The Milled Implant Bar: An Alternative to Spark Erosion

• **James S. Brudvik,** DDS, FACP •
• **Kavita Chigurupati,** BDS, MSD •

Abstract

Patients who cannot tolerate total coverage of the hard palate or whose maxillary arches are poorly formed, because of congenital, developmental or surgical defects, may be unable to wear a conventional complete denture. These patients can be successfully treated with implant-supported prostheses that cover only a minimal amount of palatal tissue. With spark-eroded castings, very precise restorations can be constructed to fit such implant supports. However, these castings are so expensive that cost precludes their use for many patients. This article presents an alternative approach, developed with the refined techniques used for removable partial dentures, which can yield results similar to those for spark-eroded castings at a fraction of the cost. The clinical and laboratory procedures involved in this technique are described.

MeSH Key Words: *dental casting technique; dental prosthesis design; jaw edentulous, rehabilitation*

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For any patient with a completely edentulous maxilla, total palatal coverage is usually required to create adequate retention for a complete denture. However, several groups of patients with completely edentulous maxillae cannot tolerate total coverage of the hard palate. The most common group consists of patients with an exaggerated gag reflex. In other patients the maxillary arches are so poorly formed, because of congenital or developmental defects or as a result of surgery or trauma, that they cannot wear a conventional complete maxillary denture.

All of these patients can be successfully treated with an implant-supported removable prosthesis that covers only a minimal amount of the palatal tissue lingual to the denture teeth. If the palatal coverage is to be reduced or eliminated in this way, superstructure castings that fit on the implants are usually required for adequate strength with minimal bulk. The implants, usually 6 in number and adequately spaced, are typically joined with a bar of some sort to provide maximum splinting of all the fixtures. It is on this bar substructure that the denture superstructure is created and fitted, either through spark-erosion techniques or with a modified removable framework for a partial denture (made from chrome cobalt).

With the denture superstructure (casting) thus formed, it may be necessary to place retentive components in or on the bar to afford retention against vertical dislodgement. Loops, nail heads or beads on the castings retain the denture base resin and the denture teeth.

Spark-erosion techniques allow the creation of very precise restorations for implant-supported removable prostheses.[1] Because the gap between the implant component and the denture superstructure is well controlled and kept to a minimum, this technique offers maximum stability and retention. Unfortunately, such precisely fitting superstructures are so expensive that cost precludes their use for most patients. The laboratory cost for spark-eroded castings is about $3,000, and the prosthesis must be created in a laboratory specially equipped to provide this service. An alternative type of prosthesis, developed with the refined techniques used for removable partial dentures, can offer similar results at a fraction of the cost.[2]

Initial Clinical Procedures

Surgical preparation for implant placement in the edentulous maxilla often entails sinus elevation and bone grafting to create adequate bone to hold the implants.[3] The techniques for these procedures are adequately described in

the dental literature and are a standard of practice for oral surgeons and periodontists who place implants.[4] The literature indicates that at least 4 to 6 implants should be placed.[5,6] There is no particular advantage to placing implants in the anterior region if the posterior implants are well integrated and joined with a bar equivalent. In fact, implants in the anterior region often pose problems for the restoring dentist, as the space requirements for proper placement of anterior teeth may be violated.

Impressions

A preliminary impression, of sufficient quality to allow fabrication of a temporary denture base, is made. On this temporary base, accurate jaw relation measures are recorded. For both esthetic and functional reasons, the final position of the denture teeth must be established before the implants are placed. A variety of surgical stents can be made from this set-up to inform the surgeon of the desired implant positions.

The final impression for either type of denture superstructure is the same. The master cast should have implant analogues, which ideally are perfectly related to each other in the master cast, so that the initial fabrication of the components can proceed. The master cast is mounted, with an autopolymerized resin base, in centric relation to the opposing cast. A tooth set-up is then completed for the patient's approval, so that the final position of the bar can be determined. An occlusal index is formed to allow the denture teeth to be repositioned on the master cast at any time in the construction process.

