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 teeth. The inherent advantages of ID are the preservation of the patient’s natural appearance and mastication ability, and the protection of the surgical wound. An intraoral scanner (IOS) has been successfully applied, and the system showed comparable levels of trueness and precision values in full-arch scans. 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 fabrication. Recently, Kattadiyil et al. and Mansour et al. 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. As Kattadiyil et al. described, however, recording appropriate extensions of movable tissue was impossible with an IOS. Mansour et al. also emphasized the need for clinical research to use an IOS in other Kennedy classifications of partially.
A digital approach to a definitive immediate denture... 

Lin et al. 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 movement.

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. 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. 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 cost. Therefore, the remaining maxillary teeth were scheduled for removal at the placement of a definitive ID.

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 reflection. As indistinguishable three-dimensional and poorly traceable structures are characteristics of the edentulous areas, incorrect stitching of the captured
images may occur\(^{20}\). 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 Alginates; 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
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 cast\(^{29}\). 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 surface\(^{29}\). 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 deflective occlusal contacts\(^{30,31}\). 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\(^{2,32,33}\).
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 processing. The ID was processed and polished.

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

Discussion

Since Williams et al. 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 device.

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. The altered cast also eliminated chemical bonding between the printed cast and heat polymerizing resin during processing. 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 technician. Further development of the IOS and software is also necessary for the direct registration of dynamic soft tissue morphology.

