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DENTAL TECHNIQUE

Immediately loaded interim complete-arch implant-supported fixed dental prostheses fabricated with a completely digital workflow: A clinical technique

José Espona, DDS, MSc,[a] Elena Roig, DDS,[b] Akram Ali, DDS, PhD,[c] and Miguel Roig, MD, DMD, PhD[d]

ABSTRACT

A digital method for delivering an immediately loaded interim complete-arch implant-supported prosthesis is described. Reference pins were used to accurately superimpose a postoperative scan with the scan bodies in place on a preoperative scan with the framework design, including the interocclusal relationship and the occlusal scheme. A prefabricated auxiliary device was used after surgery to record the position of the implants and after scanning to obtain an accurate transfer of the implant positions by means of a free software program, allowing an excellent fit of the fabricated prosthesis. This technique can help in the fabrication of an interim prosthesis with better fit and comfort and reduced chair time than conventional techniques. (J Prosthet Dent 2019;■:■-■)

Immediate loading of a complete-arch implant-supported prosthesis is predictable and is a standard treatment option for selected patients.[1-3] The procedure is complex and requires adequate knowledge, skill, and clinical expertise.[4] Digital workflows have been introduced to simplify the protocol, reducing treatment time.[5,6] Nevertheless, standard workflows are usually required, which include impression making immediately after implant placement, finishing of the interim prosthesis in the dental laboratory, and/or cementing the interim prosthesis to interim copings in the patient's mouth.[7-9] Accurately transferring the vertical dimension of occlusion (VDO) to the prosthesis[10] and recording the optimal interocclusal relationship may require time-consuming adjustments.[11]

An intraoral scanner (IOS) can be a good alternative to elastomeric impressions for accurately recording the location of the implants immediately after placement. However, the accuracy of the scan may be insufficient to allow passive fit of the framework in a complete-arch implant-supported prosthesis.[12,13] The use of an auxiliary device can help achieve adequate accuracy.[14] A prefabricated device such as the MedicalFit device (Dentalesthetic) can be used to simplify the process and eliminate the time required for the fabrication of a custom device. This plastic device has one flat surface and the other surface with anatomic teeth shapes (Fig. 1).

Another problem in using IOS immediately after surgery is the difficulty in making interocclusal records because of the lack of anatomic references.[15] By placing several pins (Ti-System; curasan) before the surgery, the accuracy in overlapping the presurgical and postsurgical intraoral scans can be improved, allowing the dental technician to work with the interocclusal records sent with the first set of standard tessellation language (STL) files. Recording an accurate scan and the intermaxillary relationship allows the dental technician to deliver an interim prosthesis with an optimal fit, the planned VDO, and well-controlled occlusion and esthetics. The protocol allows the delivery of the interim prosthesis in a monolithic material in 3 visits. The second and third visits can be in 1 day or on 2 consecutive days.

[a]Associate Professor, Department of Restorative Dentistry, School of Dentistry, International University of Catalunya, Barcelona, Spain.
[b]Doctoral student, Department of Restorative Dentistry, School of Dentistry, International University of Catalunya, Barcelona, Spain.
[c]Associate Professor, Department of Restorative Dentistry, School of Dentistry, International University of Catalunya, Barcelona, Spain.
[d]Professor, Department of Restorative Dentistry, School of Dentistry, International University of Catalunya, Barcelona, Spain.

Figure 1. MedicalFit device used. Plastic plate with one flat surface and other with anatomic forms to facilitate intraoral scanning.

Figure 2. Initial optical intraoral scan. Mandibular and maxillary arches and interocclusal relationships recorded.

