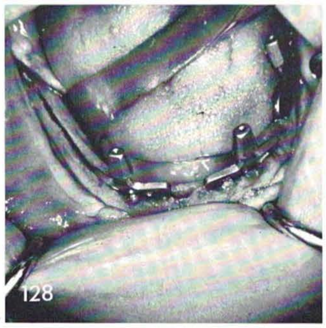

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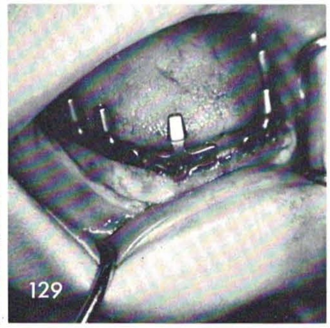

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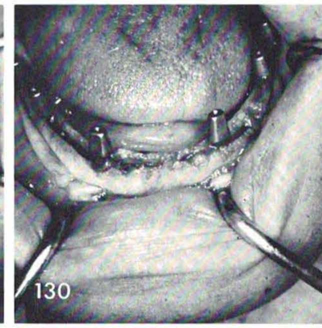

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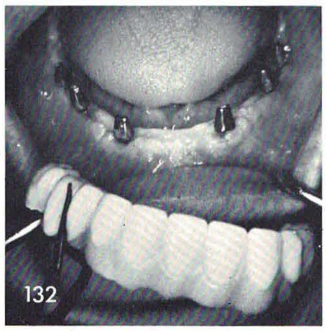

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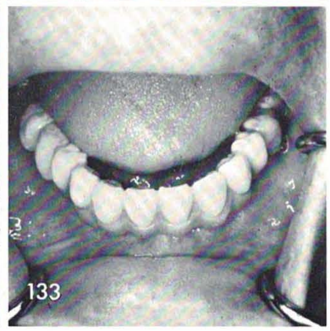

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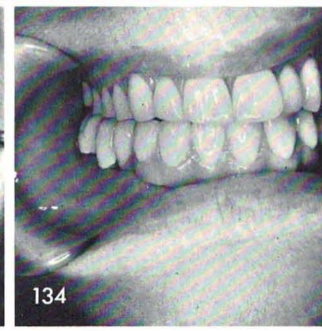

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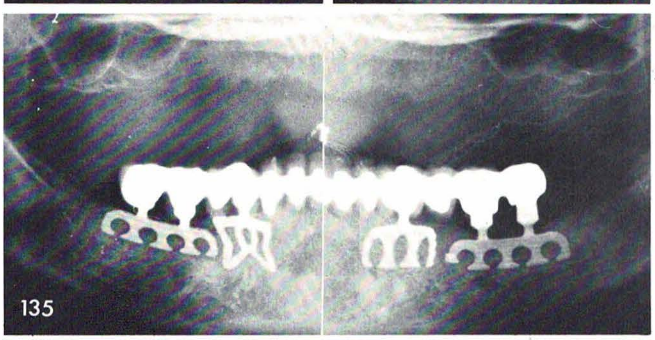

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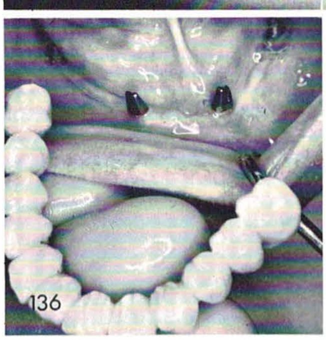

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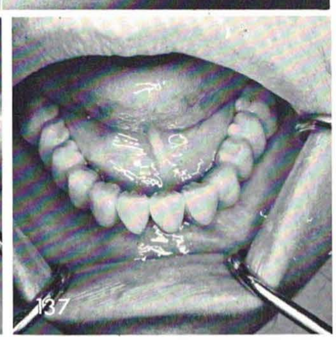

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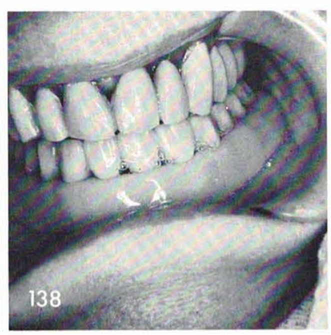
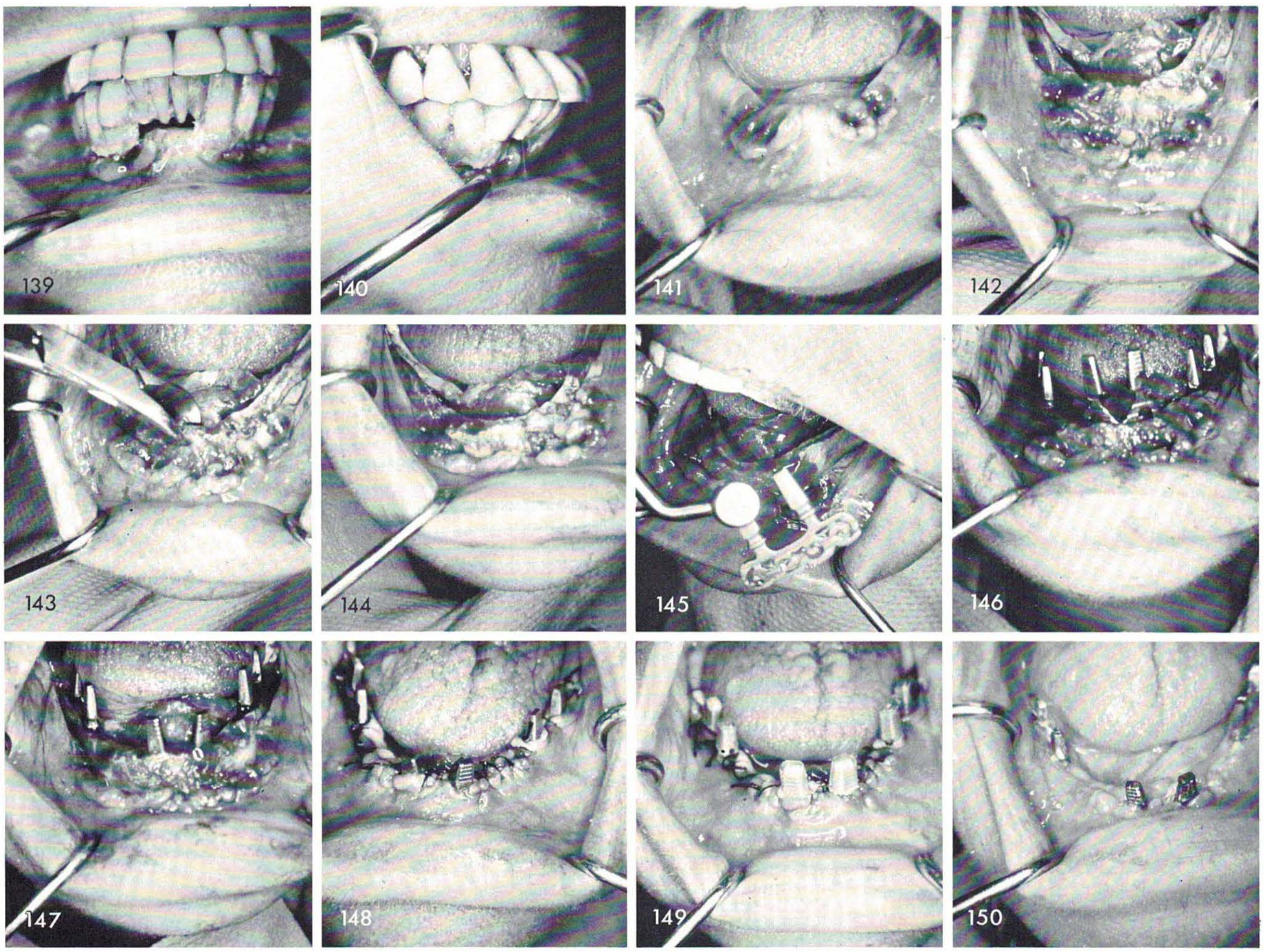


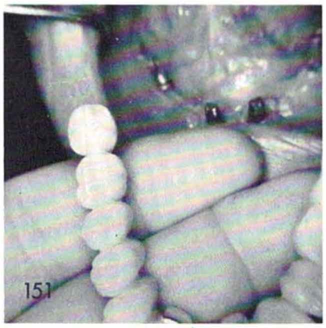
138

In situations where many periodontally involved teeth have to be extracted, fig. 127, leaving the mandible totally edentulous then at least six months must elapse before re-entering the area to insert bladevents, figs. 128, 129, 130. Fig. 131 shows the fabricated restoration, again with a pink gum-line. It is then fitted and cemented, figs. 132, 133, 134. The final x-ray, fig. 135.

Often only four protruding posts can be used, instead of the usual six, fig. 136, to support a full arch splint, fig. 137. In order to build out the lips a snap-on pink acrylic stent was fabricated, fig. 138, which was removed after meals.



A terribly neglected mouth on, believe it or not, a beautiful woman who was petrified of dentists and more petrified with the thought of having to wear a removable conventional denture, figs. 139, 140. The teeth were removed, fig. 141, the bone exposed, the sockets cleansed of all debris, fig. 142, and with a bone rongeur the anterior alveolus was smoothed, widened and flattened, fig. 143, to allow enough room for the grooves for the bladevents, fig. 144, which were tapped into their proper positions, figs. 145, 146, 147. The tissues were sutured closed, fig. 148, and in order to avoid another visit for this highly nervous patient, plastic copings were immediately utilized over the posts, fig. 149. Within two and a half weeks the prosthesis was completed, figs. 150, 151, 152. A x-ray shows the completed case, fig. 153.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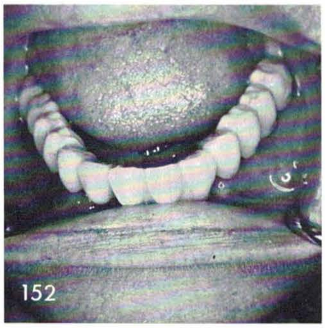
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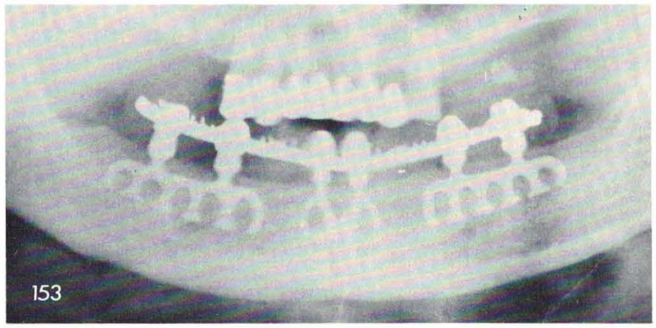
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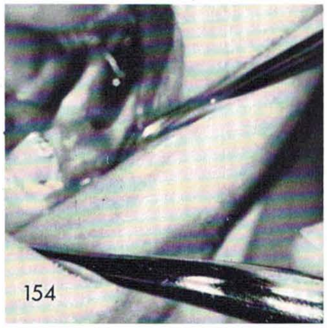
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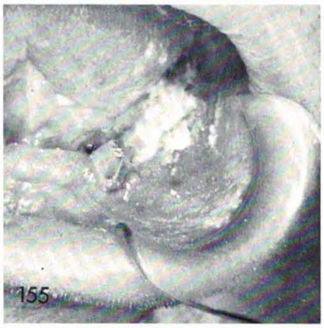
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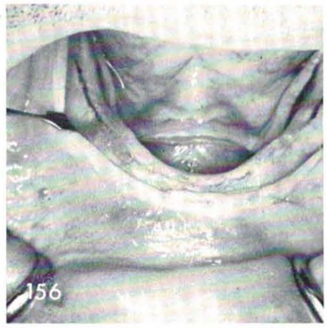
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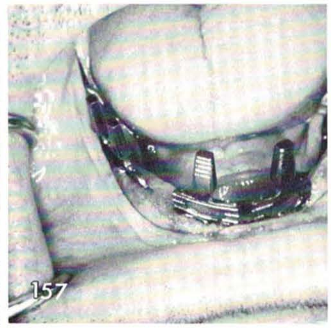
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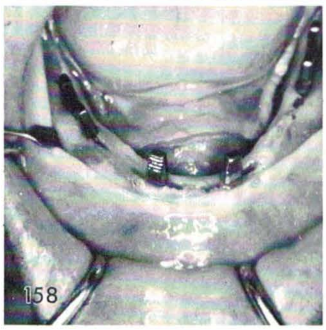
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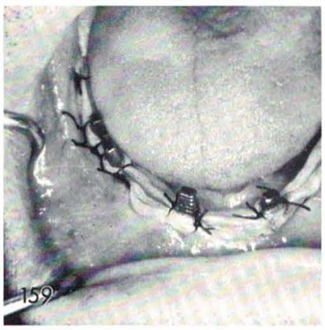
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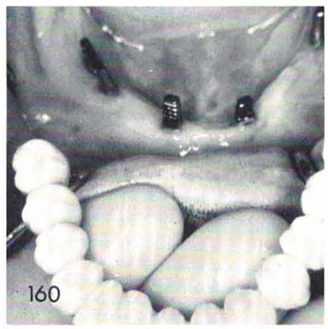
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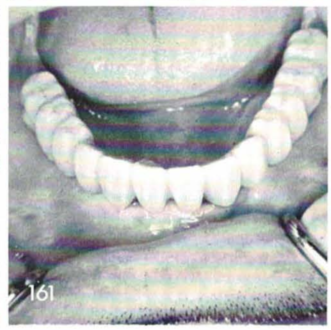
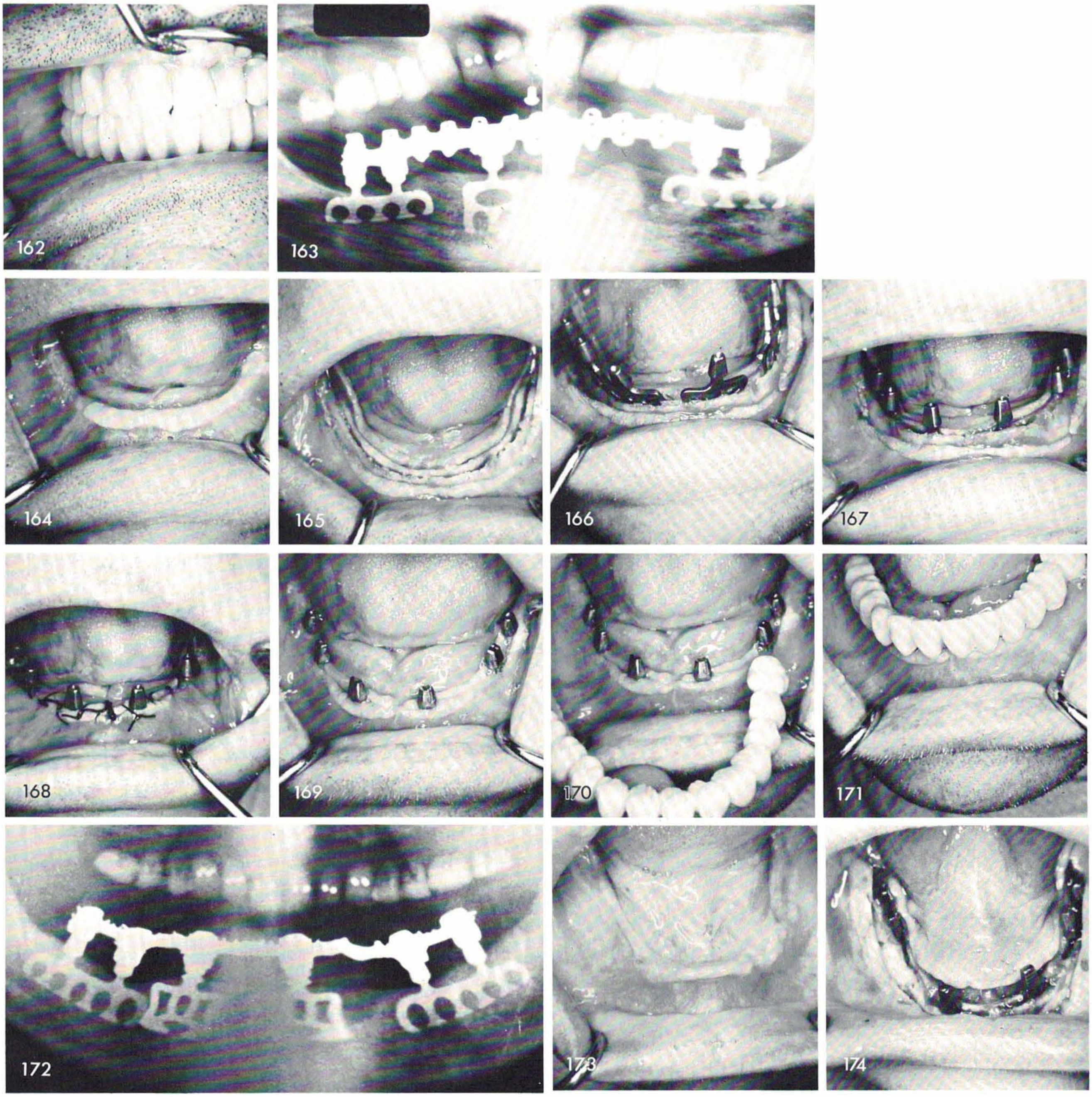
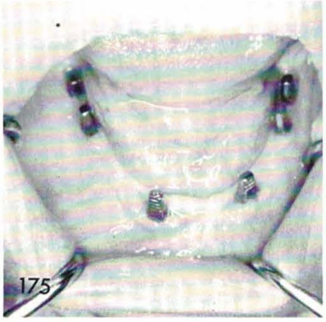

161

This next case shows what a failing blade, that was over-retained in the bone for a long period of time can do, fig. 154. The exact same situation occurred on the other side. Both blades were removed, plaster of paris was gently placed into the areas of bone loss and the remaining two teeth both severely periodontally involved were removed, fig. 155. The patient wore a conventional denture for nine months untill all the bone regenerated to nearly the same height as the buccal and lingual cortices of bone that flanked the original implant failure site. Nine months later the tissues were incised and reflected to expose the bone and grooves were made, fig. 156. Four blades were symmetrically inserted and tapped to proper positions, figs. 157, 158. Suturing was accomplished, fig. 159, and uneventful healing enabled the fixed bridge to be cemented into place with no complications, figs. 160, 161, 162. The post-operative x-ray, fig. 163.



When the ridge is high and wide, fig. 164, the making of the grooves becomes less difficult, fig. 165. The blades can be tapped into position with a little more authority, figs. 166, 167, and the tissues are then sutured, fig. 168. Within several weeks healing is almost completed, fig. 169, and the bridgework is cemented with a hard cement, figs. 170, 171. Final x-ray, fig. 172. Sometimes there exists a labial overhang of bone, fig. 173, which should be removed to lessen the chances of perforation of the underlying labial plate of bone when the groove is made and the implants are set into them, fig. 174. The healed tissues, fig. 175, readily accept the full arch fixed restoration, figs. 176, 177, 178, 179. Final x-ray, fig. 180.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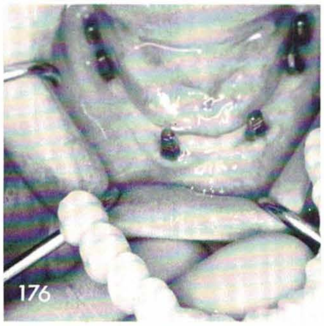
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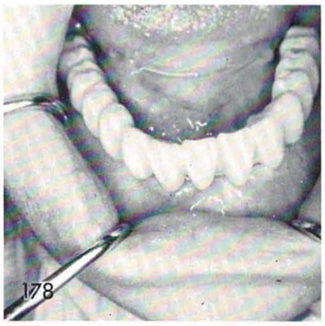
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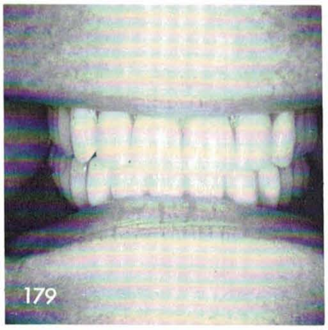
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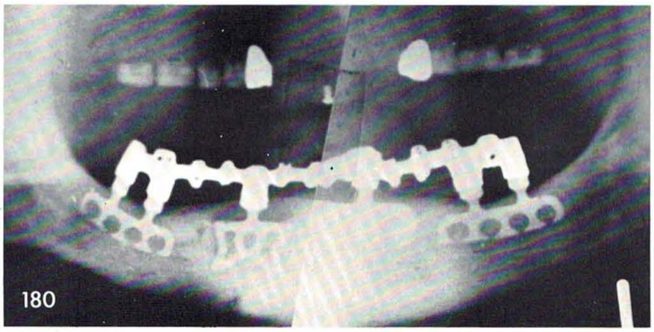
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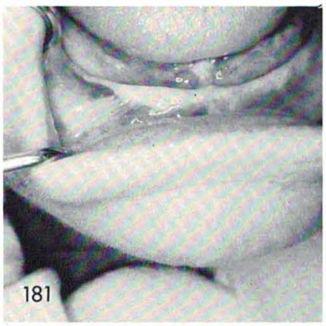
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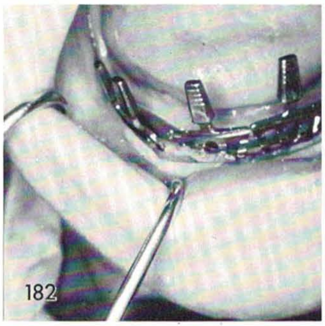
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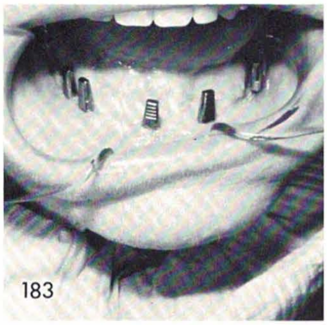
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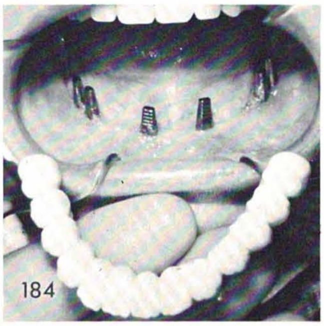
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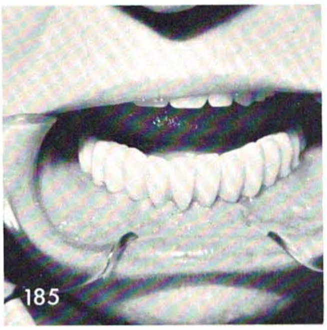
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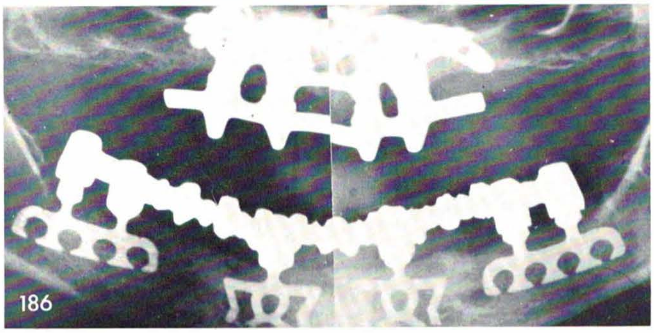
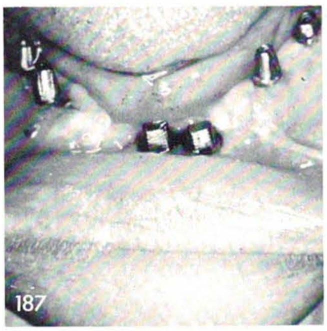
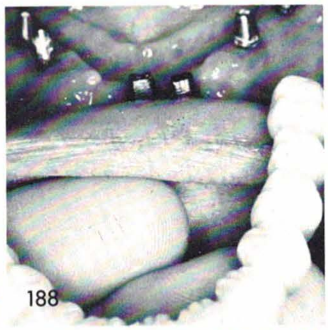
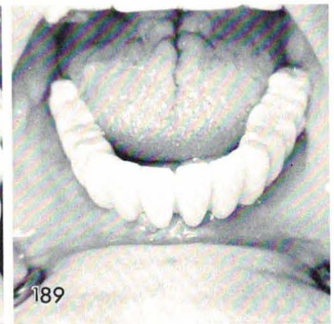
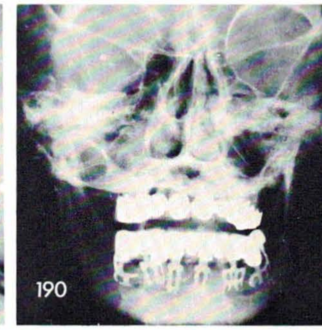

186

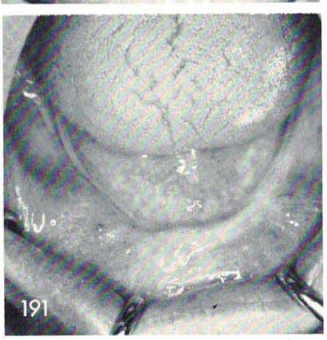
A knife edge ridge with high muscle attachments, fig. 181, must be carefully evaluated before implant therapy is started. The blades are inserted carefully into the knife-edged ridge, fig. 182, and with the lowering of the muscle attachment, these tissues also can heal uneventfully, fig. 183. A full arch acrylic over gold prosthesis was used here, figs. 184, 185. The post-operative x-ray, fig. 186.

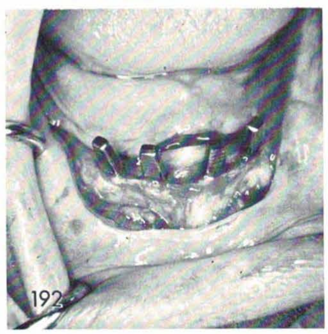


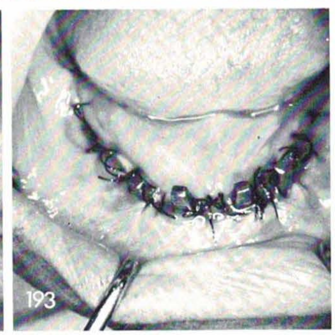


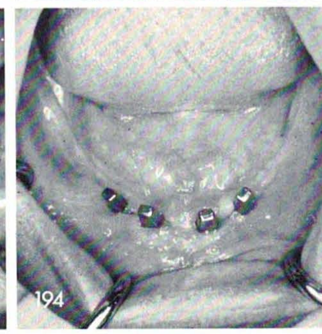


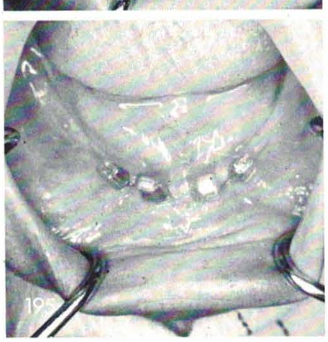
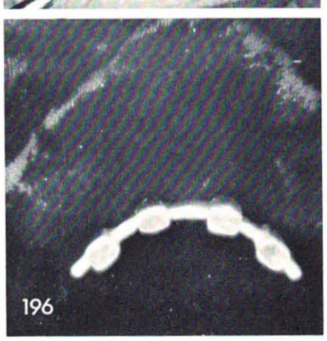


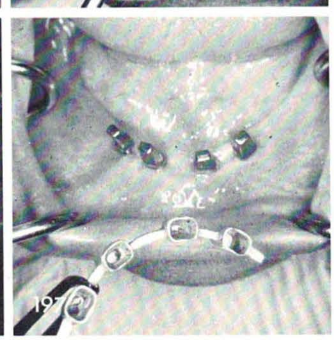
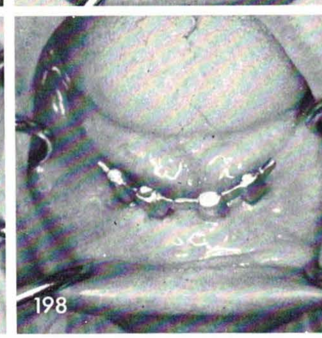






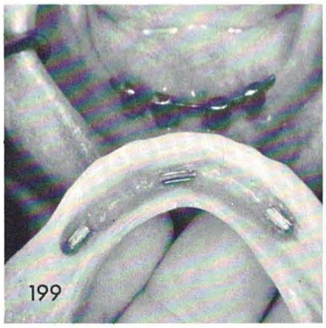


This case has already been in the mouth of my secretary for over seven years, figs. 187, 188, 189. A postero-antero roentgenogram reveals quite clearly the curvature of the blades around the arch and the restoration they have been supporting, fig. 190.

It is possible, at times, to utilize only the anterior portion of the totally edentulous mandible, fig. 191, for denture support using two double posted blades, figs. 192, 193, 194. Plastic copings are fitted over the blade posts, fig. 195, to facilitate an Andrews type bar system joined by four copings, fig. 196, which is cemented over the protruding implant posts, figs. 197, 198,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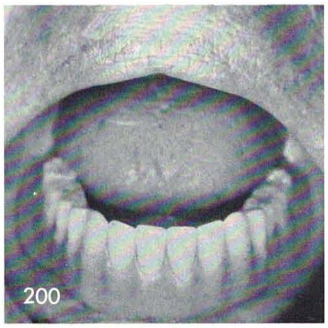
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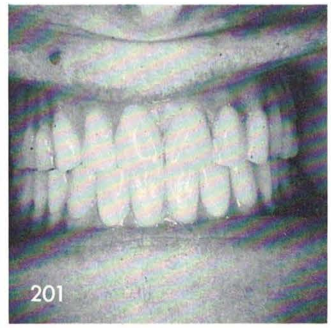
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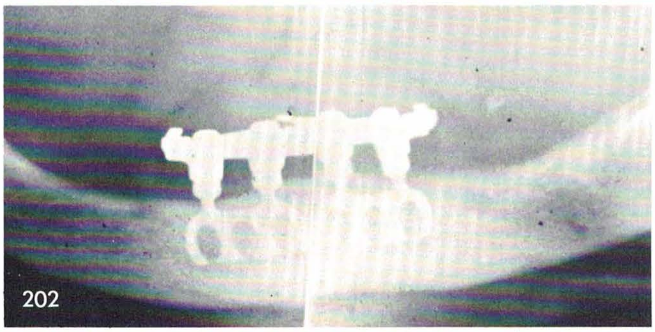
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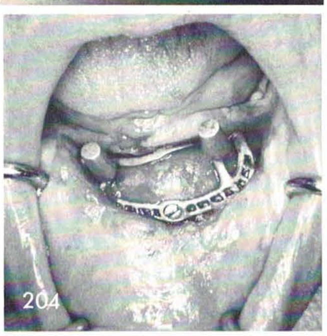
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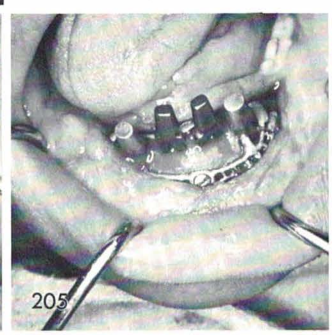
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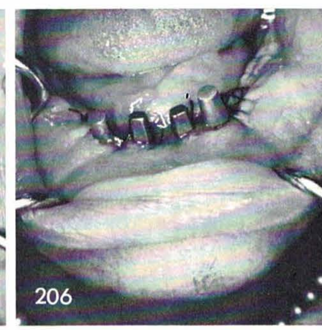
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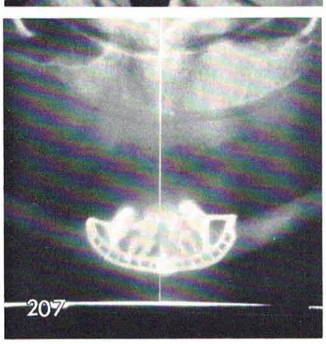
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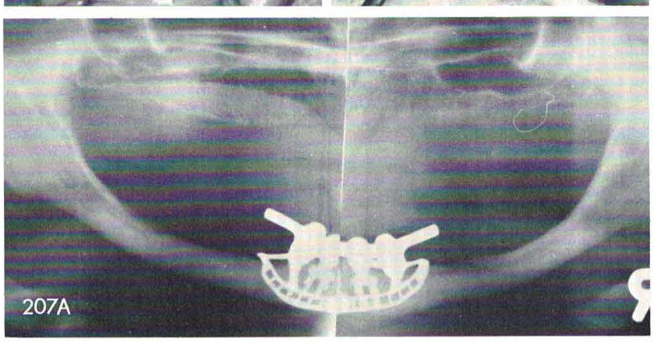
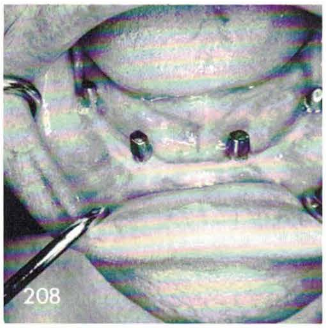

207A

to support the denture which contains internal clips for retention, figs. 199, 200, 201. A post-operative x-ray, fig. 202.

Another way of obtaining anterior support is to use a combination of a partial subperiosteal implant, figs. 203, 204, and two endosteal blades, figs. 205, 206, which are later joined together with a rigid meso-structure. The x-ray shows this case before the mesostructure was cemented into position, fig. 207, and after the meso-structure, fig. 207a.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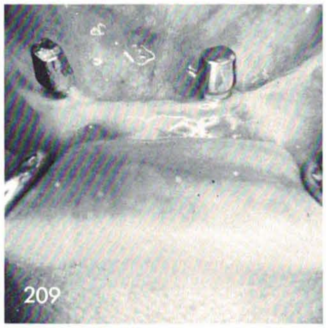
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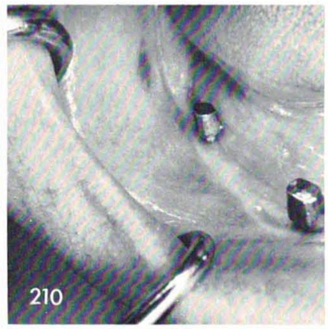
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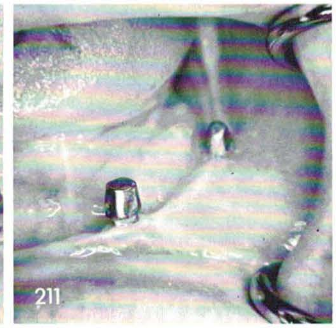
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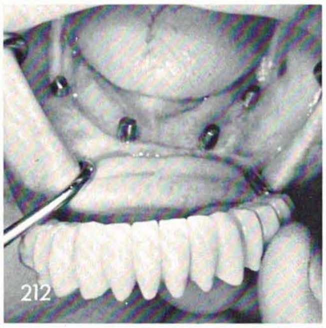
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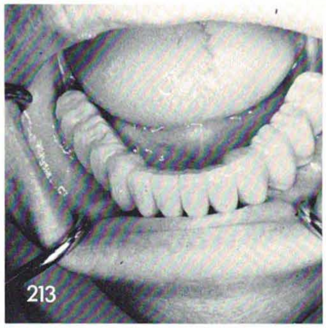
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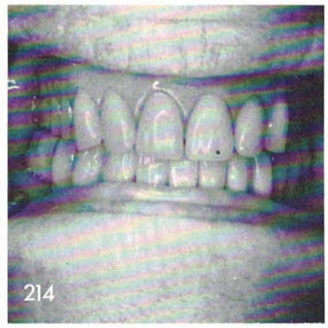
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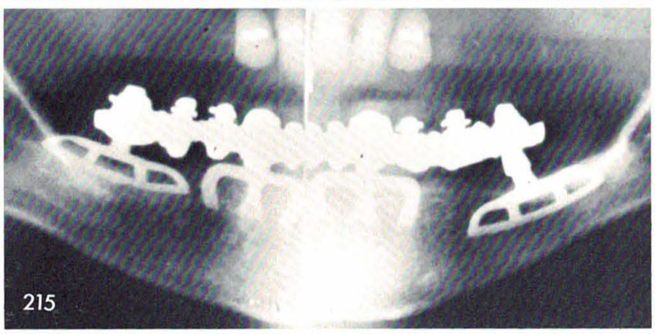
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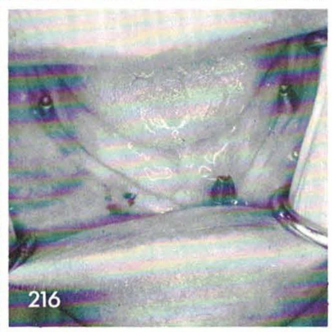
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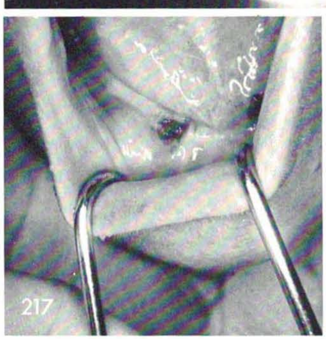
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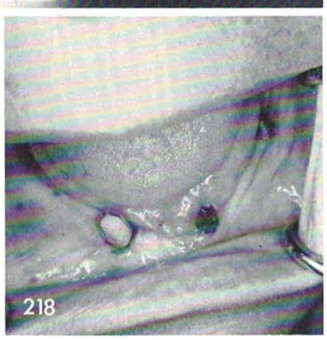
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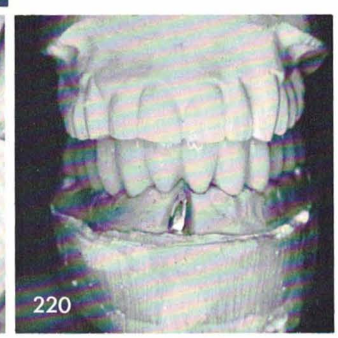
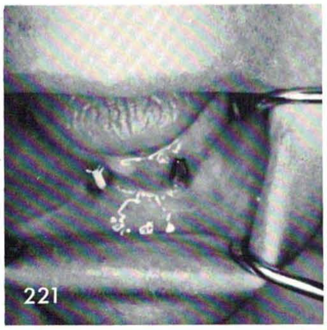

220

Four magnificently functioning blades are seen in figs. 208, 209, 210, 211. An acrylic over gold fixed prosthesis was cemented over the blade posts, figs. 212, 213, 214. This case was done at the Institute for Graduate Dentists in 1968 when the woman was in her middle seventies and still remains functioning with very little bone loss as seen on this nine year post-operative x-ray, fig. 215.

This case represents a very unusual and rare occurrence. Four bladevents functioned successfully for several years when one day she appeared in my office with the right cuspid neck of the blade severed completely from its body, fig. 216. The existing prosthesis had to be removed,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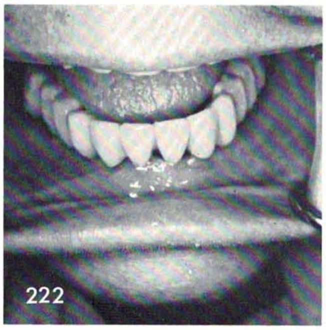
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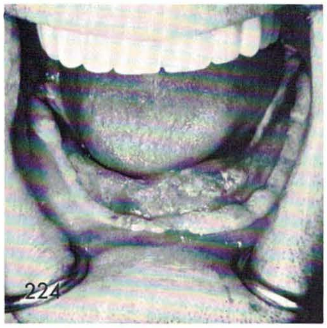
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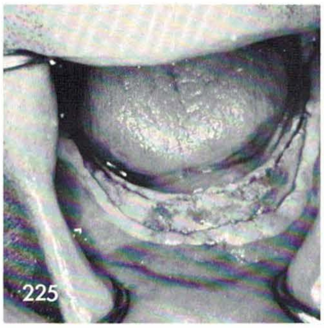
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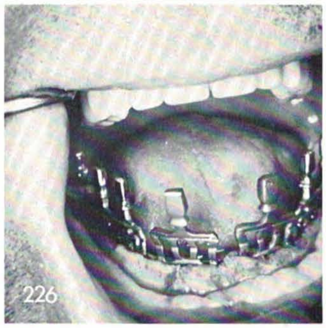
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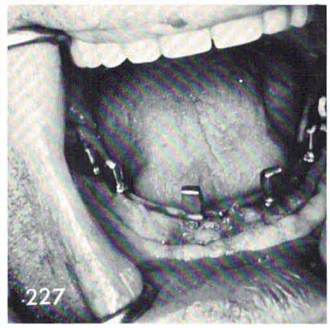
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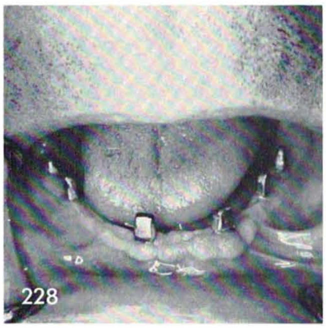
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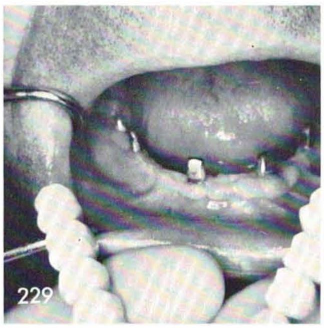
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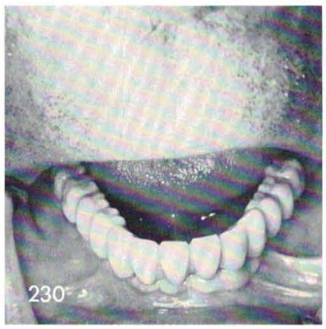
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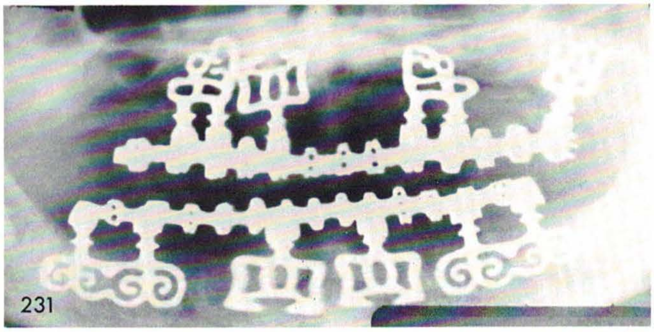
being that the neck broke off half way from the body of the blade. It was possible to expose the remaining portion of the neck, fig. 217, and by filling one of the prefabricated plastic copings with cold cure acrylic, fig. 218, which was picked up with an elastic impression, fig. 219.

A new prosthesis was processed with the new gold post, fig. 220, that fitted exactly over the remaining portion of the neck and fitted accurately inside the cuspid crown. Fig. 221 shows the new right cuspid post cemented over the broken neck of the blade to help support the new prosthesis, fig. 222. A nine year x-ray shows the case to be working out very well, fig. 223.

When the alveolar bone is dense and thick I often use my newer designed blades which are slightly wider bucco-lingually than the original most widely used titanium blades, fig. 224. The grooves are made in a similar manner but must be made extremely deep and sometimes even slightly widened, fig. 225, to accommodate the broader type blades, figs. 226, 227. The healing is magnificent and the retention of these blades in bone is unsurpassed, fig. 228. A full arch fixed prosthesis is then cemented to place, figs. 229, 230. The post-operative x-ray, fig. 231.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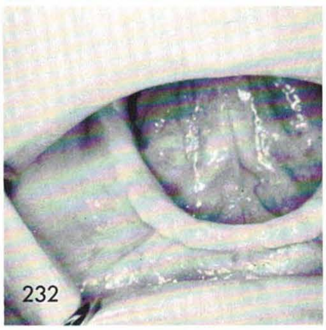
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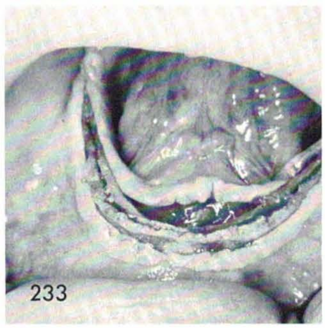
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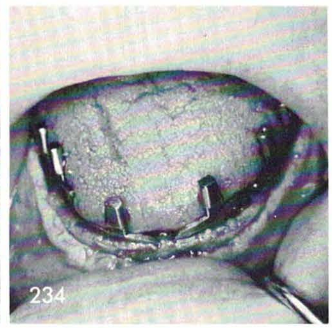
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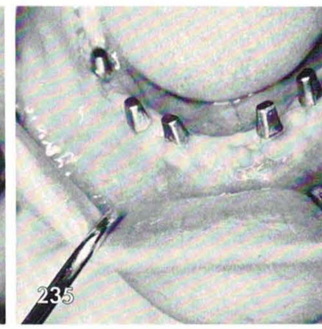
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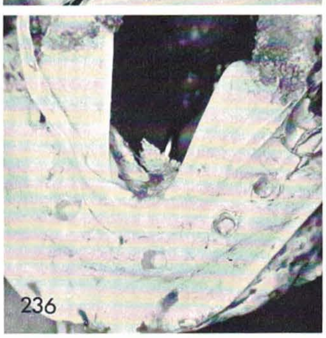
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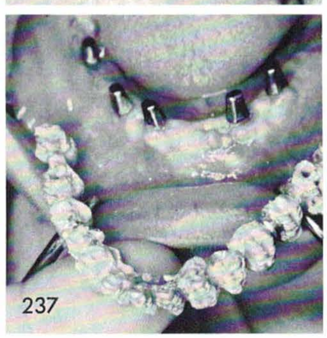
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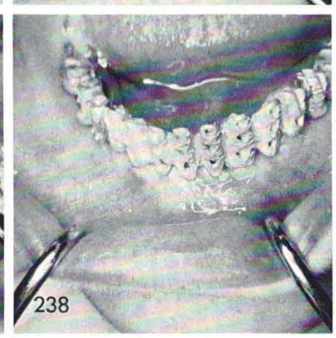
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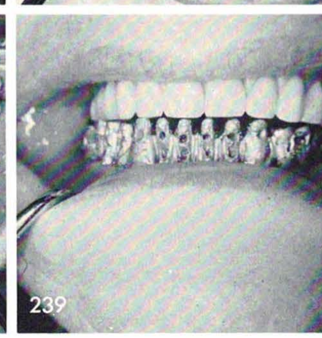
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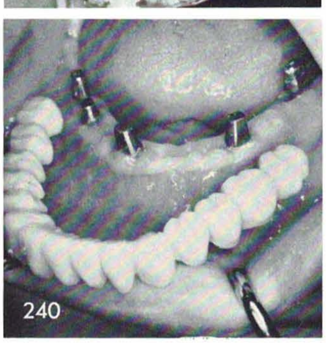
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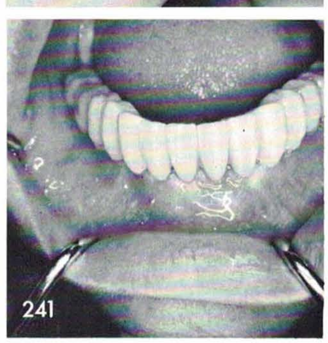
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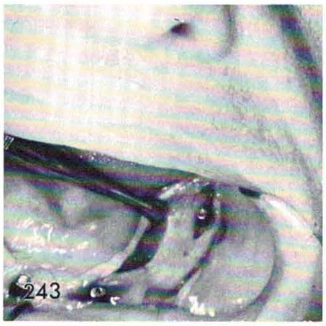
242

One must be careful when reflecting the tissues of a patient whose mandible contains a "labial roll over", fig. 232. Very often if not careful the tissues that are reflected beneath the labial bulge can be torn, thus slowing down the healing mechanism. In this case, however, a clear reflection was possible, fig. 233. Blades were symmetrically inserted, fig. 234. Healing was uneventful, fig. 235. An elastic impression of the posts was taken, fig. 236, for the casting of a one piece superstructure, figs. 237, 238, 239 and to accommodate the processing of acrylic teeth, figs. 240, 241. This x-ray was taken seven years post-operatively, fig. 242.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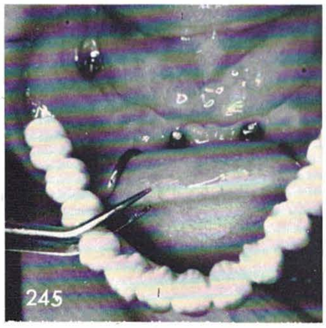
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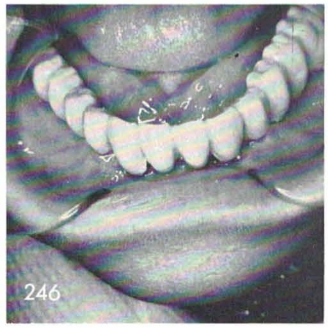
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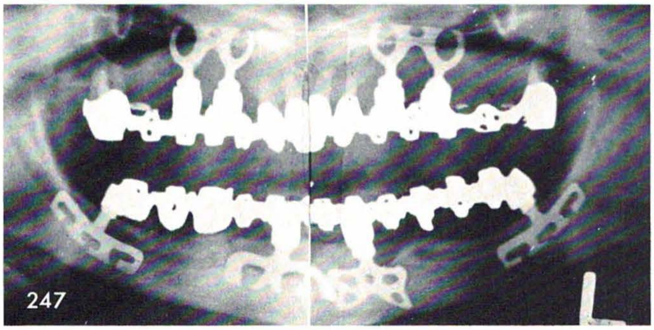
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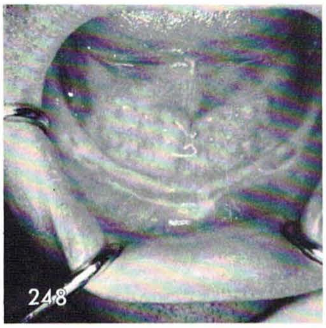
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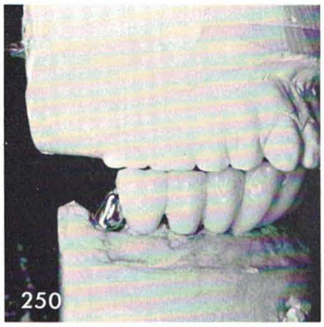
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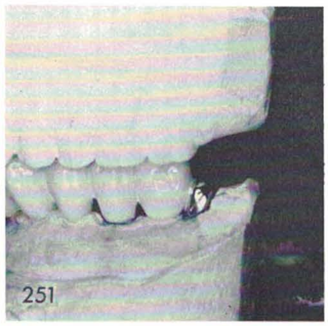
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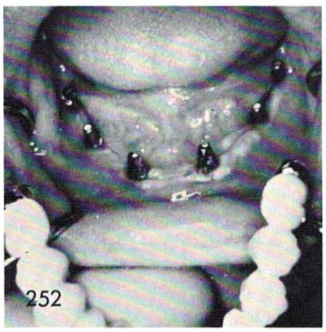
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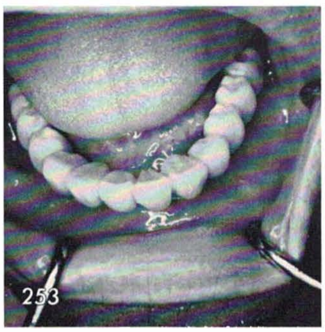
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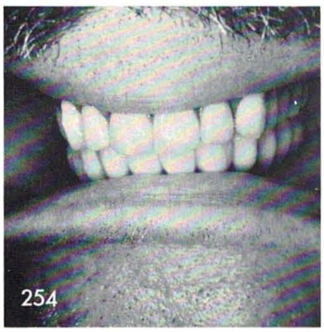
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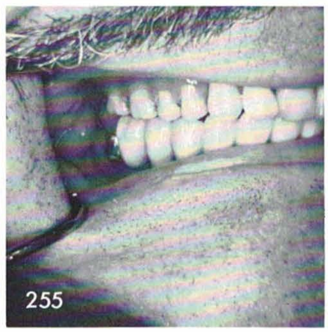
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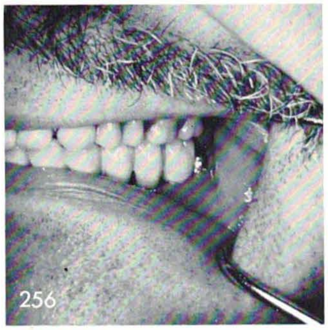
Occasionally, in situations where the posterior crest is only a millimeter or two above the canal and due to an extreme concavity beneath the mylohyoid ridge blades are inserted near the external oblique ridge rather than on the lingual side of the ridge to avoid a paresthesia, figs. 243, 244. This case worked out exceptionally well, figs. 245, 246, 247. However, I do not recommend placing a bladevent extremely buccal to the ridge as there is usually no attached gingivae in this area and a cross-bite occlusion often results.

It is not always possible to line up the blade posts so that the corresponding crowns of the restorations will fit directly over them, fig. 248. Fig 249 shows how the posterior crown was con-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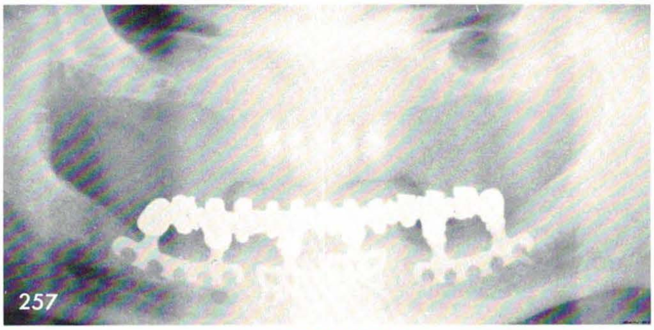
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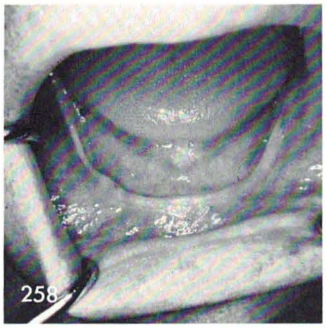
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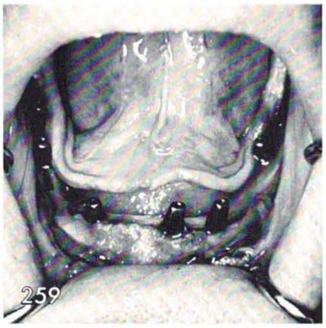
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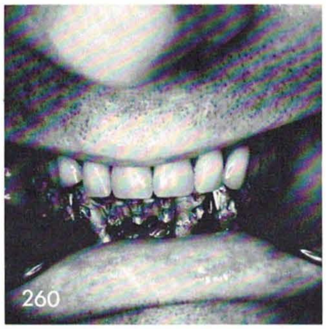
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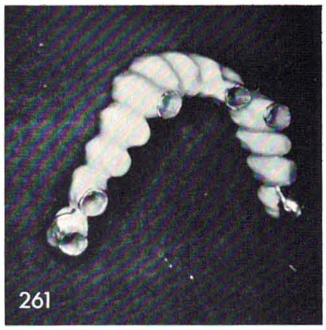
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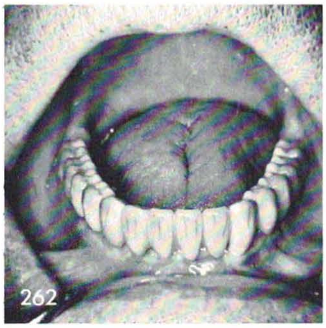
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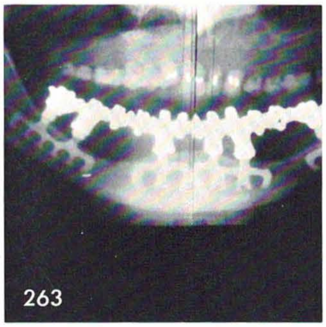
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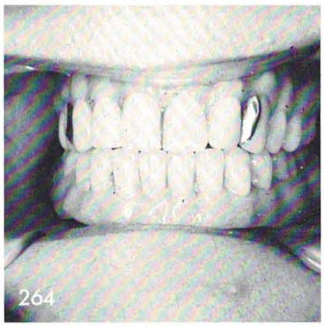
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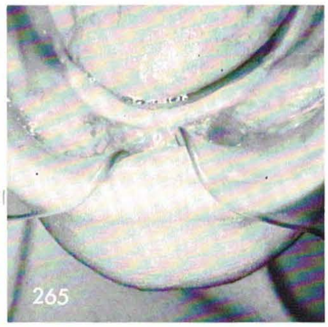
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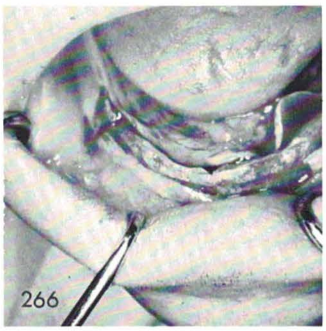
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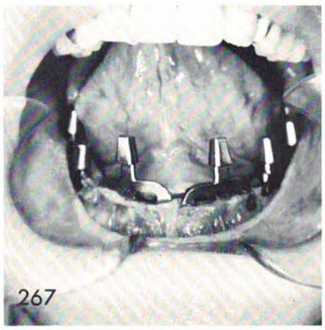
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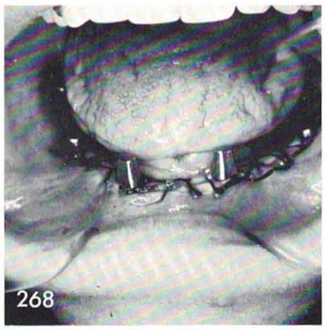
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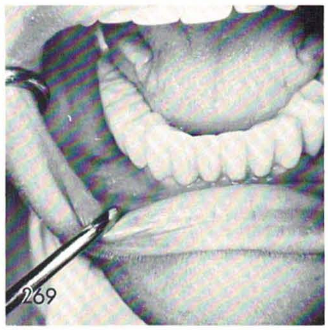
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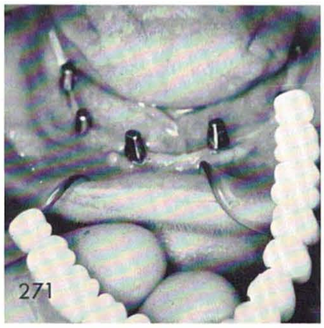
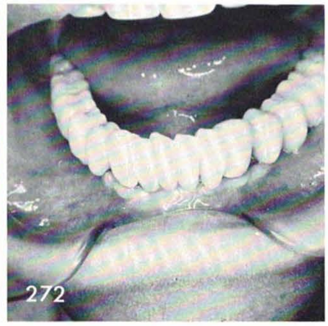
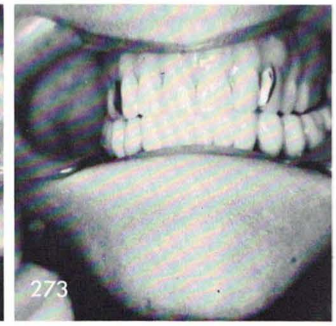
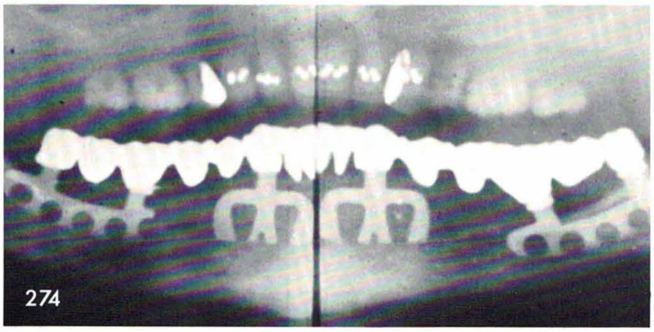
toured in order to avoid improper design and how the gold coping was left uncovered to act as the posterior support and how the interproximal embrasure between the gold coping and the last crown was maintained, figs. 250, 251. In this manner the patient was able to continue flossing in between the final restorations, figs. 252, 253, 254, 255, 256. A post-operative x-ray, fig. 257.

In this edentulous situation, fig. 258, blades were inserted around the arch, fig. 259, but due to the unusually thick fibromucosal tissues which are very seldom present in the mandible the gold work, fig. 260, had to be designed in such a fashion that a long and thin collar would



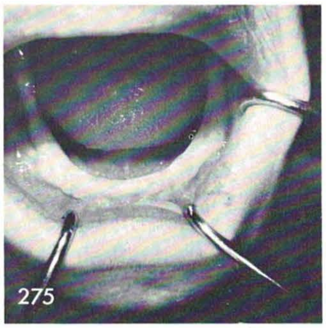






slip beneath the thickened tissue with the supra-gingival portion of the restorations, flaring out labially and slightly labial to the center of the labial and buccal free marginal gingivae, fig. 261. The bridge and implants remain in place after eight years, fig. 262. The post-operative x-ray, fig. 263.

