CASE LETTER

# A New Look at the Blade Implant

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## Origin of the Blade Implant

The blade was originally designed due to the need for an implant for knife-edge and extremely shallow ridges, which had presented problems for root-form implants and tripodal pins. Linkow[1–5] recognized the time had come to move completely from trying to duplicate or simulate the roots of teeth with implant designs. It is the very nature and morphology of natural teeth that, in time, they may have to be extracted because of periodontal conditions. The roots are lost at the expense of the labial and buccal plates of bone, seldom due to loss of the palatal or lingual bone.

Nature made a mistake: It provided a maximum amount of bone on the lingual and palatal cortices, where it is not needed, and a minimum amount of bone flanking the teeth labially and buccally, where it is needed to resist lateral forces, anterior thrusts of the tongue, and premature contact of the teeth during lateral and eccentric movements of the mandible.

When the teeth are lost, periodontal stimulation to the bone terminates, so it resorbs due to hypofunction. A venous, arterial, and capillary stasis takes place, causing swelling, engorgement, and edema of the blood vessels, thereby creating pressure to the bone beyond its physiologic capacity, causing resorption. How could one expect to reenter the severely resorbed edentulous ridge 5 or 10 years after the teeth were lost with an implant resembling the root of a tooth when most of the depth and width of bone needed for support has been lost?

An implant had to be designed that utilizes the horizontal rather than the vertical dimension. It also had to be designed with large openings, or vents, in its body to allow for osteogenesis to occur. It had to be designed in such a way that its wedge-shaped body could be angled obliquely off the horizontal plane, bisecting the severely angled bone that usually exists in the maxillae. It had to be designed to permit bending or adjusting of the necks so that the posts of the implants would be parallel either to one another or to the remaining prepared abutment teeth.

A technique for blade insertion had to be designed and simplified so that dentists could do it successfully with minimum difficulty.

The endosteal blade implant can resist lateral forces possibly just as good as natural teeth for several reasons:

- The blade is narrow at its widest point so that the shoulder has far more bone flanking it buccally and labially than do natural teeth. By preparing the channels more to the lingual and palatal surfaces of the ridges, the blades can have even more bone flanking them labially and buccally (where the bone is needed to resist lateral forces) since the labial and buccal plates of bone are always thinner than the palatal and lingual surfaces.
- Most blade implant designs contact more bone on one of their flat surfaces than do any of the single-rooted teeth. Blades, having two broad flat surfaces, can contact nearly as much bone as do the roots of teeth.
- Blades have holes, or vents, through their bodies to allow bone growth. Teeth do not have openings through their roots.
- The blade uses the horizontal principle, unlike the tooth, which utilizes the vertical dimension. Thus, the lever arm action and torquing of the blades is minimized, thus resisting lateral forces.

Bone also resorbs from trauma and is traumatized each time any type of implant is inserted. The scalpel must cut through the mucosa, submucosa, and periosteum, injuring many blood vessels and nerve endings. The bur then cuts through the circumferential bone lamellae, the interstitial bone lamellae, and the Haversian bone lamellae. Many osteocytes and osteoblasts are cut, crushed, and killed. Many of the anastomosing processes that join the osteocytes to each other (to bring in nutrients and oxygen and allow for the exit of waste products) are severed. The bur may cut into a Volkmann's canal, which brings the blood supply from the innermost surface of the periosteum directly into a central axial canal of an osteon. The bur may also cut and destroy some of the hemopoietic bone marrow or involve an area in which osteoclastic activity is occurring. These are all normal constituents of everyday histogenesis of bone.

