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CLINICAL REPORT

Digital conversion of interim to definitive complete arch implant-supported fixed prostheses using intermediate scanning technique with a laboratory screw: A clinical report

Faris Khalifa, BDS,[a] Walaa Magdy Ahmed, BDS, MSc, Dip Prosthodontics, PhD, FRCDC,[b] Amr Ahmed Azhari, BDS, MSc, CAGS, MSBI, PhD,[c] Puvipat Pattanachaipuvanon, DDS, MSc,[d] Atheer Ahmed Alhammadi, BDS,[e] Sultan Albeshri, BDS, MS,[f] and Anas Abdullah Lahiq, BDS[g]

ABSTRACT

The accurate alignment of digital scan data is a critical step in providing a complete arch implant-supported prosthesis, mainly because of the lack of stable and repeatable reference points in edentulous arches. This limitation poses a significant challenge when attempting to align multiple surface geometry datasets precisely. This clinical report describes a practical and efficient procedure that enhanced the accuracy of digital dataset alignment and facilitated a fully digital workflow for the design, fabrication, and conversion of interim prostheses into definitive complete arch implant-supported prostheses. (J Prosthet Dent 2026;136:1-7)

Complete arch implant-supported prostheses have become an increasingly predictable and effective treatment for patients with a terminal dentition or complete edentulism.[1,2] The combination of immediate implant placement and immediate loading protocols has significantly improved patient satisfaction by reducing treatment time and eliminating the need for removable interim prostheses.[3] Parallel to this, the integration of digital technologies has introduced new levels of accuracy, efficiency, and predictability in the planning, surgical execution, and fabrication of prostheses.[1,2] A completely digital workflow combined with immediate loading offers advantages of reduced chair time, improved communication, and optimal control over esthetics and function.[3]

Several studies have described complete arch digital scanning techniques[4–24] and how to improve accuracy when transferring an interim prosthesis to a definitive prosthesis for patients receiving complete arch implant-supported prostheses.[4–6] Monaco et al[4] described a method of transferring interim prosthesis features to definitive prostheses. Computer-aided design was used to create 3 sets of digital scans for implant-supported prostheses by capturing the interim prostheses and surrounding gingival tissue, 3-dimensional (3D) implant positioning data, and extraoral scans of the interim prostheses. Similarly, Cappare et al[5] presented a technique for converting interim to definitive prostheses using intraoral scanning with splinted scan bodies, orthodontic wire, and light-polymerizing flowable composite resin. Another technique applying a custom scanning device with windows was proposed by Ahmed et al.[6] The present clinical report describes the comprehensive management of a patient with advanced periodontal disease and progressive tooth loss using early implant placement, the immediate loading of

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[a]Researcher, Department of Implant Dentistry, King Abdulaziz University Dental Hospital, Jeddah, Saudi Arabia.
[b]Associate Professor, Department of Restorative Dentistry, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia.
[c]Assistant Professor, Department of Restorative Dentistry, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia.
[d]Lecturer, Department of Prosthodontics, Mahidol University, Bangkok, Thailand.
[e]Researcher, Prosthodontics Department, Aseer Dental Specialized Center, Abha, Saudi Arabia.
[f]Assistant Professor, Department of Periodontics and Community Dentistry, College of Dentistry, King Saud University, Riyadh, Saudi Arabia.
[g]Researcher, Prosthodontics Department, Aseer Dental Specialized Center, Abha, Saudi Arabia.