The patient presented herself with a lower denture which she was totally frustrated with, fig. 264. The ridge posteriorly and anteriorly was knife-edged and very shallow, figs. 265, 266. She was warned of a very good chance of a parethesia but she insisted that she did not care and would still rather have the implants, fig. 267. Posteriorly the blades had to go buccally. The tissues were sutured closed, fig. 268, and an immediate temporary acrylic splint was fabricated, fig. 269. Several more visits took place which included the fitting of the gold castings and the completed porcelain-fused to metal prosthesis was ready to be cemented, figs. 270, 271, 272, 273. The x-ray shows the well inserted bladevents. fig. 274.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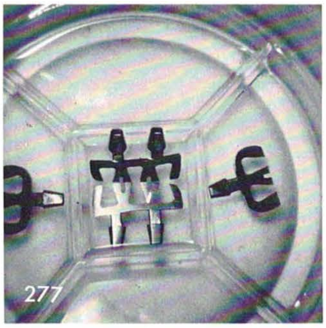
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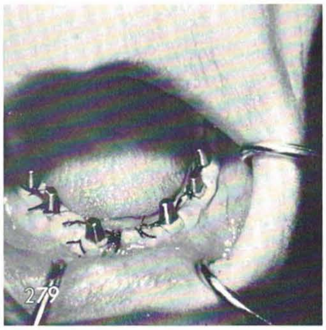
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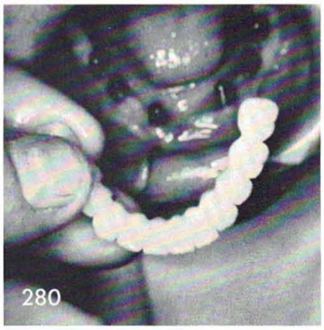
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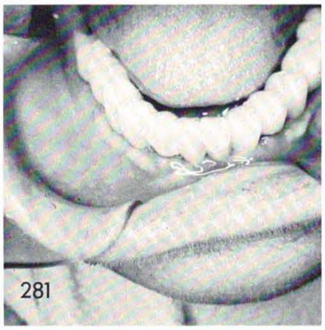
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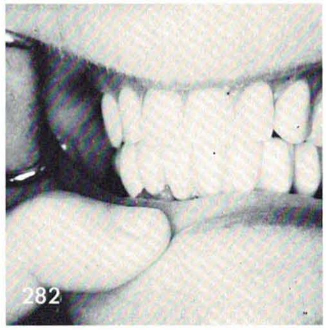
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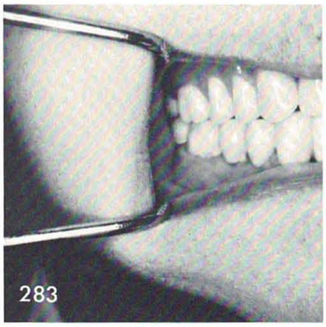
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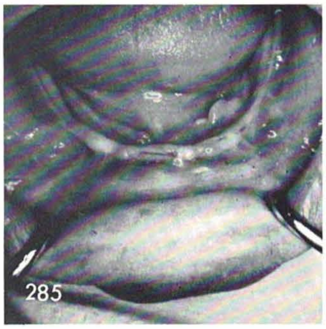
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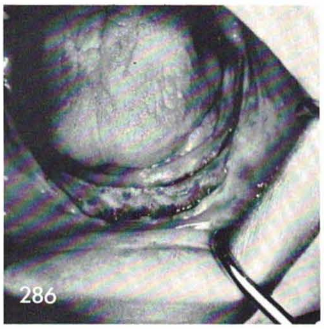
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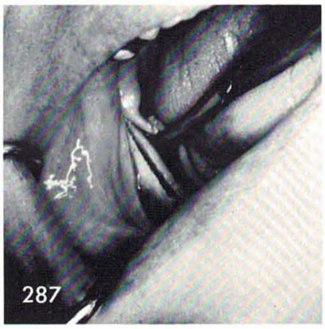
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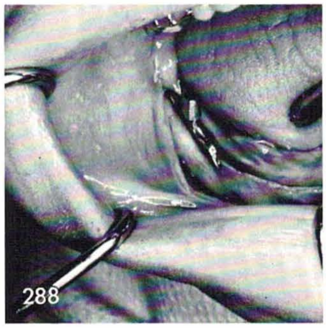
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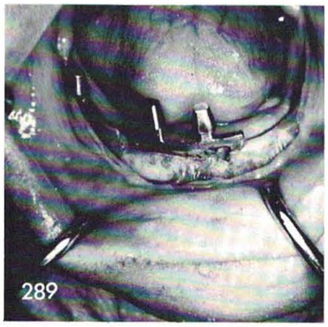
Fig. 275 shows a clinical view of the tissues covering an extremely knife-edge ridge, fig. 276. These early designed blades were used in fig. 277, and tapped properly into the already widened ridge which was accomplished by flattening out the most superior surfaces several millimeters downward, fig. 278. After suturing, fig. 279, healing was excellent, fig. 280, and the porcelain restoration was cemented into place, figs. 281, 282, 283. The post-operative x-ray, fig. 284.

The only implant in the entire world that can be adapted into knife-edge ridges which is more often the common rather than the uncommon situation that exists are the bladevents. Figs.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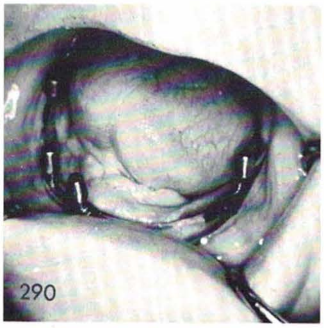
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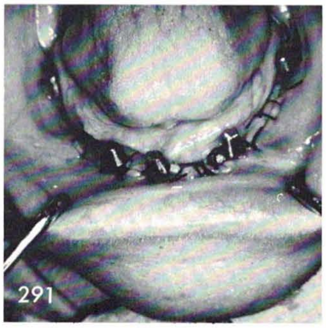
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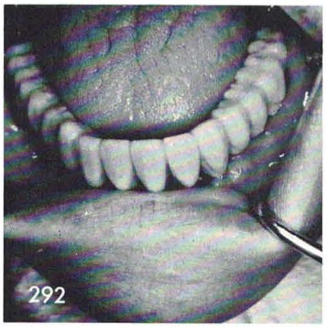
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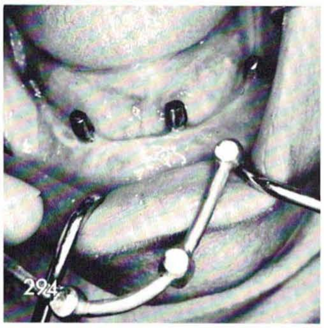
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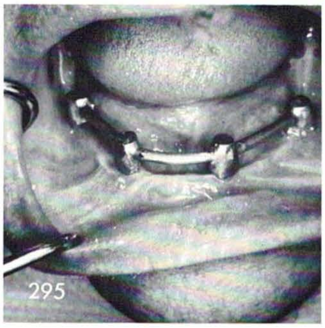
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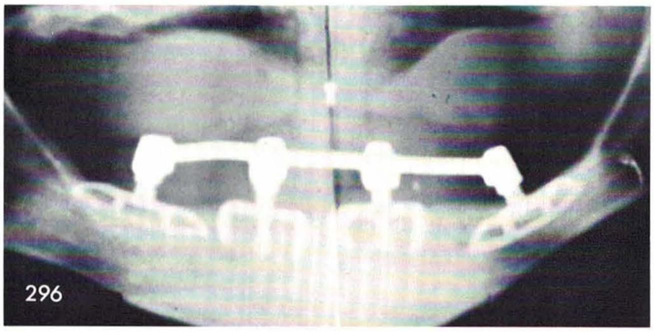
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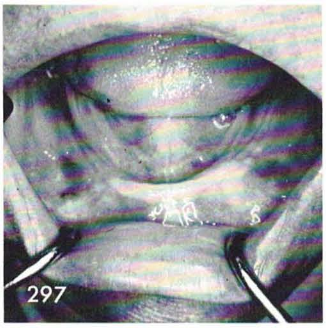
285 and 286 reveal the extremely thin ridge. A clean and steady groove is first made posteriorly, fig. 287, and carefully the blade is gently tapped into proper position, fig. 288. The ridge is widened anteriorly so that blades can also be successfully inserted there, figs. 289, 290. The remaining blades are inserted and the tissues are sutured, fig. 291, and the prosthesis cemented into position, fig. 292. A nine year post-operative x-ray reveals this successfully functioning case, fig. 293.

In those situations where the patient cannot afford a full arch fixed restoration then a Dolder bar-coping support should always be constructed and cemented over the blade posts, figs. 294, 295, which in turn will serve as a support for the removable denture. The post-operative x-ray fig. 296.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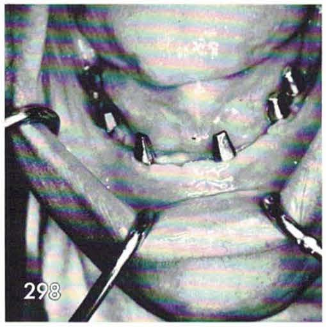
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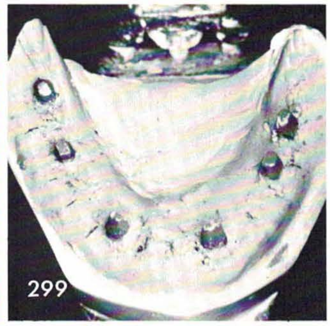
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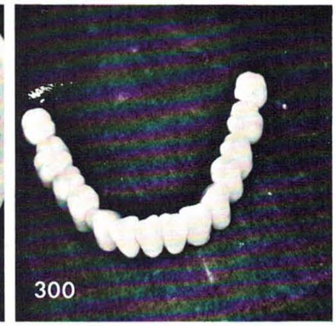
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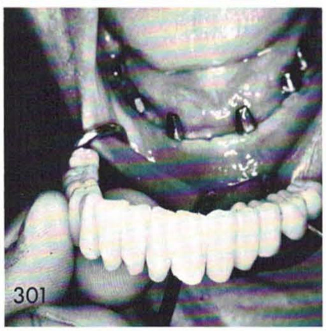
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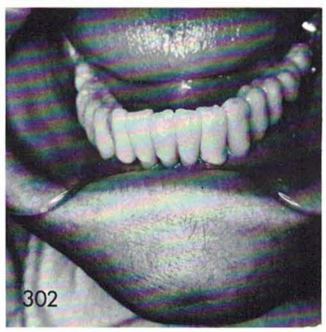
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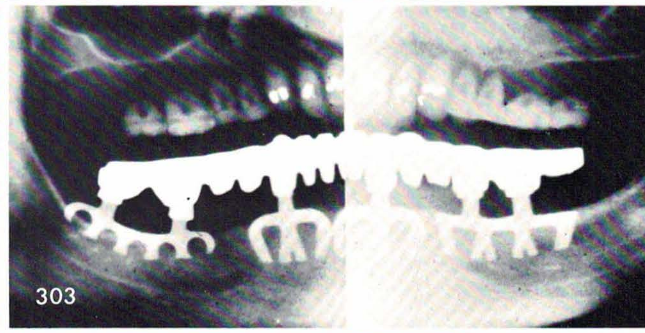
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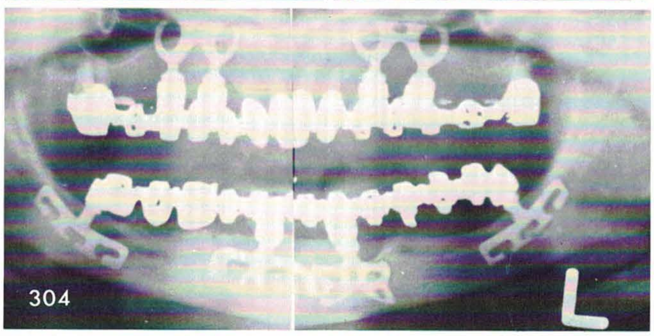

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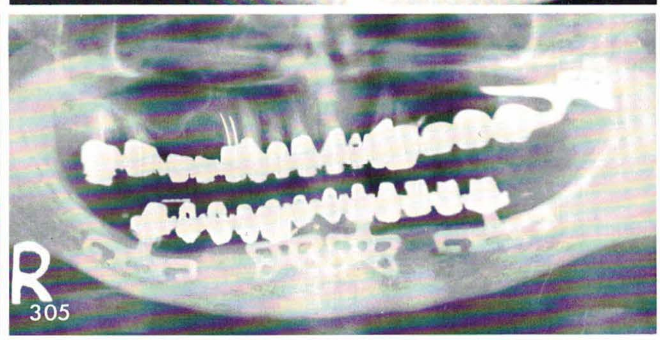

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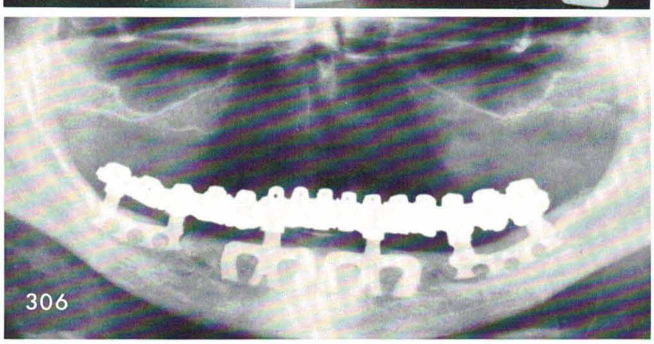
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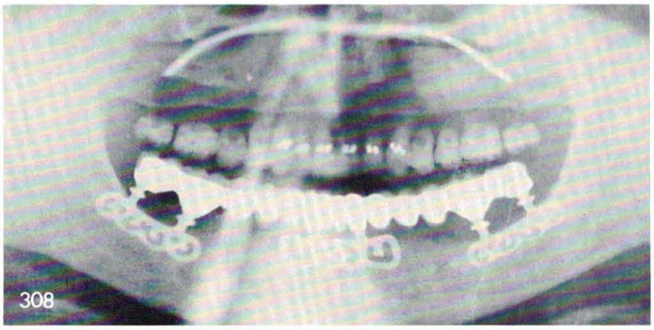
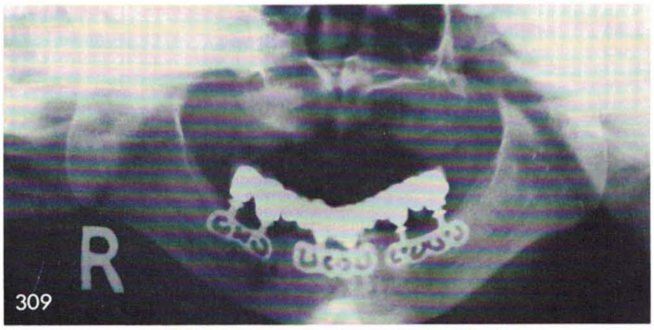
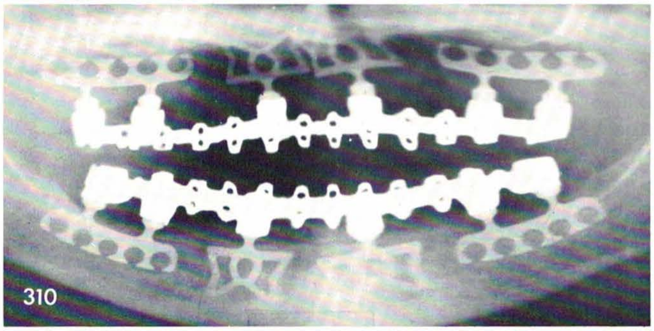
307

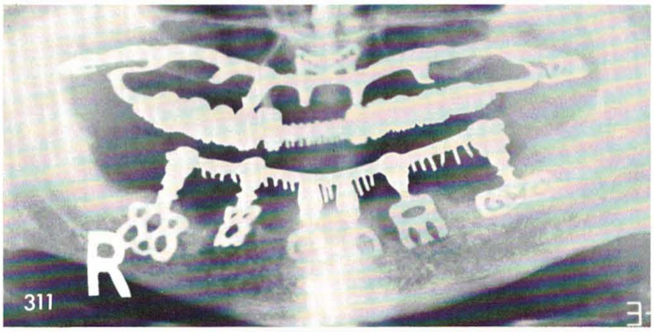
A totally edentulous case, fig. 297, with bladevents, fig. 298, can rapidly be completed with the use of a one piece elastic impression into which epoxy dies can be fashioned, fig. 299. A porcelain full arch prosthesis was the restoration used in this case, figs. 300, 301, 302. The post-operative x-ray, fig. 303.

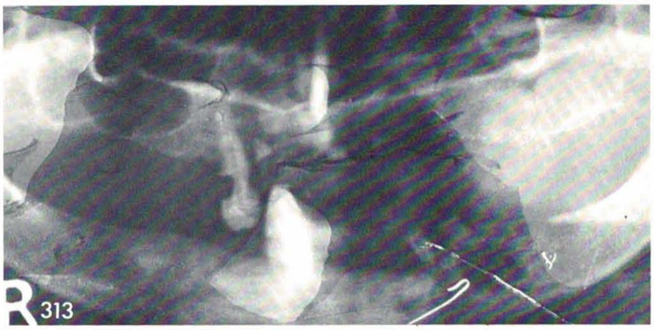
Figs. 304 through 312 show x-rays of totally edentulous mandibular blade cases.

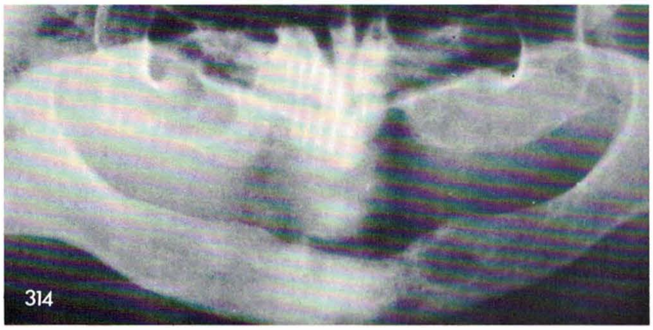












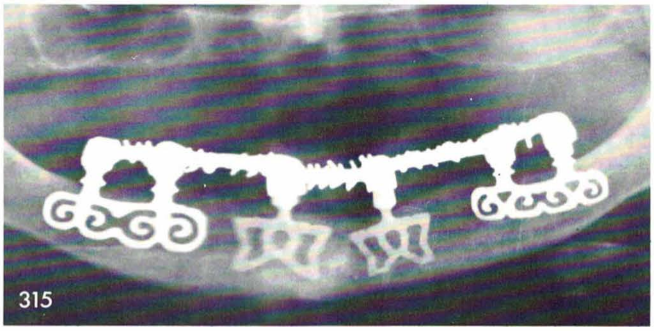
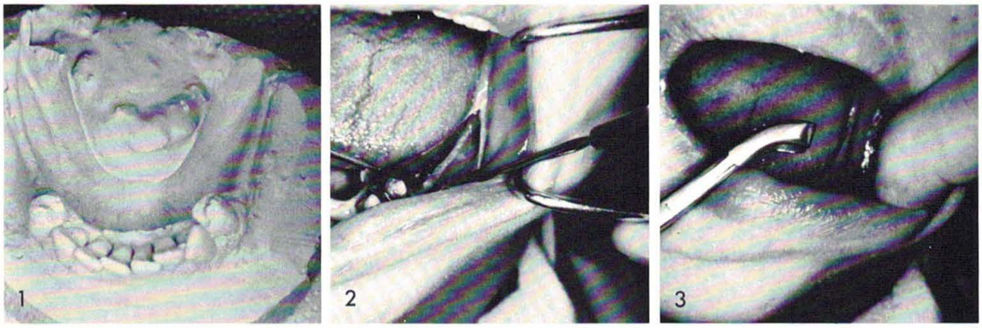


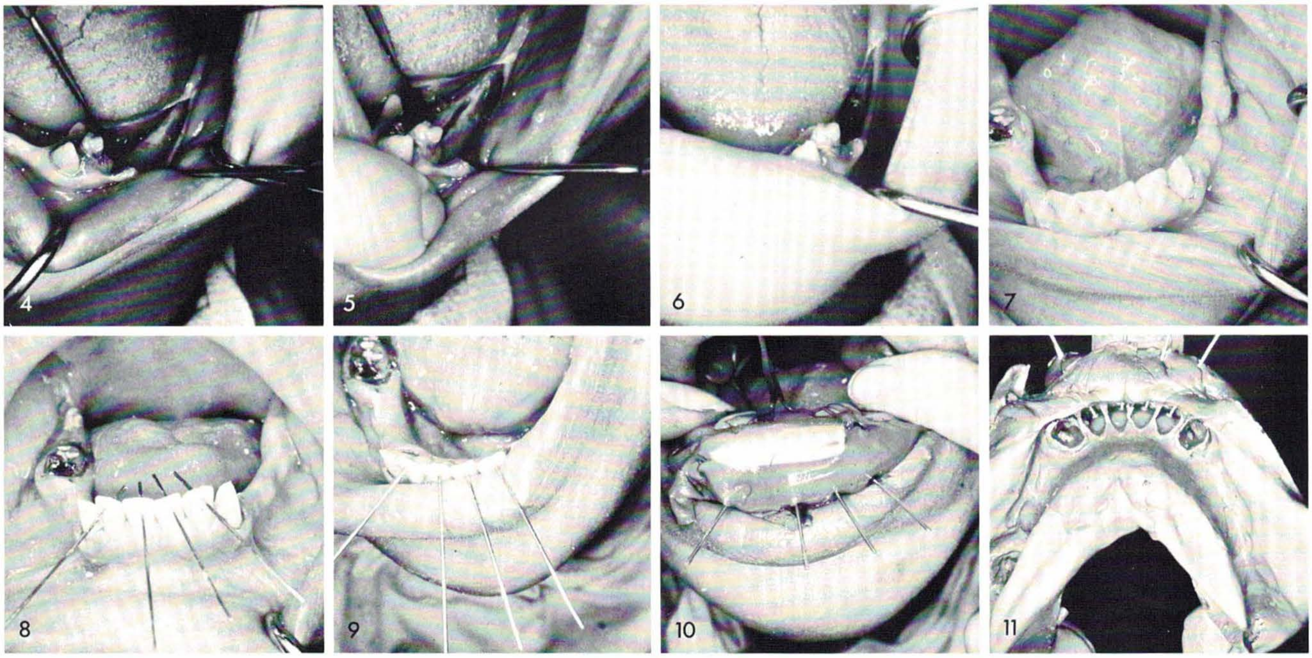
Fig. 313 shows a case with an odontoma of a large residual cyst in the lower left bicuspid region. Also, a mass of tartar existed around and below the right cuspid.

Fig. 314 shows post-operative x-ray revealing the cyst still persisting.

Fig. 315 is an x-ray after two years of lower blades. The cyst had filled in with bone.

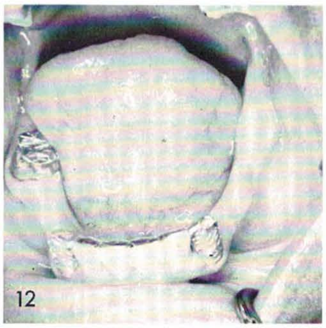
Partially Edentulous Cases with Extremely Knife Edge Ridges





In an extremely knife edge ridge, figs. 1, 2, it is imperative that before a blade can be contemplated, it must be interpreted whether or not the occlusal table can be made wide enough to accept a groove, by reducing the fragile crestal bone. Either with a bone rongeur, fig. 3, round stone, or bur, or all three, the ridge is reduced and widened, fig. 4, and the groove is made, fig. 5, and the implant is accepted, fig. 6.

Fig. 7 shows a knife edge ridge on the left posterior quadrant. Holes were drilled horizontally above the pulp horns through the four incisor teeth and pins were placed through them, fig. 8. They were then backed up to fit flush with the lingual surfaces of the incisor teeth, fig. 9, to facilitate the impression technique, fig. 10, allowing the impression to be removed without tearing or distorting, fig. 11. The necessary lingual castings were fashioned to fit over the prepared lingual surfaces of the incisors and full crown coverage restorations were cast for the remaining cuspids and right molar, fig. 12.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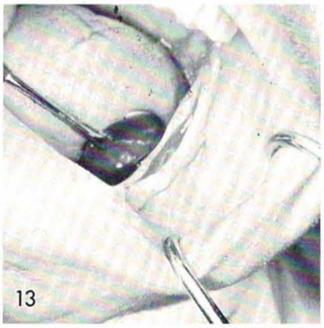
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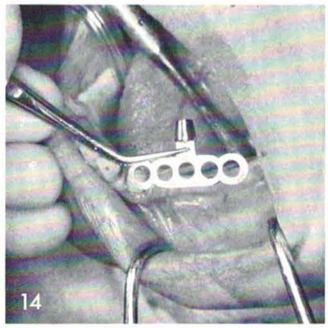
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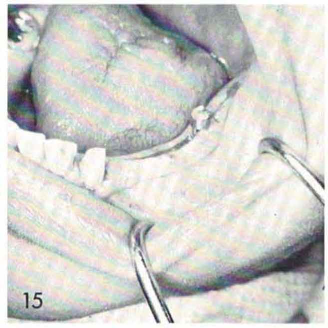
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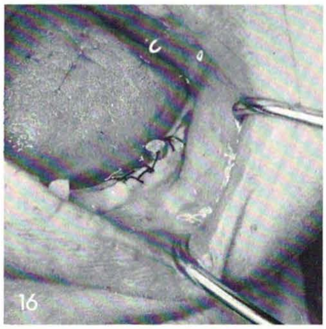
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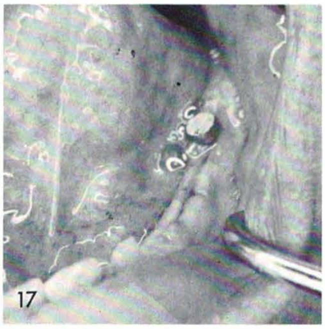
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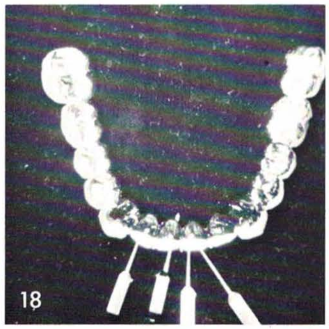
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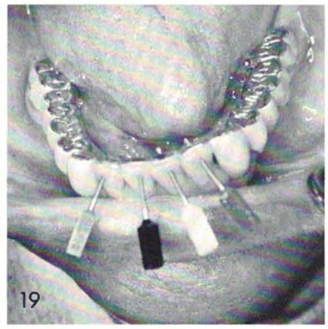
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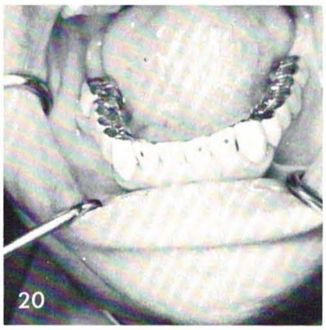
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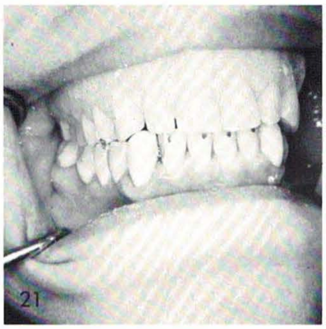
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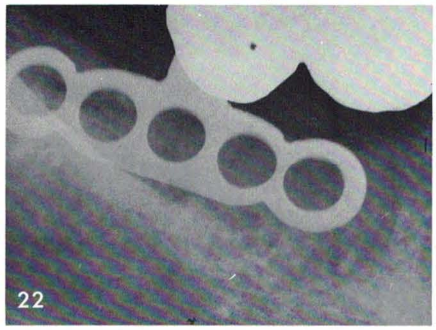
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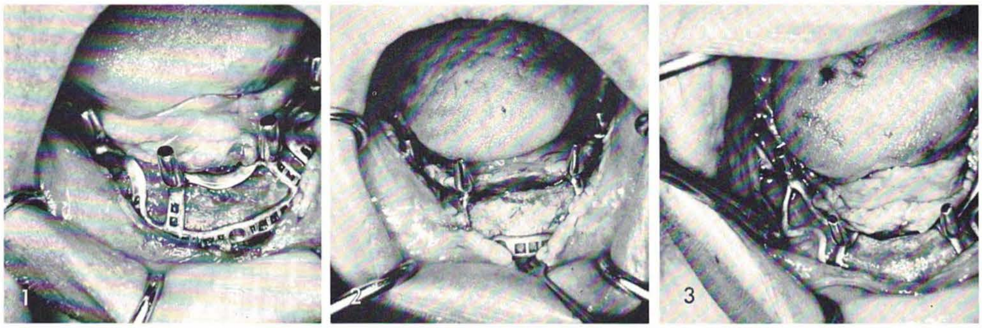
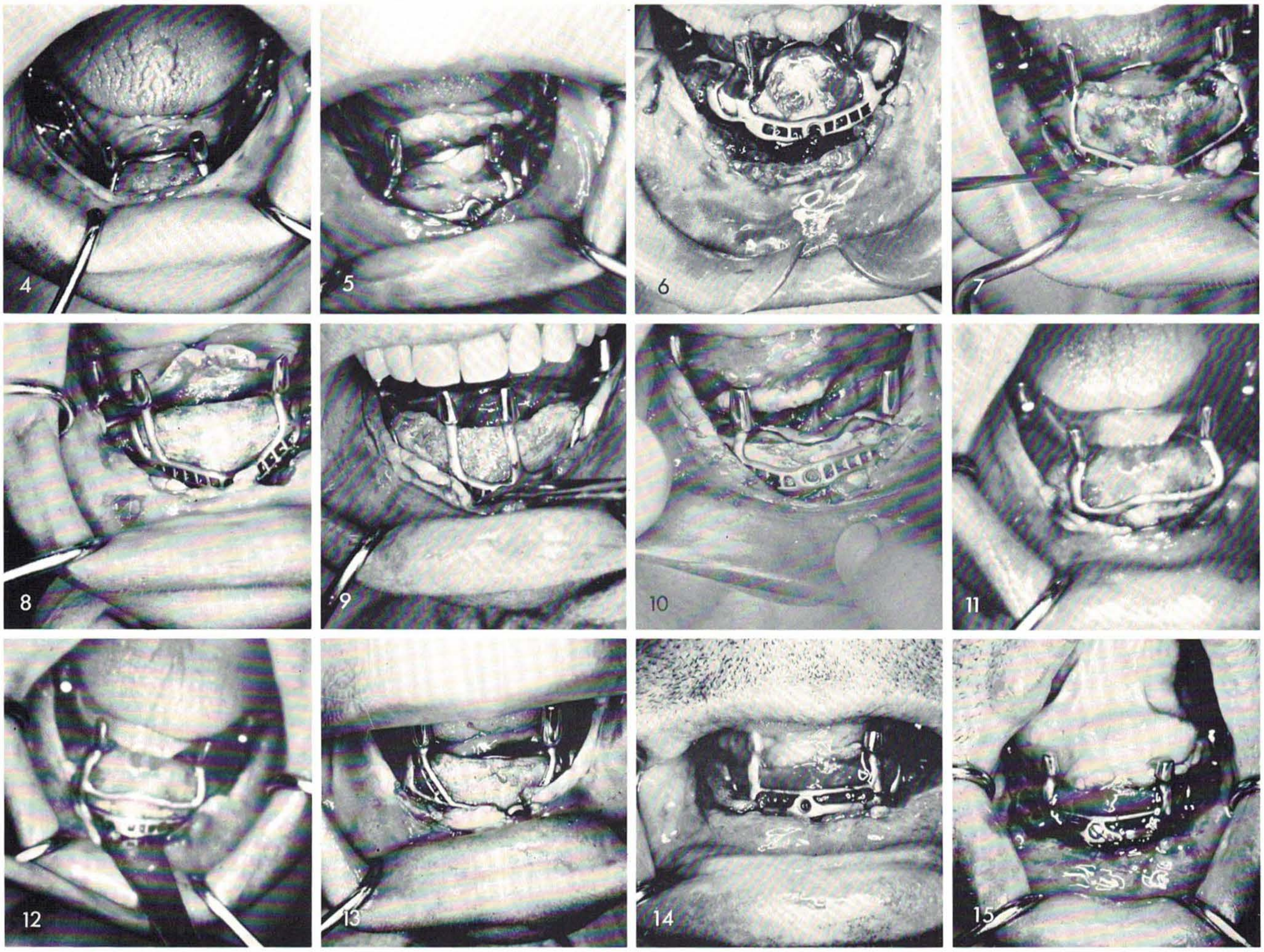
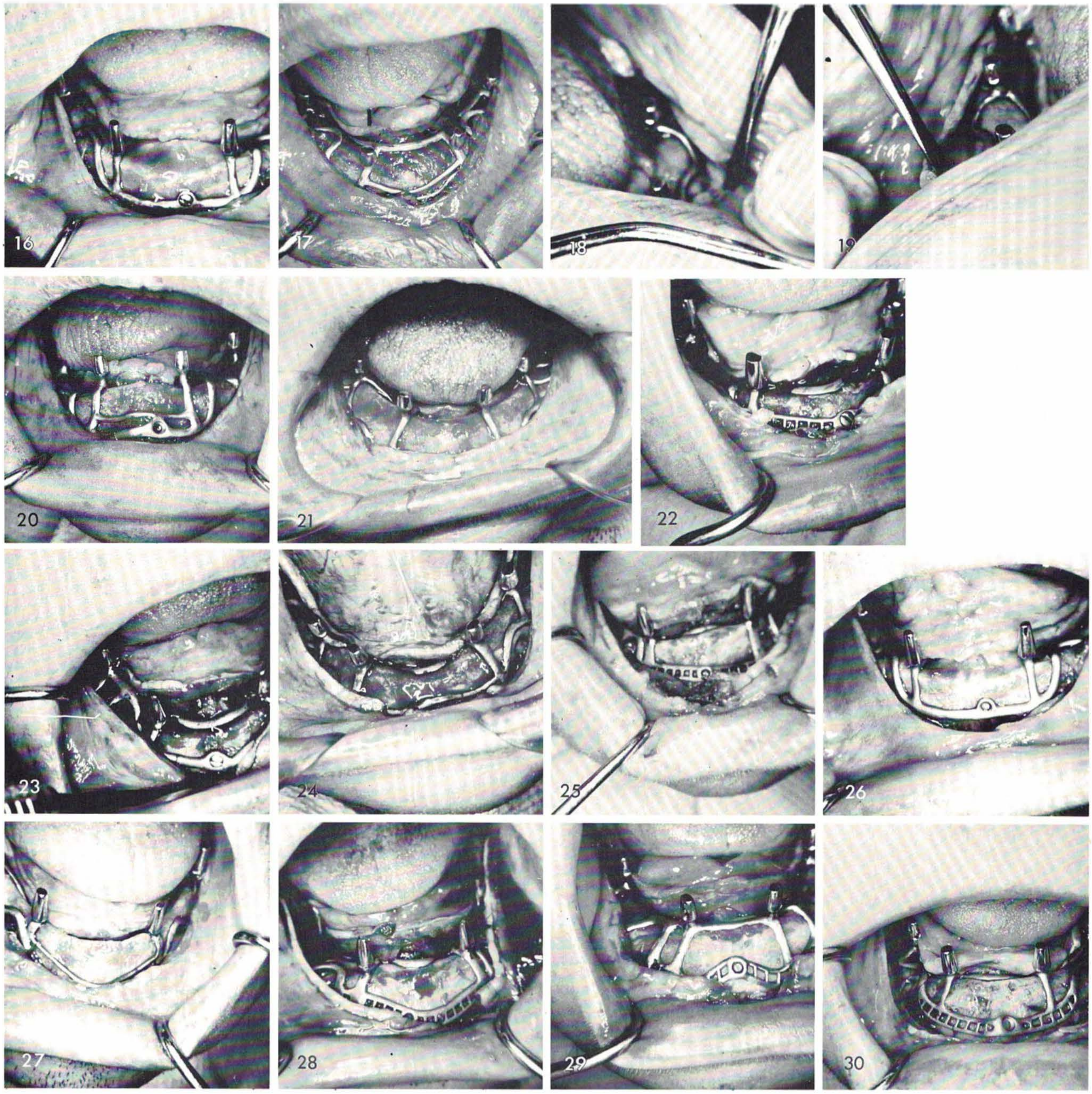
The tissues were then incised and reflected, fig. 13, exposing the knife-edge ridge and the earlier designed bladevent was inserted, figs. 14, 15, and sutured, fig. 16. After the sutures were removed, fig. 17, the acrylic veneer bridge was completed, fig. 18, and cemented into place with the non parallel pins cemented and "screwed" into position, figs. 19, 20, 21. Fig. 22 was the post-operative periapical film revealing the bladevent and fig. 23 shows a panoramic x-ray.

Subperiosteals on Bone





When the impression technique is exact and the design concept is followed out according to what we know about the morphology and anatomy of the mandible, then an excellent fit of the implant, which is imperative for its success, is the result. Figs. 1-38 show the exact fit of many designed subperiosteal implants, some of them going directly into healed sockets and some of them showing an anterior screw.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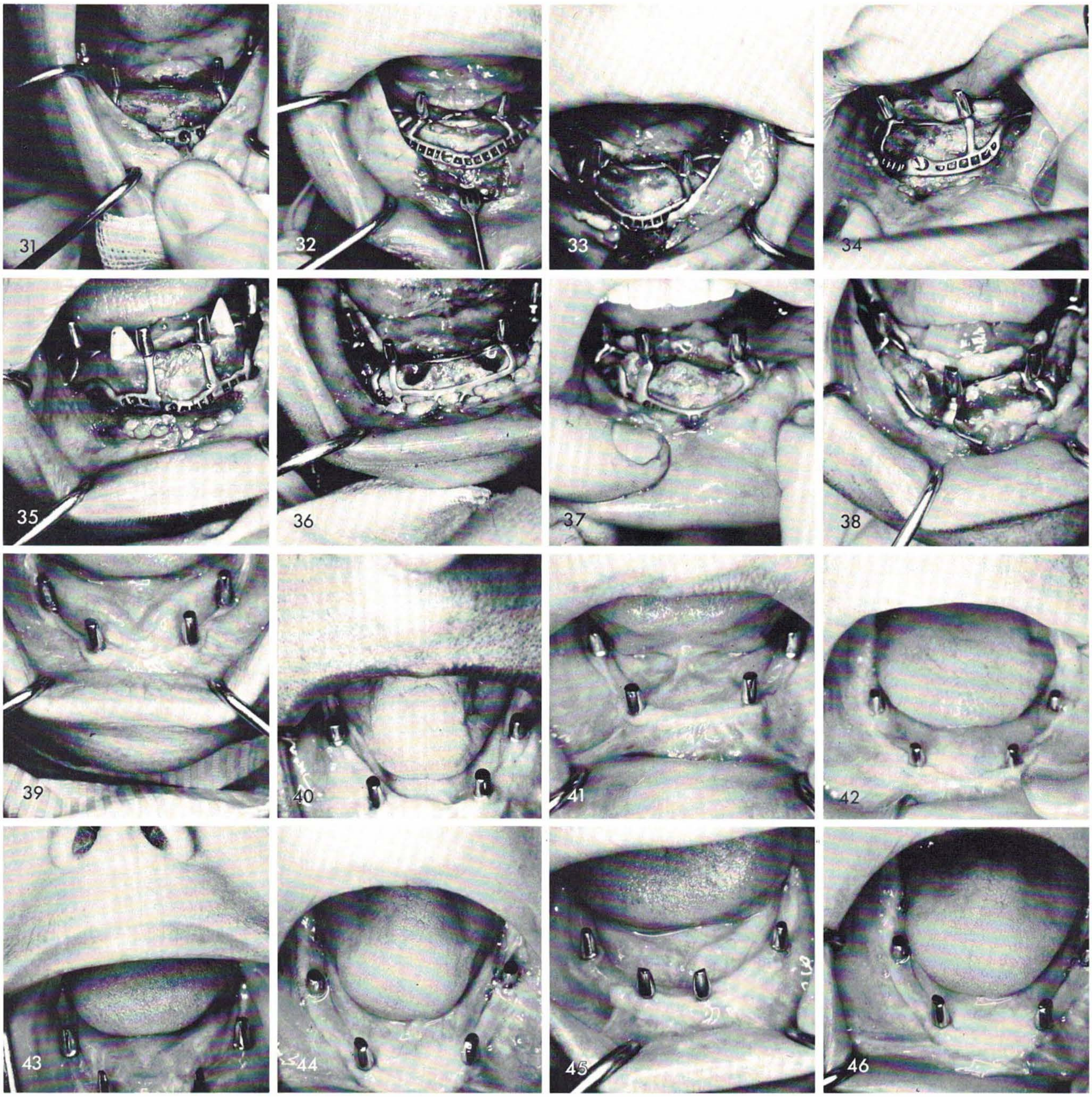
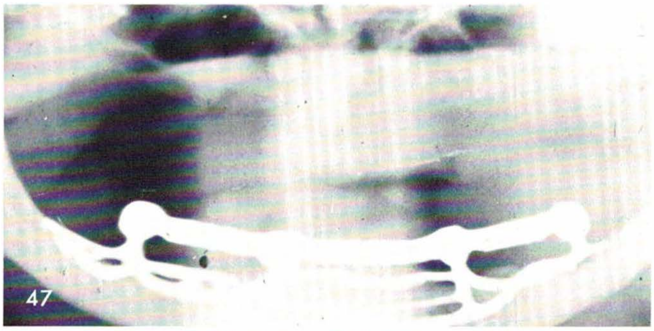
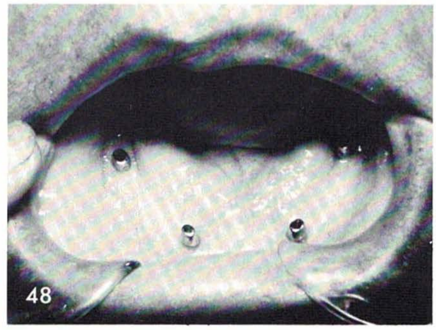
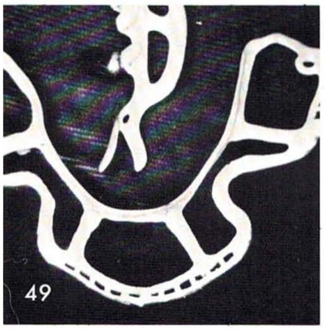
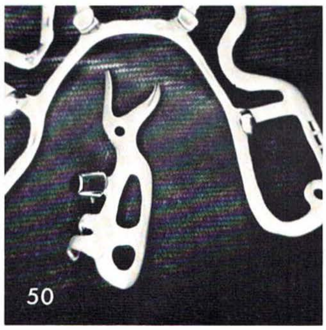


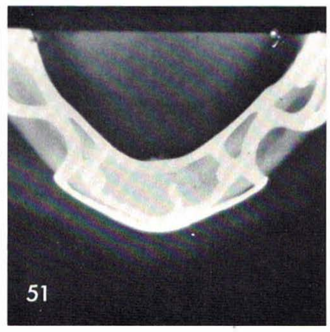
When they fit as exactly as these did and the soft tissues were tenderly cared for and the prosthetic phase carried out with the utmost knowledge and skills, the tissues around the subperiosteal implant posts usually respond remarkably well as seen in figs. 39 through 46. Fig. 47 shows a seventeen and one half year post-operative x-ray of a subperiosteal implant, that was done after an original failure with my first attempt in 1953. Fig. 48 shows the clinical appearance.





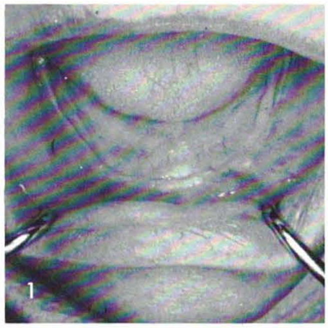


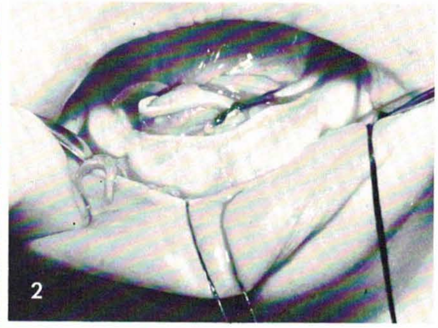


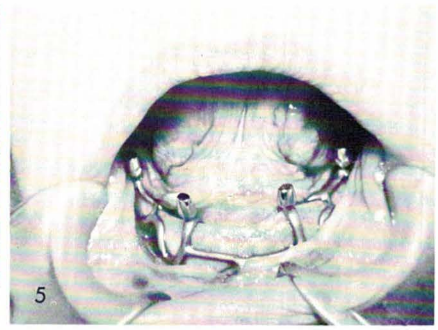


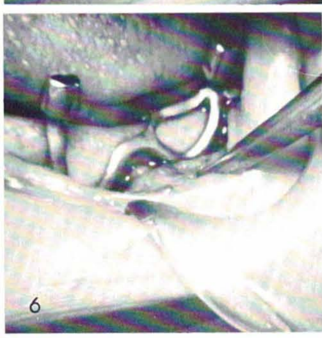
Some of my subperiosteal implant designs have been imploded with porcelain and aluminum-oxide, figs. 49, 50. Occlusal films show how implants should fit over bone, fig. 51.

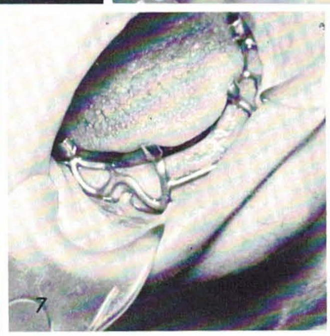
Subperiosteals

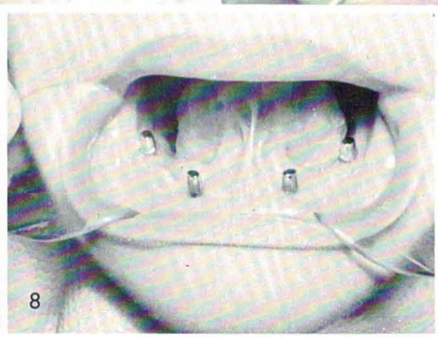


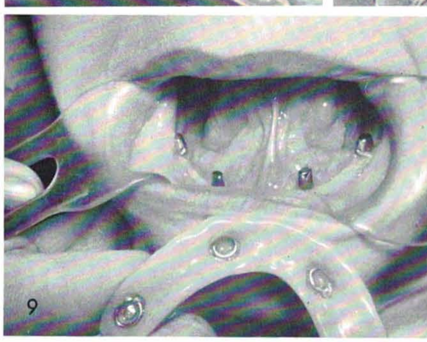




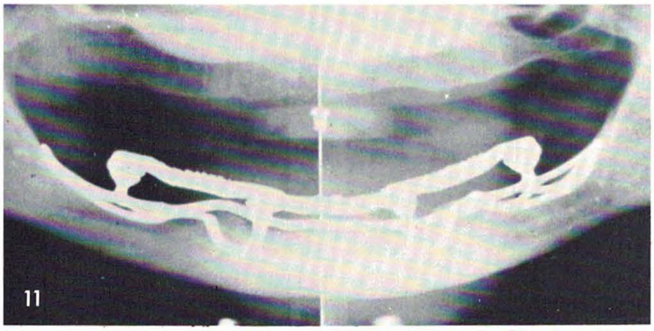








A flat ridge where very little bone exists above the inferior alveolar canal is usually an indication for a subperiosteal implant, fig. 1. As flat as the ridge looks covered with tissue, the underlying dense bone very often exhibits a great deal of surface area, fig. 2, for the support of a subperiosteal implant. Carefully the mental nerve bundles are dissected out. In this case, besides the main bundle a very thin accessory branch was seen several mm. distal to it, fig. 3, and was also noticed on the opposite side, fig. 4. If the impression was accurate the fit of the implant will also be exact, fig. 5. The buccal peripheral strut must accommodate the mental nerve and vessels exiting the mental foramina on both sides by circumventing them, figs. 6, 7. This case healed uneventfully, fig. 8, and the implant denture which is implant borne and not tissue borne con-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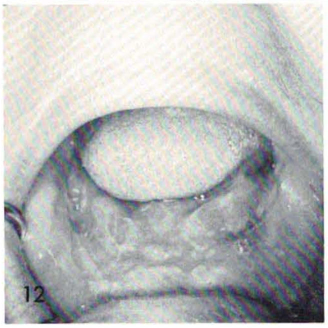
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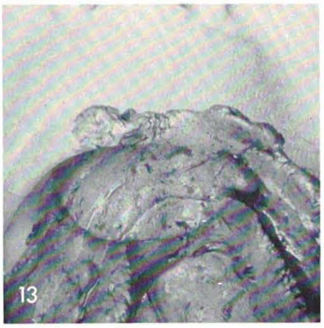
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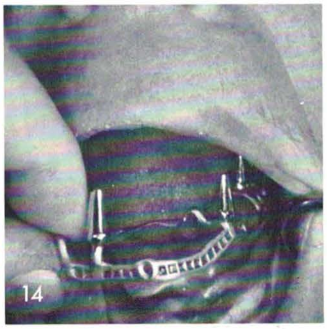
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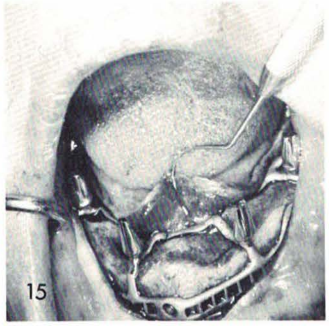
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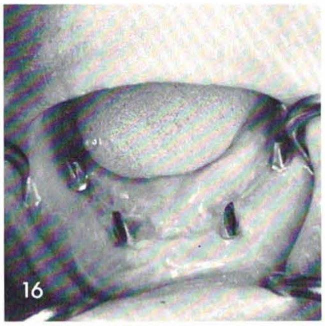
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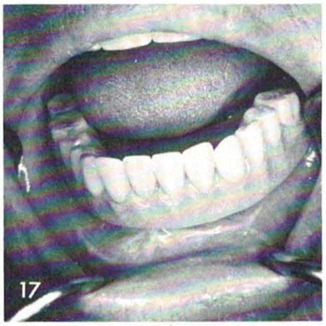
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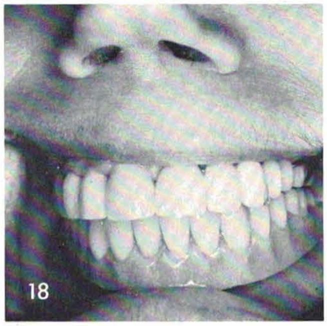
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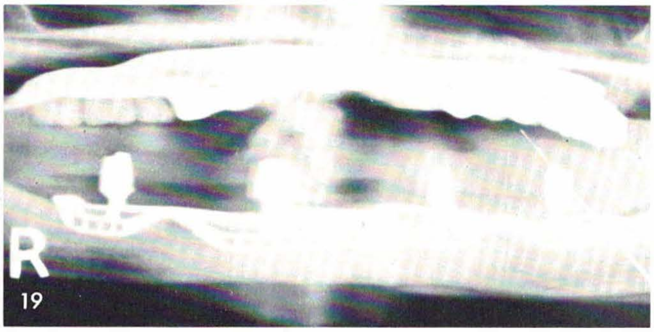

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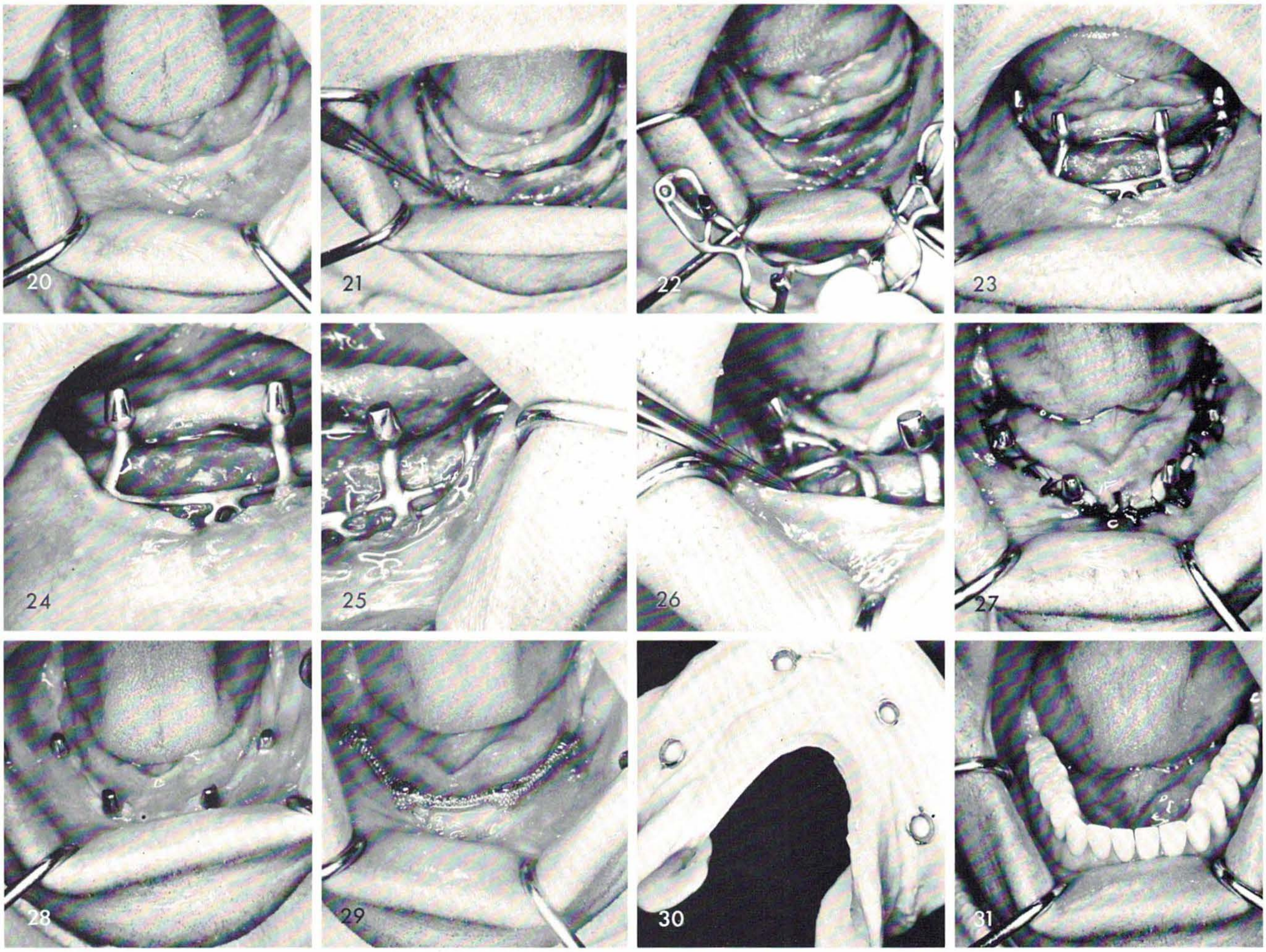
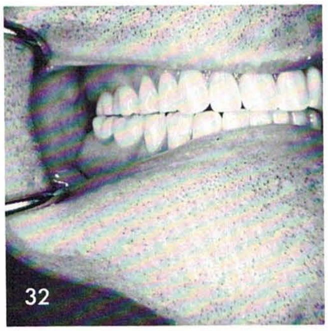
tains four, 360° circumferential clasps that can be adjusted over the posts of the subperiosteal implant, figs. 9, 10. A post-operative x-ray shows the accurate fit, fig. 11.

Even with extremely concave situations as seen clinically, fig. 12, the rubber base impression reveals good bone height, fig. 13, for a properly designed implant, fig. 14, to fit with great accuracy and retention over the atrophied mandibular bone, fig. 15. Very often, in order to obtain healing such as was obtained in this case accessory labial and buccal incisions had to be made to the periosteum. Some of the scar tissue seen here is from the accessory incisions, fig. 16. The implant denture is implant borne and does not touch the tissues, figs. 17, 18. The post-operative x-ray, fig. 19.



In cases where "flabby" tissue exists, fig. 20, somewhere during the first or second surgical phase these tissues must be reduced for future success of the implant. The tissues are incised and reflected, fig. 21, and at the end of the same day the implant is placed into position, figs. 22, 23, 24, 25, 26, and the tissues are sutured, fig. 27. The healed tissues no longer reveal the original "flabbiness", fig. 28. The superstructure framework is placed over the posts, fig. 29, an inter-occlusal record of centric relationship is then taken and the framework is picked up with an alginate, fig. 30, or with one of the medium bodied elastic impression materials. An accurate impression of the healed soft tissues in between the posts must be produced.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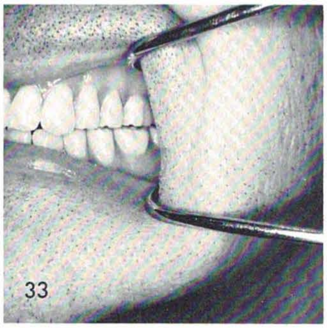
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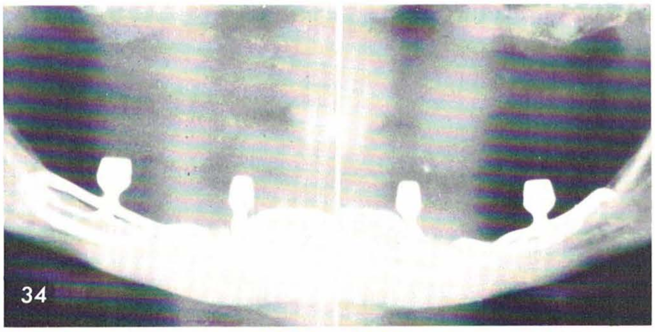
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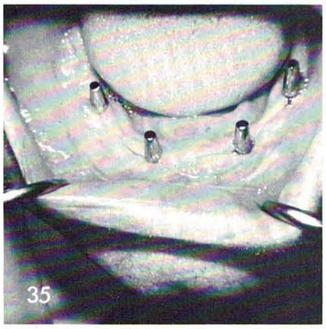
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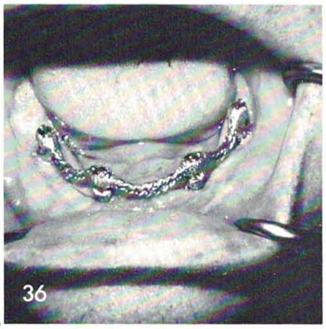
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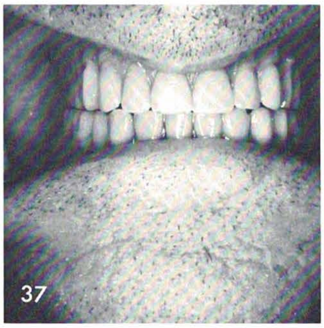
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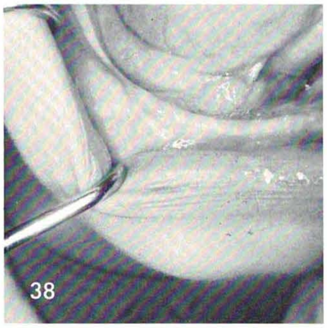
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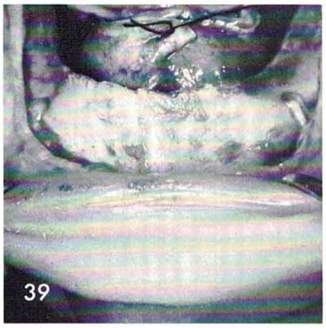
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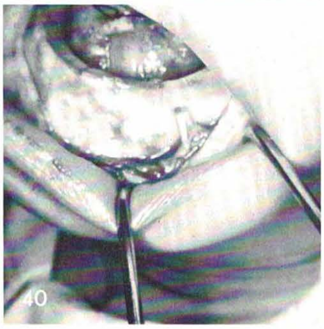
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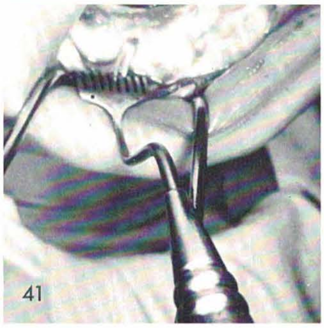
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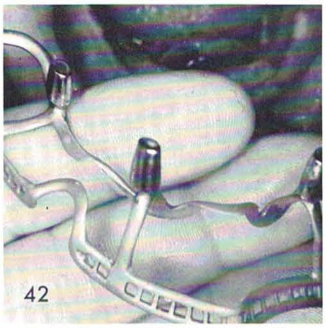
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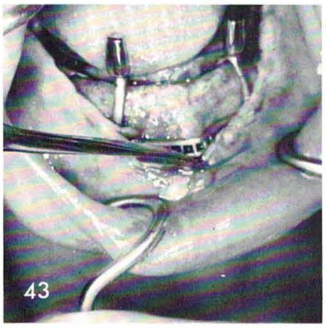
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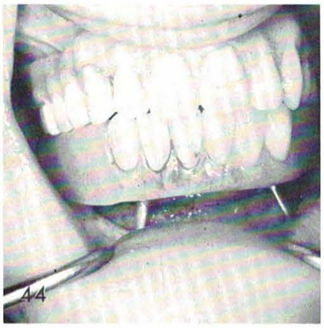
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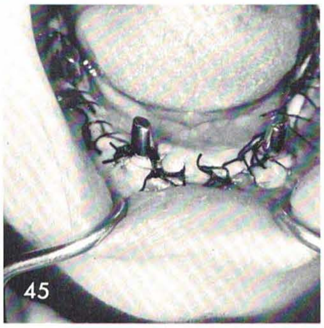
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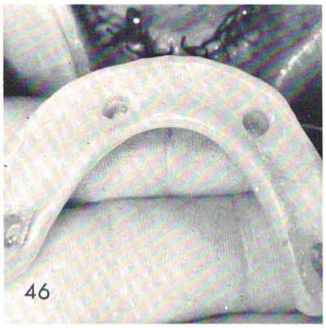
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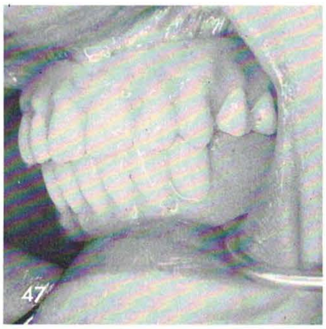
The implant denture, always includes acrylic teeth with zero degree inclined planes, fig. 31, and the occlusion with the new upper denture (which also should always be done) must be exact, figs. 32, 33. The post-operative x-ray shows the accurate fit, fig. 34.

