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DENTAL TECHNIQUE

Immediate placement of a previously manufactured interim screw-retained implant-supported crown by using the implant position determined in the guided implant planning

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ABSTRACT

The present technique describes a computer-guided workflow for the immediate implant placement and interim restoration of a previously manufactured screw-retained interim implant-supported crown. As the implant position determined in the computer-aided implant planning was used to fabricate the interim implant-supported crown, the surgical implant guide incorporated a guide to orient the implant, enabling the orientation and fit of the interim crown. This technique aimed to optimize clinical time, enhance predictability, minimize intraoperative adjustments, and improve patient experience. (J Prosthet Dent xxxx;xxx:xxx-xxx)

Postextraction immediate implant placement has been reported to be a reliable treatment with a high success rate.[1–3] For this procedure, it is essential to plan the implant position considering the 3-dimensional (3D) bone availability and to ensure implant stability and accurate placement within the bone.[4–6] With the introduction of computer-aided implant planning procedures, the ideal position of a postextraction immediate implant can be planned in a specialized software program, and the implant placed using surgical guides.[7–16] This ideal implant position also allows the design of an immediate restoration with an adequate emergence profile, which has been identified as essential to optimal esthetics and function.[17–22] Nevertheless, achieving the exact match between the definitive position of the implant and the planned implant position has been reported to be a challenging procedure.[14,15,23–26]

Immediate prosthetic rehabilitation of a postextraction immediate implant allows for tooth replacement in the same appointment,[27] reducing treatment time, preserving soft tissue morphology, and improving immediate esthetics.[28] The difficulty in accurately reproducing the planned implant position has led to the development of alternative techniques for obtaining an interim restoration after implant placement. These can be divided into 2 methodologies: the adaptation or relining of a previously manufactured interim crown at the definitive implant location[29–32] and the registration of the definitive implant position to manufacture an interim single crown to be placed during the first few hours or even the day after the surgery.[33–35]

The presented manuscript describes a technique for completing an immediate interim restoration after implant placement using a previously manufactured interim screw-retained implant-supported prosthesis. The implant position determined in the computer-aided implant planning is used to fabricate the interim implant-supported crown.

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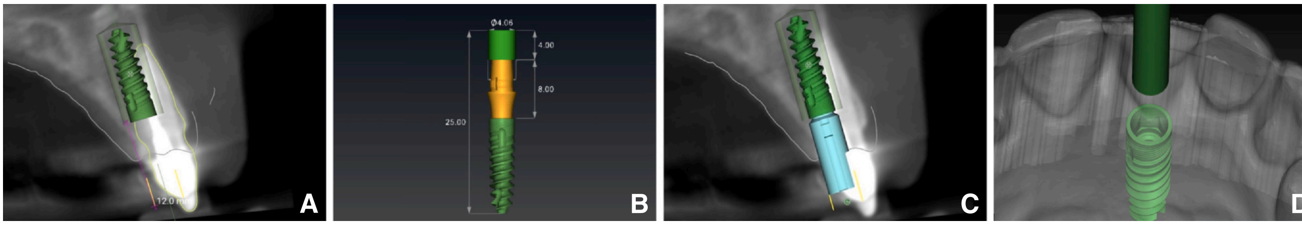

Figure 1. Digital surgical planning. A, Planned implant position. B, Sleeve-to-implant offset. C, Implant position with virtual scan body. D, Virtual orientation of implant connection toward labial side.

Since for a single-crown the engaging geometry of the screw-retained prostheses must align precisely with the engaging geometry of the implant, the surgical implant guide incorporates a guide to orient the implant, enabling the orientation and fit of the interim crown. This technique allows for the immediate rehabilitation of dental implants with a screw-retained, previously manufactured restoration, without the need to adapt or reline the prostheses, reducing clinical time and making the procedure more comfortable for the patient.

TECHNIQUE

The technique is described for a 51-year-old patient who was a nonsmoker and American Society of Anesthesiologists (ASA) type I with a maxillary left central incisor deemed nonrestorable because of a root vertical fracture.

