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DENTAL TECHNIQUE

Computer-guided implant surgery for immediate implanting and loading: The STIL technique

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ABSTRACT

A method is described for minimizing errors in positioning a surgical template during the insertion of implants immediately after extraction and the placement of interim prostheses with immediate loading. The technique, called sequential template immediate loading (STIL), uses modular templates to fix pins before extracting the teeth, thus giving a reliable position for the subsequent templates for inserting the implant and placing the interim prosthesis. (J Prosthet Dent 2020;■:■-■)

Computer-guided dental implant surgery represents a predictable technique with advantages over the traditional approach to implant insertion.[1,2] Under ideal conditions, it can reduce implant positioning errors,[3-5] facilitate the management of the flapless technique, shorten chair time, improve the postoperative course, and reduce patient morbidity.[1,2,6] Begun in the late 1990s and introduced to dental practice in the early 2000s for the flapless treatment of completely edentulous patients, computer-guided surgery has become popular in a wide range of clinical situations.[7-11] Tooth-supported templates have been reported to be more accurate than either mucosa-supported or bone-supported templates.[3,10-13]

Computer-guided surgery can also be used where regenerative techniques are needed with implant insertion.[14,15] Fixing pins can be used to attach the template to the maxilla in accordance with the digital planning of the implant position. However, when the implants are placed immediately after extraction, the surgical guide template cannot be evaluated in the oral cavity before the teeth are extracted, and the positioning of the surgical guide may lack accuracy,[16] leading to inaccurate implant placement.

A technique has been described to improve the insertion of interim prostheses after immediate implants, but not the positioning of the template.[17] A fully guided surgical procedure in which the implant was inserted by means of a mounted guiding device has been described.[18,19] This solution has been reported to be more accurate than other approaches, such as the first-bur-guided or the half-guided options, and this difference in accuracy was greater for less experienced operators.[18,19] Others used the superimposition-anchor microscrew system[20] and ball attachments[21] to improve the accuracy of the surgical guide. The present article describes a recently developed surgical guide called the sequential template immediate loading (STIL) device for the clinical management of implants placed immediately after tooth extraction.

TECHNIQUE

The technique is demonstrated in a patient with no facial deformities who was scheduled for treatment of the maxilla with an implant-supported fixed dental prosthesis.

1. Make a traditional impression with a polyether material (Impregum; 3M), record the occlusal

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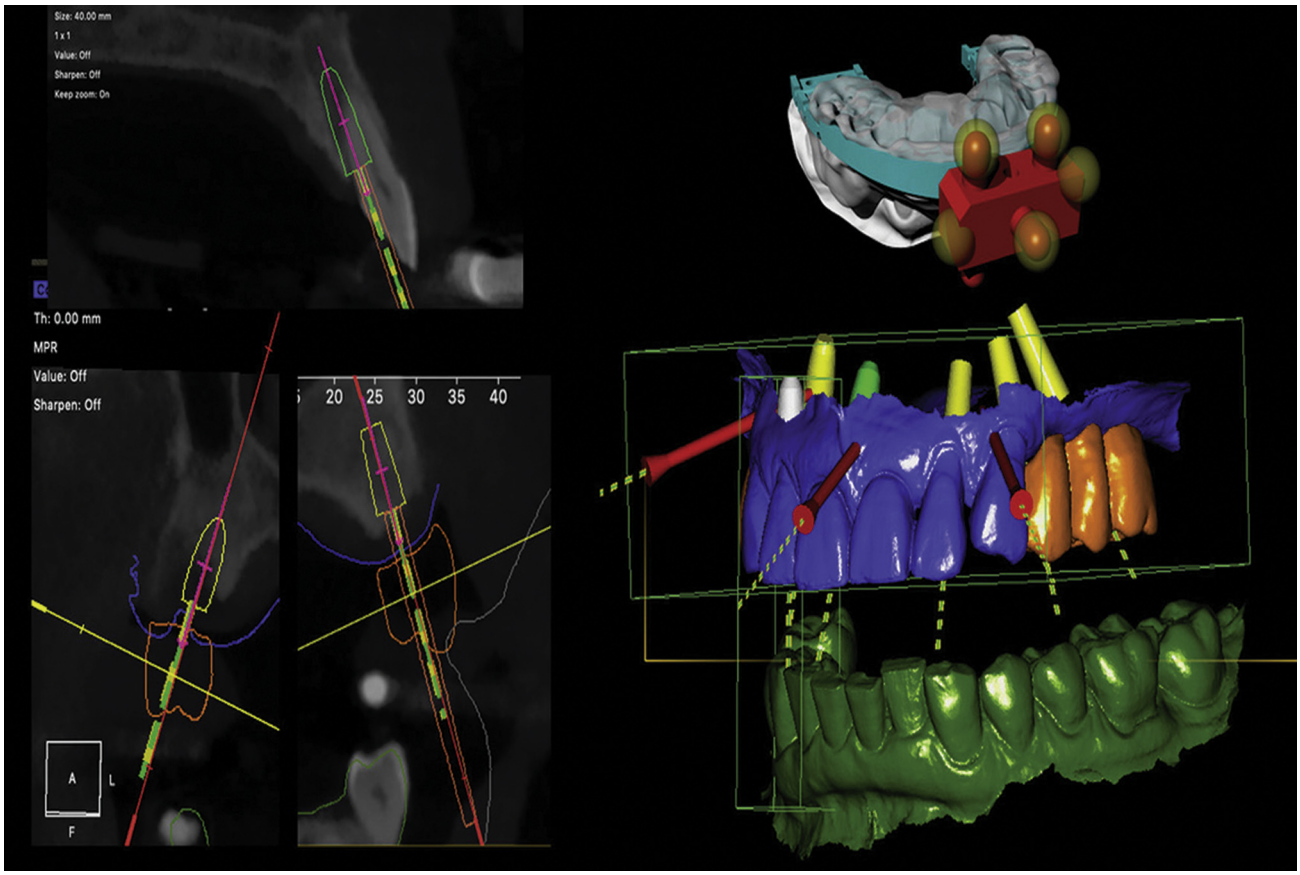

