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DENTAL TECHNIQUE

Design and fabrication of a fixed implant-supported interim restoration from a dynamic navigation virtual plan

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ABSTRACT

A technique is described in which an interim implant-supported restoration was designed and fabricated before surgery from a virtual treatment plan created in and executed with dynamic navigation. The virtual treatment plan was imported into a dental computer-aided design and computer-aided manufacturing (CAD-CAM) software program for the design of the interim restoration. Once designed, the interim restoration was fabricated with additive manufacturing. The soft-tissue contours were evaluated after 12 weeks. (J Prosthet Dent 2019;■:■-■)

Guided implant placement is an accurate way of executing a virtual treatment plan.[1,2] Dynamic navigation is a form of guided implant placement in which the implant surgeon watches a monitor to view implant site preparation and implant placement.[1] Custom interim components designed and fabricated from the virtual treatment plan can be delivered at the time of implant surgery. A fixed implant-supported interim restoration is designed to enhance esthetics, provide support for the proper contouring of gingival tissue, and increase patient satisfaction with the overall dental implant process.[3-8] Direct or indirect techniques are currently used to fabricate these restorations.

The purpose of this article was to describe a technique for designing and fabricating a single-unit fixed interim restoration by using a dental computer-aided design and computer-aided manufacturing (CAD-CAM) software program from a virtual treatment plan created in a dynamic navigation software program. The interim restoration is designed and fabricated before implant surgery. This technique may decrease the overall patient appointment time compared with other currently available methods.

TECHNIQUE

1. Evaluate the area to determine whether it is suitable for an immediate dental implant placement with a fixed interim restoration (Fig. 1). The fractured maxillary left second premolar was noted by the referring dentist to have a questionable prognosis, but the patient elected to defer treatment.
2. Mold a fiducial marker (X-Clip; X-Nav Technologies) onto the contralateral side of the patient's dentition from the planned surgical site. Once molded and fit is verified, obtain a cone beam computed tomography (CBCT) image and export it in a Digital Image for Communication in Medicine (DICOM) file format. Remove the clip, label, and store for the upcoming surgery.
3. Obtain diagnostic maxillary and mandibular intraoral scans and interocclusal registration. Select a shade for the interim restoration. Review the treatment plan with the patient and confirm the surgery date and time.
4. Import the DICOM file into the dynamic navigation treatment planning software. Align the diagnostic scans onto the CBCT and virtually design the proposed definitive restoration. Figure 2 shows the virtual implant positioned in a restoratively driven manner. When finalized, export the virtual implant and accompanying intraoral scan as a standard tessellation language (STL) file.
5. Create a treatment in dental CAD-CAM software (exocad CAD design for labs; exocad GmbH) for a screw-retained implant restoration. Import the

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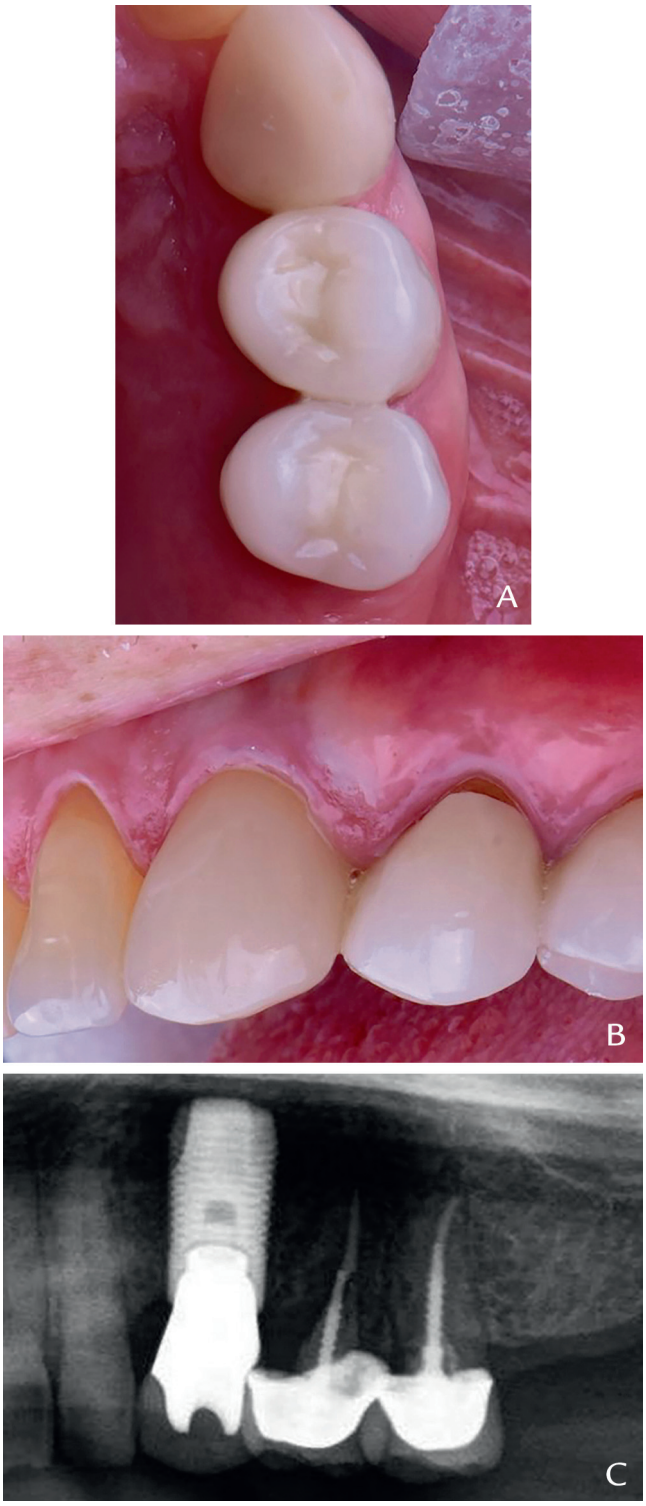

