

A Digital Approach to a Definitive Immediate Denture: A Clinical Report

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Even though an immediate denture (ID) is a practical prosthesis, fabricating an ID may be challenging, as unexpected removals of periodontally compromised teeth may occur during an impression procedure. This clinical report introduces a digital approach to a maxillary ID. An intraoral scanner was applied to prevent accidental extraction. A physical cast and a resin pattern of a framework were fabricated with rapid prototyping technology. A proper border and retention was also achieved by an altered cast impression.

Key Words: Altered cast impression; Computer-aided design and computer-aided manufacturing and rapid prototyping; Immediate denture; Intraoral digital impression

Introduction

An immediate denture (ID) is a removable dental prosthesis fabricated for placement immediately following the removal of a natural tooth or teeth¹⁾. The inherent advantages of ID are the preservation of the patient's natural appearance and mastication ability, and the protection of the surgical wound²⁻⁶⁾.

An intraoral scanner (IOS) has been successfully applied, and the system showed comparable levels of trueness and precision values in full-arch scans⁷⁾. With the development of computer-aided design and computer-aided manufacturing (CAD/

CAM) and rapid prototyping (RP) in dentistry, a digital approach has entered the field of denture fabrication⁷⁻²²⁾. Recently, Kattadiyil et al.¹⁸⁾ and Mansour et al.¹⁹⁾ published clinical reports about Kennedy Class III situations with an IOS. The metal frameworks revealed accurate fit and the tooth-supported partial removable dental prostheses exhibited proper adaptation to the soft tissue^{18,19)}. As Kattadiyil et al.¹⁸⁾ described, however, recording appropriate extensions of movable tissue was impossible with an IOS. Mansour et al.¹⁹⁾ also emphasized the need for clinical research to use an IOS in other Kennedy classifications of partially

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edentulous situations. Lin et al.²⁰⁾ overcame this limitation for an implant-supported overdenture by fully retracting the cheeks and lips during the scan. However, adjustment of the overdenture flange may be necessary to prevent impingement on a patient's muscular movement²⁰⁾.

No articles on an ID with an IOS, which requires the dynamic registration of soft tissue extension, are available. This clinical report describes an alternative technique for the fabrication of a maxillary ID.

Case Report

A 75-year-old female patient with maxillary and mandibular partial removable dental prostheses presented. The patient complained of mobile teeth and fractured anterior artificial teeth in the maxilla (Fig. 1A). The patient requested a new prosthesis for improved masticatory efficiency and esthetics. The remaining maxillary teeth were only the left premolars that were restored with splinted cast crowns, and exhibited severe caries and periodontitis. In a periapical radiograph, widening of the periodontal ligament space of the first premolar, resulting from a secondary occlusal trauma, was observed (Fig. 1B). A periapical inflammatory lesion was also observed at the apex of the second premolar

of the second premolar. The abutment teeth were indicated for removal. The anterior artificial teeth in the maxillary partial removable dental prosthesis were defective due to intimate contact with mandibular incisors. Due to limited finances, the patient rejected an implant prosthesis and interim prosthesis. The patient had a medical history of chronic hepatitis, primary gonarthrosis, tension-type headache, and anxiety disorder^{23,24)}. Considering the medical factors, age and socioeconomic aspects, a maxillary definitive ID was recommended to maintain the patient's occlusal vertical dimension and maxillomandibular relationship, and to reduce the total treatment time, appointment, and cost⁶⁾. Therefore, the remaining maxillary teeth were scheduled for removal at the placement of a definitive ID⁶⁾.

A digital impression with an IOS (TRIOS Color Pod; 3Shape Inc., Copenhagen, Denmark) was planned to prevent accidental extraction of the remaining teeth. Pressure-indicating paste (Pressure Indicator Paste; Mizzy Inc., Cherry Hill, NJ, USA) was thinly applied on the cast crowns with a dental microapplicator (Microbrush; Microbrush Intl., Grafton, WI, USA) because of reflection²⁵⁾. As indistinguishable three-dimensional and poorly traceable structures are characteristics of the edentulous areas, incorrect stitching of the captured

