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Case Report

Management of compromised residual alveolar ridges using hollow denture with three-dimensional printed spacer and specialized impression technique

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ABSTRACT

Impression making in compromised residual alveolar ridge is a regular challenge in rehabilitating patients with conventional removable complete dentures. In patients who cannot afford implant-supported dentures, specialized impression technique is a viable and justified option for fabrication of complete dentures. More often, the stability of denture in such patients becomes a deciding factor between failure and success. Furthermore, increased interarch space may result in increased height of maxillary and/or mandibular dentures with corresponding increase in weight, which further compromises the retention and stability of the prosthesis. This article describes an amalgamation of Hobkirk's impression technique in a case of resorbed maxillary residual alveolar ridge with a flabby anterior segment and fabrication of hollow maxillary dentures using a "three-dimensional printed dental spacer" with a "double-flask technique." The weight of the final prosthesis was reduced therefore contributing to improved retention and stability of the final prosthesis.

Key Words: Double-flask technique, Hobkirk's impression techniques, hollow denture, three-dimensional printed spacer

INTRODUCTION

Flabby tissue is an excessive movable/displaceable tissue occurring generally when an edentulous ridge opposing natural teeth is replaced by a hyperplasic soft tissue. It occurs most commonly in the anterior region of the maxilla. These easily displaceable tissues get compressed adversely affecting the three most important aspects of complete denture, i.e., retention, stability, and support. Over the years, various impression techniques including mucostatic impression technique, double-spacer technique, and window tray technique have been advocated to record the nonflabby tissues to obtain optimal support and also prevent the displacement of flabby tissues.[1]

Increased inter-ridge space following residual ridge resorption is another compounding factor that increases the weight of prosthesis. Reducing the weight of the prosthesis increases retention and stability, especially in the maxillary dentures. Various approaches with the usage of solid three-dimensional (3D) spacer, dental stone, cellophane, silicone, and modeling clay have been described in fabrication of hollow dentures.[2]

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The following case report describes the rehabilitation of a patient with flabby tissues using a combination of Hobkirk's technique for impression along with a 3D spacer incorporated in a hollow maxillary denture, to overcome the problems of retention, stability, and support.

CASE REPORT

A 65-year-old male patient reported a chief complaint of inability to chew food due to loose and worn-off existing dentures. He gave a history of loss of teeth over a period of 4–6 years. The patient had been edentulous for the past 15 years and was wearing the present complete denture prosthesis since then. The existing dentures had become loose and ill-fitting causing discomfort and difficulty in chewing food. Further, the patient also felt that the upper denture was heavy and easily dislodged.

Treatment plan

Clinical examination revealed resorbed maxillary ridge with anterior flabby tissue, flat (atrophic) mandibular ridge, and increased interarch space [Figures 1 and 2]. After eliciting a thorough patient's history and clinical evaluation, various treatment options including preprosthetic surgery followed by conventional complete denture prosthesis, an implant-supported prosthesis, and conventional complete denture prosthesis were discussed. The patient being not desirous of surgical intervention opted for a conventional complete denture. The final treatment plan was to rehabilitate the patient with a hollow maxillary complete denture fabricated using a "3D surgical guide spacer" utilizing window impression technique for the maxillary arch and differential pressure impression technique for the mandibular arch with balanced occlusion.

Clinical procedure

The primary impressions using irreversible hydrocolloid impression material (Neocolloid; Zhermack) were made and primary casts were fabricated in type II dental stone. A custom tray was fabricated using sprinkle-on method with autopolymerizing acrylic resin (RR self-cure acrylic resin, Dentsply, India). While making the maxillary secondary impression, tray extensions were checked and border molding was done in a conventional manner using a low-fusing impression compound (DPI Pinnacle Tracing Sticks). Spacer wax was removed and impression was made using medium-body polyvinyl siloxane impression material (Elite HD+, Zhermack, Germany) [Figure 3a]. Impression was then retrieved from the mouth and a window was created in the region of flabby tissue, the outline of which had been marked [Figure 3b]. Multiple relief holes were made in cut section of tray, the rest of the tray was seated in the patient's mouth, and light body polyvinyl siloxane impression material (Elite HD+, Zhermack, Germany) was loaded in the region of flabby tissue, following which the window section was replaced in its original position [Figure 3c].[3]