Figure 1. Preoperative views of maxillary left first premolar. A, Occlusal view. B, Facial view. C, Periapical radiograph.

virtual plan created in the dynamic navigation software. Select a Ti-base (DESS straight Ti Base, DESS) abutment for the restoration and place the virtual implant on as shown in Figure 3. The software completes this process in a method similar to detecting a scan post and replaces it with a selected prosthetic component. Figure 4 shows the anatomic contour crown designed on the Ti-base abutment. Save the crown as an STL file.

6. Print the STL file by using a 3D printer (NextDent 5100; Nextdent B.V.) in the selected resin (NextDent C&B MFH; NextDent) of the shade chosen previously. Wash and light-polymerize the printed material according to the manufacturer's instructions. Cement the Ti-base and crown together with light-polymerizing resin. Polish, label, and store. Figure 5 shows the completed interim restoration.
7. At the surgery appointment, atraumatically extract the maxillary left first premolar. Seat the fiducial marker and perform the implant surgery under dynamic navigation. Ensure the system is properly calibrated and perform system checks before each osteotomy according to the manufacturer's protocol. When the drilling protocol is complete, place the dental implant by using dynamic navigation. Ensure the rotation of the internal hexagon of the implant corresponds to the planned virtual implant. Place particulate allograft in the space between the implant and buccal bone.
8. Insert the interim restoration and adjust the proximal and occlusal contacts as needed. Tighten the abutment screw to 15 Ncm and seal the access hole by using Teflon tape and light-polymerizing composite resin (Tetric EvoFlow, Ivoclar.)
9. Visually and radiographically evaluate the healing 12 weeks after surgery (time period as seen in Figures 6, 7).

DISCUSSION

This report describes a completely digital workflow for designing an interim implant-supported restoration from a dynamic navigation virtual treatment plan. The restoration was fabricated by additive manufacturing, assembled, and finished before implant surgery. At the time of surgery, the surgeon placed the implant under dynamic navigation and inserted the interim restoration with minimal adjustments.

A similar technique has been reported where a virtual treatment plan was created to design a static guide and interim restoration.[9] While implants placed with static guides and dynamic navigation have been shown to have similar accuracies, dynamic navigation has advantages.[10] As dynamic navigation allows the surgeon to watch the preparation of the implant site and implant insertion in real time, it does not require the use of a static guide. This facilitates its use in areas of limited interocclusal space and does not require a manufacturer's specialized guided drill kit to perform the surgery.