Another case about two and one half weeks after the sutures were removed, fig. 35, also reveals accessory incisions. The superstructure framework is fitted over the protruding posts and the horizontal portion must not touch the soft tissues, fig. 36. The finished case, fig. 37.

A clinical picture of asymmetry, fig. 38, can be caused by asymmetrical muscle attachments or unequal height of bone itself as was the reason in this situation. Notice that more bone exists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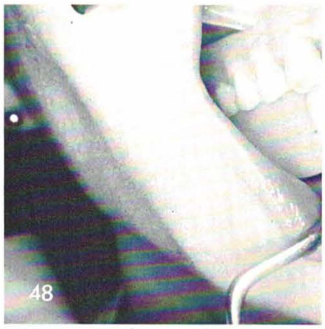
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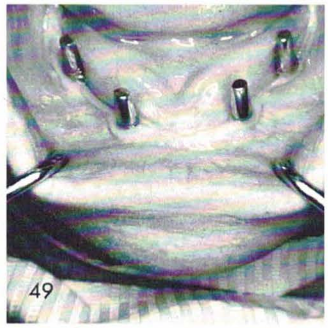
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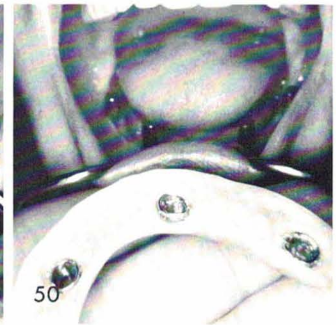
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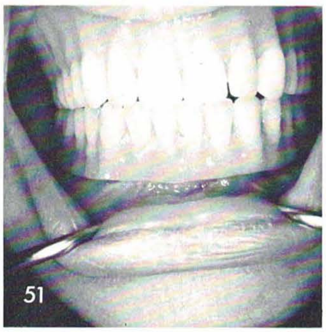
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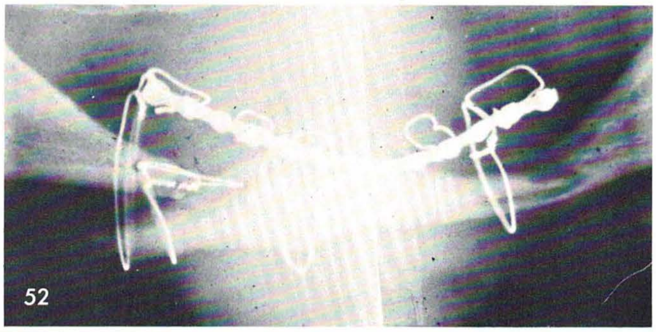
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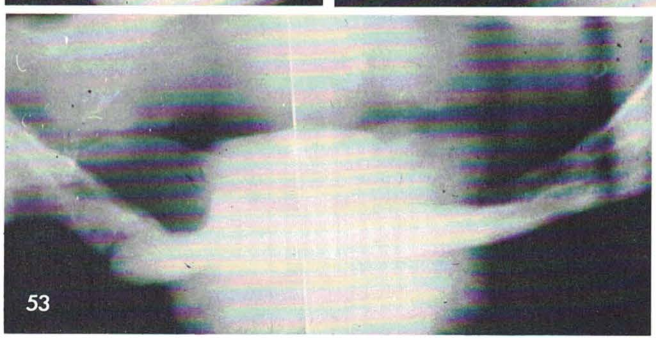
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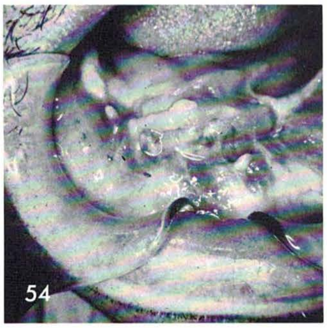
above the right mental bundle than the left one, figs. 39, 40, 41. The implant, usually fenestrated along most of the labial and buccal peripheral strut except for the areas that circumvent the mental bundles is inserted, figs. 42, 43, and the temporary acrylic stent which includes six anterior acrylic teeth and two geometrical planes of occlusion posteriorly is fitted over the implant posts, fig. 44. It should be quite a distance away from the bone and should occlude accurately to the existing upper denture as it was fabricated from a "bone bite". The tissues are sutured closed, fig. 45, and the acrylic stent is once more fitted, fig. 46, making certain of proper occlusion, figs. 47, 48, and being certain that its base is implant borne only.

The necks of the subperiosteal implant must always be in attached gingivae thus the posterior protruding posts should always be on or very near the mylohyoid ridges, fig. 49. The implant denture is snapped into position, figs. 50, 51.

This fractured mandible was wired to the patients existing all acrylic denture, which cannot be seen on an x-ray, fig. 52. At the end of eight weeks a complete bony union had been accomplished, fig. 53, although the body of the mandible on the right side was extremely foreshortened.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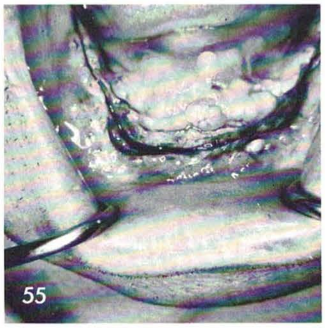
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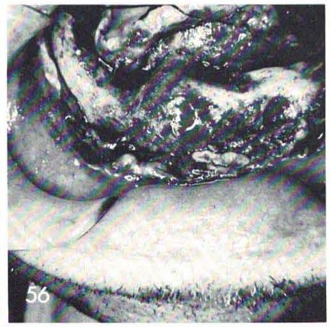
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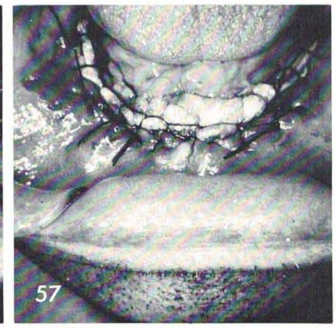
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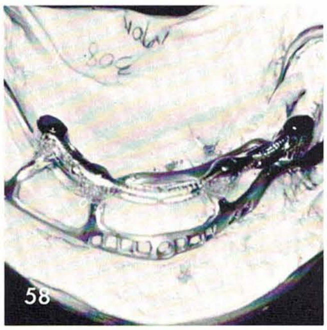
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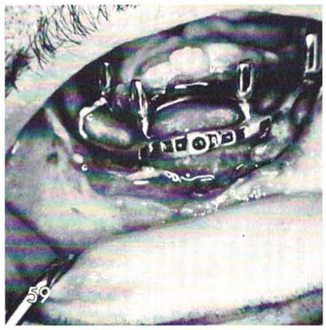
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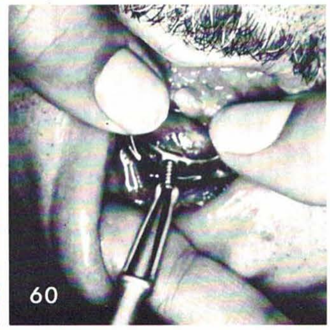
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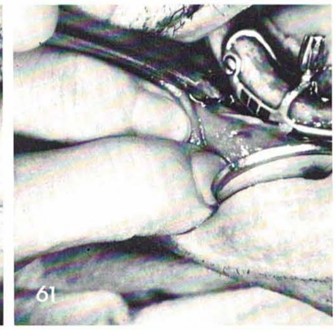
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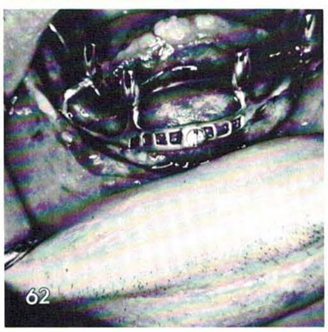
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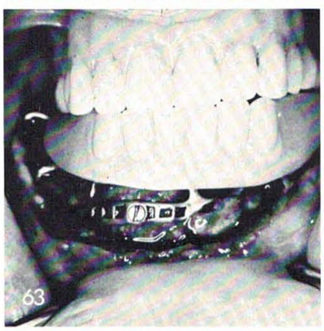
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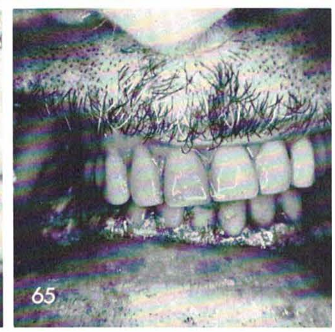
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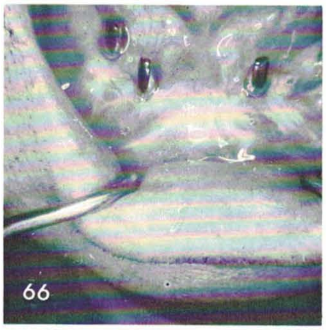
Clinically the tissues were greatly scarred and the floor of the mouth was at the apex of the tissue, fig. 54. The incision, fig. 55, and reflection of the thickened tissues was difficult. As can be seen, fig. 56 shows the complete bony union on the right side. After the impression the tissues were sutured closed, fig. 57, because of poor healing and the pulling away of the tissues after surgery surgery "two" was not performed before six weeks had passed. The subperiosteal implant and superstructure as seen on the master model, fig. 58, and in the mouth, fig. 59. To make sure the implant would not move during the expected slow healing of the scarred tissues Vitallium screws used with a Vitallium screwdriver were used to stabilize the implant, figs. 60, 61, 62.

The temporary stent reveals the asymmetry between the midline of the face and the center of the symphysis represented by the horizontal screw, fig. 63. A tremendous amount of sutures were needed to adapt the tissues to one another as well as accessory incisions in the buccal fold all around the arch, fig. 64. To retard the healing of the accessory incisions a periodontal packing was used and held in place by the temporary stent, fig. 65. Healing was beyond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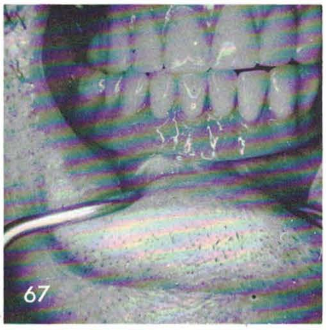
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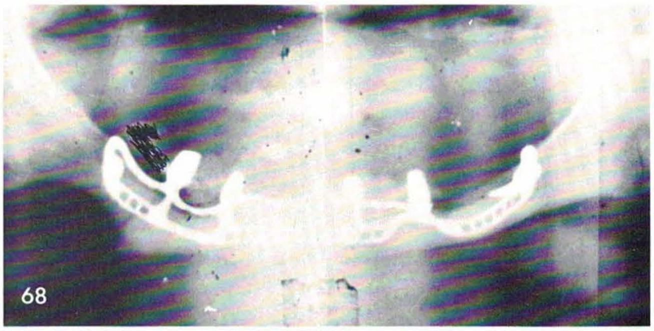
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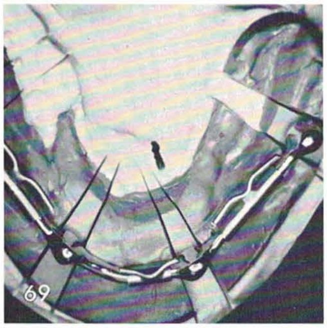
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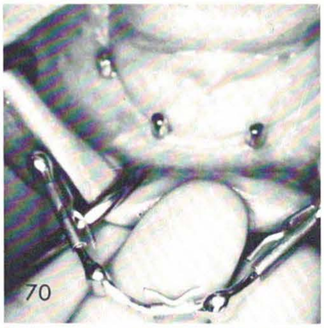
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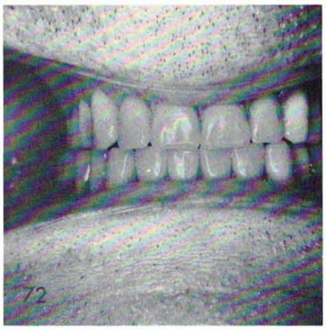
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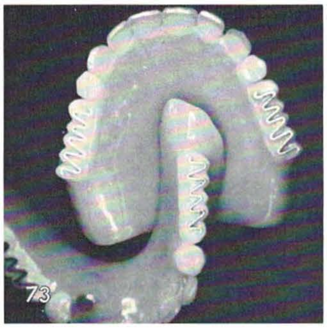
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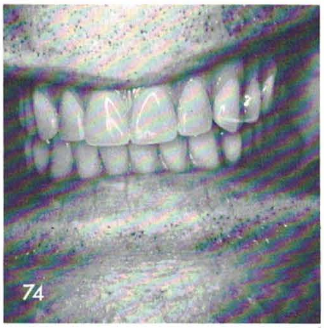
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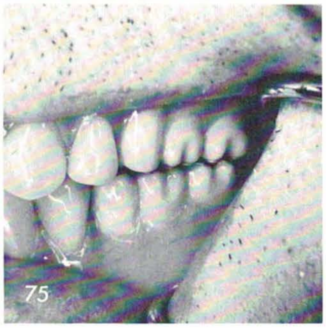
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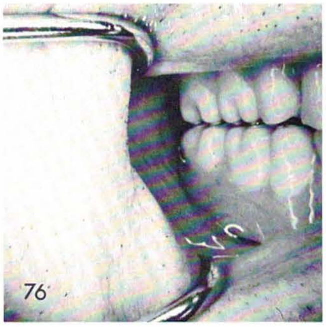
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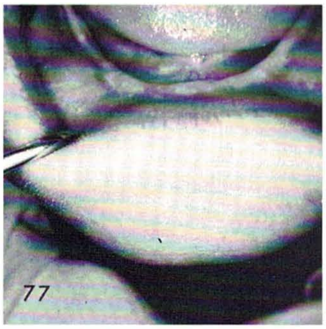
expectations, fig. 66, and the implant denture was fitted to place, fig. 67. Although asymmetry of both sides of the jaw existed, the patient wore this appliance successfully for more than six years before he had a heart attack and died. The post-operative x-ray, fig. 68.

Many problems occurred with the retention of the dentures after several years with the early designed extremely short posts. Internal clasps broke reducing the overall retention of the implant denture even though the implants were successfully functioning.

Before I started designing the posts to be much larger, improvising the existing short posted subperiosteal implants had to be done. Dolder or Andrew type bars attached to gold copings were used with internal clips, figs. 69, 70, 71, 72. Sometimes Hardy posterior teeth are used in those cases where patients require a sharper grinding apparatus, figs. 73, 74, 75, 76.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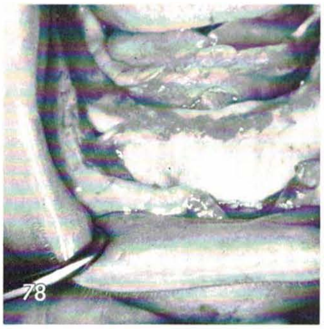
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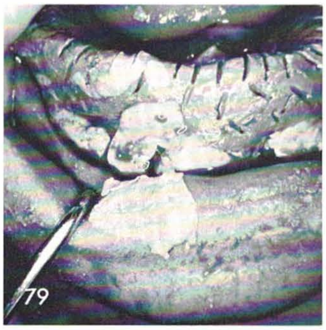
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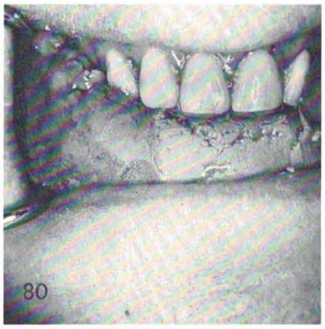
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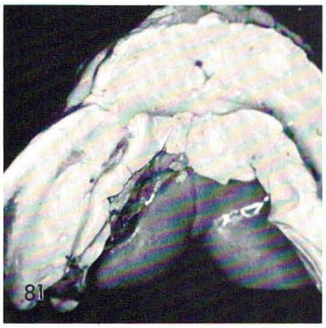
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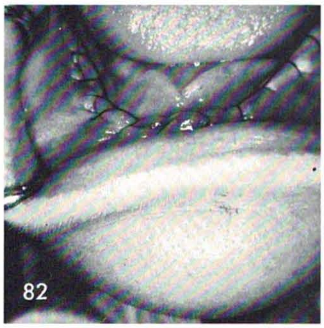
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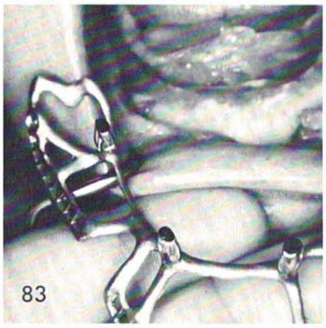
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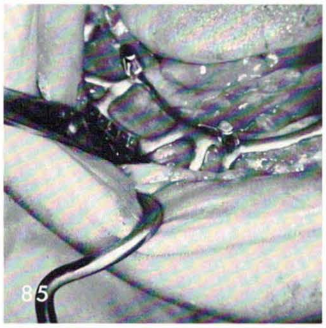
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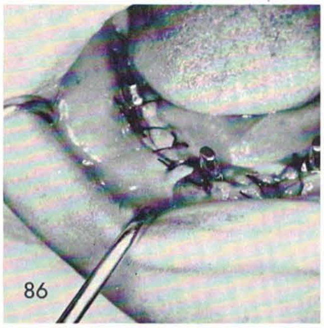
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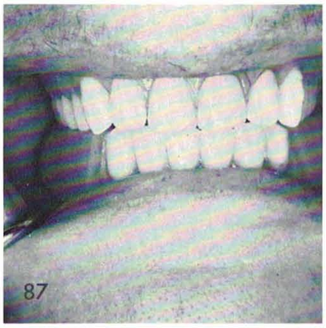
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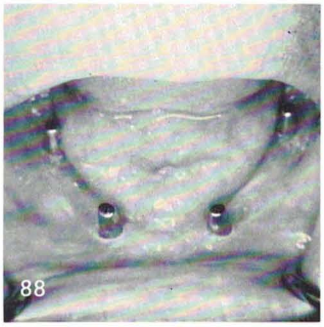
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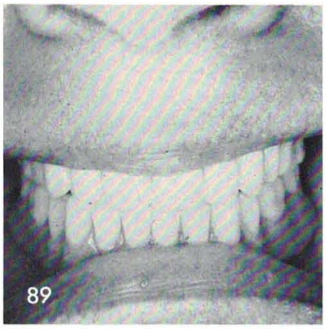
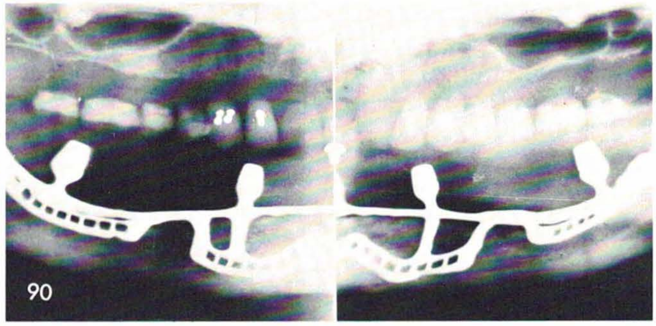
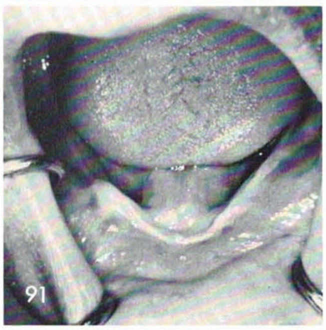
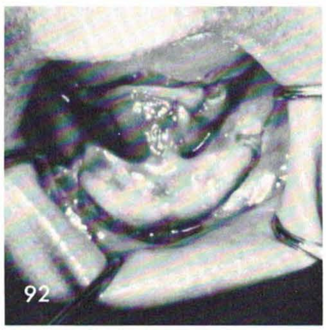
In these totally edentulous cases, fig. 77, great care must be taken to cleanly expose the bone and making sure not to stretch or cut the neurovascular bundles, fig. 78. This impression was done with heavy and light Imput material without a tray, fig. 79. The top of the heavy bodied material is then notched with bur marks to allow more of the same material to adapt to it while taking the bite relationships, fig. 80. The impression must include a good peripheral roll of the external oblique ridges, the symphysis, the mylohyoid ridges, the genial tubercles and the bundle of nerves and vessels exiting the mental foramina, fig. 81.

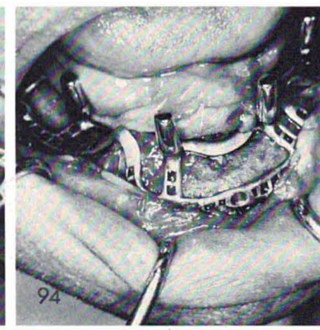
The tissues are sutured together, fig. 82. At the next visit, preferably three weeks later after the tissues have healed from the first surgical visit, the implant is inserted, figs. 83, 84, 85, and the tissues are sutured closed, fig. 86. The patient leaves the office with the temporary acrylic denture, fig. 87. Healing can take anywhere from three to six weeks, fig. 88. The completed case, fig. 89, and x-ray, fig. 90.

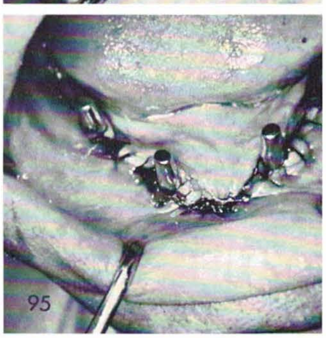


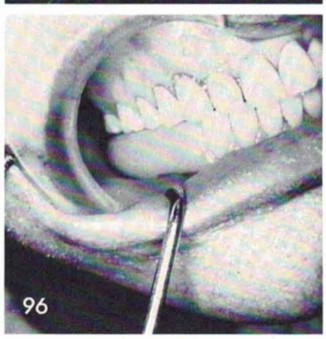


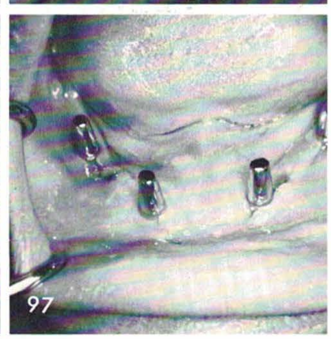


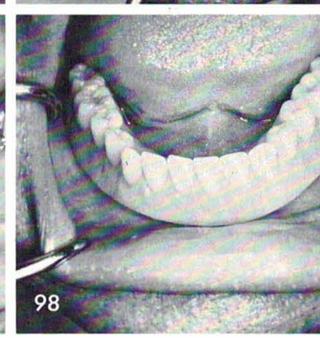


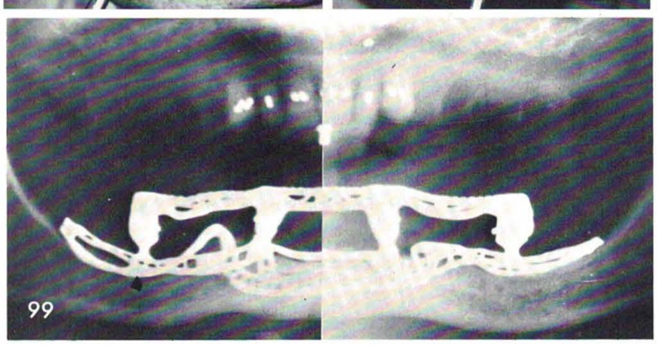




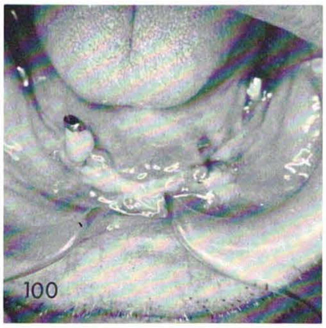








An unusual looking view of the covered mandible, fig. 91. The bone is exposed, fig. 92, and the implant fitted, figs. 93, 94, and the tissues sutured, fig. 95. The temporary acrylic stent is carefully checked for proper occlusion and must be relieved of any tissue interference, fig. 96. The tissues as they looked three weeks post-operatively, fig. 97. The completed implant denture does not touch the tissues, fig. 98. The post-operative x-ray, fig. 99.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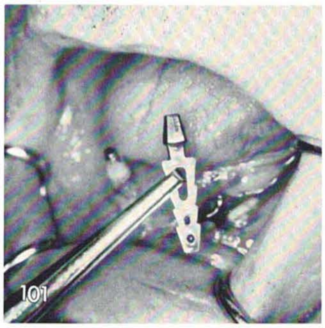
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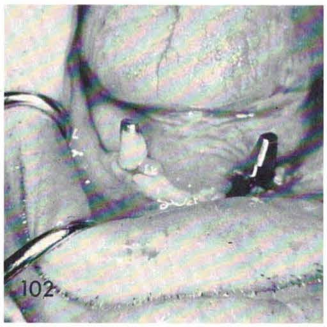
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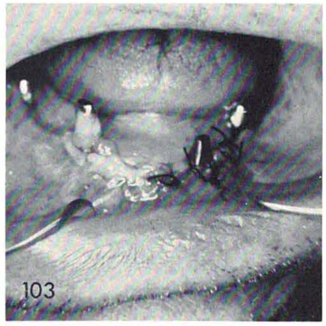
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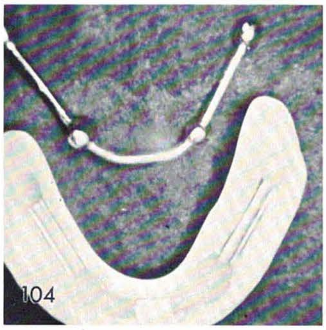
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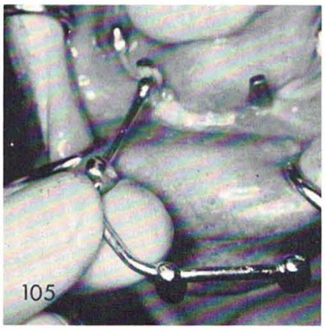
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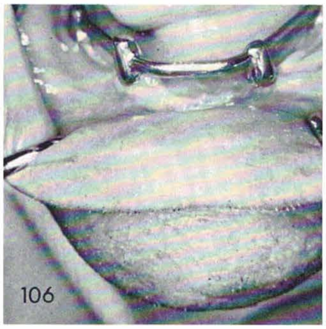
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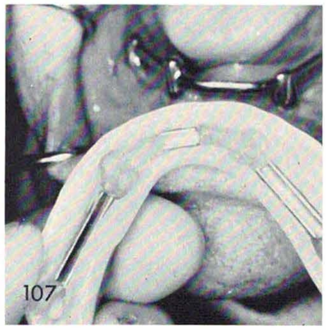
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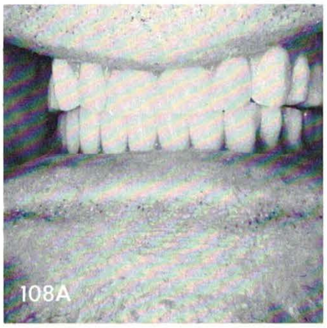
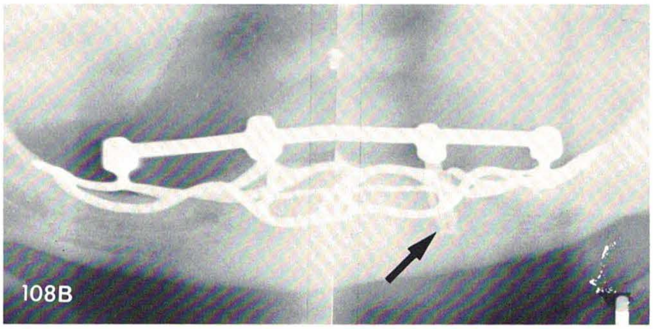
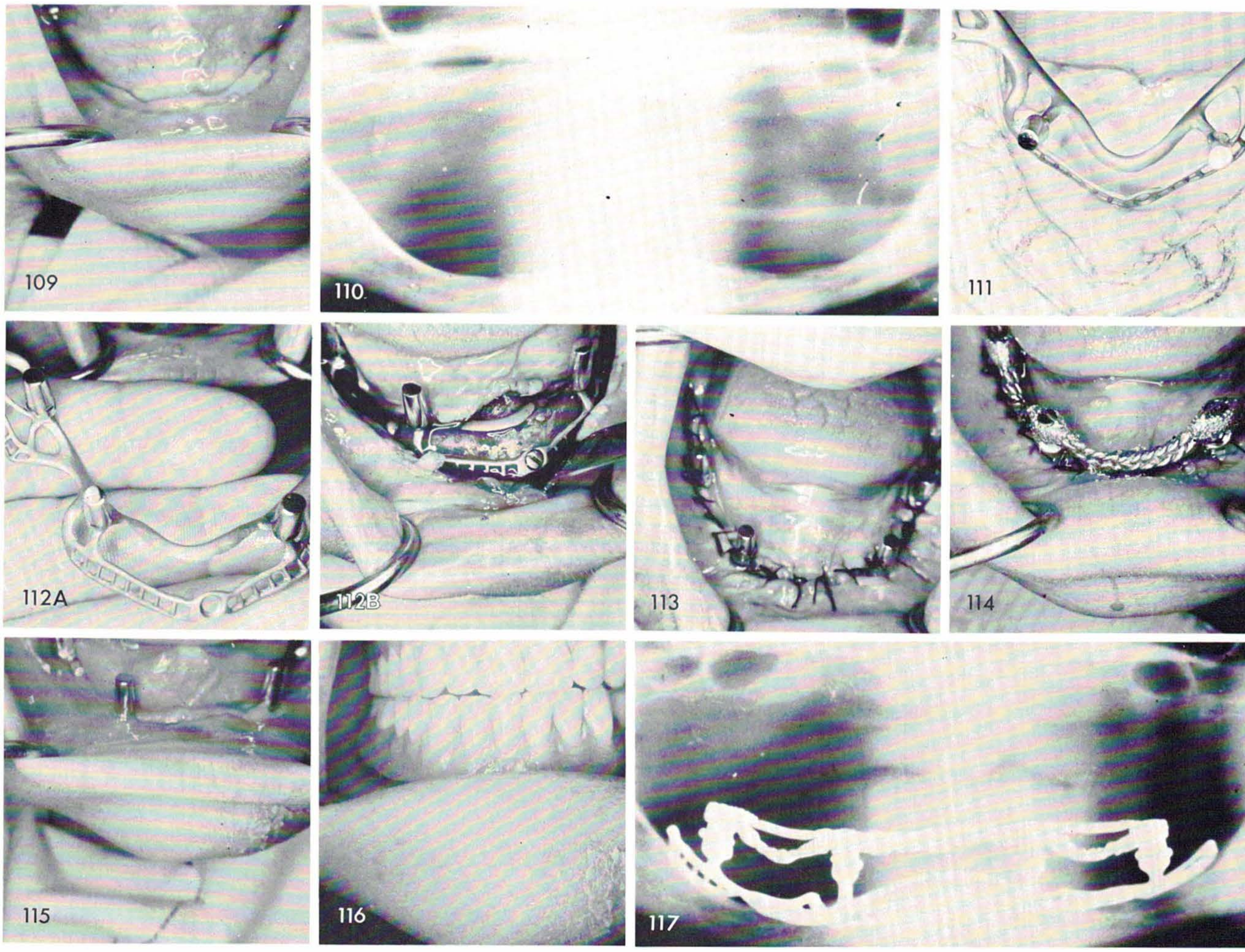
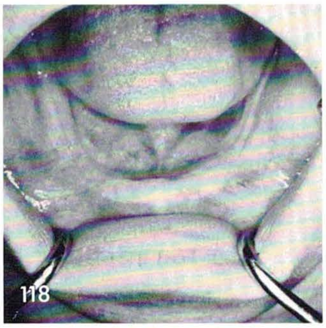

108A

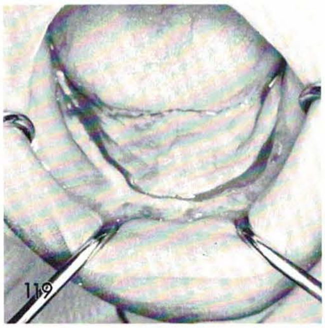

108B

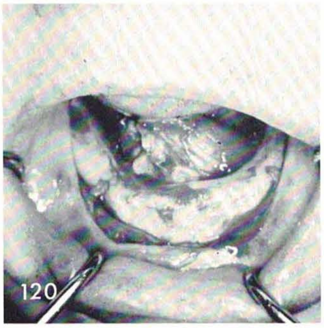
Because of poor implant design with exceptionally long necks at the expense of shorter posts, the left neck of the cuspid implant snapped off from its base and it was decided to build up the right neck with a very hard acrylic for more support and better denture support, fig. 100. A blade-vent was inserted into the bone in the same area where the left neck broke off, figs. 101, 102, 103, and impressions of the three subperiosteal implant posts and the blade post was taken to fabricate a Dolder bar and coping structure to splint the isolated blade to the three remaining posts and give support to the new denture with the aid of internal clips, figs. 104, 105, 106, 107, 108A. The entire case is in for 12 years, the blade with new superstructure is in for seven years. Post-operative x-ray, fig. 108B.

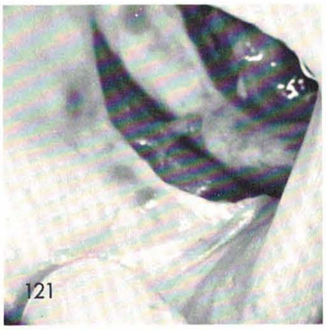


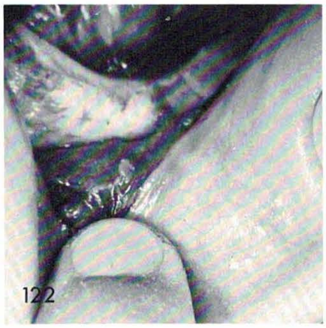
Besides clinical observation, fig. 109, the pre-operative x-ray is the determining factor as to whether or not the patient is a subperiosteal implant candidate, fig. 110. From accurate impressions the subperiosteal implant is fabricated, fig. 111, and fitted and sometimes screwed to the bone, figs. 112A, 112B. Sutures are applied using circumferential mattress and simple surgical interrupted sutures, where necessary, fig. 113. Often, at the same visit the superstructure is fitted and picked up with an elastic impression to save the patient a week's waiting for the completed implant denture, fig. 114. Notice the longer posts that are so much needed in this extremely resorbed mandible, fig. 115. The finished case, fig. 116, and 7 year post-operative x-ray, fig. 117.

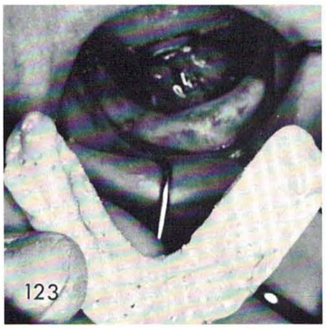


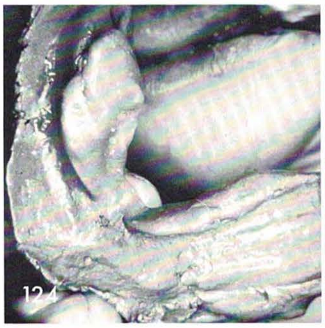


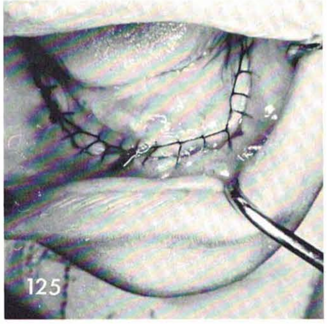


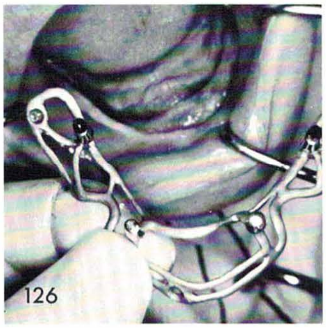


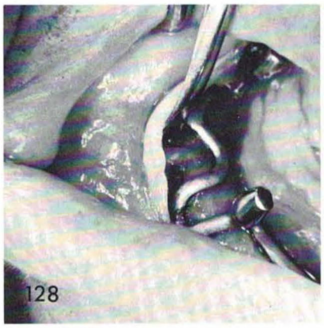


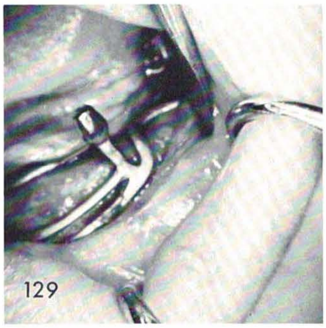






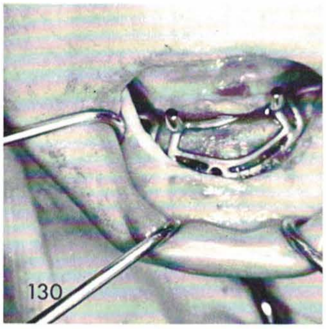


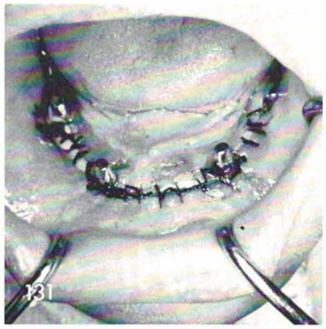


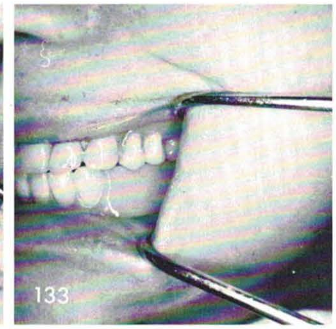


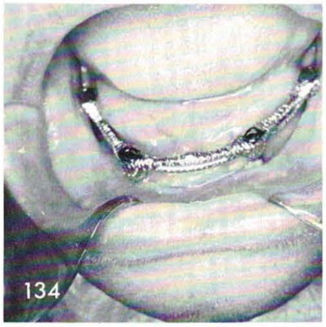
In all edentulous cases, fig. 118, it must be determined if the mental bundle is on the crest or below it. In those situations where it is close, the incision must be made lingually so as not to cut off the bundle, fig. 119. Careful reflection of the tissues and exposure of the bone reveals both bundles to be right near the top of the resorbed ridge, fig. 120. Care must be taken not to sever any portion of the bundles going to the cheeks, figs. 121, 122. For extreme accuracy an acrylic tray was moulded directly over the exposed bone and then notched for retention, fig. 123, for the rubber base impression material, fig. 124. The tissues were closed, fig. 125.

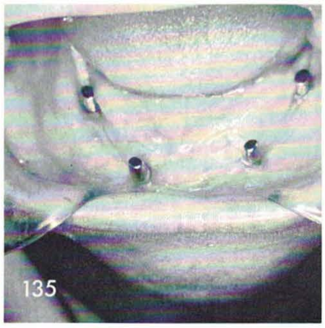
Three weeks later the implant was placed over the bone, figs. 126, 127, 128, 129, 130, and the tissues were sutured, fig. 131. Figs. 132, 133 show the acrylic stent. The superstructure

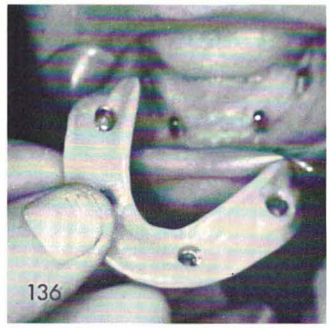


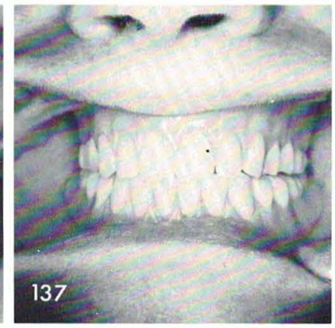


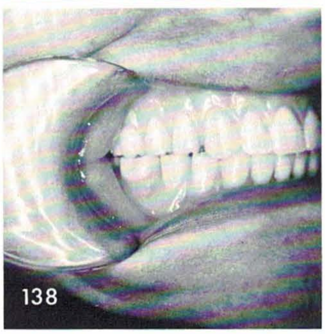



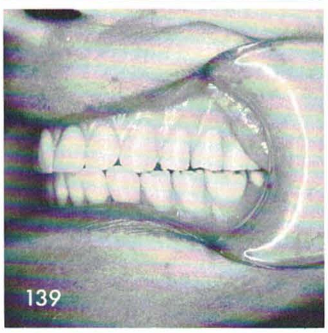


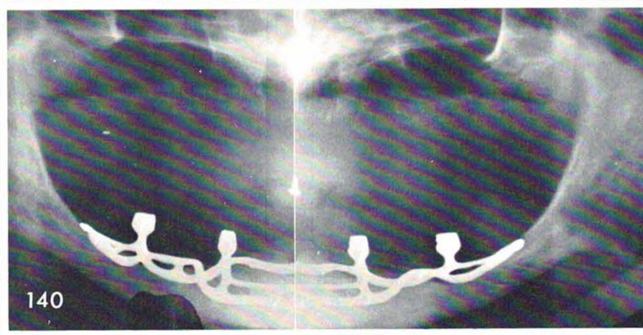


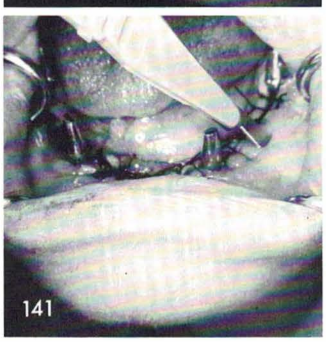


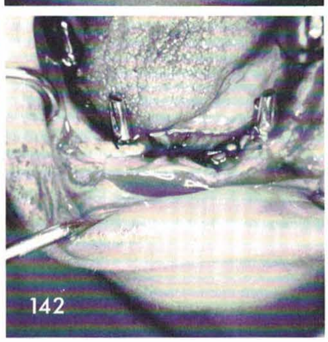


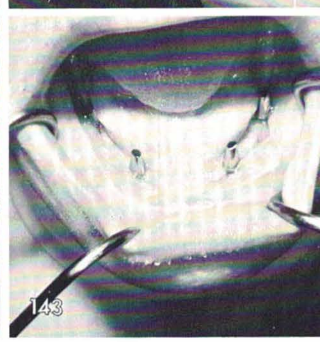


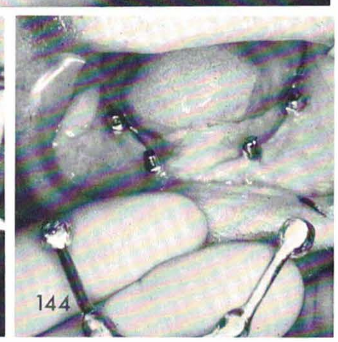






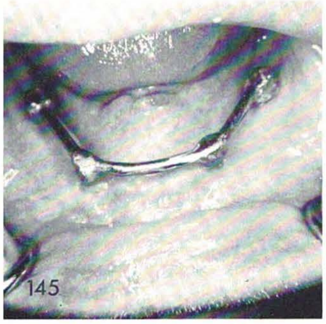






is fitted, fig. 134. The healed tissues, fig. 135, and the completed prosthesis, figs. 136, 137, 138, 139, and post-operative x-ray, fig. 140.

When it is difficult to suture the tissues together without having to pull too hard accessory incisions lateral and buccal to the implant framework directly through the tissues to the periosteum but not through it gives excellent results, figs. 141, 142, 143. Figs. 144, 145, 146, 147, 148 show another early case with short posts that needed further support.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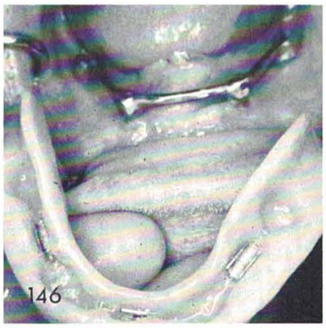
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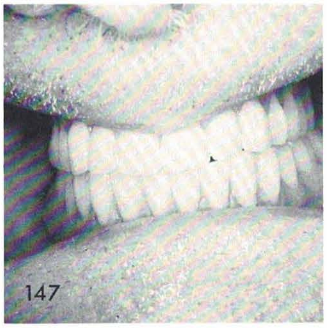
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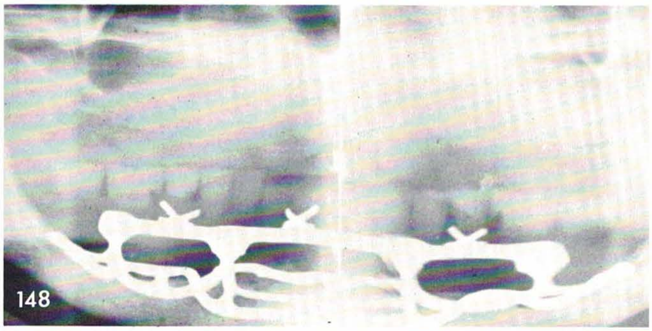
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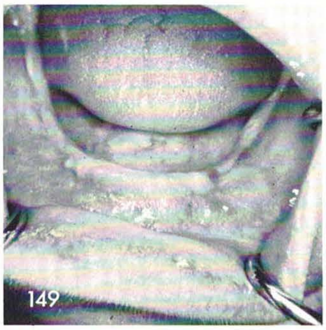
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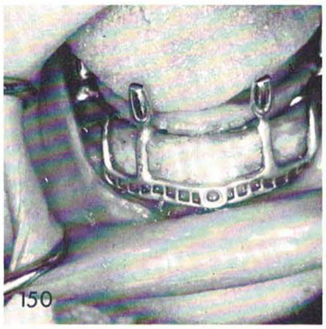
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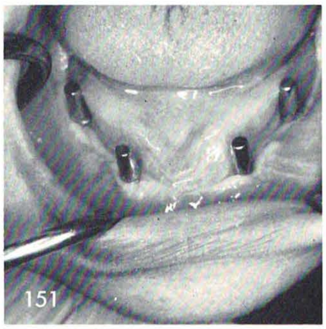
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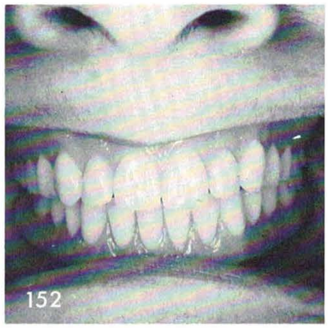
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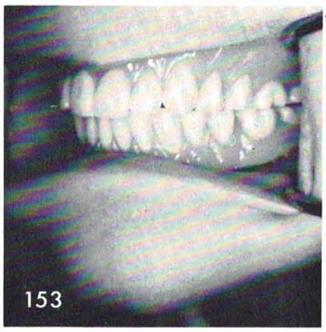
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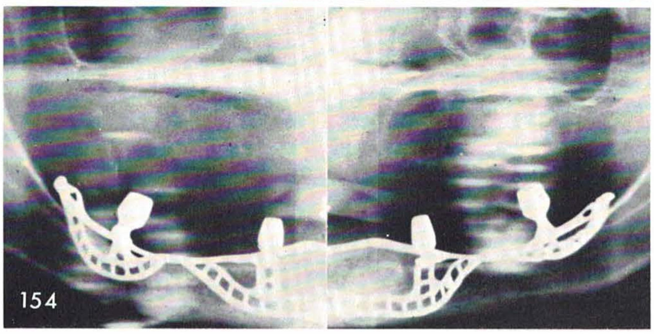
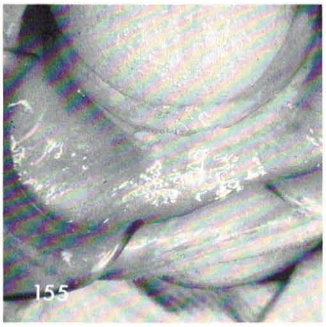

154

Another case, fig. 149, showing the accurate fit of the subperiosteal framework, fig. 150, and the healing, fig. 151, and completed denture and x-ray, figs. 152, 153, 154.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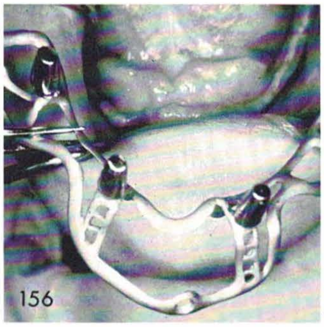
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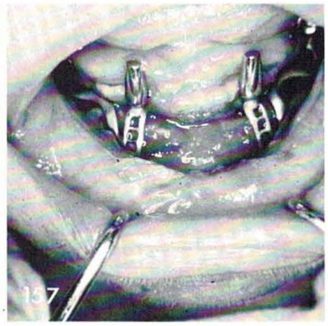
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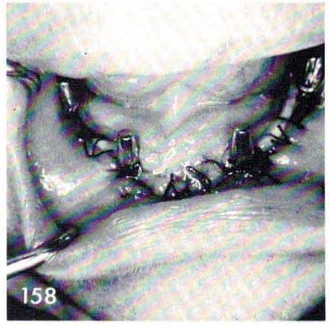
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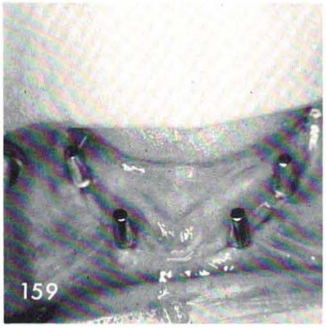
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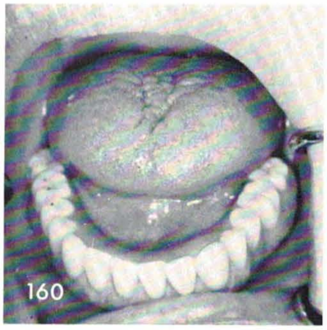
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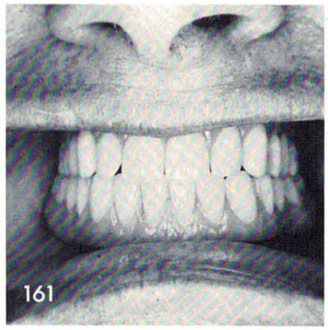
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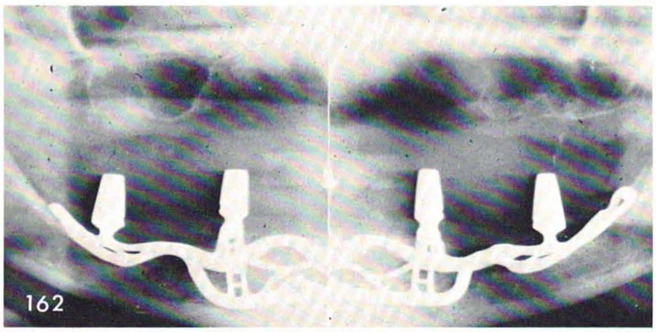
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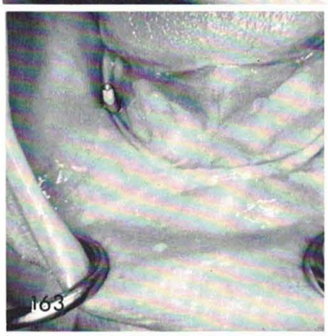
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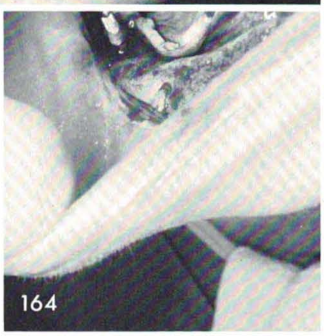
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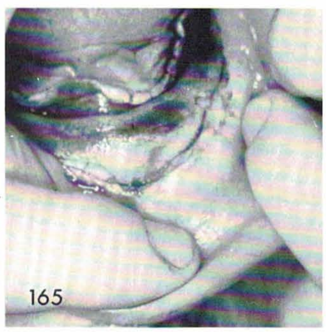
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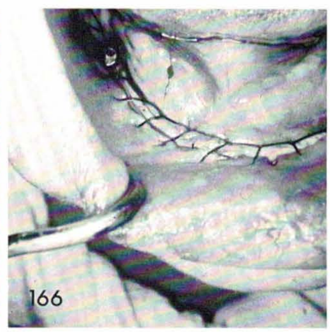
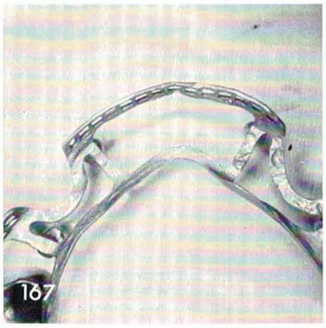
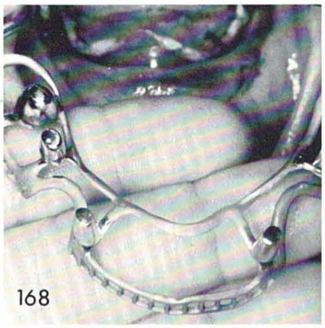
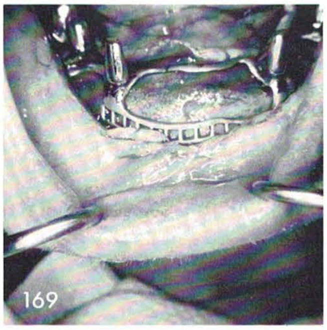

166

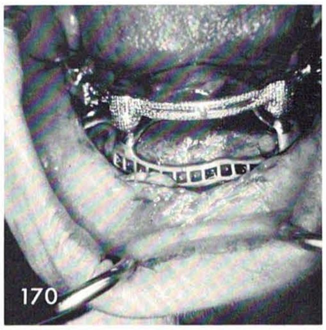
This next case, fig. 155, was designed with fenestrated secondary struts and solid primary struts, figs. 156, 157, 158, 159, 160, 161, 162.

