# A Predictable Precision Cast for Multi-Unit Screw-Retained Implant Prosthesis: Rationale and Technique

Lambert J. Stumpel, III, DDS; Walter H. Haechler, MDT; and Edmond Bedrossian, DDS

**ABSTRACT**

The aim of this article is to describe a technique derived from the premachined cylinder luting technique with the goal to predictably fabricate a highly precise master cast. An impression can be taken directly at implant level or, with some technique modification, at the abutment level. Concurrently, multiple techniques can be employed to fabricate the final framework with the assurance that a framework that fits the cast will fit in the mouth. This predictability improves the workflow of the restoring dentist and laboratory technician since multiple framework try-ins and adjustments are eliminated.

From the early years of implant dentistry, it was recognized that if implants were to be connected it was to be done in a passive, nonstress-inducing manner.[1-3] Recent literature suggests a wide variation in biological tolerances in relation to the detrimental effects from static loading, as would be created by ill-fitting framework-to-implant connections.[4-7] The gold screw to the abutment in the Brånemark system creates a clamping force of 300 N.[8] When the fit is incorrect, some of these forces will be transferred as axial and torque forces into the prosthetic components and the bone implant interface. In vivo research[9-11] confirms the introduction of considerable stresses when implants are connected using traditional prosthetic techniques.

The induction of unfavorable stress in the implant-suprastructure connection may be responsible for loss of osseointegration and failure of prosthetic components.[12-14] Discrepancies are inherent in the different stages of any framework production, due to different material and technique characteristics. This has led authors to question the feasibility of attaining a completely passive implant and suprastructure connection using conventional techniques.[15-17] Potential discrepancies between the oral situation and the master cast can be associated with impression techniques,[18-22] repositioning techniques,[23] and stone expansion.[24-26]

In trying to improve definitive precision, one of the techniques that has been developed is the concept of intraorally luting premachined cylinders to the metal implant framework. Multiple variations of this technique have been described,[27-29] all aiming at



**Authors /** Lambert J. Stumpel, III, DDS, is in private practice in San Francisco. He is also the director of implant prosthetics, Surgical Implant Training, at the Highland Hospital Oral and Maxillofacial Residency Program, University of the Pacific, San Francisco. Dr. Stumpel is also an assistant clinical professor at the University of California San Francisco School of Dentistry, Department of Restorative Dentistry.

Walter H. Haechler, MDT, is a master dental technician in Corte Madera, Calif.

Edmond Bedrossian, DDS, is in private practice in San Francisco. He is also the director of surgical implant training at the Highland Hospital Oral and Maxillofacial Residency Program, University of the Pacific. Dr. Bedrossian is also an associate professor and director of restorative implant training at the University of the Pacific Advanced Education in General Dentistry, Residency Program.

creating a passively fitting framework. Improved fit compared to the result of conventional techniques has been confirmed by different authors.[30-32]

The aim of this article is to describe a technique derived from the premachined cylinder luting technique with the goal to predictably fabricate a highly precise master cast. An impression can be taken directly at implant level or, with some technique modification, at the abutment level. Concurrently, multiple techniques can be employed to fabricate the final framework with the assurance that a framework that fits the cast will fit in the mouth. This predictability improves the workflow of the restoring dentist and laboratory technician since multiple framework try-ins and adjustments are eliminated.

## Technique

1. Tighten implant level transfer impression copings (Nobel Biocare, Goteborg, Sweden) after confirming complete seating with radiographs.

2. Capture relationship of impression posts and soft tissue with polyvinyl impression material (Extrude Extra, Kerr, Romulus, Mich.) in a stock tray (Coetray, GC America, Alsip, Ill.).

3. Connect implant level analogs to impression copings (Nobel Biocare, Goteborg, Sweden). Inject gingival mask (Henry Schein, Inc., Melville, N.Y.), and form cast in stone (Tuff Rock Formula 44, Talladium Inc., Valencia, Calif.).

4. Use this primary cast, after mounting, for the conventional prosthetic workup. The resulting implant-supported trial setup is connected with two nonhexed temporary cylinders (Attachments International, Inc., San Mateo, Calif.). The first cylinder is connected on the primary cast to the try-in base. The second cylinder is connected intraorally with Triad gel (Dentsply International, Inc., York, Pa.) to the acrylic resin base.

5. Modify impression copings (Nobel Biocare, Goteborg, Sweden) by removing the hexagonal elements on the internal aspects of these copings. This will eliminate any locking onto the external hex of the implants. The external aspects of the copings are air abraded with 50 µm of aluminum oxide. This will enhance the future bonding between the luting composite and the metal. Connect the modified copings to the implant analogs.

6. A uniform spacer is created with help of a 3/16-x-1/8-inch vinyl tubing.

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The modified impression coping is heated over a Bunsen burner, pushed into the tubing, and cut to the desired height. The approximate spacer thickness is 0.5 mm.

7. Fabricate a rigid pattern by connecting the impression copings together with GC resin (GC America Inc., Alsip, Ill.). The connecting areas are approximately 3 mm in diameter. For easy removal and separating between vinyl and resin, a fine film of petroleum jelly is applied. After hardening of the acrylic, unscrew the impression copings, then remove the assembly from the primary cast, and push the copings and the vinyl spacers out of the framework.

