JPD

THE JOURNAL OF PROSTHETIC DENTISTRY

DENTAL TECHNIQUE

A CAD-CAM technique for conversion of interim-to-definitive restoration in patients with complete edentulism

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The careful adjustment of interim implant-supported fixed prostheses is essential to ensure overall success and patient satisfaction with the definitive restoration in terms of occlusion, tooth shape, function, and esthetics.[1] Interim restorations allow testing of the shape and contour of the prosthesis to achieve easy cleaning yet prevent food accumulation between the alveolar ridge and the suprastructure.[1] Several attempts have been made to transfer information from the implant-supported fixed interim restoration to the definitive restoration.[2–5] However, the authors are unaware of a current technique that can reproduce the details of the interim restoration without significant distortion, which consequently makes additional adjustments necessary in the definitive restoration.

The computer-aided design and computer-aided manufacturing (CAD-CAM) techniques developed for digital impressions could be used to reproduce the interim restoration.[6] Until recently, restorations were recreated by scanning both the interim restorations and definitive casts with laboratory scanners.[6,7] This technique has the same deficiencies posed by conventional impressions and casts. To avoid errors of the CAD-CAM-production workflow, it would be preferable to digitize without using definitive casts. Therefore, this technical report describes the CAD-CAM fabrication of definitive restorations based on direct digital impressions of interim restorations made by

ABSTRACT

An interim restoration is a prototype for the definitive prosthesis and preserves the occlusal information and the original vertical dimension of the occlusion. Several techniques have been developed to transfer the information from implant-supported fixed interim to definitive restoration. However, these conventional techniques have limitations, and they are time-consuming, require making impressions and stone casts, and mounting in an articulator. The purpose of this article was to describe a digital technique to accurately transfer the information from complete-arch implant interim restoration to definitive restorations without using definitive casts. (J Prosthet Dent 2017;■:■-■)

using intraoral scanners. This technique allows dentists to make definitive restorations without stone casts.

TECHNIQUE

1. Generate a digital model of the interim restoration by scanning the prosthesis extraorally with an intraoral scanner (TRIOS3; 3Shape A/S) (Fig. 1). Scan the occlusal, lingual, buccal, and gingival surfaces of the restoration.

2. Record the virtual occlusal registration through optical scanning of the labial surfaces of the interim restoration and opposing teeth in the patient's mouth by using the same intraoral scanner, while maintaining the existing occlusal vertical dimension. Next, virtually align the scanned interim prosthesis and opposing tooth images by using the occlusal registration as a reference in a virtual design software (Dental Designer; 3Shape A/S). The digital recording of the interim restoration with the opposing teeth is now complete (Fig. 2).

Figure 1. A, Interim prosthesis. B, Scan of interim prosthesis base. C, Scan of buccal surfaces of interim prosthesis.
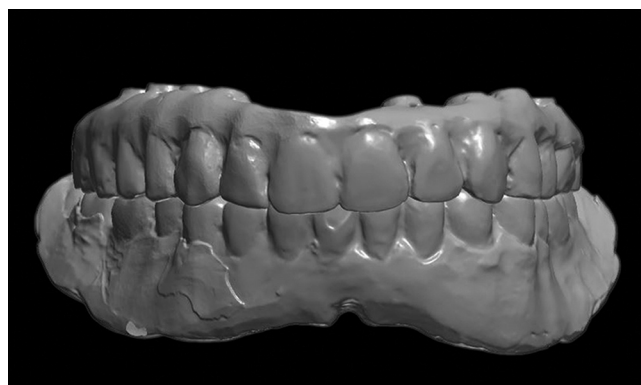
Figure 2. Virtual occlusal registration.
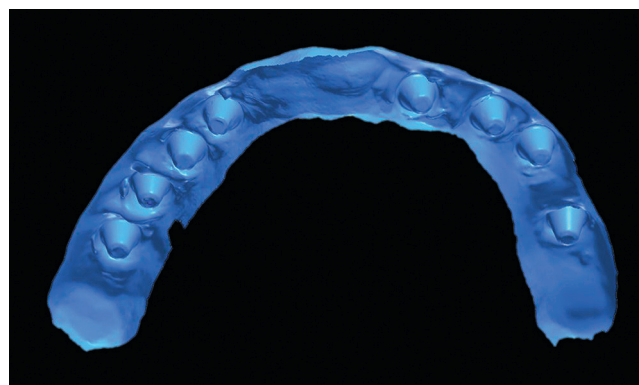
Figure 3. Inverted image of interim prosthesis.