TECHNIQUE

1. Obtain intraoral optical scans (TRIOS 3; 3Shape) of both the arches and the occlusion (Fig. 2). Obtain frontal photographs from a 45-degree angle with the lips at rest, with a maximum smile, and by using lip retractors. All photographs must include the eyes. Make a cone beam computed tomography (CBCT) (CS 8100; Carestream Dental LLC) scan of the patient to obtain a Digital Imaging and Communications in Medicine (DICOM) file (Fig. 3). Import and superimpose both DICOM and STL data sets into an implant planning software program (DTX Studio; Nobel Biocare Services AG). Determine the initial steps of the treatment (Fig. 4). Send all files and pictures to the dental laboratory technician.
2. Import the STL files and photographs into a computer-aided design and computer-aided manufacturing (CAD-CAM) software program (Dental System; 3Shape) and design a complete-arch implant-supported fixed dental prosthesis. Approve the STL data sets of the design before the surgery (Fig. 5).
3. Import the STL file with the definitive design into the surgical implant planning software (DTX Studio) and superimpose it on the original STL file and the original DICOM file. Plan the implants and design a surgical guide. Export the STL file of the surgical guide and 3D print or mill the guide.
4. Place 3 to 4 Ti-System pins in the maxilla (Fig. 6A). Ensure the pins are placed in locations that will not be contacted during surgery. Scan the arch again with the pins in place before surgery (Fig. 6B).
5. Extract the teeth that might interfere with the complete seating of the surgical guide and place the implants. Select and screw multiunit abutments (Nobel Biocare Services AG), screw scan bodies (AVINENT) into the abutments, and make a new intraoral optical scan, ensuring that all the pins are included in the scan (Fig. 6C).
6. Remove the scan bodies and screw the interim copings (Temporary Snap Coping Multi-unit Plus; Nobel Biocare Services AG) to the multiunit abutments. Adapt a MedicalFit device to the interim copings, with the anatomic surface toward the implants, and attach the device to the interim copings with flowable composite resin (Tetric EvoFlow; Ivoclar Vivadent AG) (Fig. 6D).
7. Once attached, unscrew the interim copings to remove the device, screw ScAnalog implant replicas (Dynamic Abutment Solutions) to the interim copings, make an optical scan of the ScAnalog replicas and the auxiliary device, and send all obtained STL data sets to the dental laboratory (Fig. 7).
8. Superimpose the file with the scan bodies on the file with the MedicalFit device. By using a mesh managing software program (Autodesk Meshmixer; Autodesk Inc), reposition the scan bodies in the STL file of the intraoral scan. Superimpose the corrected STL file over the prosthodontic planning file by using the pins as reference. Adapt the designed framework to the ScAnalog implant replicas in the STL data set and mill the prosthesis in polymethylmethacrylate (PMMA) resin (PMMA BLOK; Huge Dental Material Co). As the overall procedure requires 3 to 4 hours, schedule the patient for the next step, the same, or the following day. Screw the interim prosthesis to the multiunit abutments at a torque of 15 Ncm.
9. Close the access holes with Teflon tape and composite resin (Esthet-X; Dentsply Sirona) (Fig. 8).

