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CLINICAL REPORT

# Stereophotogrammetric impression making for polyoxymethylene, milled immediate partial fixed dental prostheses

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## ABSTRACT

Immediate post-extraction and same-day placement of interim prostheses have increased patient acceptance of implant-supported prostheses. However, for immediate prostheses supported by multiple implants, meeting passive fit and esthetic standards is often challenging. In this clinical report, implant photogrammetry was combined with conventionally obtained digitized casts to prepare an interim, milled prosthesis from a polyoxymethylene (POM) disk, using computer-aided design and computer-aided manufacturing techniques. The following 2 conclusions were drawn. First, stereophotogrammetric scanning appears to be a reliable method for making impressions of immediate, implant-supported partial prostheses, and second, POM is suitable for preparing immediate interim screw-retained prosthetic implants. (J Prosthet Dent 2017;■:■-■)

Improvements in function and comfort with immediately placed implant-supported fixed dental prostheses (FDPs) have led to clinical advantages[1] and increased patient satisfaction.[2] In addition, interim prostheses accommodate soft tissue modifications and furnish more information than other options for the subsequent fabrication of the definitive prosthesis. Although immediate prosthesis placement is regarded as a treatment with long-term predictability,[3] one of the major problems posed is adaptation to implants, particularly when several are involved. The resulting prosthesis must fit precisely and afford the patient suitable esthetics and function.

Photogrammetry is a technique that collects data and information on the shape and location of an object relative to that of others in a given space and on its movement or deformation.[4,5]

A recently introduced photogrammetric system for digital implant impressions could increase patient convenience while affording suitable accuracy. It is an alternative imaging method for multiple implant-supported restorations,[6-9] including complete arch implant-supported FDPs.[10]

In photogrammetry, scans are recorded by an extraoral receiver, eliminating the need for making overlapping images with intraoral scanners and, theoretically, positioning the 3-dimensional (3D) implants more accurately than intraoral scanners. Research is needed to confirm accuracy, however.

This clinical report describes the use of photogrammetry to record 3D implant position to prepare immediate multiple implant-supported interim restorations.

## CLINICAL REPORT

A 53-year-old woman presented seeking predictable esthetic rehabilitation of the maxillary anterior teeth (Fig. 1). Her medical history was unremarkable, despite her heavy smoking (>20 cigarettes/day) and poor oral hygiene.

Her treatment plan was based on diagnostic casts, periodontal charting, and radiographs. The plan consisted of extracting the right maxillary first premolar, lateral incisor, and central incisor and the left maxillary central and lateral incisors, with the immediate

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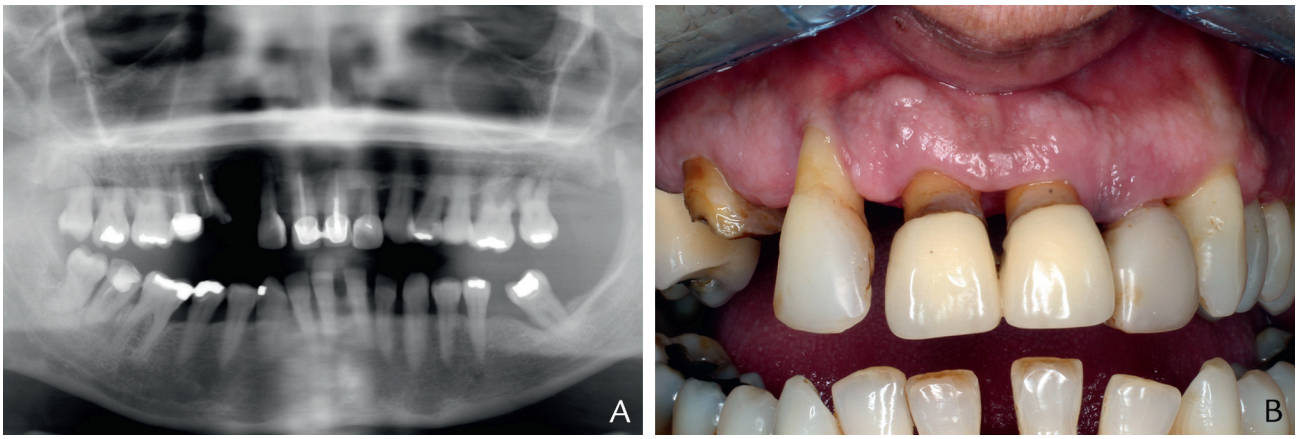


**Figure 1.** Initial patient condition. A, Panoramic radiograph. B, Intraoral view.

placement of 3.8×12-mm implants in the right maxillary first premolar, the left canine, and the left lateral incisor sites.