The implant is then inserted. Because the first phase of bone metabolism is the catabolic breakdown stage, if the implant is not designed correctly, it could loosen during this early stage of bone breakdown. Other implants may need

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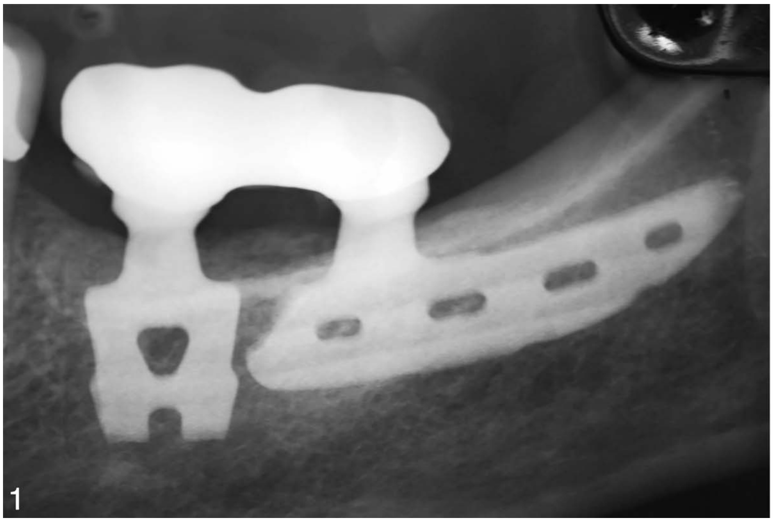
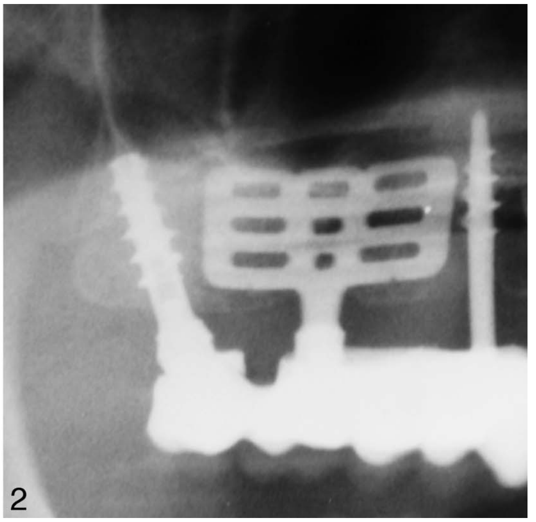




**Figures 1 and 2. Figure 1.** Fixed prosthesis supported by two blade implants. **Figure 2.** Blade implant inserted in upper molar area bearing posterior occlusal forces in cooperation with different types of screw implants.

immediate stabilization or have to be deeply buried beneath the alveolar crest with the hope of establishing some integration a few months later. The blade implant needs no immediate stabilization. Inserted correctly, it can remain in the mandible unsupported for many months with no mobility. In the maxillae, the definitive prosthesis should be completed 5 to 8 weeks after blades are inserted.

## Blade Implant Design Rationale

A blade implant is an artificial anchor for a prosthesis (Figure 1). Designing an artificial abutment requires considering the fundamental relationships between a prosthesis, an abutment, and supporting bone.

### *Stress*

The abutment must withstand stress, principally from a lateral direction. A blade implant's broad face provides at least as much surface-to-bone contact as does the root of a natural tooth fully encased in healthy alveolar bone.

Force on the post is directed downward by the narrow neck, distributed mesially and distally along the shoulders, and led off by the legs. Thus, distance and the narrowness of the pathways help dissipate force well away from the initiating site, minimizing the danger of bone trauma at the crest of the ridge (Figure 2).

### *Biocompatibility*

The overall narrowness of the blade and the interruption of its longest dimension with vents minimally disrupts the continuity of living tissues. Titanium, from which most blades are made, is well tolerated by the tissues.

### *Design adaptability*

The blade implant is 1.25 mm wide at the shoulder and tapers down to 0.5 mm at the apex, which permits fitting or angling it into narrow sites. Its broad face, usually aligned along the dental arch, comes in numerous designs to accommodate morphologic problems. Double-posted designs provide two abutments in a single surgical site. The body, or post, of the implant may be bent to better suit a particular site.

