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DENTAL TECHNIQUE

Reverse scan technique: A verification method for the implant position in intraoral scans

Pavel Hyspler, MD,[a] Jakub Strnad, Dipl Ing, PhD,[b] Radim Sala, Dipl Ing,[c] and Tatjana Dostalova, MD, PhD, Dr Sci, MBA[d]

ABSTRACT

This article describes a fully digital method of verifying and increasing the accuracy of the position of implants in extensive prosthetic restorations. This cost-effective, timesaving, and versatile procedure uses a laboratory scanner, a scannable implant analog, and a printed interim implant-supported prosthesis to refine the virtual definitive cast. (J Prosthet Dent xxxx;xxx:xxx-xxx)

Intraoral scanners have advantages, but they have limited accuracy for extensive tooth- or implant-supported prostheses. The reduced accuracy is because of the 3-dimensional (3D) modeling used when the small surface scans are merged by the software program into a 3D cast. Inaccuracy has been reported to increase with an increased scan path and a lack of reference surfaces.[1,2] Different techniques and devices have been described to reduce these errors,[3] including the use of extraoral scanners,[4–6] cone beam computed tomography,[7–9] and laboratory scanners,[10] available in most contemporary dental laboratories.

The completely digital workflow described combines previously published improvements in intraoral scanning and introduces the novel use of the scannable implant analog and laboratory scanner, eliminating the need for casts and merging errors. The technique represents a cost-effective, timesaving, versatile, fully digital procedure applicable for most indications in fixed implant-supported prosthodontics.

TECHNIQUE

1. Screw in the scan bodies (BioniQ; Lasak) and use an intraoral scanner (3Shape; 3Shape A/S) to scan the maxilla, mandible, and soft tissues (Fig. 1). To facilitate the scanning process, first scan the jaw with scan bodies, copy the 3D cast, remove the scan bodies, and then scan the soft tissues. If the scanning process is incomplete and the scanner head needs to be returned repeatedly to the same place, connect the scan bodies (Continuous Scan Strategy) with autopolymerizing resin (Pattern Resin LS; GC Corp), wax (Ceradent; SpofaDental) or place 3D markers on the soft tissues with a liquid dental dam (Rubber Dam liquid; Cerkamed).
2. Import the scans into the CAD (Computer aided design) program (exocad; exocad) and model the interim implant-supported prosthesis. Apply the digitized denture or the printed wax pattern used for implant planning as a pattern. If the standard tessellation language file of the denture does not easily match the scan, join it with the extension of the planned implants in the implant program (Romexis; Planmeca), defined to be the same size as the scan bodies. Do not model the interim implant-supported prosthesis in contact with the gingiva but leave a 2- to 3-mm space. This will facilitate scanning the soft tissue in the subsequent step (Fig. 2).

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[a]Head, Dental Department, The Military University Hospital Prague, Prague, Czech Republic; and PhD student, 1st Medical Faculty, Charles University, Prague, Czech Republic.
[b]Development Director, Private practice, Prague, Czech Republic.
[c]Head, Technical Department, Private practice, Prague, Czech Republic.
[d]Professor, Department of Dentistry, 2nd Medical Faculty and Faculty Hospital Motol, Charles University, Prague, Czech Republic

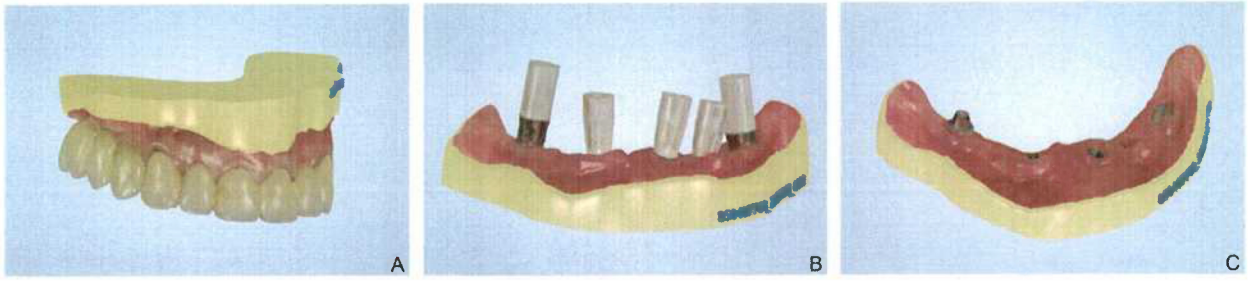

Figure 1. Preliminary scans. A, maxilla. B, mandible. C, soft tissues.