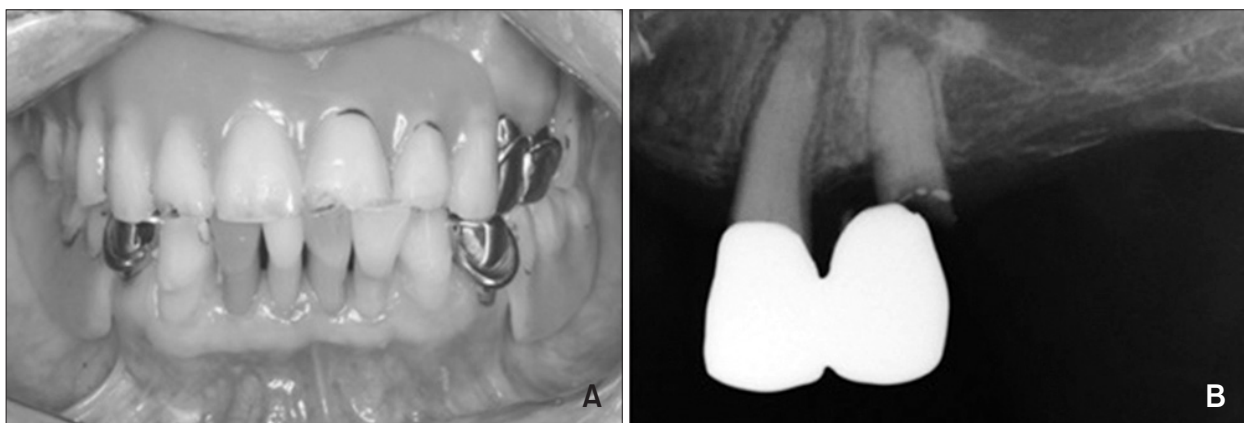


Fig. 1. (A) Preoperative clinical view. (B) Preoperative radiograph. Note the widened periodontal ligament space around the first premolar and the periapical inflammatory lesion at the apex of the second premolar.

images may occur²⁶). Irregular shapes were drawn with calcium hydroxide endodontic medicament (Vitapex; Neo Dental Intl., Federal Way, WA, USA) on the unmovable soft tissue that had not been influenced by retraction. The shapes were connected by zigzag lines (Fig. 2). This measurement reduced the total time for scanning. Inaccurate processing and summation of matching errors were also prevented. After making the maxillary digital impression (Fig. 3), the mandibular impression was made with an irreversible hydrocolloid (Cavex Alginate; Cavex, Haarlem, Netherlands).

In a laboratory, CAD software (exocad DentalCAD; exocad GmbH, Darmstadt, Germany) was used to remove the shapes and lines made by the endodontic medicament. A physical cast was fabricated with an RP machine (Fortus 450mc;

Stratasys, Eden Prairie, MN, USA). After scanning the cast, the framework was designed with CAD software (SensAble System; SensAble Technologies, Wilmington, MA, USA) (Fig. 4)^{8-11,18}. The design information was transferred to the RP machine (ProJet DP 3000; 3D Systems Inc., Rock Hill, SC, USA), which then fabricated a resin pattern (Fig. 5). This pattern was cast in a cobalt-chromium alloy (Wironium Plus; Bego, Lincoln, RI, USA) (Fig. 6). Sheet wax (Modeling Wax; Associated Dental Products Ltd., Purton, UK) was placed on the cast and a wax occlusion rim was fabricated with autopolymerizing resin (Ostron 100; GC Corp., Tokyo, Japan).

After evaluating it intraorally, blockout was performed on the palatal area of the interproximal space with boxing rope wax (Utility Wax; Atria, Seoul, Korea). An altered cast impression, except

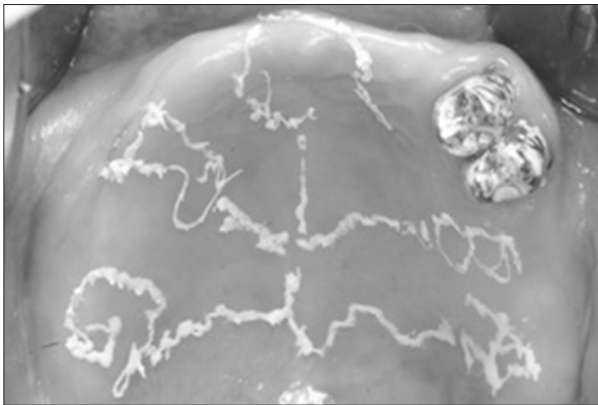


Fig. 2. Application of pressure-indicating paste and calcium hydroxide endodontic medicament.

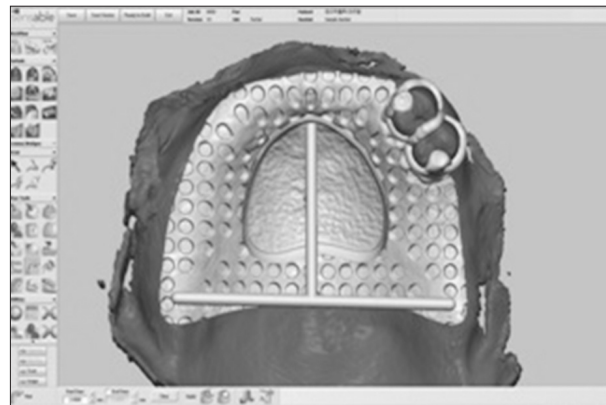


Fig. 4. Software view of virtually designed framework.