## Blade Insertion

The uniform design of blade implants simplifies insertion. Insertion procedures must be rigidly followed for correct seating of the implants. The blade must be immediately stable upon insertion; the bottom of the post must meet the alveolar crest (Figures 3, 4, and 6c)

### *Revealing the site*

Clean rapid surgery is used to incise the overlying tissue straight down to the bone in a single stroke as well as to peel the periosteum and overlying tissues away from the site. Enough bone must be revealed to visualize the direction and morphology of the site.

### *Making the implant socket*

The dimensions must be exactly as follows:

*Length (Mesiodistal)*

The length of the channel is as least as long as the mesiodistal length of the blade and should never be shorter.

*Depth*

There must be sufficient bone to bury the implant up to the bottom of the post. In dense bone, a bur or a piezo-electric scalpel is used to open the socket to this entire depth. When the bone is porous, the socket is made slightly shallower. Tapping the implant will break the few delicate trabeculae under the legs, leaving those under the vents intact for additional security.

*Width (Buccolingual, Buccopalatal)*

The width should be as narrow as possible, preferably no wider than the diameter of the bur. This is essential to take advantage of the blade's wedging action.

The only bur to use is the No. 700XL. When the socket must be deeper than its shaft permits, the No. 700XXL is substituted. The bur always must be sharp and used with a water coolant to prevent overheating the bone.

### *Seating the blade*

The blade should slip easily into the prepared channel, but not more than 1–2 mm below the crest of the ridge. If the channel has been curved to follow the dental arch, the blade must be bent to fit passively.

At this point, parallelism of the post with the other abutments is checked. Adjustments are made by withdrawing the blade along the axis of the socket, and bending or twisting the neck of the post while tightly holding the body of the blade with pliers (Figure 5).

The lodged implant is gently tapped—never hammered—to its correct depth. If the post has been bent, only the shoulders are tapped, with the shoulder set instrument contacting the shoulder slots. If the implant resists being seated correctly, it is removed and the bur is used to deepen the channel or to remove the interfering bone.

### *Closing the wound*

The wound is cleaned and closed with simple interrupted sutures. These may be removed in 5 to 8 days.

### *Postoperative considerations*

In completely edentulous patients, a prefabricated full-arch provisional prosthesis is placed into position immediately after surgery for esthetics, function, and stability. Impressions should be made over healed tissues. After surgery, the definitive prosthesis should be inserted in approximately 5 to 8 weeks

## Choosing the Implant Site

Because stabilization, retention, and support are the goals for a prosthesis, the ideal site for each implant is determined by prosthodontic considerations. However, bone morphology may necessitate its location elsewhere.[6] Usually, this is not a serious drawback because it is the post of the implant—not its body—that must complement the dental arch. The implant's body may be placed into or over the best bone, provided its post either protrudes into the desirable occlusal plane or can be bent or adjusted into it.

### *Bone*

The amount and nature of bone in a prospective site determines whether or not an implant can be used, and, if so, which type.

Alveolar bone is highly responsive to mechanical stimulation, or a lack of it. Tolerable internal tension is osteogenic, while concentrated external pressure causes resorption. A blade is inserted into alveolar bone, where it partners with the natural forces in the area.

Residual alveolar bone tends to be more porous and fragile in the maxillae as compared with the mandible, necessitating additional caution while drilling and tapping. Furthermore, in the maxillae, the occlusal surface of the alveolar crest often lacks a covering of cortical bone, making the clean retraction of the overlying soft tissues a little more difficult.[7] Linkow[1–3] claims that the bone of the anterior nasal spine, canine eminences, and the palatal surface of the palatal crest are just as dense as the bone in the mandible.

