Use of a Digitally Planned and Fabricated Mandibular Complete Denture for Easy Conversion to an Immediately Loaded Provisional Fixed Complete Denture. Part 1. Planning and Surgical Phase

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This article describes a unique prosthetically driven protocol that uses computer-aided engineering to develop sophisticated, scientific algorithms that guide the fabrication of a conversion denture using the AvaDent Digital Denture system (Global Dental Science). This system is combined with NobelClinician (Nobel Biocare) implant-planning software to optimize accuracy and to make it easier and faster to convert a denture to an immediately loaded provisional implant-supported fixed complete denture following implant placement, using a NobelGuide surgical template. *Int J Prosthodont 2014;27:417–421. doi: 10.11607/ijp.3825*

Computer-aided design/computer-assisted manufacturing (CAD/CAM) technology has become available for the fabrication of complete dentures. It offers the following advantages: *(1)* ability to provide dentures in two appointments, *(2)* high accuracy in the fit of the denture base because it is milled from prepolymerized denture base resin fabricated under high pressure, *(3)* less residual monomer, *(4)* a repository of digital data that permits fabrication of a spare denture with the same base morphology and tooth positions, and *(5)* digital data repository that makes it easy to fabricate a replacement for lost or damaged dentures. Having to learn new clinical procedures and mailing impressions and records to a digital denture manufacturing company, rather than having the denture fabricated locally, are a couple of disadvantages to the process. The fabrication cost of digital dentures is comparable to those associated with traditional complete denture processes.

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Digital dentures also have affected the way clinicians are diagnosing, treatment planning, and completing dental implant therapy. Careful acquisition of data with precise execution of clinical procedures is vital to optimal use of this technology. The precision of computer-guided implant surgery relies, in part, on intimate fit of the removable radiographic template or prosthesis used during the scanning phase.[1] With CAD/CAM technology being commercially available for the fabrication of complete dentures,[2,3] it is now possible to improve the mucosal fit of radiographic templates used during the data acquisition phase by milling prepolymerized resin, thereby eliminating polymerization shrinkage. The combination of digital complete denture (CD) fabrication technology with digital planning of implant placement can optimize accuracy and make it easier to convert a CD to a fixed implant-supported prosthesis at the time of implant placement. The technique of converting a CD to a provisional implant-supported fixed CD has been reported many times in the literature,[4–11] and Balshi[7] introduced the term *conversion prosthesis*.[1] However, this conversion technique and prosthesis have never before been designed or modified using a digital CD fabrication process and digital implant planning software.

The purpose of this patient treatment report is to describe how the AvaDent Digital Denture system (Global Dental Science) can be combined with NobelClinician (Nobel Biocare) digital implant-planning software to optimize accuracy while reducing the number of clinical appointments required to fabricate a CD that can be converted to an immediately loaded mandibular fixed CD. This combined process makes it easier to convert a CD to a provisional fixed CD and

Fig 1 Maxillary and mandibular definitive impressions with the AvaDent records.

reduces the time required during the surgical implant placement appointment.

Part 2 will describe and illustrate the unique prosthodontic procedures used to fabricate the definitive prostheses following implant healing.

Clinical Report

A completely edentulous 70-year-old woman presented for treatment at the Loma Linda University School of Dentistry, requesting more retentive dentures, especially for her mandibular arch. The patient's uneventful medical history placed her in the American Society of Anesthesiologists (ASA) Physical Status 2 classification, healthy but with mild systemic disease. She exhibited a philosophical attitude based on the House mental classification guidelines, fell within a Class II on the prosthodontic diagnostic index (PDI), and demonstrated an Angle Class I maxillomandibular relationship.