Figure 1. Planning of guided surgery and superimposition with radiopaque landmark device.

relationship (Ramitec; 3M), and make a facebow record (Denar Slidematic Facebow; Whip Mix Corp).

2. Send all intraoral data to the dental laboratory technician to obtain a diagnostic waxing. Scan the diagnostic cast by using a laboratory scanner (InEos-Xs; Dentsply Sirona).
3. Obtain a cone beam computed tomography (CBCT) scan of the maxilla by using a radiopaque landmark device (Evobite; 3Diemme). Stabilize the device with polyether material (Ramitec; 3M).
4. Input the CBCT scan, diagnostic cast, waxing, and radiopaque landmark device data into the 3D-guided surgery planning software (3Diagnosys 4.2; Ires srl). Match all data and plan the surgical placement of implants according to the design and position of the diagnostic waxing (Fig. 1).
5. Load the implant project in a computer-aided design (CAD) software program (PlastyCAD; 3Diemme) to obtain the surgical guide template with a semi-automatic process in a standard tessellation language (STL) file. Design the STIL template, starting from the virtual dentulous cast. Use this cast to create a mixed-support template based on the patient's anatomy before surgery. Then use the CAD program to divide the template into 2 pieces, one containing what will become the base of the template with the housing for the fixing pins (template 1) and the other containing the tooth support (template 2). The 2 parts can be connected by means of slots with ball attachments (Rhein). When assembled, use these 2 templates to establish the position of the fixing pins before extracting the teeth (Figs. 2-4). To do so, place the assembled templates (1 and 2) in the oral cavity and fix the pins in place (Fig. 5A-C). Then remove the tooth-supporting part (template 2) and extract the teeth. Leave template 1 in place with the pins until the end of the procedure (Fig. 5D).
6. After completing these steps, use the CAD program to make the dentate cast virtually edentulous. Design the part to position after the extractions (template 3) from template 1. The template 3 design has slots for inserting the dental implants according to the virtual plan and diagnostic waxing (Figs. 6,7). After extracting the teeth, attach template 3 to template 1 with the aid of the ball attachments and then proceed with the guided insertion of the implants (Fig. 8).
7. With the edentulous cast in the CAD program with template 1, design the interim prosthesis according