Framework Construction

The gold cylinders or UCLA-type abutments are placed on the laboratory analogues with either wax or a combination of autopolymerized resin and wax on their outer surfaces. The selected bar forms are added to the waxed cylinders (the Hader Bar, Attachments International, San Mateo, Calif., is a commonly used bar form). The buccolingual position of the bars is determined with reference to the desired final tooth position. Additional wax is added to the lingual surfaces of the cylinders to create bulk for milling. Parallel guiding planes are established on the lingual contours of the added wax on the cylinders by means of a dental surveyor or a wax-milling burr in a milling machine (Fig. 1). Additional guiding planes are established on the distal slope of the most posterior

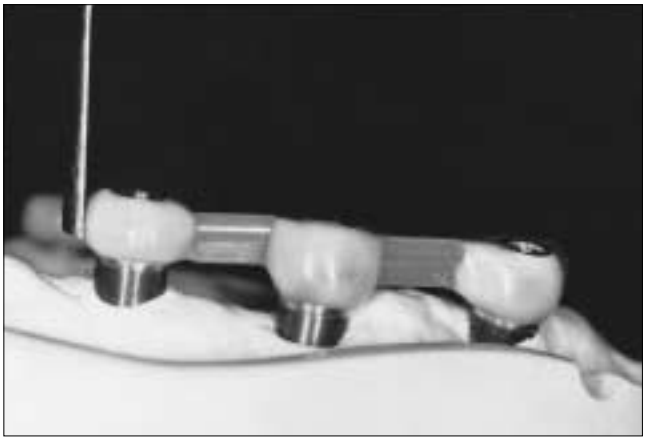

Figure 1: *Waxing of parallel guiding planes on the lingual and distal contours of the cylinders.*

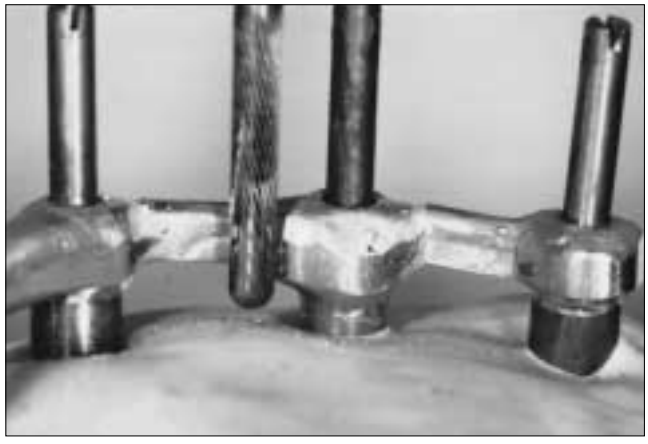

Figure 2: *Final milling of the cast bar.*

Figure 3: *Blocking out of the completed bar.*

Figure 4: *Completed casting seated on the implant bar.*

cylinder to create anterior–posterior stability. The waxed bar substructure is sprued and cast in the usual manner.

The bar substructure is often cast in segments, so that the sectional fit can be verified intraorally and the segments soldered or laser welded to yield a passively fitting unit. Once this has been accomplished, the finished casting must be returned to the master cast. Often, some of the implant analogues must be repositioned, since only rarely does the bar substructure fit exactly the same in the mouth and on the cast. If there are large errors in implant position on the master cast, it is often easier to pick up the entire assembly in another final impression in a custom tray. This transfer impression is made with a firm material (such as Impregum F, ESPE, Norristown, Pa.). All undercuts on the bar substructure must be blocked out with soft wax before the impression is made so that the impression can be removed without distortion. After the bar substructure is removed from the mouth, new laboratory analogues are attached to the bar and the bar is reinserted in the master impression. The impression is then boxed and poured. This master cast must be related to the opposing cast before construction is completed.

Final milling of the bar substructure is performed with parallel-sided milling burrs in a milling machine (for example, the Kavo EWL-K9 milling machine, Leutkirch, Germany) (Fig. 2). The actual size of the milled surfaces varies greatly, depending on the space available. The desired final result is a series of parallel guiding planes on the lingual surfaces of the gold cylinders. The labial surfaces are not milled. The bar substructure can be made to fit directly onto the implant or onto the transmucosal abutment, depending on the space available between the implant head and the desired occlusal plane.

