Rehabilitation With an Implant-Supported Metal-Acrylic Fixed Prosthesis After Ameloblastoma Resection in Mandible: Clinical Case Letter

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INTRODUCTION

Due to the quality of the soft and hard tissue of the reconstructed site, the esthetic and functional rehabilitation of jaw resection patients is among the greatest of challenges for surgeons and prosthodontists. Patients may have improved oral function after receiving dental implants in resected and reconstructed sites; these implants can provide the sufficient support, stability, and retention for prosthodontic rehabilitation. There are various types of prostheses, including fixed, hybrid, or overdentures with retainers. Intra-arch distance is the primary factor that determines the type of prosthesis. The original design of fixed removable prosthesis using the 2-stage endosseous implant system was developed by Branemark. Generally, the fixed removable prosthesis resembles a flangeless denture that is retained by several osseointegrated implants and referred to as hybrid prosthesis. The prosthesis is composed of a metal framework/substructure that it is covered by resin teeth and is screwed onto implants. There is no contact between the prosthesis and the tissues of the alveolar ridge.

There are some clinical conditions for which an implant-supported hybrid prosthesis may be preferred, including in cases with increased intra-arch distance, a decreased need for soft tissue support, those with limited financial resources, or patient preference. According to these conditions, a review of the literature reveals that there are multiple diverse methods regarding framework design in implant-supported hybrid prosthesis. Frameworks have been fabricated according to the following criteria: bulk for strength, adequate access for oral hygiene procedures, and strategic thinning of implant frameworks to allow for retention of acrylic resin denture teeth and denture bases. The use of computer-aided design/computer-aided manufacturing (CAD/CAM) allows improvement in the accuracy of prosthetic frameworks and potentially greater success with implant-supported hybrid prosthesis. CAD/CAM technologies have also eliminated conventional waxing, casting, and finishing procedures; in addition, the deficiency associated with these procedures has also been eliminated.

With the advent of CAD/CAM protocols, milled titanium frameworks have become quite popular in implant prosthodontics. The original treatment protocol includes the fabrication of cast metal frameworks that fit accurately on restorative platforms, abutments, and/or endosseous implants. Titanium bar-shaped frameworks may also be designed to splint implants together; it has been reported that these provide retention and support for the functional and esthetic portions of the fixed hybrid prosthesis.

Although there are a number of studies reporting procedures for the prosthetic rehabilitation of mandibular discontinuity defects, there is limited data on implant-supported CAD/CAM-manufactured partially hybrid prosthesis for the management of jaw defects. Therefore, this clinical case aimed to describe the rehabilitation of a patient with an implant-supported, screw-retained hybrid prosthesis fabricated on a CAD/CAM titanium framework after undergoing a partial mandibular resection and reconstruction with an autogenous iliac graft, which was subsequent to treatment for ameloblastoma.

DESCRIPTION OF THE CASE

A 20-year-old woman presented with the chief complaint of swelling along the right mandible that had been continuing for the past year. Patient’s past medical history was unremarkable. An intraoral (Figure 1) and radiological examination showed a well-defined, radiopaque-lucent multilocular lesion, approximately 5 cm in size, extending antero-posteriorly from the apex of #28 to the ascending border of the ramus and inferiorly to the lower border of the mandible (Figure 2a). Histopathologic examination confirmed the diagnosis of plexiform ameloblastoma. Mandibular partial resection and simultaneous reconstruction with iliac bone graft were performed under general anesthesia (Figure 2b and c).

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FIGURES 1–5. **FIGURE 1.** Pre surgical clinical image of the ameloblastic mandible. **FIGURE 2.** (a) Pre surgical radiological image of ameloblastoma. (b) Post surgical radiological image of reconstructed mandible. (c) Resected ameloblastic material after 24-hour wait in formaldehyde solution. **FIGURE 3.** Radiological image of placed implants 10 years after reconstruction. **FIGURE 4.** Intraoral location of implants. **FIGURE 5.** Impression copings attached to implants.
for prosthetic rehabilitation at 10 years after having tumor surgery. Radiographic evaluation confirmed complete healing of the operation site and that the graft was well-maintained. After diagnostic cast evaluation, an increased inter-arch distance and erupted #2, #3, #4, and #5 through the edentulous partially resected right mandible were observed. Therefore, an implant-supported, screw-retained CAD/CAM designed hybrid prosthesis and CAD/CAM fabricated maxillary premolar and molar all-ceramic fixed crowns were planned. Two dental implants were placed in the #27 (3.8 mm × 10.5 mm) and #30 (4.6 mm × 10.5 mm) regions of the right mandible (Figure 3; BioHorizons; Birmingham, Ala). Periodontally-involved #26 was extracted. The implants were followed up for 2 months via clinical evaluation and radiographs. After an osseointegration period of 4 months without functional loading, we began the prosthodontic protocol. Second-stage surgery was performed under local anesthesia, closure screws were removed, and healing caps were placed (Figure 4). After 1 week, when the soft tissue had grown around healing caps, impression copings were placed onto the implants (Figure 5). Definitive impressions were taken with an open custom tray with polyether impression material (Impregum; 3M ESPE, St. Paul, Minn) and face-bow procedure (Artex Facebow; Jensen Dental, North Haven, Conn) was performed.

In the laboratory, maxillary and mandibular master casts were poured and mounted in a semi adjustable articulator (Artex Type CT Articulator; Jensen Dental). The abutments (multi-unit abutments; BioHorizons) were attached to the implant replicas incorporated into the mandibular master cast to get a rough idea of then inter arch space required for the fabrication of the hybrid prosthesis. The master casts and the abutments were scanned with an extraoral laser scanner by using a CAD tool (DWOS; Dental Wings, Montreal, QC). Titanium framework of the hybrid prosthesis was computerized and designed (Figure 6a through c).