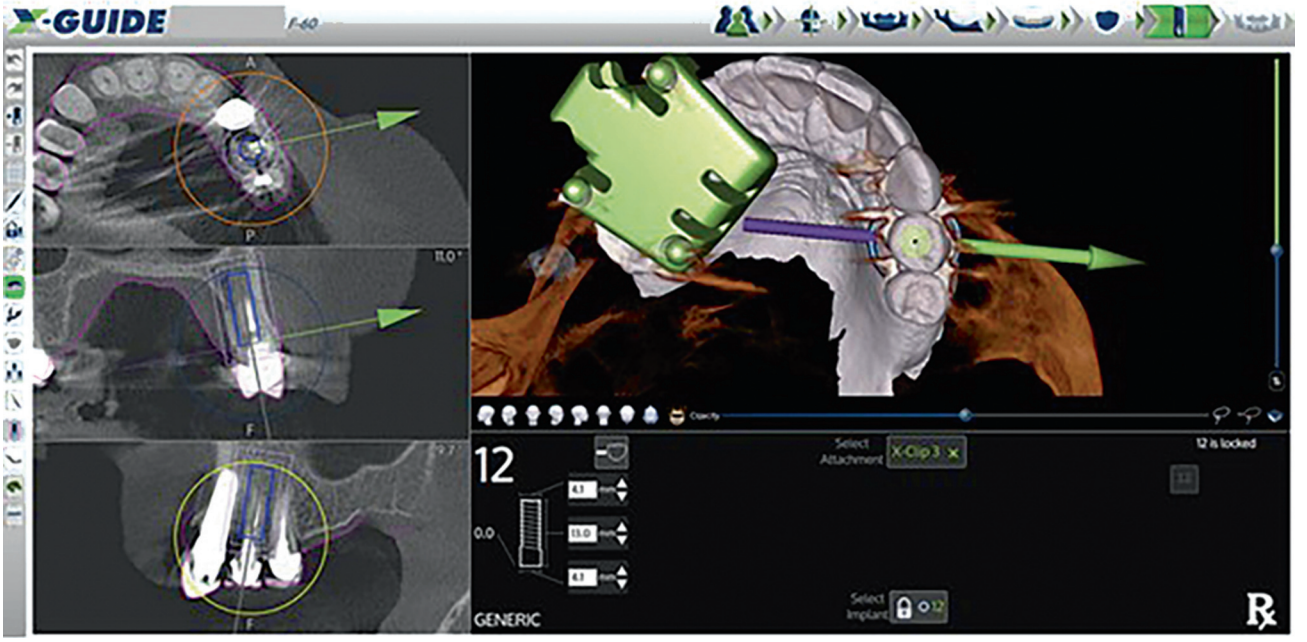

Figure 2. Virtual treatment plan created in dynamic navigation software.

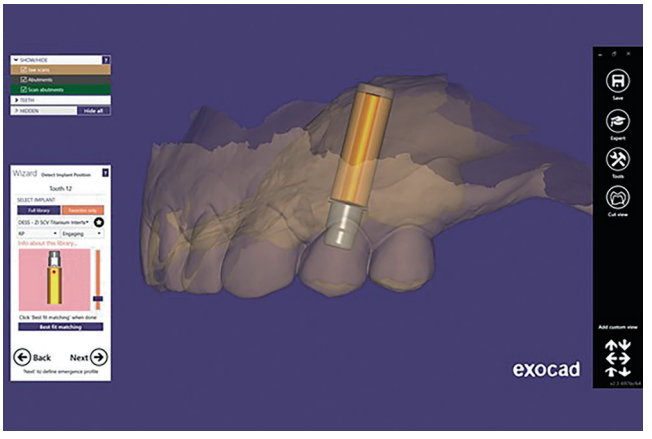

Figure 3. Virtual dynamic navigation treatment plan imported into CAD-CAM software and virtual Ti-base placed. CAD-CAM, computer-aided design and computer-aided manufacturing.

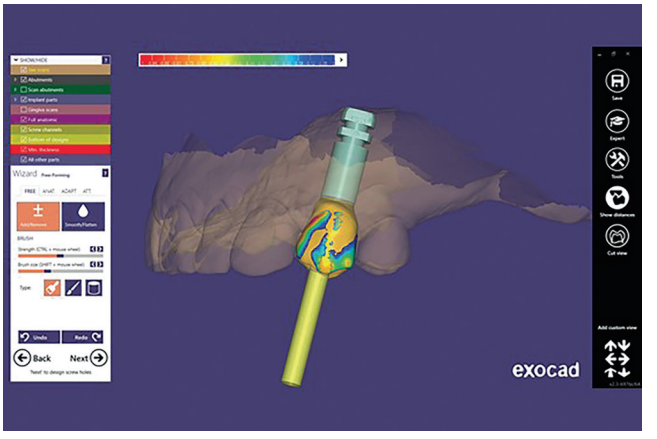

Figure 4. Screw-retained implant-supported restoration for maxillary left first premolar.