Digitization began with a scan of the diagnostic cast to generate a standard tessellation language (STL) file (Fig. 2). After the teeth had been extracted, implants (Biohorizons Tapered Internal) were inserted to 35 Ncm to ensure adequate primary stability,[11,12] and machined transepithelial abutments of known height were screwed into the implants. Photogrammetric abutments, that is, flag-shaped, white-dotted elements designed to be recognized by an extraoral stereophotogrammetric camera (PIC camera; PIC dental, Iditec North West SL), were screwed into the transepithelial abutments. The stereophotogrammetric device consisted of 2 photogrammetric cameras working in unison and able to record 150 images/min (Fig. 3).

The information furnished by the photogrammetric abutments and gathered by the camera was processed by software (Pic Cam Soft v1.1; PIC dental, Iditec North West SL) that generated a digital file showing the 3D location of the implant platforms and their angulation (Fig. 4A). The STL file showed the locations of the implant platforms relative to one another in the form of position vectors (Fig. 4A). The flag-shaped abutments were then removed, and a second conventional alginate impression (Cavex CA 37; Cavex Hollan BV) was made of the soft tissues and adjacent teeth, including the platform for the abutment of known height screwed into the implants to ensure best-fit alignment. The cast made from the impression was then digitized with a scanner (Dentalwings 5 series; Dental Wings Inc). These 2 digital files, one for the implants and the other for the soft tissue and teeth, were subsequently overlaid to a best-fit alignment to generate the definitive digital model with information on teeth, soft tissues, and implants (Fig. 4B).

With these files and scanning the preliminary definitive cast as a reference to maintain parameters such as the midline and incisal edge, the interim screw-retained

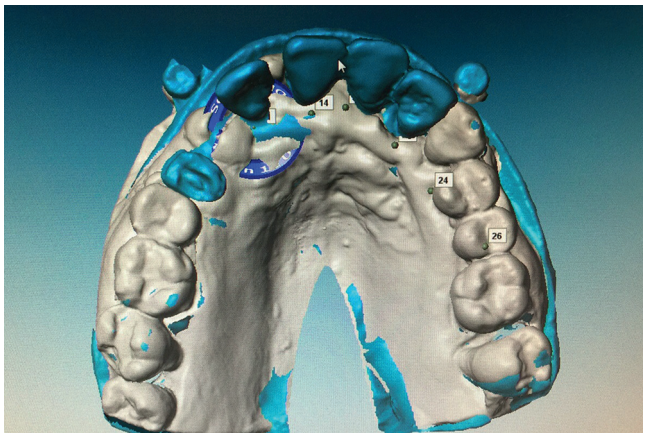


**Figure 2.** Digitized image of diagnostic cast.

implant FDP was computer-modeled (Fig. 4C, D). The prosthesis designed was milled from a (Vita B2) polyoxymethylene (POM) disk (Acetal resin; Delrin; Dupont USA) and screwed to the implants just a few hours after insertion. In the absence of machined connections and as the Sheffield test could not be conducted, an alternative finger pressure test was performed to ensure a proper fit. The screw access channels were subsequently filled with polytetrafluorethylene[13] and interim restoration (Telio CS Inlay; Ivoclar Vivadent AG) material. An occlusal adjustment was made to prevent contact in eccentric movements.

The 1-week (Fig. 5A) and 3-month (Fig. 5B) follow-up examinations revealed no complications. Correcting the gingival volume deficiency on the facial side of the right maxillary lateral incisor with a connective tissue graft from the maxillary tuberosity (Fig. 5C) delayed placement of the definitive prosthesis.

