

Custom 3D printed flexible attachments for the management of patients with limited mouth opening – A case report

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Abstract

The rehabilitation of microstomia patients presents difficulties during the fabrication of dentures as the maximal mouth opening is inadequate. This condition may result from the surgical treatment of orofacial cancer, cleft lip, trauma, burns, Plummer–Vinson syndrome, Systemic Lupus Erythematosus, or scleroderma. The reduced mouth opening also leads to difficulty in speech, mastication, and psychological problems secondary to facial disfigurement. It is often difficult to apply conventional clinical procedures to fabricate prostheses for patients who demonstrate limited mouth opening since it is difficult to follow the protocol of fabrication of prosthesis and also insertion and removal of the one-piece prosthesis into the oral cavity. The present case report focuses on the

rehabilitation of a patient with microstomia using a sectional prosthesis and custom 3D printed hinge which enabled easier and competent removal and insertion by the patient. The sectional denture reinforced with a custom hinge can be more comfortably removed and inserted by the patient with reduced mouth opening. It is a simple and cost-effective method for the rehabilitation of microstomia patients.

Keywords: Systemic Lupus Erythematosus, Restricted Mouth Opening, Sectional Denture, Custom 3D printed hinge

Introduction

Prosthetic rehabilitation of a patient is challenging when mouth opening is lesser than the size of a prosthesis. Microstomia or restricted mouth opening can occur as a

result of trauma, congenital or developmental abnormalities^{1,2}. Other causes include autoimmune disorders like systemic lupus erythematosus or due to surgical management of cleft lip and carcinomas of the orofacial region.³⁻⁶ Surgical management of carcinoma can lead to reduction in the vestibular depth, size and movement of the tongue which further complicates the rehabilitation protocol of desired results. Prosthetic rehabilitation of patients with microstomia can be challenging throughout the entire process of denture fabrication starting from impressions to final prostheses fabrication. Due to inadequate opening of the mouth, the impression making and fabrication of dentures using conventional methods is often difficult. Various methods have been described in the literature for the fabrication of prostheses using modified treatment procedures⁷⁻⁹ In this article, a modified treatment protocol has been utilized for the fabrication of sectional dentures for the maxillary arch and mandibular arch.

Case report

A 52-year-old woman reported with a chief complaint of inability to chew food due to loss of teeth. Her medical history revealed that the patient was diagnosed with systemic lupus erythematosus 7 years ago and is on medication for the same. On examination, she had a restricted mouth opening of 26 mm. Intra-oral examination revealed a partially edentulous maxillary arch with a fixed partial denture in relation to 11,12,21,22 and a completely edentulous mandibular arch (Figure 1) Various treatment options were discussed and since the patient did not agree to any surgical intervention to increase the opening of the mouth, alternative modified treatment protocol using sectional maxillary denture and the mandibular complete denture was tried.

Procedure

Preliminary impression: Preliminary impressions for both dental arches were obtained with a putty silicone impression material (Dentsply, Aquasil) (Figure 2a,2b). Two similar sized stock trays were cut into two halves in such a manner that the cut extends beyond the midline in opposite regions. The first tray was used to make the preliminary impression of one part of the ridge followed by impression of the remaining part of the ridge using the second. First tray was then poured using dental plaster. The cast retrieved from the first impression was placed over the other impression and was secured with compression bands or rubber bands. The area of the cast that overlaps the second impression works as a guide in the placement of the cast. Then the second sectional impression was also poured. Finally, a single diagnostic cast from two different sectional impressions was obtained (Figure 3)

Definitive impression

Before border molding, a sectional custom tray was fabricated in two parts. One part of the tray had a handle extending towards the other with a die pin attached to it. The other part had die pin stoppers attached to it. (Figure 4a,4b) Border molding was done in sections using low fusing impression compound (DPI; Pinnacle: India). A definitive impression was made using monophasic impression material (Dentsply, Aquasil) by inserting the part containing the stopper first, followed by the one containing the handle and die pin. Handle and die pins helped in accurate repositioning of sectioned tray intraorally. (Figure 5) After the definitive impressions were made, the trays were approximated back extra-orally using the die pin attached to the handle and stoppers attached to the denture base. A master cast was prepared in a usual manner with type III dental stone (Kalstone, Kalabhai Karson, Mumbai).

