

Rehabilitation of a Partially Edentulous Patient with a Cast Partial Denture using Hybrid Analog-Digital Technique: A Case Report

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Abstract

Removable partial dentures are still considered the best treatment option where long-span crowns, bridges, and implants are not possible. When edentulous portions are too large, a cross-arch stabilization and uniform distribution of forces is necessary for the longevity of remaining natural teeth and soft tissues. The insertion and removal of dentures, as well as regular oral hygiene, are straightforward processes. The advancement of technology in the digital field has made dentists deliver more calculated and precise prostheses. The advantages of computer-aided design (CAD)/computer-aided manufacturing are eliminating manual surveying and conventional wax up which is more technique-sensitive and time-consuming. CAD allows for simple adjustments and edits to a design, resulting in a more precise design and fit of the components, leading to better-fitting prosthetics that improve patient comfort. This case report involves both analog and digital methods of fabricating a cast partial denture.

Keywords: 3D printing, Computer-aided design/computer-aided manufacturing, Cast partial denture, Casting, Stability.

INTRODUCTION

Edentulousness, the condition of tooth loss, can lead to both esthetic and biomechanical issues. The prevalence of partially edentulous patients has risen, likely due to global aging and improved oral health prevention measures. For these patients, prosthetic solutions offer several rehabilitation options, such as removable partial dentures (RPDs) and fixed partial dentures, which can be either tooth-supported or implant-supported.^[1] These options help restore function and appearance for those missing some of their teeth. The numbers and location of missing teeth significantly influence the treatment planning and effectiveness of a prosthesis in restoring and maintaining functions comparable to natural teeth.^[1]

Despite the growing popularity of prosthetic implants, patients frequently cannot utilize such types of prostheses because of physiological, anatomical, or financial limitations. As a result, RPDs are sometimes the only viable option for treatment.^[2] Advancements in computer-aided design (CAD)/computer-aided manufacturing technology have enabled the creation of RPD frameworks using additive and subtractive methods. Advanced 3D dental modeling software is utilized

to create digital files suitable for milling or 3D printing. RPD frameworks may now be designed in 3D using commercial CAD software systems such as 3Shape Dental System and Exocad.^[3]

The fabrication of a wax pattern is one of the technique-sensitive procedures in casting partial dentures (CPDs). Wax patterns used for these dental restorations involve minute details of the future prosthesis and should not be distorted since this can seriously affect the patient's overall prosthodontic or restorative treatment success. It also impacts how accurately the completed metal casting fits the patient's mouth.^[4]

Prototyping helps to eliminate the waxing stage from the denture manufacturing process, which lowers the possibility

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of mistakes and improves quality control in the dental lab. In addition, the time required to prepare the removable prosthesis is decreased by the automatic identification of the insertion axis and rapid detection of retentive zones. Prototyped dentures have sufficient adaptability, are comparable to conventionally manufactured prostheses, and require fewer modifications.^[2]

CASE PRESENTATION

A 48-year-old female patient presented to the Department of Prosthodontics and Crown and Bridge with a chief complaint of missing teeth and difficulty eating. Her medical history revealed that she had been diabetic for the past 5 years and was under oral antidiabetic medication. The patient stated that she had a dental extraction done about 2 months ago in the maxillary right and the left posterior region. The patient also stated that she lost some teeth due to caries and periodontitis.

On intraoral examination, missing teeth in relation to 13, 14, 15, 16 and 22, 23, 24, 25, 26 Kennedy's Class III modification I in the maxilla and 34, 35, 36, 37, 44, 45, 46, and 47 Kennedy's Class I in the mandible and dental caries in 12, 17, and 27. There was markable soft-tissue loss buccally on both the arches (Figure 1). The patient did not want to undergo any extensive treatment or surgical procedure, and hence, a conservative treatment had to be planned. The treatment plan was as follows, CPD in the maxillary arch and interim acrylic partial denture in the mandibular arch. Because the patient was willing for dental implants in the mandibular arch on a later date after controlling her blood sugar level.

Prosthetic procedure

After oral prophylaxis and the restoration of 12, 17, and 27 with composites, upper and lower diagnostic impressions were made with alginate (Algitex – DPI, India). Diagnostic models were poured into Type II dental stones. After diagnostic mounting, it was decided to fabricate full metal crowns with rest seats in the most posterior abutments (17 and 27) for hygiene and undercut issues. The crowns were prepared, and metal crowns with rest seats were cemented with glass ionomer cement (GIC Type I GC CORP, Tokyo, Japan). Rest seats were prepared in 11, 21, and 12 which will act as both auxiliary rest and indirect retainer. A custom tray was fabricated using Blatter Fein's technique, and the final impression was made with very heavy-bodied additional silicone (putty) and light-body impression materials. The casts were poured using type IV dental stone (Gemstone, India). The casts were then scanned using an extraoral scanner (UP3D-USA).