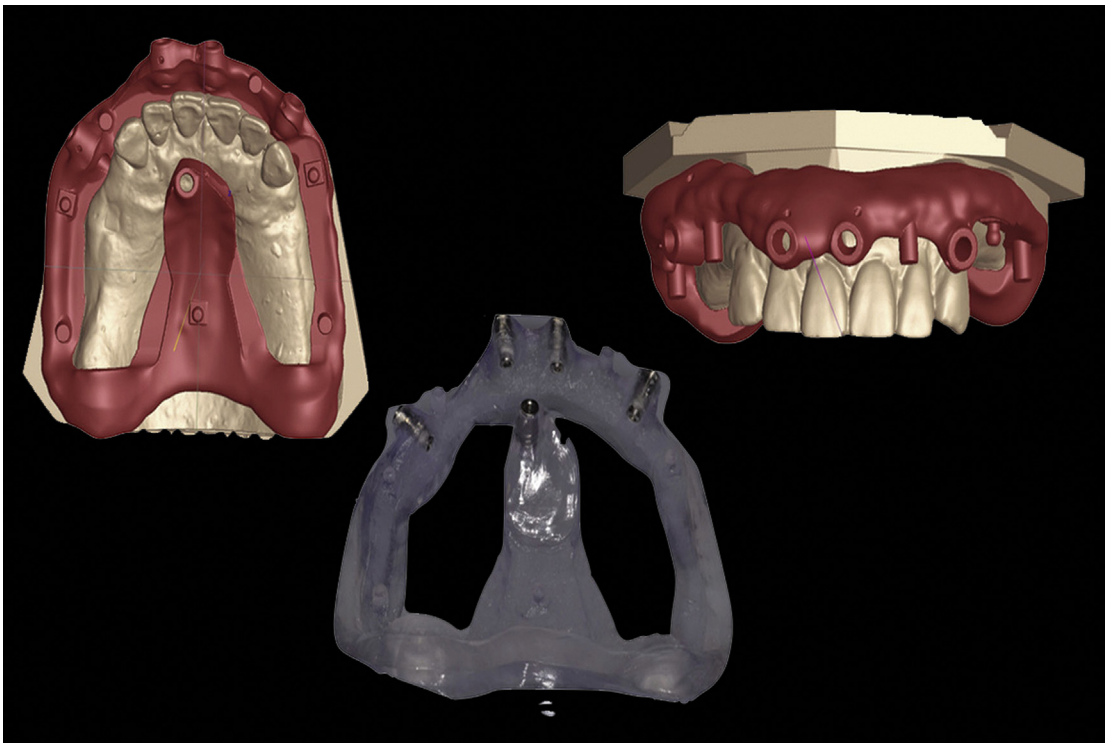

Figure 2. Template 1 with positioning of pin.

Figure 3. Computer-aided design of sequential templates 1 and 2.

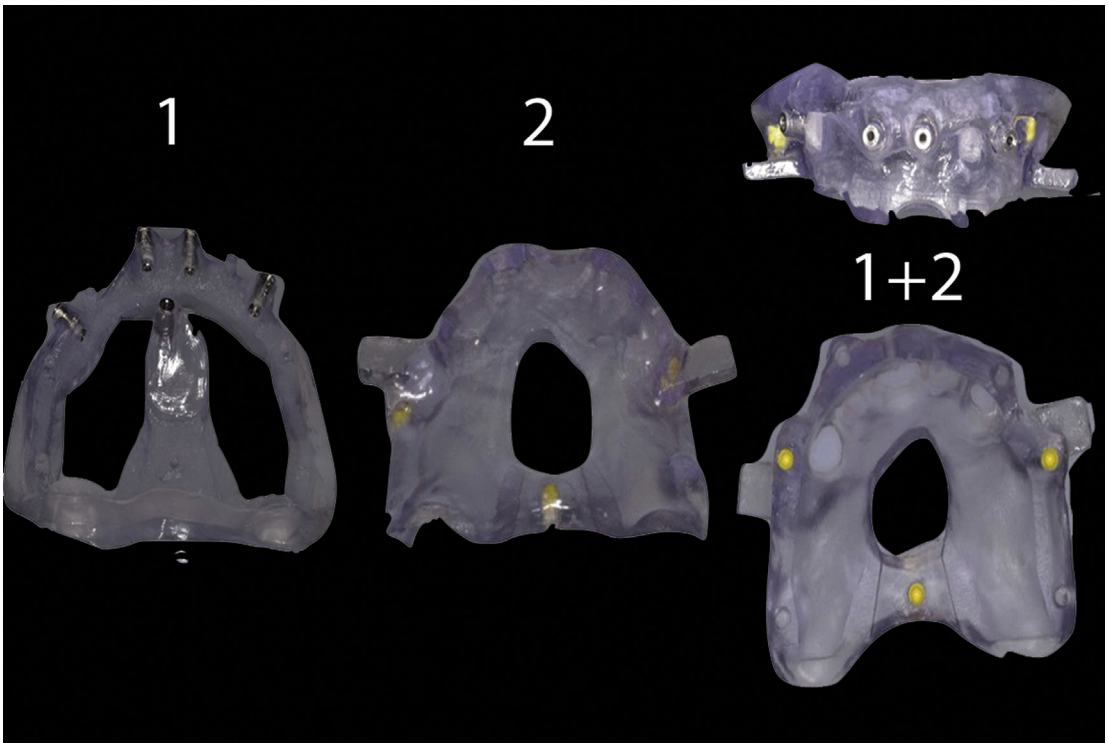

Figure 4. Assembled templates 1 and 2. Arrangement used to lock fixing pins in place before extracting teeth. Residual tooth position template 1 correctly oriented.

