DENTAL TECHNIQUE

A technique for immediately restoring single dental implants with a CAD-CAM implant-supported crown milled from a poly(methyl methacrylate) block

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An interim implant-supported prosthesis is beneficial in confirming esthetics, contours,1-3 and peri-implant tissue architecture.1-8 Proussaefs7 suggested the term “guided tissue healing,” where an interim implant-supported prosthesis was used to guide the soft tissue architecture. Interim restorations for single dental implants can be effectively provided on the day of surgery.8-12 Various methods have been suggested for transferring the soft tissue contours to the laboratory, including the use of the interim prosthesis as a custom impression coping,8,13 intraoral fabrication of a custom impression coping,12,14,15 implementation of digital scanning technology,16 and fabrication of milled impression copings.6,7 Joda17 reported that soft tissue tends to collapse after the interim prosthesis is removed. Therefore, accurate duplication of the peri-implant soft tissue could be difficult with conventional prefabricated impression copings.

The purpose of this article was to describe a technique where an interim screw-retained implant-supported crown could be fabricated from a milled poly(methyl methacrylate) (PMMA) block the same day of implant surgery with the use of a transfer stent (TS).18 In addition, a customized impression coping could be milled from a titanium blank, a process associated with superior accuracy.19 The contours of the custom impression coping could be designed to be identical to those of the interim prosthesis.

ABSTRACT

This technique is used when a single dental implant is placed. A stent made of autopolymerized acrylic resin was used to transfer the implant position to the laboratory. Once the implant position was transferred, the stone cast was scanned, and a computer-aided design and computer-aided manufacturing (CAD-CAM) interim implant-supported crown was milled from a poly(methyl methacrylate) (PMMA) block. A titanium insert, in contact with the implant platform and not the PMMA material, was used to support the crown. The interim prosthesis was then placed intraorally. The soft tissues were sutured, and the interim prosthesis was left for a period of at least 3 months to confirm osseointegration and allow the soft tissue to heal. A CAD-CAM titanium impression coping was made and used for the definitive impression. The contours of the impression coping were identical to the contours of the interim restoration. The data of the digital design of the interim prosthesis were saved, and the definitive prosthesis was fabricated with contours identical to those of the interim prosthesis. (J Prosthet Dent 2018;119:339-44)

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1. Evaluate the soft tissue around the edentulous area for signs or symptoms of pathosis (Fig. 1). Make complete-arch preliminary impressions preoperatively of the patient’s maxillary and mandibular arches with polyvinyl siloxane (PVS) impression material (Genie VPS; Sultan Healthcare). Make an interocclusal record with PVS occlusal registration material (Exabite II NSD; GC America, Inc) at the maximum intercuspal position.
2. Use the preliminary impressions to fabricate diagnostic stone casts. Use the diagnostic casts to fabricate a TS made of light-polymerizing acrylic resin (Triad; Dentsply Sirona). Make a hole on the TS at the edentulous area.18

3. Use an oversized osteotomy drill to simulate the osteotomy of implant placement on the stone cast (Fig. 2). Evaluate the simulated oversized osteotomy (SOO) on the diagnostic stone cast. A vacuum shell based on the diagnostic wax pattern can be used as a guide but is not necessary at this stage because the goal is to create a SOO that would accommodate the implant analog on the day of surgery; high precision, therefore, is not needed.

4. Reflect full-thickness labial and lingual flaps and, with the patient under local anesthesia, place the dental implant with the aid of a surgical stent and copious saline irrigation (Fig. 3A). Place an open tray impression coping on the implant and position the TS intraorally. The impression coping should be located in the hole prepared in the laboratory. Ensure there is no contact between the impression coping and the TS.

5. Place autopolymerizing acrylic resin around the impression coping and the TS (Fig. 3B). Remove any excess autopolymerizing acrylic resin material that would interfere with the occlusal screw access of the impression coping. Allow proper time for the polymerization to occur; remove the TS with the attached impression coping and attach an implant analog to the impression coping.

6. Mix autopolymerizing acrylic resin and place it in the SOO (Fig. 4A). Create a small vent hole around the vestibular area of the SOO to allow the venting of any excess acrylic resin material. Place the TS on the diagnostic stone cast and allow the acrylic resin to adequately polymerize (Fig. 4B). After polymerization, remove the TS; implant positioning has been replicated on the diagnostic stone cast. Then attach a scanning abutment and scan the stone cast (D700; 3Shape).

7. Design the contours, esthetics, and emergence profile of the interim screw-retained restoration (ISRR) by using the software that accompanies the specific scanner (Fig. 5A). The software provides internal space in the interim prosthesis in which the titanium prefabricated insert can be attached. Confirm the design, and mill the ISRR from a blank of prepolymerized PMMA, using a milling machine (TS150 Milling Solution; IOS Technologies).20 Attach a titanium insert to the interim prosthesis with resin cement (Panavia F2.0; Kuraray America, Inc) (Fig. 5B). Evaluate the contours, emergence profile, and interproximal contacts on the stone cast.

