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A Novel Approach for Converting a Mandibular Complete Denture to a Fixed Interim, Screw-Retained Implant Prostheses: A Case Report

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Abstract

For most of the last century, conventional complete dentures have been the standard of care and the most common treatment for edentulous patients. Technological advancements in fabrication techniques may significantly reduce the number of office visits required to fabricate complete dentures. Immediate occlusal loading with mandibular full arch prostheses has been extensively researched and is now one of the standards of care for edentulous patients. A clinical technique for converting a mandibular immediate complete denture to an interim full arch, screw-retained fixed prosthesis with novel implant restorative components for immediate loading on four implants is described.

Dental prostheses have been defined as artificial replacements (prostheses) of one or more teeth (up to the entire dentition in either arch) and associated dental/alveolar structures. Dental prostheses are subcategorized as either fixed dental prostheses (FDPs) or removable dental prostheses (RDPs).[1] RDPs that replace an entire arch of teeth are complete dentures. Complete dentures may be fabricated conventionally with processed acrylic resin [poly(methyl)methacrylate), (PMMA)] or they may be manufactured with computer assisted design/computer assisted manufacturing (CAD/CAM) protocols.[2,3] These clinical/laboratory protocols have specific benefits and limitations. Immediate loading of multiple, splinted dental implants with full arch prostheses has become more routine due to high survival rates.[4,5] Workflows for removable and fixed dental prostheses have converged. There has been increased emphasis on digital technology in the design and fabrication of RDPs; it is now possible to make removable prostheses completely with digital workflows.[6] For the purposes of this article, the term "removable dental prostheses" will be replaced with "complete dentures."

There are a variety of digital solutions for the fabrication of complete dentures. Some solutions have focused on milling[7] or printing monolithic dentures;[8] others have focused on milling or printing teeth and denture bases separately and adhering denture teeth to denture bases.[9,10] Others have focused on either printing or milling denture bases and adhering prefabricated denture teeth to denture bases.[11] Each proposed solution has benefits and limitations.[10] Lozada et al[12] described a technique for converting digitally planned and fabricated complete dentures into interim screw-retained protheses during the osseointegration period. Joshi et al[13] reported common complications with computer-engineered implant-retained complete dentures that included denture tooth dislodgement and fracture. Several contributing factors associated with prosthetic complications have been identified including (1) amount of destruction/change to dentures during the conversion process from removable to fixed prostheses, (2) denture material/fabrication techniques, (3) length of cantilever/anterior posterior spread ratios, and (4) spacing of implants.[14,15] Slauch and Bidra[16] demonstrated an improved technique for determining implant locations within dentures that reduced the amount of alterations to dentures during the conversion process from removable to fixed prostheses. Their objective was to improve strength and durability of the interim fixed prostheses, as well as reduce the number of prosthetic complications.[16]

A popular solution to reduce alterations to interim prostheses involves the use of guided surgery and a fixed reference guide to position prostheses during pick-up procedures. One of the objectives with this protocol is to decrease the amount of structural changes to conversion prostheses. One implant company (Nobel Biocare, Yorba Linda, CA) introduced special multi-unit abutments and temporary cylinders (Temporary Snap Coping Multi-Unit Plus, catalog #38915) with finger springs. The finger springs were designed to snap onto the multi-unit abutments without the need to secure cylinders to abutments with screws. The intended benefit for these components was to expedite the pick-up procedure by decreasing the amount of time associated with insertion/removal of the temporary cylinders using screws. One drawback to this protocol is that the temporary cylinders, since they are not screwed into place, can be displaced from the abutments during the pick-up procedures. Displacement of the cylinders during the pick-up procedure will likely result in the resultant prosthesis not seating on the multi-unit abutments correctly. This would require that the procedure be redone.

The current case report demonstrates a technique with new implant restorative components (separable fasteners) to convert a mandibular complete denture to an interim screw-retained fixed implant prosthesis with reductions in cost, time, and complexity.

Figure 1 Patient's pretreatment condition with teeth in maximum intercuspation; note the significant anterior vertical overlap and rampant caries.