to the diagnostic waxing and implant plan by using the CAD software program (PlastyCAD; 3Diemme). Include the framework and tooth shape of the interim prostheses in the design, with the slots for the interim dental implant abutments in the same position as the slots for the dental implants, and select the type of angled dental implant abutment for each dental implant (Fig. 9).

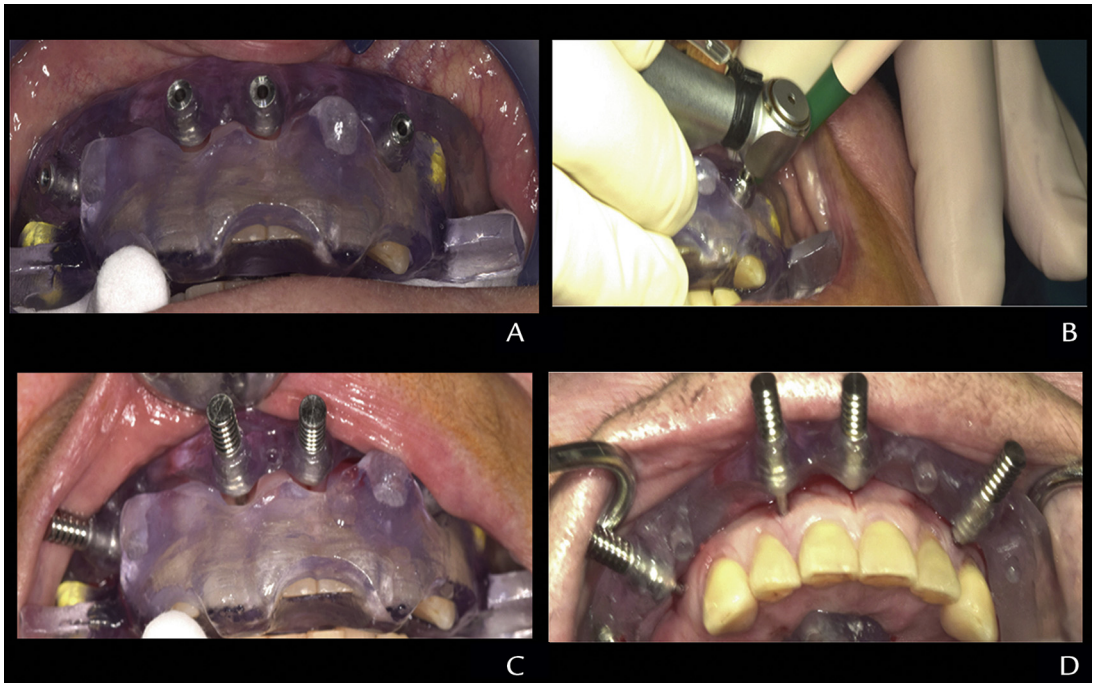

Figure 5. Clinical steps. A, Assembled templates 1 and 2 intraorally. B, Procedure to fix pins in place. C, Removal of template 2. D, Template 1 in place with pins.

Figure 6. Computer-aided design of sequential templates 1 and 3.

