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A Method of Locating the Abutment Screw Access Channel with Cone-Beam Computed Tomography and a 3D-Printed Drilling Guide

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Contents

A method of locating the abutment screw access channel with cone-beam computed tomography and a 3D-printed drilling guide

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Abstract

In managing loose abutment screws, locating precisely the position of the screw access channel is difficult. This technique describes the use of cone-beam computed tomography (CBCT) and surgical guide planning software to locate the screw access channel with the intention of retrieving a loosened cement-retained implant-supported prosthesis. The method minimizes damage to the abutment crown assembly.

Screw loosening is one of the most frequent mechanical complications observed in implant-supported dental prostheses,1, 2, 3 especially with respect to cement-retained implant-supported restorations.[4] To retrieve a loosened cement-retained implant prostheses, it may be necessary to create a screw access channel through an existing restoration. Several methods for locating the screw access channel have been described, including using ceramic stains,[5] acrylic resin;[6] fabricating a vacuum-formed template,[7] forming a silicone putty matrix,[8] using a handpiece sleeve,[9] making extraoral and intraoral photographs,[10] and designing and printing a drilling guide at the time the implant abutment is designed.11, 12 All these techniques require a definitive cast to fabricate a drilling guide. The precision of the procedure is variable and depends on the chosen technique and the capabilities of the clinician.[13] Other methods use intraoral radiographs[14] or cone-beam computed tomography (CBCT).[15] In both techniques, a definitive cast is not required for guide fabrication; however, these methods may result in inadvertent damage to a ceramic restoration or to the abutment because of freehand drilling.

This report describes the fabrication of a 3-dimensional (3D) printed drilling guide that precisely locates the abutment screw access channel of cement-retained implant prostheses using CBCT and surgical guide planning software. Little or no damage to the cement-retained implant-supported prostheses or implant abutment is possible, even when precementation diagnostic or definitive casts are missing. This technique is particularly useful for retrieving multiple splinted units.

Technique

1. Determine clinically that the loose cement-retained implant prosthesis and abutment are still united by cement and that the loss of screw preload is the cause of the loose restoration.
2. Make a CBCT (Scanora 3DX; Soredex) to create a Digital Imaging and Communications in Medicine (DICOM) format file.
3. Make an irreversible hydrocolloid impression (Jeltrate; Dentsply Sirona) in order to fabricate a stone cast (Microstone; Whip Mix Corp).
4. Scan the cast with a laboratory scanner (D900; 3Shape) to provide a standard tessellation language (STL) file.

5. Both the DICOM and STL files are loaded and aligned in the surgical planning software (Blueskyplan3; Blue Sky Bio LLC). An implant is selected and placed in the desired position with respect to the in vivo implant position. This step will determine the direction of the screw access channel (Fig. 1A) and design of the drilling guide. The drilling guide is fabricated to accommodate a round diamond rotary cutting instrument (BR6379.31.023; Brasseler USA) (Fig. 1B). The digitally planned guide is sent to a dental laboratory or a computer-aided design and computer-aided manufacturing (CAD-CAM) company (Blue Sky Bio LLC) for fabrication of a 3D printed drilling guide (Fig. 2).