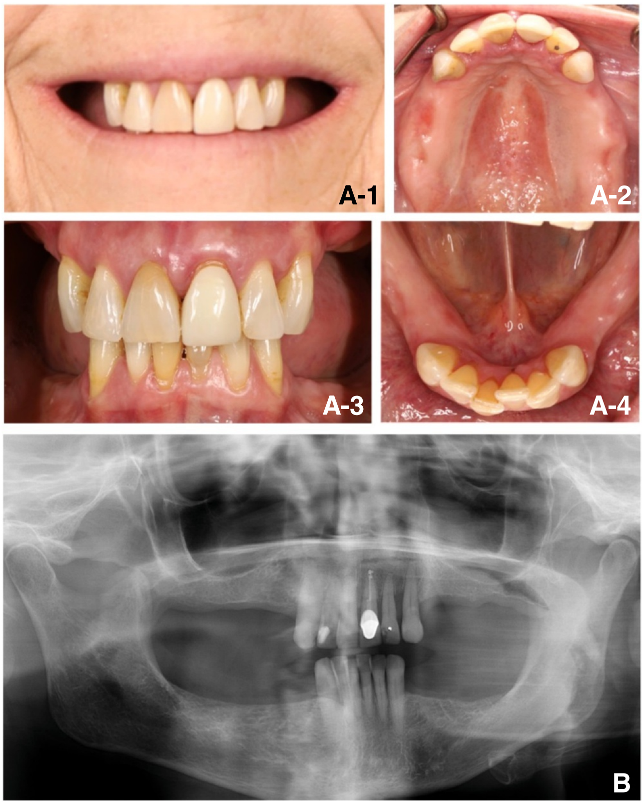

Figure 1. A, Preoperative extraoral and intraoral photographs. B, Preoperative panoramic radiograph.

interim prostheses, and the digital conversion of interim restorations into definitive prostheses.

CLINICAL REPORT

A 68-year-old woman presented to the implant clinic at Tufts University School of Dental Medicine, Boston, MA, with the following complaint: “I need to get implants; my teeth are loose, and I don’t have teeth in the back.” Her medical history included psoriasis and a bilateral hip replacement in 2016. The patient had no known drug allergies but reported dairy intolerance. She was a nonsmoker, used no recreational drugs, consumed alcohol occasionally, and was classified as American Society of Anesthesiologists II and “Philosophical” according to the House classification.[7] Dentally, she had a history of multiple dental restorations and extractions performed at various times. She reported progressive tooth mobility and used to wear interim removable partial dentures in both arches. However, because of poor fit, the patient stopped wearing them. She was diagnosed with advanced periodontal disease and partial posterior edentulism (Fig. 1). The treatment plan included complete mouth extraction, immediate dentures fabrication, and implant placement with immediate loading. A cone beam computed tomography scan (Planmeca CBCT; Planmeca) using a dual-scan protocol was obtained to aid in surgical guide fabrication.[8]

Digital planning involved placing 6 implants in each arch using a fully guided surgical protocol (Fig. 2). The number and distribution of implants was determined based on the complete arch immediate loading protocol by the International Team of Implantology Consensus 2017.[9,10] All guides and prostheses were 3D printed (P30+; Institut Straumann AG) by following the manufacturer's guidelines.

The mandibular implant surgery began with the insertion of a mandibular fixation pin guide (Template Fixation Pins; Institut Straumann AG) using occlusal registration with a maxillary complete denture. The fixation pin guide was removed, and a full-thickness mucoperiosteal flap was reflected. The bone-reduction guide was then seated with the fixation pins, and bone reduction was performed. The osteotomy guide was then seated, and all implants were placed in the left first molar, left first premolar, left lateral incisor, right lateral incisor, right first premolar, and right first molar sites in the mandibular arch (Bone Level Tapered Implant; Institut Straumann AG) in a guided fashion. Each implant achieved primary stability (torque values exceeding 40 Ncm). Multiunit abutments (SRA; Institut Straumann AG) were connected and tightened to 35 Ncm, as recommended by the manufacturer. The immediate loading prostheses were seated onto the base guide after the interim abutments (Immediate Temporary Abutment; Institut Straumann AG) had been fixed to the multiunit abutments and were picked up directly using a flowable composite resin (Filtek Bulk Fill Flowable Restorative; 3M) (Fig. 3). The interim prostheses were validated for occlusion, esthetics, and phonetics.