1. Obtain a digital imaging and communication in medicine (DICOM) file by using a cone beam computed tomography (CBCT) scan (CS 9300; Carestream Health Inc). Subsequently, record a complete arch scan by following the recommended scanning pattern and scanning distance,[36,37] without rescanning methods,[38] under controlled ambient conditions,[39,40] and using a calibrated intraoral scanner (TRIOS 5; v.23.1.4 (2.18.0.2); 3Shape A/S) and export the standard tessellation language (STL) files.
2. Import STL and DICOM files into an implant planning program (RealGUIDE Design v.5;5.20231024; 3Diemme) and superimpose the files to virtually plan the tooth extraction and the immediate implant placement. In this step, use virtual replicas of the implant (Alpha Bio Multineo CS, 3.73×13 mm implant; Alpha-Bio Tec) and implant abutment (Omnibase 3.5; Alpha-Bio Tec) to virtually select the ideal position guided by both the bone availability and the prosthesis (Fig. 1A-C). Additionally, select the offset (9 to 12 mm) between the intaglio surface of the guide ring of the surgical implant guide and the implant platform based on the surgical implant kit. For this patient, an offset of 12 mm was selected (Fig. 1B). To predict the implant position with precision, virtually position the implant so that 1 of the flat faces of the connection is oriented toward the facial side (Fig. 1D).
3. Design a surgical implant guide based on the implant position determined in step 2 with no less than 3 mm in thickness. Mark the labial surface of the surgical guide with a line to allow the appropriate orientation of the implant's connection during surgical placement. This is a crucial point, as it aligns the engaging geometric shape with the one designed in the interim crown, as explained in Step 2. Export the STL file of the surgical implant guide to the software program of a vat-polymerization printer (SprintRay Pro 2; SprintRay Inc) (Fig. 2A).
4. Print the surgical implant guide from a biocompatible resin (Surgical Guide 3; SprintRay Inc.) at 90-degree orientation and a layer thickness of 35 µm.[41,42] Clean the guide with 99.9% isopropyl alcohol in the washing system (SprintRay Cleaning System; SprintRay Inc) and then photopolymerize it in a device (SprintRay ProCure; SprintRay Inc) (Fig. 2B).
5. Design the interim screw-retained prosthesis as follows:

Figure 2. Surgical guide planning and manufacture. A, Design of surgical guide with labial orientation mark. B, Printed surgical metal sleeveless guide.

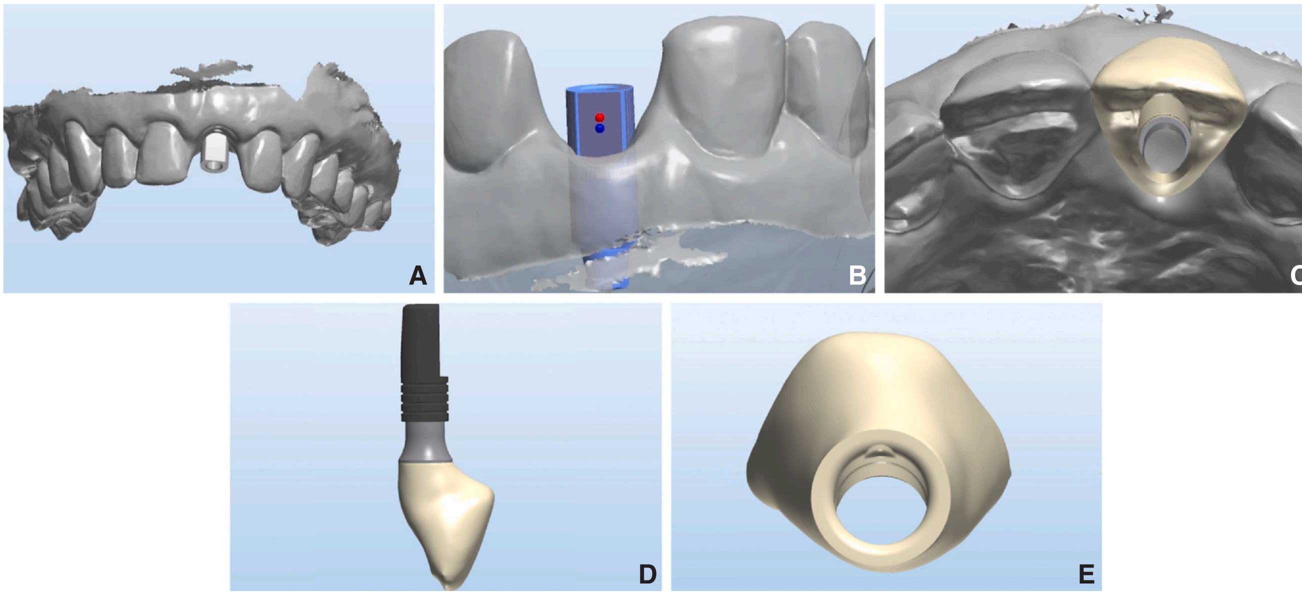

Figure 3. Digital restorative planning for immediate interim prosthesis placement. A, Importing implant and scan body libraries into computer-aided design software program for virtual restoration design. B, Alignment of virtual scan body to define rotation and screw channel. C, Screw channel design. D, Design of profile emergence for screw-retained interim restoration. E, Groove design on intaglio surface to guide restoration positioning during cementation.