3. Invert the interim prosthesis image by using CAD software (Shape Designer; 3Shape A/S) (Fig. 3). In other words, invert the image of the internal side of the cylinder that is negatively recorded into the positively recorded image.

4. Merge the images of the cylinder cap and the inverted cylinder by using semiautomatic 3-dimensional (3D) object adjustment. In this process, the images are virtually merged by matching 3 points that are present in both the cylinder cap and the inverted cylinder images (Fig. 4).

5. Once the images of the cylinder cap and inverted cylinder are merged, a digital model of the cylinder cap and the base of the interim prosthesis with the opposing teeth mounted in the occlusal vertical dimension is obtained (Fig. 5).

6. Once the digital model is obtained, design a virtual metal framework and crowns by using virtual design software (Dental Designer; 3Shape A/S) (Fig. 6).

7. Fabricate the metal framework and crowns by using the CAD-CAM milling process (Fig. 7).

DISCUSSION

The purpose of this article was to describe a digital technique to accurately transfer the information from complete-arch implant interim restoration to definitive restoration without using definitive casts. The main advantage of the proposed technique is that clinicians can obtain a definitive digital impression by scanning the interim prosthesis with intraoral scanners and inverting the interim prosthesis image. This technique offers information on the contours, esthetics, and occlusion of the interim prosthesis, the positions of the implants and abutment cylinders, and the vertical dimension of occlusion, which in turn, leads to the design of a definitive restoration. The technique is useful, especially for those clinicians who may not have a laboratory scanner in their dental office, where data can be acquired by using an intraoral scanner and sent to the laboratory for fabrication of a definitive prosthesis.
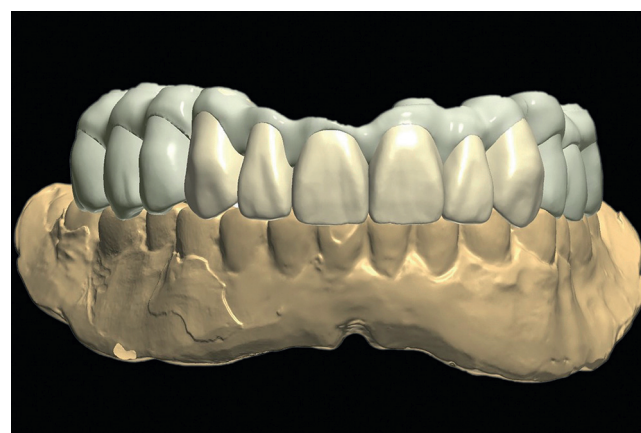
Another advantage of the proposed technique is that the interim prosthesis can be duplicated or modified by using the scanned image of the interim prosthesis. The main function of the interim prosthesis is to verify the esthetics, function, and occlusion intraorally. If needed, the interim prosthesis can be modified and the occlusion adjusted by using the proposed technique. Therefore, the design of the definitive prosthesis can be more effectively accomplished based on the data obtained through an interim prosthesis. In the present patient, the interim prosthesis was modified to correct the discrepancies between the maxillary and mandibular midlines.
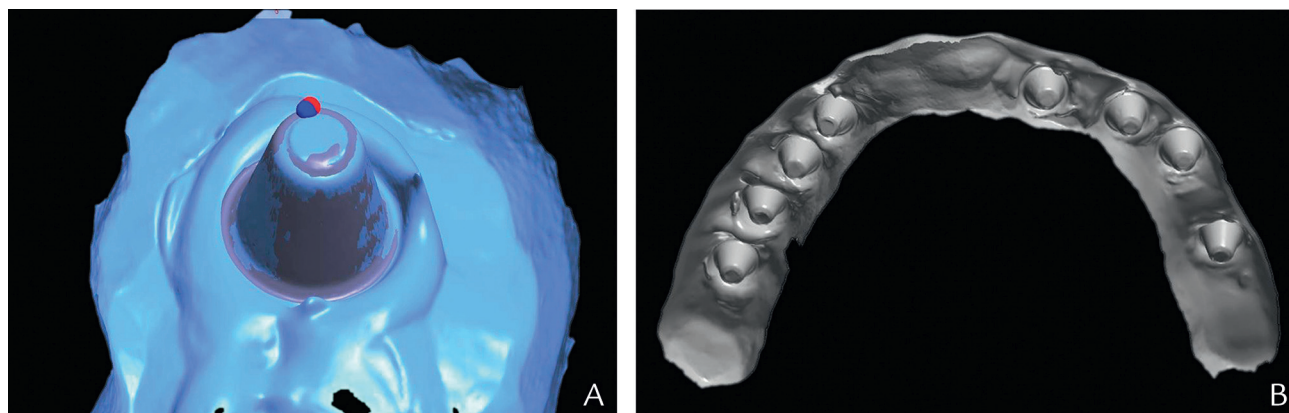
Figure 4. A, Merged images of cylinder cap and inverted cylinder images. B, Inverted image of interim prosthesis and its cylinder cap image.