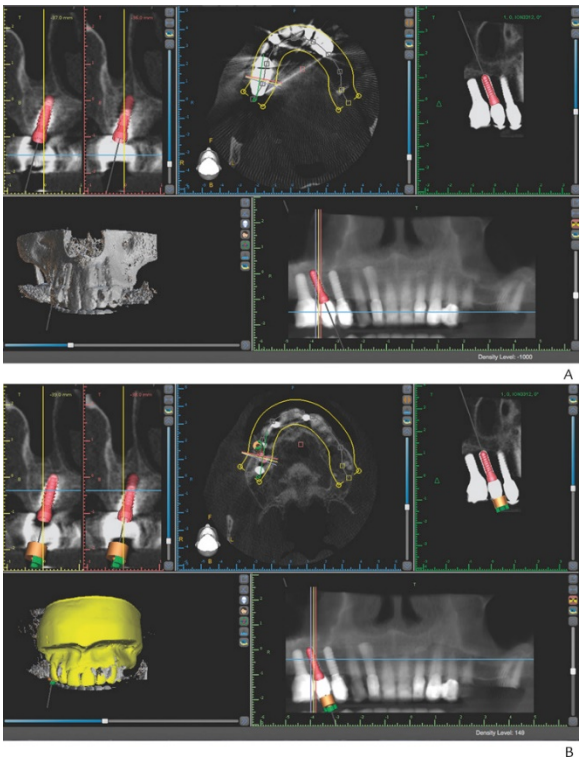

Figure 1. A, Determination of direction of screw access channel by combining CBCT Digital Imaging and Communications in Medicine (DICOM) file image and standard tessellation language (STL) file image. B, Design of drilling guide to accommodate round diamond rotary instrument.

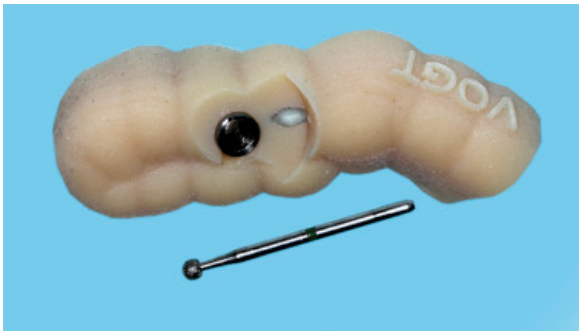

Figure 2. Three-dimensional (3D) printed drilling guide and round diamond rotary instrument.

6. After receiving the 3D printed drilling guide, assess the fit clinically and then drill through its sleeve with the round diamond rotary instrument (Fig. 3). During drilling, verify that the direction of the rotary cutting instrument is as planned by making an intraoral radiograph (Fig. 4).

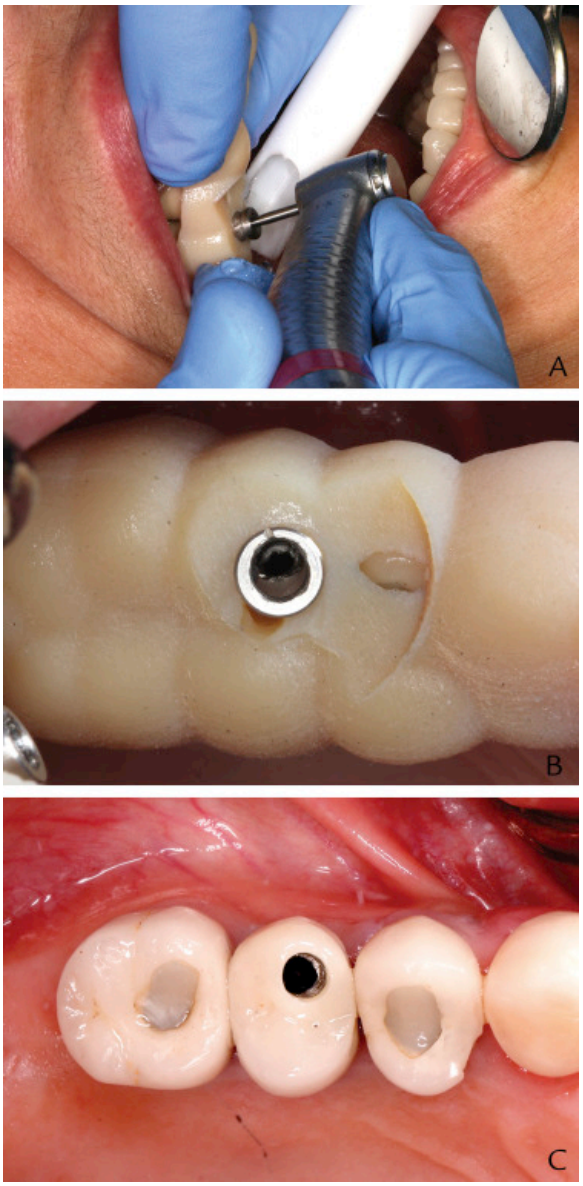

Figure 3. A, Drilling procedure with 3-dimensional (3D) printed drilling guide. B, Close-up image of screw access hole opening. C, Precisely drilled access hole with minimal damage.