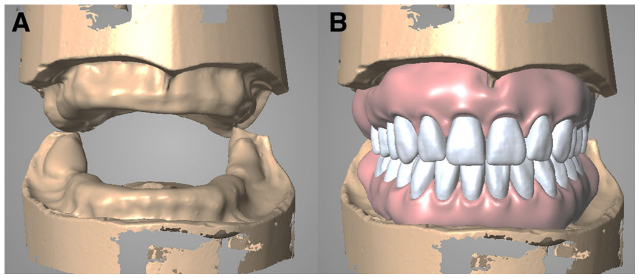

Figure 2 Digitized models after virtual removal of the teeth and alveoloplasty in both jaws; (B) completed denture setups.

Clinical report

A 25-year-old male presented to one of the authors (BK) requesting treatment for his partial edentulism in both jaws. He had a history of leukemia with two incidences of recurrence. He had undergone chemotherapy over the past 3 years; this had a deleterious effect on salivary output. The decreased quality and quantity of saliva, combined with poor oral hygiene and diet, resulted in rampant caries (Fig. 1). This patient wanted a fixed prosthodontic solution.

After thorough and complete physical and radiographic examinations, including cone beam computed tomography (CBCT), he was diagnosed with a nonrestorable dentition. The treatment plan included extraction of the remaining natural teeth, alveoloplasty as needed, dental implant placement to support/retain fixed, screw-retained maxillary/mandibular full arch prostheses. For occlusal loading to occur, the implants had to achieve at least 35 Ncm of insertion torque.

Maxillary and mandibular immediate complete dentures were fabricated using a combination of conventional analog/digital technologies and techniques. The centric relation (CR) record was made at an increased occlusal vertical dimension (OVD) to optimize occlusion, restorative volume, and facial esthetics.

Digitization

The casts and interocclusal relationship were digitized using a dental laboratory scanner (Series 7, Dental Wings, Montreal, QC, Canada) and imported into Dental Wings software, denture module (Fig. 2A). The digital denture set-ups were completed and .stl files were generated for each arch (Fig. 2B). The dentures were fabricated with combined digital and analog technologies.

Virtual implant planning was done with an implant planning software program (Blue Sky, Libertyville, IL). Implant positions were planned relative to tooth locations dictated by the teeth in the virtual dentures.

The surgical guide was printed using a 3D printer with polyjet technology (Stratasys Objet Eden 260V, VeroDent MED670 material).

Surgery

The surgical procedures were performed with moderate sedation, supplemented with local anesthesia. Maxillary teeth were extracted; the sockets were grafted with particulate cortical bone (MinerOss, BioHorizons, Birmingham, AL). Anatomic conditions precluded implant placement at this time and due to the planned increase in OVD, maxillary alveoloplasty to gain restorative space was not required. Primary closure was achieved with continuous horizontal mattress resorbable sutures (Ethicon, Bridgewater, NJ); the maxillary immediate complete denture was inserted; it was noted to fit well.

Local anesthesia was applied in the mandible. Full thickness flaps were reflected approximately from first molar to first molar. The mandibular incisors were extracted; the canines and premolars remained to retain and support the implant surgical guide. Alveoloplasty was performed and provided the requisite restorative volume needed for the implant restorative components, denture base and denture teeth. Using the surgical guide, osteotomies were prepared in sites that corresponded to teeth #'s 19, 23, 26, and 30. All implants reached implant insertion torque values of at least 35 Ncm.

The remaining teeth were extracted and bony recontouring was finalized. Straight multi-unit abutments (MUAs, BioHorizons, Birmingham, AL) with 2.5 mm collar heights were placed on the implants. The abutments were placed such that the screw access openings were located within the lingual surface of the anterior denture base and the occlusal surfaces of the posterior teeth. The abutment screws were torqued to 30 Ncm.