This titanium framework was manufactured from Grade IV titanium block (Cares; Straumann, Basel, Sweden) in an industrial machining center by using a 5-axis-milling CAM unit (DC40 Milling Machine; Yenadent, Istanbul, Turkey). Titanium frameworks were checked with radiograph to confirm the acceptable fit over the abutments (Figure 7). The tooth set up of the hybrid prosthesis was performed over the framework with prefabricated composite denture teeth (Sr Phonares II Type; Ivoclar Vivadent, Schaan, Liechtenstein) and tried-in clinically. On the other hand, at this appointment, root canal treatment and preparation were performed for #2, #3, #4, and #5.

Four-unit, right maxillary all-ceramic fixed crowns (CEREC Blocs C; Sirona Dental GmbH) were chairside fabricated (CEREC 4.3; Sirona Dental GmbH, Salzburg, Austria). The hybrid prostheses and fixed crown were adjusted intraorally to verify maxillomandibular relationships associated with unilaterally balanced occlusion for the final wax try-in. Then the screw-retained hybrid prosthesis was sent to the laboratory to construct with heat-curing acrylic resin (ProBase Hot; Ivoclar Vivadent).

At delivery, previously finished all-ceramic fixed crowns were cemented (Relay Unicem; 3M ESPE). After processing, finishing, and polishing, the hybrid prosthesis was shaped to have slight contact with the mucosa, allowing for proper hygiene procedures. The abutments and the prosthesis were screwed and torqued according to the manufacturer’s recommendations. The prosthesis was checked for final fit between the denture base and soft tissues, and for stability, retention, intercuspal relation, esthetics, and phonetics (Figure 8). The screw access holes of the hybrid prosthesis were covered with composite resin (Filtek Z250; 3M ESPE). The patient was instructed on how to clean the prosthesis. The patient was evaluated in the first 6 months and then once each year, and thus far, has been followed up for 2 years and has had no complications.

**DISCUSSION**

This clinical treatment describes the procedural details of a mandibular screw-retained, implant-supported hybrid prosthesis with a titanium framework, which was produced by using the CAD/CAM technique. The bar-shaped framework minimized lateral and rotational displacement. Screw attachments supplied rigid retention and reduced possible movement along the route of insertion. This type of prosthesis is available to patients with unilaterally resected and reconstructed mandibles, and they often provide satisfactory results.

It has been reported that dental implants can be successfully placed in reconstructed jaws. Chiapasco et al emphasized that the long-term survival rates (96.7%) of implants placed after jaw reconstruction promote good prognoses for implant-supported prosthesis. In the present case, the patient had partially resected mandibular arch and over-increased intermaxillary distance. Associated with this condition, based on clinical and laboratory analysis, two types of prosthetic designs were proposed, as follows: (1) Removable, MP-clip-bar-retained overdenture: It was impossible to use two retentive clip attachments due to the inadequate mesial cantilever and inter implant length of the bar. (2) Fixed, implant-screw-retained titanium framework and hybrid prosthesis: In cases of advanced ridge resorption and tissue loss, in which soft tissue support is demanded from the flanges of the prosthesis, this design was indicated. Hybrid prosthesis was recommended if intermaxillary distance is over 15 mm. If the mentioned distance is excessive, the prosthetic superstructure may be too long, which may cause overloading to the implants. In the present case, the intermaxillary distance was 18 mm, and edentulous side was antero posteriorly long. Another important factor during the planning of implant-supported hybrid prosthesis is determining the appropriate functional design. The need to obtain a desirable passive framework fit and implant stabilization with the reconstructed mandible were considered when determining the best manufacturing technique.

Traditionally, metal frameworks of hybrid prosthesis were fabricated using the lost-wax technique and casting noble alloys. Several studies have shown that the fabrication of metal frameworks for hybrid prosthesis by using the CAD/CAM technique offer improved passivity of fit than those fabricated from the casting technique. This is because the metal frameworks are designed with CAD/CAM with cold milling technique from a metal alloy block, therefore eliminating the dimensional changes of the metal. Titanium and titanium alloys are well-suited for clinical dentistry because they have
perfect corrosion resistance, low gravity, and biocompatibility, and are inexpensive.\textsuperscript{18} In the present case, after considering the patient’s factors associated with implant locations, ease of retention procedures, intermaxillary distance, and long-term maintenance, we decided that it would be best to use an implant-supported, screw-retained hybrid prosthesis fabricated with CAD/CAM. Furthermore, we only scanned the master model and designed that shape, screw holes, and planes of frameworks of this kind using the CAD/CAM technique. We eliminated previous production of a wax, resin, or composite template, which is then scanned using an extraoral scanner because the new design software offers the option of totally designing the framework without a template.

The prosperous treatment outcomes for this patient are in agreement with the results of similar studies,\textsuperscript{29,30} which reported no biological and prosthodontic complications related to implant-supported hybrid prosthesis that are retained by a titanium framework. It should be understood that passive fit is
the preliminary condition for implant survival and not achieving it leads to mechanical and biological failures.\textsuperscript{31} Zarb and Jannson stated that if a clinical fit was not obtained, framework should be sectioned, an intraoral index made, and then the segments should be soldered.\textsuperscript{12} As a result, implant bar-supported screw-retained CAD/CAM hybrid prosthesis appears to be a viable treatment procedure in the partially resected mandible after tumor surgery.

**ABBREVIATIONS**

CAD/CAM : computer-aided design/computer-aided manufacturing

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**NOTE**

The authors declared no conflict of interest.

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