The patient reported no problems during the 6 months between implant placement and placement of the definitive restoration. Despite her smoking and poor oral hygiene, gingival tissue compatibility was observed to be good when the interim prosthesis was removed

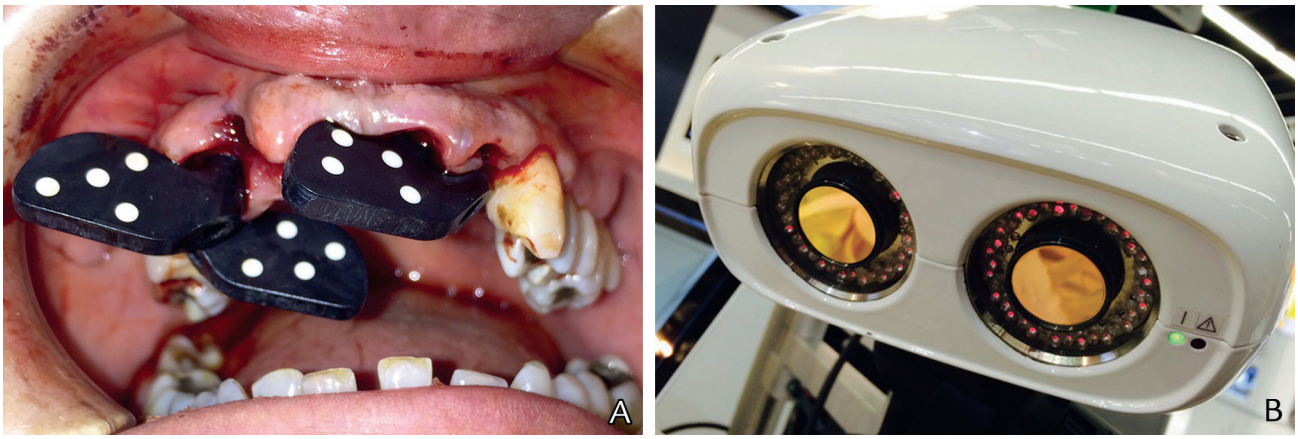


**Figure 3.** A, Stereophotogrammetric abutment on transepithelial abutment. B, Extraoral stereophotogrammetric camera.

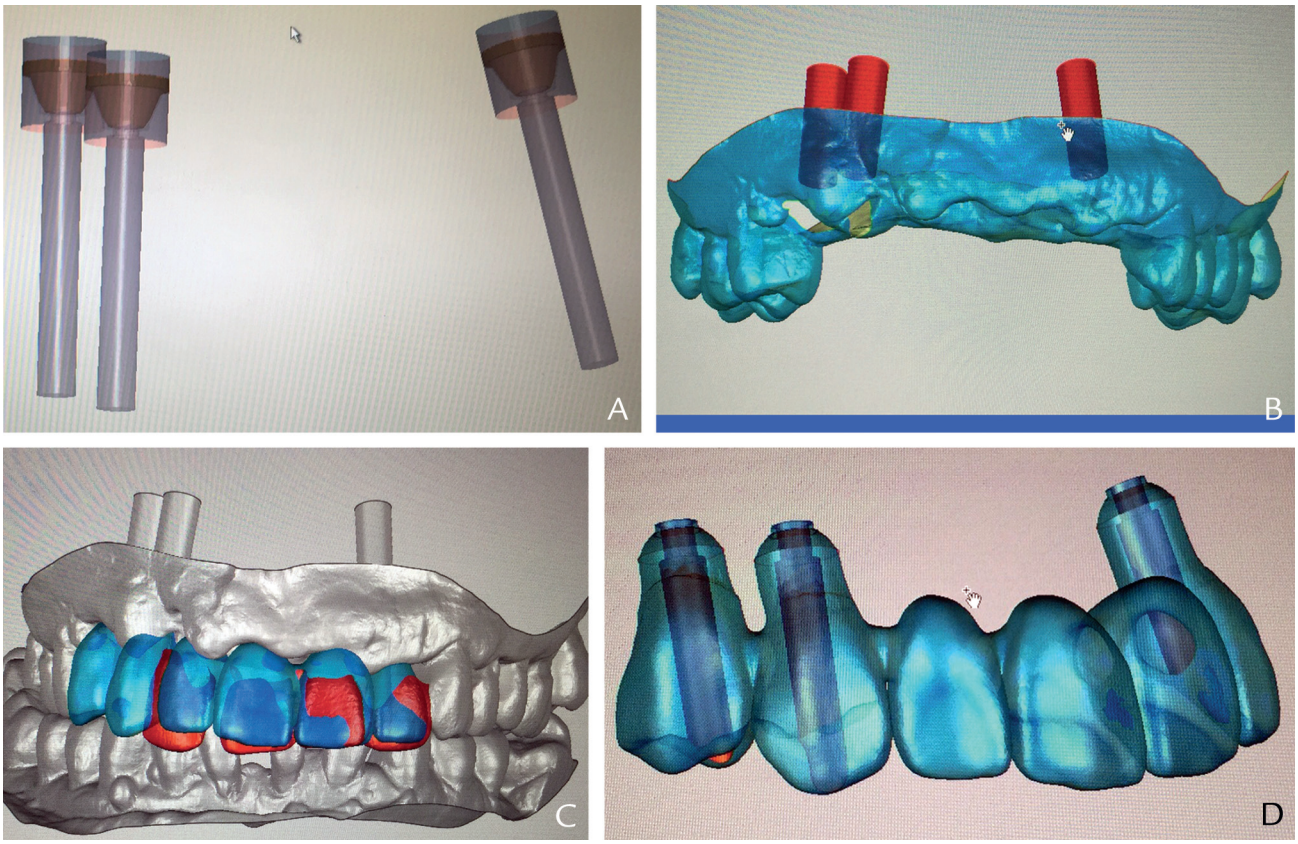


**Figure 4.** A-D, Digital files, step-by-step, from 3D locations of implants to definitive CAD design.

after 6 months, although the POM materials were distinctly stained (Fig 6).

Because their 3D location had been recorded, no further impressions of the implants were needed to make the definitive prosthesis. However, an updated impression of the soft tissue was required to record changes since the day of the surgery. The interim FDP was subsequently removed, and healing screws of known height were positioned. An alginate impression was made, and its resultant cast was scanned to obtain a digital model that was best-fit aligned to the implant scan to generate the definitive cast, including soft tissue and adjacent teeth.

Prior to generating the definitive prosthesis, we conducted an esthetic test, using a 3D printer (Objet30 OrthoDesk; Stratasys) for alterations. The definitive prosthesis consisted of a sintered cobalt-chromium (Starbond CoS Powder 30+; Schseftner Dental Alloys,


**Figure 5.** Polyoxymethylene prosthesis. A, Examination at 1 week. B, Examination at 3 months after placement. C, Examination after connective tissue graft.