8. Cast this wax framework in Chrome Cobalt (Jelenko JP, Jelenko, Armonk, N.Y.). Reposition the cast framework onto the impression copings on the primary cast. The framework shows a uniform space of approximately 0.5 mm circumferentially around the titanium cylinders. This space will eventually be filled with composite resin.

9. Intraoral isolation is accomplished with a rubber dam and cheek retractors. A sheet of rubber dam (Hygenic Dental Dam, Coltene/Whaledent, Inc., Mahwah, N.J.) is placed over the impression copings on the primary cast, marked, and perforated with a rubber dam punch. This rubber dam is placed over the copings intraorally. When a more rigid setup is required, a reinforced rubber dam can be fabricated by placing a sheet of ethylene vinyl acetate material over the copings on the primary cast. The copings are marked and perforated with a lab bur to a dimension of approximately 8 mm. The outer dimensions of the cast are transferred to the EVA sheet. The EVA sheet is cut with scissors according to this line. Multipurpose adhesive (Super 77, 3M, St. Paul, Minn.) is sprayed over this EVA sheet, and a sheet of rubber dam is placed over it. Once the glue has dried, the extending part of the rubber dam is removed. This EVA/rubber dam sandwich is placed over the copings on the primary cast. The copings are marked, and these markings are perforated with a rubber dam punch.

10. Remove the intraoral healing caps, and place the modified impression copings onto the implants. As the hexagonal mating part has been removed, the copings will seat with-

out binding onto the implant flange. Tighten the copings and place the rubber dam over the copings. Fit the cast framework — this should be non-binding and passive — with some residual spacing between the bar and the copings. One will find that this spacing now can be less uniform then on the primary cast, indicating discrepancies between this cast and the intraoral situation.

11. Clean the surface of the impression coping with alcohol and dry completely. Exercise care as not to contaminate the metal surfaces with saliva. Mix Panavia F (Kuraray America, New York, N.Y.), a dual polymerizing phosphate-modified luting composite resin with high bond strength to metals;[33,34] and place in a needle tube syringe (Centrix, Shelton, Conn.). Position the framework over all the cylinders and hold in position as to create the best distribution of the available space between all cylinders and the intaglio of the framework. On the primary cast, this space was an even 0.5 mm; intraorally the distribution is most often different. Now inject the Panavia F between the cylinder and the framework, stabilize the framework so it is fitting passively, then initiate polymerization of the luting composite resin with a curing light (Demetron 500, Kerr, Romulus, Mich.). As the light will only have access to the peripheral composite resin, the assembly is left in place for 10 minutes to complete the chemical polymerization step of the composite resin. At this time, the exact relative three-dimensional positions of all the implant platforms is now recorded.

12. The next step is to relate the implant position to the soft tissue. Remove the rubber dam from the bonded assembly by cutting it away. Create access in a stock tray so all the lab screws protrude trough it. A polyvinyl siloxane material is used for the impression (Extrude extra, Kerr, Romulus, Ill.) — low viscosity is injected around the framework and high viscosity in the tray. Position the tray so that all the screws are accessible. Upon setting of the impression material, loosen the screws. The luted frame assembly is embedded within

the pick-up impression.

13. Position new implant analogs onto the cylinders of the framework. The analogs have a hexagonal top, whereas the cylinders do not. The position of the hexagon is inconsequential, as the definitive framework will not have the mating internal hexagon. Tighten the analogs with similar tightness to the cylinders to the implant platforms. Soft-tissue mask material (Gingival Mask, Henry Schein, Inc. Melville, N.Y.) is injected into the impression. After setting, minimal expansion stone (Tuff Rock Formula 44, Talladium Inc., Valencia, Calif.) is poured into the impression. The authors' hypothesis is that any expansion of the stone will be of diminished consequences as far as implant position is concerned. Since the assembly is massive and rigid, it will resist the expanding stone from displacing the analogs. This is in contrast to a similar assembly made in acrylic resin where the expanding forces can bend the acrylic resin assembly, thus creating inaccuracies.

14. Dental stone undergoes a delayed linear expansion,[35] therefore the cast is left undisturbed for 72 hours. Upon setting, the screws are

Figure 1. The primary cast with impression copings.

Figure 2. The EVA sheet is adapted to the copings and will function as a carrier for the rubber dam.

Figure 3. The modified impression coping. The hexagonal component has been milled out.

Figure 4. The modified impression copings are connected to the implants.

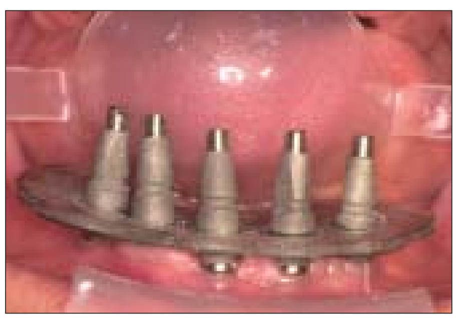

Figure 5. The reinforced rubber dam is placed.