– Import files obtained in Step 2 into a computer-aided design software program (Dental System v2022; 3Shape A/S), including the STL file of the implant position, the chosen implant abutment (Omni base; Alpha-Bio Tec), and the corresponding implant scan body (Implant level scan body, IOSB-CS, Ref. 3837; Alpha-Bio Tec) (Fig. 3A).
– Align the implant scan body with the file of the implant position to define the position of the engaging connection (Fig. 3A, B). Design the interim restoration considering the implant position, ensuring a suitable emergence profile, respecting the minimal thickness of at least 1.0 mm for the axial walls and 1.5 mm in the occlusal area, and leaving the screw access channel on the palatal side (Fig. 3C, D). Additionally, since the interface for the restoration was virtually selected in the software program, an internal groove will automatically be created in the virtual restoration. This groove will allow the restoration to be positioned according to the planned orientation during cementation to the interface (Fig. 3E).
– Save the interim restoration design STL file and export it to the milling unit software program (MedinHouse by MillBox, v.2024; CIMsystem).

6. Manufacture the interim screw-retained crown following these steps:

– Nest and mill the restoration by using a monolayer polymethylmethacrylate disk (A2 95×20-mm polymethyl methacrylate (PMMA) block, Huge Dental) in a milling machine (CORiTEC 150i PRO; imes-icore GmbH) (Fig. 4A).
– Polish the restoration (VLTOOLKIT; bredent GmbH) following the sequence of coarse, medium, and fine rubber polishers and finish the surfaces

Figure 4. Fabrication of screw-retained interim restoration. A, Milled polymethyl methacrylate monolayer with labial mark groove. B, Polished interim crown. C, Cementation onto titanium based abutment.

Figure 5. Surgical procedure. A, Atraumatic extraction preserving alveolar walls. B, Fit and stability of surgical guide. C, Implant placement with transport carrier. D, Implant position; occlusal view.

with polishing paste (Acrypol; bredent GmbH) followed by a high-gloss polishing paste (Abraso-Starglanz; bredent GmbH) to achieve a smooth and glossy surface (Fig. 4B). Cement the restoration to the titanium abutment (Tibase Omnibase with 3.5-mm gingival height. Ref: 5493; Alpha-Bio Tec) with an appropriate adhesive (Multilink Hybrid Abutment; Ivoclar AG) (Fig. 4C). In this procedure, the position of the interim restoration is determined by a protrusion on the interface that matches the internal groove of the restoration.

7. At the surgical appointment, extract the tooth while preserving the bone of the alveolar walls (Fig. 5A).
8. Place the dental-supported metal sleeveless surgical guide and confirm its stability and fit before starting the surgical drilling (Fig. 5B). Then perform the complete drilling sequence (GSTK guided surgery kit; Alpha-Bio Tec) with profuse irrigation.
9. Using the transport carrier, place the implant until the depth stop is reached (Fig. 5C). Then turn the carrier until its mark matches the labial reference made on the surgical guide (Fig. 5C).
10. Once the implant has been placed, remove the carrier using an extractor (GSTK surgery kit; Alpha-Bio Tec) and the surgical guide. Fill the gap between the implant and the socket with xenograft material (Bio-Oss; Geistlich Pharma) to preserve the ridge contour (Fig. 5D).
11. Screw the milled PMMA interim crown cemented to the titanium abutment to the implant at the indicated torque (Fig. 6A, B). If no flap was raised, sutures may be omitted. Adjust the occlusion to eliminate all static and dynamic contacts.
12. Make a parallel periapical radiograph to verify the implant placement and prosthetic fit (Fig. 7A). A postoperative STL scan can also be obtained and superimposed with the planning STL file to evaluate implant deviation and verify surgical accuracy (Fig. 7B).