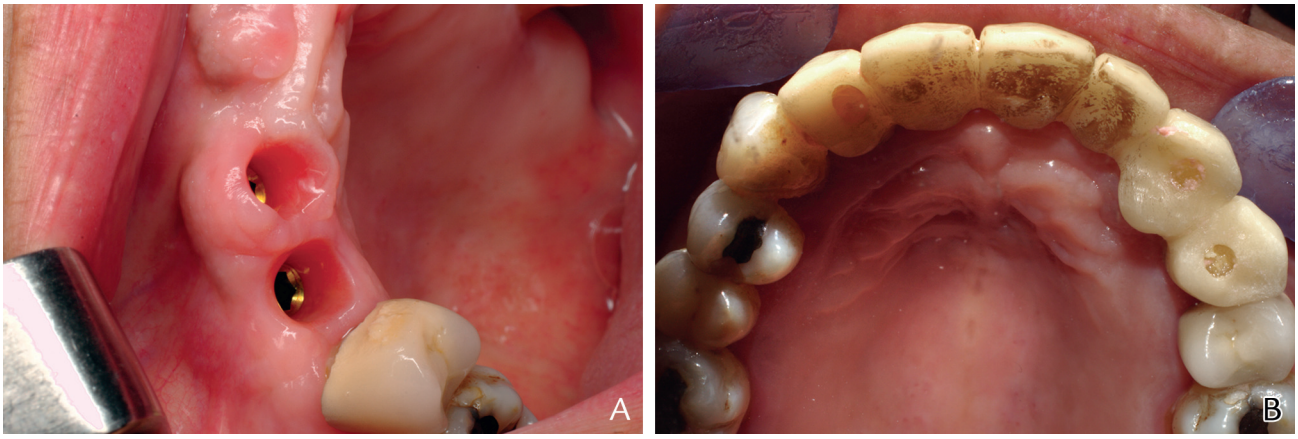


**Figure 6.** Six-months' view shows (A) excellent soft tissue appearance and (B) palatal staining.

S&S Scheftner GmbH) framework machined at the implant connections (Fig. 7). The Sheffield test and finger pressure were applied, and periapical radiographs made to evaluate for passive fit. The framework was then sent to the laboratory to add a resin-based veneer (Ceramage; Shofu), after which the definitive prosthesis was inserted to the manufacturer's recommended torque (30 Ncm) (Fig. 8).

## DISCUSSION

Although implant digital impression making has developed, most of the existing systems do not allow adequate fit for long-span fixed prostheses or complete arch restorations.[9] In the absence of any need for overlapping and the concomitant accuracy of the implant positions digitized, stereophotogrammetry is a useful and effective tool for producing immediate prostheses with a predictably correct passive fit (desirable to prevent complications[14]). However, as it does not reproduce soft tissue, a conventional cast must be digitized or an additional intraoral scan generated to supplement the information furnished.

POM exhibits higher wear resistance and surface hardness than other polymers.[15,16] That holds promise for its use in immediate, interim, screw-retained, metal-free, implant-supported FDPs. POM also exhibits high thermal and abrasion resistance, good biocompatibility, and reasonably good esthetics.[17]

**Figure 7.** Machine-sintered cobalt-chromium screw-retained framework.

## SUMMARY

Stereophotogrammetric scanning seems to be a reliable method for making impressions of immediate, implant-supported partial FDPs. POM is suitable for preparing immediate interim CAD-CAM screw-retained implant fixed dental prostheses. For the patient described in this article, the POM material remained intact for the 6

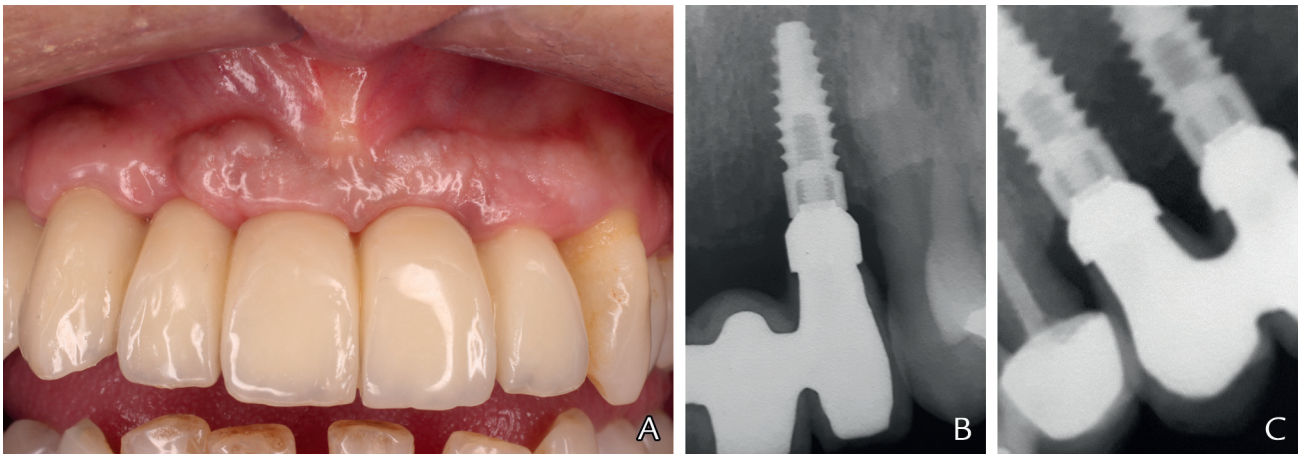


**Figure 8.** A, Esthetic outcome. B, C, Passive fit of definitive prosthesis.

months it was in the patient's mouth. Although the prosthesis was observed to darken and stain, possibly because the patient was a smoker, biocompatibility with the soft tissues was good, with no gingival inflammation around implant emergence areas. POM appears to be a suitable material for interim, screw-retained, implant FDPs for periods of up to 6 months.

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