Resorption may leave a sharp or uneven ridge in either arch. A sharp ridge can be reduced until it is broad enough to accept a blade. Leveling an uneven ridge is rarely necessary because a desirable occlusal plane may be achieved by adjusting the heights of the posts, and the restoration is not tissue borne. The higher bone in an uneven ridge may also provide the better implant site.

Undercuts or concavities along the walls of either arch should be avoided. In many cases, simply angling the blade solves the problem.

### *Mucoperiosteal tissue*

Mucoperiosteal tissues tend to be relatively thin and easy to detach intact from the mandibular bone. In the maxillae, they thicken after tooth loss and often deceptively pad the ridge. Maxillary tissues have a relatively copious blood supply, and may reflect years of irritation by a conventional denture.

Because hard and soft tissues are more troublesome in the maxillae, it is suggested that the inexperienced dentist begins with mandibular implant restorations when he or she can.

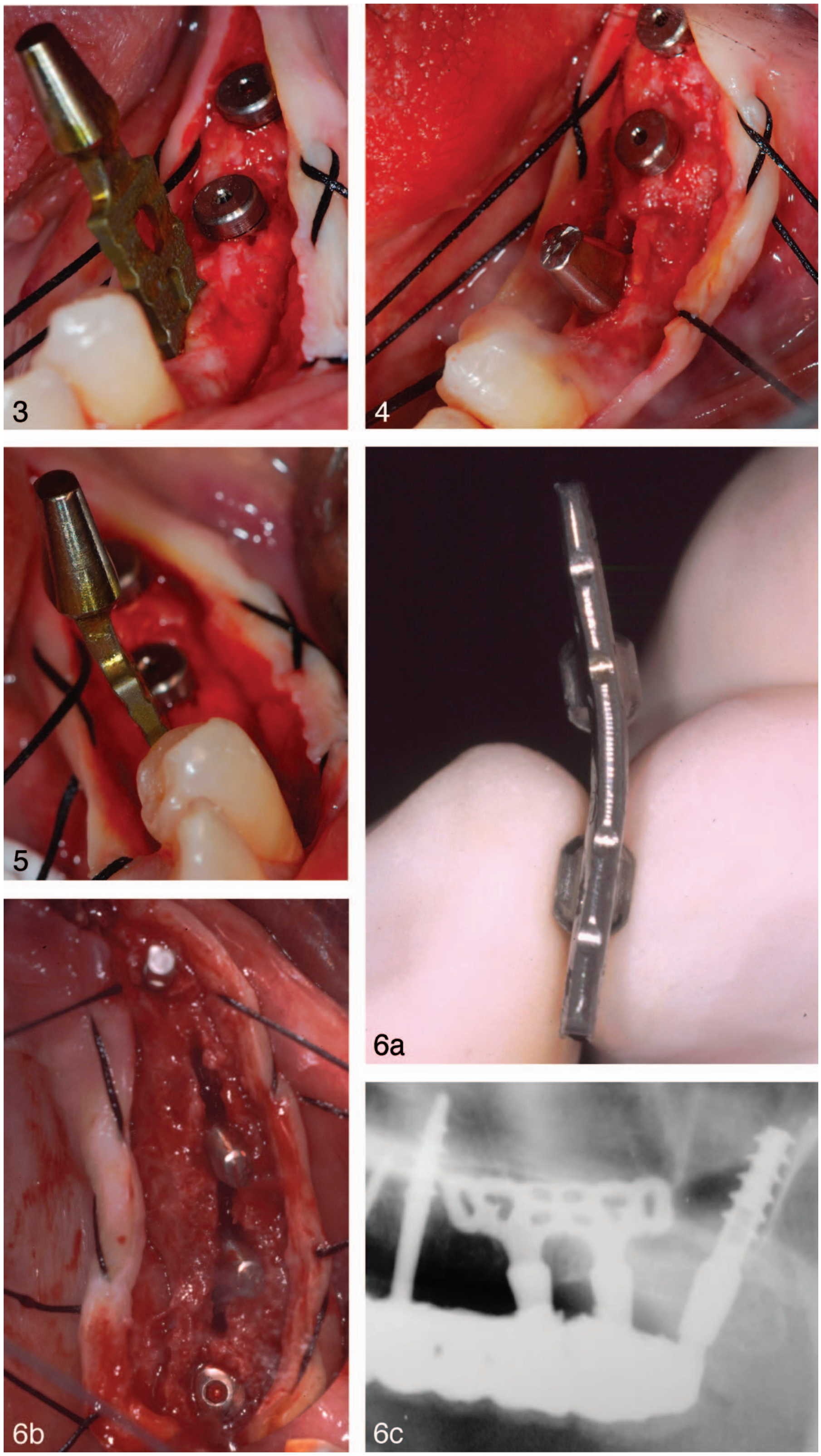
### *Maxillary arch*

There is usually enough bone from the lateral incisor to the first bicuspid region to insert blades. The midline location should be carefully analyzed before surgery. It is a weaker area, and the incisive foramen may be near the crest of a highly resorbed ridge.

Most problems occur posteriorly because of bone loss and sinus expansion. Controlling factors in this area in the location and amount of residual bone and the shape and extent of the sinus. Posterior maxillary areas are also the most difficult operative sites. Great care must be taken in incising and retracting the tissues because of the greater palatine foramen and local tendinous attachments. Sinus penetration should be avoided, although some safety margin is provided by the sinus membrane's tendency to be easily pushed up intact from the bone.