After comprehensive evaluation and data collection, a treatment plan was developed for the patient that included fabrication of a new maxillary CD and placement of four mandibular anterior implants to support and retain an immediately loaded mandibular fixed CD. As an interim step, the plan included converting a uniquely designed and digitally fabricated mandibular CD into a mandibular immediately loaded fixed implant-supported prosthesis at the time of implant placement. To improve denture fit and patient comfort while simultaneously enabling the patient to adapt to new denture base forms and tooth positions, it was determined that provisional maxillary and mandibular CDs would be placed prior to implant placement. These dentures would be digitally planned and milled using the AvaDent Digital Denture system.[2]

The clinical protocol used with this patient's treatment involved combining the digital denture fabrication process with NobelClinician implant-planning software to create a specific, efficient, and coordinated digital protocol for fabrication of provisional dentures, radiographic template, conversion denture, NobelGuide (Nobel Biocare) surgical template for placement of the implants, and clinical conversion of the unique, digitally fabricated conversion denture to a provisional fixed CD at the time of implant placement.

Technique Description

1. Maxillary and mandibular definitive impressions were made using the AvaDent customizable impression trays, following prosthodontic impression principles (Fig 1).
2. The AvaDent Anatomical Measuring Device (AMD) trays were adapted to the edentulous arches using impression material, and adjustments were made to the central bearing stylus to achieve an appropriate occlusal vertical dimension (OVD). Centric relation was recorded at the determined OVD, using the gothic arch tracing plate and stylus incorporated into the AMD. The lip support flange on the maxillary AMD was then adjusted to provide adequate lip support. An appropriate plastic tooth mold template was selected and attached to the lip support flange to record the size and position of the maxillary anterior teeth.
3. The final records included the complete arch impressions, connected maxillary and mandibular AMDs recording the OVD and centric relation (see Fig 1), and a laboratory work authorization form with information related to tooth mold and shade and denture base resin and shade, as well as options regarding stippling, rugae, and posterior palatal seal. These items were sent to Global Dental Science for fabrication of the AvaDent provisional CDs. The company also offers an "advanced try-in" option (a wax trial denture with a milled resin base) in case the clinician prefers to verify esthetics, phonetics, occlusal vertical dimension, centric relation, and occlusion.[2] This option was not requested for this patient's situation. An electronic preview of the virtual teeth arrangement was accepted prior to the milling process. The AvaDent process uses subtractive

Fig 2 Maxillary and mandibular provisional complete dentures.

Fig 3 Mandibular radiographic template with fiduciary markers.

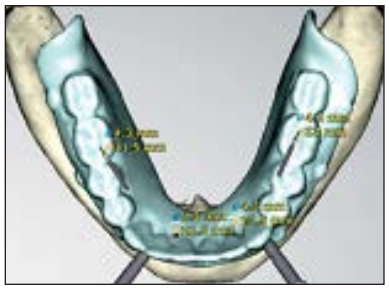

Fig 4 Virtual planning of the implant placement using the NobelClinician software.

milling of a prepolymerized "puck" of denture base resin to create the dentures using five-axis milling. The provisional dentures (Fig 2) were fully milled (including both the denture base and teeth) using a proprietary technique. A radiographic template that was a duplicate of the mandibular provisional denture into which fiduciary markers (ie, gutta percha placed into spherical indents made on the facial cameo surface) were integrated also was fabricated by AvaDent (Fig 3). A cone beam computed tomography (CBCT) scan prepared of only the radiographic template was produced; the radiographic template was positioned intraorally using an index, and a CBCT scan of the patient was done following the NobelGuide/NobelClinician protocol.[12] The surgical planning for implant placement was performed using NobelClinician software based on the orientation of the denture bases and teeth to the existing bone and vital anatomical structures so that the most appropriate locations could be identified for each implant. To avoid the neurovascular bundle and to achieve an appropriate anterior-posterior (A-P) separation of the implants to offset the desired posterior cantilever length, the posterior implants had to be angled distally. The angulation of the posterior implants was calculated and appropriate posterior multi-unit abutments were selected to correct the tilted orientation of the implants.