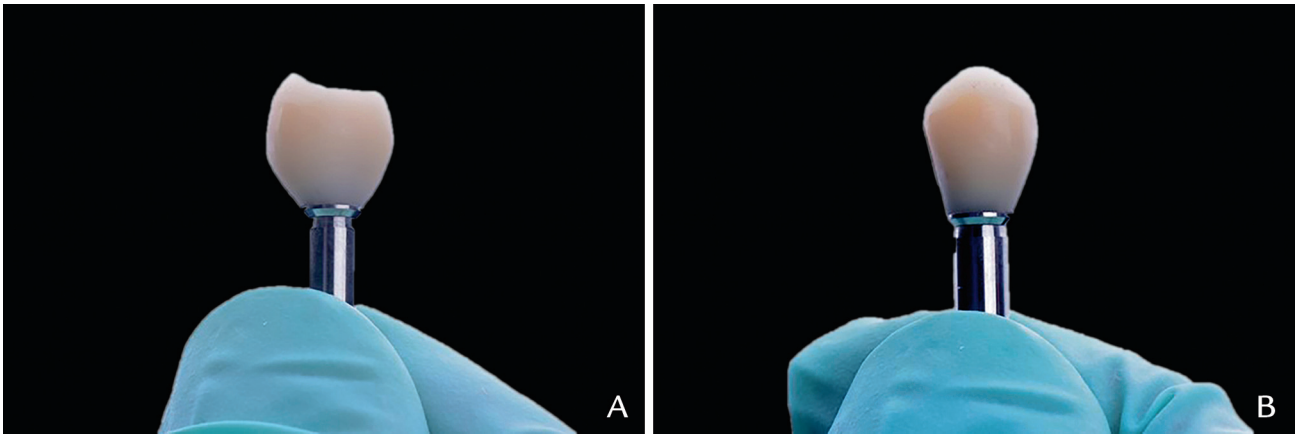

Figure 5. Interim restoration. A, Proximal view. B, Facial view.

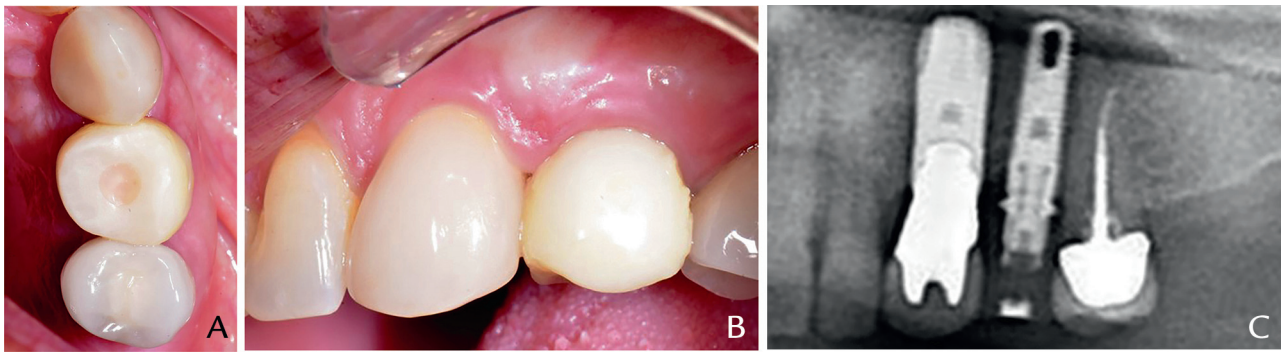

Figure 6. Interim restoration 12 weeks after placement. A, Occlusal view. B, Facial view. C, Periapical radiograph.

Figure 7. Soft-tissue emergence profiles 12 weeks after placement. A, Occlusal view. B, Facial view.

It also eliminates the need to outsource any part of the preoperative planning if the facility is not equipped with a method for guide fabrication.

Other reports have been published on using CAD-CAM technology to design and fabricate interim implant-supported restorations.[3,11-13] The present workflow builds upon these articles and uses recently introduced digital dental technology to complete the implant surgery in an accurate manner, which allows a prefabricated interim restoration to be inserted with minimal adjustment. The crown portion of the interim restoration in this report was fabricated by additive manufacturing. Printed resin has been reported to have adequate wear resistance for dental use.[14] One disadvantage of printed resin is the limited range of shades available.

An open architecture system consisting of DICOM and STL file formats was used in this technique to allow for choices of hardware and software selections. These choices were made as the ideal ones for designing the workflow and were not limited to a closed architecture system where proprietary file extensions would limit choices. Practitioners should be mindful of these differences between open and closed systems when implementing new digital dental technology in their practice.

Proficiency with dynamic navigation is essential before implementing this workflow. Surgeons must be comfortable with the system and place implants accurately according to the virtual treatment plan before providing an interim restoration designed in the manner described in this report. Outsourcing for the design and fabrication of the interim restoration may be needed if the facility does not have the necessary equipment and software.

SUMMARY

This clinical report describes a technique where a dynamic navigation virtual plan can be used to design and fabricate an immediate implant-supported interim restoration before surgery. This technique relies on the

accurate execution of a virtual plan performed with dynamic navigation so that the interim restoration can be delivered at the time of surgery.

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