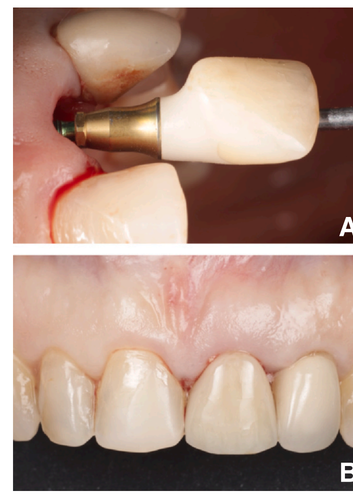

Figure 6. Interim restoration placement. A, Prefabricated polymethyl methacrylate interim crown installation. B, Frontal view of screw-retained interim crown.

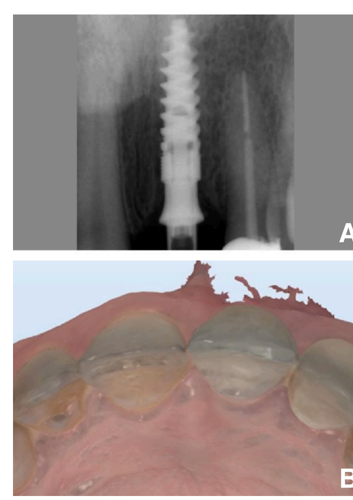

Figure 7. Postoperative assessment. A, Periapical radiograph confirming implant position and prosthesis fit. B, Postoperative intraoral scan of interim screw-retained crown.

DISCUSSION

The presented technique follows a completely digital workflow that combines static guided implant placement with immediate loading through prefabricated restorations. This approach provides a minimally invasive, accurate, and predictable protocol. Integrating surgical and prosthetic planning—achieved through CBCT, intraoral scanning, and a computer-aided design and computer-aided manufacturing (CAD-

CAM) software program—supports the execution of complex procedures while reducing clinical time and minimizing the need for intraoperative adjustments.[10,11,43]

Digital indexing of the implant, specifically by orienting the flat surface of the connection toward the labial aspect, ensures controlled and accurate 3-dimensional placement. It allows the placement of the screw-retained immediate prefabricated restoration. This workflow eliminates the need for postoperative intraoral scans and relining or adjusting the interim restoration, reducing the risk of errors and increasing surgical efficiency. Nevertheless, adequate primary stability of the implant must be acquired in the planned position. If deeper insertion is required to obtain this stability, the interim crown's position will consequently be affected.

Regarding the guided surgery, a key requirement is that the surgical kit allows modification of the offset height between the guide ring and the implant head. This adjustment is crucial to avoid interference between the drills and surrounding soft or hard tissues, which could otherwise interfere with the complete preparation of the surgical bed and prevent accurate placement of the implant in its virtually planned position.[12,13] Additionally, surgical guides with or without metal sleeves can be used to follow the presented technique.[23–26,31]

The digital planning of the interim restoration, coupled with the virtual integration of design elements derived from the planned implant position, facilitated the execution of a guided immediate loading protocol. This approach eliminated the need for intraoral relining procedures, ensuring improved precision and efficiency in the restorative process.[17,21,22] This technique provided excellent prosthesis fit while maintaining the blood clot and enabling healing of soft tissues. The success of digital procedures depends on easily accessible libraries that contain all necessary implant components and interface elements and scan body systems to ensure workflow accuracy and eliminate component conflicts.[21]

The presented technique provided a better method than traditional methods since it reduced chair time and improved accuracy while shortening the wait for an interim restoration, providing an effective process for immediate implant placement and direct loading procedures on a screw-retained implant supported single-crown. However, this technique is presently not indicated for definitive prostheses because of potential minor discrepancies in implant positioning, the expected remodeling of the peri-implant soft tissues, and the requirement that the interim restoration remain free of both static and dynamic occlusal contacts throughout the osseointegration period. Future clinical studies are required to rigorously evaluate the clinical efficacy and long-term outcomes of this technique.

SUMMARY

Accurate 3-dimensional implant positions and the immediate placement of implants alongside prefabricated interim restorations are achievable using this digital method. The virtual planning of the restoration and emergence profile together with guided implant surgery allows minimally invasive procedures that reduce chair time and ensure high prosthetic accuracy. Dental libraries support the entire process to ensure components match and to reduce the need for in-operation modifications. Immediate function and cosmetic benefits enhance the experience for patients. The protocol achieves a reliable and efficient approach as an alternative in advanced digitally assisted implant-supported prostheses.

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