4. The virtually determined implant positions (Fig 4) were finalized using the NobelClinician software, and the required data was sent to Nobel Biocare for fabrication of a NobelGuide surgical template. The virtual implant positions were then used by Global Dental Science to fabricate an AvaDent mandibular conversion CD (Fig 5). This conversion denture had channels milled through the denture base at the appropriate positions where temporary copings would be located after their attachment to the implant abutments. It also had a premilled slot located around the denture base with a small number of struts that connected the peripheral denture base to the central portion of the conversion denture that functioned as the immediate provisional fixed CD. The presence of the channels and slot facilitated easy conversion of the denture to a fixed prosthesis while using the positional stability of the peripheral denture base to accurately orient the prosthesis in the patient's mouth during attachment of the denture to the temporary copings. Because the AvaDent conversion denture is milled from a dense block of prepolymerized resin, in addition to being monolithic (the resin base and teeth are one unit), it can provide additional strength compared to a denture fabricated from a conventional process.[2] Hinze et al[13] reported a 10.8% incidence of fracture with the traditional conversion denture within the first year of the provisional phase of treatment. Should a fracture occur with a monolithic conversion denture, it can be repaired as usual, and, if desired, an exact duplicate can be fabricated via the stored digital data.

Fig 5 AvaDent milled conversion denture with slots and channels for easy pick-up and separation.

5. The NobelGuide surgical template (Fig 6) was used to place the NobelReplace Conical Connection implants (Nobel Biocare) as planned virtually (Fig 7). Nobel Biocare multi-unit abutments were attached to the implants and the abutment screws torqued to the manufacturer's recommended values. Nobel Biocare temporary copings were then attached to the multi-unit abutments (Fig 8).

Fig 6 Mandibular NobelGuide surgical template.

Fig 7 Sequential osteotomy performed for placement of implants using the NobelGuide surgical template.

Fig 8 Temporary copings placed onto the Nobel Biocare multi-unit abutments.

Fig 9 *(left)* AvaDent conversion denture seated into position.

Fig 10 *(center)* Autopolymerizing resin being flowed to connect temporary copings to conversion denture.

Fig 11 *(right)* Cameo surface views of the AvaDent fixed conversion denture and the separated section.

6. The AvaDent conversion denture was positioned over the temporary copings with the denture base (Fig 9) and occlusion guiding its appropriate position. The denture was connected to the temporary copings by flowing autopolymerizing acrylic resin between the channels in the denture and the temporary copings and allowing the resin to polymerize (Fig 10). The temporary coping screws were then loosened and the prosthesis was removed from the mouth. The struts were sectioned to separate the peripheral section of the denture base from the central portion that would serve as the immediate fixed CD (Fig 11). Autopolymerizing resin was flowed as needed between the denture base and the temporary copings where voids were present to attain a smooth transition between the denture base and copings (Fig 12). The converted mandibular provisional fixed CD was finished, polished, and attached to the implant multi-unit abutments using the temporary coping screws. The occlusion was finalized against the previously fabricated maxillary provisional CD (Fig 13) and the temporary coping screws were torqued to the recommended value (15 Ncm). Postoperative medications and instructions were given, specifically requesting that the patient use only a soft diet for the initial healing period. The patient was very satisfied with the treatment provided (Fig 14).

Conclusions

It is possible to record the clinical information required for digital fabrication of CDs in one appointment and to use the resulting digital data to fabricate an AvaDent milled conversion denture. This digital conversion denture has a unique design that incorporates channels based on the implant positions determined using NobelClinician software. It also contains a peripheral slot so it can easily be modified into an immediately loaded provisional fixed CD, saving significant time—especially during the surgical implant placement appointment.

Fig 12 Intaglio surface view of the AvaDent fixed conversion denture.

Fig 13 Frontal view of the maxillary provisional and mandibular fixed conversion dentures in centric occlusion.

Fig 14 Smile view of the patient with the provisional prostheses.

Acknowledgments

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