The combination prosthesis: A digitally designed retrievable cement- and screw-retained implant-supported prosthesis

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Screw-retained prostheses have the advantage of being easily retrievable.1,2 However, the presence of occlusal access channels compromises their esthetics, ceramic strength, and occlusion.3 Cement-retained prostheses are easier to fabricate, offer easier delivery in the posterior area of the mouth, and have higher potential for passive fit.3,2,4,5 Although an earlier systematic review focusing on implant and prosthesis survival rate indicated no differences between cement-retained and screw-retained prostheses,6 a more recent systematic review revealed significantly more biological complications with cement-retained prostheses, whereas screw-retained prostheses demonstrated increased technical complications.7 Similar findings were published by Wittneben et al8 and Millen et al,9 where screw-retained restorations were associated with an increased rate of technical complications. Finite element analysis10 and clinical11 studies have indicated similar results when screw-retained prostheses were associated with an increased risk of mechanical complications.

A major limitation of cement-retained implant restorations is the difficulty in removing the excess cement.12,13 Residual cement remnants have been associated with peri-implantitis.14-19 To address this limitation, some authors20-23 have introduced a new design of screw-retrievable and cement-retained implant supported prostheses featuring the combined advantages of both modes of retention. Nissan et al23 in a clinical study reported that the combination of cement- and screw-retained implant prosthesis improves the survival rates of the prosthesis and lowers the cost of maintenance without increasing the risk for porcelain fracture or screw loosening.

The purpose of this article was to describe a digital workflow for the fabrication of a combination screw- and cement-retained prosthesis for patients with partial edentulism. The combination prosthesis may offer the advantages of both retentive mechanisms for the definitive implant prosthesis.

TECHNIQUE

1. Inspect the peri-implant soft tissue for any sign of soft tissue pathosis. Evaluate periapical radiographs to ensure osseointegration. Evaluate implant mobility by using either the Perio test device (PerioTest; Siemens AG)24 or resonance frequency analysis.25 In the clinical situation, 2 parallel threaded, root form resorbable blast medium (RBM)-surfaced dental implants (Hahn Tapered Implants; Glidewell Laboratories) were placed at the maxillary left first premolar and first molar area. 

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2. Make complete-arch definitive impressions of the patient’s maxillary and mandibular arches with polyvinyl siloxane impression (PVS) material (Genie VPS; Sultan Healthcare). Make an interocclusal record with PVS occlusal registration material (Exabite II NSD; GC America Inc). Fabricate the definitive stone cast from Type IV dental stone (Glastone; Dentsply Sirona) after making the definitive impression with the intraoral splinting technique.

3. Place a scanning abutment on the implant analog and scan the impressions (D700; 3Shape). Simulate the definitive prosthesis with the provided software. Design 2 separate milled titanium abutments and a cementable superstructure zirconia prosthesis (Fig. 1). Design the cementable prosthesis with an occlusal access opening so that access to the abutment screw can be obtained from the occlusal surface (Fig. 2).

4. Mill the titanium abutments from a titanium blank (Inclusive Custom Titanium Abutments Blanks; Glidewell Laboratories) and the cementable superstructure zirconia prosthesis (Fig. 1). Design the cementable prosthesis with an occlusal access opening so that access to the abutment screw can be obtained from the occlusal surface (Fig. 2).

5. Mill the titanium abutments from a titanium blank (Inclusive Custom Titanium Abutments Blanks; Glidewell Laboratories) and the cementable superstructure zirconia prosthesis (Fig. 1). Design the cementable prosthesis with an occlusal access opening so that access to the abutment screw can be obtained from the occlusal surface (Fig. 2).

6. Position the prosthesis over the abutments (Fig. 3B). Evaluate the interproximal contact areas; and complete the prosthesis fit, occlusion, esthetics, and accessibility for oral hygiene.

7. Place cement (RelyX Luting Plus Cement; 3M ESPE) in the prosthesis and secure the prosthesis over the abutments. Apply pressure and allow sufficient time for the cement to polymerize (Fig. 4).

8. Clean the excess cement from the occlusal access channels and remove the prosthesis (Fig. 5A). The prosthesis has now been converted into a screw-retained prosthesis. Remove the excess cement from the cervical area of the prosthesis (Fig. 5B).

9. Insert the definitive combination prosthesis intraorally. Tighten the abutments according to the manufacturer’s recommendations. Confirm occlusion and proximal contacts. Place a cotton pellet and composite resin (Filtek Supreme Ultra; 3M ESPE) to seal the occlusal access channels (Fig. 6).