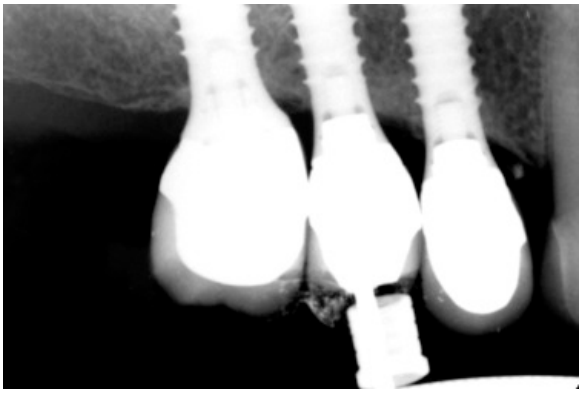
Figure 4. Radiographic verification.

7. Remove the drilling guide, unscrew the abutment screw, and remove the crown abutment assembly. Ensure that the crown abutment assembly is securely cemented and then clean the assembly with a 0.12% chlorhexidine gluconate solution (Peridex; 3M Oral Care).
8. Place the crown abutment assembly in the mouth and tighten the new abutment screw according to the manufacturer's torque recommendations.
9. Fill most of the screw access opening with polytetrafluoroethylene tape. Then use a pink composite resin (Pink opaque; Cosmedent, Inc) to mask the metal color. Finally, place a tooth color composite resin (Revolution Formula 2; Kerr Corp) (Fig. 5). Adjust the occlusion as necessary.

Figure 5. Retrieved implant prosthesis with screw access hole filled with composite resin.

Discussion

This technique presents a method of retrieving a loosened cement-retained implant prosthesis using CBCT and CAD-CAM. After successfully removing the loosened cement-retained implant prosthesis, it is converted into a screw-retained implant prosthesis with a direct composite resin restoration covering the screw access channel.

The advantages of this method are that it eliminates freehand drilling and reduces the possibility of damaging the existing crown and abutment. In addition, no precementation records are needed. The cost of the CBCT and the 3D printed drilling guide may be less than fabricating a new crown. Moreover, the CBCT-driven drilling guide may produce a smaller access opening and result in less damage than typical freehand drilling.[13]

Although the level of radiation received from a CBCT is less than that from conventional computed tomography, dosages are considerably higher than conventional dental radiography.[16] The benefits of CBCT in dentistry are undeniable; however, its use must be justifiable compared with conventional techniques.[16]

The retrieval of the loosened cement-retained implant prostheses and the integrity of the prosthesis and implant abutment depend on the drilling technique, the accuracy of the drilling guide, and the existing access channel direction. If a drilling procedure is inaccurate, it may cause unnecessary damage to ceramic surfaces and compromise the removal of the existing restoration. If the screw access hole is outside the occlusal table, such as on a cusp tip area or labial surface, then the retrieval and reuse of the

loosened cement-retained implant prostheses may not be desirable. It may be better to fabricate a new restoration to eliminate possible fracture or for esthetic reasons. Therefore, the direction of the implant screw access hole should be carefully evaluated during the diagnostic phase.

Summary

The technique for fabricating a 3D printed drilling guide by using CAD-CAM and CBCT to retrieve a loosened cement-retained implant prosthesis will help dental clinicians deal with emergency situations with abutment screw loosening of cement-retained implant-supported fixed prostheses. With this method, the screw access channel can be located precisely, and the existing crown can be retrieved when a patient presents to the practice with no treatment records and no definitive cast.

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