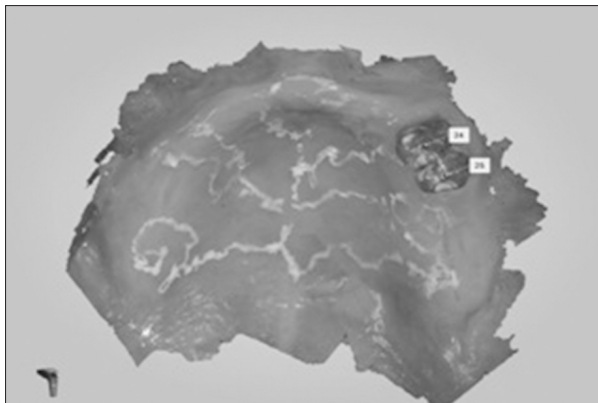


Fig. 3. Software view of digital impression of maxilla.



Fig. 5. Stereolithographic resin pattern and support material.

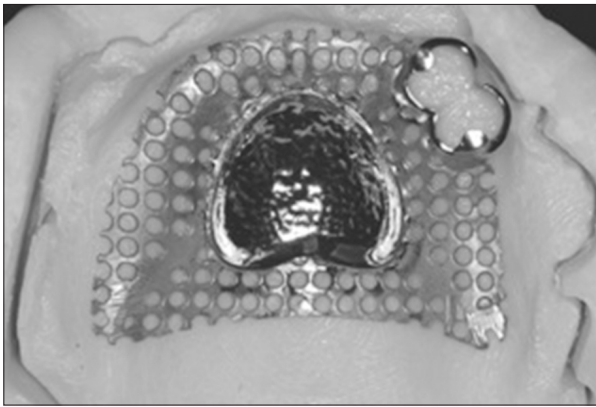


Fig. 6. Cast metal framework.

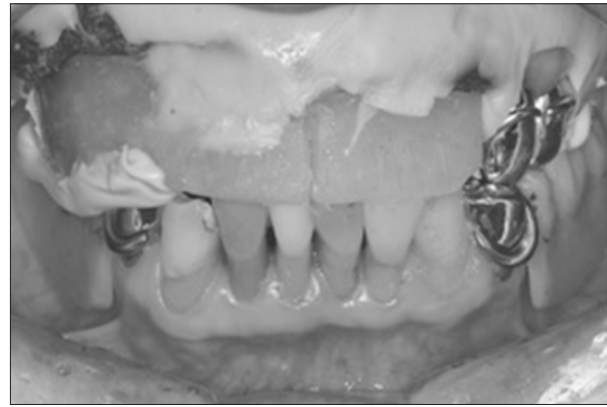


Fig. 8. Maxillomandibular relationship record with stable framework.

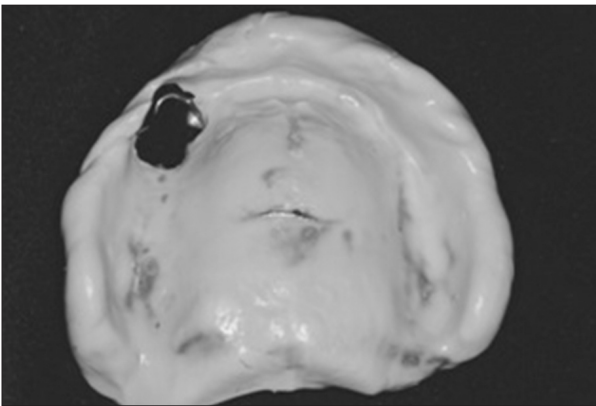


Fig. 7. Altered cast partial dental prosthesis impression. Note the proper registration of the peripheral border tissue.

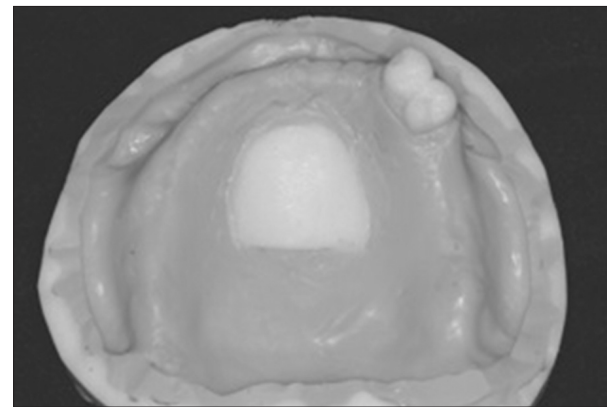


Fig. 9. Altered cast.

for the mobile teeth, was made with a modeling plastic impression compound (Peri Compound; GC Corp.) and a polyvinyl siloxane material (Aqualsil; Dentsply Caulk, Milford, DE, USA)^{27,28}. By using a syringe tip, the polyvinyl siloxane material was applied to the buccal vestibule around the mobile abutments (Fig. 7). With this measure, the possibility of accidental extraction was reduced and the peripheral border tissue was completely registered. A facebow transfer and maxillomandibular relationship record were obtained with a polyvinyl siloxane occlusal registration material (Regisil; Dentsply Caulk) (Fig. 8).