Fabrication of sectional denture base with custom made hinge

Before beginning with denture base fabrication, a wax pattern resembling a hinge was adapted over the palatal surface of the maxillary cast and alveolar ridge of the mandibular cast. After fabrication, the wax pattern was retrieved and scanned using an extra-oral scanner (UP3D Dental laboratory scanner). Using the scanned file, a custom hinge was 3D printed with an SLA printer (Crealty LD-002H). The printing material used here was a flexible Thermoplastic Poly Urethane material (TPU). (Figure 6a,6b,6c) Now, the custom printed hinges were adapted onto the maxillary and mandibular casts. Denture bases were fabricated by incorporating the custom hinges in such a manner that it is foldable (Figure 7a,7b)

Jaw relation, teeth arrangement, and wax try-in:

Wax occlusal rims were fabricated over the denture bases and a maxilla-mandibular relationship was recorded. The trial denture bases were tried intraorally and the jaw relationship was verified. After try-in, maxillary and mandibular master casts were flaked and dewaxing was performed.

Denture processing, finishing, and insertion

After dewaxing, the custom hinges were carefully retrieved from the denture bases and adapted over the maxillary and mandibular master cast respectively. Packing was done following the conventional compression moulding technique and dentures were fabricated. Finishing and polishing were done and finally, dentures were inserted. (Figure 8a, 8b) Post insertion follow-up was done after one month and necessary adjustments were made.

Discussion

Prosthetic rehabilitation with complete denture prosthesis in microstomia patients is challenging. Various methods of fabrication and attachments have been used to design a

denture which the patient can use easily.¹⁰ Various authors have used orthodontic expansion screws to fabricate sectional trays and other used metal pins and an acrylic resin block to attach the sections of the impression trays. In literature, a flexible plastic tray intended for fluoride application was also used to make the preliminary impression.⁸ On one of the sections, they prepared a stepped butt-joint to make a definitive impression. McCord et al⁹ described a complete denture for maxillary arch consisting of 2 pieces joined by a stainless-steel rod of 1 mm diameter fitted behind the central incisors. In the present article, we have discussed a combined and modified method of sectional complete denture fabrication for the maxillary and mandibular arch. To determine the long-term success of this technique, recall at periodic intervals and maintenance are needed. In literature, various attachments like pins, bolts, and Lego pieces have been used for the locking mechanism of sectional impression trays fabricated for patients with the limited oral opening as described by Conroy and Reitzik.¹¹ When mouth opening is limited, joining two pieces of a sectional denture intraorally may be problematic. Suzuki described a technique where he used a foldable, single-piece denture for rehabilitating patients with microstomia.¹² Care should be taken to fit the hinge along a line connecting the tip of the residual ridge with the posterior edge of the denture and along the midline. Fitting hinge higher than the tissue surface has adverse effect of limiting the tongue volume. The sectional prosthesis connected by custom printed hinges described in this clinical report was convenient in terms of insertion and withdrawal of complete denture and there was no visible fracture or wear observed.

Conclusions

This clinical report describes a simple and cost-effective method to fabricate prosthesis for a patient with

microstomia. The use of custom printed hinges for making successful sectional impressions and sectional dentures has been described. The sectional complete denture prosthesis attached by custom hinges for microstomia is one of the options to rehabilitate wherein conventional treatment options are not conducive. Also seen prostheses are comfortable during insertion and removal of the prosthesis.