Maxillary implant surgery was performed 2 weeks later in a similar fashion using a fixation pin guide. The position of the surgical guide was confirmed using the occlusal registration with the mandibular interim prostheses. A full-thickness flap was reflected, and the surgical guide was inserted and fixed in place. Implants were placed in the right first molar, right first premolar, right lateral incisor, left lateral incisor, left first premolar, and left first molar positions in the maxillary arch (Bone Level Tapered Implant; Institut Straumann AG). All implants were placed with primary stability (insertion torque >35 Ncm), followed by the placement of multiunit abutments tightened to 35 Ncm. Immediate loading was performed by securing interim abutments to the multiunit abutments.

Following a 3-month healing period to allow osseointegration, digital scans were obtained using an intraoral scanner (TRIOS 4; 3Shape A/G). The maxillary and mandibular soft tissues were first scanned, followed by the polyetheretherketone scan bodies (Scanbody; Institut Straumann AG). To aid in superimposition, 3 scan bodies were removed and replaced with 3 laboratory screws in each arch. A scan was then performed

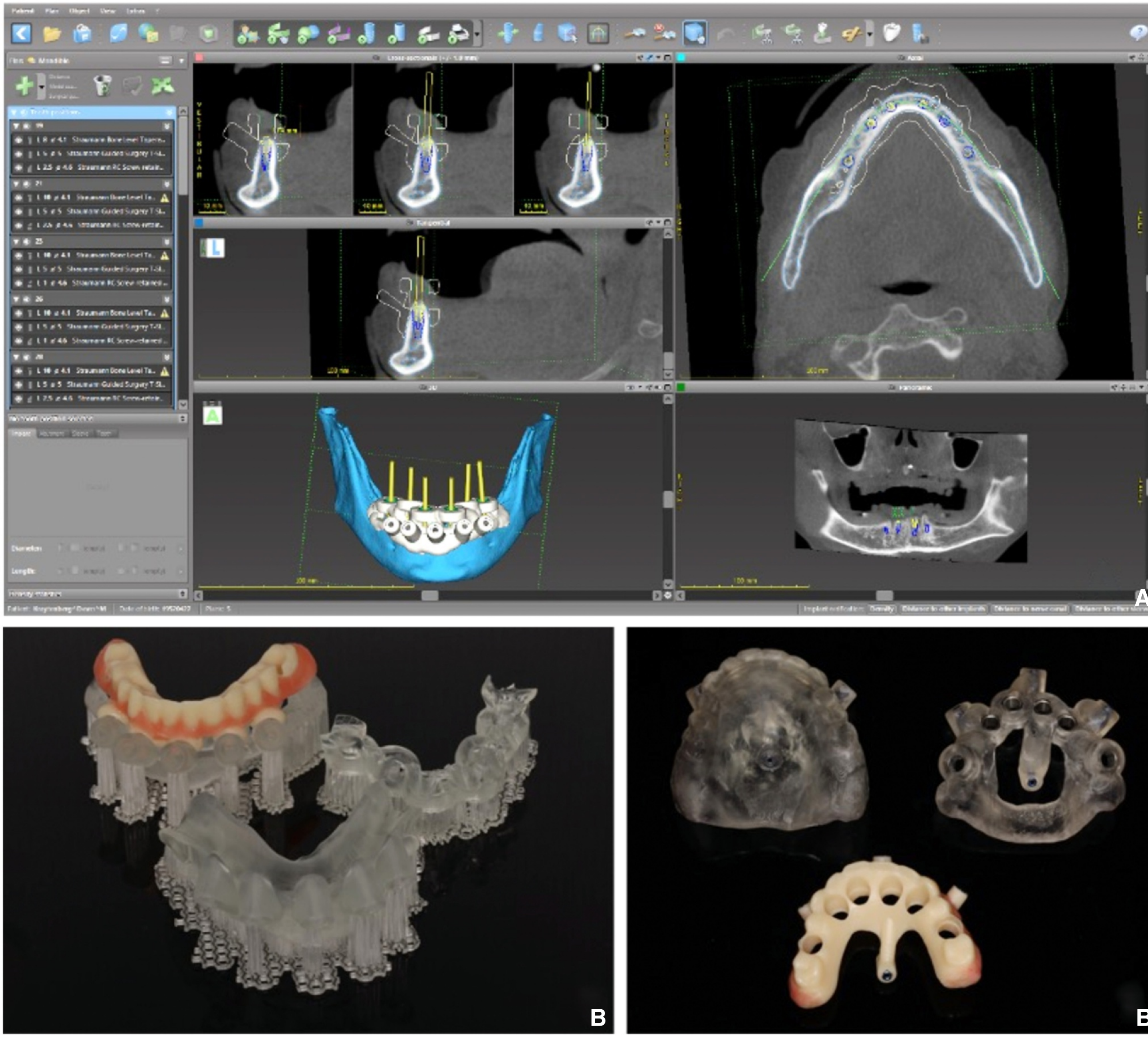

Figure 2. A, Implant planning using cone beam computed tomography. B, Mandibular and maxillary printed surgical guides and interim prostheses.