## Completely Edentulous Maxilla

Anteriorly, a single-posted blade is set—preferably in the cuspid region—on each side of the midline. Posteriorly, two more blades are inserted. Ideally, a long, specially designed double-posted maxillary blade can be set in the bone below the sinus. The posts protrude into the bicuspid and molar regions (Figure 6).




**Figures 3–6. Figure 3.** A blade implant being inserted into bone. **Figure 4.** The bottom of the post is placed at the level of the alveolar crest. **Figure 5.** The post has been gently bent before insertion into bone. **Figure 6.** (a) A double post blade has been bent to correspond to the anatomy of the ridge. (b) The blade is inserted into the bony crest. (c) Radiograph of the blade after 6 years in function.

One double-posted blade may be inserted anterior to an expanded sinus and another posterior to it in the normal dental arch.

When sinus expansion or bone fragility prohibits seating posterior blade implants, other posterior sites are sought. The tuberosity may be wide enough to accept a specially designed blade seated buccopalatally (Figure 7) or may be deep and long enough to insert an asymmetrical blade mesiodistally (Figure 8).

### *Mandibular arch*

As in the maxillae, the anterior region provides relatively easier implant sites as compared with the posterior areas. There are no major blood or nerve vessels anteriorly. The bone at the symphysis is solid and reinforced by the mental protuberance. Because of the density of the bone in this region, care must be taken not to overheat it with rotary instruments.

Posteriorly, the location of the mandibular canal is important, because implant procedures should not impinge upon its neurovascular bundle. The vessels are also threatened when the soft tissues are incised and reflected in the regions of the mental foramina. A bony shelf overhanging a concavity (prime example: the submandibular fossa) is not an appropriate site for a blade because of the ease in fracturing such a prominence.

It is almost always possible to use blades anteriorly to provide lateral incisor or cuspid abutments. These may extend from a single implant set on each side of the midline or from a double-posted design curved across it.