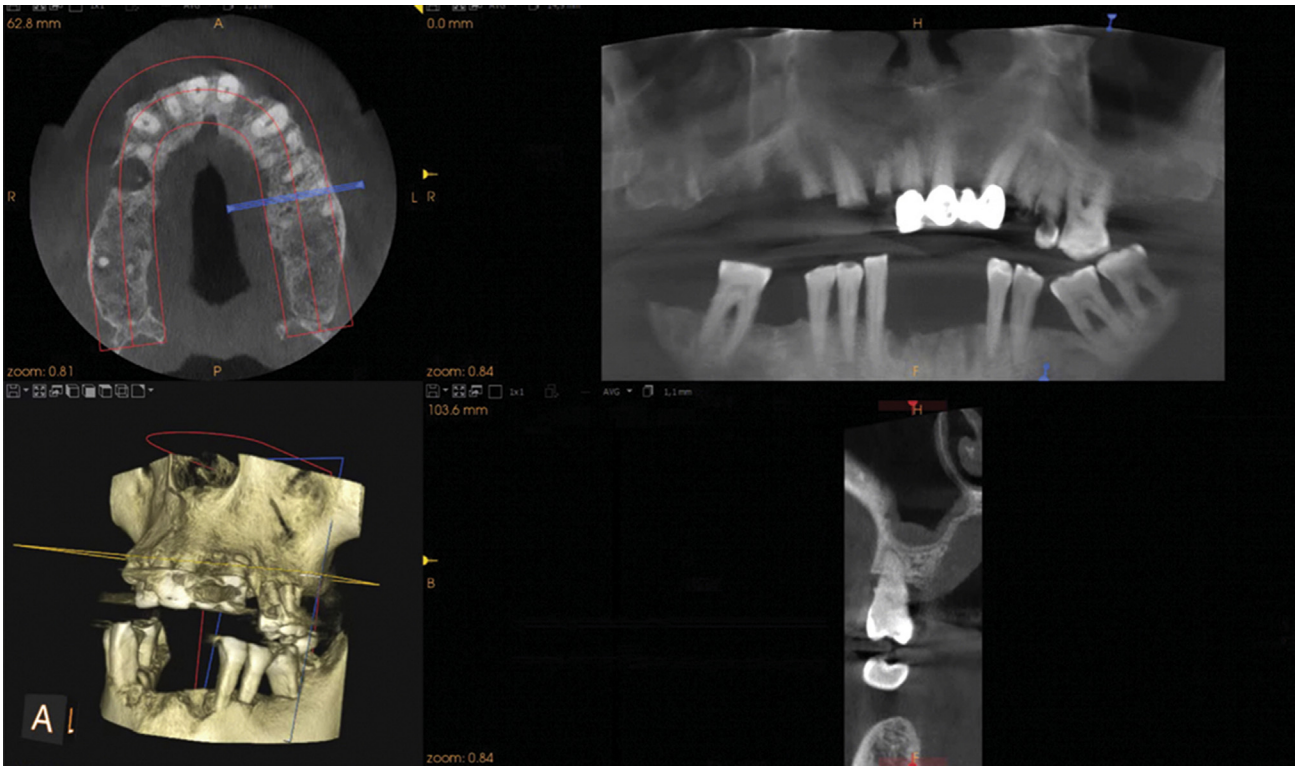

Figure 3. Cone beam computed tomography (CBCT) scan.

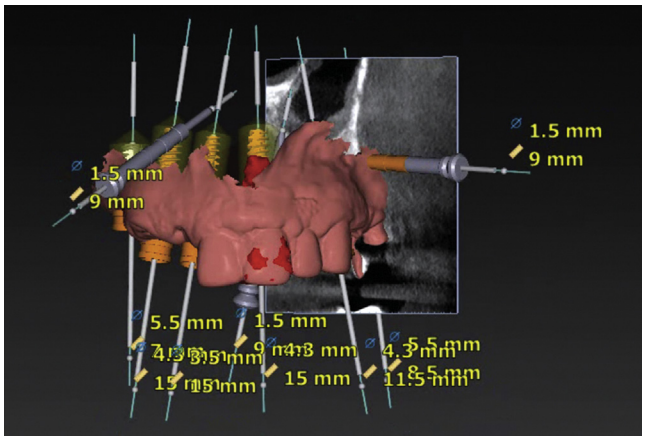

Figure 4. STL file obtained from intraoral scanner and DICOM file obtained from CBCT imported to implant planning program for initial phase of treatment planning. CBCT, cone beam computed tomography; DICOM, Digital Imaging and Communications in Medicine; STL, standard tessellation language.

Adjust the occlusion, perform the required esthetic corrections, and explain the usual postoperative instructions.

DISCUSSION

The current digital workflow can help optimize clinical efficiency and quality. It can deliver an interim prosthesis with excellent fit, correct VDO, and well-controlled occlusion, minimizing the required clinical time.

As the interocclusal records with the proposed technique are made before surgery, an occlusal position is produced that is almost identical to the preoperative occlusion. Such precision is difficult to achieve with techniques that record these details intraoperatively or that clinically adapt a previously fabricated prosthesis directly after surgery. Compared with the techniques that use a previously fabricated prosthesis and are delivered immediately after implant placement, the proposed technique requires a delay of at least some hours or even a day. Nevertheless, the overall treatment time decreases, and patient comfort increases.

The use of pins for reference might not be essential in situations where anatomic references, such as the palate, can be used. Nevertheless, as changes in these anatomic references might affect the accurate superimposition of the STL files, it seems prudent to use the pins in all the patients where a completely digital workflow is used.

For an accurate prosthesis, the device used (in this case, MedicalFit) should be exactly the same as the STL file in the dental laboratory technician's library. Attempts to use or design similar devices without being sure of the accuracy of the device will lead to inaccuracies in the fit of the prosthesis.