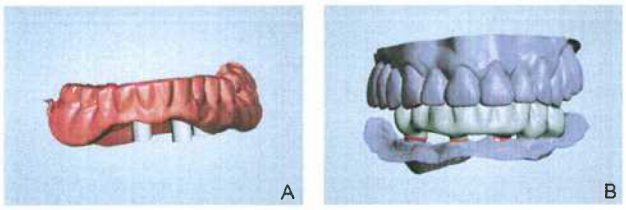

Figure 2. A, STL model of CBCT digitized denture combined with extension of planned implants. B, Gingivally reduced interim implant-supported prosthesis. CBCT, cone beam computed tomography; STL, standard tessellation language.

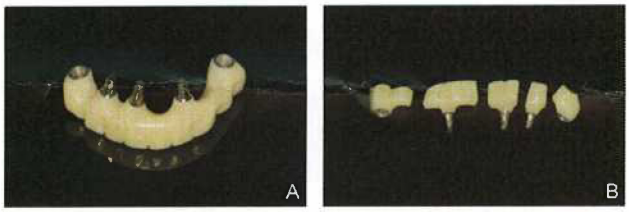

Figure 3. A, Printed interim implant-supported prosthesis. B, Sectioned prosthesis.

3. Produce the interim implant-supported prosthesis from an interim resin (NextDent C&B MFH; 3D Systems) using 3D printing (Original Prusa MedicalOne; Prusa Research) or computer numerical control milling (AG Motion2; Amann Girrbach AG).
4. Bond (Multilink Hybrid Abutment; Ivoclar AG) the titanium base (Uni-Base; Lasak) to the interim implant-supported prosthesis. The use of nonrotational abutments will be beneficial for this step, simplifying the splinting.
5. Section the interim implant-supported prosthesis with a disk (405.514.220HP, Rotadent) into pieces containing only 1 abutment. Because of the polymerization contraction of the material, keep the space between the sections as small as possible (Fig. 3).
6. Screw the parts of the interim implant-supported prosthesis into the mouth. The pieces must not be in contact. Bond them together with composite resin cement (Dentocem; Itena Clinical) or flowable composite resin (Gradia Direct Flow; GC Corp). Make sure that the adhesion of the splinting material to the interim implant-supported prosthesis is adequate.
7. Use the same material to register the jaw relations. If necessary, adjust the interim implant-supported prosthesis with a bur (H79EF.104.040; Komet).
8. Make the definitive IO (Intraoral)scans first with the interim implant-supported prosthesis; try to scan the tissue under the prosthesis as well. Next, create an opposite and an occlusion scan. Then, copy the working scan and delete the interim implant-supported prosthesis. Scan the remaining unscanned soft tissue. The prescan function can be used successfully with some types of scanners (Fig. 4).
9. Screw the scannable implant analog (AnalogSC; Lasak) onto the bonded interim implant-supported prosthesis and scan it with the laboratory scanner (AG Map 300; Amann Girrbach AG) (Fig. 5).
10. Align the bonded interim implant-supported prosthesis scan obtained with the laboratory scanner to the definitive IO scan acquired intraorally. Assign the required abutments to the scannable implant analog in the same way as a regular scan body (Fig. 6).
11. Fabricate the prosthesis with a CAM procedure (computer numerical control milling, 3D printing selective laser sintering) (Figs. 7, 8).

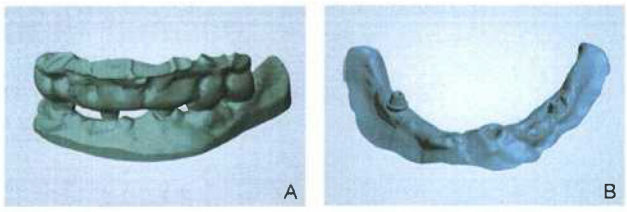

Figure 4. A, Definitive intraoral scan of interim implant-supported prosthesis. B, Definitive scan of soft tissue.