When blades are used anteriorly, two abutment posts on each side of the arch, protruding into the second bicuspid and second molar regions, may be supplied by the following methods:

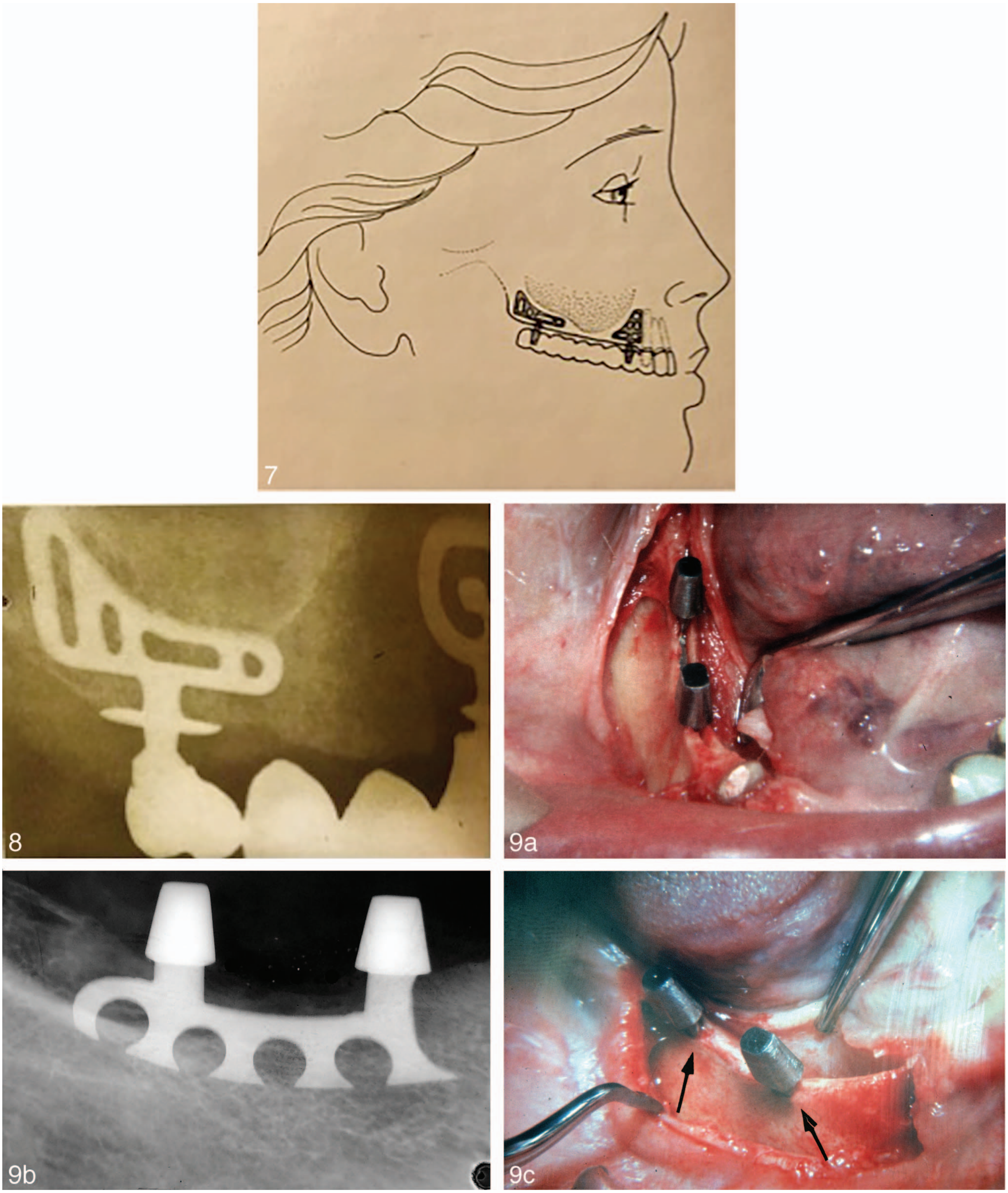
- A long double-posted blade set into the bone over the mandibular canal is ideal. It provides two abutments in a single surgical site. The face of the blade should be as tall as insertion requirements allow. Increasingly shallower designs permit burying the implant correctly in shallower bone, with its posts resting at the top of the ridge (Figure 9).
- Two single-post blades may be used in an uneven ridge (Figure 10).
- Extensive bone loss may leave the mandibular canal so close to the surface that a subperiosteal implant is indicated.
- If the mandibular canal is dehiscent, it may be deepened and the neurovascular bundle lowered out of contact with the implant. In a completely edentulous mandible, a tripodal mandibular subperiosteal implant would be the treatment of choice, thereby avoiding the dehiscent nerve.