8. Insert the ISRR, and suture the flaps (Fig. 5C). Ensure that the interim crown is slightly in infraocclusion. Confirm occlusal clearance at approximately 40 μm with 4 layers of 10-μm shim stock (Occlusal registration strips; Patterson Dental Supply, Inc). Evaluate the proximal contacts with a single layer of shim stock before sealing the occlusal access hole. Allow proper time for osseointegration to occur.

9. While the implant is allowed to osseointegrate, design a customized impression coping by using the same software and follow the gingival contours
of the ISRR (Fig. 6). Mill the custom titanium impression coping (CTIC) from a titanium blank by using a milling machine.

9. After osseointegration has been conformed, remove the ISRR and evaluate the tissue profile (Fig. 7A). Insert the CTIC and make the definitive impression with PVS impression material (Fig. 7B).

10. Design the definitive prosthesis to have identical gingival contours as the ISRR (Fig. 8A). A screw-retained CAD-CAM milled zirconia crown with a metal insert was fabricated in the described clinical situation.21,22

11. Insert the definitive prosthesis (Fig. 8B). Confirm esthetics, occlusion, and interproximal contacts. The gingival contours of the definitive prosthesis should be identical with the gingival contours of the ISRR and CTIC. Place a cotton pellet and composite resin (Filtek Supreme Ultra; 3M ESPE) to seal the occlusal access hole.

**DISCUSSION**

The objective of the proposed technique is to offer an immediate interim restoration and obtain peri-implant soft tissue contours similar to those of the definitive prosthesis. The gingival contours of the ISRR can be used as a reference by the corresponding software to produce a CTIC and definitive prosthesis with identical gingival contours.

The use of a TS during implant surgery has been described18 as a method of transferring implant position in the laboratory and fabricating an ISRR indirectly. With the described technique, the ISRR is milled from a PMMA blank, which has better mechanical properties...
than autopolymerized acrylic resin because of polymerization shrinkage before the milling process, is initiated.20

The conventional protocol for fabricating an ISRR after implant surgery involves the use a prefabricated interim abutment and a clear vacuum shell fabricated based on a diagnostic waxing.11,12 However, the autopolymerizing acrylic resin may lack the mechanical properties to withstand pressure applied from the surrounding tissue that tends to relapse. In addition, effectively isolating blood and saliva from the operating area may be challenging. Therefore, the metal acrylic interface may be easily contaminated. With the described technique, the fabrication of the ISRR is made extraorally, avoiding saliva or blood contamination or surrounding tissue collapse.

In the described technique, a CTIC was used to transfer soft tissue anatomy. The described CTIC was designed with contours identical with those of the ISRR and the definitive prosthesis. Custom impression coping milled from a PMMA block has been described6,7; however, a customized impression coping milled from titanium may be preferable because of the material’s rigidity and stability as compared with PMMA.

Alternatively, a digital scan can be made to replicate the soft tissue profile after healing has been completed.16 However, Joda17 reported 21.7% shrinkage of the peri-implant soft tissue within 10 minutes of removing the interim restoration. The degree of soft tissue shrinkage before digital intraoral impression can be completed is unknown.

The main disadvantage of the proposed technique is the additional cost involved with designing and fabricating the ISRR. The proposed technique assumes that the clinician has access to a milling machine the day of implant surgery. Alternatively, the ISRR can be placed the next day after implant surgery. The reduced chair time and the feasibility of obtaining and replicating soft tissue contours similar those of the definitive prosthesis may justify the additional cost.
The described technique offers an alternative method of obtaining soft tissue contours similar to those of the definitive prosthesis by using a milled titanium healing abutment. The obtained contours are transferred to the laboratory with a custom milled titanium impression coping. A clinical study is needed to validate the use of the described technique.

REFERENCES

Noteeworthy Abstracts of the Current Literature

A comparative analysis on two types of oral implants, bone-level and tissue-level, with different cantilever lengths of fixed prosthesis

Mosavar A, Nili M, Hashemi SR, Kadkhodaei M
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**Purpose.** Depending on esthetic, anatomical, and functional aspects, in implant-prosthetic restoration of a completely edentulous jaw, the selection of implant type is highly important; however, bone- and tissue-level implants and their stress distribution in bone have not yet been comparatively investigated. Hence, finite element analysis was used to study the influence of cantilever length in a fixed prosthesis on stress distribution in peri-implant bone around these two types of oral implants.

**Material and Methods.** A 3D edentulous mandible was modeled. In simulations, a framework with four posterior cantilever lengths and two types of implants, bone-level and tissue-level, was considered. A compressive load was applied to the distal regions of the cantilevers, and the von-Mises stress of peri-implant bone was investigated. The independent t-test and the Pearson correlation coefficient analyzed the results ($\alpha=0.05$).

**Results.** Stresses in the cortical bone around the bone-level implants were greater than those in the tissue-level implants with the same cantilever length. In addition, by extending the cantilever length, the stress values in peri-implant bone increased. Therefore, when the cantilever was at its maximum length, the maximum stress was in cortical bone and around the bone-level distal implants.

**Conclusions.** The results of the present study indicate that treatment with tissue-level implants is potentially more advantageous than with bone-level implants for implant-supported fixed prostheses.

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