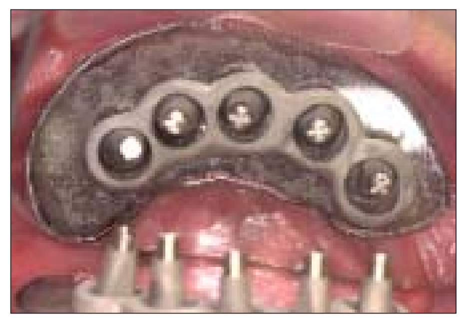

Figure 6. Bird's eye view showing the spacing between the bar and the copings.

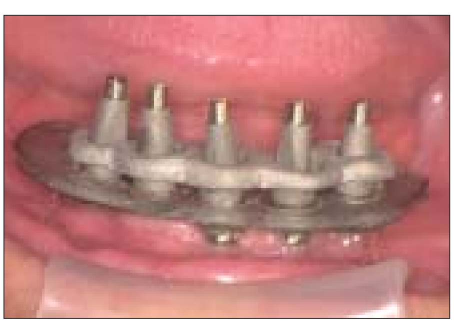

Figure 7. Buccal view — the bar is fitting passively.

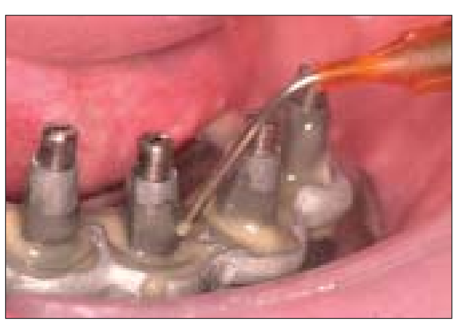

Figure 8. Panavia F is injected in the space between the bar and the copings

Figure 9. The bar is stabilized, and photo polymerization is initiated.

loosened and the impression separated from the cast. The precision cast is trimmed on a dry trimmer and is then ready for the manufacturing of the final framework for the multi-unit screw-retained implant prosthesis.

## Summary

Implant-supported frameworks require a high level of precision of fit.

Figure 10. The bonded assembly.

Figure 11. The bar has been removed for illustrative purpose.

Figure 12. The rubber dam has been removed, and the assembly is readied for a pick-up impression.

Figure 13. The pick-up impression is relating the soft tissue to the implant position.

Figure 14. The final precision cast.

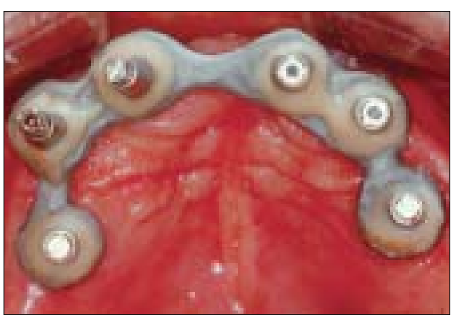

Figure 15. A maxillary impression bar.

Figure 16. The final hybrid restoration.

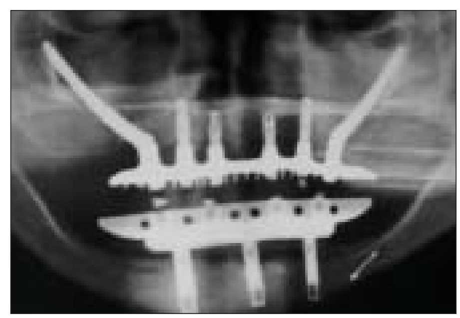

Figure 17. Radiographic depiction of final maxillary hybrid prosthesis.

Figure 18. An impression bar on the primary cast.

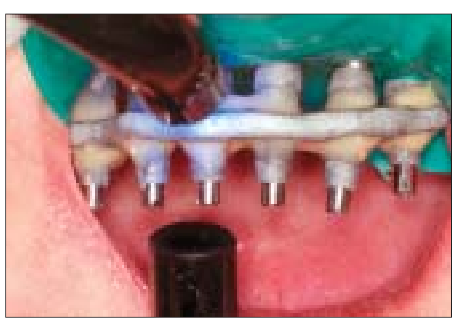

Figure 19. Photo polymerization of the Panavia F cement.

Figure 20. The screw-retained maxillary hybrid.

Well-fitting frameworks will minimize prosthetic and biologic complications. Clinically attaining this level of prosthetic precision is difficult, and many production techniques have been developed. The objective of the implant team is to deliver a high-quality restoration through a predictable production process. The predictability of the process enables the control of time, cost, and quality. A framework fitting a cast will only fit in the mouth if the cast is an accurate reflection of the intraoral situation. The objective of the described technique is to generate a predictable precision cast. The additional cost of the impression bar is easily recouped with the decrease in clinical and laboratory time. Improving the level of control of the production process will decrease the stress of the team serving the implant patient. CDA


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**To request a printed copy of this article, please contact /** Lambert J. Stumpel, III, DDS, 450 Sutter St., Suite 2530, San Francisco, CA 94108 or stumpel@pacbell.net.