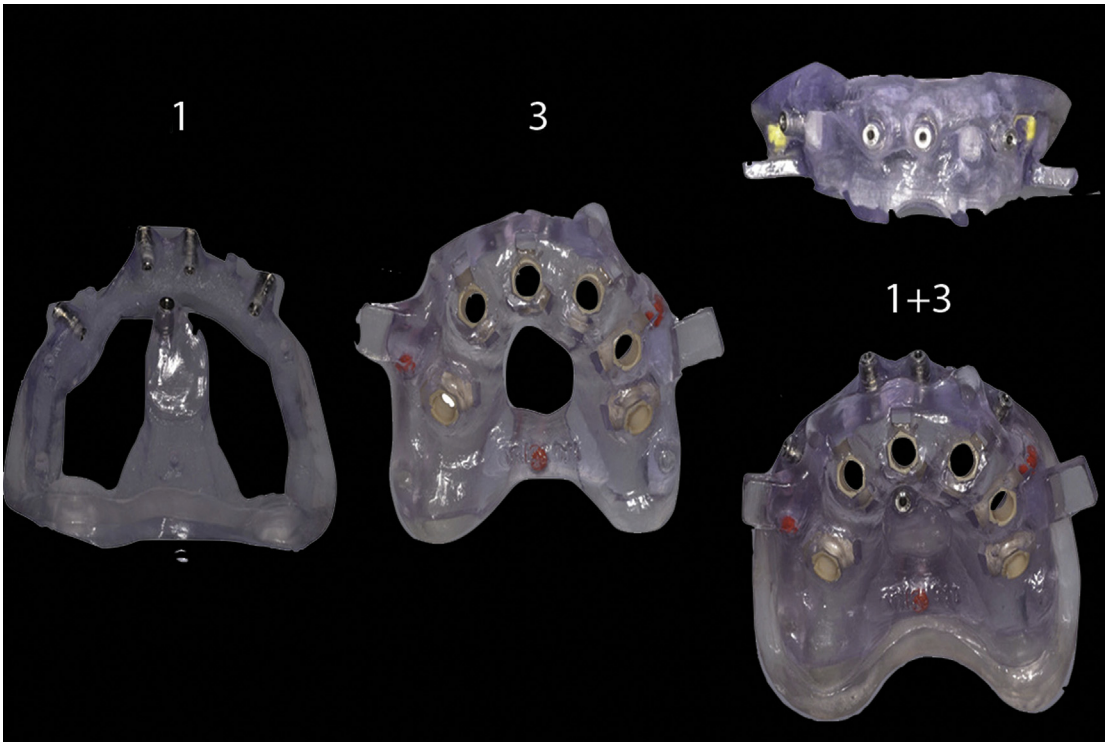

Figure 7. Assembled templates 1 and 3. Template 1 not removed after extractions. Template 3 then attached to template 1 for guided insertion of implants.

