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Fabrication of a Fixed Retrievable Implant-supported Prosthesis Based on Electroforming: A Technical Report

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Abstract

This article describes a method of fabricating a fixed retrievable implant-retained prosthesis based on electroforming. This method combines the advantages of both the cement- and screw-retained prostheses, including passive fit, ease of fabrication, and retrievability. The absence of visible occlusal screw-canals adds to its increased esthetic appeal.

Implant rehabilitation of the edentulous jaw remains one of the most complex restorative challenges due to a number of variables that affect both the esthetic and functional aspect of the prosthesis.[1] Implant-supported prostheses for edentulous patients can be removable or fixed; fixed restorations may be either screw- or cement-retained. Because they can be easily retrieved, screw-retained restorations have been widely used. They are considered the gold standard by many clinicians.[2,3] Nevertheless, cement-retained prostheses have increasingly become the restoration of choice for implant rehabilitation of the edentulous patient due to an increasing demand for an esthetic result, as well as other advantages, such as requiring a less demanding laboratory procedure and having a higher framework passivity.[3-5] Cement-retained restorations can compensate for shortcomings in the fabrication procedure through the cement layer,[4] while a screw-retained prosthesis cannot, because it requires a demanding technical procedure that includes the casting of a one-piece framework on cast-to abutments. Enhancing the accuracy and the passivity of fit of screw-retained restorations involves time-consuming passivation procedures, such as electroerosion or laser-welding.[6-8]

The fabrication of implant-supported prostheses is based on many sensitive steps. Each step involved in the production process is prone to inaccuracies that can add to a misfit of the final superstructure.[3] Potential errors can occur during the impression procedure, the fabrication of the master cast or wax patterns, or the investing, the casting, and the firing of the porcelain. By choosing the most accurate procedure possible, the influence of each of these sources of error can be minimized. The impression made using the pick-up method with splinted impression copings has the fewest errors.[9] By bonding the framework to a mesostructure, the investing and casting procedures, as well as the firing of the porcelain, do not influence the precision and passivity of fit, which can contribute to distortion of the superstructure.[10] Gaps resulting from imprecision can be compensated for by using a luting agent. Therefore, this intermediate element needs to possess properties that can withstand cyclic loading forces over a long period of wear, be resistant to chemical reactions caused by bacteria, and be able to retain its retentive force. To date, no material has been found that can fulfill these criteria. Thus, any cement material will have its drawbacks.

A very precise fit is necessary to achieve retention without applying cement. This can be accomplished by using electroforming technology on conical or in part-parallel abutments. The successful use of this technology in implant dentistry includes removable dentures retained by a cone-shaped telescopic crown.[11] The retention mechanism of conical double crowns based on electroformed copings is known to have a desirable retentive force over a longer period of time.[11,12] The electroforming technology used in implantology involves the deposition of 24 K gold directly onto the abutment or primary structure, which allows a marginal median accuracy of 4.9 μm.[11,13,14]

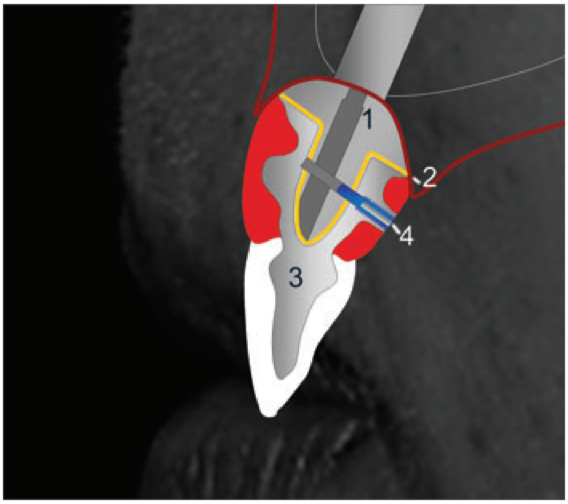

Figure 1 The basis of the superstructure consists of vertically screwed abutments (1), on which electroformed copings are galvanized (2), a tertiary structure casted in one piece (3) carrying the ceramic glued onto the electroformed copings (2) and for additional retention, three horizontal screwed bolts (4) placed throughout the restoration.

This technical report describes an implant-retained, fixed superstructure consisting of a single primary unit, either an individually fabricated or a prefabricated abutment vertically fastened to the implant. The electroformed copings, which serve as a mesostructure, are placed on these primary units. The tertiary structure carrying the porcelain is bonded to the mesostructure. The luting agent is administered as a very thin film between the coping and the primary unit to minimize bacterial leakage and not for retentive purposes. For additional security to avoid unexpected displacement of the restoration, a limited number of horizontal bolts are used (Fig 1).