Conversion procedures (Overview)

The 3-dimensional orientation of the maxillary immediate denture was used as the reference for orienting and positioning the mandibular prosthesis. The intaglio surface of the mandibular denture was loaded with quick setting poly vinylsiloxane [(PVS), Blu-Mousse® Classic, Parkell, Inc., Edgewood, NY] occlusal registration material. A layer of polytetrafluoroethylene [(PTFE)3M™ PTFE Tape, Minneapolis, MN] tape was placed over the PVS material in the mandibular denture, seated intraorally over the MUAs with the patient in centric occlusion, and the denture removed shortly thereafter. The PTFE barrier provided two benefits: (1) it prevented material from entering the MUA screw channels, and (2) it allowed denture removal prior to setting of the PVS material. This "impression" located the positions of the MUAs. Five mm deep wells were made in the denture base directly through the PVS material. The denture base remained intact. This procedure takes considerably less time when compared to the more traditional technique of placing tall temporary cylinders onto the MUAs, drilling holes into and through the denture base to accommodate the MUA/temporary cylinders, adjusting the heights of the temporary cylinders to fit into the occlusal scheme and then injecting resin to lute the cylinders to the denture with the denture in the optimal position.

Conversion procedures (Clinical)

The surgical flap was closed. Sutures and any portion of the MUAs exposed occlusal to the gingival tissues were blocked out with light-cured gingival barrier (Kool-Dam, Pulpdent, Waterton, MA) (Fig. 3).

Low profile temporary cylinders (Ti bases, Smart Denture Conversions, Apex, NC) with aggressive undercuts were secured to the MUAs with new implant restorative components called "separable fasteners" (Smart Denture Conversions, Apex, NC) (Fig. 4). Separable fasteners resemble conventional prosthetic screws for MUAs, except that the screw heads are made of polyetheretherketone (PEEK). Separable

Figure 3 Close up clinical image of a low profile Ti base with separable fastener in place on a multiunit abutment; sutures and abutment undercuts were blocked out with light cured resin. Autopolymerizing PMMA was added to the Ti base prior to the clinical pick-up procedure.

fasteners are headless screws; PEEK screw heads are press-fit onto the nonthreaded portion of the separable fasteners. Separable fasteners retain temporary cylinders to MUAs; they are placed with a special low-torque driver to avoid inadvertent separation of the PEEK heads from the screws. Since the PEEK heads are retained to the fasteners via a press-fit, the PEEK heads will be removed from the fasteners when the denture is removed after polymerization of the resin pick-up material. This requires approximately 3 lbs. of vertical force. This step is unique to this system; it is not possible with conventional screw-retained components, as clinicians need access to the screws to loosen them prior to removal of the prosthesis.

Autopolymerizing acrylic resin (Alike, GC Dental Products, Tokyo, Japan) was mixed and placed into a modified-tip 10 cc Monoject syringe (Monoject, Medtronic Minimally Invasive Therapies, Minneapolis, MN). The resin was placed onto the intaglio surface of the denture and around the temporary cylinders intra-orally. The denture was placed over the Ti bases and the patient was manipulated into centric occlusion, at the pre-selected OVD. Water irrigation and high-volume suction were used to minimize the heat generated during the exothermic chemical reaction of the PMMA.

After the acrylic resin polymerized in the mouth, the denture was removed by using the back end of cotton forceps to gain purchase points on the distal flanges of the mandibular denture. Vertical force was generated occlusally with the cotton forceps; the prosthesis was removed. The temporary cylinders