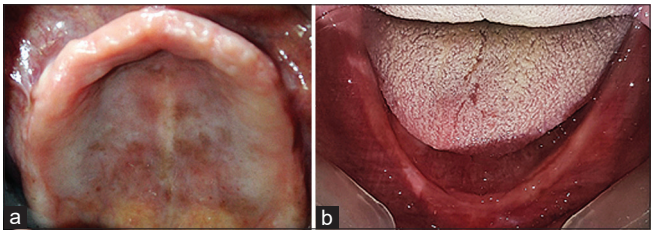

Figure 1: (a) Pretreatment intraoral view maxilla, (b) pretreatment intraoral view mandible.

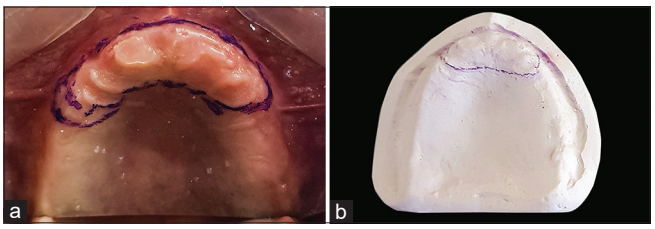

Figure 2: (a) Marking of flabby tissue in maxillary arch, (b) marking of flabby tissue on primary cast.

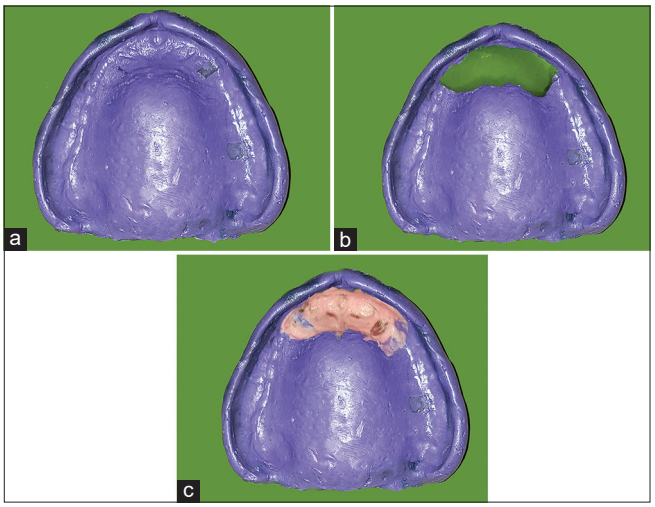

Figure 3: (a) Secondary impression of maxillary ridge using regular body polyvinyl siloxane impression material, (b) window preparation and seating of impression in the patient's mouth, (c) impression of the flabby tissue using light body polyvinyl siloxane impression material.

Mandibular impression was made using differential pressure impression technique wherein impression was made using medium body polyvinyl siloxane impression material after border molding (Elite HD+, Zhermack, Germany) [Figure 4a], 0.5 mm of the material was removed from the alveolar crest, and second impression was made using the light body polyvinyl siloxane impression material (Elite HD+, Zhermack, Germany) [Figure 4b].[4] Maxillomandibular relations were registered and the casts were mounted on a semi-adjustable articulator. Teeth arrangement was done and intraoral try-in was done by evaluating phonetics and esthetics to clinicians and patient's satisfaction.