Figure 2 If a provisional precedes the fabrication of the definite restoration, the provisional is duplicated in polyurethane and used as a matrix for silicon keys. Therefore, the provisional should allow repositioning on the implant analogs of the master cast.

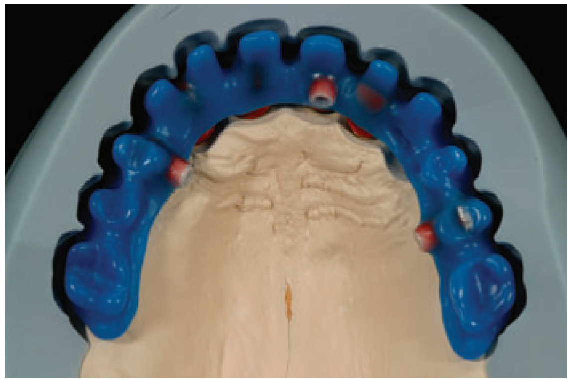

Figure 3 The silicone matrix guides the waxing of the tertiary structure.

Technique

The traditional procedure involving an open-tray impression from the fixture level using splinted transfer copings should be done for master cast fabrication. Followed by the registration of the centric relation position, a wax try-in is used until the teeth are ideally positioned. This is either transferred into the fabrication of a provisional fixed implant-retained restoration or directly used as a template for the fabrication of the definitive restoration. If a provisional restoration precedes the definitive restoration, the procedure is started at step 1, otherwise proceed to step 2.[15,16]

1. A duplicate of the implant-retained provisional restoration using a polyurethane resin (Alpa-Pur; Alpina W. Seibicke GmbH & Co KG, Munich, Germany) is made and repositioned on the implant analogs of the master cast poured with type IV gypsum (uni-base® 300; Dentona AG, Dortmund, Germany) (Fig 2).
2. A silicone matrix (Sil-Tech; Ivoclar Vivadent AG, Schaan, Lichtenstein) to guide the fabrication of the waxing is made either of the wax try-in or of a duplicate of the provisional restoration (Fig 3).
3. The primary units are cast in high-gold casting alloy (Orplid CF; Hafner, Pforzheim, Germany), although prefabricated abutments may also be used. The cast abutments

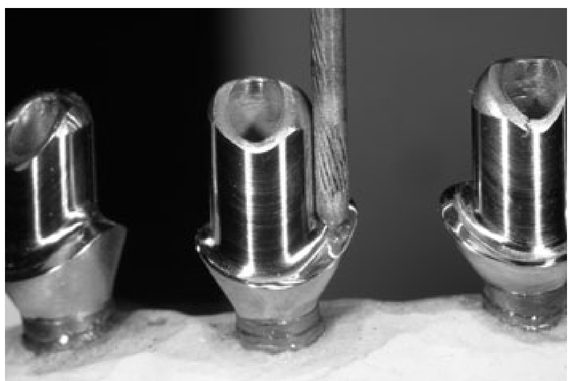

Figure 4 The individually fabricated abutments are milled parallel in the lower third, and with a 2° angle in the upper two-thirds.

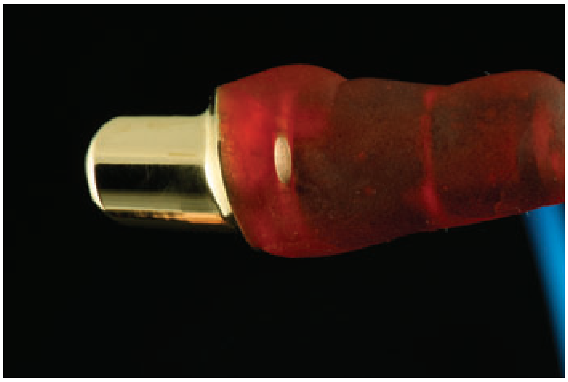

Figure 5 The primary units (abutments) are prepared for the electroforming process using an autopolymerizing resin to cover areas not subject to electroforming.

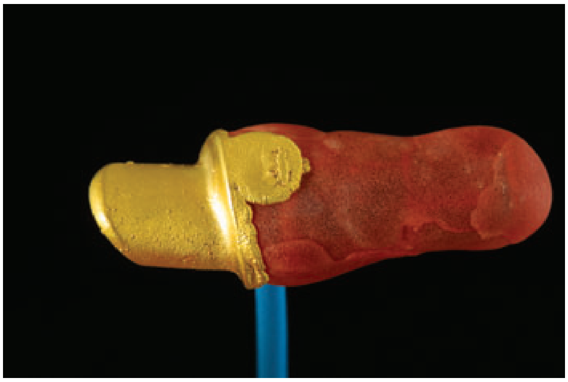

Figure 6 Gold (24 K) is deposited directly onto the abutment with a thickness of 0.2 μm.