using both scan bodies and laboratory screws. After scanning, the scan bodies were removed, and the interim prostheses were reattached by placing the laboratory screws in the same positions to act as a fixed reference for superimposition (Fig. 4). The superimposition of the soft tissue scan with the scan body and interim prosthesis scans as an intermediate scanning technique (IST) allowed the accurate digital duplication of the interim and its seamless conversion to a definitive prosthesis by aligning the standard tessellation language (STL) files from scans with and without the interim prosthesis (Fig. 5).

The definitive prostheses were digitally designed and milled from zirconia monoblocks (KATANA Zirconia HT; Kuraray Noritake Dental Inc), a highly translucent, multilayered zirconia containing 3Y-TZP, 4Y-TZP, and 5Y-TZP, and then partially layered with feldspathic porcelain (VitaVM9; Vita Zahnfabrik). The definitive prostheses were screwed onto the definitive abutments at 15 Ncm (Fig. 6). The fit was verified using screw resistance tests,[11] periapical radiographs, and occlusion (Figs. 7, 8). The patient was satisfied with the esthetics, function, and comfort of the prostheses. Postoperative radiographs and follow-up appointments were scheduled.

DISCUSSION

Scans for complete arch implant-supported prostheses for edentulous patients are challenging, mainly because

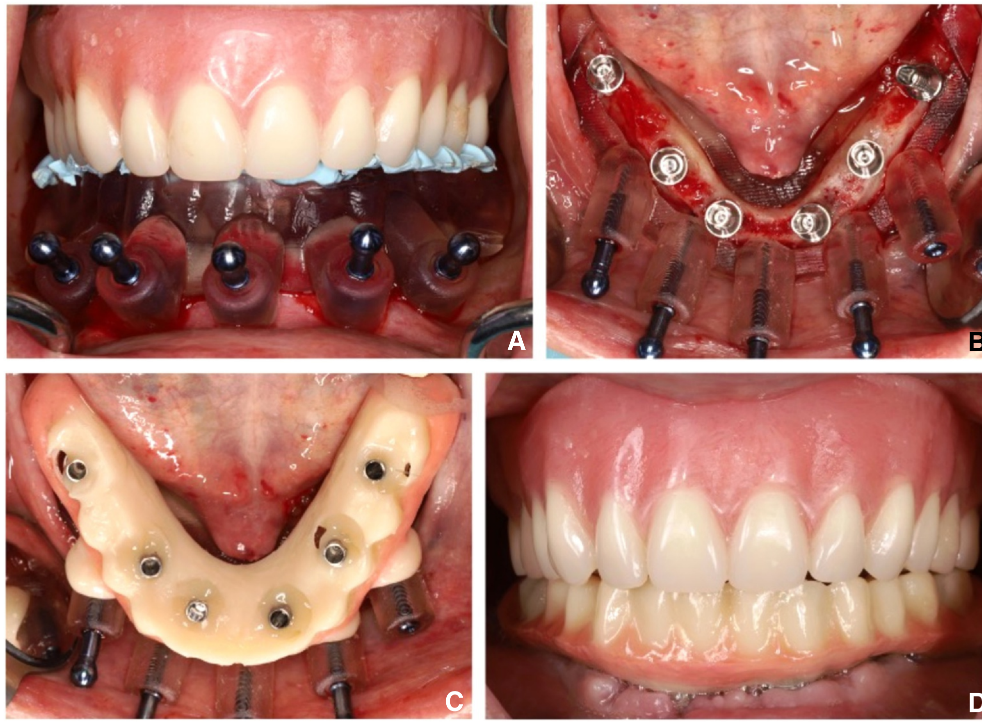

Figure 3. A, Surgical guide in situ with occlusal registration to confirm proper setting of guide. B, Implants placed in correct position. C, Immediately loaded interim prostheses. D, Frontal view of mandibular prostheses after immediate loading with maxillary complete denture.

