Dental Research Journal

Case Report

Fabrication of a customized impression metal jig for an implant-supported overdenture with a milled bar

Yeganeh Memari[1], Azadeh Tadayonfard[2], Amir Fayaz[1], Elaheh Beyabanaki[1]

[1]Department of Prosthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran, [2]Department of Prosthodontics, School of Dentistry, Ahvaz University of Medical Sciences, Ahvaz, Iran

Received: 25-Jun-2019
Revised: 24-Aug-2019
Accepted: 03-May-2020
Published: 06-Apr-2021

Address for correspondence:
Dr. Elaheh Beyabanaki, Department of Prosthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
E-mail: e.beyabanaki@gmail.com

ABSTRACT

The use of computer-aided design/computer-aided manufacturing technology simplifies the laboratory and clinical steps for the fabrication of implant prostheses. It also reduces additional costs for the prosthetic components and technical procedures. This article describes a modified impression technique using an impression metal jig to enhance the accuracy of final impression and also to eliminate the need for the try-in of resin pattern of the milled bar.

Key Words: Computer-aided design, dental implant, edentulous jaw, implant-supported dental prosthesis

INTRODUCTION

Implants enhance the retention, stability, and support for removable prostheses as compared to conventional complete dentures. Furthermore, patients wearing implant-supported overdentures have higher satisfaction and quality of life.[1,2] When the interocclusal space is adequate, the implants could be splinted through using bar attachments which could prevent the application of twisting forces to the implants under the posterior loading.[3]

Conventionally, bar attachments are made by the lost-wax and casting technique. This method can be time-consuming, cost-intensive, and possibly needing several try-in appointments (if soldering was necessary).[4] Furthermore, passive fit of a cast bar might be influenced by the impression accuracy and also laboratory procedures including wax-up, investing, and casting.[5-7] There are several studies that suggest a relationship between superstructure misfit and mechanical and biological problems including screw loosening, abutment fractures, and bone loss around the implants.[8,9]

On the other hand, fabricating the milled bars using computer-aided design/computer-aided manufacture (CAD/CAM) system enhances the accuracy and simplicity of clinical and laboratory steps.[4,10-15] Milled bars could be made with either conventional impression methods or digital impression. Whenever intraoral scanners are not accessible for the dentist, milled bars could be made through laboratory scanning of the master cast. Knowing laser welding of titanium-milled bars is not conventionally feasible,[16] making an accurate impression and also verifying the impression accuracy is of great importance for

Access this article online

Website: www.drj.ir
www.drjjournal.net
www.ncbi.nlm.nih.gov/pmc/journals/1480

How to cite this article: Memari Y, Tadayonfard A, Fayaz A, Beyabanaki E. Fabrication of a customized impression metal jig for an implant-supported overdenture with a milled bar. Dent Res J 2021;18:23.

this technique.[7,17] This case presents a modified impression procedure that enhances the accuracy of final impression used for making a milled bar with no need for a try-in session.

CASE REPORT

A 76-year-old man was referred to with the chief complaints of a loose mandibular denture and difficulty chewing. Diagnostic workup was performed to assess the amount of restorative space. The treatment plan was decided to be a maxillary conventional denture and a mandibular bar-retained overdenture. A radiographic template was fabricated using transparent autopolymerizing acrylic resin (Caulk, Dentsply, USA). Implant sites were then drilled and filled with gutta-percha in the guide. Cone-beam computed tomography imaging revealed adequate volume of bone in the interforaminal region. Then, the radiographic template was modified into a surgical guide with removing the lingual flange. Then, implant number, positions, and diameters were determined based on the dimensions of the available bone, arch form, diagnostic setup measurements, and patient's financial status.

At the first surgical session, four regular-neck (4.1 mm × 10 mm) tissue-level implants (Straumann AG, Switzerland) were inserted in the interforaminal region. Three weeks later, after reducing the intaglio surface of the mandibular denture with an acrylic bur, a tissue conditioner material (ViscoGel, Dentsply, USA) was added. The second-stage surgery was performed 3 months later.