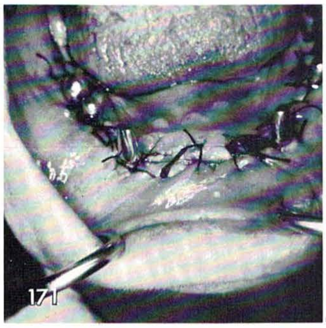
A remaining blade post firmly anchored into the bone existed in this otherwise totally edentulous mandible, fig. 163. The bone was exposed revealing the mental foramina on both sides, figs. 164, 165, and after the impression which included the existing blade post, the tissues were sutured closed, fig. 166. The casting framework included a coping that would be cemented

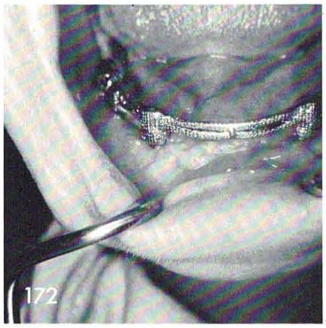


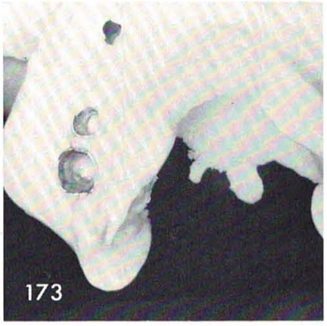


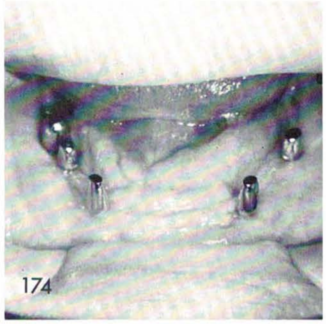


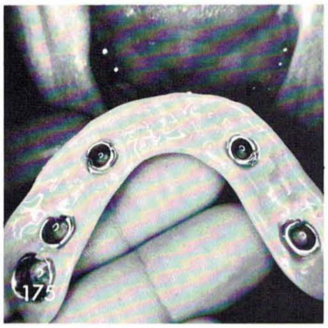


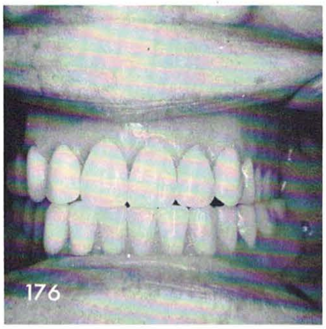


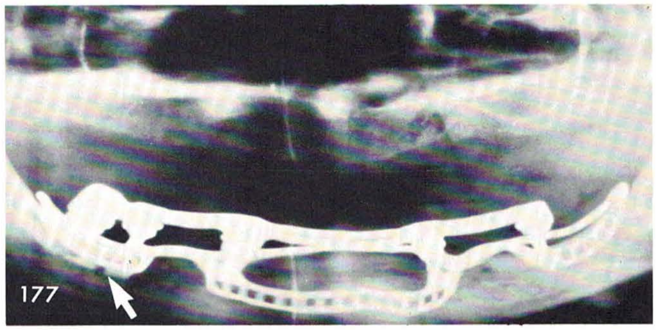




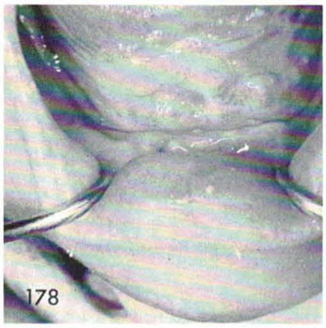








over the blade post, figs. 167, 168, 169, 170, 171. The superstructure was placed over the subperiosteal implant posts and the blade post, fig. 172, and pulled off with an alginate impression to obtain an accurate impression of the soft tissues, fig. 173. The tissues healed uneventfully, fig. 174, and the implant denture having five clasps rather than four was snapped into position, figs. 175, 176. The x-ray reveals the blade on the right side and the implant coping over it, fig. 177.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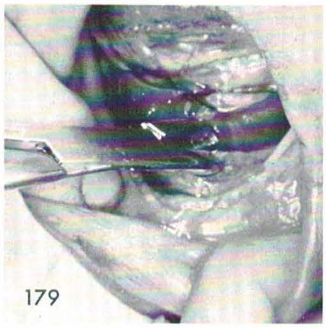
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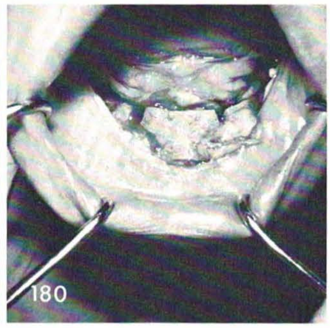
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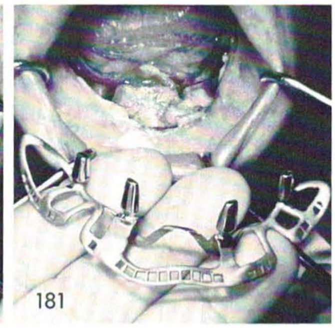
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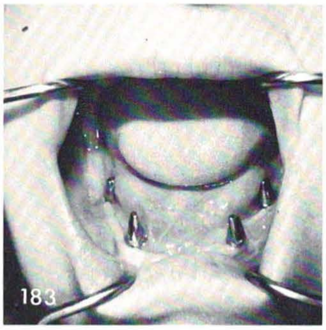
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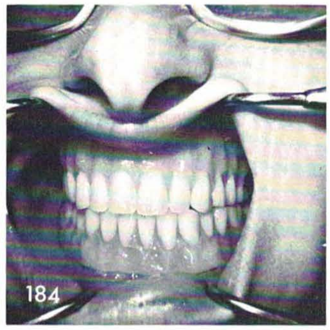
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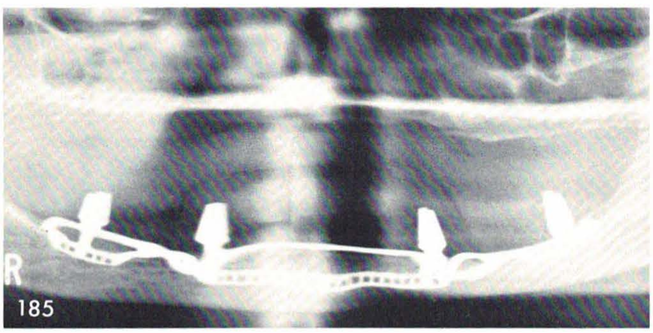
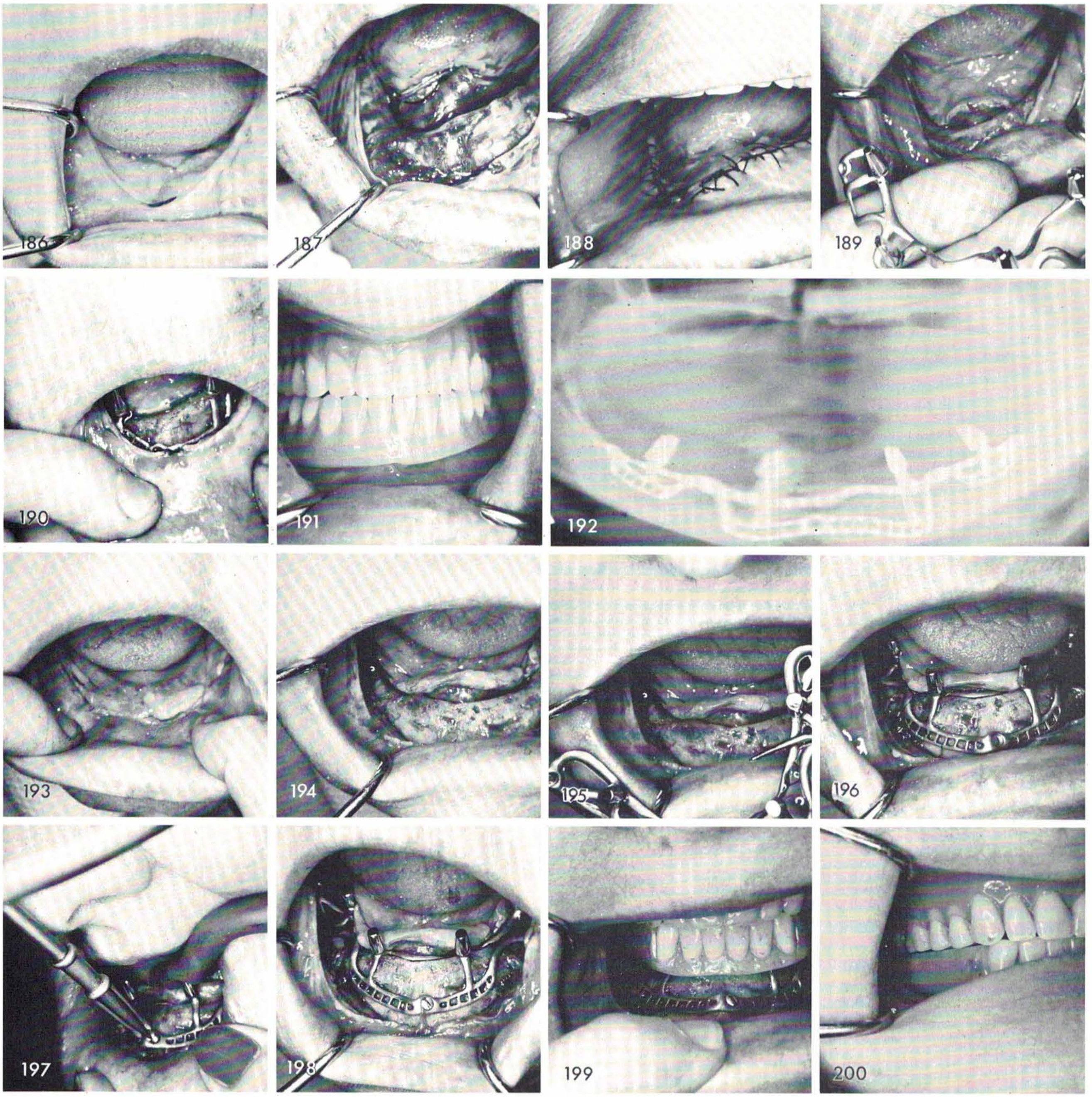


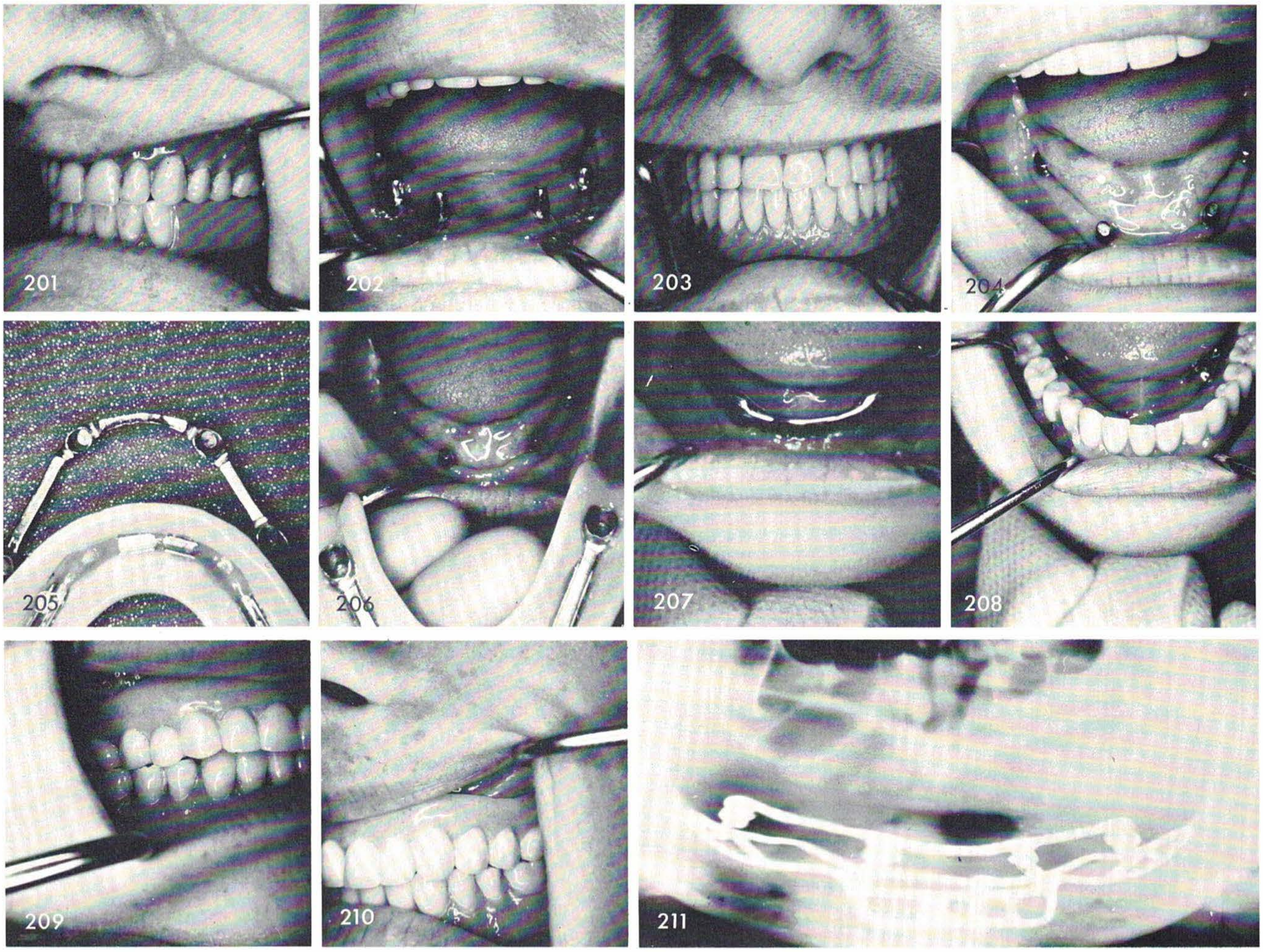
185

When it is determined that a knife edge ridge exists beneath the soft tissues, fig. 178, a bone rongeur is sometimes used to remove it, fig. 179. In these situations where alveolar bone still exists anteriorly cross over struts made deep into the bone to its denser basal portion are made, fig. 180, to support the struts of the implant that support the anterior posts, figs. 181, 182. Healing in these situations also is usually excellent, fig. 183, and the denture is completed. Fig. 184 shows accuracy of the fit. Final x-ray, fig. 185.



Asymmetrical mandibles, fig. 186, also can be indicated for subperiosteal implants as seen in figs. 187 through 192.

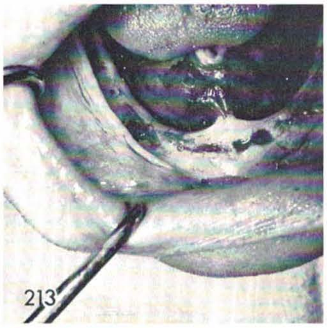
Even when the clinical picture makes it seem nearly impossible for a subperiosteal implant, fig. 193, when exposing the bone an entire new picture takes place, fig. 194. Figs. 195, 196 show the accurate fit of the implant and figs. 197 and 198 show the careful technique of fixating the



implant to the bone when needed. The try in of the temporary denture, figs. 199, 200, 201, the healed tissues, fig. 202, and finished case, fig. 203.

Another case of extremely short posts, fig. 204, requiring an Andrew's type bar-coping system with internal clips, figs. 205, 206, 207, 208, 209, 210, 211.


212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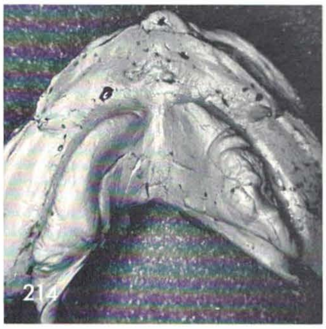
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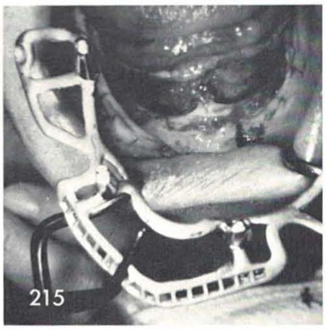
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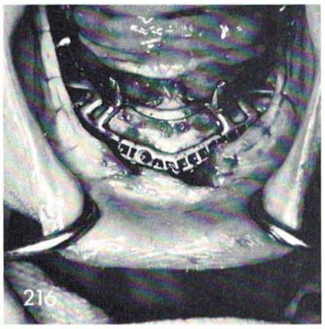
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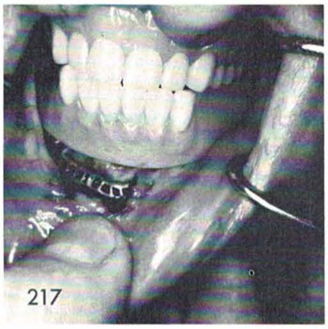
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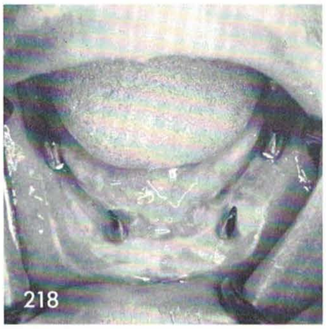
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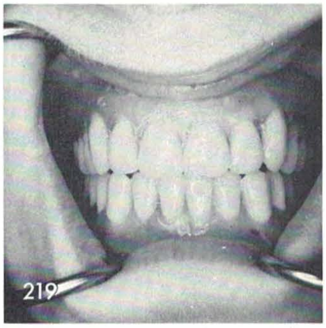
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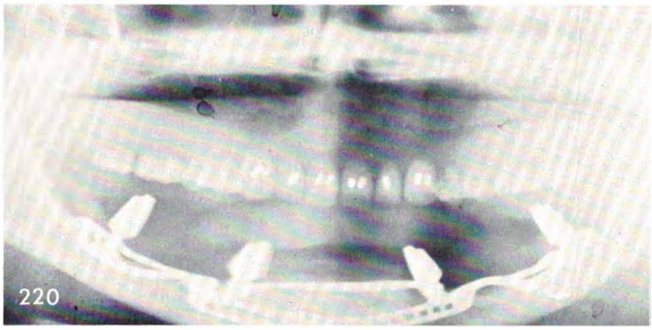
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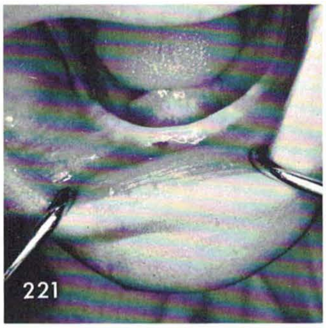
An extremely resorbed clinical picture, fig. 212, reveals also an extremely atrophied mandible, fig. 213. An impression and bite of heavy silicone material was used, fig. 214, which began the processing of the subperiosteal implant, fig. 215, which fitted with extreme accuracy, fig. 216. The temporary denture was carefully checked, fig. 217. The tissues healed remarkably well, fig. 218, and the dentures were completed, fig. 219. Fig. 220 shows the x-ray.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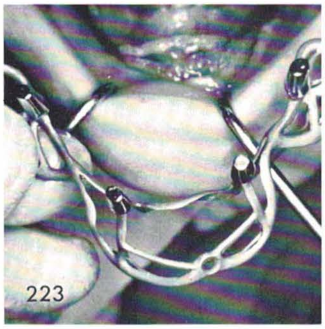
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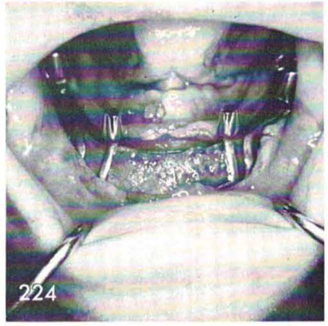
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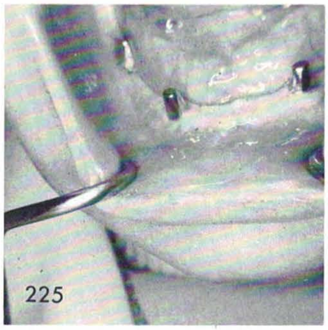
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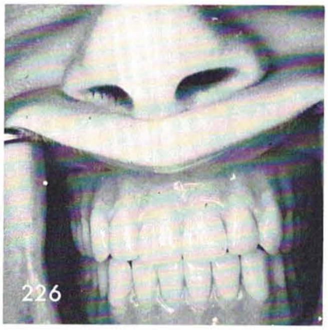
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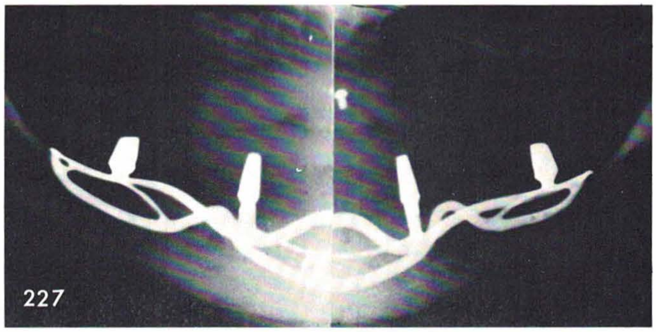
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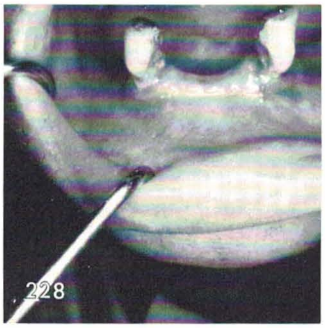
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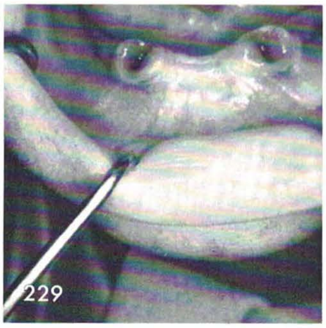
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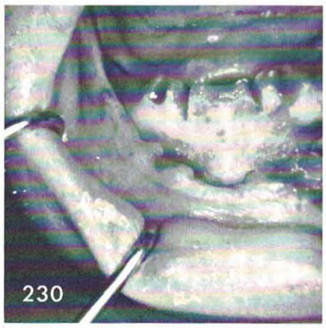
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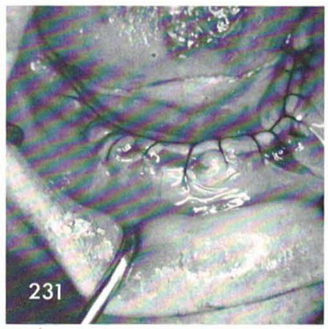
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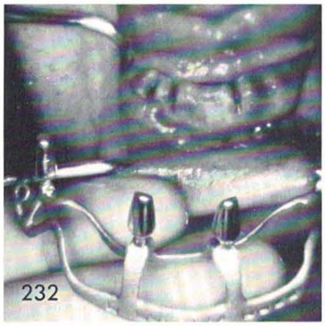
This case shows more height anteriorly than is usually needed, fig. 221. The exposure of the bone showed that alveolar bone still existed anteriorly, fig. 222. The implant was fitted directly over the alveolar bone in this situation, figs. 223, 224, with excellent results, so far, for over nine years, figs. 225, 226. X-ray, fig. 227.

Very often, subperiosteal implants have been inserted immediately after or several weeks after teeth have been extracted and the struts were made to pass directly into the sockets, by-pass them or made to fit into predetermined grooves where alveolar bone still existed. This case shows two remaining teeth, fig. 228, that were extracted, fig. 229. Accessory grooves were made between the sockets, fig. 230, and the tissues sutured closed, fig. 231. The implant framework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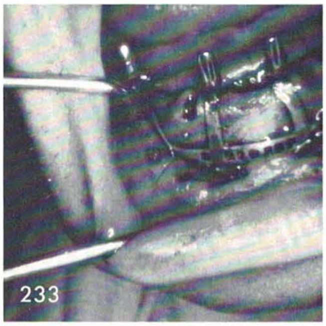
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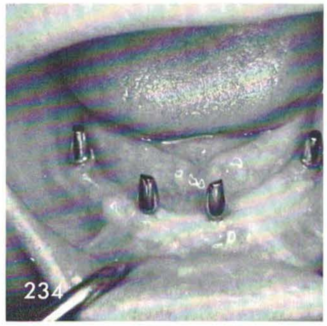
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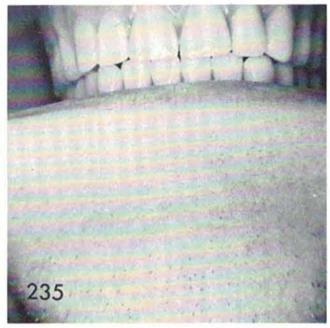
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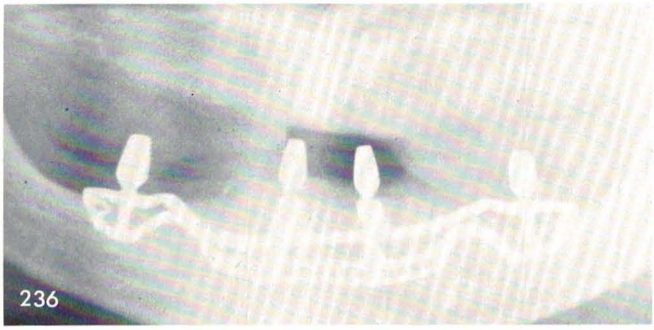
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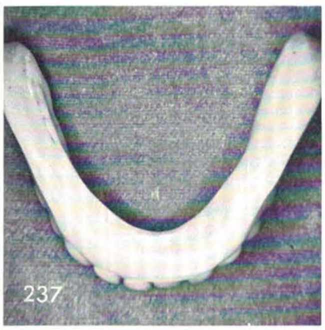
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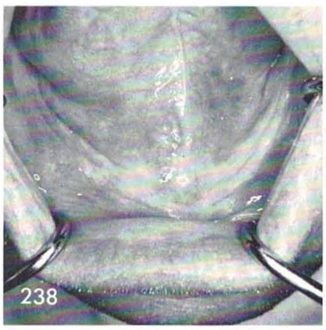
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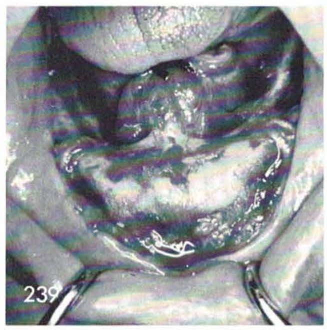
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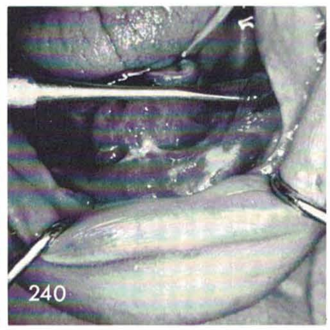
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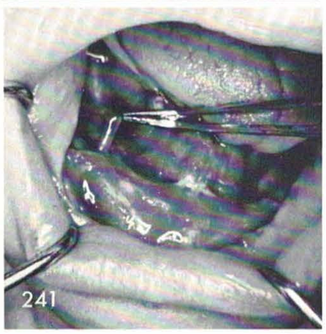
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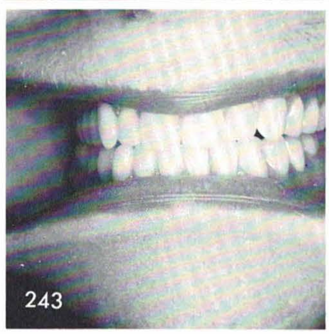

243

fitted over the bone accurately and the anterior cross-over struts fitted exactly into the grooves, figs. 232, 233. Healing was excellent, fig. 234, and the dentures given to the patient, fig. 235. Fig. 236 is the post-operative x-ray.

A convex tissue bearing denture surface, fig. 237, revealing a concave clinical picture, fig. 238. Enough bone still existed anteriorly, fig. 239, although the inferior alveolar nerve was easily lifted out of its unprotected canal, figs. 240, 241. Healing, here too, was excellent, fig. 242, and the case successful, fig. 243.

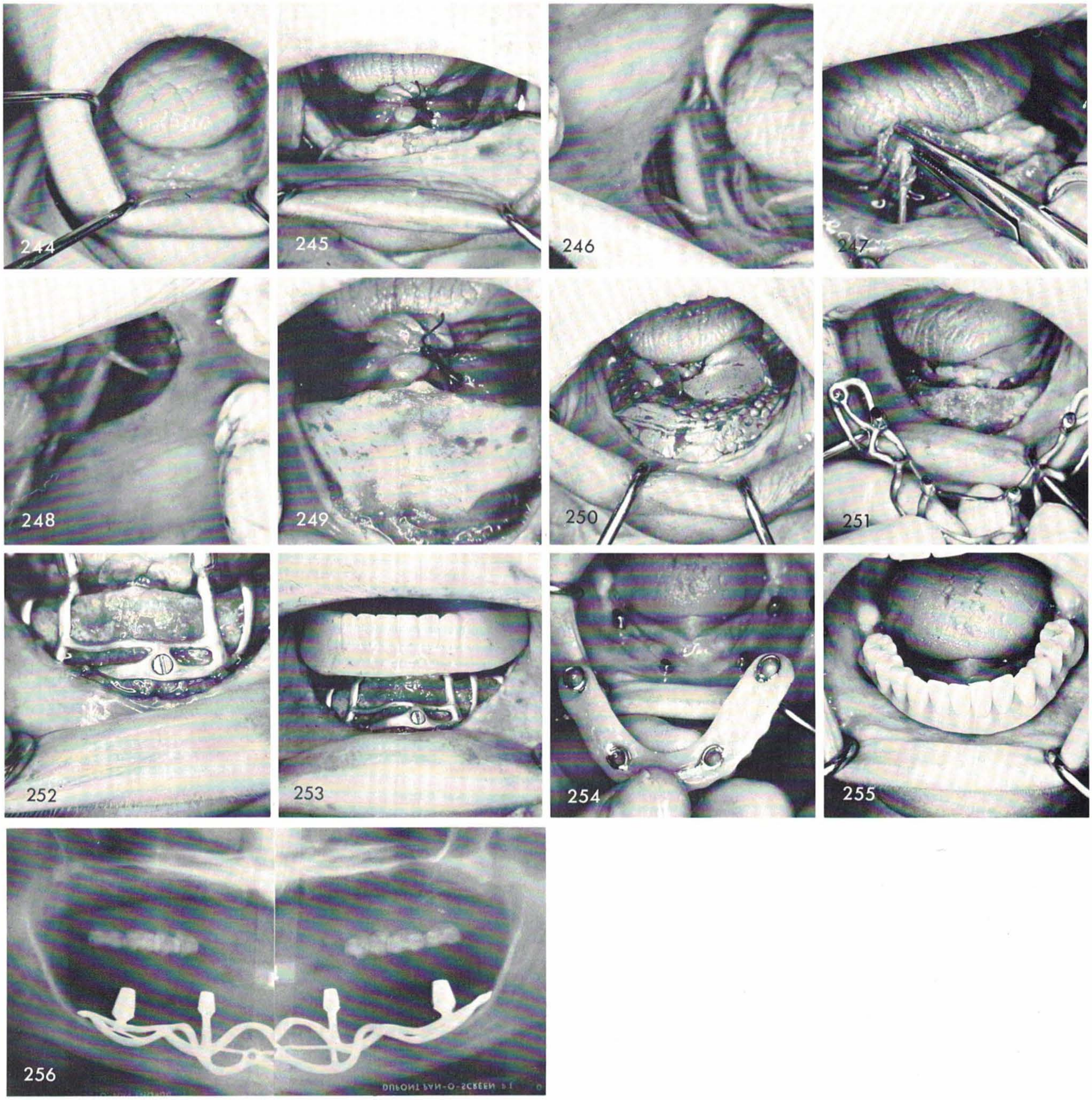
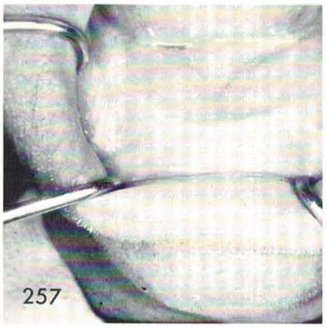


Fig. 244 reveals a severely resorbed mandible, with underlying nerve exposures, figs. 245, 246, 247, 248. Enough bone still exists anteriorly, fig. 249. After covering the nerves with tin foil an impression is taken, fig. 250, for the casting of the implant, fig. 251, which was screwed into position, fig. 252. The temporary stent is tried in, fig. 253, and the final prosthesis completed after sufficient healing had taken place, figs. 254, 255. The x-ray, fig. 256. The design of this implant was made not to cross over the nerve bundles.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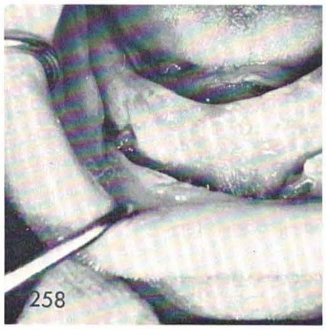
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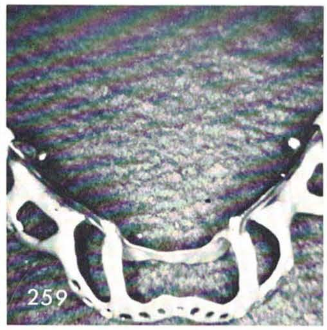
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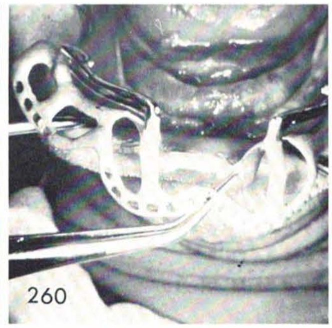
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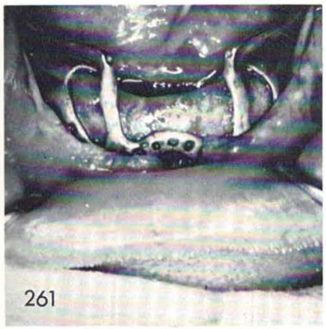
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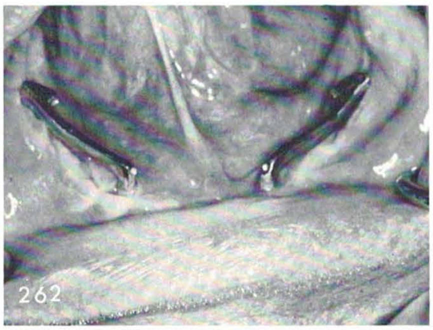
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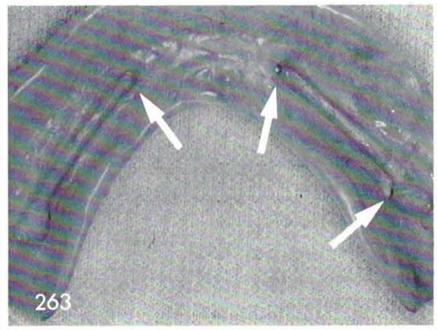
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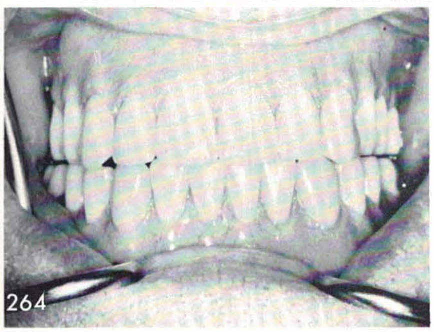
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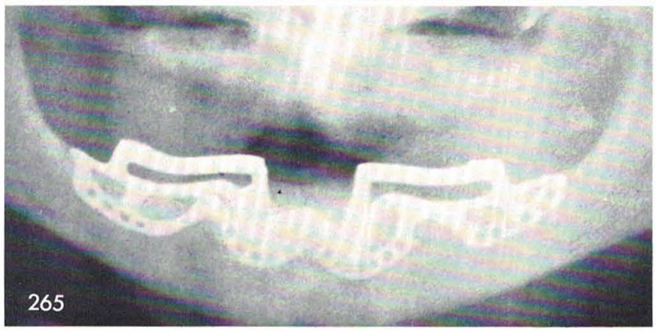
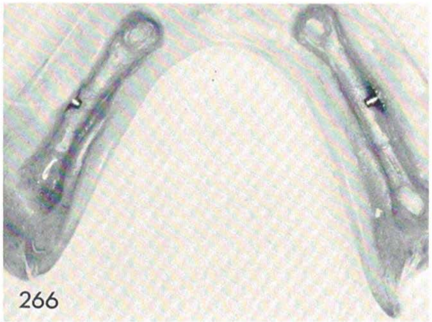

265

In this edentulous patient, fig. 257, some of the later designs were used. The bone was exposed, fig. 258, and the subperiosteal implant, with two horizontal bars instead of four posts was included in its design, figs. 259, 260, 261. Healing was excellent, and notice the tiny depressions in the anterior portion at the beginning of the horizontal bars and posteriorly and lingual to the bars, fig. 262. These act as a base for the spring-type ball bearings seen on the inside of this denture, called inter-coronal attachments, fig. 263, which gives excellent retention of the denture, fig. 264. Fig. 265 shows the new designed implant.



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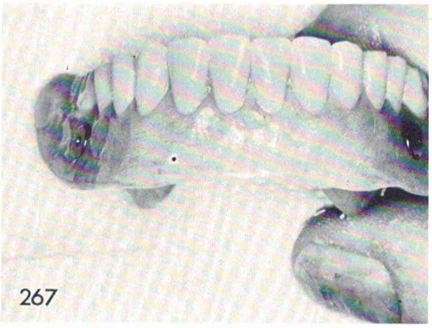

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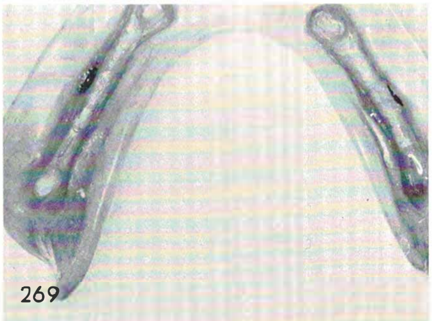

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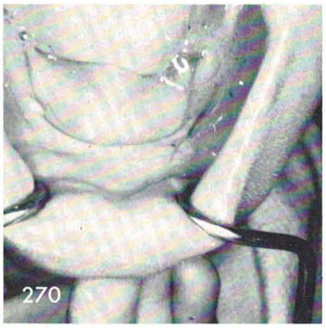

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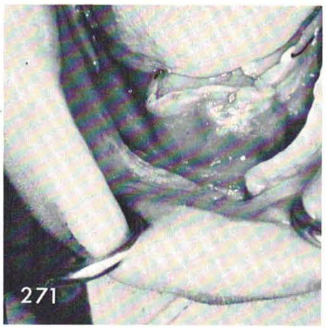

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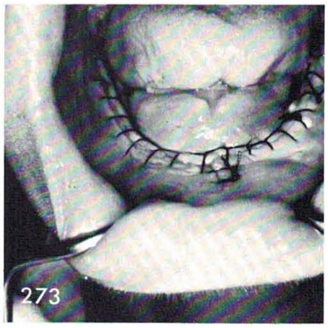
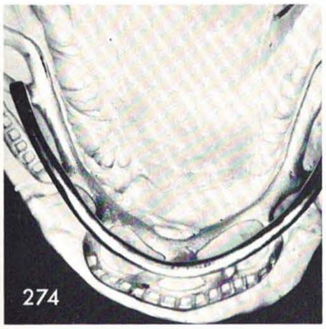


273

Even more practical than these attachments is the latest horizontal passive type Lew attachments, which work out exceptionally well with these horizontal bars. Each bar is cast with a tiny hole passing through it on each side to accept the attachment. When the horizontal attachments are pushed inside and through the holes in the bar, fig. 266, and the outside heads of the attachments are flush with the denture, fig. 267, the denture is locked into position and cannot be removed until the patient pulls the head of the attachment laterally in both directions, fig. 268, in order to release the horizontal extensions, fig. 269.

In this severely resorbed mandible, figs. 270, 271, 272, 273, the implant was designed with a continuous horizontal bar off three joining parts in order to prevent torquing of the extremely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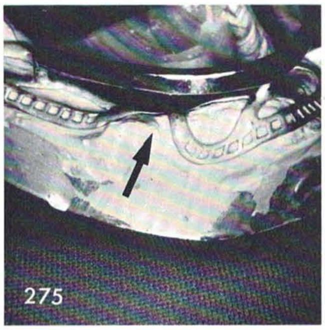
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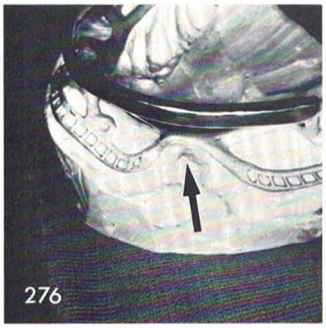
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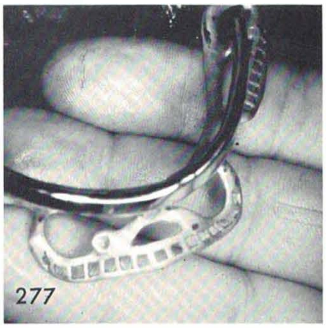
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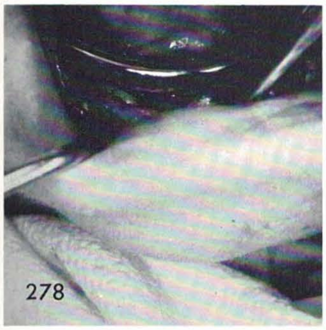
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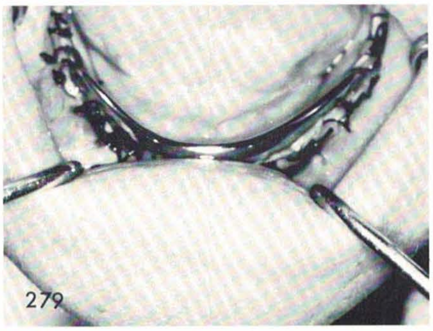
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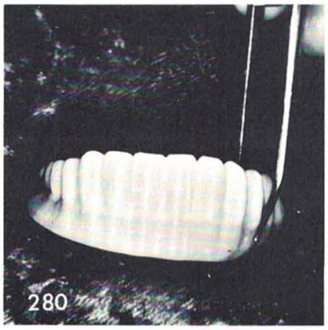
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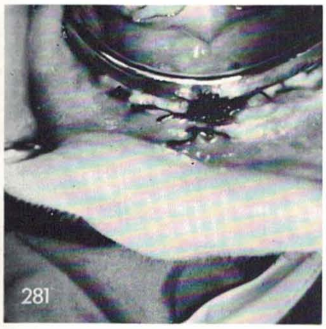
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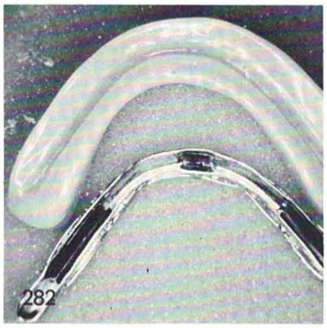
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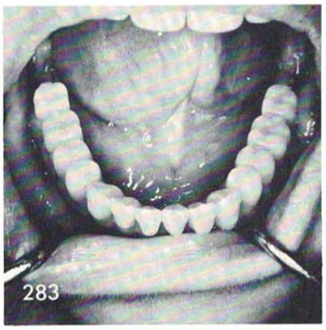
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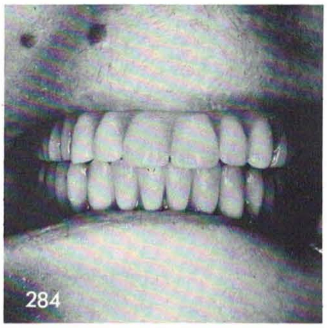
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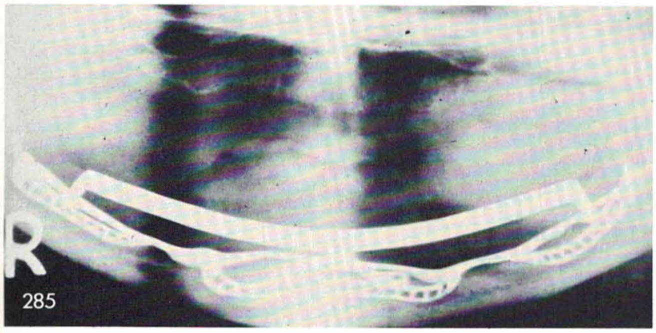
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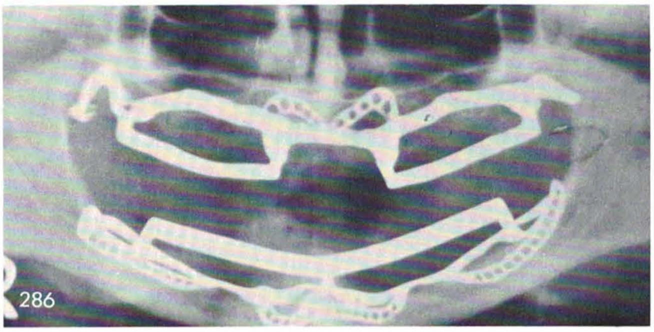
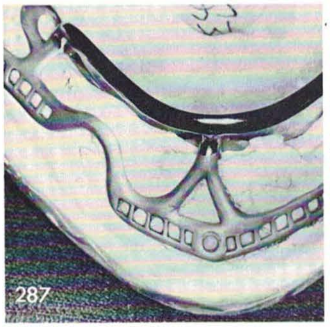

286

thin and weak portion of the substructure framework in the areas of both mental foramina, fig. 274. Being that the mental bundles were so far over the ridge the buccal peripheral struts had to blend in with the lingual strut thus creating two weak areas, figs. 275, 276. Three weeks after the first surgical stage, the implant was placed over the bone, figs. 277, 278, and sutures were placed beneath the horizontal bar, fig. 279. A temporary acrylic denture was fabricated, fig. 280. Healing was uneventful, fig. 281. The implant denture included a metal superstructure with internal clips, fig. 282, seen on next page. The completed case, figs. 283, 284, 285, 286.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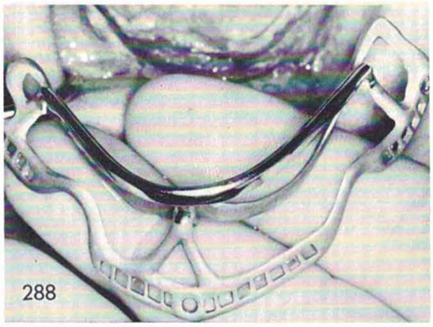
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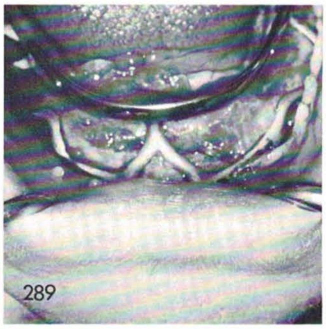
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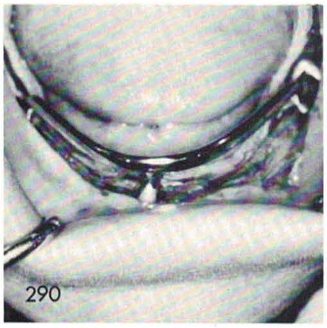
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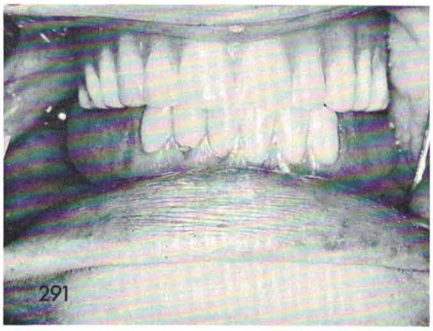
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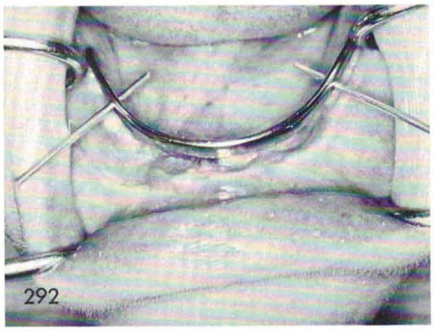
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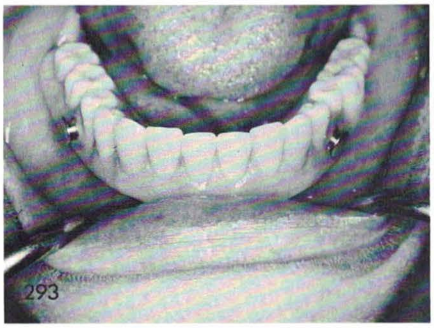
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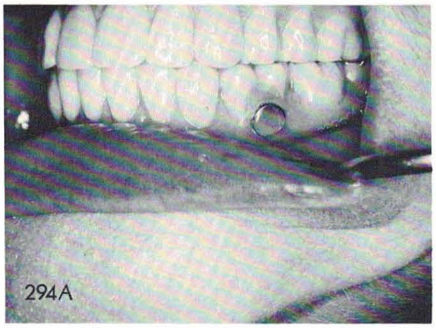
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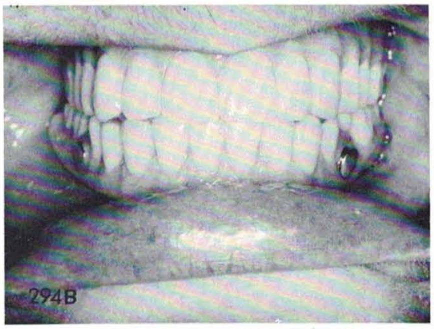
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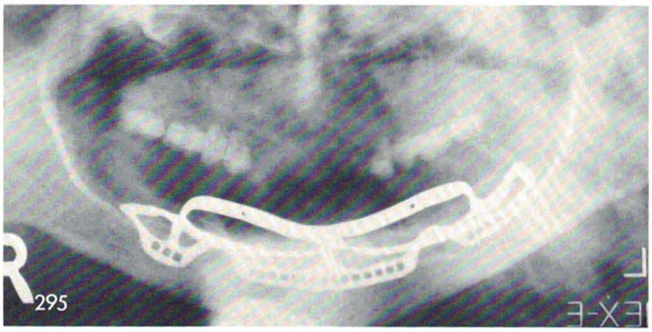

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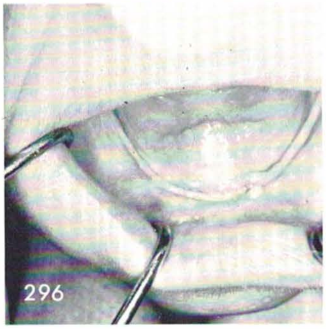
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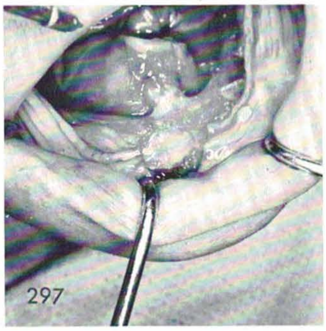
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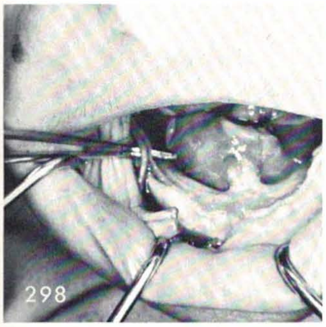
Sometimes implants were made from the very beginning with a bar-superstructure, for supporting the implant denture that contained horizontal Lew attachments, figs. 287, 288, 289, 290, 291, 292, 293, 294a,b, 295.

One of the most difficult cases I have ever done is seen in fig. 296. Upon exposing the bone, fig. 297, both inferior alveolar nerves along their entire extent along the body of the mandible as well as both mental neurovascular bundles were exposed, fig. 298. While lifting each nerve up a mandibular canal was created and an inverted T or keyhole was fashioned on the buccal surface of the bone to create a mental foramen, fig. 299. The inferior alveolar nerve was pushed into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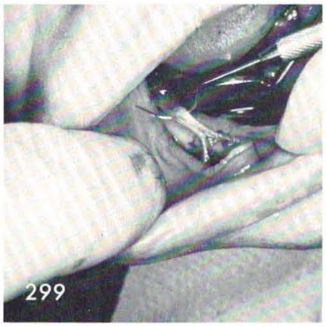
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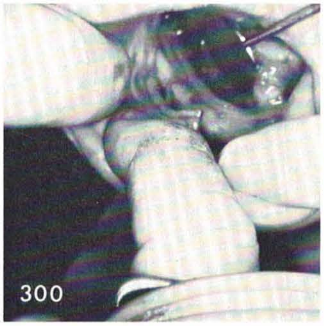
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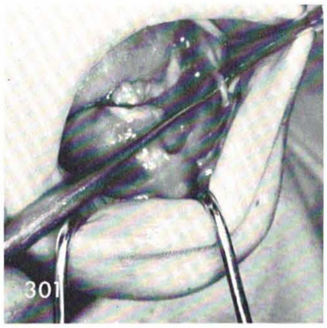
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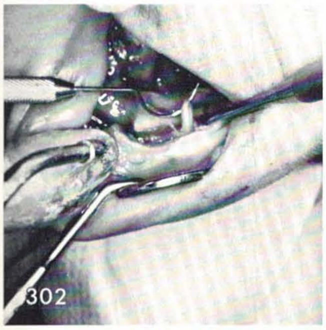
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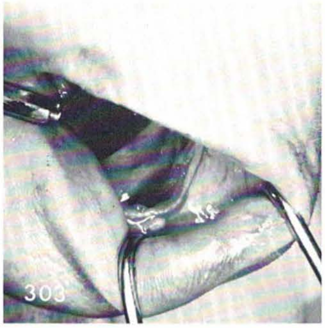
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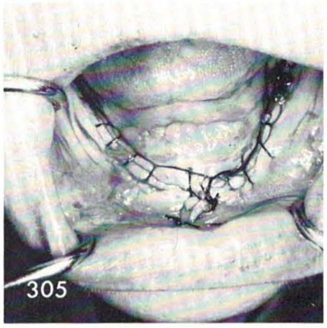
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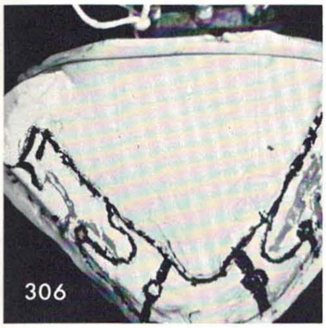
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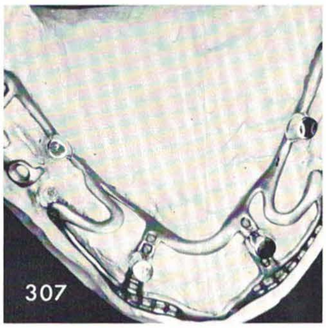
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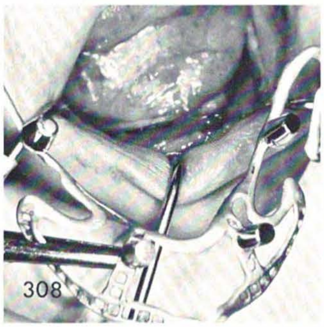
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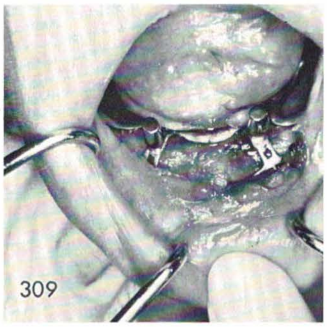
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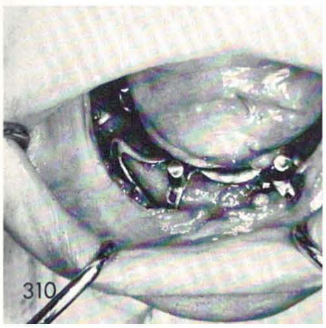
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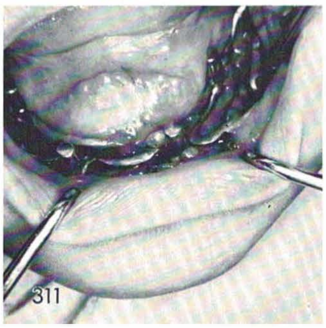
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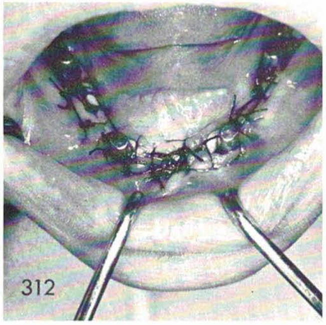
the newly formed canal and being that the vertical portion of the inverted T was narrower than the mental branch, it prevented the mental bundle from rising outside its wider and rounder newly created mental foramen, fig. 300. The same procedures were carried out on the opposite side, figs. 301, 302, 303. After covering the exposed nerves with a soft wax an impression of the mandible was taken with Citricon, fig. 304, and the tissues were sutured closed, fig. 305. On the master model the subperiosteal implant was designed in such a manner that no cross struts passed over the area, where the nerves were originally exposed, fig. 306, and the implant was cast, fig. 307. About five weeks later the implant was carefully seated after a complete lingual incision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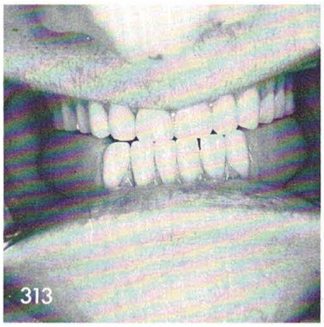
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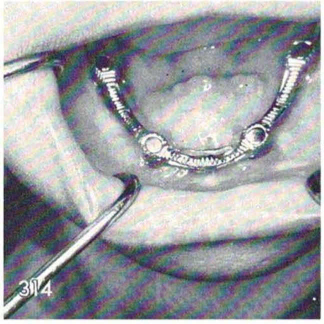
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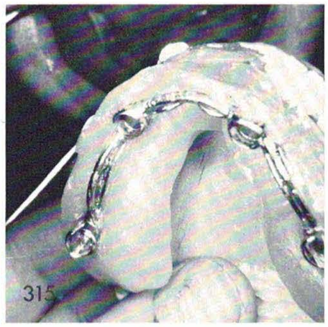
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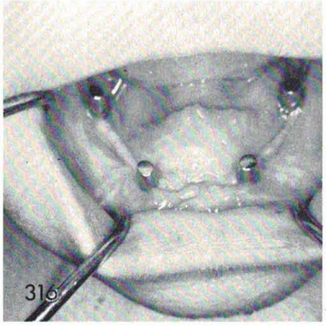
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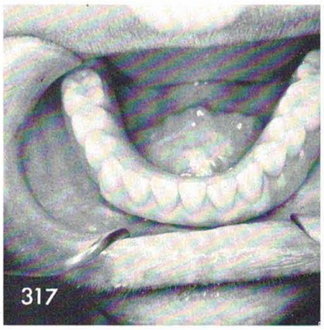
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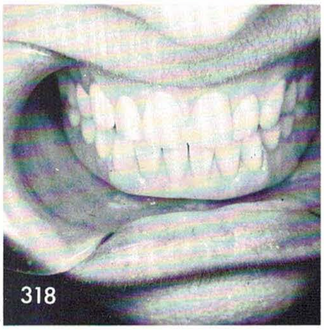
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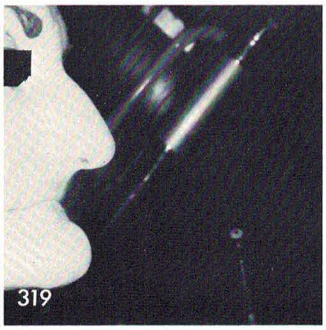
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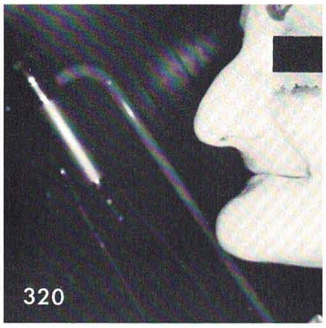
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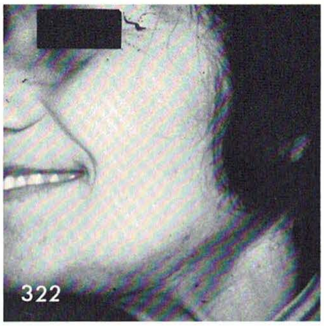
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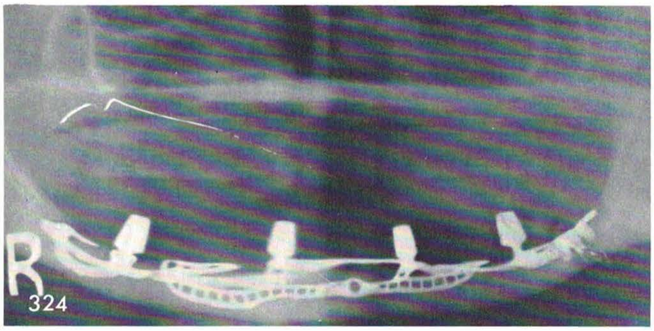

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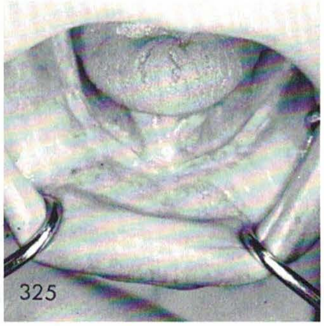
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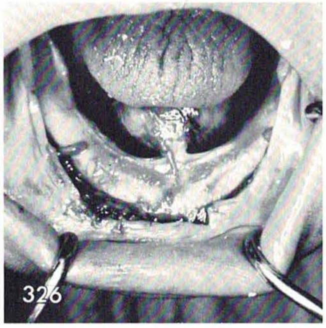
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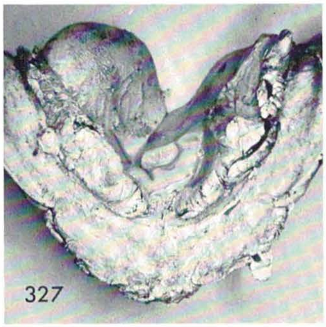
was made, figs. 308, 309. Figs. 310, 311 shows the nerves to be intact in the newly prepared canals. The tissues were carefully sutured being certain not to suture too deeply thus involving the nerve bundles, fig. 312. The temporary stent, fig. 313. The tissue healed excellently, fig. 314, a wax bite was taken, fig. 315. Six weeks later shows good tissue healing, fig. 316. The denture and subperiosteal implant have been successfully functioning for over seven years, figs. 317, 318. Before and after shots, figs. 319, 320, 321, 322, 323. The post-operative x-ray, fig. 324.