Figure 7 The abutments and copings are positioned intraorally to be collected with an individually fabricated pick-up tray.

Figure 8 Autopolymerizing resin is used for a stable positioning of the copings in the tray. This step is essential for fabricating a new master model, enabling the gluing of the electroformed copings to the tertiary structure in the laboratory.

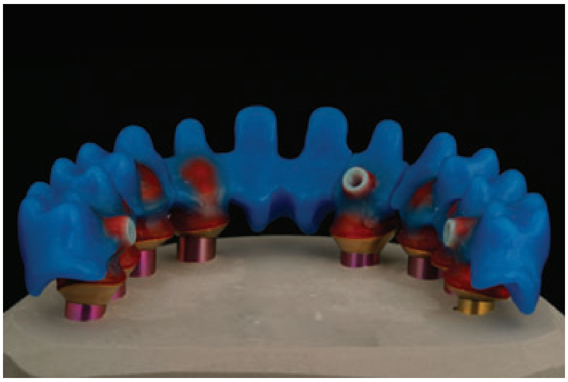

Figure 9 The waxing of the tertiary structure is performed on the new master model.

Figure 10 The porcelain is applied in the usual manner. Pink and white ceramic can be used in this type of restoration if needed.

are milled parallel in the lower third with a 2° angle in the upper two-thirds to ensure an easy incorporation (Fig 4).

4. The primary units are prepared for the electroforming procedure by spray-coating the abutments with a thin layer of silver lacquer. Prior to the spraying of the silver lacquer, all areas not to be electroplated are covered with autopolymerizing resin (Pattern Resin; GC Dental Corp., Tokyo, Japan) (Fig 5). The primary units are then placed in a fully automated electroplater (HF Vario Plus; Hafner) (Fig 6). The copings are easily separated from the abutment, as the latter has parallel polished surfaces.
5. Clinically, the primary units are placed intraorally with the electroformed copings seated on the primary units

Figure 11 After the porcelain work is finished, the tertiary structure is glued to the electroformed copings using the new master model.

Figure 13 Definitive fixed implant-retained prosthesis placed intraorally.

(Fig 7). These are then collected using a prefabricated pick-up tray made of light-polymerizing resin (Individulux; Voco, Cuxhaven, Germany) and using an autopolymerizing resin (Pattern Resin) (Fig 8). This step is essential to ensure that the structure fits accurately, and it also enables the gluing of the tertiary structure to the mesostructure in the dental laboratory.

6. The primary units are connected to the implant analogs and accurately repositioned into the splinted electroformed copings. A new model with type IV gypsum (unibase® 300) is then poured.
7. The waxing of the tertiary structure is performed on the new cast (Fig 9). Investing is performed using traditional methods, and casting results in a one-piece framework from the high-gold alloy (Expert; Jensen Industries, North Haven, CT). The space between the copings and the framework is caused by distortions due to the prior steps and allows a self-curing composite bonding agent to be accommodated.
8. Ceramic (Creation; GC Dental Corp.) is applied in the usual manner on the casted tertiary structure. Pink and white porcelain may be used if needed (Fig 10).
9. In the laboratory, using the new cast, the electroformed copings are glued (AGC-Cem; Wieland Dental Technik, Pforzheim, Germany) into the porcelain-carrying tertiary structure (Fig 11).
10. After gluing, the copings are perforated with a multidrill 1.4 mm (Bredent, Senden, Germany) to carry the horizontal bolts (Security Lock 1.4 mm; Bredent).
11. The primary units are placed intraorally, and the appropriate torque is applied to tighten the abutments. A very thin layer of provisional cement (ImProv; Dentegris Deutschland GmbH, Düsseldorf, Germany) is applied at the margin of each of the copings to seal them from bacterial leakage; this cement is not required for retention. Care should be taken to ensure that the copings are not totally filled with cement, because this would hinder the placement of the prosthesis due to the precise fit of the copings (Fig 12).
12. The occlusion is checked, and instructions for proper oral hygiene should be given (Figs 13 and 14).

Summary

The procedure described allows the fabrication of an esthetic and retrievable fixed implant-retained prosthesis. It also has the advantage of being an easy and timesaving chairside treatment, as the bonding of the tertiary structure to the mesostructure can be performed in the laboratory. The technique combines

Figure 12 The copings are lined with a thin layer of provisional cement in the marginal area to minimize bacterial leakage.

Figure 14 Implant-supported prosthesis placed in the maxilla and mandible of the edentulous patient.

the advantage of the screw-retained restoration by allowing the predictable removal of the structure with the advantages of cement-retained restorations by increasing the passivity of the fit, as well as enhancing the esthetic and occlusal design, because no vertical screw-canals are present.

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