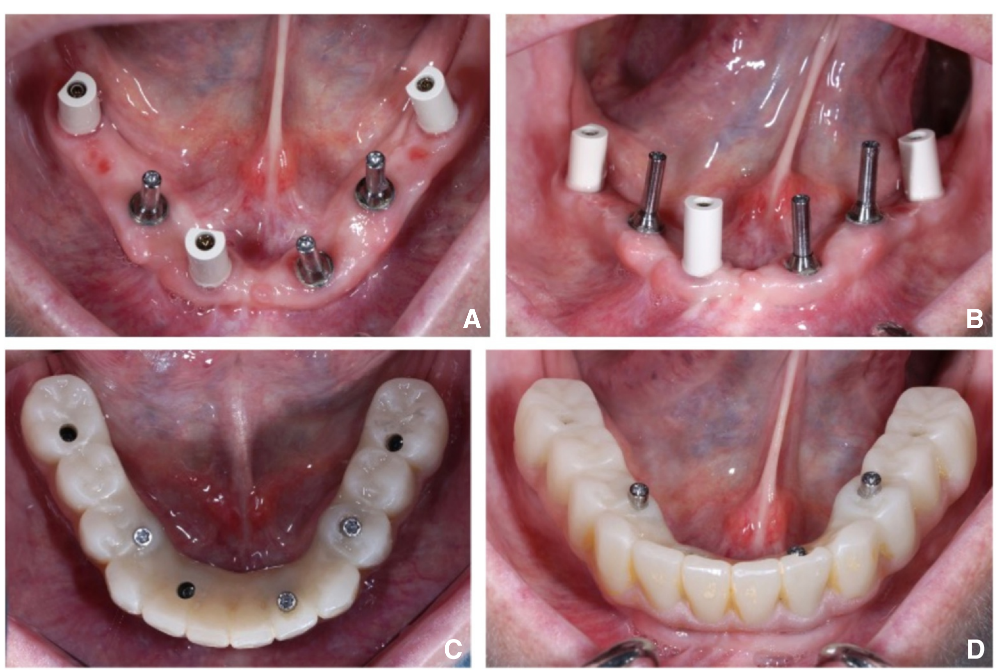

Figure 4. A, B. Definitive digital scanning, Laboratory screws fixed to 3 implants as fixed reference during superimposition. C, D. After insertion of interim prostheses, laboratory screws used for accurate alignment of scans.

of the absence of anatomic landmarks such as the mandibular arch, making the superimposition of scans with scan bodies and interim prostheses challenging. Various strategies have been proposed to improve scan accuracy in edentulous situtaions.[12] Papaspyridakos et al[13] introduced a double-scanning protocol using fiducial markers. In their technique, an initial scan of the fixed interim prostheses was performed with markers attached to keratinized soft tissues; this was followed by a second scan with the scan bodies placed while