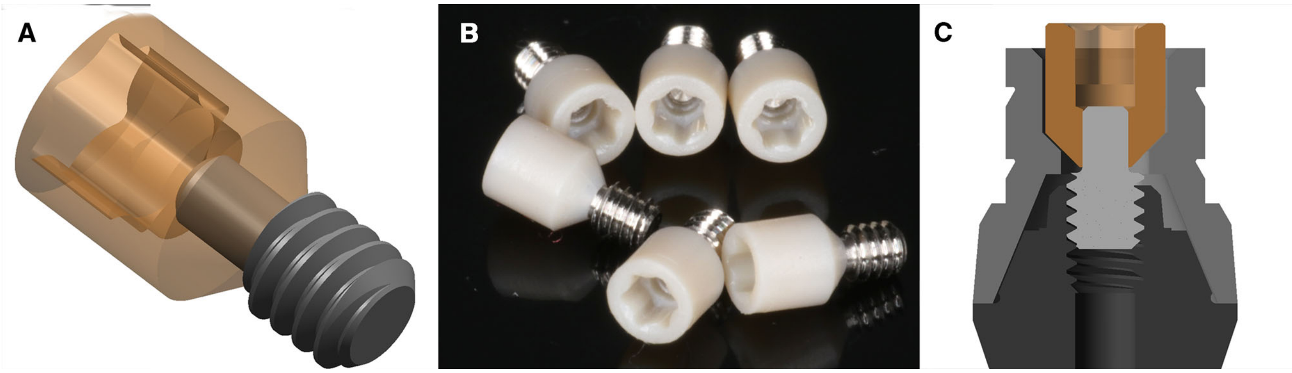

Figure 4 (9A) Schematic illustration of a separable fastener with PEEK screw head (translucent gold color) and threaded metal body (silver color). The PEEK head is press-fit onto the threaded screw; it will slide off the occlusal portion of the screw with removal of the denture during the conversion procedure. (B) Separable fasteners with hexed PEEK screw heads. (C) Schematic lateral illustration of a separable fastener with PEEK screw head (gold color) and screw (white), Ti base (light grey), and MUA (dark grey).

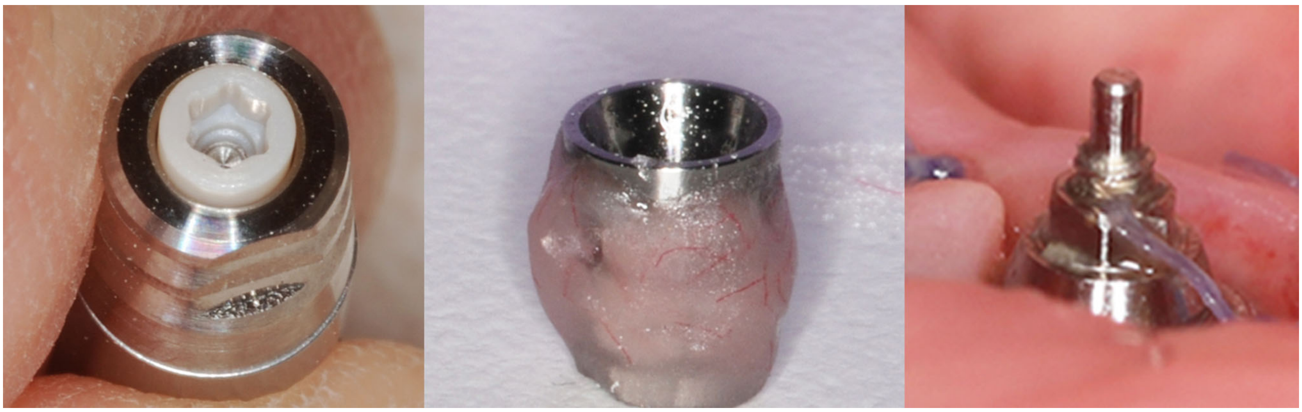

Figure 5 [Left] Close up image of Ti base with separable fastener in place (occlusal view), as received from the manufacturer. [Middle] Close up image of low profile Ti base with autopolymerizing resin in place. [Right] Clinical image after the pickup procedure. The metal threaded portion of the fastener remained in place in the abutment; the Ti bases and PEEK screw heads were in the prosthesis.

(Ti bases) and PEEK screw heads remained within the prosthesis. The separable fasteners' threaded screws remained in the MUAs clinically (Fig. 5). This is the unique portion of this procedure and is facilitated by the design and materials of the separable fasteners. The threaded screw portions of the separable fasteners were removed from the MUAs with a special retrieval tool made for contra-angle latch handpieces rotated in reverse (Fig. 6).

After the denture was removed, the nonthreaded portions of the separable fasteners were contained inside the pick-up resin in the denture; the temporary cylinders were no longer retained to the MUAs. The PEEK heads and Ti bases were now inside the denture base.

Hygienic, interim hybrid prosthesis contours were established in the laboratory.