A 2-mm thick layer from the surface of the edentulous area on the cast was trimmed with tungsten carbide burs (SH 79E, SH 137E; Shofu Inc., Kyoto, Japan) and retention grooves were

made on the inner rim of the cast²⁹. After the lack of interference between the cast and the impression was verified, escape holes were made and petroleum jelly (Vaseline; Unilever, London, UK) was applied on the impression surface²⁹. The polyvinyl siloxane material was loaded into the impression. The impression was placed onto the cast and an altered cast was fabricated (Fig. 9). The casts were mounted onto a semi-adjustable articulator (KaVo PROTAR Evo 7; KaVo Dental GmbH, Biberach, Germany), instead of the proprietary-nonadjustable articulator, to reduce defective occlusal contacts^{5,30,31}. The artificial teeth (Endura; Shofu Inc.) were arranged.

After clinical assessment (Fig. 10), the premolars on the cast were severed 1 mm away from the gingival margin and the clasps were eliminated^{2,32,33}.



Fig. 10. Trial insertion of artificial teeth arrangement.

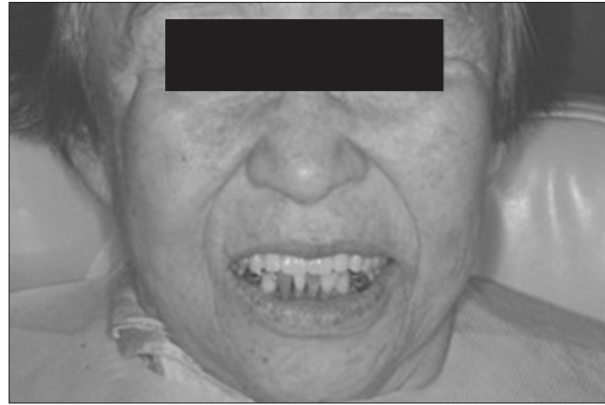


Fig. 12. Immediate complete denture in place.

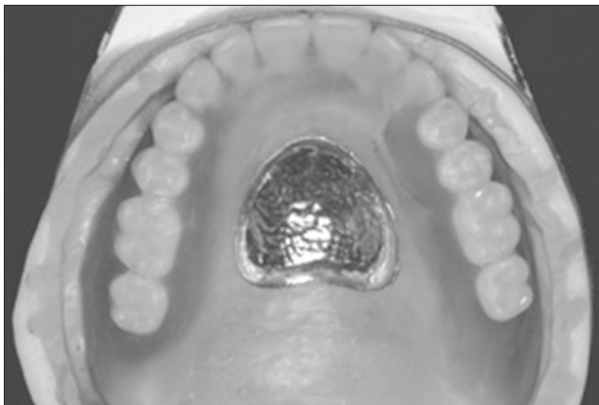


Fig. 11. Premolars arrangement.

The artificial premolars were arranged (Fig. 11) and flasking was completed. The wax was removed and a layer of tin foil was placed around the premolar area to facilitate separation after processing¹⁸⁾. The ID was processed and polished.

At the time of ID placement, removal of the premolars and minor alveoplasty were performed under local anesthesia³⁴⁾. After evaluating the fit, occlusion, and retention, the patient was instructed (Fig. 12)³⁵⁾. Postoperative appointments were conducted.

Discussion

Since Williams et al.⁸⁾ presented an article on the fabrication of a framework based on the scan of a dental stone cast, the IOS has only been used in Kennedy Class III situations because capturing

peripheral tissue movement is impossible with the current digital device¹⁸⁻²⁰⁾.

This clinical report described a technique for the registration of dynamic soft tissue morphology with the IOS and traditional impression materials. An altered cast impression was made and soft tissue extension was accurately registered in the impression^{27,28)}. The altered cast also eliminated chemical bonding between the printed cast and heat polymerizing resin during processing²⁹⁾. This technique also proved to be able to prevent accidental extraction, because the intraoral digital scanner was used and the polyvinyl siloxane material did not completely cover the mobile teeth during the altered cast impression. Moreover, the patient's adaptation to the ID was facilitated as the patient's occlusal vertical dimension and maxillomandibular relationship record were maintained.

A potential limitation of this technique is the initial hardware and software investments for the clinician and dental technician¹⁸⁾. Further development of the IOS and software is also necessary for the direct registration of dynamic soft tissue morphology^{13,19,20,26)}.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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