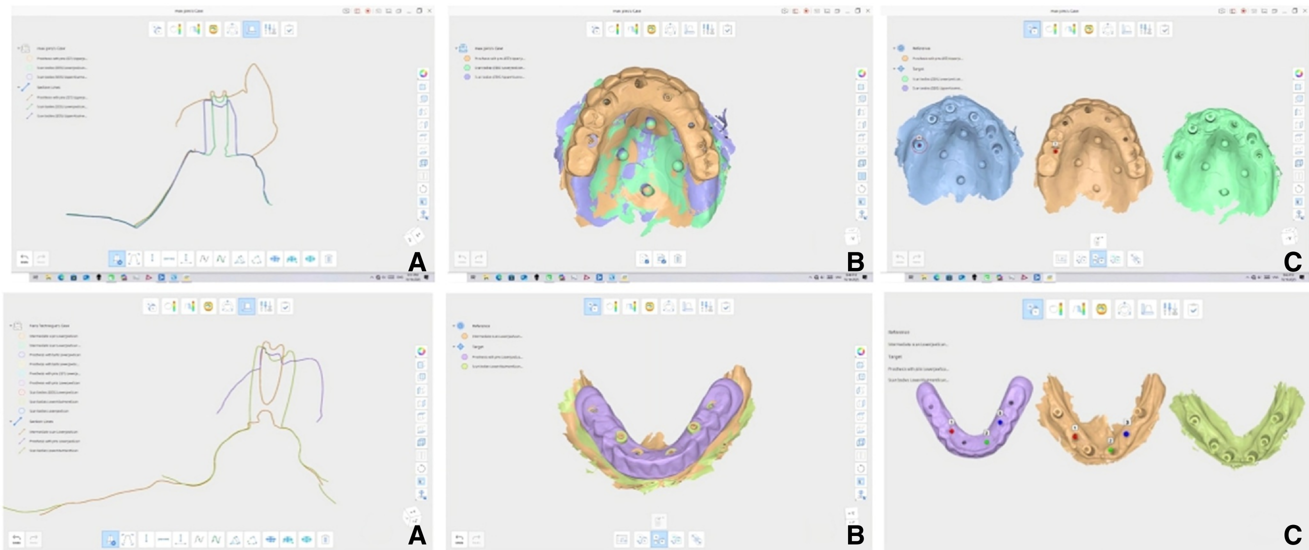

Figure 5. A, Cross section of superimposition of 3 scans, soft tissue and laboratory screws, and interim prostheses. B, Superimposed interim prostheses with laboratory screws. C, Three scans, with interim prostheses and laboratory screws in the scan, scan of scan bodies and laboratory screws, and scan bodies with soft tissue scan.

maintaining the markers in their original positions. This method facilitated the precise alignment of the scans and enhanced accuracy in patients lacking natural reference points.[13] Recent innovations by Papaspyridakos et al[14] developed reverse scan bodies[15–18] attached to a conversion interim prosthesis. This approach allowed for extraoral scanning to capture implant positions without the need for intraoral scans. This clinical report presents a novel technique for converting an interim prosthesis to a definitive prosthesis using laboratory screws as reliable landmarks. This method allowed the precise superimposition of soft tissue scans with scan body and interim prosthesis scans. The triple scan technique created windows in the interim prostheses to superimpose 3 digital scans and consequently fabricate the definitive prostheses.[19] However, clinical studies are needed to assess the accuracy and efficiency of these digital workflows for complete arch implant-supported prostheses. Marinis et al[20] developed a technique using a scannable impression pin to superimpose multiple STL files from digital scans for patients receiving complete arch implant-supported zirconia prostheses. This method simplified

Figure 6. A, Maxillary definitive prostheses. B, Mandibular definitive prostheses. C, Frontal view of definitive prostheses in centric occlusion. D, Smile view of definitive prostheses.

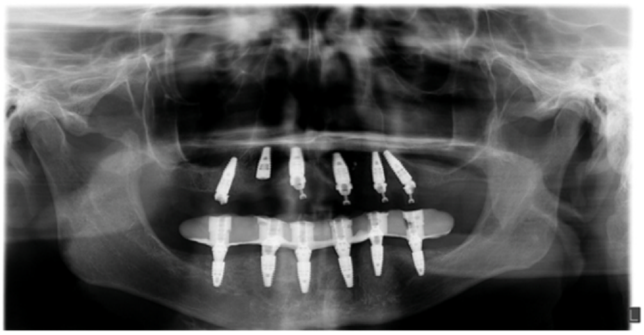

Figure 7. Panoramic radiograph immediately after placement of maxillary implants.