Laboratory procedure

After clinical try-in, trial denture was waxed-up, invested, and dewaxed using conventional laboratory procedures [Figure 5a and b]. While deflasking, the denture base was not separated from the cast. Indentations of approximately 0.5–1 mm in depth and 5 mm in width were made on the processed acrylic denture base with acrylic burs in premolar and molar regions on both sides for orientation of the 3D spacer [Figure 5c]. Two layers of 1.2-mm-thick modeling wax sheet were adapted onto the labial, palatal, and acrylic binding surfaces of the teeth present in the plaster mold embedded in the cope. It will model for the thickness of the resin obtained after processing [Figure 5d]. Putty consistency vinyl polysiloxane was mixed in equal proportions, molded into U shape, and placed over the wax adapted on the teeth [Figure 5e]. Flask was carefully closed, ensuring no open spaces. Once set, flask was open to obtain a putty template. Accuracy was inspected by adapting putty template by reassembling the dental flask with no evident gap between the cope and drag.[5]

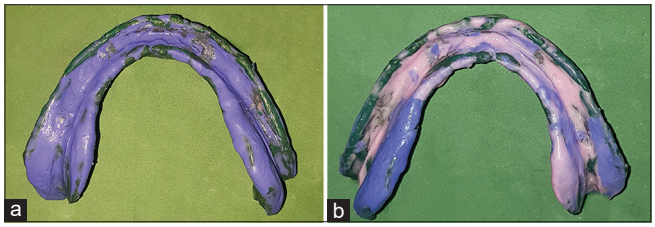

Figure 4: (a) Secondary impression of mandibular ridge using regular body polyvinyl siloxane impression material, (b) removal of the material from the crest and making impression using light body polyvinyl siloxane impression material.

To obtain a 3D printed spacer, scanning of the putty template was done using cone-beam computed tomography to obtain a Digital Imaging and Communications in Medicine [Figure 6a] file which was converted into a Standard Tessellation Language (STL) file [Figure 6b]. STL file thus obtained was uploaded into computer-aided design software. Design parameter of 1.25-mm wall thickness to create a hollow space within the solid STL file was set [Figure 7a]. Utilizing this modified file, a 3D hollow spacer with dental SG resin was obtained. [Figure 7b-d]. 3D spacer was oriented on the denture base utilizing the indentations created at premolar and molar regions on both sides. Placement was verified by checking stability and adaptation to the denture base. Subsequently, it was secured using the cyanoacrylates [Figure 8a]. Packing was done using

Figure 5: (a) Flasking of teeth setting after trial, (b) dewaxing - teeth in cope, (c) indentations on the denture base in drag, (d) adaptation of wax on the teeth in cope, (e) fabrication of putty index.

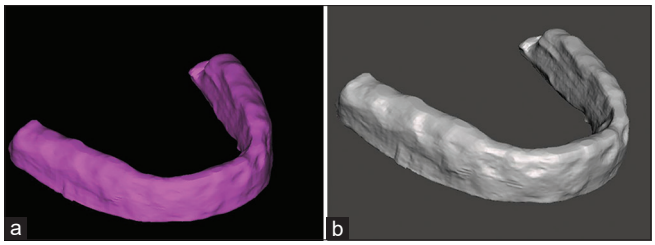

Figure 6: (a) DICOM File, (b) DICOM to STL conversion. DICOM: Digital Imaging and Communications in Medicine, STL: Standard Tessellation Language.

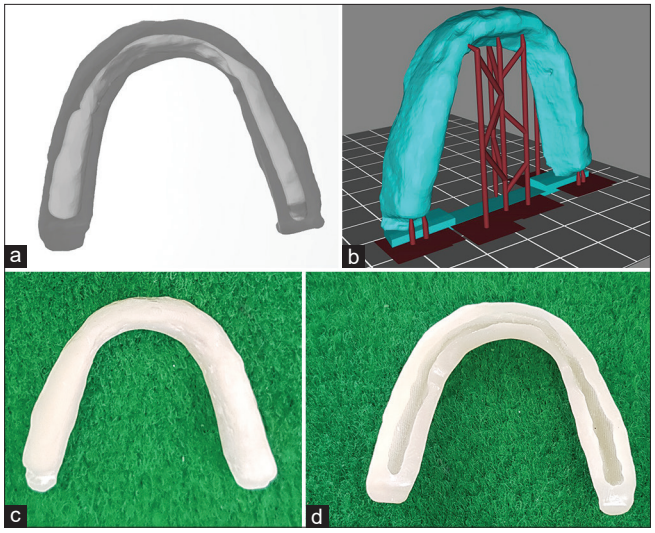

Figure 7: (a) STL file of 3D spacer, (b) attachment of supports, (c) 3D printed spacer, (d) 3D printed spacer with holllow space. STL: Standard Tessellation Language, 3D: Three dimensional.