Conversion procedures (Laboratory)

Three specific drills (contained in the starter kit) were used to create the screw access openings in a 3-step process:

1. The first drill was used to make pilot holes through the Ti bases' intaglio surfaces to the occlusal surface of the denture.
2. The 2nd drill (access drill) was used from the occlusal aspect of the holes, through the pilot drill openings in the denture base to the occlusal aspect of the Ti bases inside the denture. A stop has been manufactured into these drills to preclude damage to the Ti base.
3. The 3rd drill (clearance drill) was placed into a hand tool and the PEEK separable fastener heads were removed through the holes made by the second drill in the occlusal surface of the denture.

After the screw access openings were created, the prosthesis was polished and glazed with a light cured sealer (Optiglaze, GC Dental Products, Tokyo, Japan).

Clinically, the prosthesis was secured to the MUAs with prosthetic screws torqued to 15Ncm; the screw access openings were obturated with PVS impression material (Fig. 7).

Figure 6 Clinical image of the special bur in place on the nonthreaded portion of the separable fastener that remained in one of the MUAs after the denture was picked up; the screw was removed by running the slow speed contra-angle handpiece in reverse.

Figure 7 Clinical image of the completed conversion prosthesis in place; note the size and location of the screw access openings (smaller than conventional conversion protocols).

Screw-retained implant prostheses are removed with conventional pick-up protocols only if clinicians have access to the screws. This requires that holes be drilled completely through denture bases to accommodate the 3-dimensional positions of temporary cylinders screwed into MUAs; sometimes the holes can be quite large due to the angulations of the implants and abutments.

Discussion

This approach to denture conversion procedures for fixed interim, screw-retained full arch prostheses has resulted in high quality and durable prostheses. It has significantly decreased the time required to fabricate interim screw retained prostheses. Interim screw-retained prostheses are used to splint the implants with cross arch stabilization as well as to test esthetics, function, and prosthetic contours prior to fabricating definitive prostheses. Provisional prostheses that meet patients' esthetic and functional expectations serve as the templates for definitive prostheses.

The main advantages of the conversion technique described in this case report include: (1) improved strength of provisional prostheses secondary to decreased use of repair or pick-up PMMA, (2) decreased clinic and laboratory time for conversion procedures (with experience, conversion time takes approximately 1 hour), and (3) reduction in cost of restorative components when compared to implant manufacturer's restorative components. Strength and durability of interim prostheses are, in part, related to the amount of original denture base material remaining after conversion. The greater the amount of material removed to create passivity of the denture over the implant components generally results in thinner areas and weakened dentures. The above protocol involves low profile components and a pick-up technique with separable fasteners that results in preserving significantly more of the original processed denture. In cases of conventional conversions or guided conversions that require access openings of substantial diameter, screw channels associated with this technique are smaller.

There are several limitations with direct clinical conversions of immediate dentures to fixed interim full arch prostheses. To convert immediate dentures into fixed interim prostheses, there must be adequate implant primary stability. The authors selected 35 Ncm as the threshold for immediate occlusal loading. If implants fail to achieve this insertion torque value, the implants typically are buried for use in a two-stage surgical protocol, and the prosthesis is inserted as an immediate complete denture. Another limitation to any pick-up technique is that successful conversions are also related to implant placement and orientation. Angle corrections can be made with angled abutments, but limitations in pre-fabricated abutments may still result in implant components being placed in thinner (and weaker) portions of the prosthesis and may result in unacceptable contours and increased likelihood for prosthetic complications during osseointegration. A final limitation with the low-profile components used in this protocol is the small amount of surface area associated with the temporary cylinders. This may result in less than optimal surface contact between cylinders and denture bases during the pick-up procedure. This may result in one or more of the cylinders not attaching to the denture base. The authors have mitigated this issue by placing a thin layer of autopolymerizing acrylic resin on the cylinders in the laboratory prior to placing the cylinders intra-orally onto the MUAs.

The conversion technique described in this case report is similar in complexity to a direct, chairside pick-up for implant overdentures.[17] Staff training may be simplified because the above process expands on familiar procedures (direct pick-up for implant overdentures).