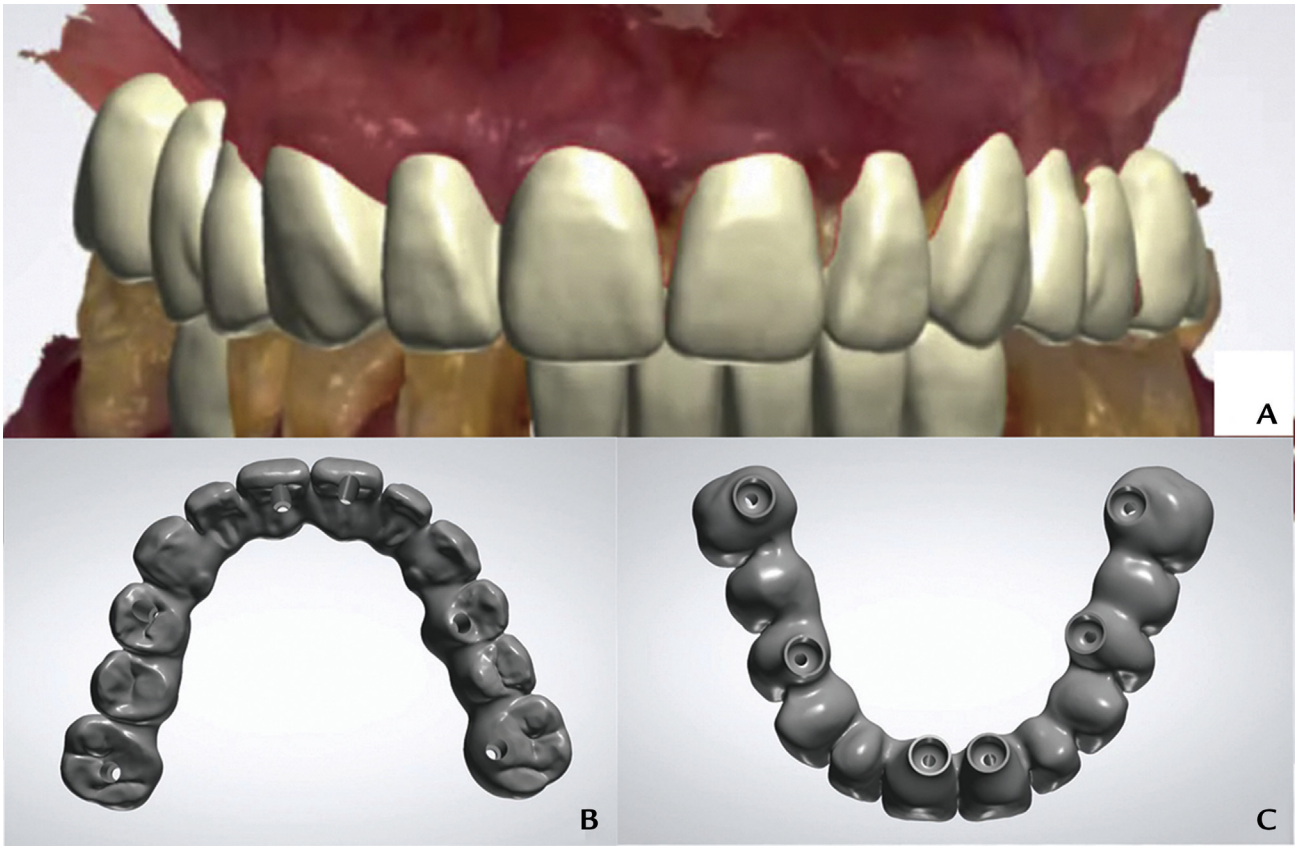

Figure 5. Files evaluated by clinician before surgery. A, Digital design. B, C, Interim prosthesis design.