Another severely resorbed mandible, fig. 325, showing the extreme shallowness of the bony structure, fig. 326. An impression of heavy and light Citricon was taken, fig. 327, and the tissues sutured together, fig. 328.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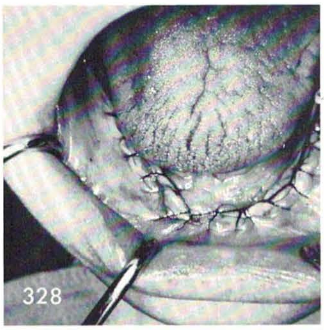
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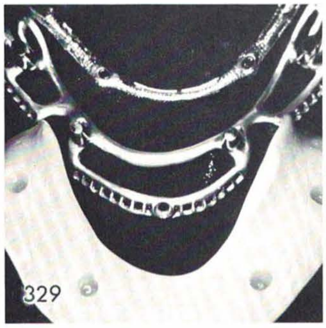
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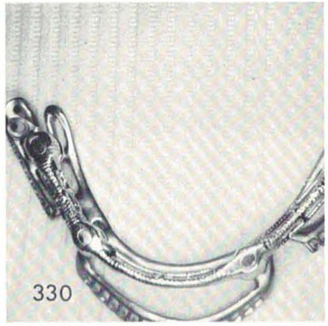
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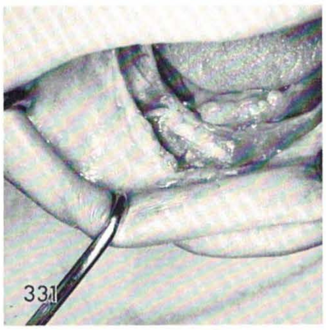
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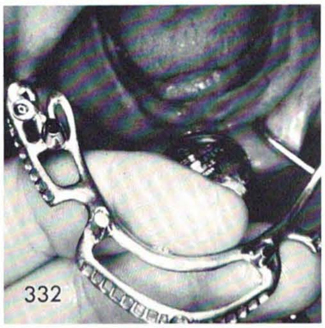
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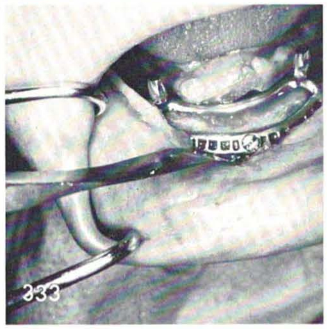
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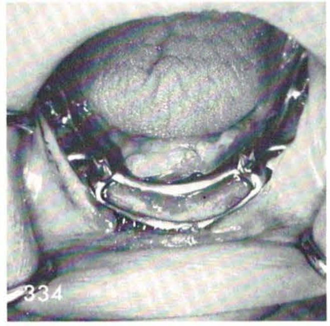
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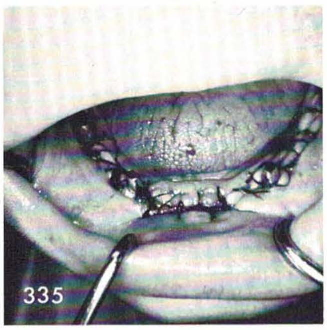
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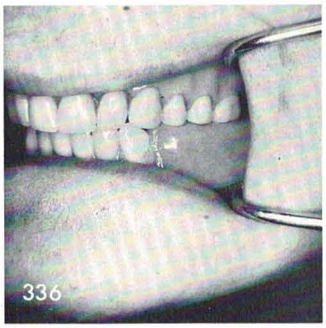
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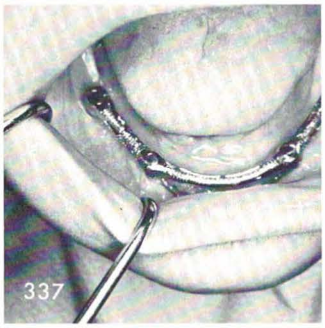
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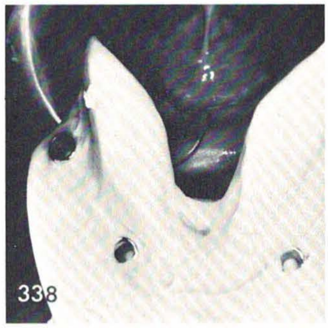
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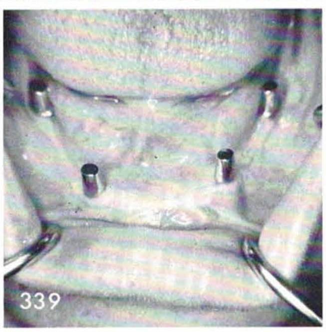
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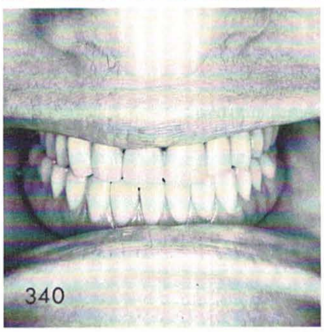
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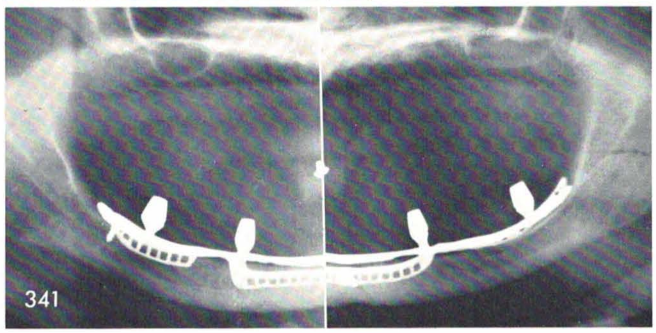
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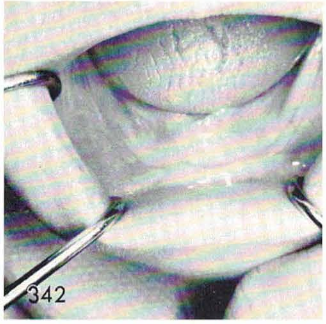
The implant substructure, superstructure and temporary acrylic stent are always made together, fig. 329. Notice that posteriorly on both sides of the implant framework there is an open area distal to the last post with no cross over strut distally, as is usually the case, fig. 320. This was to circumvent the most posterior portion of the exposed inferior alveolar nerves. Notice the inferior alveolar nerve is exposed posteriorly only, fig. 331. The implant is carefully fitted, figs. 332, 333, and screwed into place, fig. 334, and sutured, fig. 335. The acrylic stent had to fit accurately, fig. 336. The healing tissues with the superstructure frame, fig. 337, picked up with an alginate impression, fig. 338. Healing was uneventful, fig. 339, and the prosthesis gave the patient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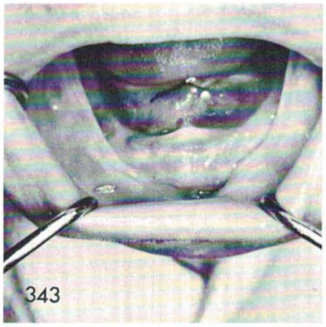
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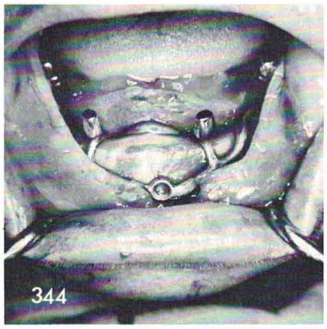
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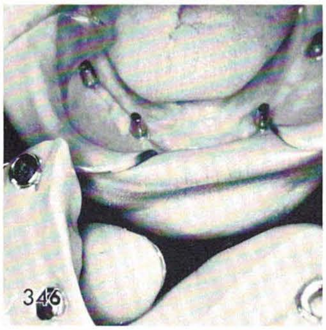
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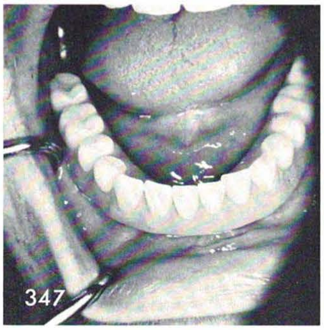
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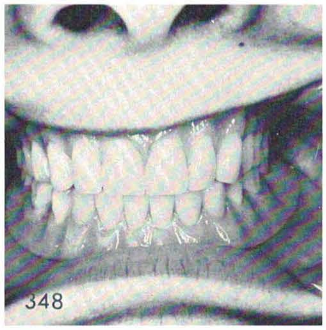
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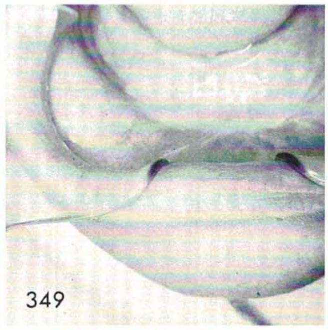
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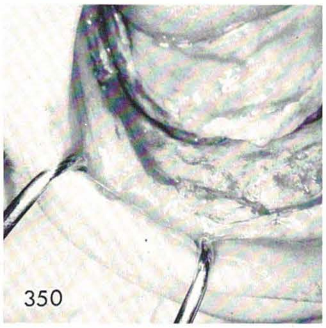
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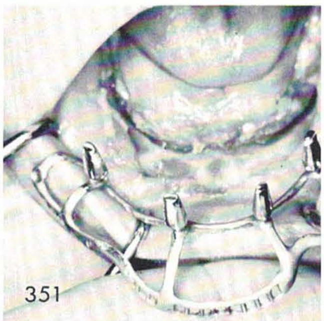
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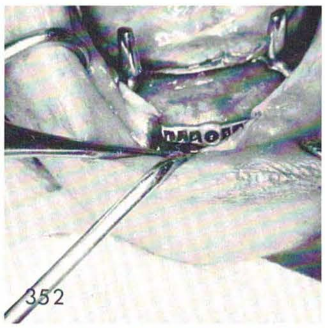
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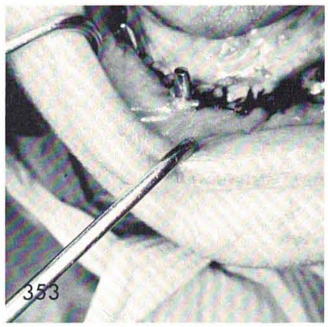
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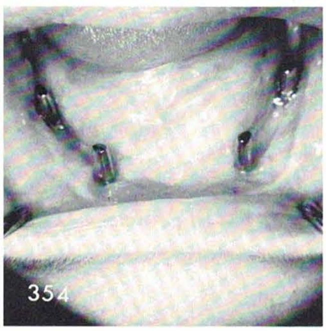
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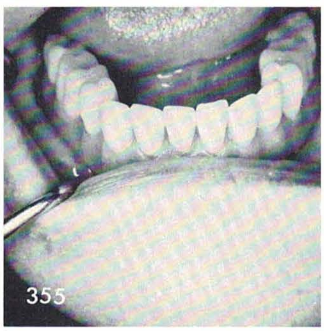
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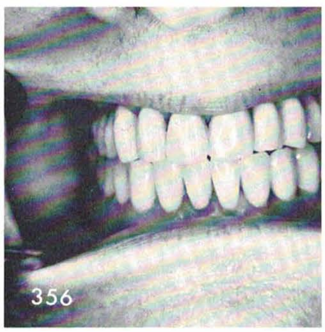
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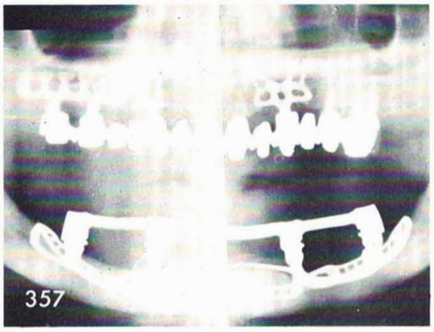
extreme comfort and confidence, fig. 340. The post-operative x-ray, fig. 341.

In severely resorbed mandibles, fig. 342, the genial tubercles and floor of the mouth are usually higher than the existing atrophied ridge, fig. 343. Therefore, the inferior peripheral strut of the implant resting on the genial tubercles is the highest area of the implant framework, fig. 344. After healing, fig. 345, all necessary steps are taken to complete the implant denture, figs. 346, 347, 348.



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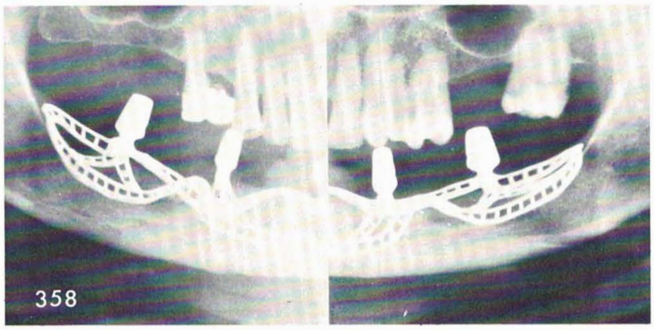

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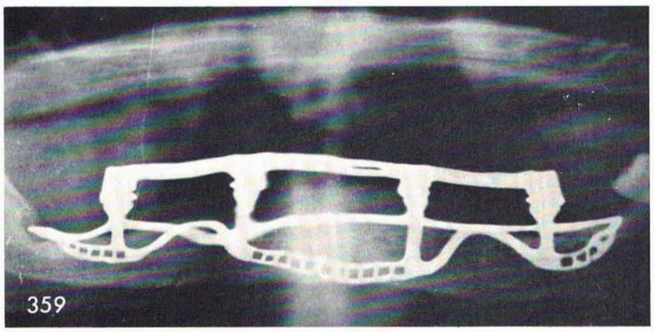

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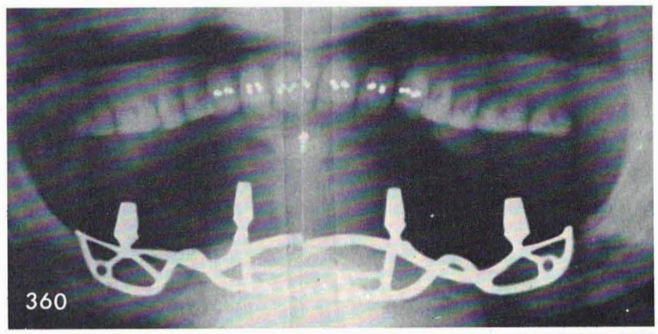

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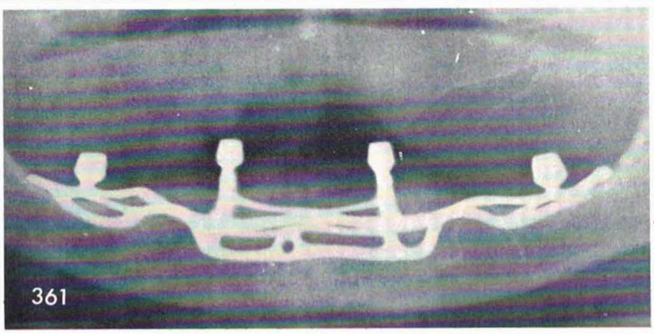

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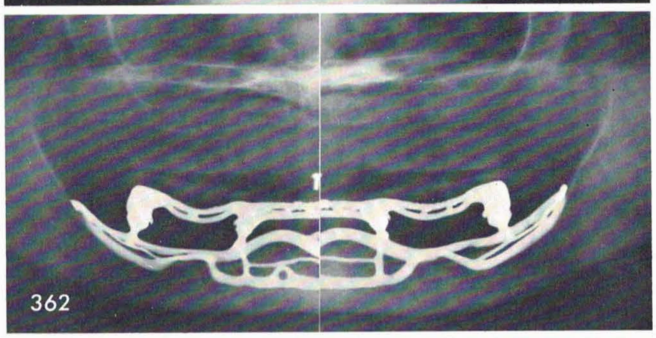

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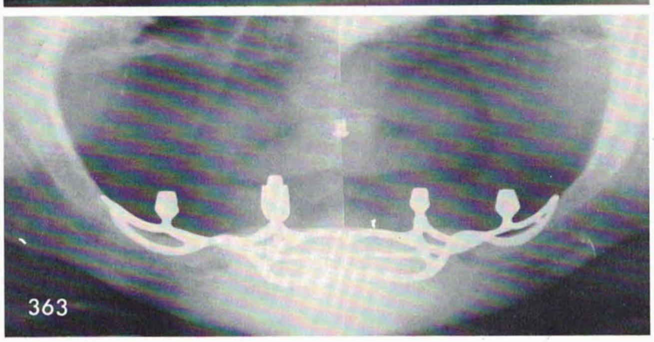

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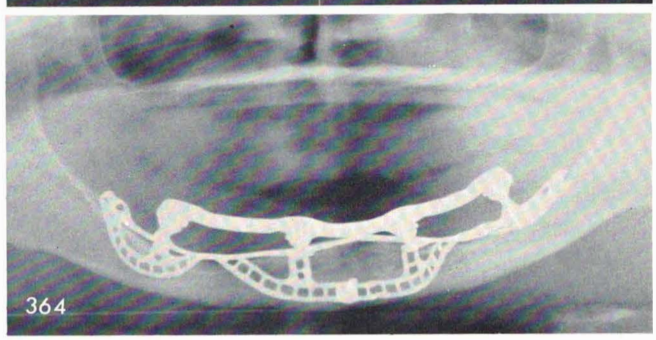
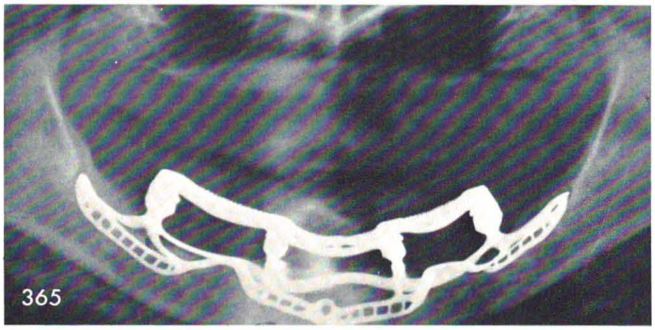


364

A most severely resorbed mandible is seen in fig. 349, still enough bone existed, fig. 350, to establish a base for the subperiosteal implant, figs. 351, 352. Healing with the aid of accessory incisions was excellent, fig. 353, and the patient enjoys the teeth, figs. 354, 355, 356.

Figs. 357 through 378 shows x-rays of various subperiosteals.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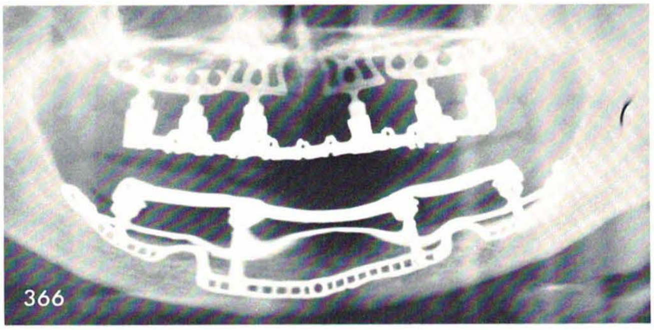
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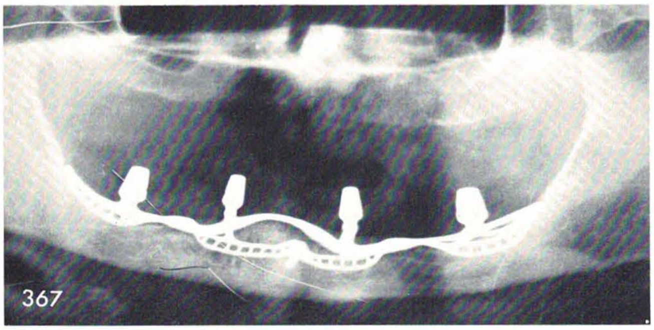
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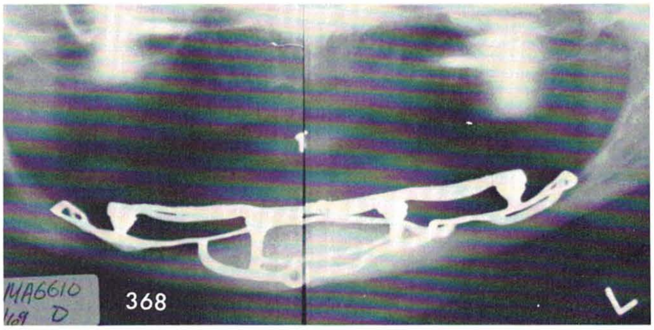
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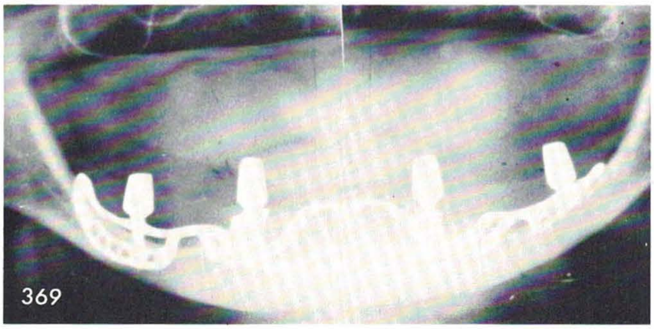
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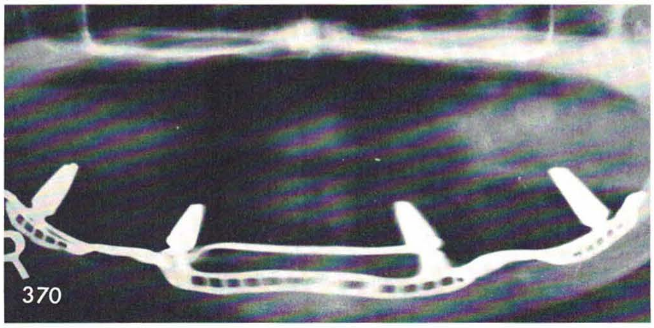
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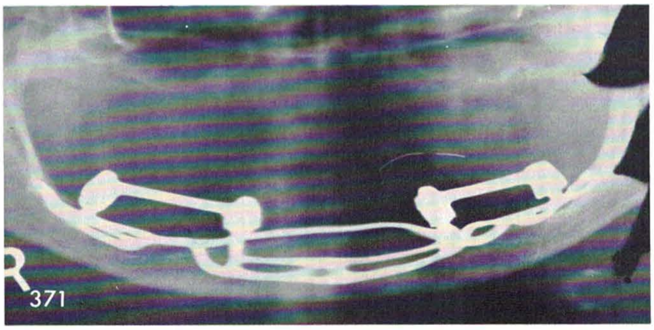
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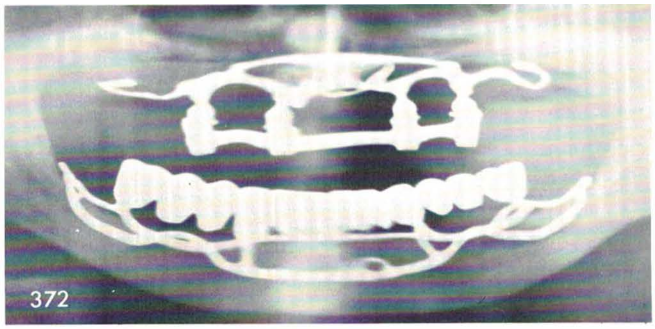
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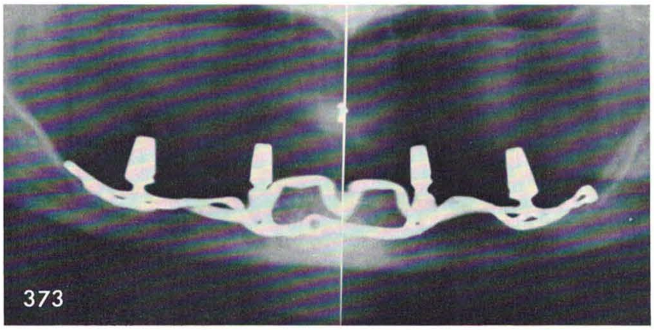
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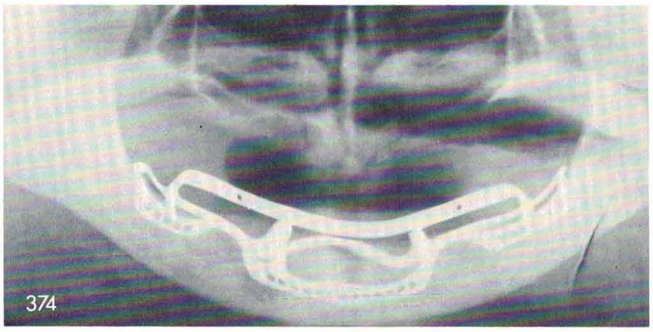
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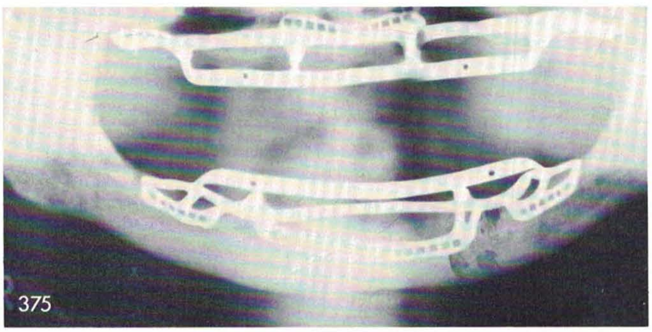
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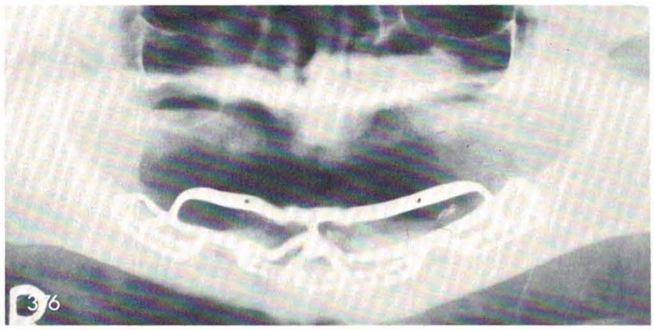
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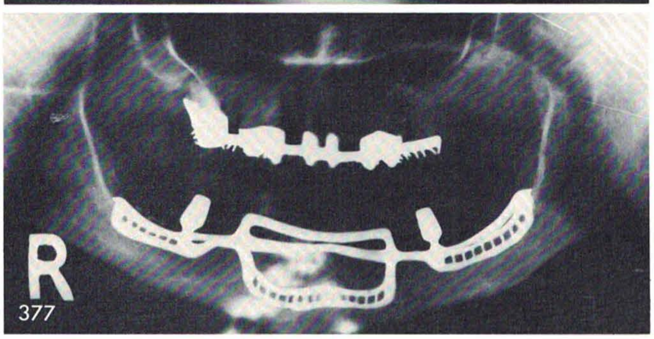

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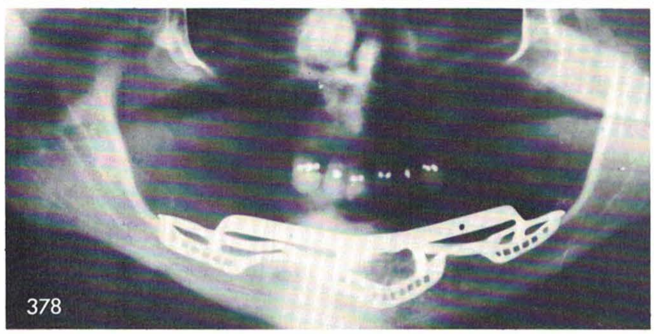
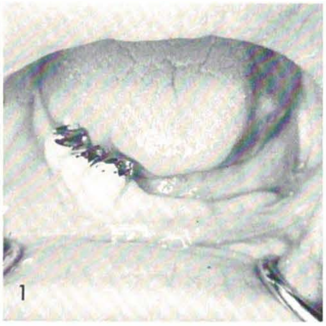

378

Universal Subperiosteal Implants



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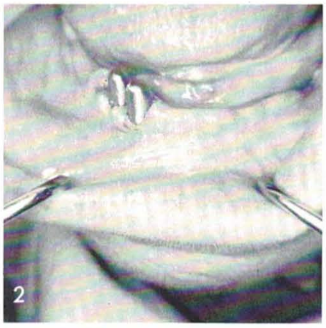

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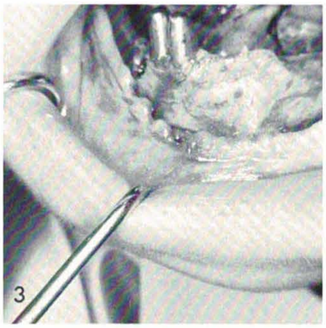

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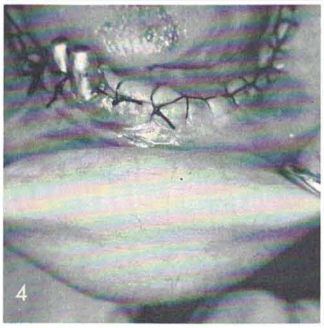

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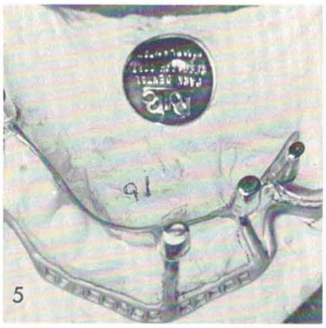

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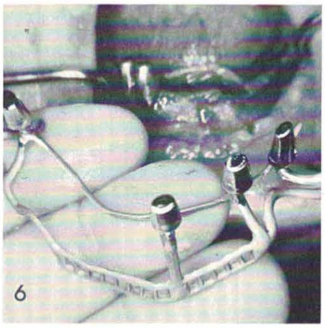

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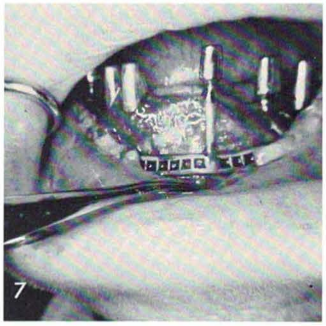

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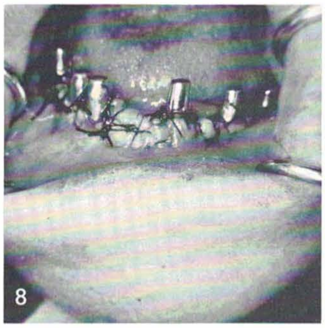

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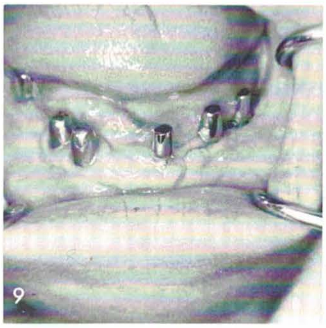

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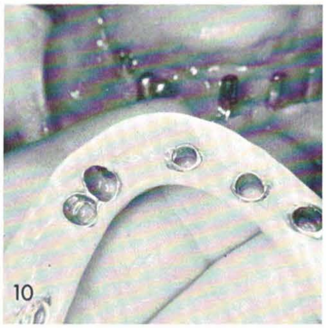

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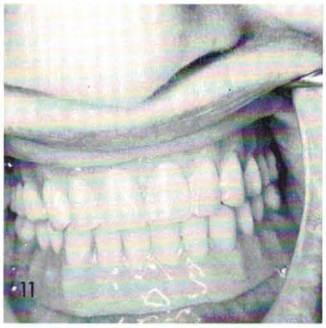

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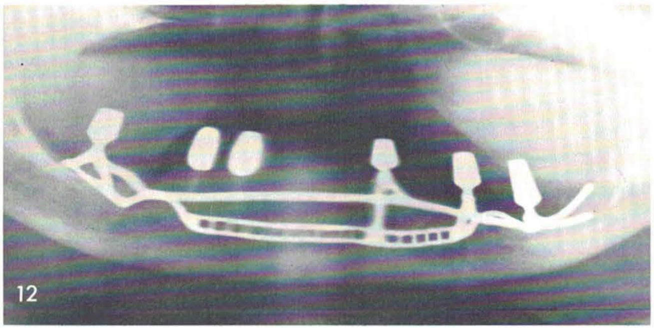
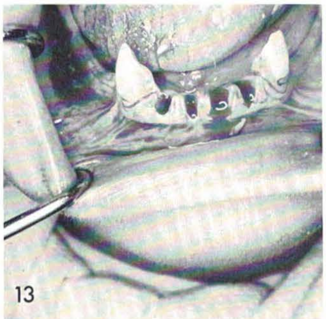


12

Often a few remaining solidly supported teeth remain in an otherwise extremely resorbed mandible, fig. 1. The good ones are saved and gold copings are cemented over them, fig. 2. The bone is exposed, fig. 3, for an impression of the entire mandible and the tissues are then sutured closed, fig. 4. The implant is designed so as to totally ignore the remaining teeth, fig. 5, and three to six weeks later it is fitted into position, figs. 6, 7, and sutured, fig. 8. Healing usually takes longer when teeth are involved. This was a four week clinical observation, fig. 9. The implant denture is seen with six clasps instead of the usual four, fig. 10. The completed case, figs. 11, 12.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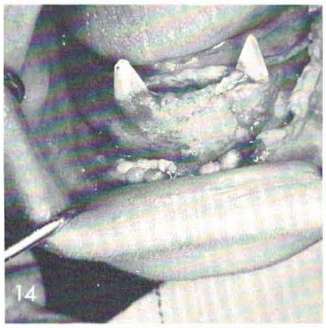
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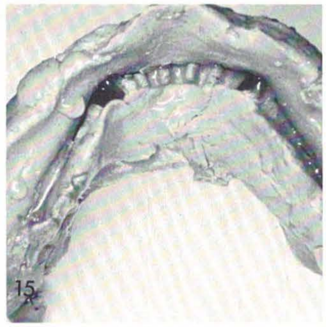
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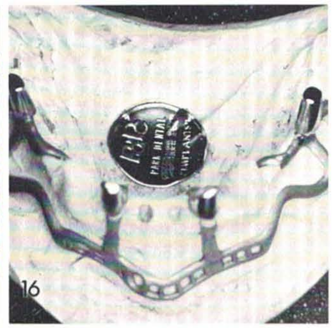
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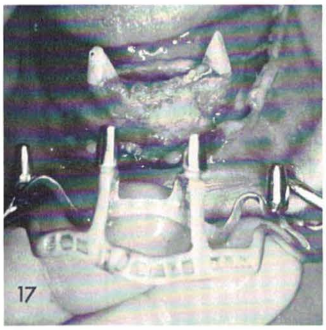
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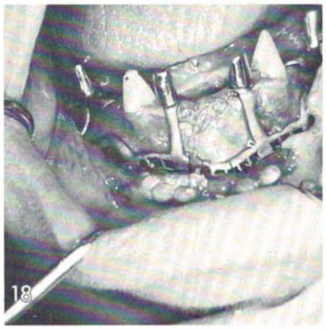
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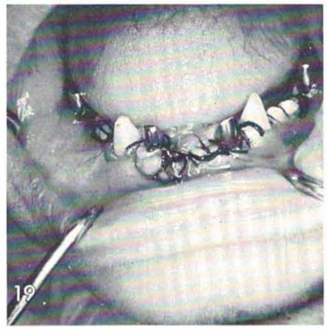
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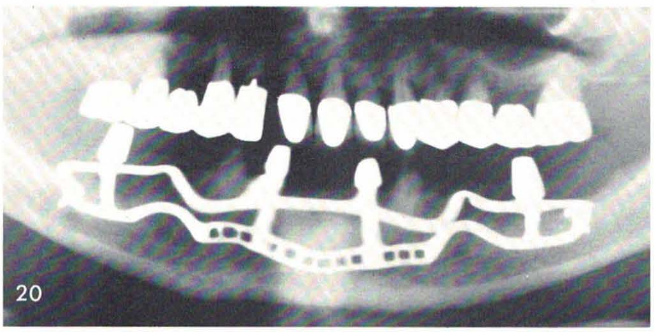
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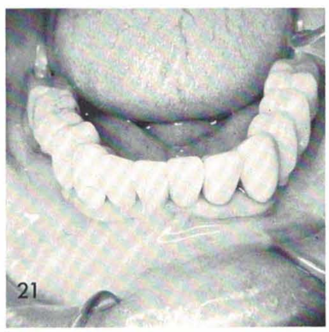
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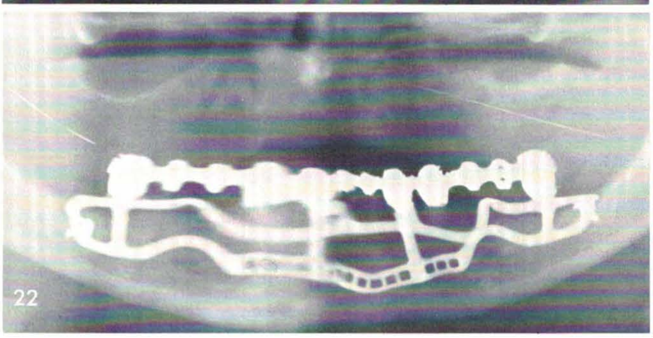
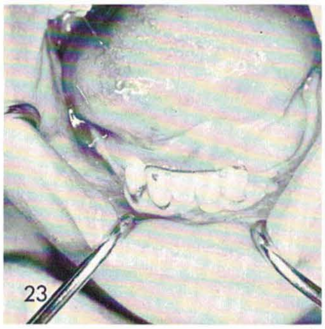

22

The four incisors because of periodontal problems had to be extracted, fig. 13. Six months later the surgery for the impression was accomplished. The teeth remaining should always be prepared for full crown coverage prior to the impression, fig. 14. The impression, fig. 15, and implant, fig. 16. The implant is fitted over the bone, figs. 17, 18, and the tissues are sutured, fig. 19. An immediate post-operative x-ray shows the implant and teeth, fig. 20. The prosthesis is fixed and cemented into position, fig. 21. The final x-ray, fig. 22.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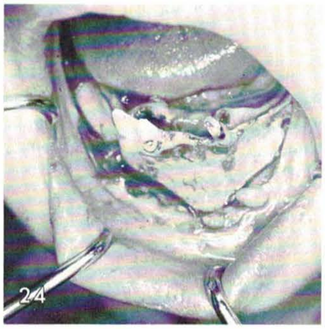
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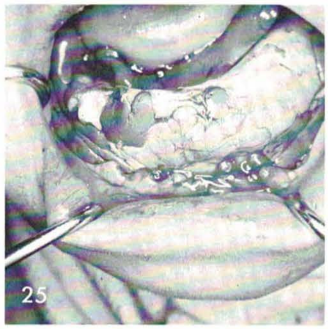
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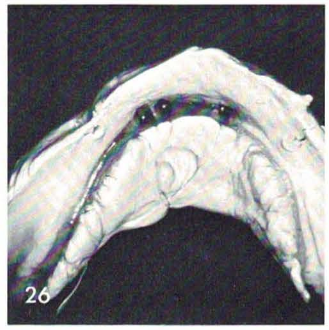
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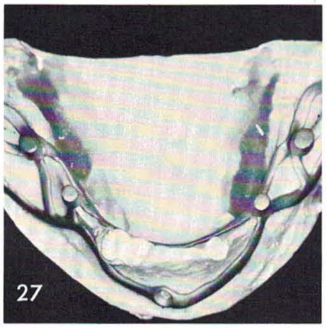
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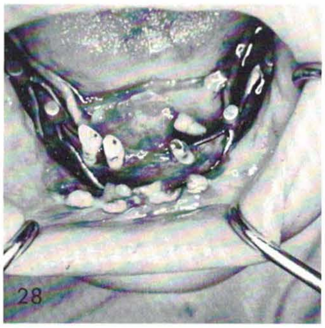
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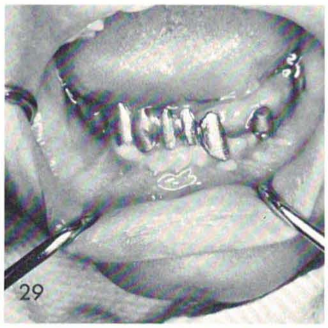
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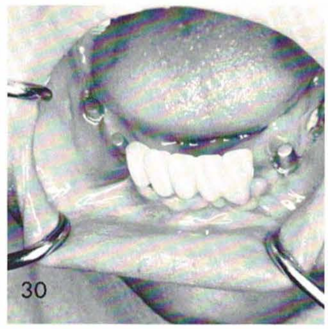
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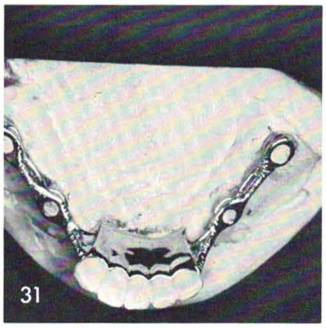
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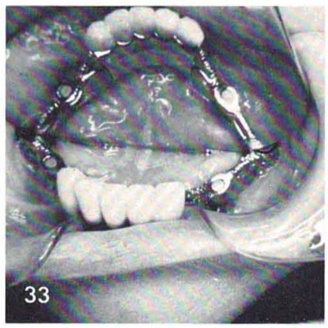
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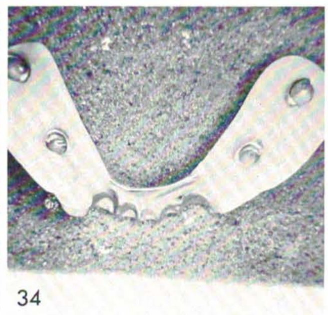
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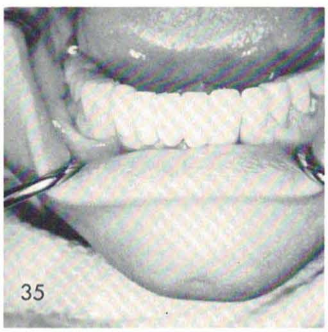
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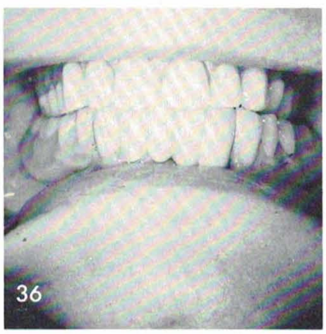
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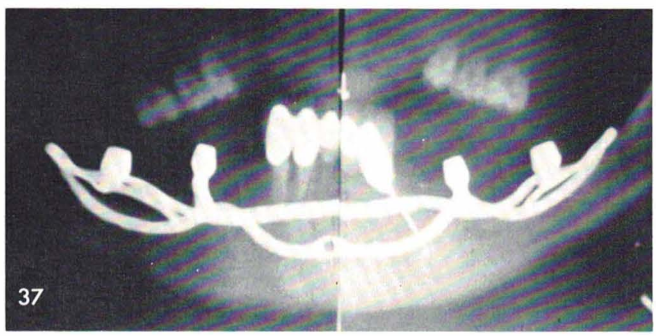
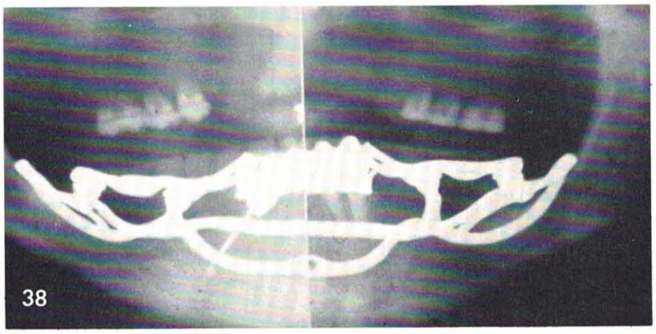

37

Another case showing some remaining well supported anterior teeth, fig. 23. The remaining teeth are prepared for full crown coverage restorations and the bone is recontoured to eliminate any infrabony pockets that may exist, fig. 24. Notice how little bone separates the left mental foramen from the resorbed crest and how much bone still exists anteriorly. The impression is taken, figs. 25, 26. The implant circumvents the remaining teeth, fig. 27. It is fitted in position, fig. 28. The healed tissues, fig. 29. The anterior teeth in this case were processed with a porcelain splint and a Kennedy type partial denture framework was cast to further support the anterior teeth and anchor on to the four subperiosteal implant posts, figs. 30, 31, 32, 33. After the case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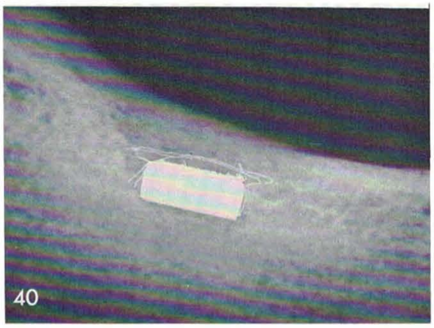
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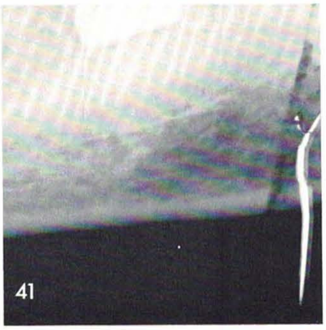
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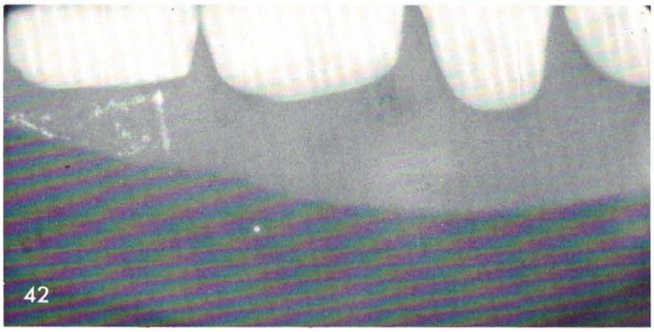
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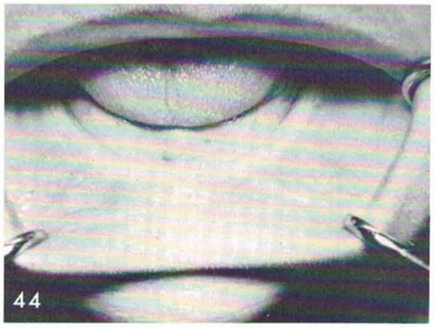
43

was processed, fig. 34, it was placed in position, figs. 35, 36, and x-rays were taken, figs. 37, 38.

One and a half to two cc of Decadron Phosphate intramuscularly after surgery seems to work very well in reducing or eliminating the swelling sequellae, fig. 39.

A very interesting case came into my office in the early 1960s complaining of a loose fitting denture with constant sore spots. Upon radiographic examination, magnets were revealed in the posterior portion of each side of her mandible, figs. 40, 41. Upon examining the lower denture, seeing no attracting magnets I decided to radiograph the teeth. They revealed no magnets, figs. 42, 43. Upon further questioning the patient, she claimed that her constant visits to her dentist complaining of pain posteriorly gradually caused all of the denture magnets to be ground away, thus establishing that even a denture with attracting magnets is still tissue borne and the patient still suffers from denture sore spots.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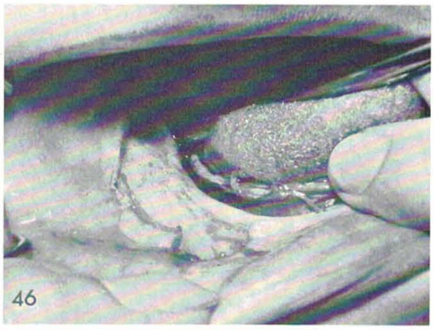
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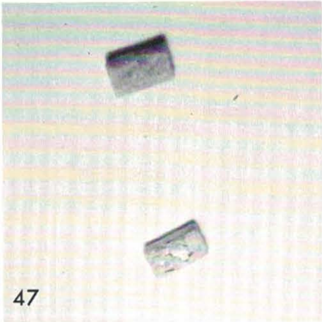
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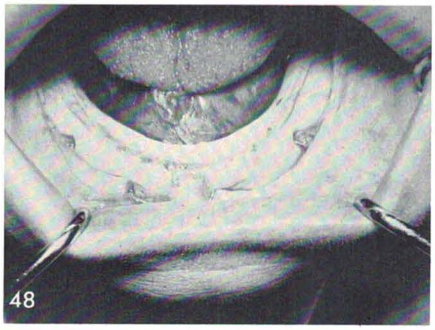
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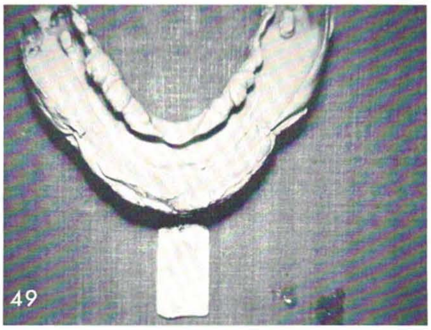
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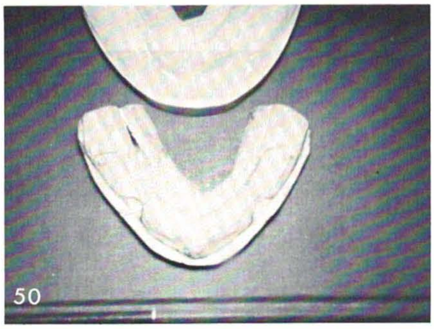
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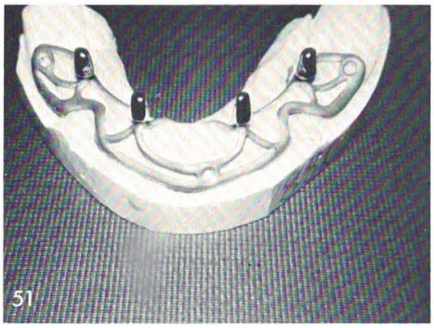
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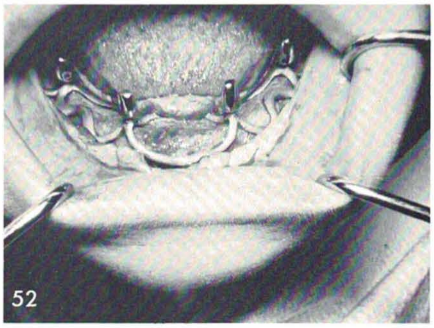
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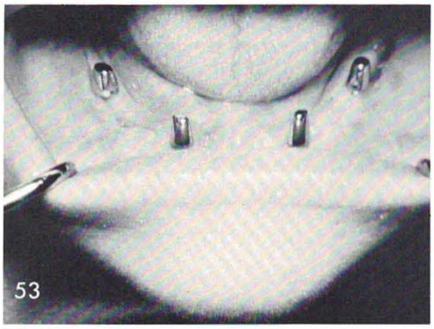
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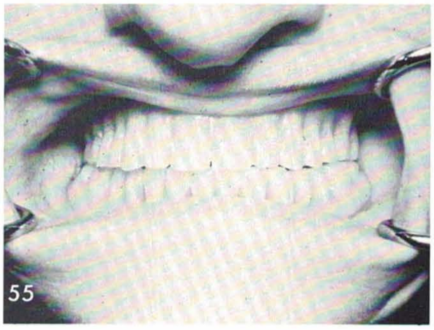
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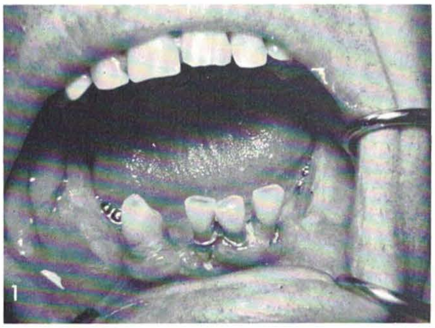
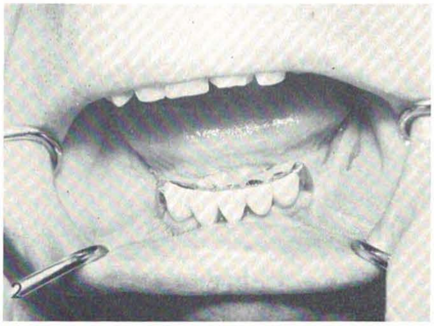
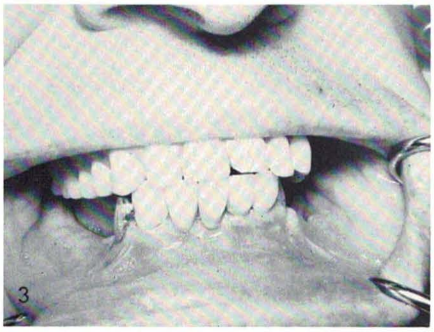
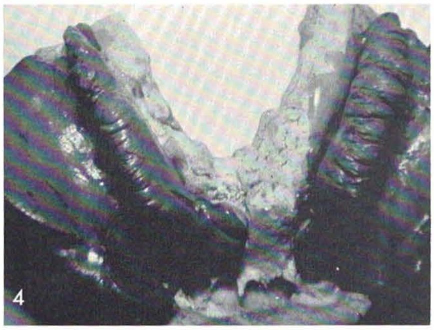
The patient accepted a subperiosteal implant and procedures were started, fig. 44. The bone was exposed, exposing the both mental bundles and the areas where the magnets were implanted posteriorly, figs. 45, 46. The magnets were removed, fig. 47, the bone cleansed of soft tissue debris, fig. 48, and an accurate rubber base impression was taken. Notice the impression included the areas where the magnets were removed, fig. 49. Fig. 50 shows stone models revealing the difference in contour between the soft tissue impression and bone impression. The implant, fig. 51, is fitted into place, fig. 52. Healing was good, fig. 53. The processed denture was then seated, figs. 54, 55.

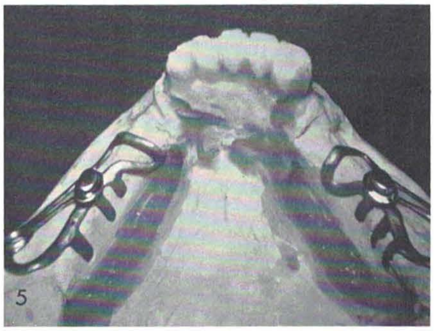
Bilateral and Unilateral Subperiosteal Implants

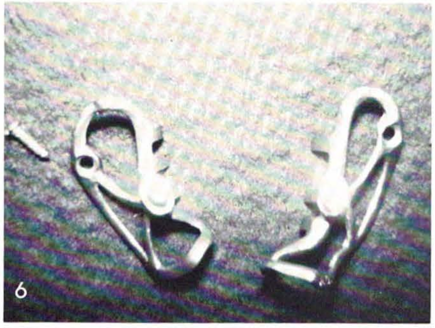


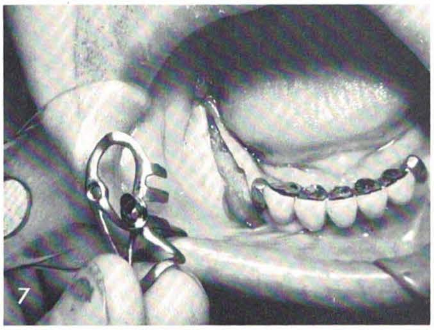


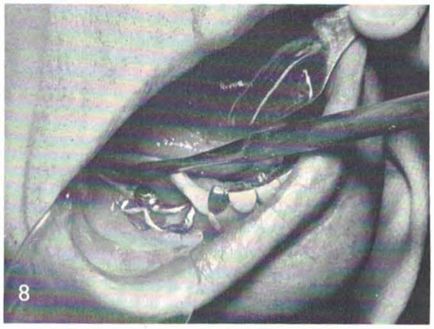


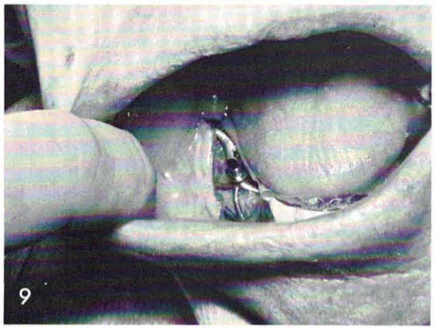


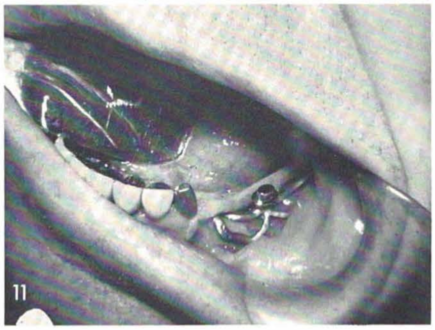




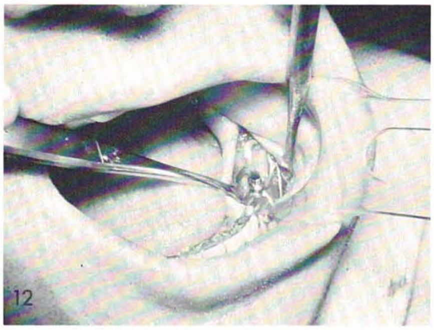


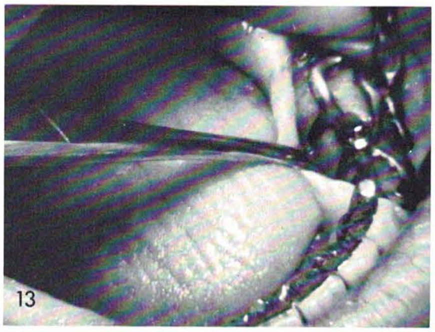


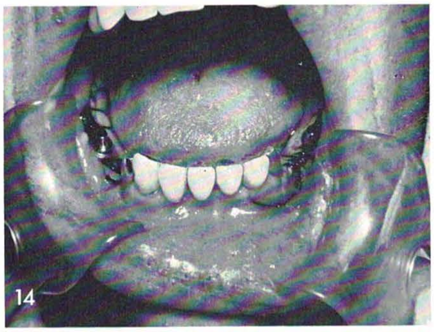


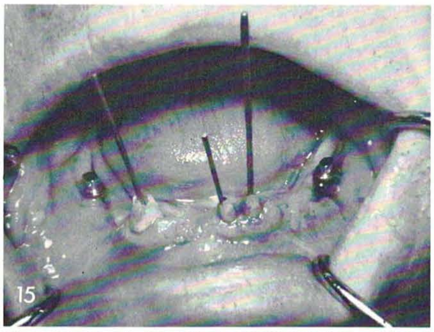


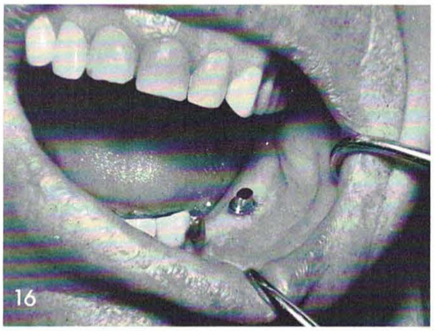
Sometimes, whether because of psychological or reasons otherwise a few remaining teeth, as bad as they may seem are utilized for support for a bilateral or unilateral subperiosteal implant, fig. 1. In this case an anterior partial fixed bridge was processed containing a cantilevered pontic at each end, figs. 2, 3. Impressions of the exposed bone on both sides of the arch were taken with rubber base material and an overall alginate impression of the entire arch was taken to pick up the two rubber impressions, fig. 4. On the master model two unilateral subperiosteal implants are seen exhibiting lingual fingers below the mylohyoid ridges, fig. 5. Recesses for possible screw fixation are built into the implant framework, fig. 6. On the second visit the implants are seated,