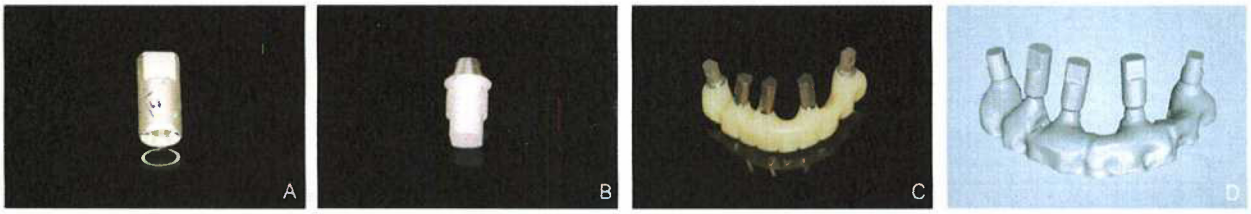

Figure 5. Reverse scan technique. A, B, Scannable implant analogs. C, Bonded reduced interim implant-supported prosthesis with scannable implant analogs. D, Laboratory scan.

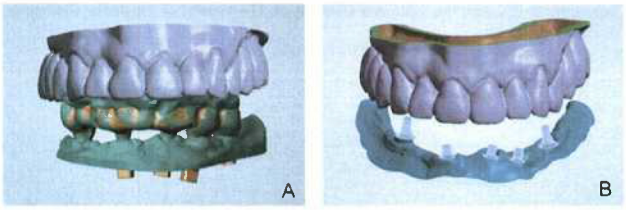

Figure 6. Reverse scan technique. A, Laboratory scan aligned to definitive intraoral scan. B, Definitive digital cast.

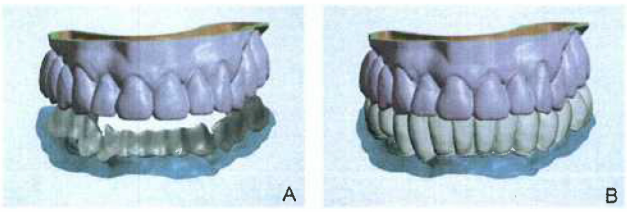

Figure 7. A, Virtual cast of metal framework. B, Virtual cast of zirconia superstructure.

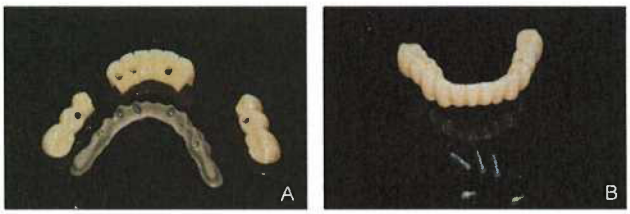

Figure 8. A, Metal computer numerical control milled framework with zirconia superstructure. B, Definitive prosthetics.

DISCUSSION

The use of intraoral scanners and a fully digital workflow has advantages, including reduced office time, increased patient comfort, and a faster learning curve.[11] Unfortunately, the applicability of intraoral scanners for longer prostheses has limits without additional steps.[12] The described procedure combines several previously described improvements with innovative ideas to facilitate and increase the accuracy of the intraoral scans. The first scan with scan bodies or using the Continuous Scan Strategy facilitates the preliminary scanning. The merging error of intraoral scanners is eliminated by scanning the bonded interim implant-supported with a laboratory scanner. Scanning the soft tissue with a reduced interim implant-supported prosthesis is more precise and rapid. The use of a scannable implant analog eliminates the necessity and inaccuracy of a cast. A disadvantage is the partial unpreparedness of current CAD software programs. Most dental implant systems do not have scan bodies for scanning implants from an impression. If they offer them, they only have a small number of supported abutments in the CAD libraries. Preliminary, unpublished measurements suggest that it is beneficial to verify all implant-supported prostheses with an axial implant distance exceeding 35 mm for the maxilla and 30 mm for the mandible. Precise determination of the critical axial distance of the implants should be investigated. Unfortunately, a generally accepted consensus on the required accuracy of implant-supported prostheses is lacking.[13]

SUMMARY

The presented technique verifies or increases the accuracy of the position of implants in extensive prosthetic restorations. This fully digital procedure uses a laboratory scanner and scannable implant analogs to increase accuracy. This method is cost-effective, not time-consuming, and is applicable for most indications in fixed prosthodontics.

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Corresponding author:
Prof Tatjana Dostalova,
Department of Stomatology,
2nd Medical Faculty and Motol University Hospital,
Charles University,
V Uvalu 84, Prague 15006,
CZECH REPUBLIC.
Email: tatjana.dostalova@fnmotol.cz.

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