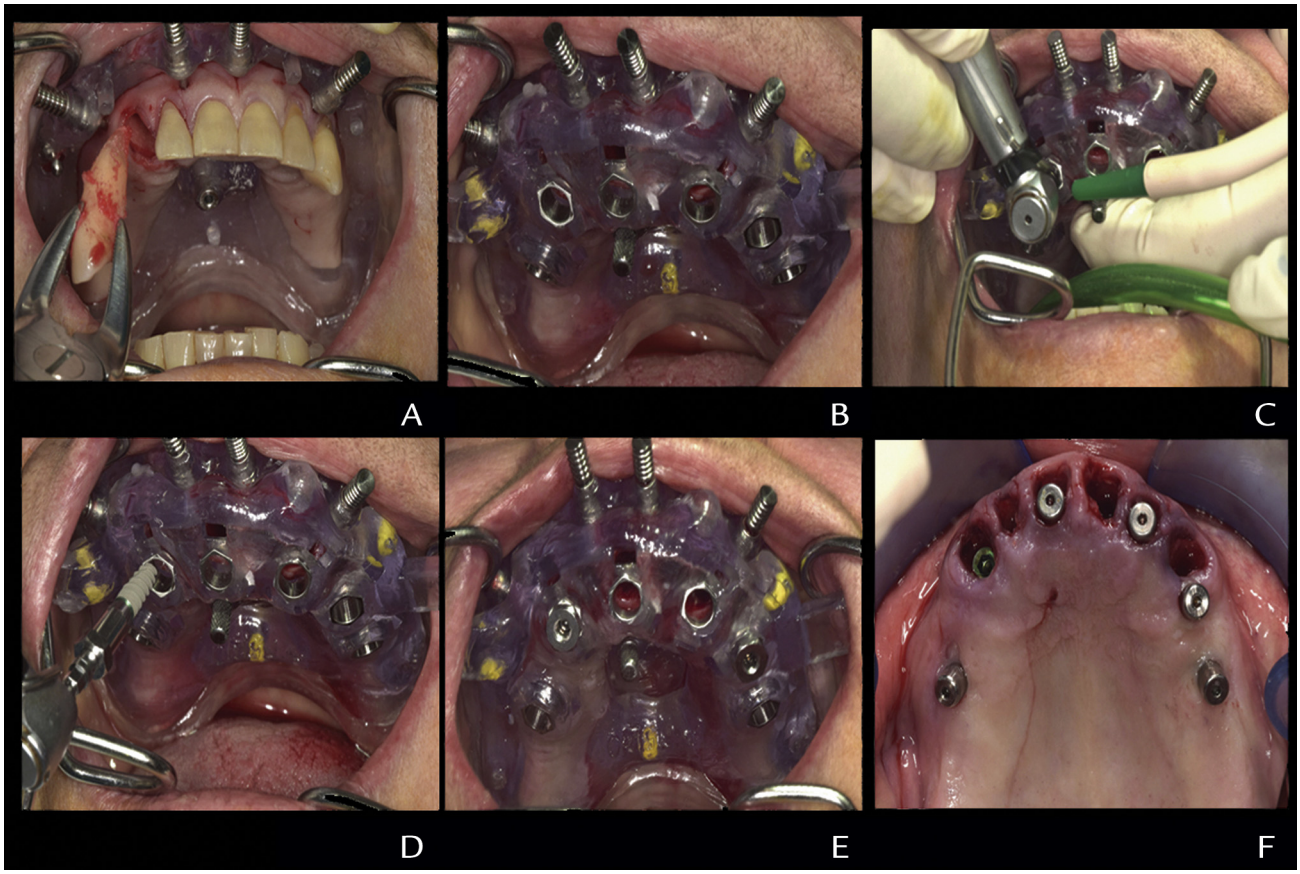

Figure 8. Clinical steps. A, Removal of template 2 and extraction of teeth. B, Template 3 attached to template 1 with aid of ball attachments. C-E, Procedures of computer-guided implant surgery. F, Occlusal view without surgical guides and after evaluation of interim prosthesis.

8. Fabricate the templates and casts by using a 3D printer (Rapid Shape D40; Rapid Shape) from resin (Ortho Plus; Shera). Mill the 2-layered interim prostheses by using a computer numerical control machine (inLab MC X5; Dentsply Sirona). Use polyetheretherketone (PEEK; Techim Group s.r.l.) to fabricate the framework and polymethyl methacrylate (PMMA; Techim Group s.r.l.) for the teeth (Fig. 10).
9. Insert the implants by fully guided surgery. Remove template 3, leaving template 1 in place, screw in the angled dental implant abutment, and attach the interim dental implant abutment and the interim prosthesis guided by the ball attachments. Evaluate the fit of the interim dental implant abutment and realign to ensure it is correctly centered (Fig. 11).

DISCUSSION

Computer-aided design and computer-aided manufacturing (CAD-CAM) technologies, computer-guided implant surgery systems, CBCT scans, and other tools such as intraoral scanners have gained popularity as they improve patient comfort, shorten operating times,[22] and reduce the clinical treatments required for implant-supported restorations.[6] A patient's remaining teeth are used as reference markers to match images[12] and stably position surgical guides in the oral cavity. During the standard procedure to place implants immediately after extraction, the fit of the surgical guide template cannot be evaluated or inserted in the oral cavity before the teeth are extracted and may not be accurately positioned because of changing anatomy.[16] This article describes a method that enables the clinician to use computer-guided templates even for implants placed immediately after extraction. The STIL procedure involves the use of 3 sequential guides: the first serves as a base to stabilize the other templates and interim prostheses; the second takes advantage of residual teeth to hold the first template in the correct position; the third is used to position the dental implants during computer-guided surgery.

A recent review reported that the fit of a tooth-supported template was more accurate than that of a template based on an edentulous ridge.[13] This prompted solutions to improve the accuracy of surgical guides. For instance, Hang-Nga Mai et al[20] used a superimposition-