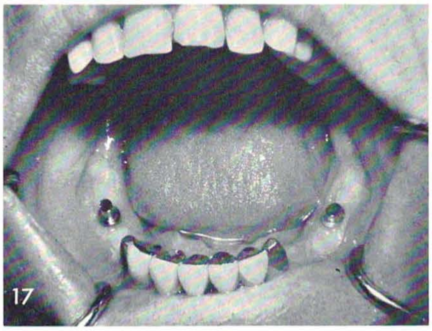


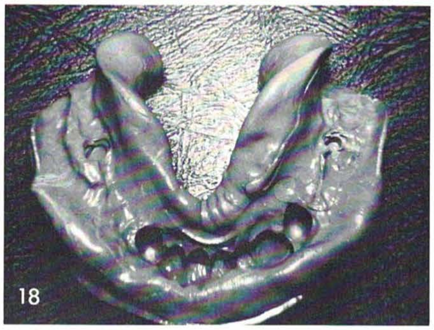


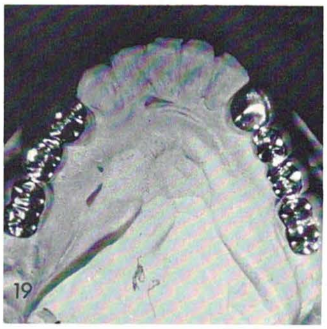


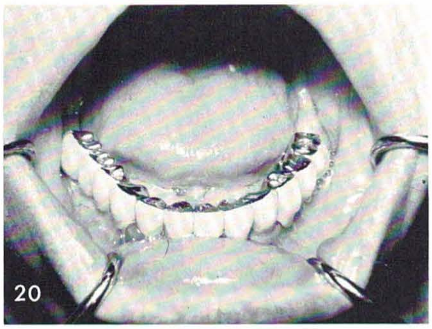


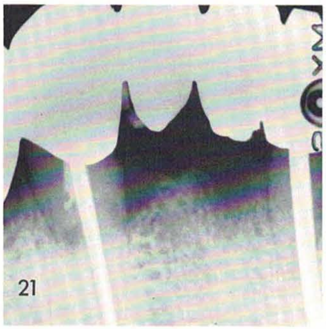


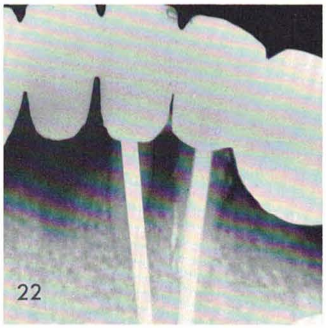


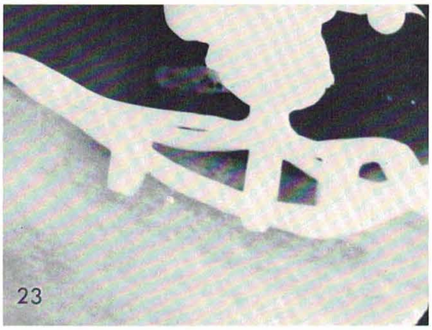




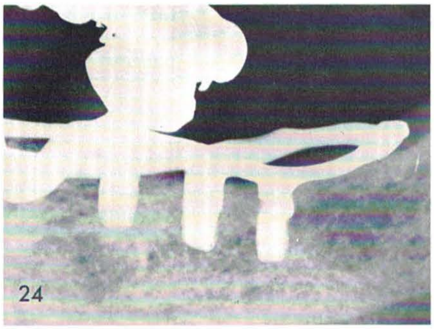








figs. 7, 8, 9, 10, 11, 12, 13, and the tissues are sutured closed, fig. 14. To give added support to the remaining anterior teeth endodontic stabilizers are introduced, fig. 15. The tissue healed well around the implant posts, figs. 16, 17. A rubber impression was then taken of the implant posts and cantilevered copings, fig. 18, to complete the bridgework, fig. 19, which was then cemented to place, fig. 20. Figs. 21, 22, 23, 24 show the stabilizers and implants.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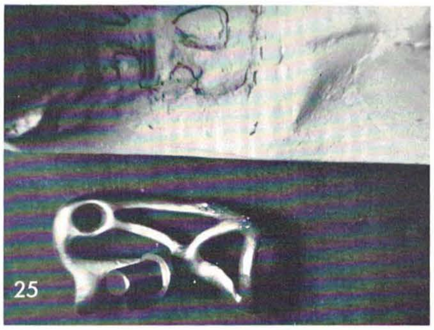
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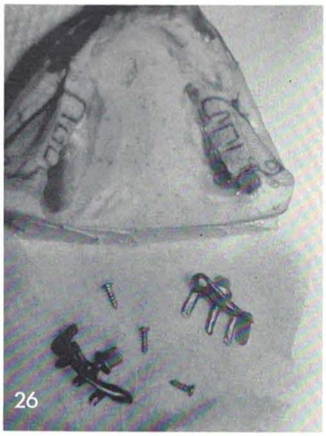
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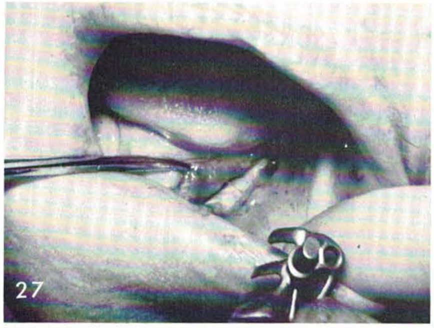
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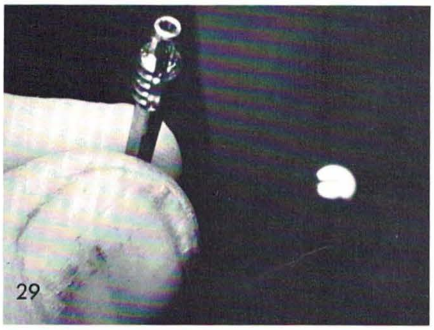
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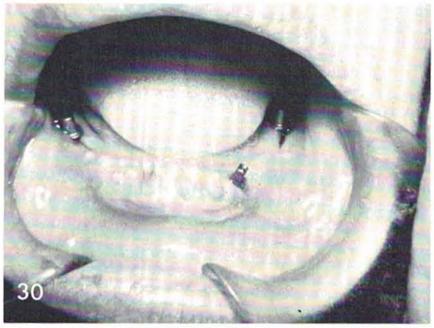
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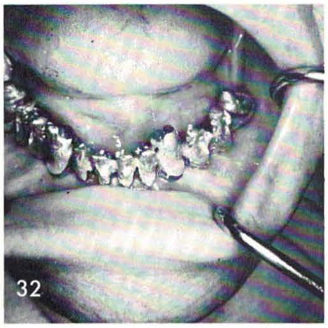
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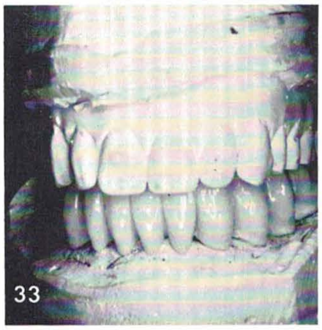
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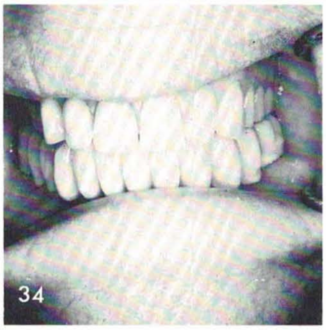
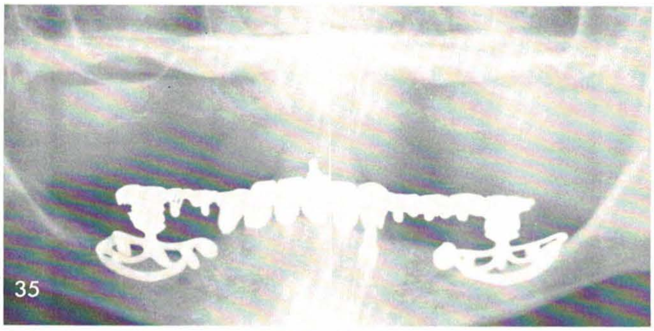

34

This case lasted about seven years before resorption of the bone around the already weakened anterior teeth and beneath the implants had dictated their removals. Figs. 25, 26 reveals a close up of the implant and master stone model. The implants are inserted, fig. 27, and the tissues sutured together, fig. 28. A vent-plant screw was screwed into the bone between the subperiosteal implant and remaining incisor tooth to give more support, fig. 29, 30. An impression was taken, fig. 31, for a gold framework, fig. 32, onto which acrylic was processed, fig. 33. The case as seen in the mouth, fig. 34, and the post-operative x-ray, fig. 35.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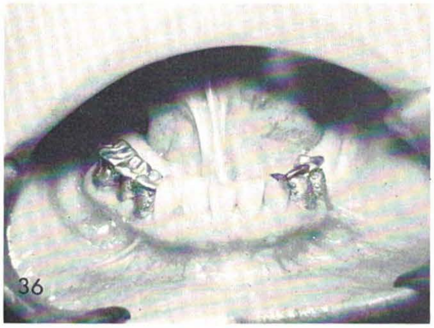
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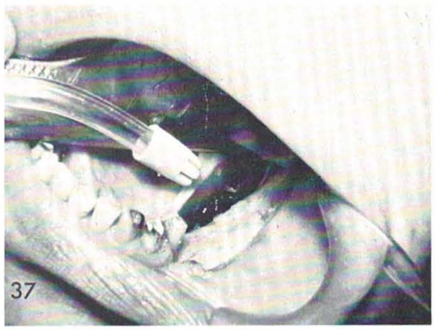
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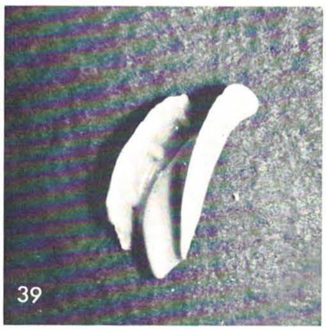
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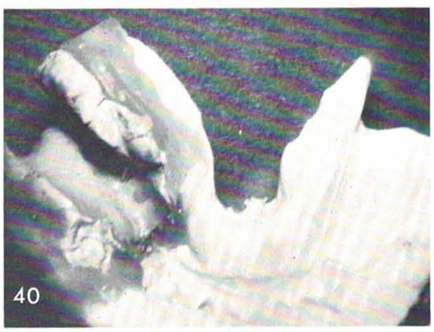
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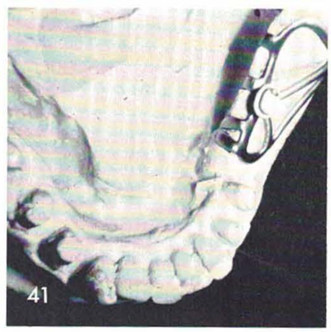
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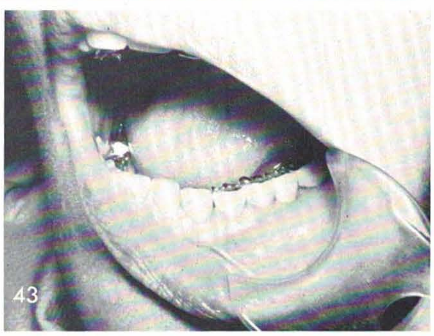
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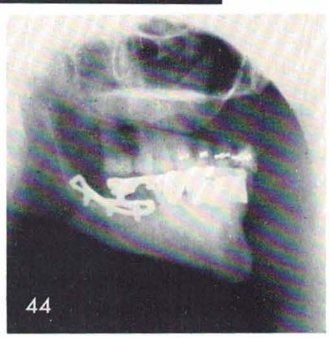
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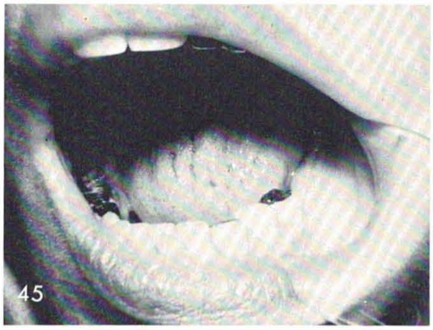
It is always best to have the castings completed, fig. 36, before the bone impression is taken so that the bridge can be completed as quickly as possible. Over the exposed bone, fig. 37, a cold cure acrylic tray was moulded, figs. 38, 39. The tray was used for a rubber base impression and the impression was picked up with a full mouth alginate impression to determine the paralleling of the implant post with the anterior abutment teeth, fig. 40. The implant with its lingual fingers fitting exactly into lingual grooves, fig. 41.

After the tissue has healed, fig. 42, the unilateral bridge is cemented to place, fig. 43. A lateral plate roentgenograph, fig. 44.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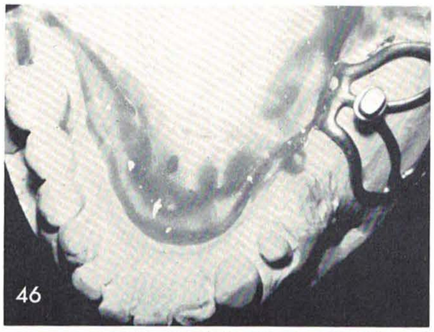
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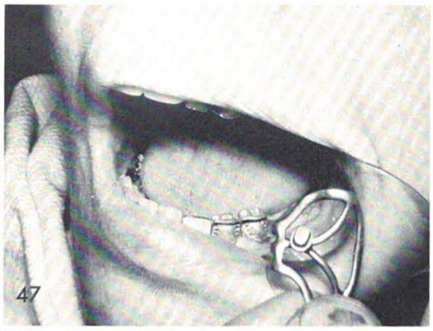
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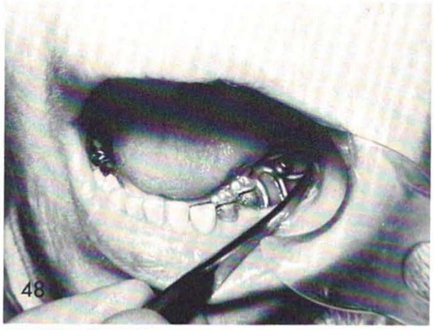
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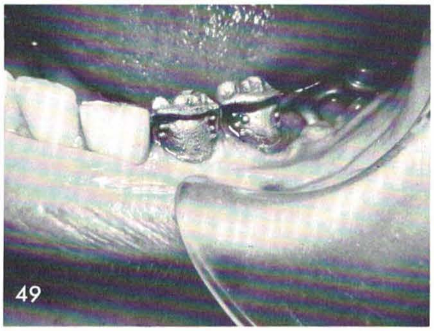
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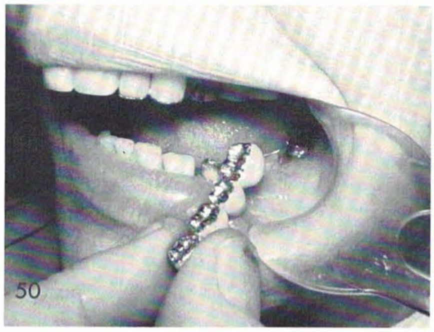
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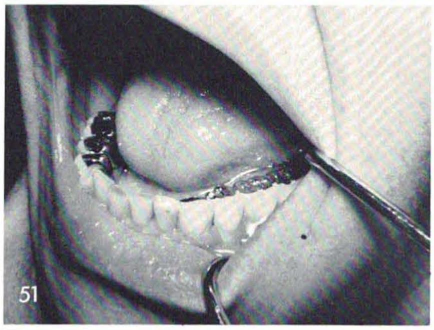
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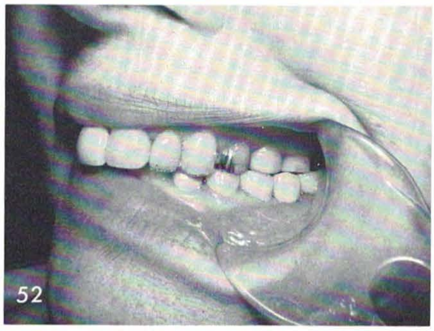
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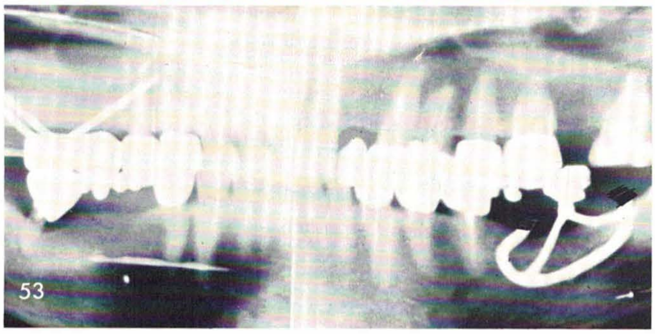
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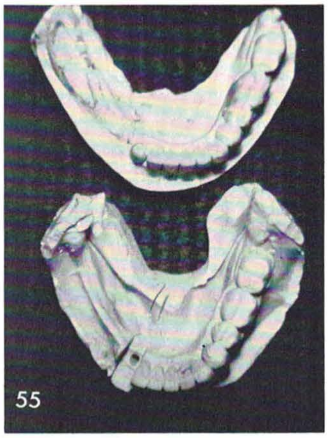
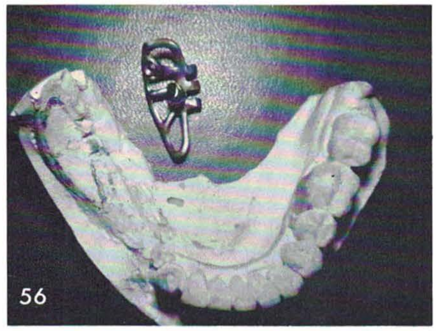
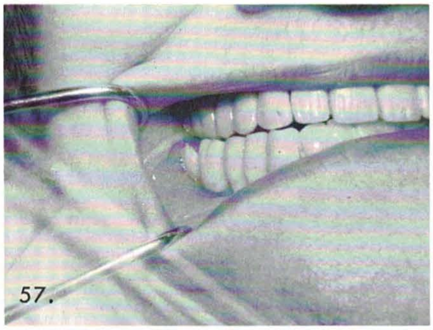
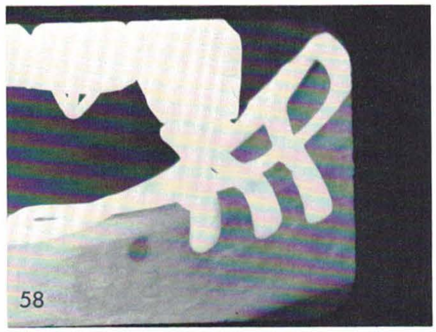
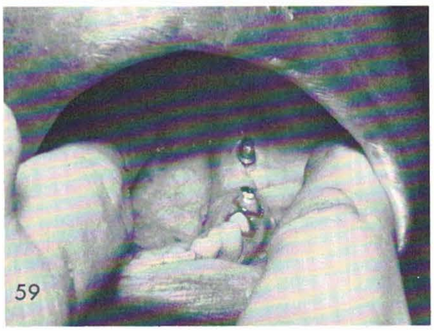
Similarly in a unilateral situation, fig. 45, an impression is taken of the bone for the fabrication of the implant, fig. 46, which should fit accurately, figs. 47, 48, 49. After healing, fig. 50, the unilateral restoration is cemented, fig. 51, and properly occluded, fig. 52. A x-ray, fig. 53.

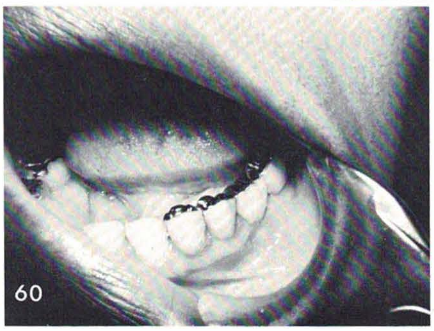


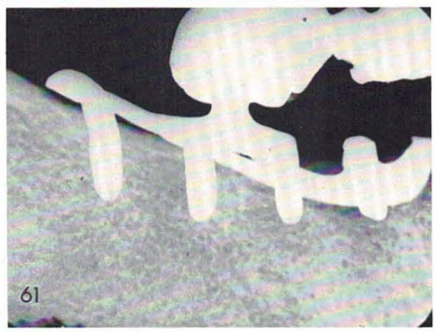






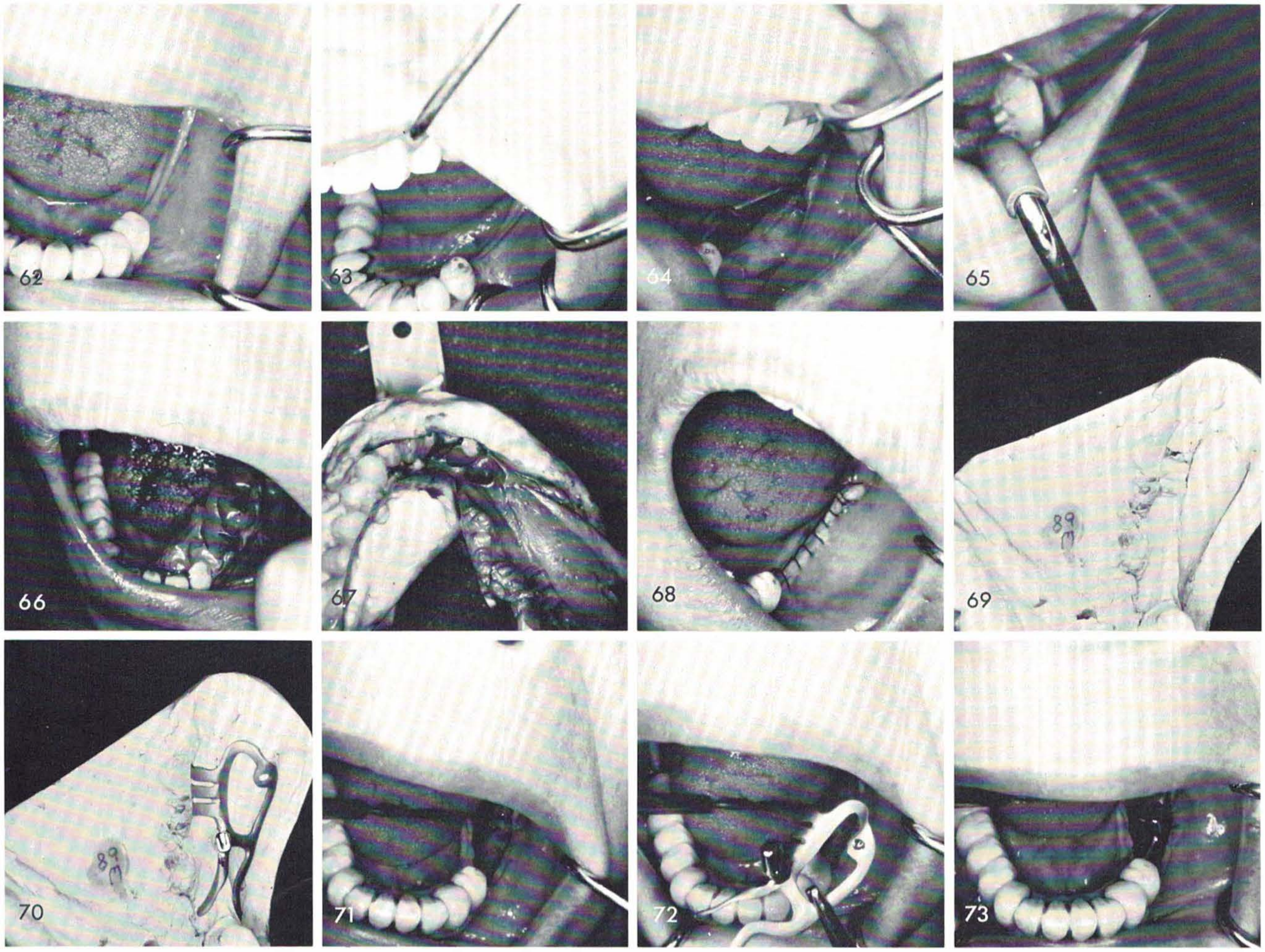




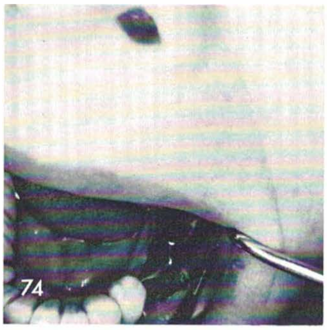


The mylohyoid ridge is the highest area in this severely resorbed mandible, fig. 54, which is so often mistaken for the "crest" of the ridge when looking at it when covered with soft tissues as seen at the bottom of fig. 55. The top shows the bone. The implant, fig. 56, and finished bridge, fig. 57. A post-operative x-ray, fig. 58.

Usually it is better to use two anterior abutment teeth to help support the unilateral sub-periosteal implant, figs. 59, 60, 61.



Very often a unilateral subperiosteal implant can get its anterior support from a cantilevered pontic extending from a previously functioning fixed prosthesis, fig. 62. An incision, reflection and exposure of the bone and the lingual groove procedures can all be done rather rapidly, figs. 63, 64, 65. An elastic impression of the bone and several of the anterior bridge teeth is taken, fig. 66, and pulled off with a full mouth alginate impression so that the implant post can be made parallel to the anterior abutment, fig. 67. The tissues are sutured closed, fig. 68. The master model is poured, fig. 69, and the uniquely designed subperiosteal implant is fabricated to fit it accurately, fig. 70. Three weeks later or the same day the tissues are re-opened, fig. 71, and the implant is fitted accurately to place, figs. 72, 73, 74, and the tissues are sutured together, fig. 75.



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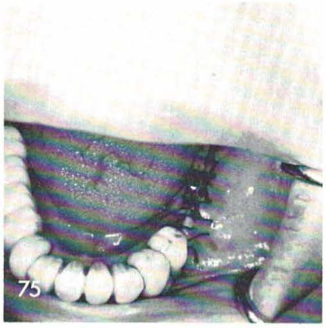

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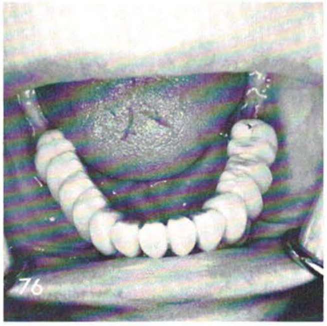

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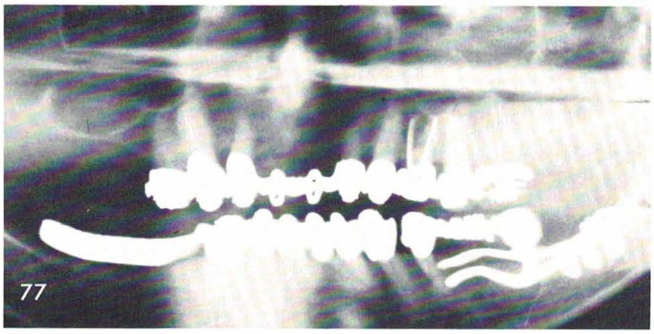

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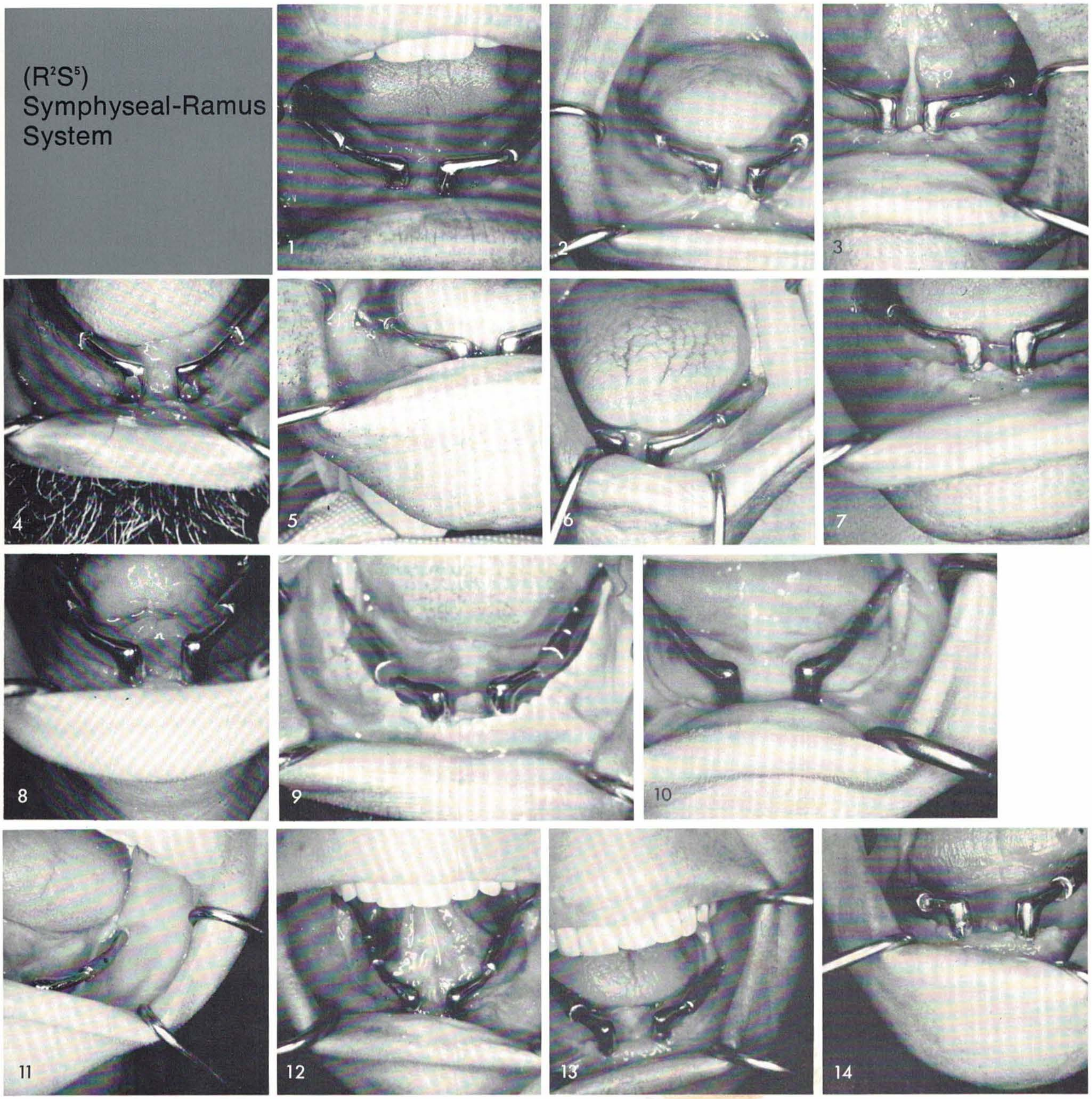
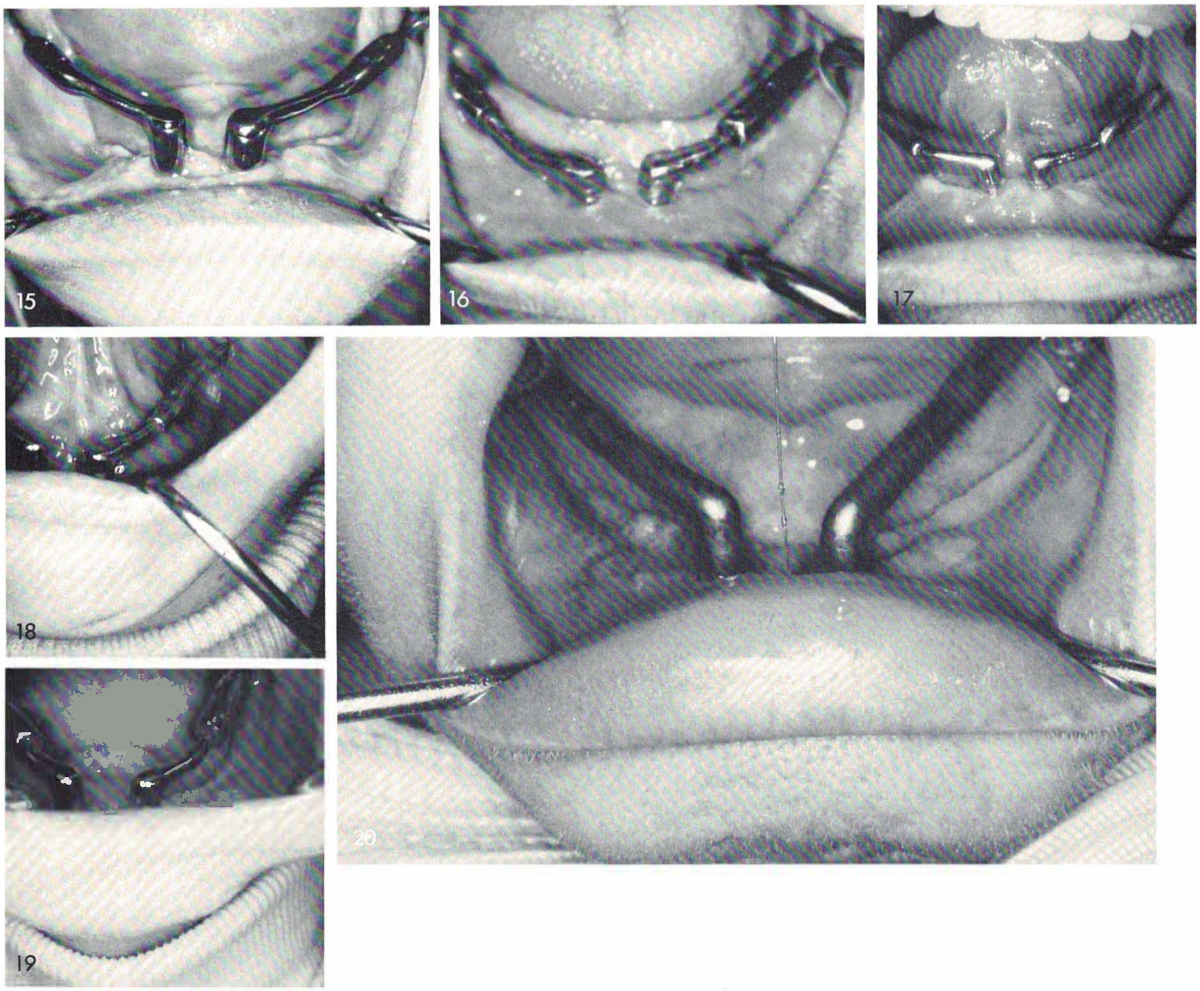
After healing takes place the cantilevered left first bicuspid pontic is prepared for a telescopic crown and the unilateral fixed bridge is completed and cemented into position, fig. 76. A post-operative x-ray, fig. 77.

(R^2S^5) Symphyseal-Ramus System



When the five piece symphyseal-ramus (R^2S^5) system is done correctly, the tissues around the critical areas should look like the ones in figs. 1 through 20.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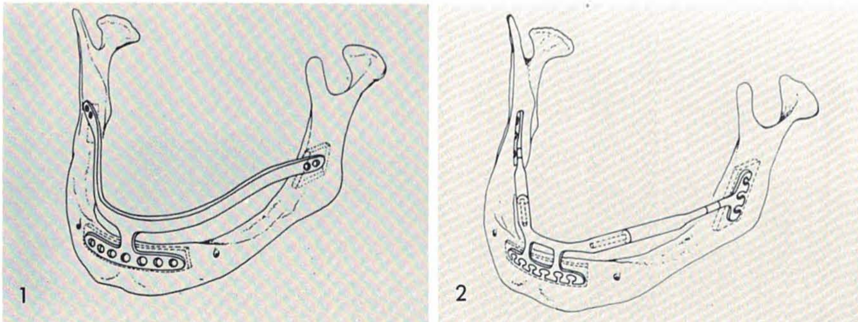
(R^2S^5) Symphyseal-Ramus System Evolution



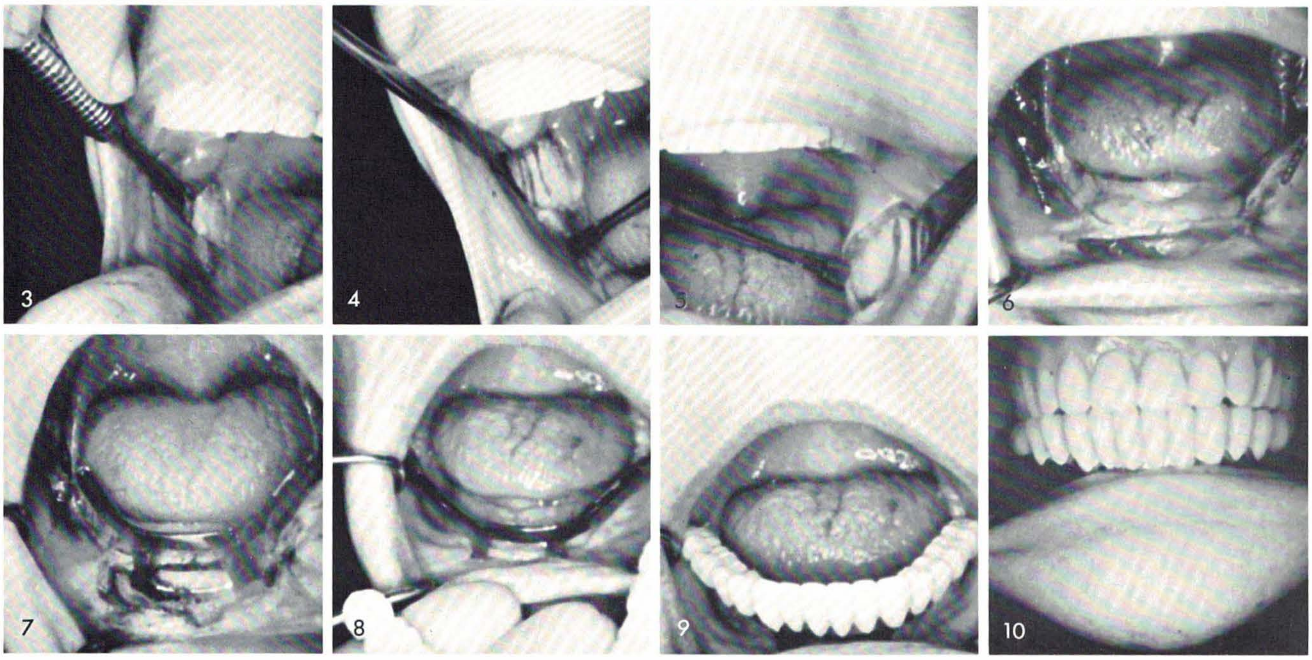
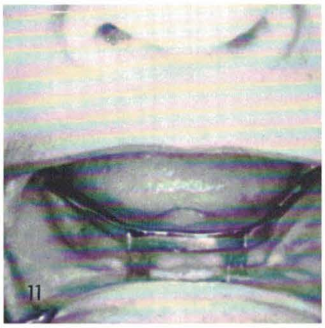


Fig. 1—The Robert's original ramus frame implant.

Fig. 2—The three piece Cloyd ramus implant.

Fig. 3—The tissues are reflected high up in the ramus and the groove is made on the buccal side, figs. 4, 5, of each ramus. The posterior ramus blades with their extensions are tapped into the grooves, fig. 6, but usually had to be removed while fitting in the bulky anterior portion, fig. 7. Great difficulty occurred when trying to passively fit the posterior extension into the anterior hollow tubes since the tubes could not be bent independently of the attached anterior blade. However, healing in many of these cases was good, fig. 8, but often cross-bites occurred because of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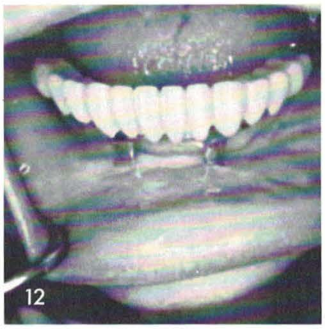
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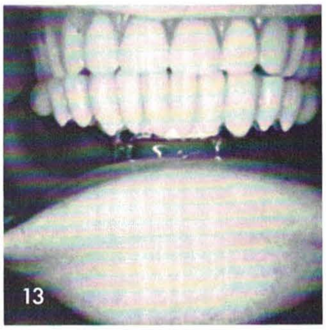
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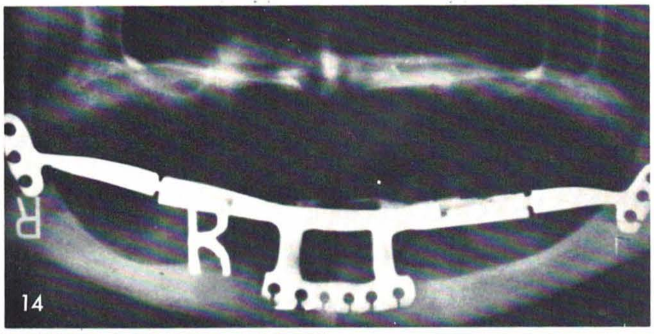
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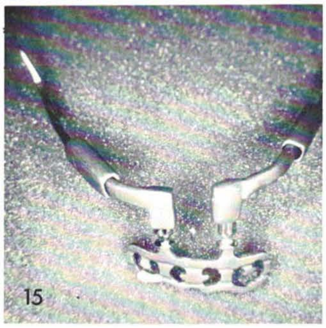
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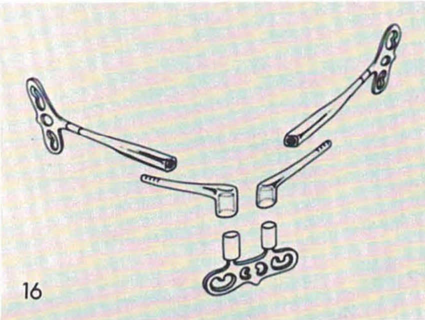
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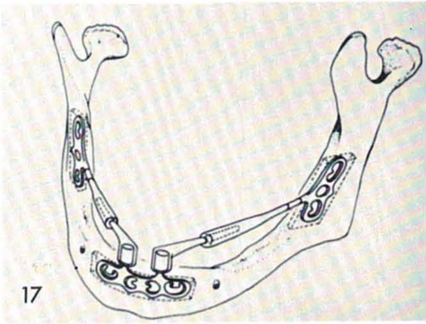
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poor implant design in the posterior areas, figs. 9, 10. Fig. 11 shows excellent healing. The all acrylic splint is cemented over the implant with Duralay acrylic cement, figs. 12, 13. A great deal of space was originally left beneath the prosthesis and soft tissues so the appliance would act as a sanitary bridge. The post-operative x-ray, fig. 14.

An early five piece symphyseal-rami-system developed by the author, fig. 15. A later version of the system, figs. 16, 17.

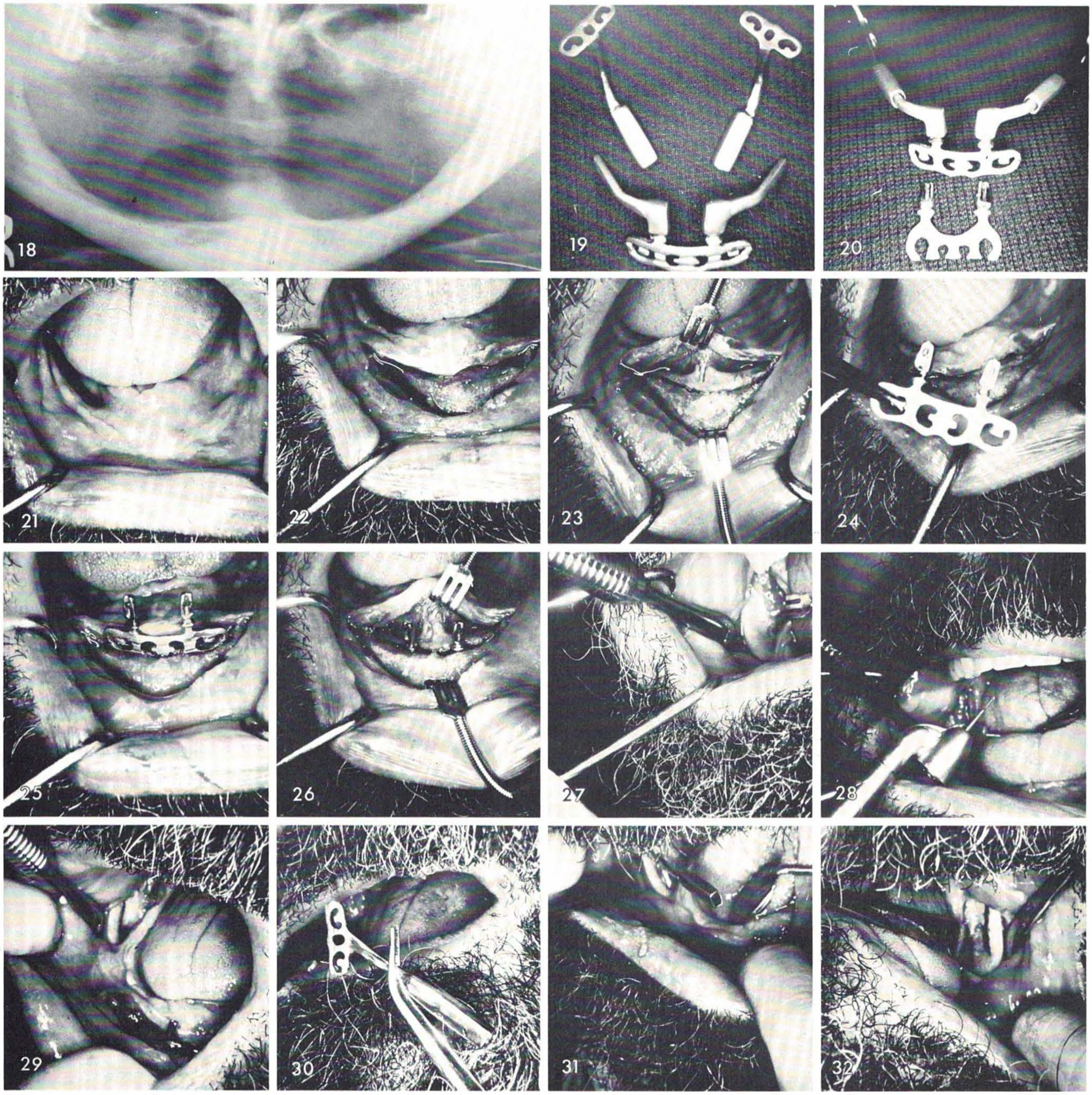
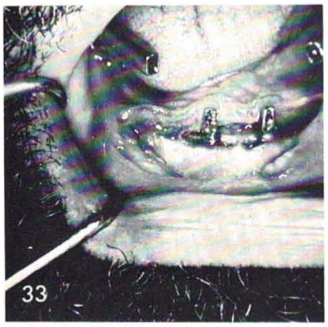
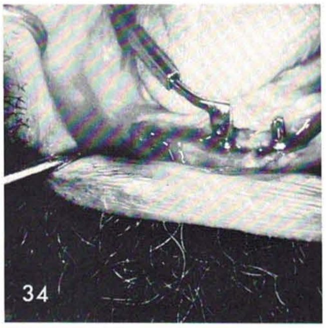
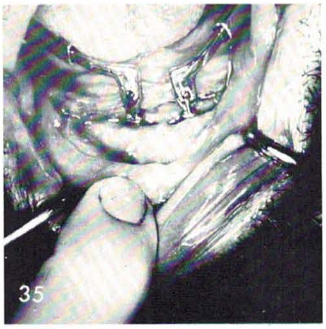
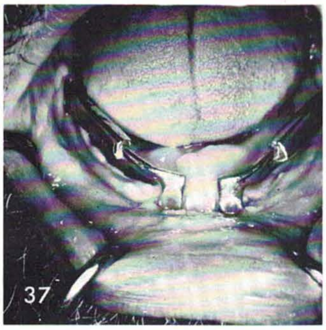


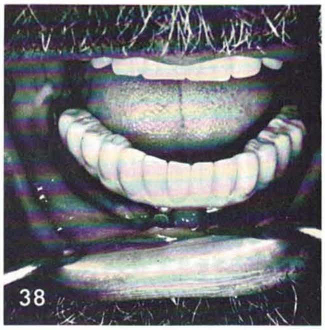
Fig. 18 shows pre-operative x-ray. The five piece system that was used, figs. 19, 20. The clinical view, fig. 21. The anterior tissues were incised and reflected, fig. 22, the groove was made, fig. 23, and the symphyseal blade was placed over the groove and tapped to place, figs. 24, 25, 26. Posteriorly the tissues covering the right ramus were incised, exposing the bone, fig. 27, and with a bayonette type hand piece, fig. 28, the ramus groove was made, fig. 29. The ramus blade was inserted, figs. 30, 31, and then the left ramus groove was made, fig. 32. Fig. 33 shows both hollow tube extensions extending from both ramus blades. The extension arm from the anterior coping was inserted into the posterior hollow tube and the coping tapped downward to fit over

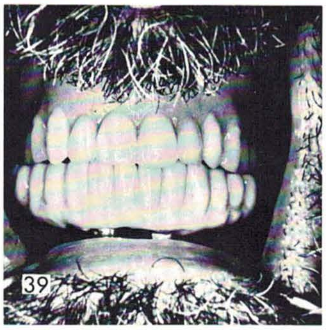


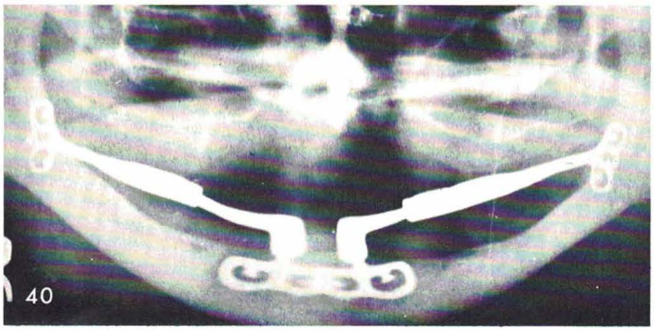




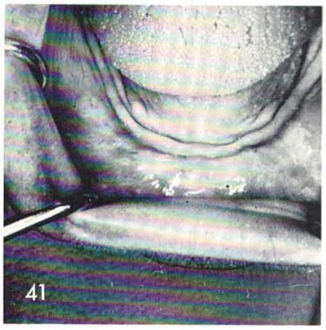








the right symphyseal blade post, fig. 34. It was repeated on the other side, fig. 35. With a syringe soft acrylic (Duralay) was syringed into the hollow tubes and anterior copings, fig. 36, and the system was joined together, fig. 37. Anteriorly, as shown here, horizontal transfixation pins were used to further lock the anterior copings. The acrylic splint, figs. 38, 39, and final x-ray, fig. 40.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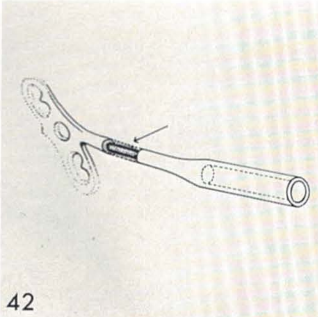
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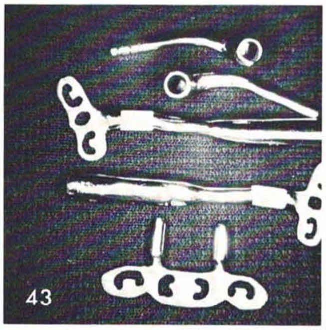
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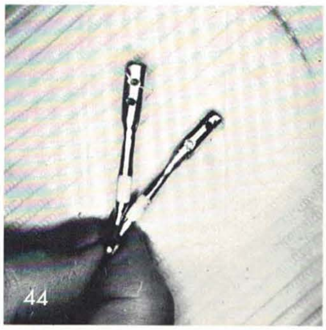
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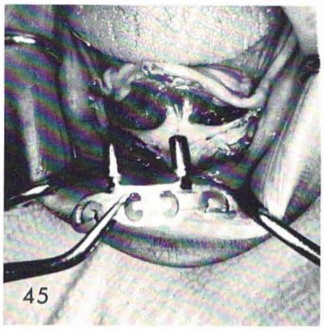
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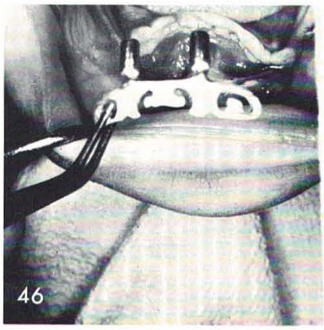
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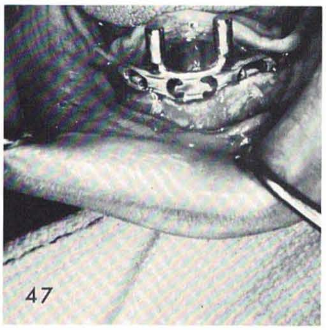
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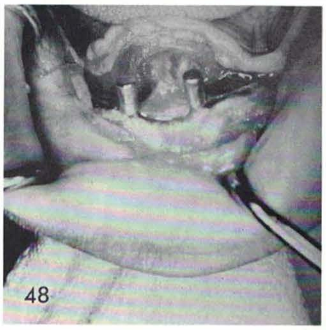
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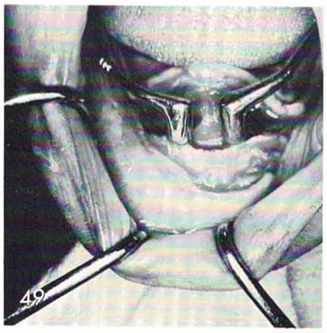
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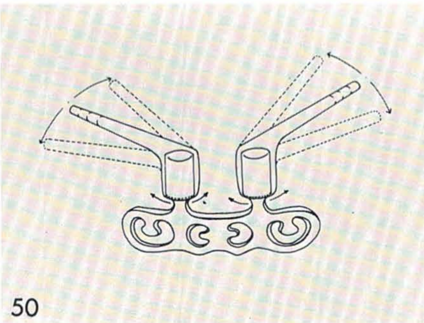
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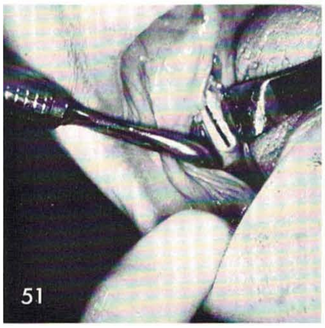
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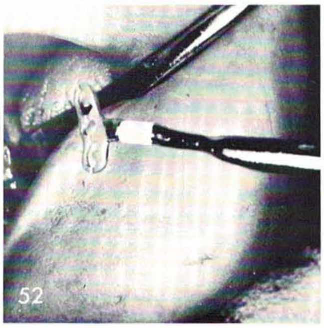
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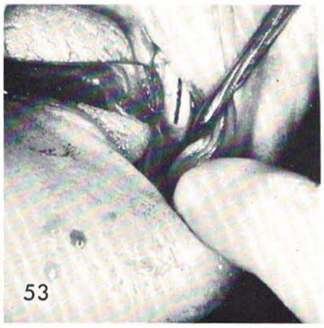
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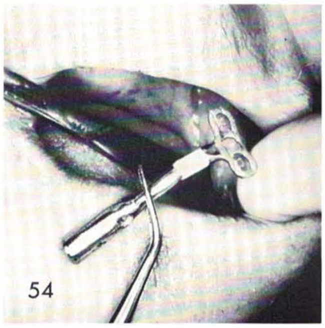
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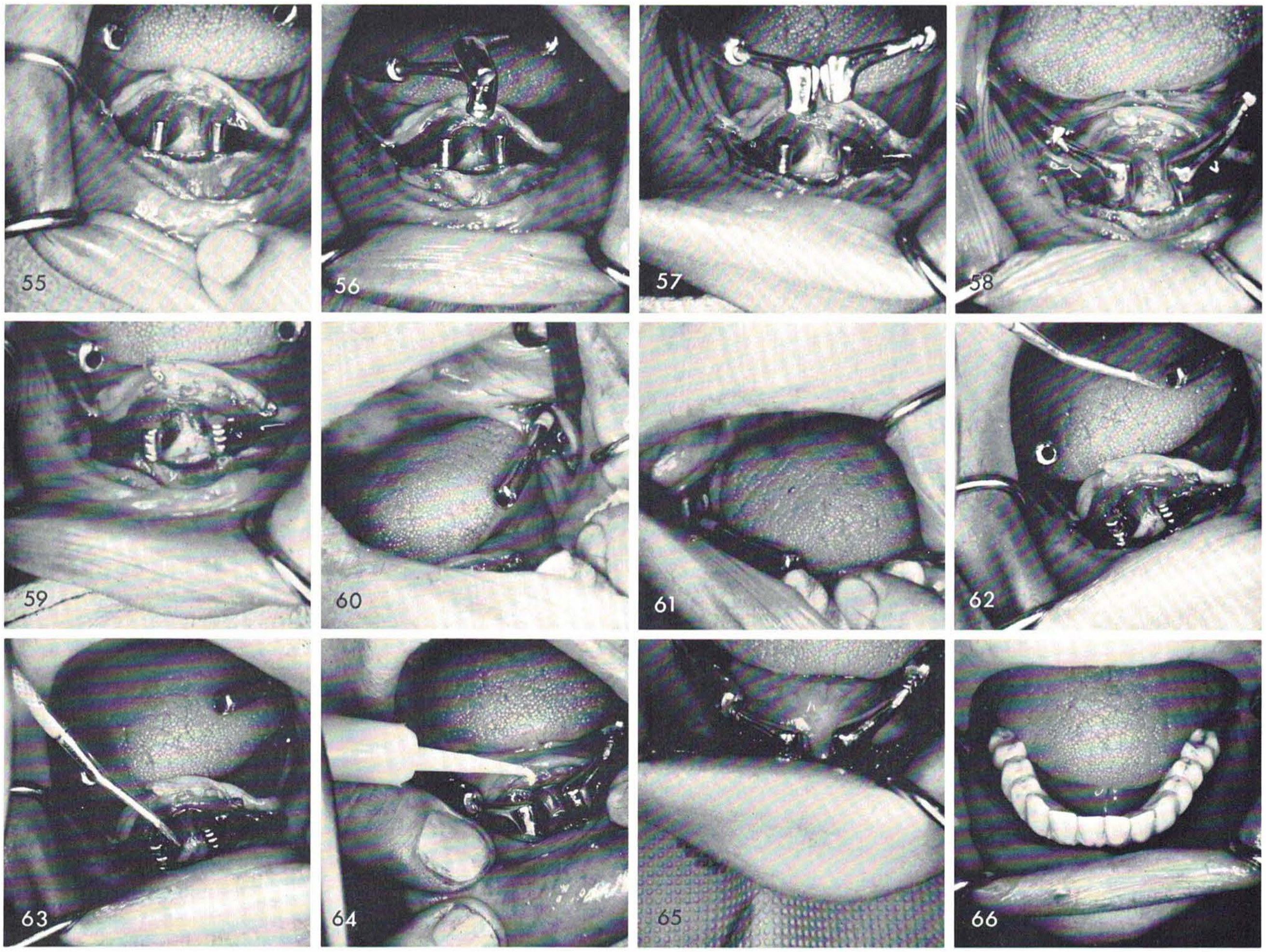
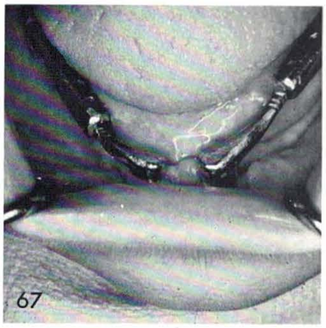
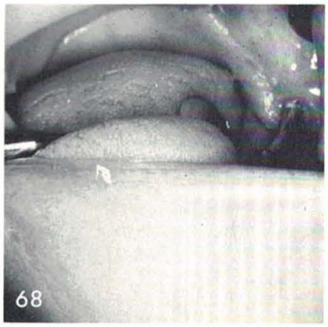
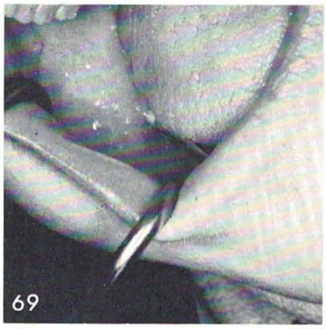
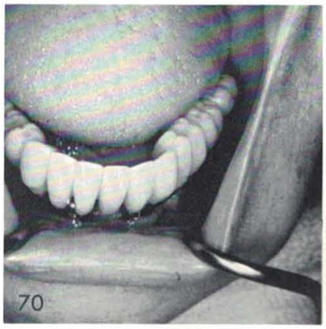
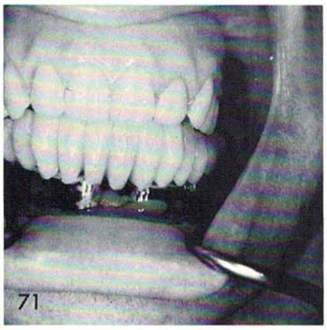
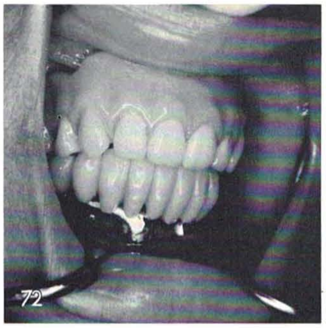
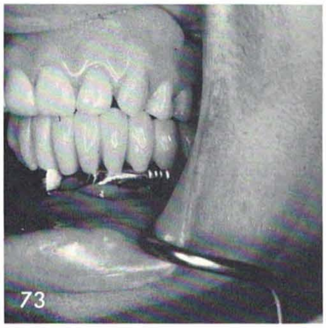
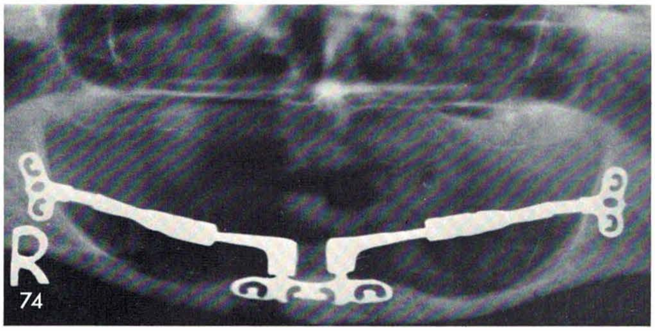
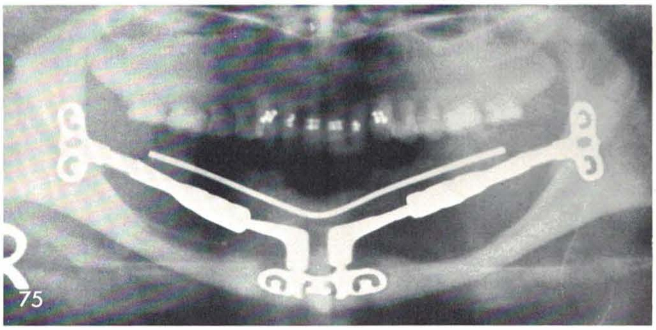
Another case, fig. 41. The arrow points to an aluminous porcelain that we developed for the soft tissues in the rami areas, fig. 42. The implant system showing the porcelain necks and perfectly round posts which eliminated any torquing action of the rami previously caused by the early one, three and five piece system, fig. 43. On top of the hollow tubes were several holes for escapage of the Duralay preventing air bubbles, fig. 44. The blade is placed into the groove, figs. 45, 46, 47, 48, and the copings with their extension arms are placed over the round posts to check the ability of "swinging" the arms in all directions, figs. 49, 50. The ramus groove and insertion of the right ramus blade, figs. 51, 52. The left groove and blade insertion, figs. 53, 54.