Figure 5. Digital model of cylinder cap and interim prosthesis base with opposing teeth mounted at occlusal vertical dimension.

Figure 6. Virtual metal framework and crown designed by using virtual design program.

A further advantage of the proposed technique is that it can also be used if repair or refabrication of the interim prosthesis is needed. The modification process does not require much time and effort because a new restoration can be easily fabricated by using the digital data from the previous prosthesis.

Restoration in a patient with complete edentulism has been associated with a high incidence of fracture of the fixed implant-supported interim prosthesis that was fabricated through a denture conversion process, especially during the healing phase.[8,9] Keerthi et al[10] suggested the use of a CAD-CAM interim prosthesis milled from a poly(methyl methacrylate) (PMMA) block. The superior mechanical properties of a PMMA block can reduce the incidence of mechanical complications associated with the use of the interim prosthesis. The technique presented can be used to fabricate a milled PMMA interim prosthesis by scanning the conversion prosthesis.

The key factor to obtaining successful, accurate definitive restorations by scanning the interim prosthesis is the state of that interim restoration. There should be no gaps or misfits in the cylinder interface with the abutments. If a

Figure 7. Definitive restoration fabricated by computer-aided design and computer-aided manufacturing, based on direct digital impressions of interim restorations made with intraoral scanners.

cylinder does not fit precisely on the abutment, it should be reseated onto the abutment.

Because this technique obtains the data for the interim prosthesis by extraorally scanning an interim prosthesis, it

may eliminate some of the limitations associated with conventional impressions, such as voids, air bubbles, inadequate mixing or polymerization, distortions, or saliva or blood intervening with the fabrication of the impression.[11] In addition, the number of office visits can be reduced with this technique, because clinical steps for conventional impressions are not needed to produce a definitive stone cast.

The prosthesis for the present patient consisted of 2 segments: a screw-retained titanium framework with gingiva-colored composite resin, and cement-retained zirconia crowns. The screw-retained infrastructure replaced the soft tissue with gingiva-colored composite resin instead of gingiva-colored porcelain. Advantages of the composite resin are that it prevents the potential distortion of the metal framework during firing of the porcelain, and repair of the gingiva-colored composite resin is straightforward.[12,13] Considering that zirconia restorations distort significantly due to allotropic changes when sintered and that horseshoe-shaped patterns are difficult to replicate without distortion,[14] titanium was used to fabricate the screw-retained infrastructure in the present prosthesis. When the definitive prosthesis was inserted intraorally, it fit passively over the 8 implants. The vertical gap of the framework−implant interface was clinically acceptable when we evaluated the framework for passive fit by using the 1-screw test[15] and periapical radiographs.

A limitation of the technique is that the accuracy of the definitive digital impression of the interim prosthesis produced by scanning the interim prosthesis with intraoral scanners is unknown. A clinical or laboratory study is needed to evaluate the accuracy of the technique.

SUMMARY

The proposed technique can facilitate the process of designing a CAD-CAM definitive prosthesis. Digital impressions for the definitive prosthesis can be obtained by scanning the interim prosthesis with intraoral scanners and inverting the interim prosthesis image. A clinical or laboratory study is needed to evaluate the accuracy of the proposed technique.

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