After 1 month, an open-tray mandibular impression was made using square impression copings (Straumann AG, Switzerland) and polyether impression material (Impregum, 3M ESPE, USA) and a stock tray. The primary cast was poured using type III dental stone (Parsdent, Tehran, Iran). Four economical tissue level regular neck plastic castable University of California, Los Angeles (UCLA) abutments (Puyan Aaj, Tehran, Iran) were connected with autopolymerizing resin (Pattern Resin, GC, Japan) and plastic sprues to fabricate a customized impression jig. Resin ball-shaped protrusions were made on the connecting sprues to provide some additional retention for the impression material for the next step [Figure 1]. The customized impression jig was cast with nickel–chromium alloy. Then, a custom tray was made on the primary cast with the presence

Figure 1: Impression jig made of plastic abutments and plastic sprues.

Figure 2: Impression metal jig connected to implants.

of the metal jig. Before making the final impression, the jig was tried in the patient's mouth using direct vision and radiography [Figure 2]. After border molding, the final open-tray impression was made using polyether impression material and the metal jig instead of using impression copings. Using tray adhesive (Impregum, 3M ESPE, USA) on the metal jig and also embracement of the metal jig with impression material from above and below enhanced the retention of the metal jig in the impression. The maxillary final impression was made using zinc oxide eugenol (SS White, USA). During the next visit, jaw relationships were recorded as well as the face bow record to mount the casts on a semi-adjustable articulator (Dentatus, ARL, Sweden). After setting up the prosthetic teeth, a clinical try-in appointment was arranged.

The designing process of bar was performed using the EXOCAD software (Exocad Dental CAD, Darmstadt, Germany). After securing the scan bodies (Straumann AG, Switzerland) to the implant analogs, the master cast was scanned twice (with and without the prosthetic teeth) to produce a three-dimensional virtual model. Then, these two scans were superimposed to design the bar with regard to the available space for the teeth and also the acrylic resin base. Custom abutments were designed according to the available space. Then, a Dolder bar was designed with a posterior parallel-walled segment leading to a minimum extension cantilever on which two channels for ball attachments were designed. The height of the bar of the tissue was set to be 1 mm. At the milling center, titanium blank was attached to the milling fixture, and milling was performed in a highly precise 5-axis milling unit (Arum VersaMILL, 5 × 200, USA). The fit of milled bar was examined [Figure 3] using the Sheffield test[17] and parallel periapical radiographs. A reinforcing metal framework, with an open construction design at the clip and attachment areas, was waxed-up on the refractory model and then was cast with cobalt–chromium alloy. A reinforcing framework was also fabricated for the maxillary single denture. Then, metal housings for a clip and two caps were attached by adapting a light-curing resin sheet on the cast. Then, the assembly was placed in a light-curing unit (Triad 2000, Dentsply, USA) for 10 min. Seating of the milled bar mesh was verified in the mouth [Figure 4] and sent to the laboratory for the processing stage. On denture delivery [Figure 5], abutments were secured to 30 NCm, the presence of the bilaterally balanced occlusion was confirmed, and hygienic instructions were provided to the patient. The follow-up sessions were arranged as necessary.

Figure 3: Try-in of milled titanium bar in the mouth.

Figure 4: Using a light-curing resin sheet to pick up the metal housings in the mouth.

Figure 5: Intraoral view of final prostheses in the mouth.

DISCUSSION

Several studies have suggested a higher accuracy for CAD/CAM milled bars as compared to cast ones.[4,10-15] In general, the CAD/CAM titanium-milled bars are more cost-effective and of lower weight as compared to the noble metal alloy bars. The ball attachments are screwed into the screw bases which are already milled with the identical paths of insertion on the bar which results in a greater accuracy in attachment insertion and reduction of the attachment wear. However, in the traditional casting, the holes are drilled into the wax-up resin patterns using milling burs which after casting is verified with a paralleling instrument mounted onto the milling handpiece. This can lead to some possible inaccuracies due to human error.[4] Moreover, if there is a need for remaking the milled bar, the existing digital design format could be reused.[10-15]