**DISCUSSION**

The primary advantage of a screw-retained design is the ease of prosthesis retrievability. Prosthetic complications can be better addressed when the prosthesis is easily retrievable. However, cement-retained prostheses have been documented to offer better esthetics, better occlusion, and superior passive fit than screw-retrievable prostheses. Superior passive fit is associated with higher reduction of stresses on the supporting implants and strain on the prosthesis. Both retentive mechanisms are acceptable as long as the clinician can weigh the advantages and limitations of each retentive mechanism for a specific clinical situation. The suggested combination screw- and cement-retained implant-supported prosthesis combines the advantages of both the cement and screw retention mechanism, offering an additional design consideration.

Rajan and Günaseelan introduced the concept of fabricating a combination screw- and cement-retained prosthesis. The concept was first applied for a single implant-supported crown where a metal-ceramic crown was cemented on a cast custom abutment. Uludag and Celik and Uludag et al described the concept of a combination prosthesis for multiunit implant restorations where a fixed metal-ceramic partial denture was cemented on multiple cast custom abutments. The significance of the described methodology is the implementation of digital technology in designing and fabricating such a combination prosthesis. Currently published papers describing the fabrication of a combination prosthesis involve conventional cast custom abutments and conventional metal-ceramic crowns or multiunit prostheses made of cast high noble metal.

The described technique is not limited by the availability of a definitive stone cast but can be applied to a clinical situation where an intraoral scanner is used instead of a definitive impression. It can also be applied for long span prostheses involving multiple abutments, assuming all abutments are designed with axial walls that would allow a path of insertion for the superstructure.

The described combination prosthesis offers an advantage compared with an implant-supported zirconia prosthesis.
fixed partial denture that involves cementation of the prosthesis on prefabricated titanium inserts. The described combination prosthesis allows the addition of porcelain on the superstructure after the prosthesis is completed. When the interproximal contacts have been confirmed, the clinician can then cement the superstructure intraorally as described. In contrast, a zirconia prosthesis that has cemented prefabricated titanium inserts does not allow porcelain application after completion because the high temperature in a porcelain oven would damage the composite resin typically used to cement the titanium inserts. Therefore, if an open contact is observed after fabricating a zirconia prosthesis with cemented prefabricated titanium inserts, the clinician may have to remake the prosthesis.

A limitation of the described design protocol is the limited clinical data available to support the implementation of such a protocol on a routine basis. Nissan et al. published a clinical study that included 274 combination prostheses that were observed over a 12-year period. In that study, the abutments were cast custom abutments, and the superstructures were metal-ceramic prostheses made of cast high-noble metal. The combination prosthesis demonstrated an improved prosthetic survival rate and lower cost of maintenance compared...
with a conventionally cemented prosthesis without an occlusal access channel.

Another limitation of the described technique was the risk of intraoral locking of the combination prosthesis during cementation. This can occur if the supporting implants are not parallel. If nonparallel implants are restored with a combination prosthesis, nonengaging abutments should be used with a custom abutment orientation device. In addition, the described technique may not be used to restore unfavorably placed implants.

**SUMMARY**

The proposed technique offers an alternative method of fabricating a cement- and screw-retained combination prosthesis by implementing digital technology. Long-term human studies are needed to validate the use of the described technique on a routine clinical basis.

**REFERENCES**

Noteworthy Abstracts of the Current Literature

Implant utilization and time to prosthetic rehabilitation in conventional and advanced fibular free flap reconstruction of the maxilla and mandible


Purpose. Precisely designed jaw reconstruction rehabilitation (JRR) is important to the integrity of the jaw structure and oral functions. Advanced three-dimensional (3D) digital surgical design and simulation (SDS) techniques have the potential to reduce time to reconstructive and dental treatment completion, thereby promoting early functional oral rehabilitation. This study investigated the use of SDS in JRR procedures.

Material and methods. A retrospective chart review was conducted on adult head and neck tumor (HNT) participants who completed JRR treatment with a fibular free flap (FFF) reconstruction. Two treatment approaches, advanced 3D SDS technique (with-SDS) and conventional, nondigitally planned technique (without-SDS), included the use of osseointegrated implants. Data were collected from adult patients treated between January 2000 and March 2014 at the Institute for Reconstructive Sciences in Medicine (iRSM). Participants were excluded if they underwent a bone-containing augmentation to the FFF reconstruction. The without-SDS group underwent a conventional, nonguided FFF reconstruction followed by nonguided implant placement. The with-SDS group underwent a guided FFF reconstruction with guided implant placement during the reconstructive surgery. The outcome measures included implant utilization (ratio of implants placed to connected) and time to prosthetic delivery. Mann-Whitney U test was used to analyze the data.

Results. The digital SDS technique (with-SDS) group completed prosthetic treatment with a significantly higher utilization of implants as well as a significantly shorter time to prosthetic delivery.

Conclusions. SDS allows an interdisciplinary treatment team to work together to create a virtual plan that leads to greater efficiency in patient treatment time and utilization of dental implants.

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