Conflict of Interest

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

1. The glossary of prosthodontic terms. J Prosthet Dent. 2005; 94: 10-92.
2. Woloch MM. Nontraumatic immediate complete denture placement: a clinical report. J Prosthet Dent. 1998; 80: 391-3.
3. Gottlieb AS, Askinas SW. An atypical chairside immediate denture: a clinical report. J Prosthet Dent. 2001; 86: 241-3.
4. Bissasu M. A simple procedure for minimizing adjustment of immediate complete denture: a clinical report. J Prosthet Dent. 2004; 92: 125-7.
5. Zarb GA, Hobkirk JA, Eckert SE, Jacob RF. Prosthodontic treatment for edentulous patients: complete dentures and implant-supported prostheses. 13th ed. St. Louis: Mosby; 2013.
6. Lee JH. Fabricating an immediate denture for a medically compromised elderly patient. J Prosthet Dent. 2015; 113: 277-81.
7. Patzelt SB, Emmanouilidi A, Stampf S, Strub JR, Att W. Accuracy of full-arch scans using intraoral scanners. Clin Oral Investig. 2014; 18: 1687-94.
8. Williams RJ, Bibb R, Rafik T. A technique for fabricating patterns for removable partial denture frameworks using digitized casts and electronic surveying. J Prosthet Dent. 2004; 91: 85-8.
9. Eggbeer D, Bibb R, Williams R. The computer-aided design and rapid prototyping fabrication of removable partial denture frameworks. Proc Inst Mech Eng H. 2005; 219: 195-202.
10. Williams RJ, Bibb R, Eggbeer D, Collis J. Use of CAD/CAM technology to fabricate a removable partial denture framework. J Prosthet Dent. 2006; 96: 96-9.
11. Bibb RJ, Eggbeer D, Williams RJ, Woodward A. Trial fitting of a removable partial denture framework made using computer-aided design and rapid prototyping techniques. Proc Inst Mech Eng H. 2006; 220: 793-7.
12. Goodacre CJ, Garbacea A, Naylor WP, Daher T, Marchack CB, Lowry J. CAD/CAM fabricated complete dentures: concepts and clinical methods of obtaining required morphological data. J Prosthet Dent. 2012; 107: 34-46.
13. Bidra AS, Taylor TD, Agar JR. Computer-aided technology for fabricating complete dentures: systematic review of historical background, current status, and future perspectives. J Prosthet Dent. 2013; 109: 361-6.
14. Kattadiyil MT, Goodacre CJ, Baba NZ. CAD/CAM complete dentures: a review of two commercial fabrication systems. J Calif Dent Assoc. 2013; 41: 407-16.
15. Lang LA, Tulunoglu I. A critically appraised topic review of computer-aided design/computer-aided machining of removable partial denture frameworks. Dent Clin North Am. 2014; 58: 247-55.
16. Infante L, Yilmaz B, McGlumphy E, Finger I. Fabricating complete dentures with CAD/CAM technology. J Prosthet Dent. 2014; 111: 351-5.
17. Kim MS, Lee JY, Shin SW. Fabricating an obturator using rapid prototyping to design the framework: a case report. Int J Prosthodont. 2014; 27: 439-41.
18. Kattadiyil MT, Mursic Z, AlRumaith H, Goodacre CJ. Intraoral scanning of hard and soft tissues for partial removable dental prosthesis fabrication. J Prosthet Dent. 2014; 112: 444-8.
19. Mansour M, Sanchez E, Machado C. The use of digital impressions to fabricate tooth-supported partial removable dental prostheses: a clinical report. J Prosthodont. 2016; 25: 495-7.
20. Lin WS, Chou JC, Metz MJ, Harris BT, Morton D. Use of intraoral digital scanning for a CAD/CAM-fabricated milled bar and superstructure framework for an implant-supported, removable complete dental prosthesis. J Prosthet Dent. 2015; 113: 509-15.
21. McLaughlin JB, Ramos V Jr. Complete denture fabrication with CAD/CAM record bases. J Prosthet Dent. 2015; 114: 493-7.
22. Bilgin MS, Erdem A, Aglarci OS, Dilber E. Fabricating complete dentures with CAD/CAM and RP technologies. J Prosthodont. 2015. doi:
10.1111/jopr.12302. [Epub ahead of print]
23. Baskin SM, Lipchik GL, Smitherman TA. Mood and anxiety disorders in chronic headache. Headache. 2006; 46(Suppl 3): S76-87.
24. Griffith JL, Razavi M. Pharmacological management of mood and anxiety disorders in headache patients. Headache. 2006; 46(Suppl 3): S133-41.
25. Lee JH, Lee KB. Alternative antireflection substance for a digital impression. J Prosthet Dent. 2015; 114: 460-1.
26. Patzelt SB, Vonau S, Stampf S, Att W. Assessing the feasibility and accuracy of digitizing edentulous jaws. J Am Dent Assoc. 2013; 144: 914-20.
27. Leupold RJ, Kratochvil FJ. An altered-cast procedure to improve tissue support for removable partial dentures. J Prosthet Dent. 1965; 15: 672-8.
28. Holmes JB. The altered cast impression procedure for the distal extension removable partial denture. Dent Clin North Am. 1970; 14: 569-82.
29. Lee JH, Cho SA. Altered polyurethane cast for a partial removable dental prosthesis. J Prosthet Dent. 2015; 114: 305-6.
30. Hobo S, Shillingburg HT Jr, Whitsett LD. Articulator selection for restorative dentistry. J Prosthet Dent. 1976; 36: 35-43.
31. Rosenstiel SF, Land MF, Fujimoto J. Contemporary fixed prosthodontics. 4th ed. St. Louis: Mosby Elsevier; 2006. p. 45-9.
32. Jerbi FC. Trimming the cast in the construction of immediate dentures. J Prosthet Dent. 1966; 16: 1047-53.
33. Phoenix RD, Fleigel JD. Cast modification for immediate complete dentures: traditional and contemporary considerations with an introduction of spatial modeling. J Prosthet Dent. 2008; 100: 399-405.
34. Bourgoyne JR. Alveoloplasty in preparation for the immediate denture insertion. J Prosthet Dent. 1951; 1: 254-67.
35. Loney RW, Knechtel ME. Diagnosing denture problems using pressure-indicating media. J Prosthet Dent. 2009; 101: 137-41.