Milled bars could be made using either conventional or digital impression techniques. However, using conventional impression method could result in some inaccuracies related to impression procedure or fabrication of the master cast.[5-7] Since the milled titanium bars cannot be laser welded easily, therefore,[17] it is necessary to confirm the accuracy of the implant master cast before proceeding with designing the bar digitally. The importance of the verification jig has been studied in previous studies.[7,16] The acrylic resin material has a 6% shrinkage which could affect the efficacy of resin verification jigs,[16] whereas gypsum jigs have shown a better dimensional stability.[16]

This article presented a modified impression technique using a metal jig that not only was used for final impression making but also eliminated the need for fabricating an extra verification jig after making the final impression. This is because there would be no dimensional change for the metal bar during impression making or cast pouring procedures. This method would ensure predictability of fit for the milled bar on the first seating which also eliminated the need for verifying the impression accuracy by trying in a resin pattern of the designed bar.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

REFERENCES

1. Raghoebar GM, Meijer HJ, Slot W, Slater JJ, Vissink A. A systematic review of implant-supported overdentures in the edentulous maxilla, compared to the mandible: How many implants? Eur J Oral Implantol 2014;7 Suppl 2:S191-201.
2. Geertman ME, van Waas MA, van 't Hof MA, Kalk W. Denture satisfaction in a comparative study of implant-retained mandibular overdentures: A randomized clinical trial. Int J Oral Maxillofac Implants 1996;11:194-200.
3. Sadowsky SJ. Mandibular implant-retained overdentures: A literature review. J Prosthet Dent 2001;86:468-73.
4. Goo CL, Tan KB. Fabricating CAD/CAM implant-retained mandibular bar overdentures: A clinical and technical overview. Case Rep Dent 2017;2017:9373818.
5. Beyabanaki E, Shamshiri AR, Alikhasi M, Monzavi A. Effect of splinting on dimensional accuracy of impressions made of implants with different subgingival alignments. J Prosthodont 2017;26:48-55.
6. Carr AB, Stewart RB. Full-arch implant framework casting accuracy: Preliminary *in vitro* observation for *in vivo* testing. J Prosthodont 1993;2:2-8.
7. Alhashim A, Flinton RJ. Dental gypsum verification jig to verify implant positions: A clinical report. J Oral Implantol 2014;40:495-9.
8. Sahin S, Cehreli MC. The significance of passive framework fit in implant prosthodontics: Current status. Implant Dent 2001;10:85-92.
9. Kallus T, Bessing C. Loose gold screws frequently occur in full-arch fixed prostheses supported by osseointegrated implants after 5 years. Int J Oral Maxillofac Implants 1994;9:169-78.
10. Katsoulis J, Wälchli J, Kobel S, Gholami H, Mericske-Stern R. Complications with computer-aided designed/computer-assisted manufactured titanium and soldered gold bars for mandibular implant-overdentures: Short-term observations. Clin Implant Dent Relat Res 2015;17 Suppl 1:e75-85.
11. Heschl A, Payer M, Clar V, Stopper M, Wegscheider W, Lorenzoni M, *et al.* Overdentures in the edentulous mandible supported by implants and retained by a dolder bar: A 5-year prospective study. Clin Implant Dent Relat Res 2013;15:589-99.
12. Pozzi A, Tallarico M, Moy PK. Four-implant overdenture fully supported by a CAD-CAM titanium bar: A single-cohort prospective 1-year preliminary study. J Prosthet Dent 2016;116:516-23.
13. Corsalini M, Di Venere D, Stefanachi G, Muci G, Palminteri A, Laforgia A, *et al.* Maxillary overdenture retained with an implant support CAD-CAM bar: A 4 years follow up case. Open Dent J 2017;11:247-56.
14. Abduo J. Fit of CAD/CAM implant frameworks: A comprehensive review. J Oral Implantol 2014;40:758-66.
15. Almasri R, Drago CJ, Siegel SC, Hardigan PC. Volumetric misfit in CAD/CAM and cast implant frameworks: A university laboratory study. J Prosthodont 2011;20:267-74.
16. Liu J, Watanabe I, Yoshida K, Atsuta M. Joint strength of laser-welded titanium. Dent Mater 2002;18:143-8.
17. Craig RG. Restorative Dental Materials. 10th ed. Philadelphia, PA: Mosby; 1997. p. 179-80.