The retentive elements are then placed on the bar and all undercuts blocked out before duplication. A palatal bead line is established as it would be for a removable partial-denture casting. The labial surfaces of the bar substructure are blocked out with a taper of 6° to 8° so that the chrome cobalt over-casting will be easier to fit (Fig. 3).

The bar and master cast are duplicated and the denture superstructure is waxed on the refractory cast. The superstructure uses the top of the bar substructure as its vertical stop. Openings are created for the retentive elements so that they can be picked up in the mouth after the denture superstructure is completely fitted to the bar substructure. A palatal external finishing line is created, and retentive beads are placed to retain the resin and the denture teeth. The labial extension of the denture superstructure ends buccal to the ridge crest and before any labial undercut is encountered.

The chrome cobalt superstructure is finished by means of very conservative techniques already established for removable partial-denture castings.[2] It is essential that the denture superstructure contact the milled guiding planes. The fitting of the superstructure to the bar substructure is the most difficult part of this technique, since access to the inner surfaces of the denture superstructure is restricted and the metal is hard to adjust. A disclosing medium (Fit Checker, GC Corporation, Tokyo, Japan) is used to identify areas of premature contact. When finally seated, the frictional fit of the superstructure results in a very stable prosthesis (Fig. 4).

Final Clinical Procedures

A variety of retentive mechanisms are available. The cross-section of the labial surface of the bar substructure is round, which allows direct retention by means of a snap undercut mechanism of the clip processed in the denture superstructure. Indirect retention is derived from the parallel nature of the lingual path of insertion.

The retentive elements are attached to the denture superstructure in the mouth to ensure positive contact between the superstructure and the underlying soft tissues. A small amount of autopolymerizing denture resin with all flocked fibres removed is painted onto the housings of the retentive elements, and the elements are placed in a pressure pot to achieve the best possible resin–housing interface. Once set, the housings and their retentive elements are placed on the bar substructure in the mouth, and the denture superstructure is seated and held in place by the clinician while an assistant paints on additional autopolymerized resin to join the housings to the denture superstructure. The fully seated position is maintained until the added resin is fully polymerized. The retention and stability of the denture superstructure is reviewed and, if acceptable, the denture teeth are repositioned from the previously made index. Associated wax contours are added to the denture superstructure for a final try-in.

Final Laboratory Procedures

Before processing the denture base resin, the superstructure must be rendered opaque, since the metal often shows as a dark line through the anterior denture base. Tinting the denture base resin to match the patient's gingival colours (with a product such as Kayon Denture Tinting Kit, Kay-See Dental Manufacturing Co., Kansas City, Miss.) completes the creation of the prosthesis. ◆

Dr. Brudvik is professor emeritus in prosthodontics, University of Washington School of Dentistry, Seattle, Washington.

Dr. Kavita Chigurupati is an assistant professor in prosthodontics, Ohio State University School of Dentistry, Columbus, Ohio.

Correspondence to: Dr. James S. Brudvik, Department of Prosthodontics, Box 357452, University of Washington, Seattle, WA 98195-7452. E-mail: brudvik@u.washington.edu.

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References

1. Van Roekel NB. Prosthesis fabrication using electrical discharge machining. *Int J Oral Maxillofac Implants* 1992; 7(1):56-61.

2. Brudvik JS, Reimers D. The tooth-removable partial denture interface. *J Prosthet Dent* 1992; 68(6):924-7.

3. Tatum OH Jr. Maxillary and sinus implant reconstructions. *Dent Clin North Am* 1986; 30(2):207-29.

4. Smiler DG, The sinus lift graft: basic technique and variations. *Pract Periodontics Aesthet Dent* 1997; 9(8):885-93.

5. Zitzmann NU, Marinello CP. Implant-supported removable overdentures in the edentulous maxilla: clinical and technical aspects. *Int J Prosthodont* 1999; 12(5):385-90.

6. Chan MF, Narhi TO, de Baat C, Kalk W. Treatment of the atrophic edentulous maxilla with implant-supported overdentures: a review of the literature. *Int J Prosthodont* 1998; 11(1):7-15.