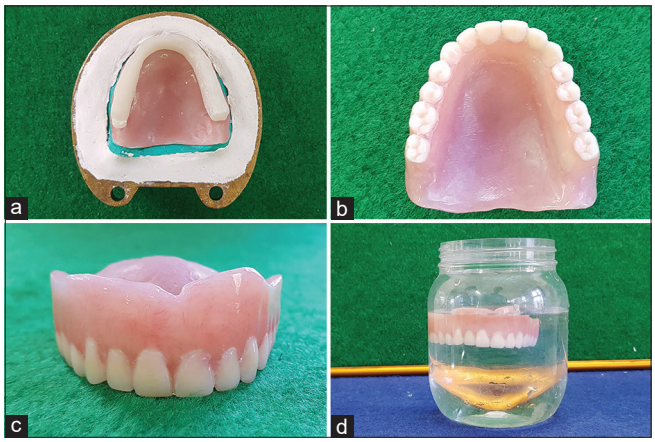

Figure 8: (a) Securing of 3D spacer to denture base using cyanoacrylate, (b) 3D spacer incorporated in the hollow denture, (c) finished prosthesis, (d) float test for hollow denture. 3D: Three dimensional.

heat cure acrylic resin and uniform closure of the flask parts was ensured to prevent any increase in vertical dimension. Processing of the denture was carried out by following conventional polymerization cycle. After deflasking, finishing and polishing of the prosthesis were done [Figure 8b and c]. The resin spacer remained within the denture [Figure 8d].[6]

DISCUSSION

Numerous techniques to increase the stability of complete dentures by reducing its weight have been described in the past. Challian and Barnett described a double-flask technique for the fabrication of hollow bulb obturator.[7] Fattore, Fine, and Edmonds modified this technique to fabricate hollow maxillary complete dentures in atrophic maxilla.[6] Various materials such as solid 3D spacer, including dental stone, cellophane-wrapped asbestos, silicone putty, or modeling clay have been used during laboratory processing to fabricate hollow dentures.[8]

This technique overcomes the challenges of making impressions in compromised ridges and flabby tissues using special impression techniques (Hobkirk's and differential pressure impression techniques) and a 3D spacer incorporation in the maxillary denture that reduced the weight of the final prosthesis and contributed to improved retention and stability. Advantage of this technique is ease of handling the 3D spacer since it is fixed to the denture base and eliminates the need of removal like in conventional procedures which is technique sensitive and tedious.[9] Minor drawbacks include cost and accessibility of 3D scanner, 3D printer, and dental SG resin material. The required thickness of dental SG resin limits the volume of space that can be created within the prosthesis. 3D spacer with defined thickness ensures even empty space through the denture. It also eliminates the tedious laboratory procedures for creating a hollow space in dentures. With even thickness of modeling wax, a uniform thickness of processed acrylic resin over the spacer can be ensured.

CONCLUSION

In the present case, the primary challenge was that of compromised retention and stability of the prosthesis due to flabby tissue, resorbed ridges, and increased interarch space. These were tackled by incorporating 3D spacer in maxillary denture which helped reduce the weight of the prosthesis. The "Hobkirk's" and "differential pressure" impression techniques were used to obtain an accurate impression of residual alveolar ridges. Hollow denture prosthesis fabricated using specialized impression technique and 3D spacer was

Figure 9: (a) Pretreatment image of the patient, (b) posttreatment image of the patient.

stable as well as retentive, thus successfully overcoming the challenges of retention and stability [Figure 9].

Declaration of patient consent

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

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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.

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