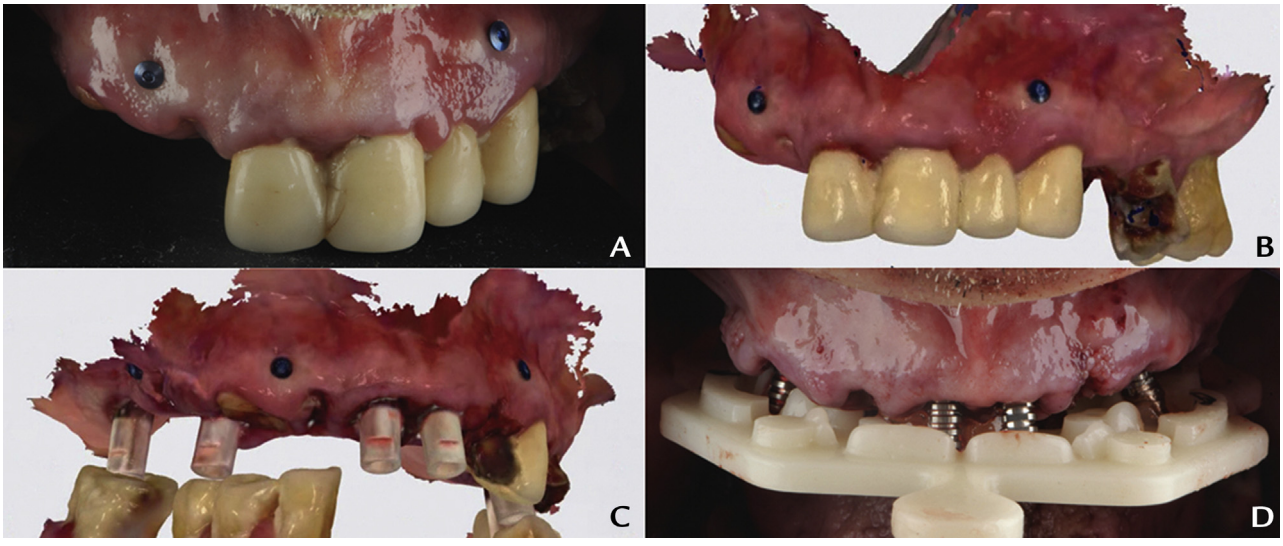

Figure 6. A, Pins placed before surgery to be used as references for superimposition after surgery. B, New scan made ensuring that all pins included. C, Scan bodies screwed to abutments after placement of implants and multiunit abutments, and new scan made, ensuring that pins included, allowing superimposition with presurgical scan and maintenance of established vertical dimension of occlusion. Although pins used, one tooth retained for STL file superimposition. D, After removing scan bodies, interim copings screwed on multiunit abutments and MedicalFit device trimmed to fit on interim abutments and attached by using Triad Gel. STL, standard tessellation language.

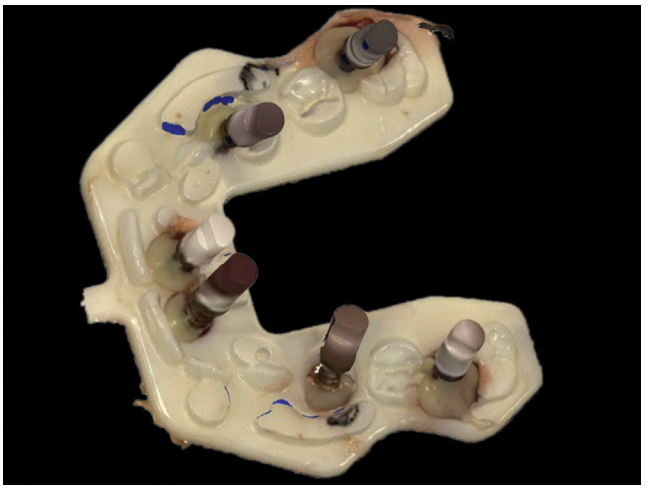

Figure 7. After removal from mouth, ScAnalog replicas screwed on interim copings. MedicalFit device scanned, and obtained STL file sent to dental laboratory. STL, standard tessellation language.

Figure 8. Interim polymethylmethacrylate (PMMA) fixed prosthesis delivered in less than 4 hours. Easily screwed on multiunit abutments with minimal occlusal adjustments required. Small discrepancies in gingival adaptation can be corrected immediately with composite resin or corrected in the definitive restoration.

SUMMARY

The current technique uses a completely digital workflow to fabricate interim complete-arch implant-supported prostheses for immediate loading. It avoids the need for intraoperative impressions or adaptation of a previously fabricated prosthesis. The use of an auxiliary device helps achieve an excellent passive fit. The use of surgical pins as references allows the accurate transfer of the interocclusal records, minimizing the need for intraoral adjustments, reducing chair time, and improving patient experience.

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Corresponding author:
Dr Miguel Roig
Department of Restorative Dentistry
Facultad de Odsontología
Universitat Internacional de Catalunya, 08021
Barcelona
SPAIN
Email: mroig@uic.es

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