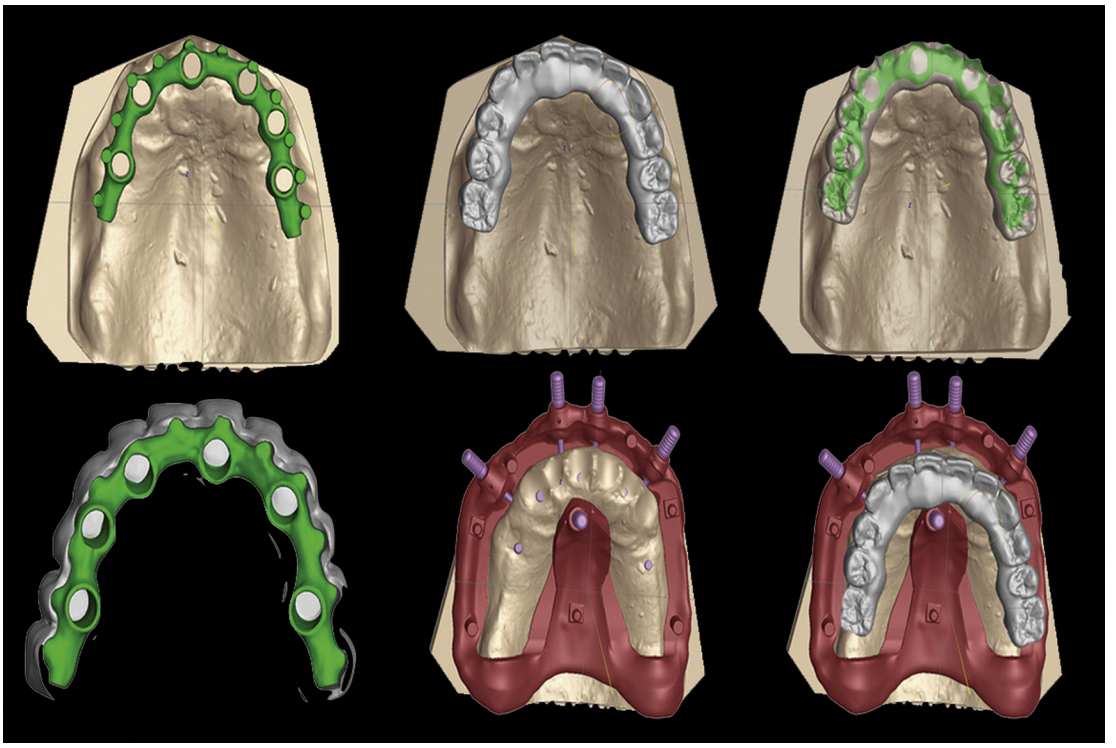

Figure 9. Computer-aided design of interim prostheses and reinforced polymethyl methacrylate framework.

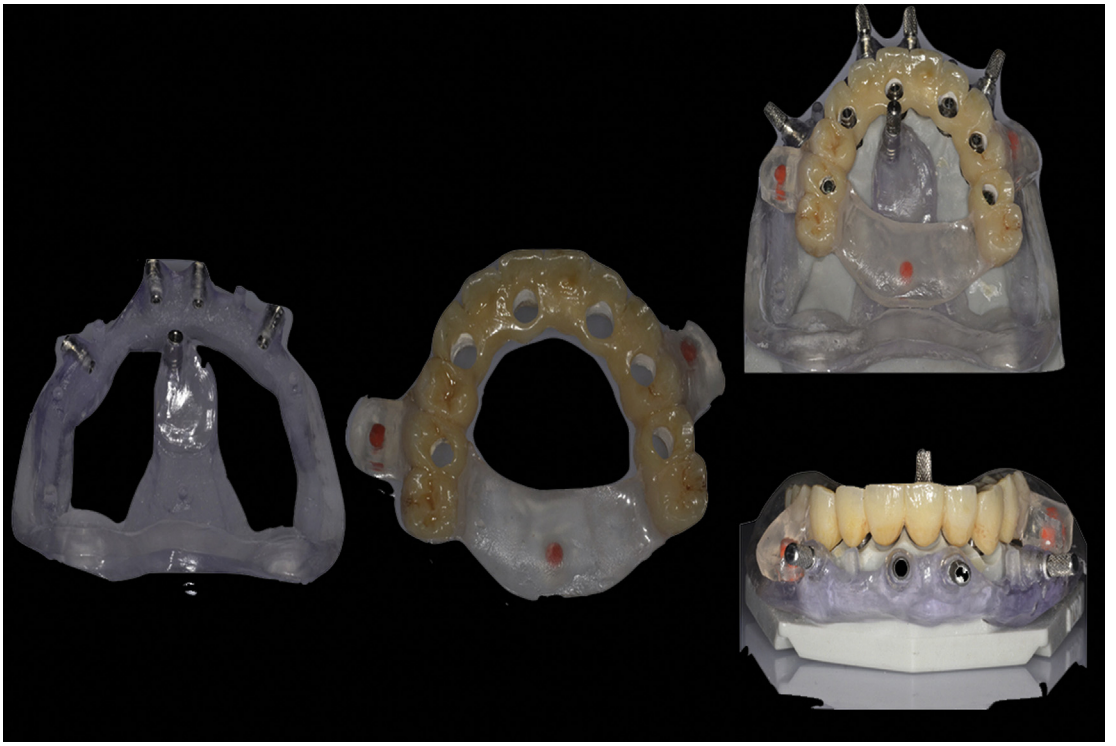

Figure 10. Interim prosthesis held in place with pins on first template (final phase of technique).