## Advantages of the Blade Implant

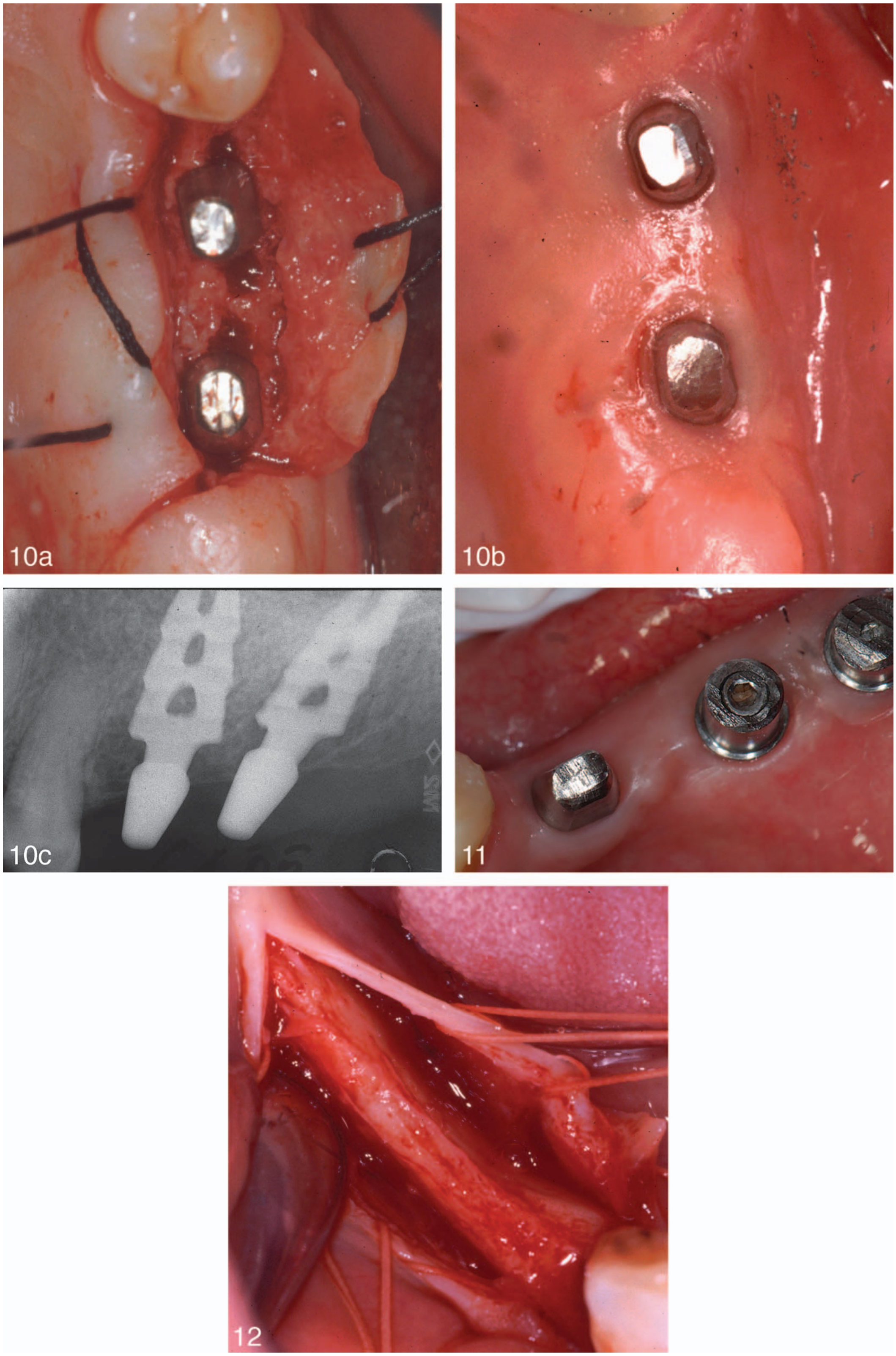
Endosteal blade implants have served well as tooth abutments for many years. Their unique designs, combined with satisfactory insertion procedures by dentists, have contributed largely to their success. The fact that blade implants can be used for most sites is also of utmost importance. These factors—as well as a properly fitted, stable, retentive prosthesis with satisfactory occlusion and support—lend themselves to the creation of artificial abutments that have passed the test of time. Once the philosophy and techniques of blade implants have been mastered by the dentist, these advantages can be realized:

- Blades can be successfully utilized in knife-edge ridges, where no other type of implant can be used.
- Blades can be easily inserted where there is very little alveolar bone height above the mandibular canal or below the sinuses or nasal cavities. Under such conditions, root form endosteal implants may not be able to be used.
- Because of their unique designs, more metal-to-bone contact is obtained as compared with other types of implants. The intraosseous portion of the blade can contact far more bone compared with some natural tooth roots.
- Blades exhibit large openings or vents within the confines of the implants themselves that allow for bone deposition.
- The wedge-shaped tapering created by the convergence of the facial and lingual flat surfaces of the blade itself results in the blade becoming tighter and tighter in the bone as it is tapped to its proper depth. Since every portion of the wedge immediately superficial to itself becomes wider, that wedge prevents any future sinking of the blade as more resistance is created from the surrounding bone.
- The healed soft tissues directly in contact with the implants are very closely adapted (Figure 11).
- The ease of insertion of the blade implant is an advantage over other implants.
- Reflecting the fibromucosal tissue and setting the implants directly into the underlying bone has more advantages as compared with screwing or drilling the screw or pin-type implants through the overlying soft tissues and then into the bone (Figure 12).
- Epithelial inclusions are not pushed into the artificial sockets, as have often been observed with screw and pin techniques. By reflecting the soft tissues, the bone is exposed, enabling the dentist to use the bone topography to the greatest advantage. Often, especially in the maxillae, the extremely thickened fibromucosal tissue camouflages the underlying and much narrower bony ridge to such as extent that there can be a deviation of as much as 7 or 8 millimeters between the actual alveolar crest as compared with the soft tissue covering it.
- The protruding posts of the blades can be more retentive for a fixed prosthesis as compared with the much smaller abutments of root form implants.
- Interchangeable prefabricated metal or plastic copings can be used advantageously.
- Because of the excellent retention of blades in bone, their protruding posts can be adjusted and made parallel to each other using heatless stones, tapered carbide burs, or diamond points without fear of loosening the implants.
- The posts of the blades are also available with either vertical or horizontal set screws to increase the retention of the prosthesis.
- Blades can be placed immediately into open sockets with bone regenerating above their uniquely recessed shoulders.

Owing to the immense benefits of the endosteal blade




**Figures 7–9. Figure 7.** Tuber blade in position. **Figure 8.** Blade inserted in the tuberosity region. **Figure 9.** (a) Double-posted Linkow blade implant inserted by Pasqualini in 1970. (b) Radiograph of double-posted Linkow blade implant. (c) Note the bony regeneration between the 2 posts.




**Figures 10–12. Figure 10.** Soft tissue healing around 2 single-post blades. **Figure 11.** Soft tissue healing around blade implant in Figure 4, shown at left. **Figure 12.** Flaps must be opened and the soft tissue separated from the bone before inserting blade implants.

implant in situations with insufficient ridge width and immediate function projected, blade implants have been included in the Auriga Protocol.[8]

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