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Legend Figures



Figure 1: Intra-oral view



Figure 2a: Preliminary impression of maxillary arch

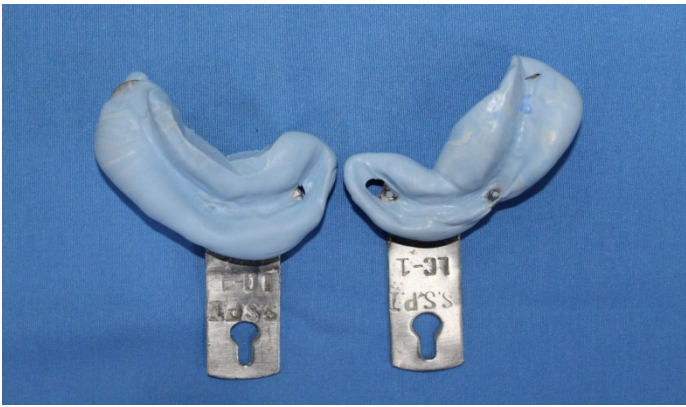


Figure 2b: Preliminary impression of mandibular arch

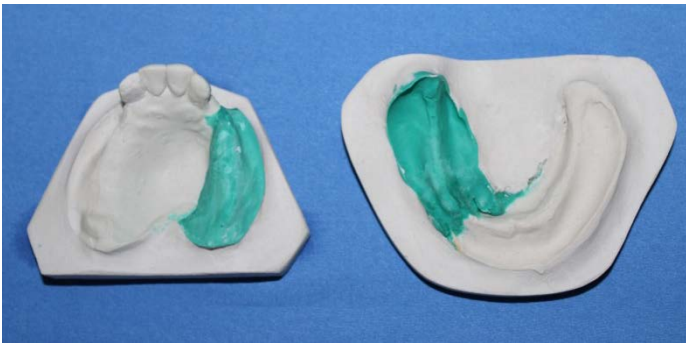


Figure 3: Primary cast



Figure 4a: Maxillary sectional tray

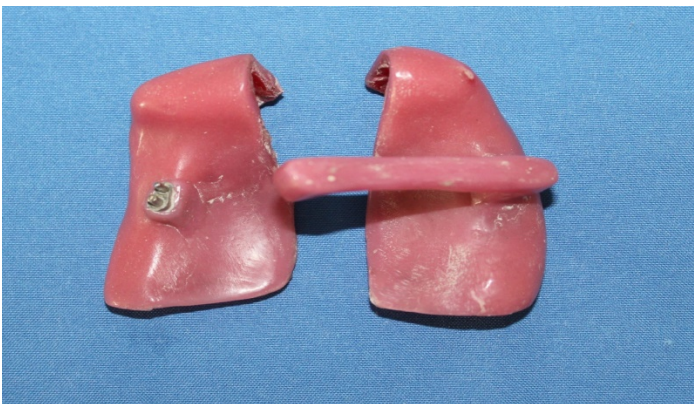


Figure 4a: Maxillary sectional tray

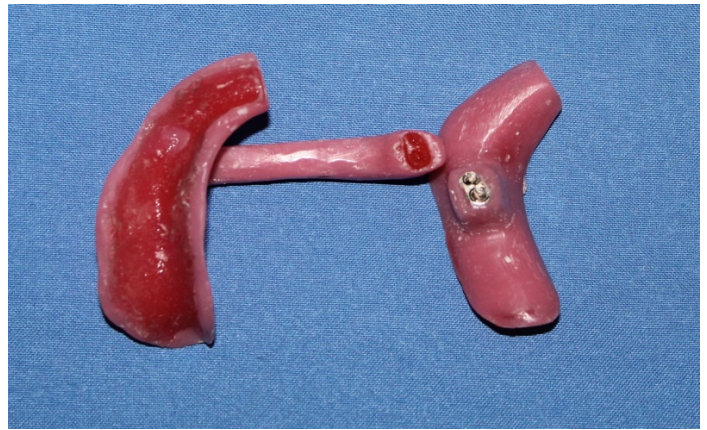


Figure 4b: Mandibular sectional tray