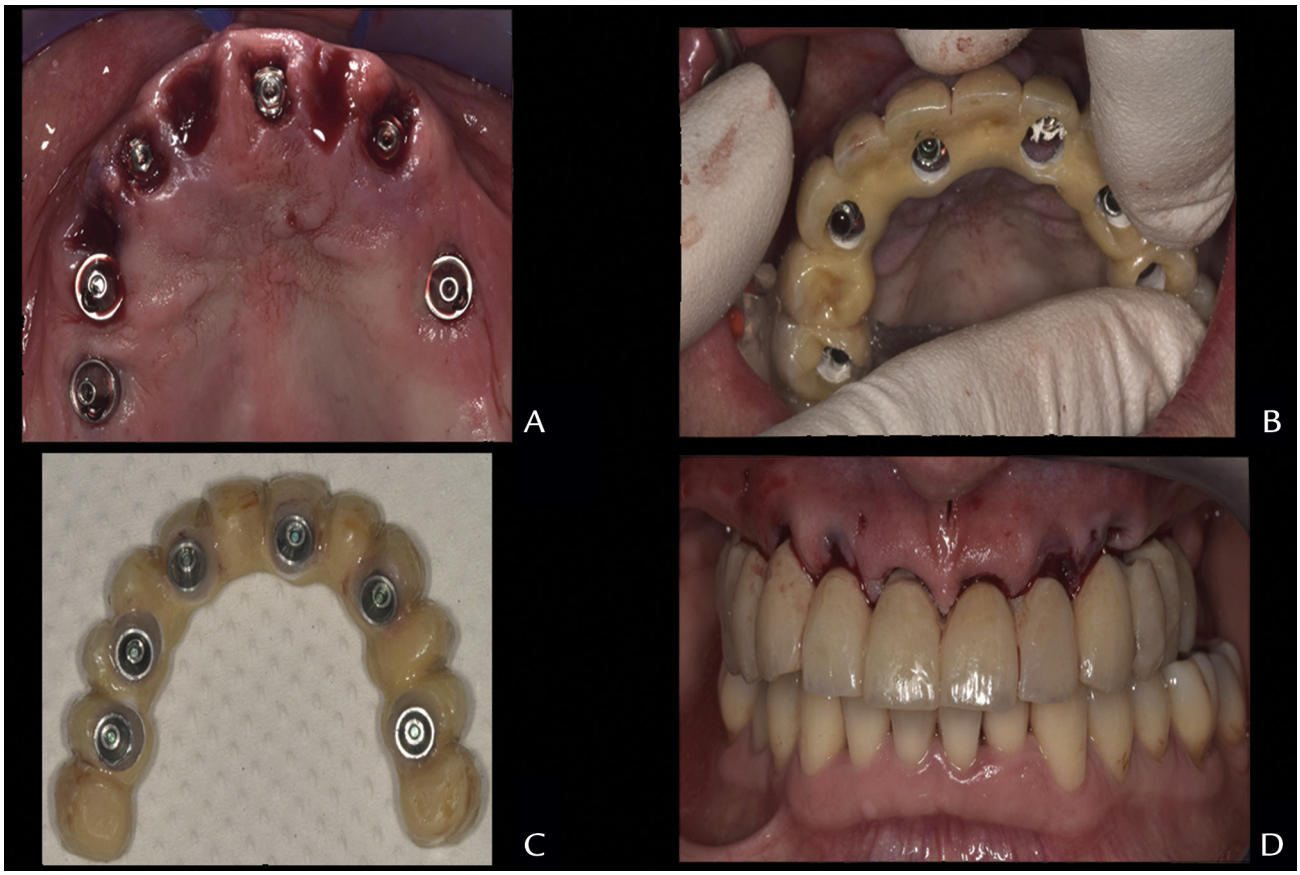

Figure 11. A, Occlusal view of angled dental implant abutments. B, Interim prosthesis during relining with autopolymerizing resin. C, D, Completed interim prosthesis.

anchor microscrew system in computer-guided implant surgery involving a posterior unilateral edentulous area, while Widmann et al[21] used ball attachments.

The conventional approach to immediate post-extractive implants using computer-guided surgery consists of extracting residual teeth before evaluating the fit of the templates. However, tooth extraction can change the anatomy of the alveolar bone and negatively affect the fit of a surgical guide. Hence, the STIL templates, designed to preserve the accurate fit of the template by using the position of residual teeth, thus enable clinicians to insert implants in the planned position more accurately than can be achieved with conventional surgery. Clinical trials will be needed to assess this procedure in terms of reducing operating times and to compare its precision with that of traditional methods.

SUMMARY

The technique described enables shorter operating times and improves the accurate fit of the surgical templates used in computer-guided implant surgery for placing implants immediately after tooth extraction.

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