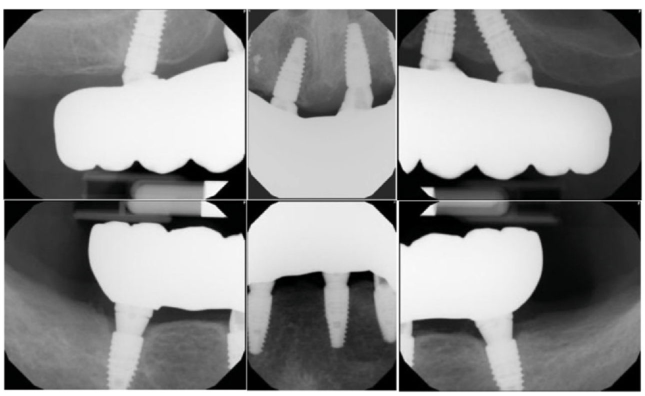

Figure 8. Periapical radiographs immediately after insertion of maxillary and mandibular definitive prostheses.

the process and allowed for an efficient digital workflow.[17] The IST technique is more accessible and does not require special components, but clinical conditions and operator preference may influence the choice.

Guided implant surgery offers high accuracy with a low complication rate.[21] Challenges include technical issues, surgical challenges, environmental factors, and human factors. Addressing these can improve outcomes. Interim prostheses are essential in implant dentistry for immediate support, stability after bone reduction, preserving soft tissue, and guiding the emergence profile for optimal esthetics.[22–25] The proposed scan superimposition method uses noncollinear laboratory screws to create a rigid reference frame, ensuring stable 3D transformation between soft-tissue, scan-body, and prosthesis datasets. Error sources include passive seating and appropriate screw size, and errors may cause mismatches. Photogrammetry technology[20] could be a solution to the lack of mandibular landmarks, with better accuracy than that of IOS for complete arch digital implant scans; clinical trials, however, are needed.

SUMMARY

This technique introduces a practical approach that uses a long laboratory screw as a fixed reference during intraoral scanning to align the soft tissue, scan body, and interim scans. The resulting superimposition improves alignment accuracy, streamlines the workflow, and ensures the precise transfer of esthetic and functional details to definitive prostheses.

PATIENT CONSENT

Written informed consent was obtained prior to publication of this clinical report and accompanying images.

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Corresponding author:
Dr Anas Abdullah Lahiq
Prosthodontics Department
Aseer Dental Specialized Center
Abha
SAUDI ARABIA
Email: anas.laheq@gmail.com

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Noteworthy Abstracts of the Current Literature

Risk factor assessment for survival of removable partial dentures and their abutment teeth: A retrospective analysis

Jacob Nisser, Jenö Kisch, Bruno Ramos Chrcanovic

Int J Prosthodont 2022 Sep-Oct;35:598–608.

Purpose. To investigate the risk factors related to failure of removable partial dentures (RPDs) and to compare the survival of RPDs when abutment teeth have good vs reduced bone support.

Materials and methods. In this longitudinal patient record-based cohort study with a mean follow-up of 44.9 months, Cox regression models were used to evaluate the associations between clinical covariates and abutment tooth failure, as well as prosthesis failure.

Results. A total of 142 patients and 172 RPDs were included. Of the 172 prostheses, 64 (nearly 40%) failed after a mean time of about 4 years. Loss of abutment teeth was the main reason leading to RPD failure, followed closely by poor fit and adaptation. No factor was shown to be statistically significant at the prosthesis level. Women (Hazard Ratio [HR]=0.542), endodontic treatment (HR=3.460), presence of post and core (HR=0.302), presence of a prosthetic crown (HR = 3.403), and abutment tooth type (in relation to incisor: canine HR=0.196, premolar HR=0.449) were the risk factors statistically significantly associated with the loss of abutment teeth. The pre-prosthesis amount of bone support of the teeth did not affect their prognosis as abutments for RPDs.

Conclusion. RPD treatment modality presented a high failure rate after a mean follow-up of 4 years. Vital abutment teeth had a better survival rate than the ones treated endodontically (whether restored with or without a post and core); nevertheless, the amount of bone support did not affect their survival.