Both hollow tubes are seen, fig. 55. The anterior extensions are fitted into the tubes, figs. 56, 57, and the entire system is tapped downward until the anterior copings fit passively over the symphyseal blade posts, fig. 58. The anterior copings with their posterior extensions are released from the posterior hollow tubes by tapping the copings, extensions and hollow tubes in an upward direction, the blade posts notched and the hollow tubes are dried thoroughly, fig. 59. Figs. 60, 61 show the blades deeply into the rami and shows the exact area where the aluminous porcelain necks are located. The tubes and posts are moisturized with methyl methacrylate monomer, figs. 62, 63, and the polymer material is syringed into the hollow tubes and anterior copings to join the system together, fig. 64. Tissues are sutured anteriorly and in both posterior sections, fig. 65, and a temporary acrylic splint is cold cured, fig. 66. Healing is seen the day the sutures

were removed, figs. 67, 68, 69, and the final acrylic prosthesis was processed, figs. 70, 71, 72, 73. The post-operative x-ray without and then with the fixed all acrylic prosthesis, figs. 74, 75.

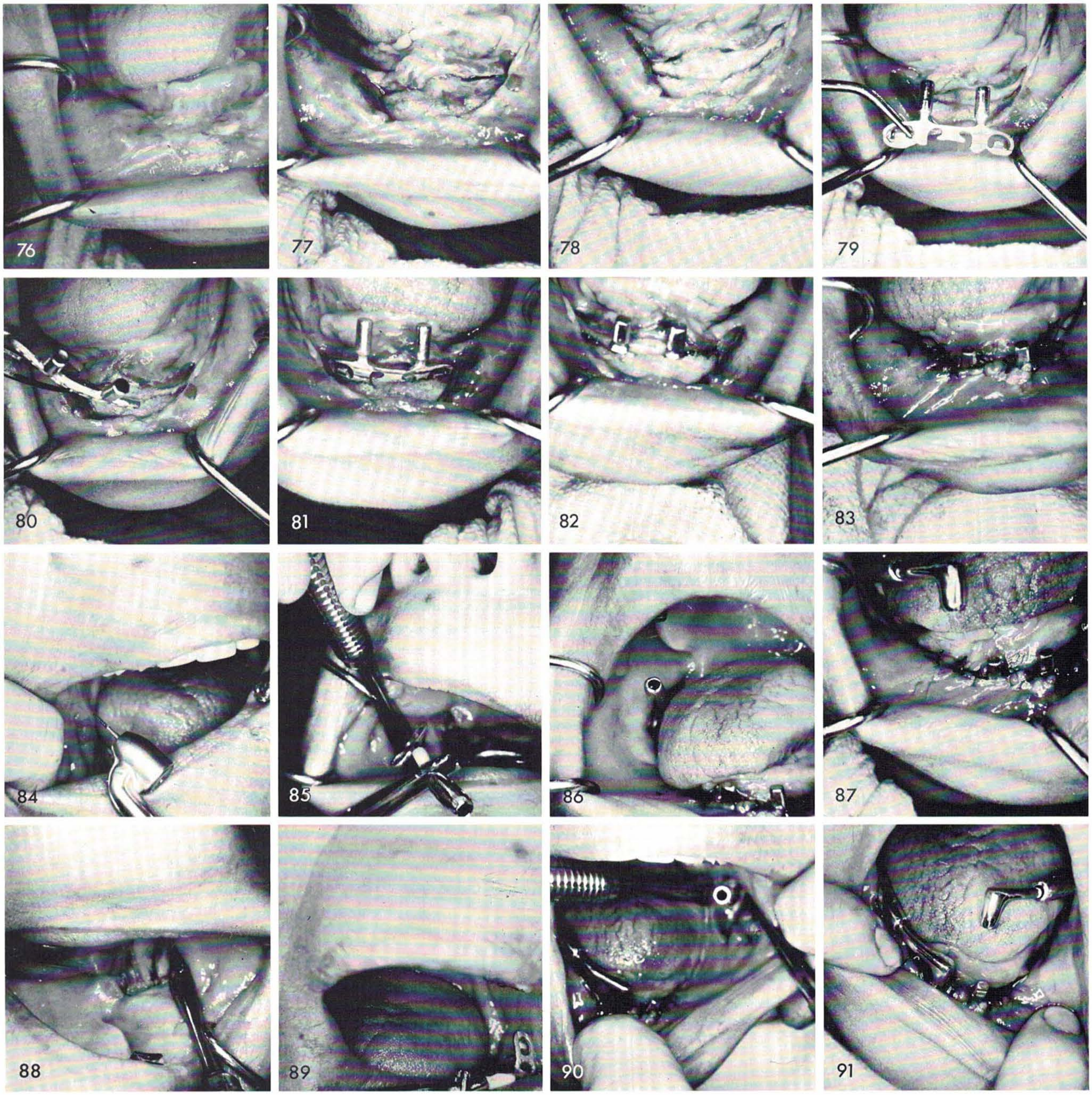
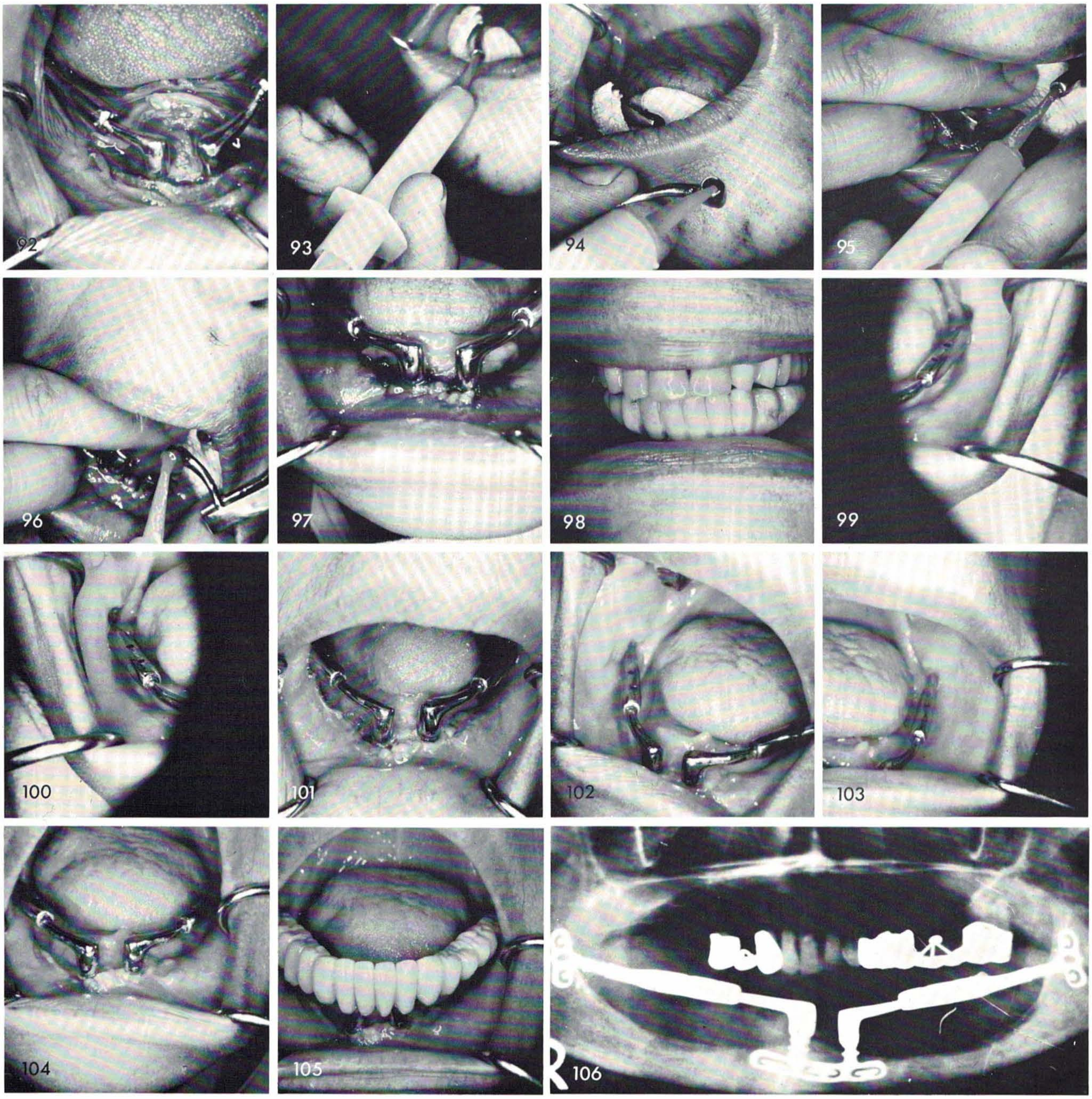
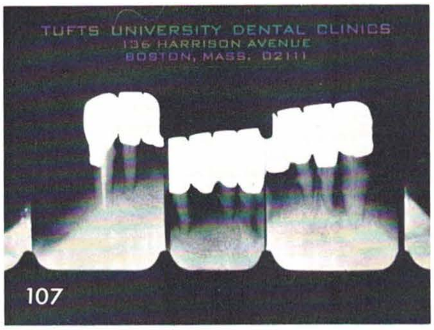


Fig. 76 shows an extremely resorbed mandible with scarred tissues caused by a subperiosteal implant that failed. The bone is exposed, fig. 77, and groove made, fig. 78. The blade is fitted and tapped into position, figs. 79, 80, 81, 82, and the tissues are sutured closed, fig. 83. The grooves are made in both rami and the various parts of the system are inserted and locked together, figs. 84, 85, 86, 87, 88, 89, 90, 91, 92. The parts are then separated so that the acrylic locking medium



can be introduced, figs. 93, 94, 95, 96, 97. A temporary acrylic splint is cold cured and the bite is adjusted, fig. 98. The healed sites posteriorly, figs. 99, 100, and anteriorly the day that the sutures were removed, fig. 101. Two weeks later, figs. 102, 103, 104, and the acrylic splint, fig. 105. The x-ray shows this case two & one half years post-operatively functioning against maxillary natural teeth, fig. 106.



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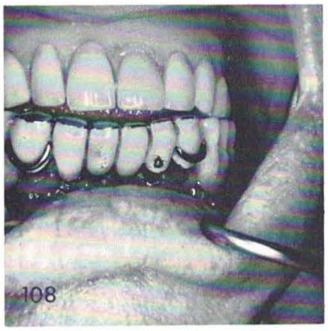
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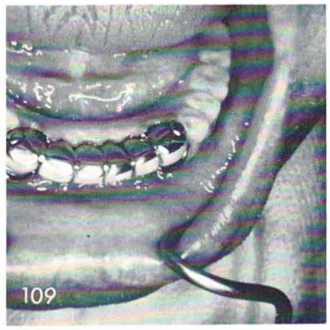
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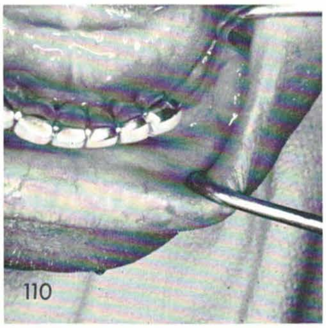
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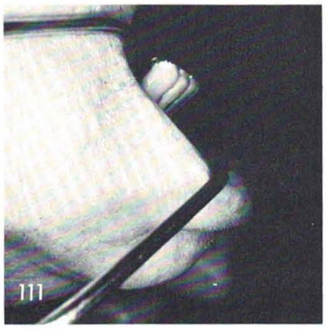
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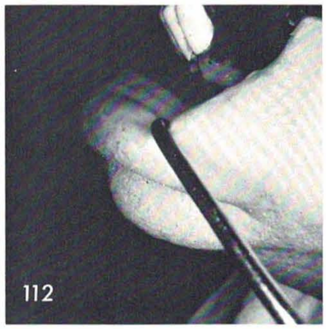
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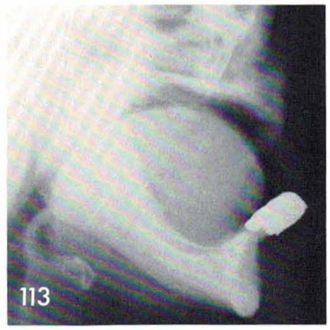
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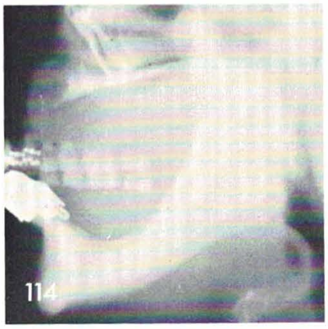
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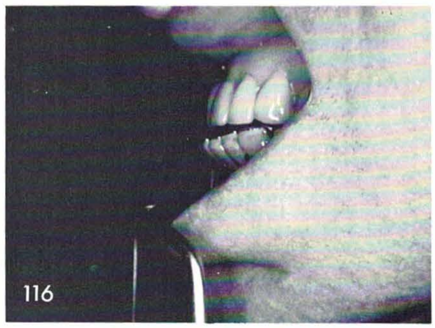
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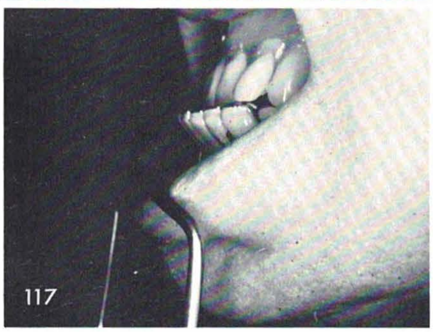
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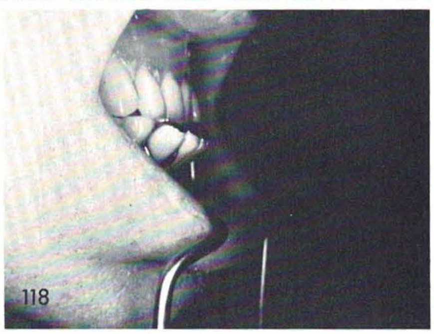
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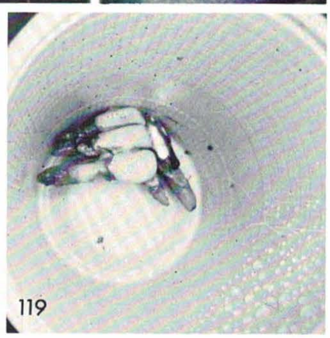
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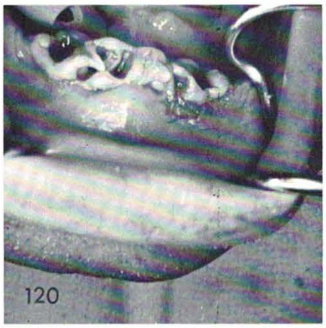
The preoperative periapical films show practically no bone above the inferior alveolar canals and condemned anterior teeth, fig. 107. Clinically, an open bite with a bilateral protrusion was seen, fig. 108. The anterior teeth flared out greatly in a labial direction, figs. 109, 110, 111, 112, 113. Fig. 114 demonstrates how far out labially the anterior teeth of his denture were brought forth to meet with the lower teeth. This distorted his entire face to such an extent that it closed his nostrils according to the patient. Profile views showing the over-extended denture, figs. 115, 116. A new denture was immediately fashioned so that the anterior teeth went behind the lower teeth by one half an inch, figs. 117, 118. The teeth were removed, figs. 119, 120,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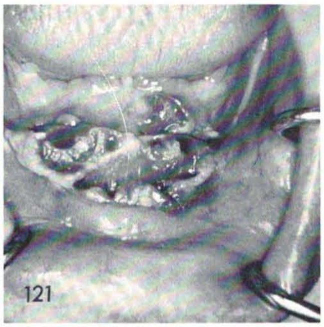
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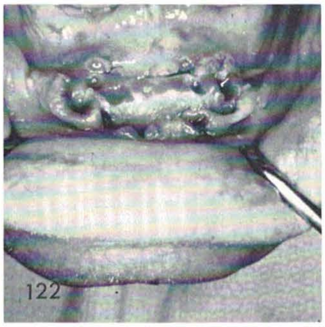
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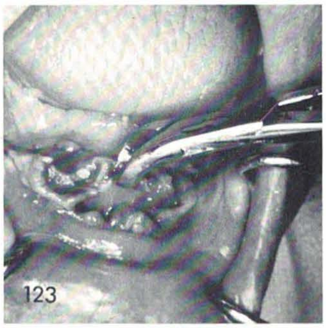
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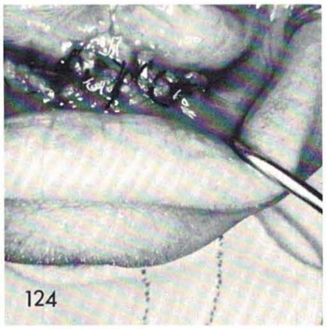
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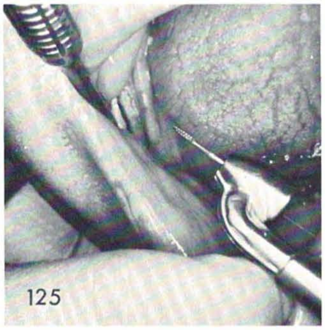
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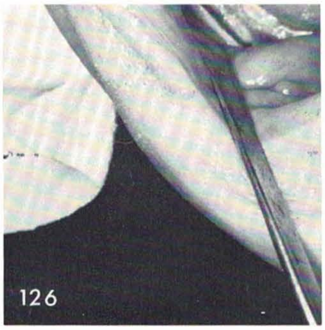
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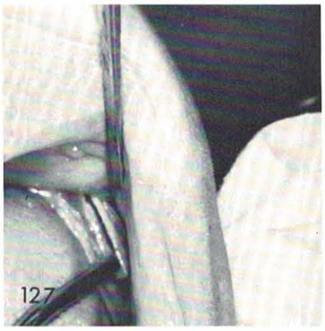
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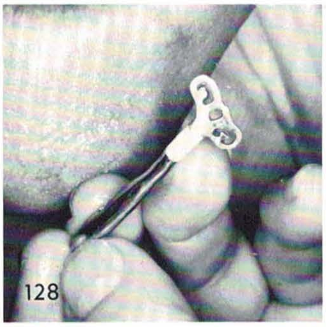
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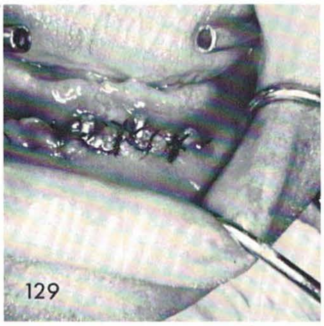
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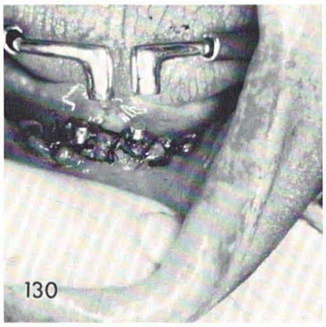
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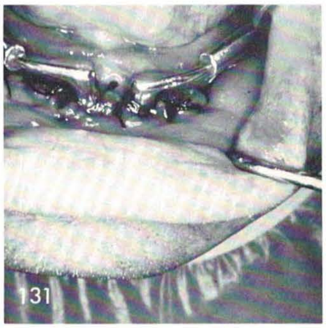
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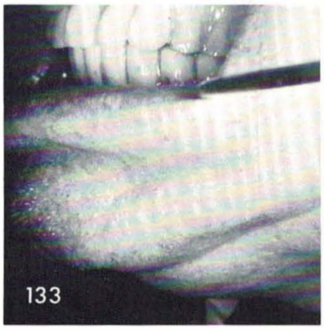
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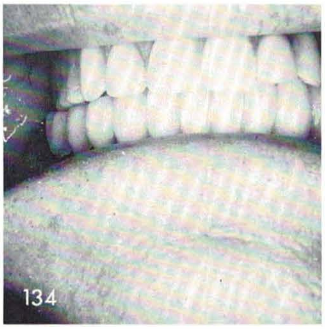
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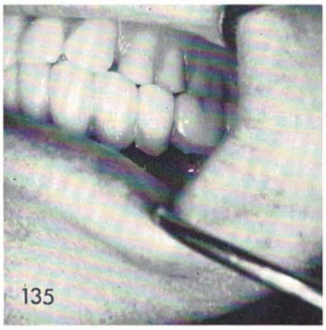
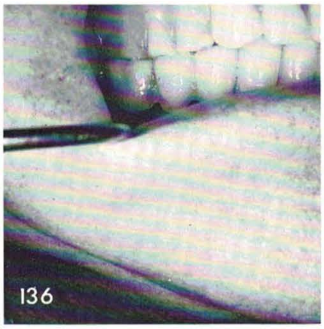

135

the bone exposed, and ridge widened to accept the symphyseal bladevents, figs. 121, 122, 123, 124. The groove was made in the right ramus, figs. 125, 126, and the left ramus, fig. 127. The blades were inserted, figs. 128, 129, and the anterior copings with their extensions were fitted, cemented and locked into place, figs. 130, 131, and the tissues were sutured closed. The healed site and temporary lower splint, figs. 132, 133. Figs. 134, 135, 136 show the preliminary wax-up.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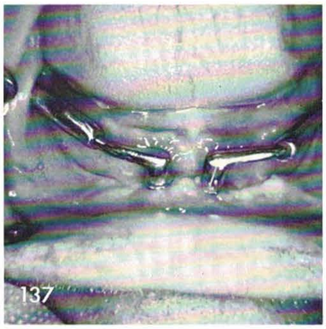
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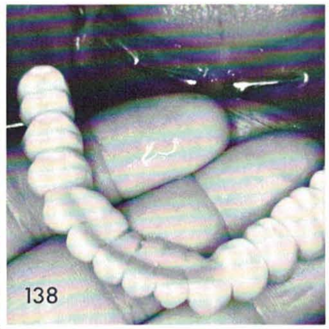
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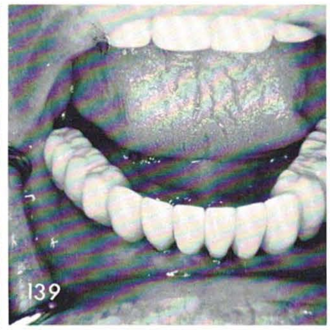
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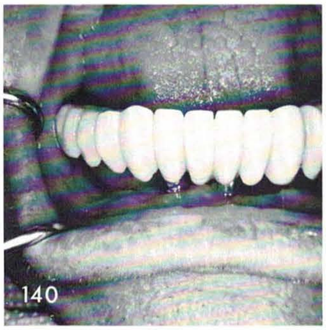
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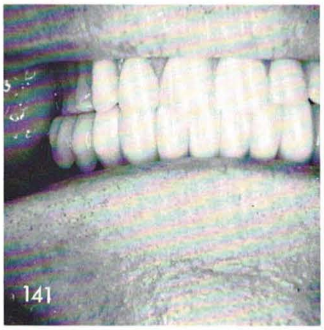
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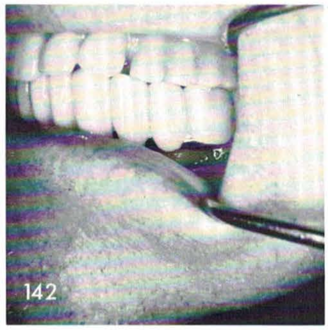
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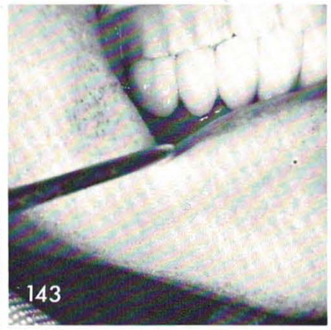
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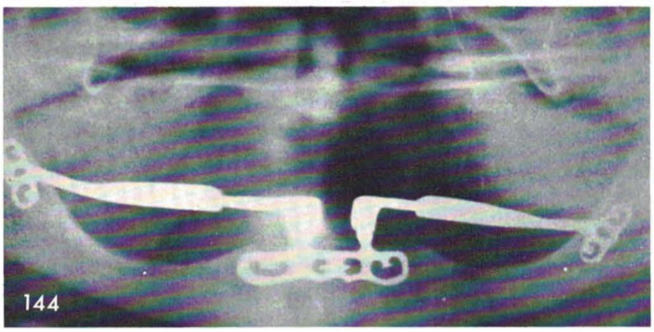
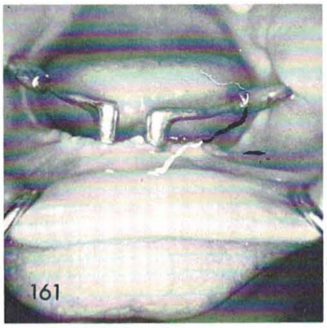

144

The clinical view three weeks post-operatively, fig. 137, and the processed acrylic restoration is cemented into correct position, figs. 138, 139, 140, 141, 142, 143. The post-operative x-ray, fig. 144.

Another case showing the extremely flat ridge, fig. 145. The underlying knife-edge ridge, fig. 146, was widened so a groove could be made, fig. 147, to accommodate the bladevent, figs. 148, 149. The tissues are sutured, fig. 150. Grooves are made in each ramus, figs. 151, 152, and independently of one another each side was completed, figs. 153, 154, 155, 156, 157, 158, 159. The healing was uneventful, figs. 160, 161, and a lower non-tissue bearing denture was fabricated to "snap-on", fig. 162. The post-operative x-ray, fig. 163.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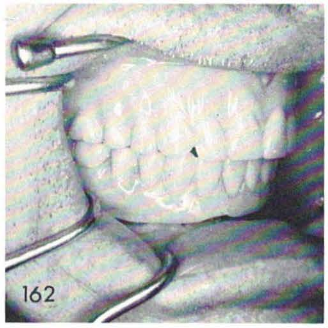
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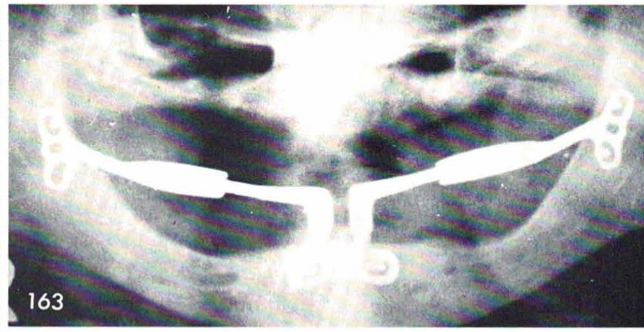
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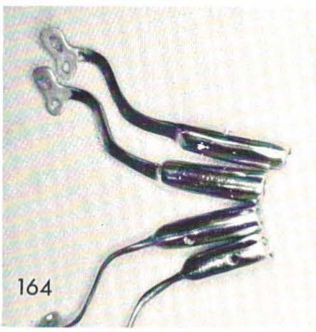
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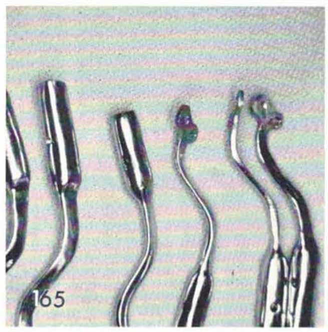
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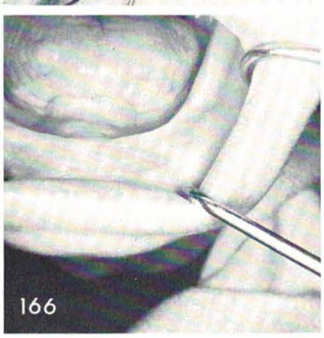
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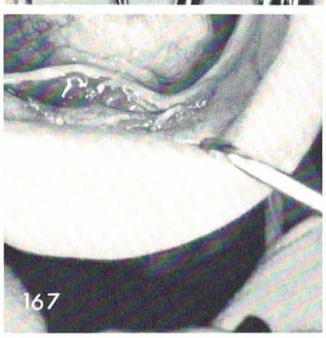
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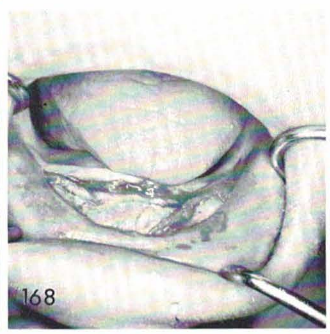
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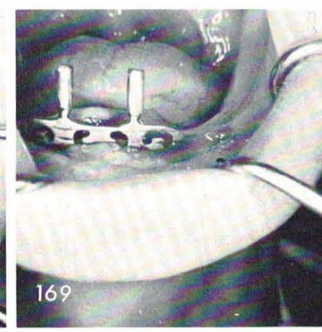
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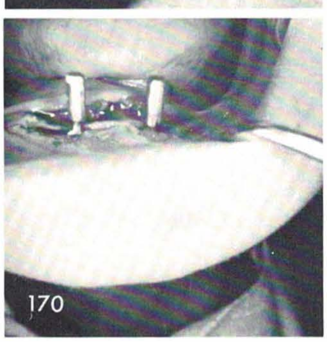
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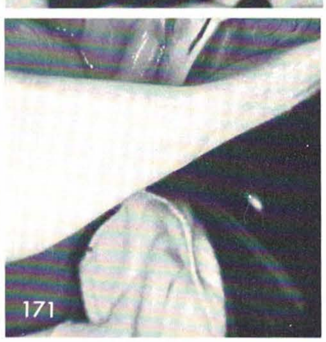
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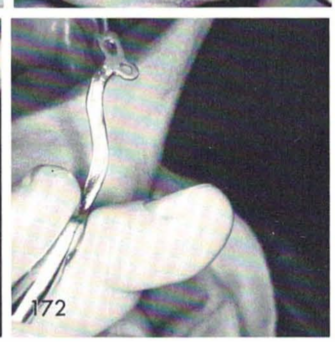
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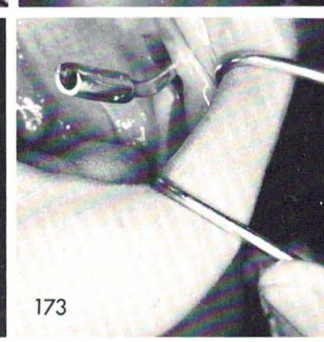
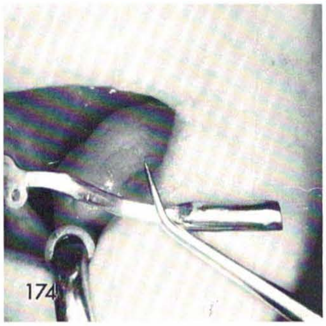

173

Some early improvements of the ramus implants had superior-inferior curves to eliminate prematurities with the opposing dentition and bucco-lingual curves to eliminate cross-bites, figs. 164, 165.

This next case, fig. 166, clearly demonstrates the technique which includes incising and reflecting the anterior tissue, fig. 167, making of the anterior groove, fig. 168, and fitting in the symphyseal bladevent, figs. 169, 170. The left ramus groove was made, fig. 171, and the ramus implant fitted and inserted, figs. 172, 173. The procedure was repeated on the right side, figs. 174, 175. The anterior parts were inserted and tapped downward to seat over the anterior blade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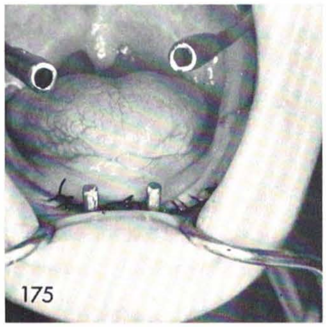
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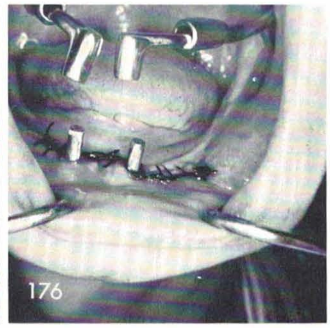
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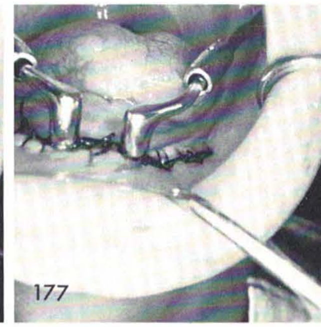
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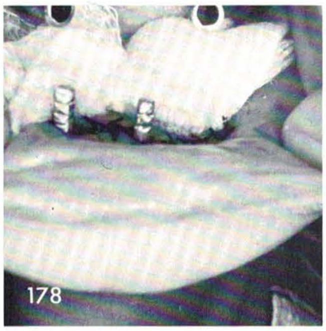
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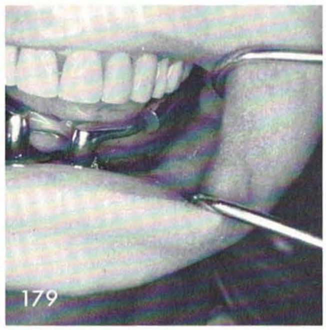
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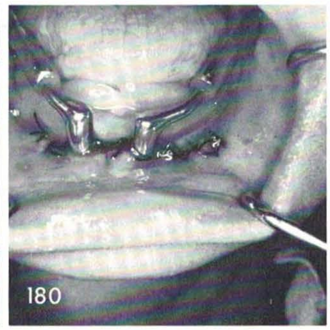
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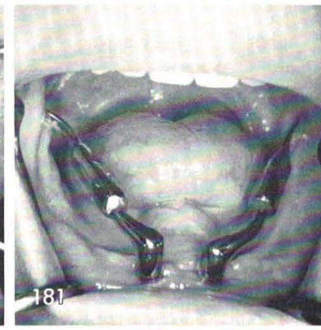
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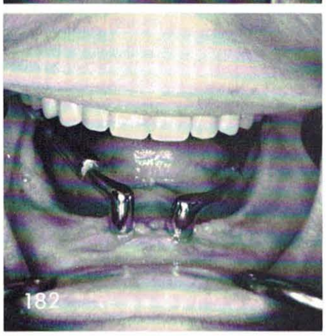
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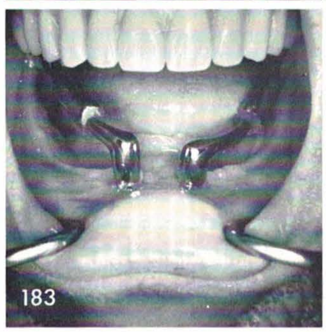
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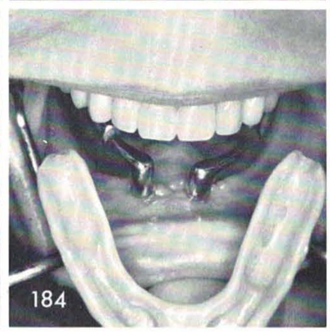
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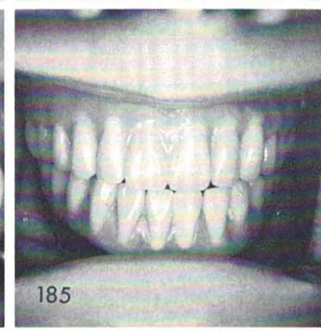
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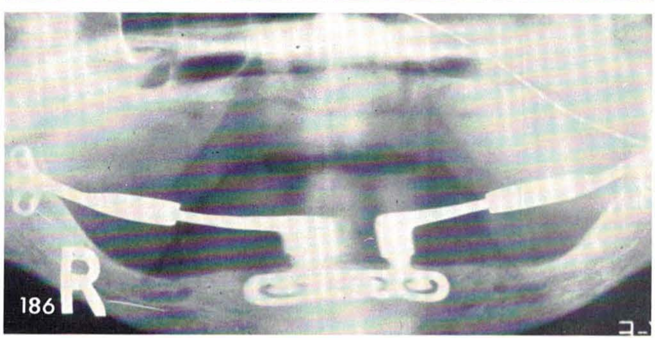
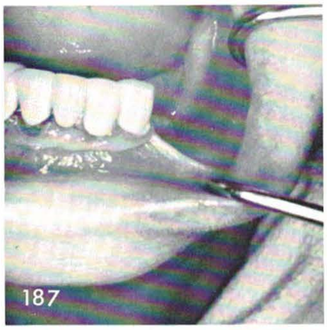
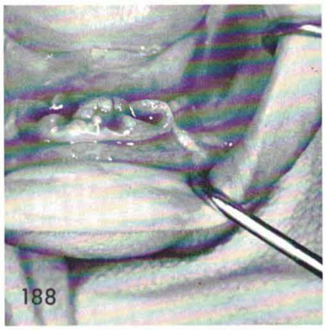
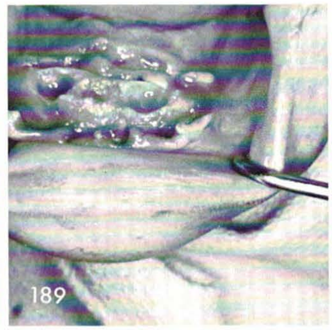

186

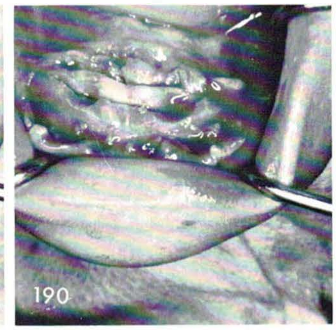
posts, figs. 176, 177, then removed so the various parts could be dried thoroughly, fig. 178, and cemented into position, figs. 179, 180. Figs. 181, 182, 183 reveals the healing.

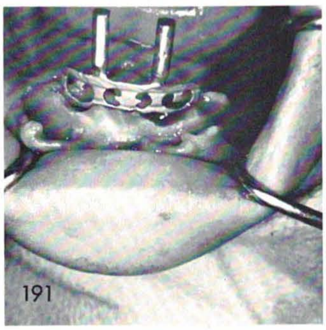
The denture is adjusted and cemented with Duralay, figs. 184, 185. Fig. 186 shows the post-operative x-ray.

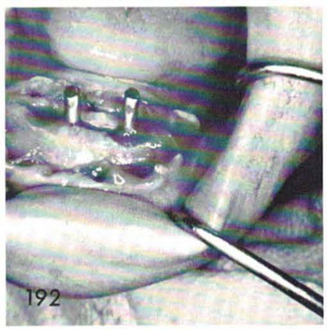


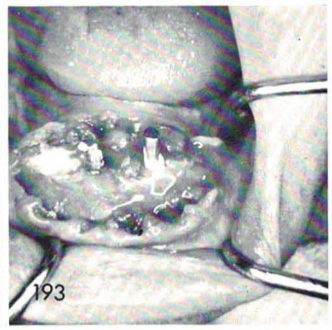


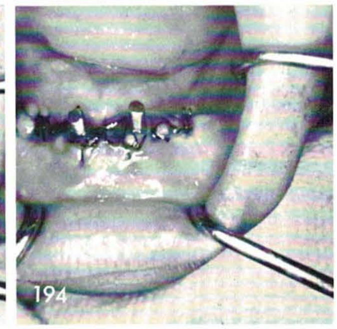


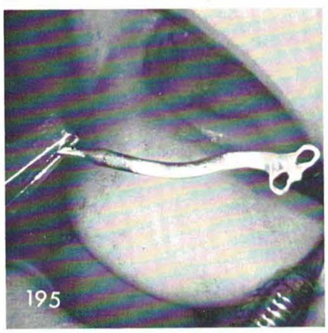


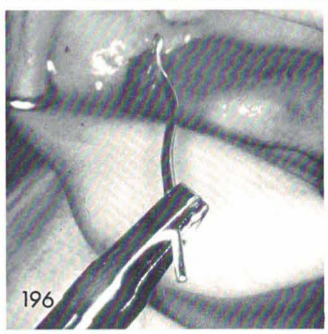


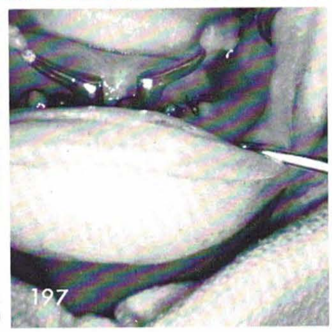




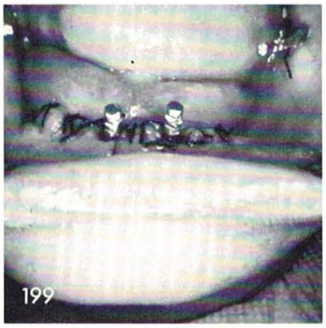








The next case shows periodontally involved anterior teeth that were removed, figs. 187, 188, the sockets cleansed of all debris, fig. 189, the groove made, fig. 190, and the blade inserted, figs. 191, 192. Sterile plaster of Paris was gently moulded into the open socket areas, fig. 193, and the tissues were sutured closed, fig. 194. Because of the difficulty in casting the long hollow tubes, I developed a five piece system using solid arms posteriorly and a shorter hollow tube anteriorly, extending from each anterior coping, figs. 195, 196. Due to a miscast of the anterior hollow extension tubes at the last moment I afixed the posterior solid arms to the original anterior solid arms with Duralay for 24 hours, figs. 197, 198, until the hollow anterior extensions were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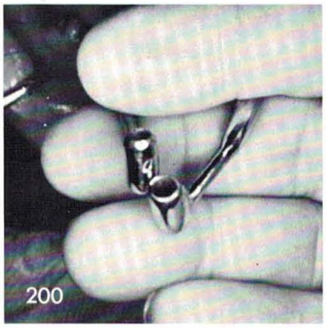
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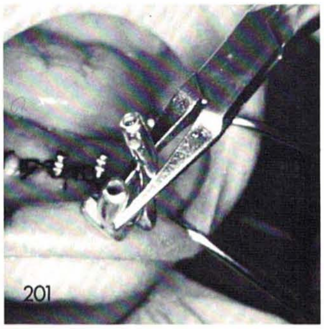
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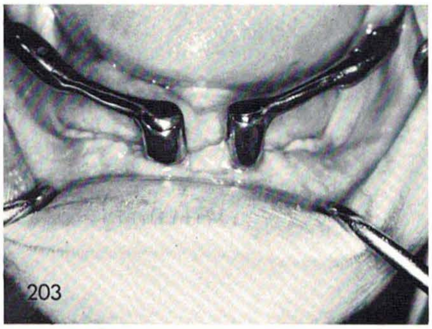
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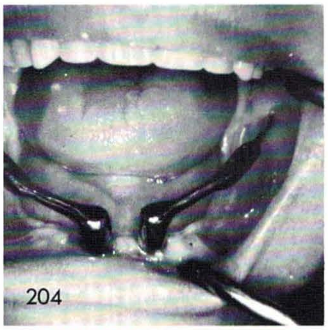
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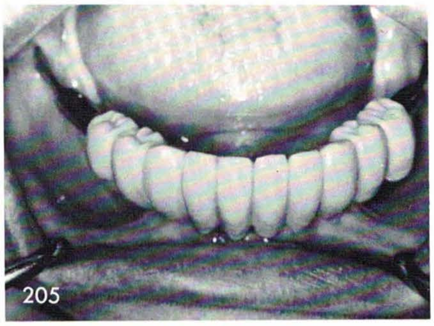
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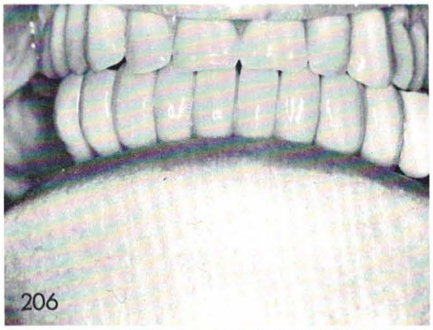
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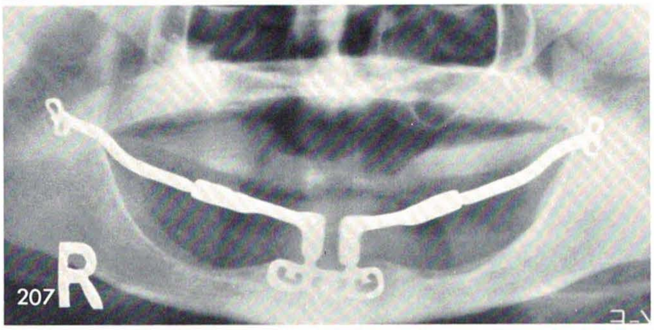
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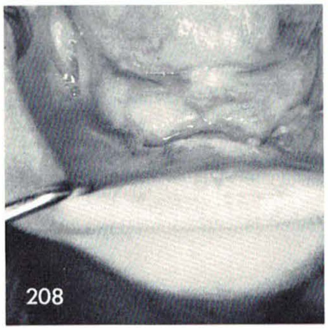
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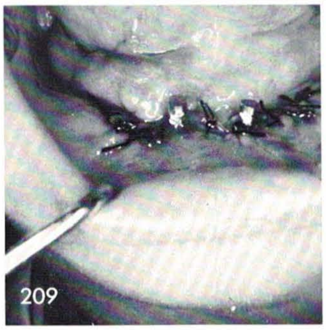
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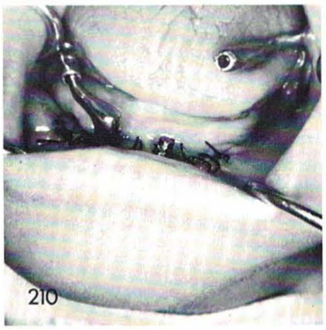
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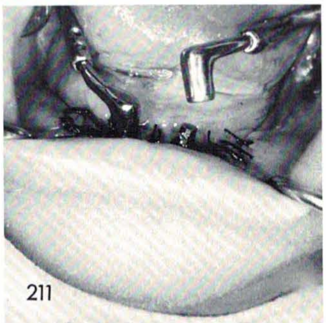
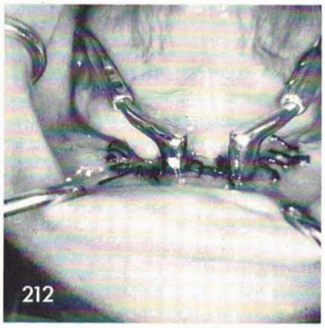

211

recast. Fig. 199 shows the tissues 24 hours later and the posterior horizontal extensions after the anterior portion was cut loose. The newly cast anterior copings with posterior horizontal tubes, figs. 200, 201, 202. The healed case, figs. 203, 204, and the teeth, figs. 205, 206, and post-operative x-ray, fig. 207.

Another case where a subperiosteal failed because of posterior tissue problems on both sides, fig. 208. The ramus blade is inserted and the tissues are sutured, fig. 209. The procedure continued to join anterior and posterior portions together, figs. 210, 211, 212. The healing was excellent, fig. 213, and the case completed, figs. 214, 215, 216, and the final x-ray, fig. 217.



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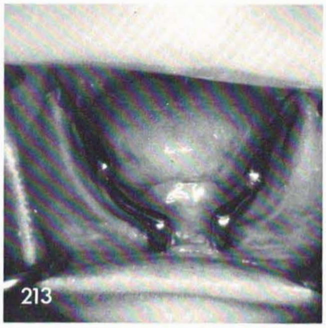

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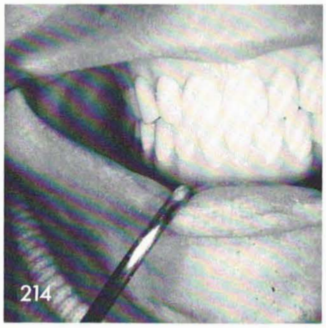

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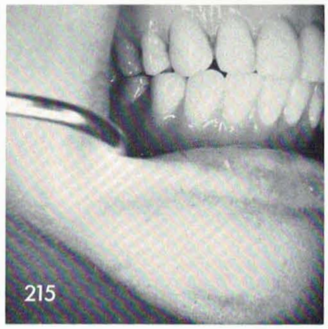

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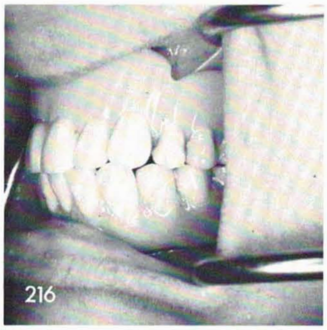

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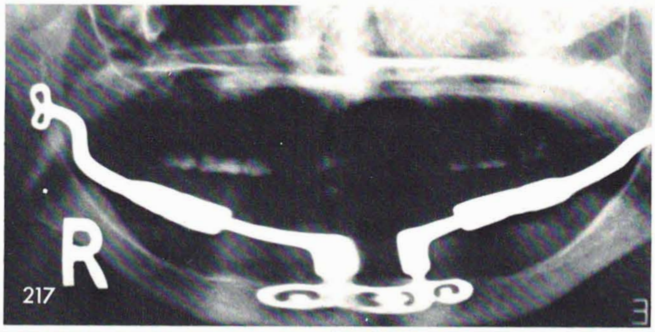

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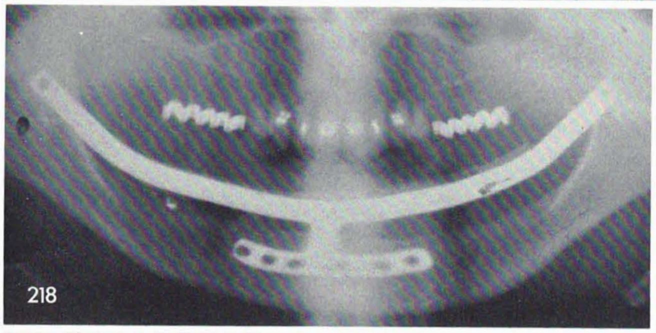

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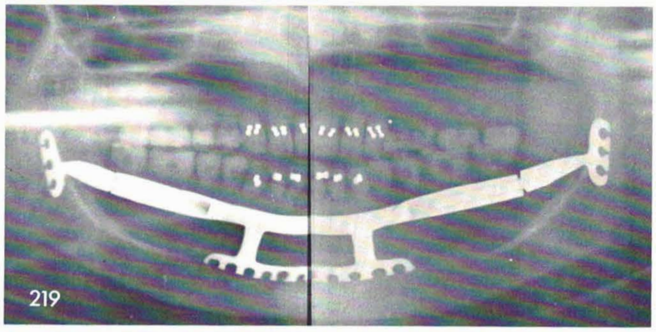

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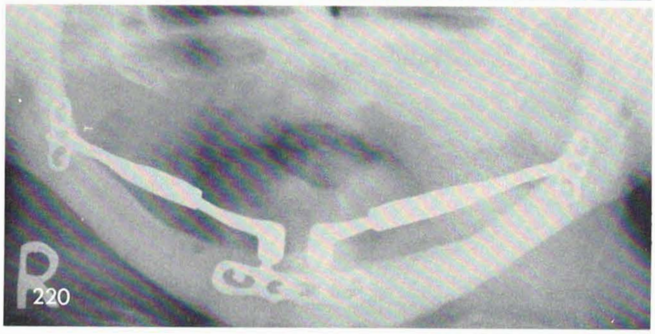

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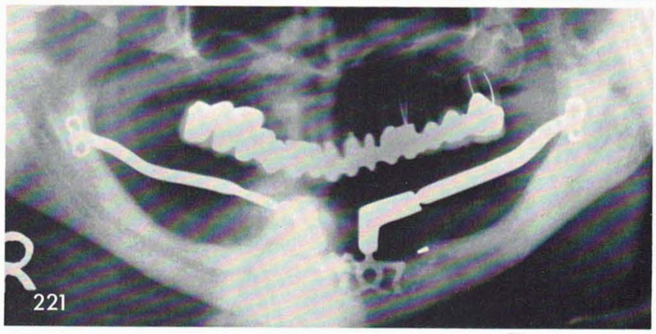
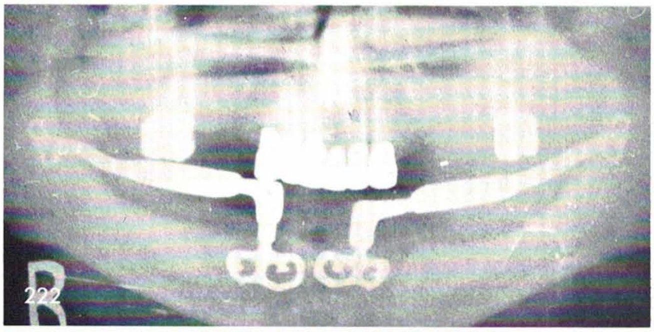


221

Fig. 218 shows the x-ray of original single frame ramus implant. Fig. 219 shows the x-ray of three piece ramus type implant. Figs. 220 through 230 shows the five piece system, R^2S^5. Fig. 231 shows x-ray of how the sliding cable saved the remaining portion of a subperiosteal. Other cases follow.



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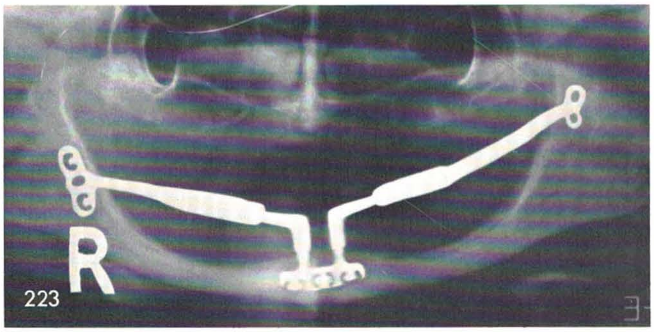

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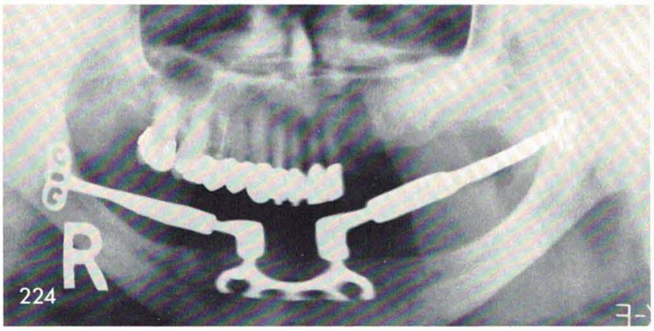

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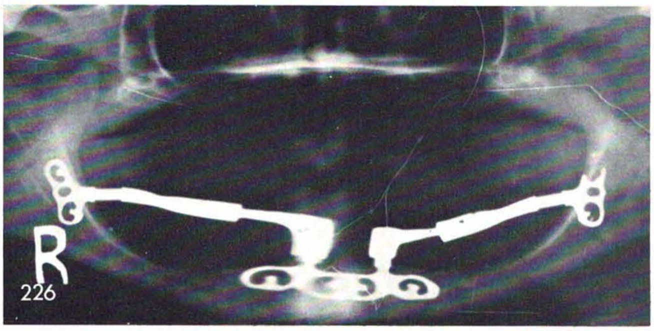

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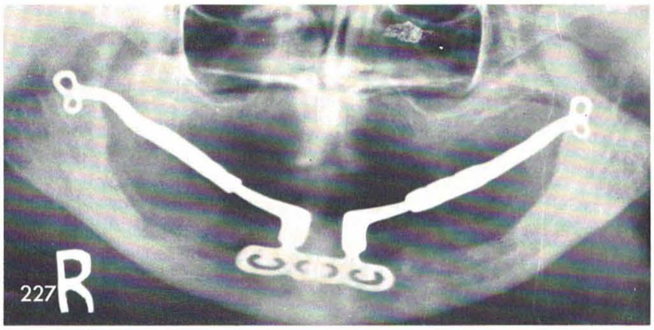

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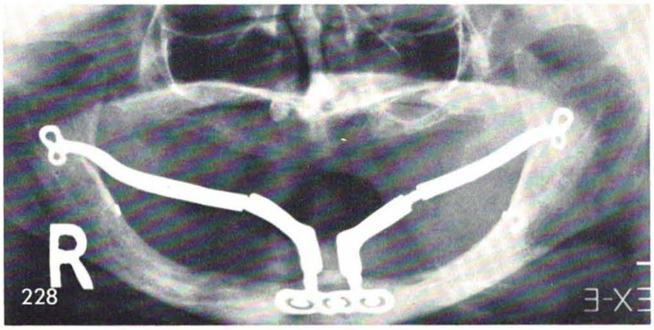

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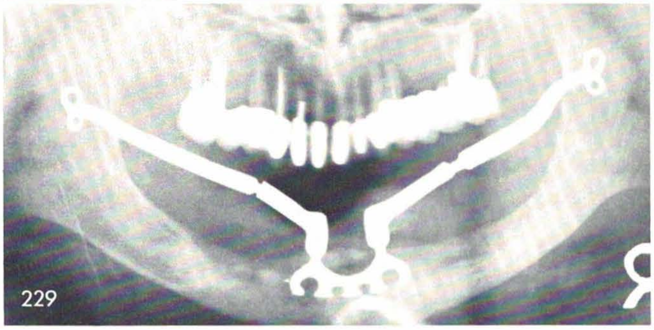
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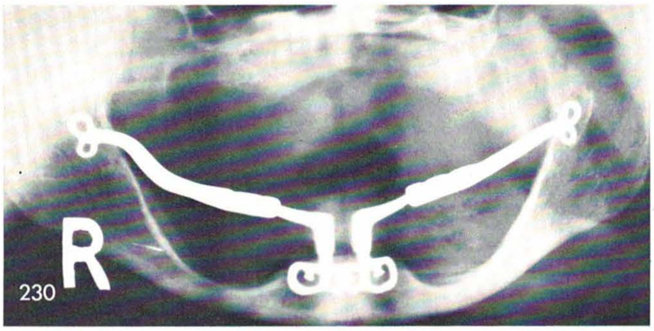
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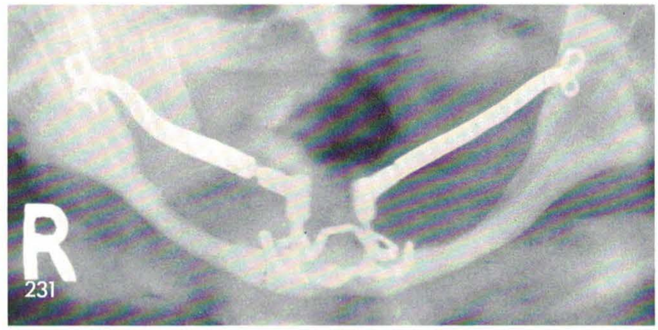
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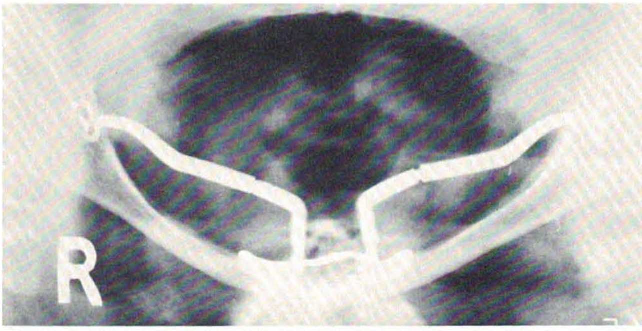
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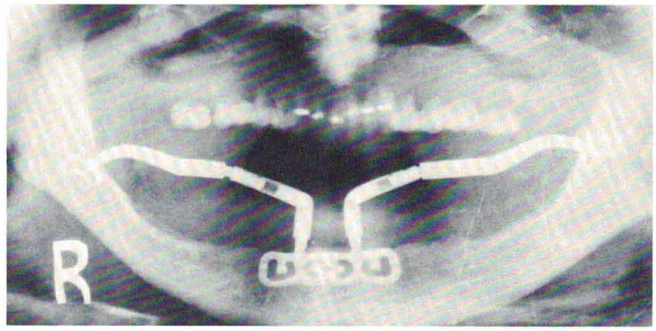
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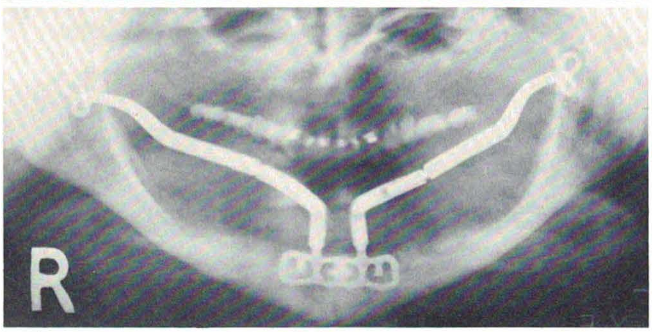
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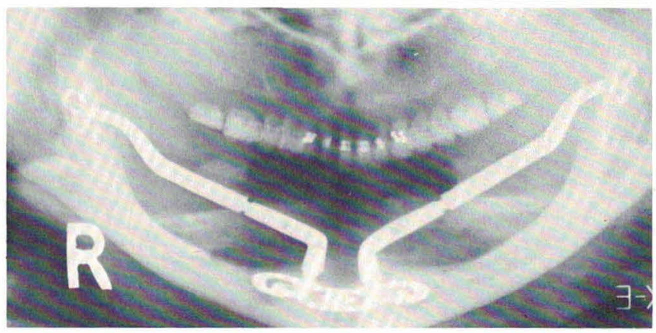
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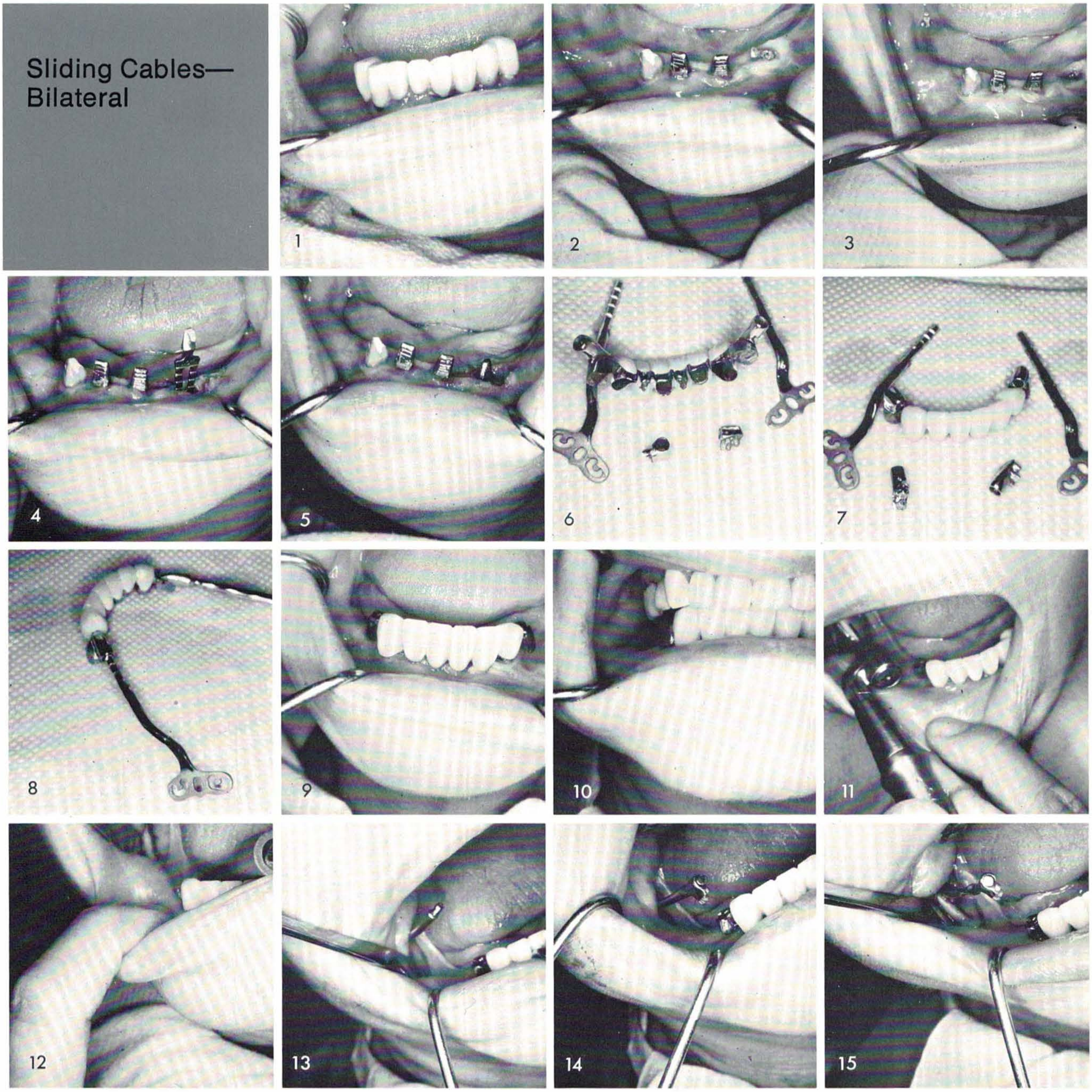
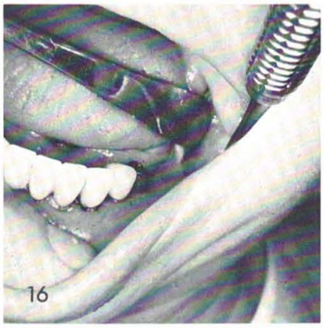
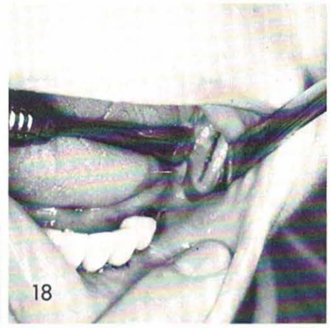
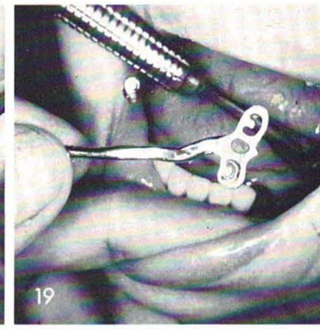
Sliding Cables— Bilateral

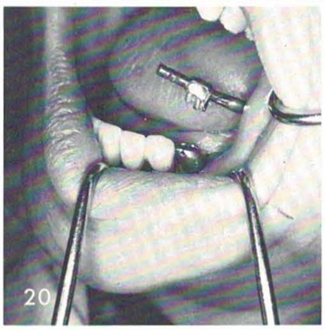


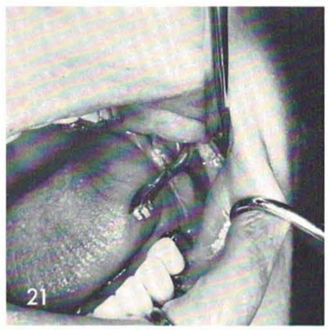
An old restoration that had to be removed, fig. 1. Only one good tooth remained, the right cuspid. A double posted socket blade was inserted anteriorly and the left cuspid split in half while trying to fabricate a gold post, fig. 2. It was removed and replaced with a bladevent, figs. 3, 4, 5. The remaining tooth was prepared for a full crown restoration and an impression of the tooth and implant posts was taken for the fabrication of the anterior prosthesis. It included several sized horizontal tubes that would be later locked into a "figure eight" lock extending from each cantilevered pontic and locked over the solid arm extending anteriorly from each ramus blade, figs. 6, 7, 8. The anterior bridge was cemented, fig. 9, and carefully occluded, fig. 10.