After digital surveying of the virtual model, it was decided to give an anteroposterior palatal strap major connector and meshwork minor connector with rests on all the remaining natural teeth present (Figure 2). The wax pattern was designed in EXOCAD software and fabricated with a 3D printer (UNIZ) (Figure 3). The wax pattern was then cast with cobalt-chromium, and a metal framework was obtained from the same. After the successful framework trial, the bite registrations were made and the casts were mounted on a Hanau wide-view



Figure 1: Pre-operative extraoral and intraoral images of Kennedy's Class III modification I maxillary arch and a Kennedy's Class I mandibular arch

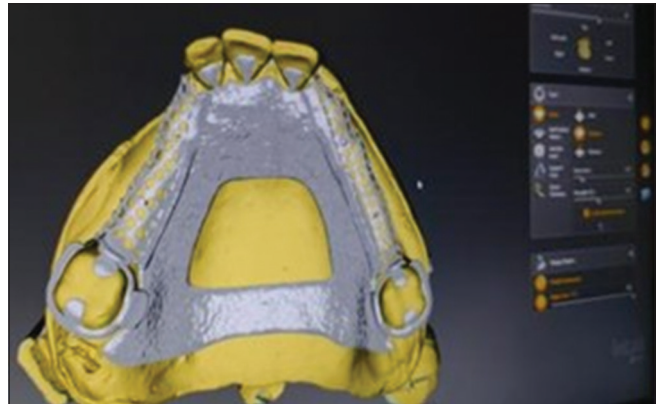


Figure 2: Designing of cast partial denture (maxilla) using Exocad software



Figure 3: 3D printed maxillary cast partial framework (wax)

articulator using a facebow. The teeth setting was done and try-in verification was completed on the following day. The patient was satisfied with the trial dentures. After obtaining the patient's consent, the framework was completed with acrylic (Figure 4) and delivered to the patient (Figure 5). The CPD was checked for the five clinical parameters, function, and esthetics.

DISCUSSION

RPDs are the gold standard treatment choice in some patient conditions. Because they offer to replace both teeth and soft



Figure 4: Final prosthesis (maxillary cast partial denture)



Figure 5: Post-operative extraoral and intraoral images

tissues. Alternative treatment options being implants and fixed prostheses are a time-consuming and cost-effective treatment. Under the given conditions for the patient, a CPD for the maxillary arch will provide a long-term treatment choice since the remaining natural teeth are very few and cannot serve as a fixed partial denture abutment. The metal framework also helps in distributing the forces evenly to the remaining natural teeth. Since the distal extension condition in the mandibular arch can be approached with fixed treatment options such as implants or precision attachments later, an interim acrylic partial denture was planned. However, the limitations of CPDs include patient adaptation, food impaction in the posterior abutments, decalcification, and comprehensive maintenance of the denture.

The main benefits of introducing CAD in the fabrication of the CPD framework involve the automatic determination of a proposed path of insertion, the rapid identification of desirable undercuts, and the immediate removal of undesirable undercuts.^[6] The advantage of this hybrid analog–digital method lies in the fact that due to the fabrication of a 3D printed model, the dexterity of laboratory procedures of cast block out, duplication, and wax pattern fabrication was avoided, thus saving the laboratory and patient's time.^[7] Conventional wax pattern adaptation requires human intervention and material manipulation that may inherently induce processing shrinkage

and/or expansion.^[3] This may lead to increased processing errors and inaccuracies, which may explain the decreased retention. Moreover, the advantages over analog methods are that it allow continuous control of sections of individual elements of the prosthesis and help in designing minimally visible components.^[5]

In this case report, the maxillary CPD satisfied the criteria given by Tregerman *et al.*, all rests were fully seated as prepared and designed,^[8] no discernible difference between tooth and metal rests was seen,^[3] all guide plates contacted the proximal tooth surfaces, and no detectable rock on the major connector was seen,^[8] circumferential clasp had continuous contact around the metal crowns over the abutment teeth 17 and 27^[8] and also, it was observed that no detectable opening from the periphery of the major connector to soft tissue.^[8]

CONCLUSION

It has been found that partial tooth loss affects food acceptability in the same way as edentulism is associated with a poor diet and compromised nutrition, and tooth loss may cause dietary changes. As a result, removable treatment options are preferred in patients who are unable to receive fixed prostheses. The CPD being a metal framework, also distributes the forces equally to the few remaining abutment teeth and helps in the longevity of the teeth and oral structures. It also offers the advantage of soft-tissue augmentation with acrylic which is not possible with fixed partial dentures. Hence, the current case report justifies the successful rehabilitation of a partially dentate mouth using a hybrid analog–digital maxillary CPD and conventional mandibular RPD.

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