Treatment costs and fees for clinical services are related to the costs of dental supplies, implant components, chair time, lab fees and other overhead costs. The conversion technique described in this report reduces the amount of chair time needed by approximately 50%; these components are approximately 30% less expensive than the components used from major implant companies and uses conventional dentures. In some guided surgical protocols, duplicate dentures need to be fabricated (at extra cost) in case implants do not achieve appropriate insertion torque values and the conversion prosthesis cannot be used.

Summary

This case report illustrated conversion of a mandibular immediate complete denture into an immediate screw-retained full arch provisional prosthesis utilizing a novel separable fastener technology. Benefits and limitations of this protocol were described and illustrated.

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References

1. The glossary of prosthodontic terms: ninth edition. J Prosthet Dent 2017;117:e1-e105
2. Perea-Lowery L, Minja I, Lassila L, et al: Assessment of CAD-CAM polymers for digitally fabricated complete dentures. J Prosthet Dent 2020;13pii: S0022-3913(20)30013-5
3. Drago C, Borgert A: Comparison of nonscheduled, postinsertion adjustment visits for complete dentures fabricated with conventional and CAD-CAM protocols: a clinical study. J Prosthet Dent 2019;122:459-466
4. Chen J, Cai M, Yang J, et al: Immediate versus early or conventional loading dental implants with fixed prostheses: a systematic review and meta-analysis of randomised controlled clinical trials. J Prosthet Dent 2019;122:516-536
5. Crespi R, Cappare P, Gastaldi G, et al: Immediate occlusal loading of full-arch rehabilitations: screw-retained versus cement-retained prosthesis. An 8-year clinical evaluation. Int J Oral Maxillofac Implants 2014;29:1406-1411
6. Goodacre B, Goodacre C: Using intraoral scanning to fabricated complete denture: first experiences. Int J Prosthodont 2018;31:166-170
7. Kalberer N, Mehl A, Schimmel M, et al: CAD-CAM milled versus rapidly prototyped (3D-printed) complete dentures: an in vitro evaluation of trueness. J Prosthet Dent 2019;121:637-643
8. Chung Y, Park J, Kim T, et al: 3D printing of resin material for denture artificial teeth: chipping and indirect tensile fracture resistance. Materials (Basel) 2018;11:pii: E1798
9. Al-Dwairi Z, Tahboub K, Baba N, et al: A comparison of the flexural and impact strengths and flexural modulus of CAD/CAM and conventional heat-cured polymethylmethacrylate (PMMA). J Prosthodont 2020;29:341-349
10. Kattadiyil M, AlHelal A, Goodacre B: Clinical compications and quality assessments with computer-engineerd complete dentures. A systematic review. J Prosthet Dent 2017;117:721-728
11. Choi J, Uy C, Plaksina P, et al: Bond strength of denture teeth to heat-cured CAD/CAM and 3D printed denture acrylics. J Prosthodont 2020;29:415-421
12. Lozada J, Garbacea A, Goodacre C, et al: Use of a digitally planned and fabricated mandibular complete denture for easy conversión to an immediately loaded provisinal fixed complete denture. Part 1. Planning and surgical phase. Int J Prosthodont 2014;27:417-421
13. Joshi N, Piermatti J, Nahon M, et al: Management of biotechnical complications associated with a full-arch implant restoration using digital and conventional workflows: a clinical report. J Prosthodont 2019;28:483-487
14. Drago C: Frequency and type of prosthetic complications associated interim, immediately loaded full arch prostheses: a 2-year retrospective chart review. J Prosthodont 2016;25:433-439
15. Saponaro P, Yilmaz B, Heshmati R, et al: Clinical performance of CAD-CAM-fabricated complete dentures: a cross-sectional study. J Prosthet Dent 2016;116:431-435
16. Slauch RW, Bidra AS: A simplified technique to record implant positions when fabricating a conversion prosthesis for immediate loading. J Prosthet Dent 2018;120:628-630
17. Matthys C, De Vijder W, Besseler J, et al: Cost-effectiveness analysis of two attachment systems for mandibular overdentures. Clin Oral Implant Res 2020;31:615-624