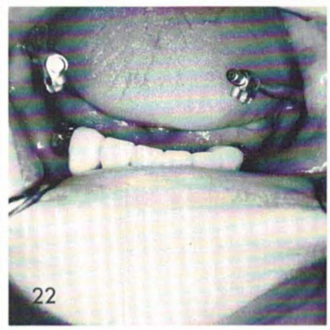


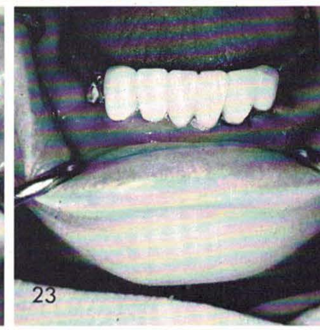


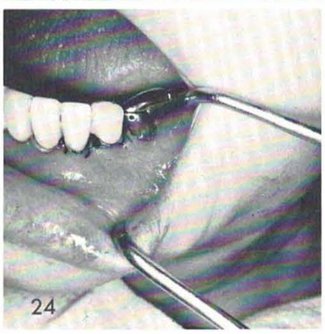


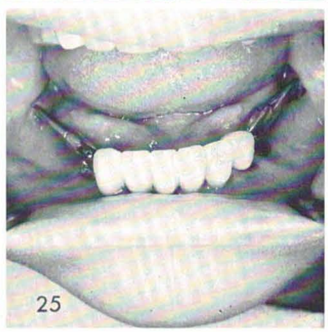


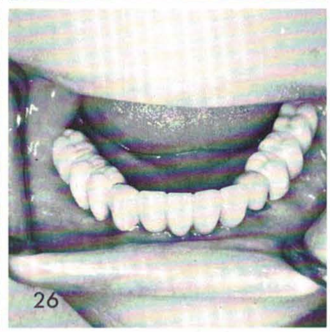


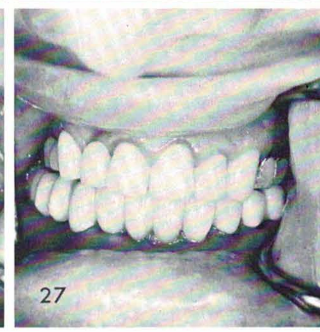


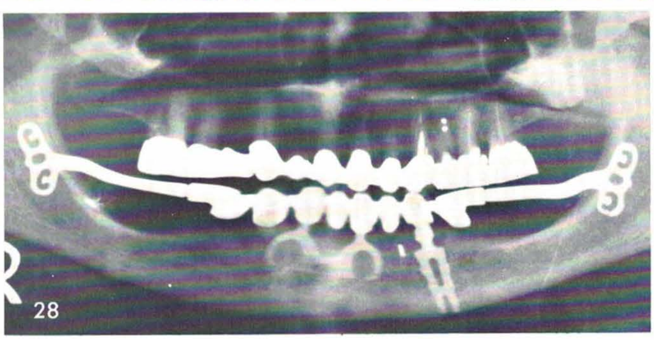




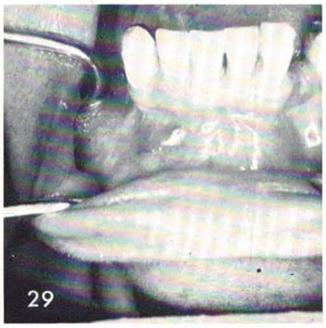








The ramus is exposed and a groove is made on the buccal side, figs. 11, 12, and the blade with its anterior cable is tapped into place so that the cable was tipping upward from the occlusal plane, fig. 13. The hollow tube with its male figure eight lock is fitted to the cable, figs. 14, 15. Steps are repeated on the opposite side, figs. 16, 17, 18, 19, 20, 21, 22. The tubes with the cables are adjusted mesially and distally as they are tapped downward to engage the female locks and then cemented into position, figs. 23, 24. One week later the tissues are healed, fig. 25, and the posterior restorations were cemented over the cables, figs. 26, 27. Fig. 28 shows the post-operative x-ray.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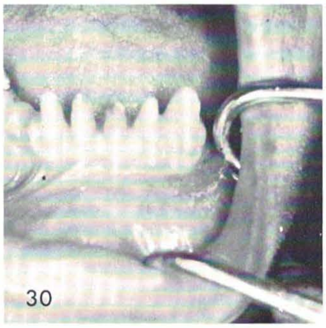
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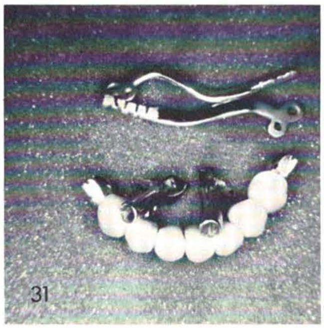
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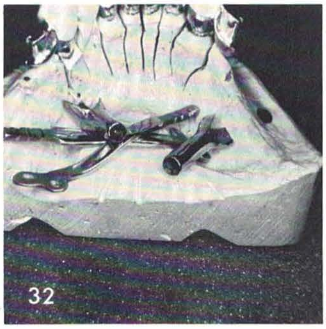
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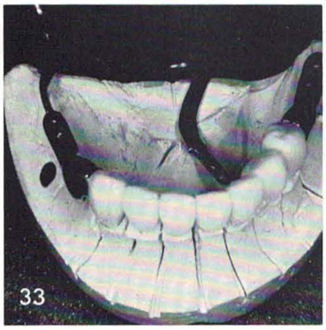
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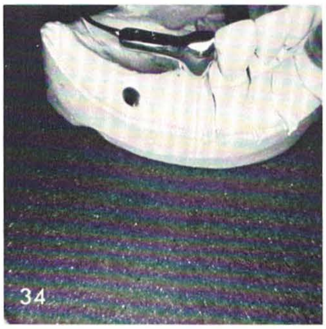
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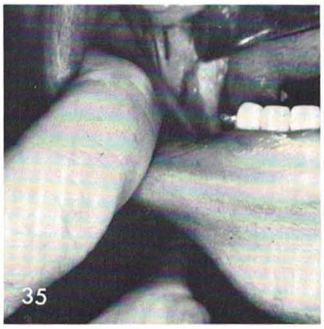
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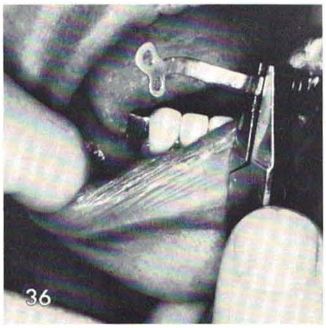
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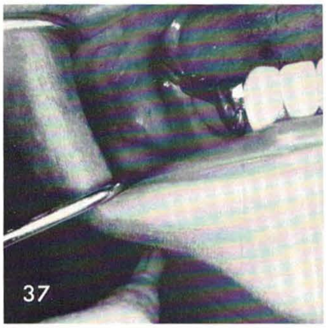
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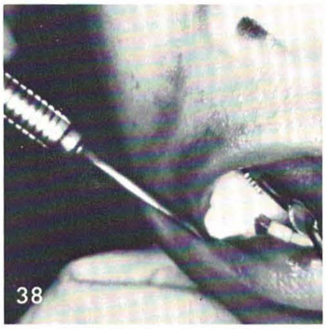
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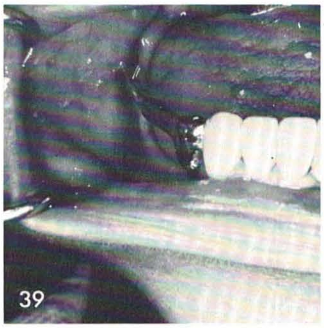
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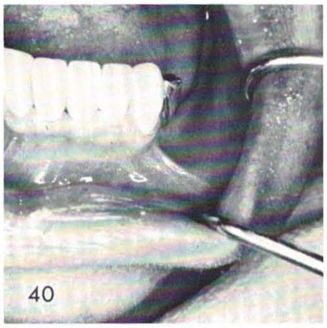
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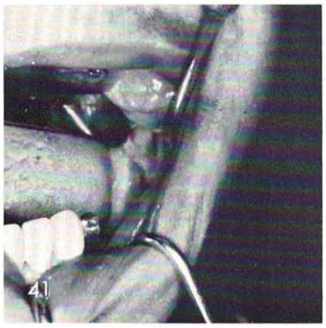
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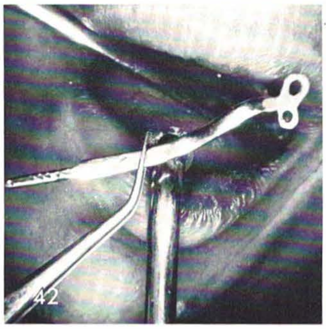
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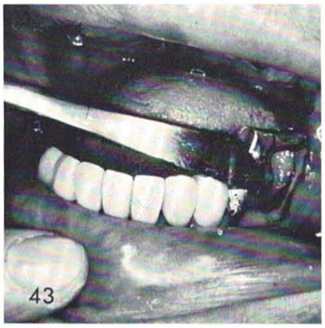
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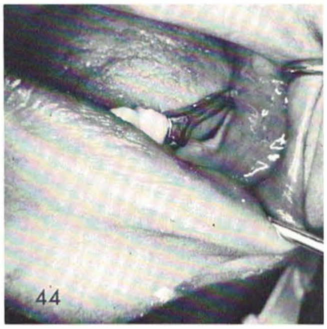
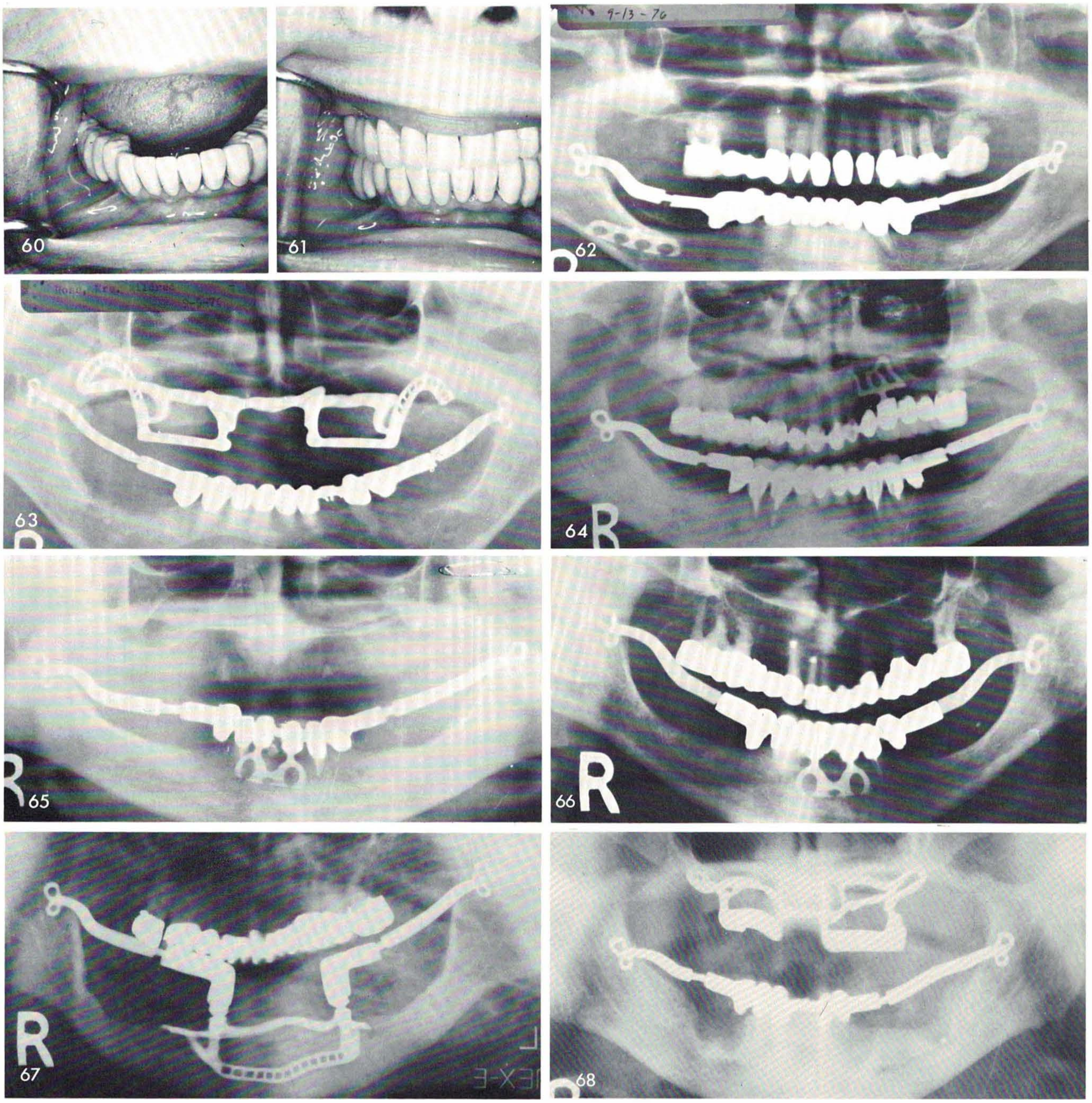

44

Another case showing remaining anterior teeth, fig. 29, that were prepared for the anterior fixed prosthesis, fig. 30. The anterior prosthesis was fabricated with two cantilevered pontics to accept two telescopic copings with distally extended hollow tubes, figs. 31, 32, 33, 34. The right ramus groove is made, fig. 35, and the ramus blade is inserted, fig. 36, tapped into proper position, fig. 37. It is then tapped upward for disengagement of the parts and final cementation, figs. 38, 39. The same procedure is followed on the other side, figs. 40, 41, 42, 43, 44. The bridge is then completed, figs. 45, 46. The post-operative x-ray, fig. 47.

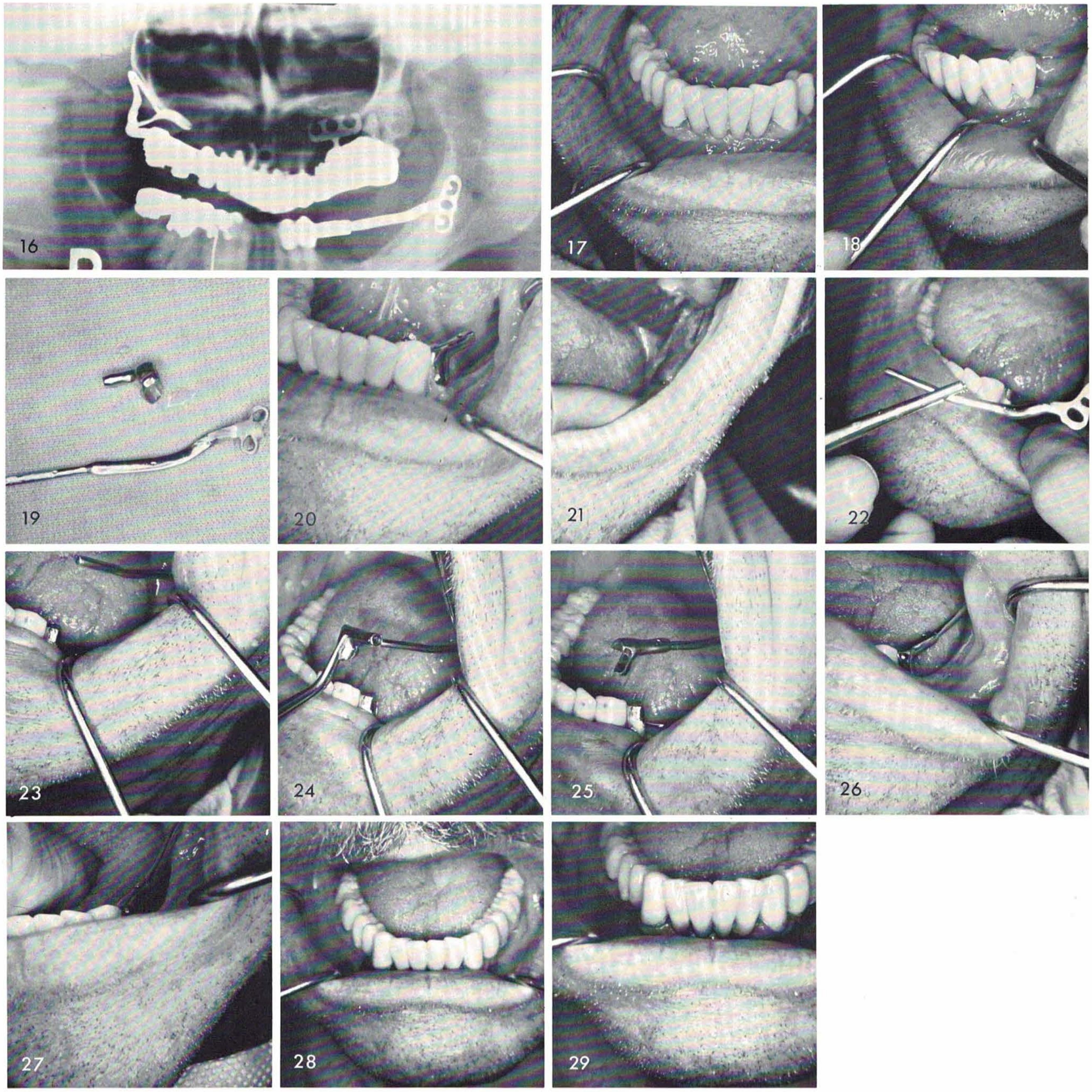
Another case showing the anterior prosthesis which must be completed before the posterior surgery can begin, figs. 48, 49, 50. The ramus groove is made and the blade is inserted, figs. 51, 52, and repeated on the opposite side, figs. 53, 54, 55. The telescopic coping with its hollow tube is fitted over the cable and can slide mesially and distally as it is tapped downward to engage the cantilevered pontic, figs. 56, 57. It is repeated on the other side, fig. 58, and the posterior quadrants are completed, figs. 59, 60, 61. The post-operative x-ray shows the reason why a sliding cable was used on the right side so as not to involve the broken, buried blade that had been functioning successfully five years prior to its breakage, fig. 62.



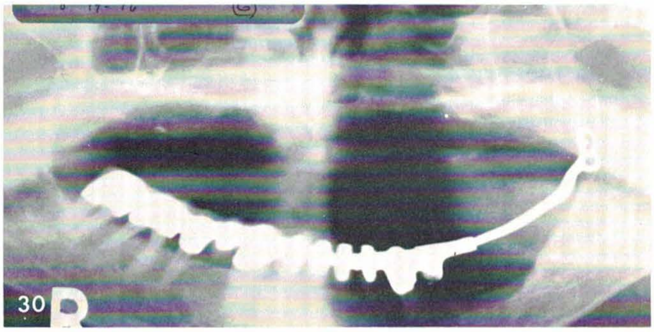
Figs. 63-68 shows x-rays of other bilateral sliding cables.

Sliding Cables—Unilateral

The anterior restoration completed with a distally extended hollow tube prior to inserting the ramus cable, figs. 1, 2. The finished restoration is fitted over the tooth preparations, figs. 3, 4. The ramus groove is made, fig. 5, and the blade is inserted, figs. 6, 7, and the anterior teeth are fitted over the cable by virtue of its hollow extension, fig. 8, and tapped downward until it fits passively over the prepared teeth, figs. 9, 10. The crowns are then tapped off of the teeth so cementation can be accomplished, figs. 11, 12, 13, and the tissues sutured above and below the posterior area. Two weeks later, fig. 14, the unilateral restoration was cemented over the cable, fig. 15. The post operative x-ray, fig. 16.



This case shows an existing fixed prosthesis with a cantilevered left bicuspid that was purposely left when the posterior teeth underneath the left side of the bridge had to be removed, fig. 17. The bicuspid pontic is then prepared for a telescopic coping with a distally extended hollow tube to engage the anterior portion of the ramus cable, figs. 18, 19, 20. The groove is made on the buccal side of the ramus, fig. 21, and the ramus blade is tapped into proper "upward" alignment, figs. 22, 23. The hollow tube is fitted over the cable, figs. 24, 25, and the coping is tapped downward to engage the prepared cantilevered pontic, fig. 26. One week later the tissue



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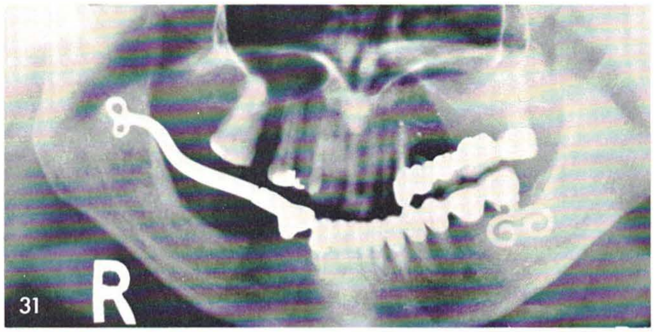

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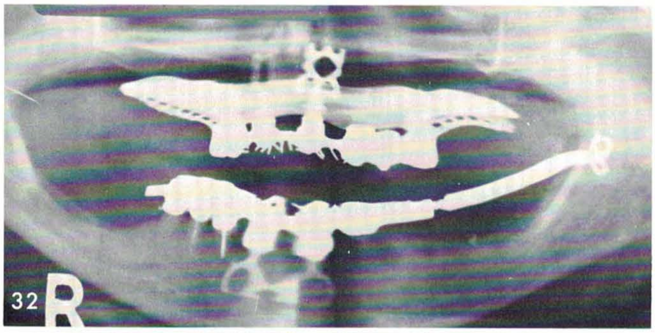

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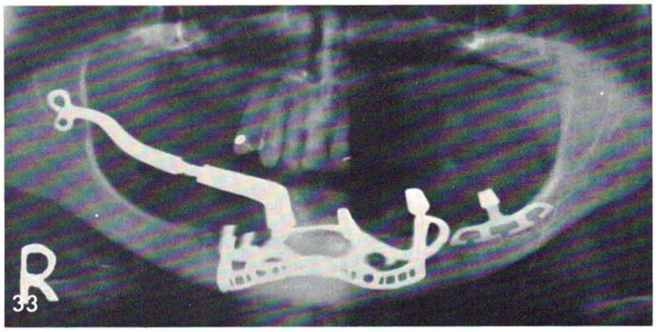

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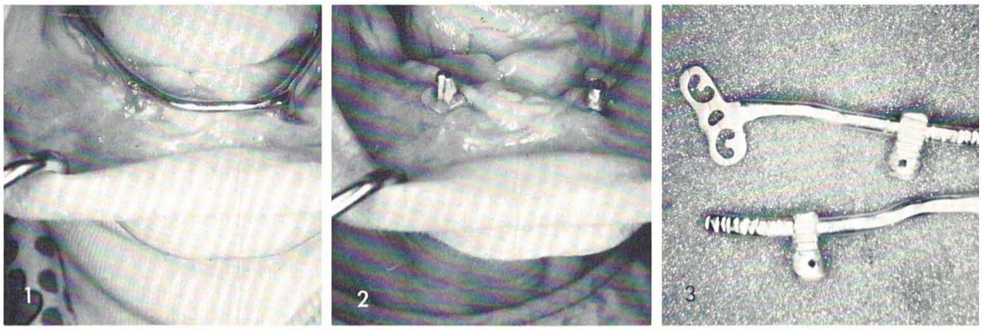
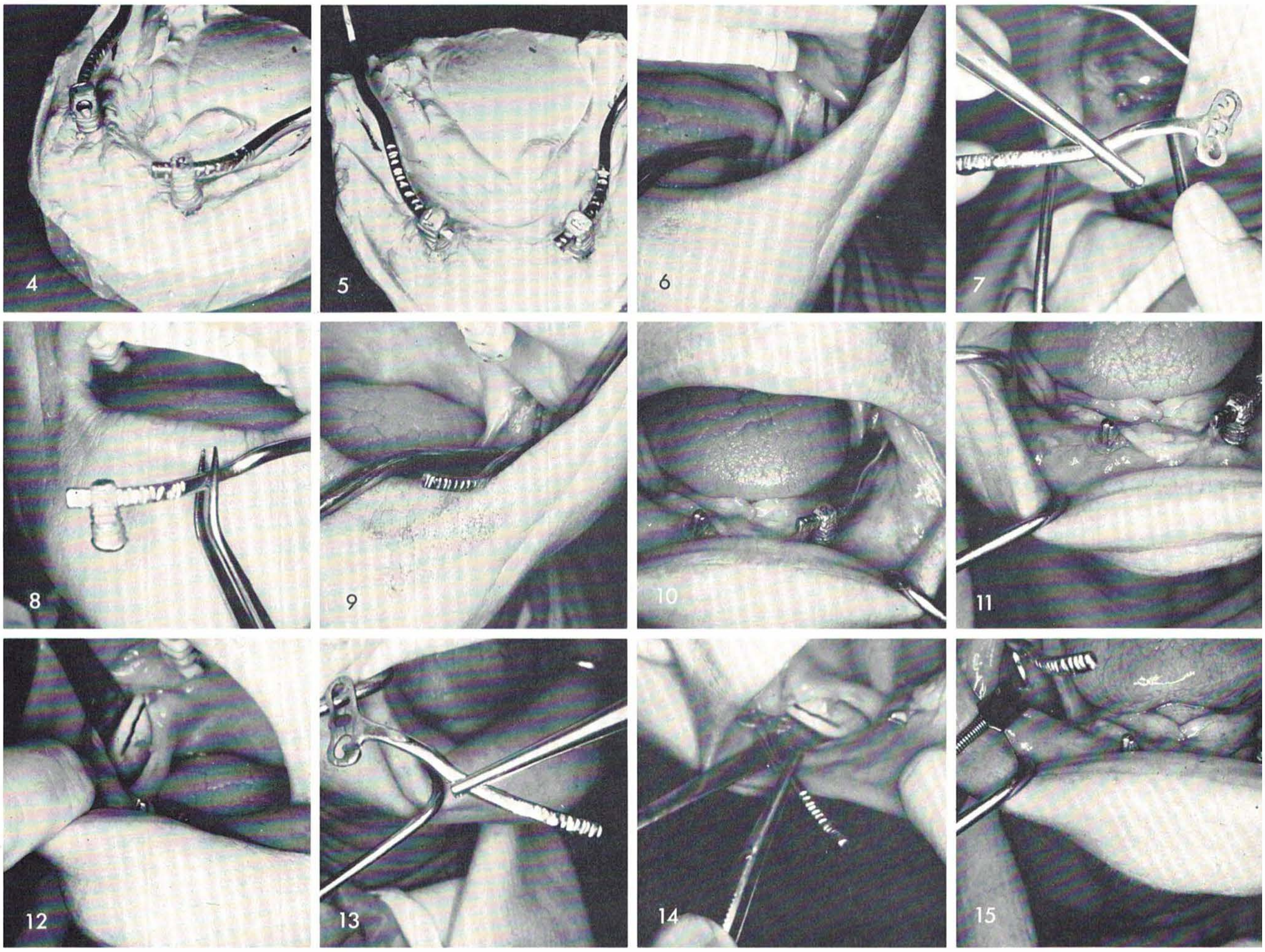
34

is excellent, fig. 27. The unilateral fixed left posterior restoration is completed and cemented over the cable, figs. 28, 29. The finished x-ray, fig. 30.

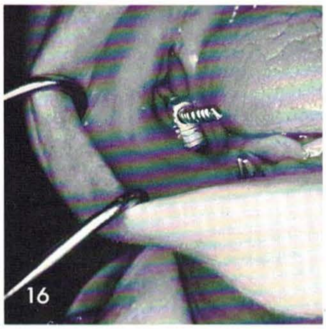
Figs. 31, 32, 33, 34 shows x-rays of other unilateral sliding cables cases.

Sliding Cables for Supporting Remaining Portions of Subperiosteal Implants





This case shows a subperiosteal implant with a horizontal superstructure bar. The posterior portions on both sides of the implant had to be severed and removed because of bone loss and the bar was also removed, figs. 1, 2. From an elastic impression of both posts copings were made to fit over the remaining posts and slide along the cables, figs. 3, 4, 5. The groove was made, fig. 6, and the ramus blade tapped to place, figs. 7, 8, 9, and the coping is tapped over the left subperiosteal post, figs. 10, 11. The procedure was duplicated on the other side, figs. 12, 13, 14, 15,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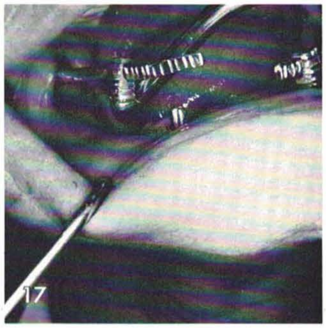
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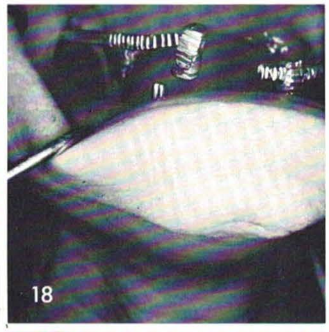
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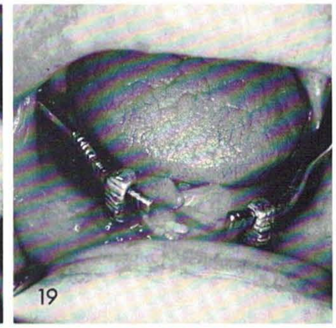
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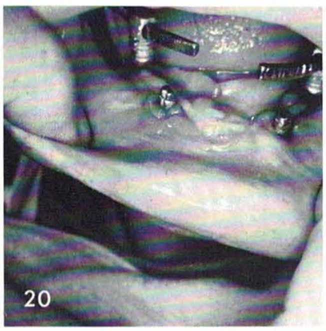
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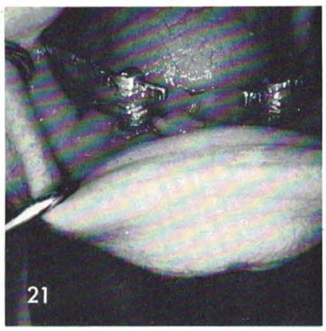
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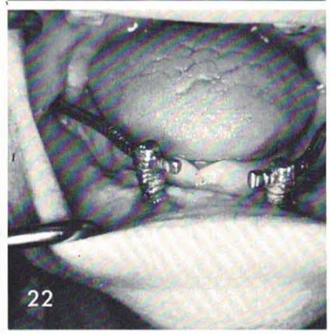
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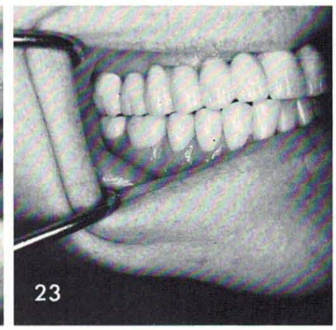
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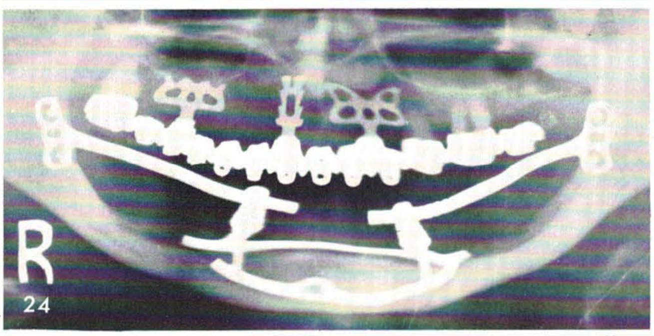

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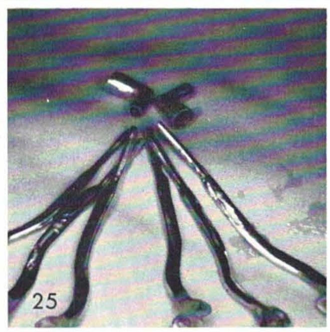
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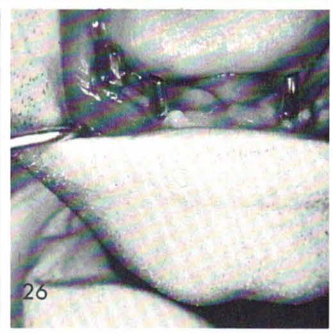
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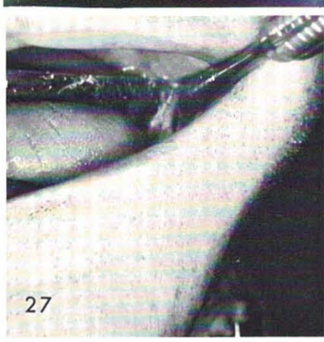
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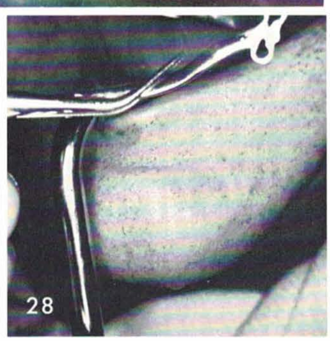
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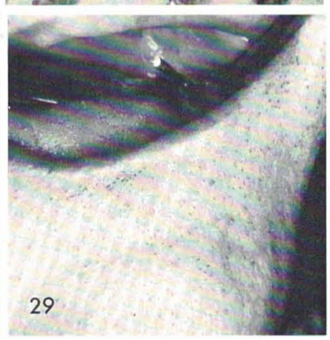
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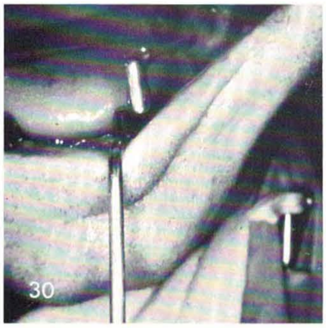
16, 17, 18, 19. They were then tapped upward for cementation, figs. 20, 21, and the posterior tissues were sutured. Healing was excellent, fig. 22, and the full denture was completed and x-rayed, figs. 23, 24. Fig. 25 shows the anterior copings with the horizontal tube extensions that must be prefabricated prior to inserting the ramus implants. Upon clinical observation the left posterior quadrant of the subperiosteal implant was previously removed, fig. 26. The tissues in the left ramus were incised and reflected to expose the bone for making of the ramus groove, fig. 27, and the implant was tapped into correct position, figs. 28, 29. The hollow tube was inserted over the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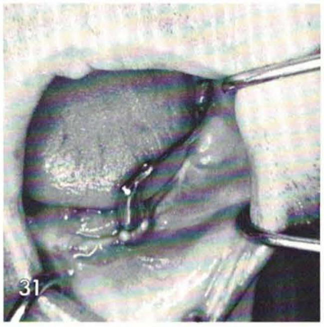
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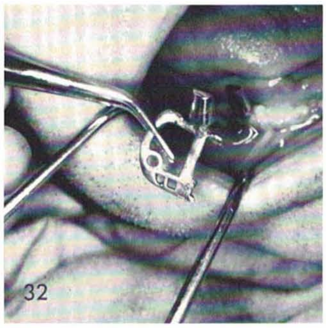
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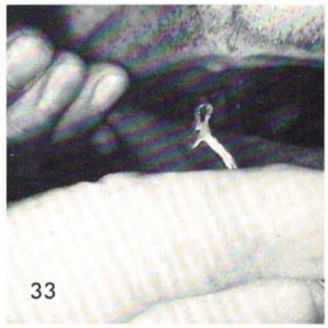
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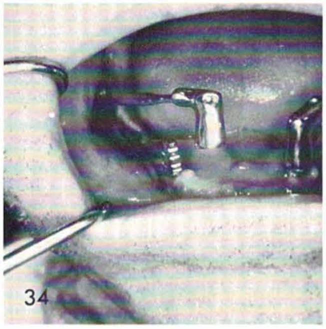
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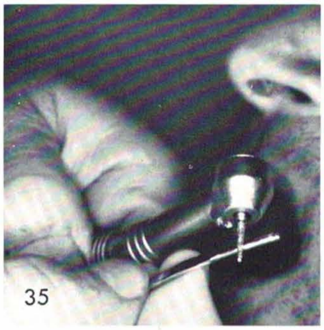
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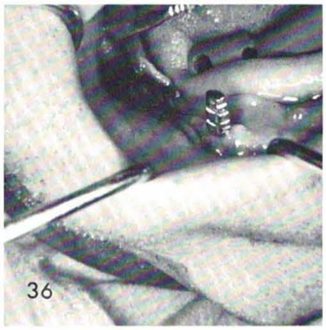
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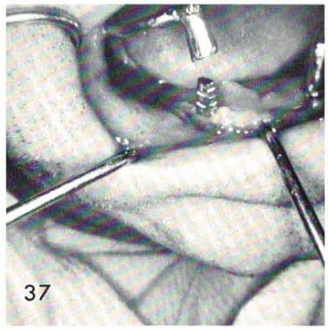
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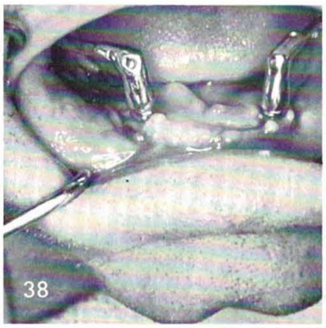
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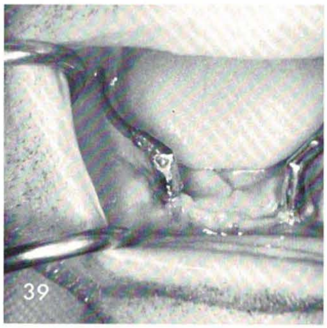
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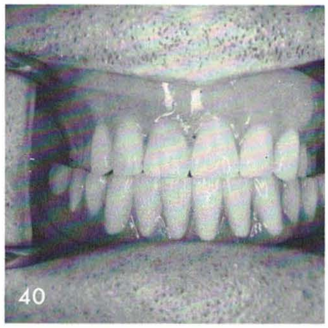
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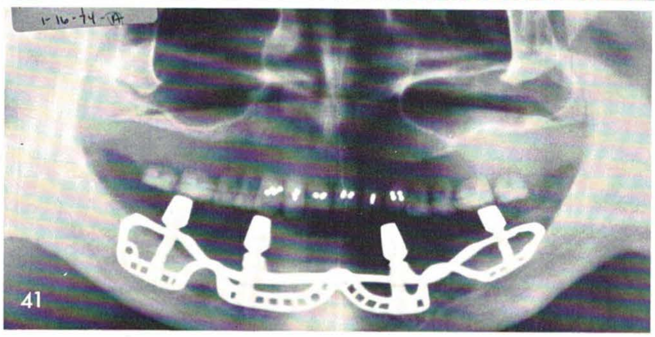
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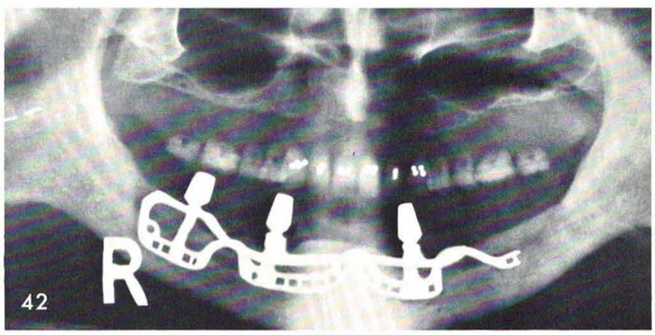

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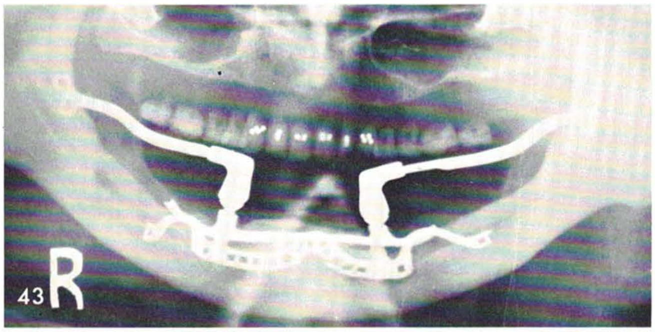
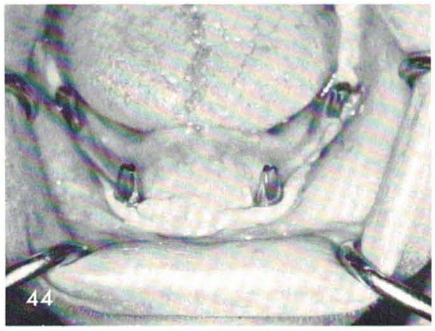
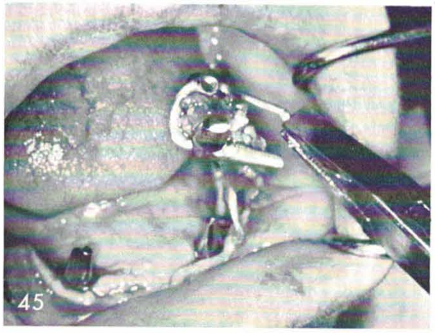
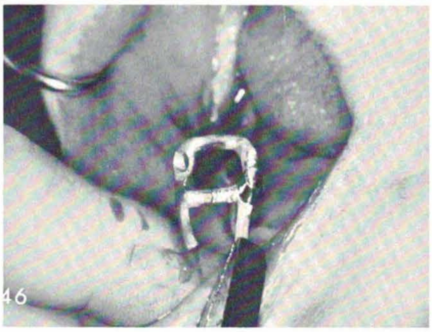
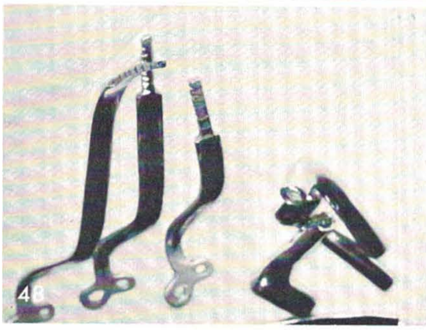
cable and the anterior coping was tapped downward to engage passively the left anterior post, figs. 30, 31. The right posterior quadrant of the subperiosteal implant was then severed and removed from the anterior portion, fig. 32, and procedures were duplicated for insertion of the right ramus implant, figs. 33, 34, 35, 36, 37, 38. The healed tissues, fig. 39, and completed denture and x-ray, figs. 40, 41, 42, 43. Fig. 44 shows a failing subperiosteal implant. The two posterior quadrants were failing and had to be severed and removed, figs. 45-46, and sutured, fig. 47. Impressions were taken of the remaining anterior posts for fabrication of the anterior armamentarium, fig. 48. The healing of the tissues around the bilateral sliding cables was excel-

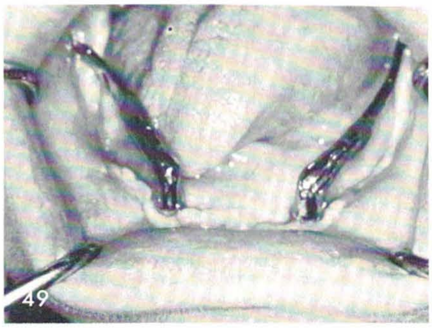


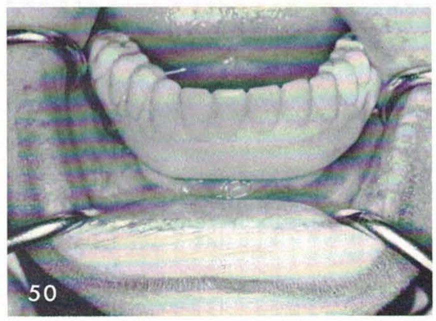






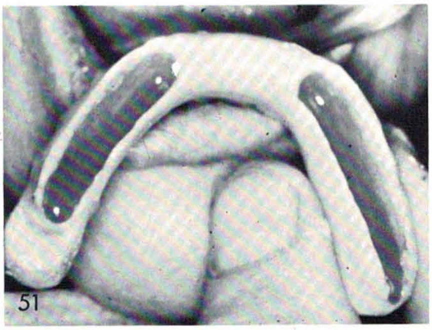






lent, fig. 49. The patient had been wearing this cold cured temporary acrylic splint immediately after surgery, fig. 50. The final denture is locked over the ramus implant with Duralay, fig. 51, and the final occlusion is adjusted, fig. 52. The post-operative x-ray, figs. 53, 54.

The final case which also solved the problem when both posterior quadrants of a subperiosteal implant had failed and was replaced with two ramus sliding cable implants, is seen in fig. 55. A removable denture with horizontal passive attachments (Lew) were very helpful, figs. 56, 57, 58, 59, 60, 61, 62, 63. Fig. 64 shows the final x-ray.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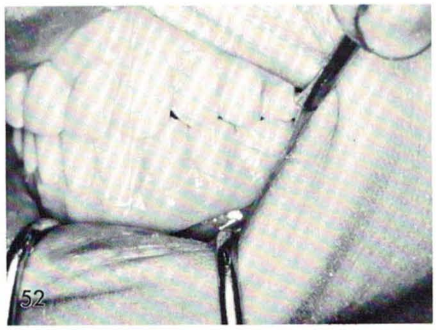
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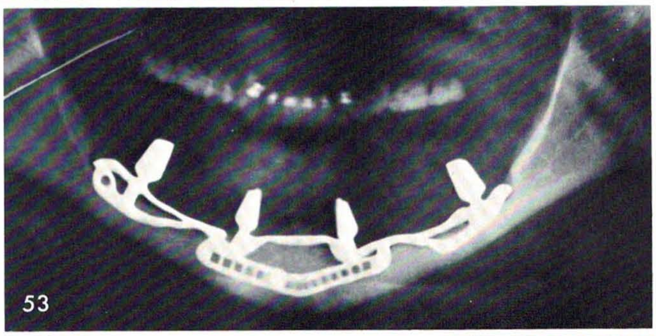
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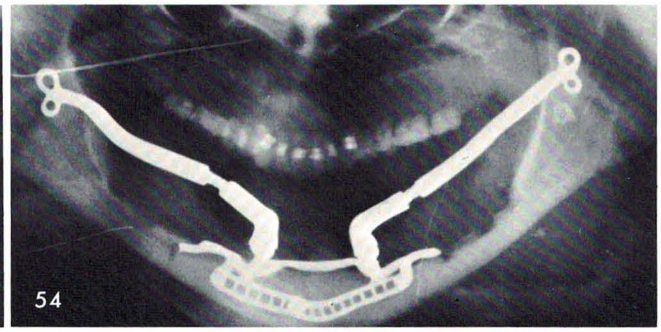
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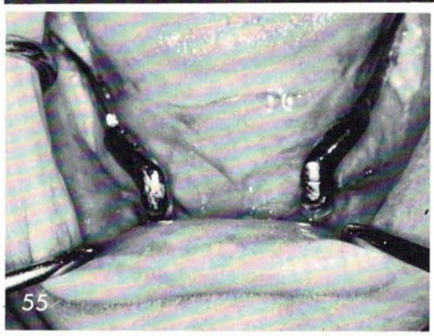
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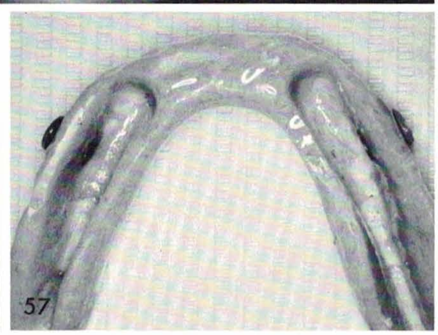
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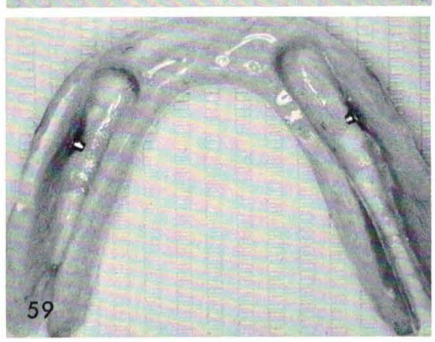
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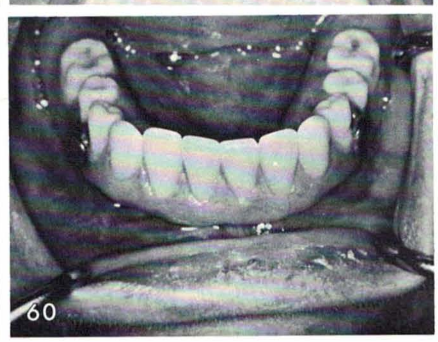
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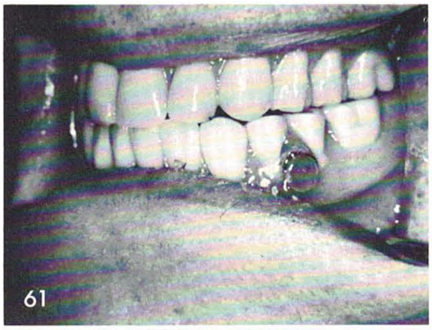

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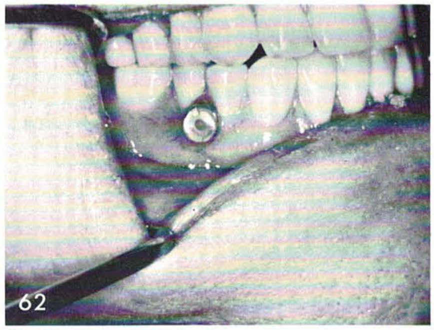

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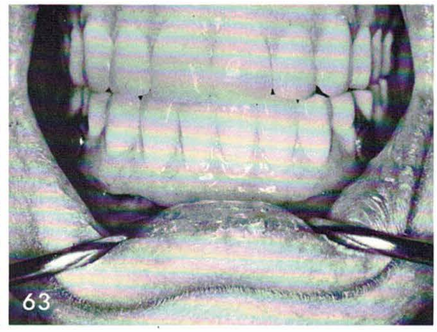

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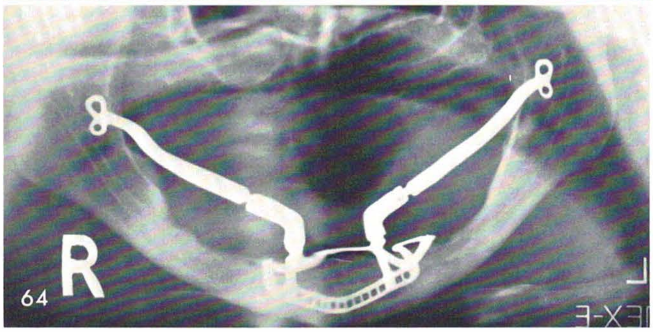

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Epilogue

Epilogue

It took many years to write these two volumes and it took the experience of many thousands of cases to enable me to draw my clinical conclusions, and establish a philosophy of implant supported reconstruction.

Many dentists have never taken a course on the subject, but still continue to question the validity and results of implantology. Before preparing their patients for conventional dentures or removable partial prostheses, I feel strongly that patients should always be carefully informed about alternative procedures, which should often include implants.

I am sure all of us are aware of the tremendous controversies that arise when new developments are announced. Implantology is not an exception. Pioneers are treated today as in years gone by. They are criticized for their failures. Their many achievements are resisted. Inventors should be helped by peers to further improve their concepts. Professionals who continually undermine advancements, owe it to their colleagues and themselves to at least be fully informed about the current state of the art before passing judgement.

When an idea is first conceived, it must go through many stages in the eyes of the profession before it might be finally and fully accepted. It first must go through the stage of discovery, years of questioning by the inexperienced, experiments, clinical studies, then re-evaluation by the profession, and eventual acceptance. Our hope is that now our peers will strive together for the true and unselfish advancement of implantology. This would result in more benefit to mankind.

On January 6, 1883, Kahlil Gibran wrote "I cannot say much now about that which fills my heart and soul. I feel like a seeded field in mid-winter, and I know that spring is coming. My brooks will run and the little life that sleeps in me will rise to the surface when called". Beautiful words from a man of great sensitivity, talent and emotion. Let us, as dentists and humanitarians become more sensitive and tune ourselves into the requests of our patients and enlighten ourselves as to the benefits of implantology.

Implantation can enable many patients, even though totally edentulous, to again have fixed teeth. The technology is here now. Not informing a patient that he might be a candidate for fixed teeth is like not treating a person who is blind, when techniques are available to restore sight.

Enough time has passed clearly indicating the validity and predictability of implants. Therefore, I would hope that the many implant advocates we have throughout this country and throughout the world, will now be morally and emotionally strong enough to stand up before skeptical colleagues and to speak in favor of these much needed benefits. To those younger colleagues who intend to make implantology an important part of their career, I hope I have inspired courage and strength.

At a recent symposium at Harvard University, forty-seven outstanding researchers and clinicians in implantology throughout the country, on a grant from the National Institute of Dental Research, were invited to assess the benefit/risk ratio of several implant types. Blade implants were the only endosseous implants approved for use with appropriate guidelines. There is no other implant in the entire world that is used with more success or in such large numbers as the Linkow blade. I've always said it is not the material but the design of an implant that is of cardinal importance for success.

As the last few lines of these two volumes are being written, I confess my work involved tears, happiness, sorrow, threats, fears, sacrifices, successes and defeats. I could not practice dentistry in any other fashion. My deep devotion to implantology and my belief in the good it brings to others, along with confidence in my own convictions, made me able to advance this much needed discipline. Thoreau once wrote, "If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music he hears, however measured, or far away."

I wish to give thanks to my wonderful and devoted office staff, that has tried to understand me and make room in their hearts during periods of stress. I appreciate their sensitivity, alertness and understanding. To my learned and devoted associate, Dr. Anna Kohn, my wonderful secretary, Mariana Randazzo, assistants, Dr. Robert Moskovits, Dr. Carmencita Mateo and Dr. Isabella Korik, technician, Efim Kharkin, and former secretary, Evelyn Gruber, I thank all of you from the bottom of my heart.

To Dr. Kenneth Judy, Dr. Charles Weiss and Dr. Robert Lichtenstein, for their efforts and help with my manuscript.

I also wish to give thanks to technicians Raymond Gerard and Joni Chamblis, for their help with my early five pieces symphyseal-ramus implant castings.

To Rick Carrier, my many thanks for the excellent art work done for this volume.

To my good friend, Jack Wimmer, for supporting implantology from the laboratory end, I also give much thanks.

Leonard I. Linkow

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