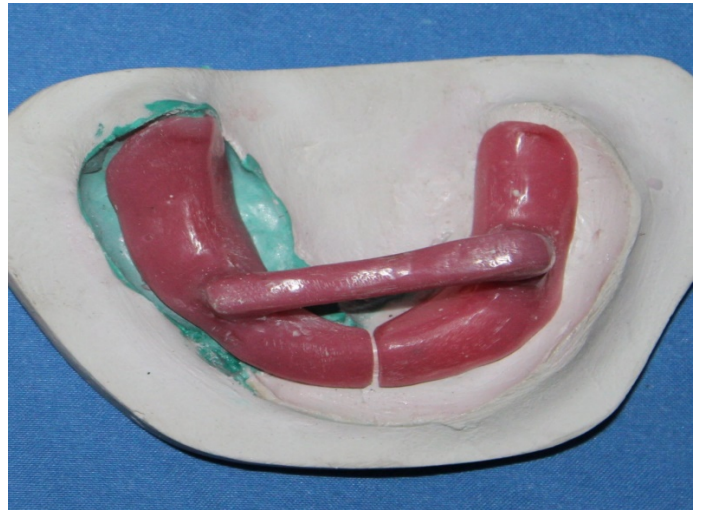


Figure 4b: Mandibular sectional tray

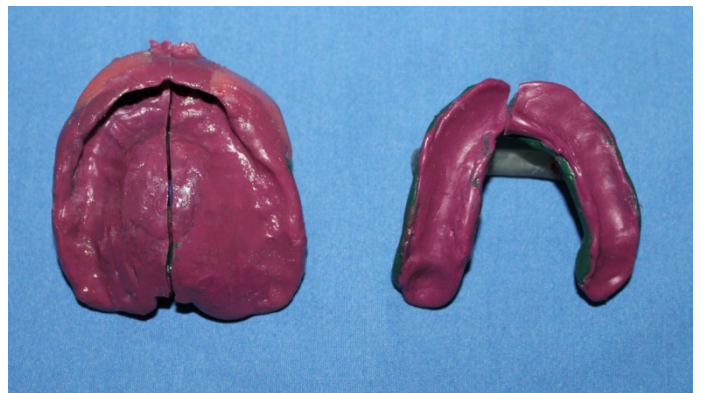


Figure 5: Definitive impression

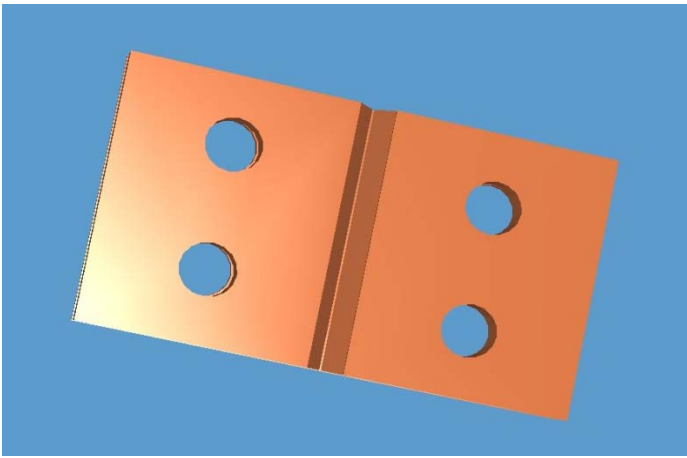


Figure 6a: Custom hinge fabrication



Figure 7a: Foldable maxillary denture base

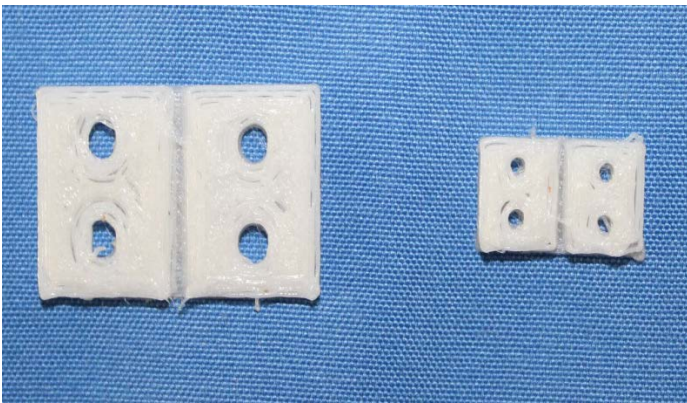


Figure 6b: Custom hinge fabrication



Figure 7b: Foldable mandibular denture base

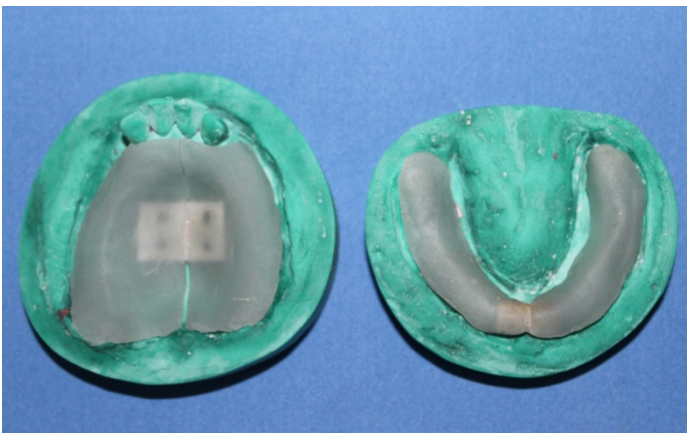


Figure 6c: Custom hinge fabrication



Figure 8a: Final prosthesis



Figure 8b: Denture insertion