Commentary

iMedPub Journals
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Prosthetics and Orthotics Open Journal

2017
Vol.1 No.1: 6

A Technique for Fabrication of Cranial Prosthesis Using Silicone Material- Editorial Commentary

Pankaj Kharade

Department of Prosthodontics, Aligarh Muslim University, Aligarh, Uttar Pradesh, India

***Corresponding author:** Pankaj Kharade, Department of Prosthodontics, Aligarh Muslim University, Aligarh, Uttar Pradesh, India, Tel: +918859990440; E-mail: drpankaj_07@yahoo.co.in

Rec date: March 16, 2017; Acc date: April 12, 2017; **Pub date:** April 19, 2017

Citation: Kharade P (2017) A Technique for Fabrication of Cranial Prosthesis Using Silicone Material- Editorial Commentary. Pro Ort Open J 1: 6.

Abstract

Cranioplasy can be performed with a range of materials such as auto-polymerizing methyl-methacrylate, heat polymerizing methyl-methacrylate, high temperature vulcanizing medical grade silicone and metal. Conventional as well as advanced techniques such as virtual planning and printing have been used for fabrication of cranial prosthesis. Every material has its own advantages as well as drawbacks. High temperature vulcanizing medical grade silicone is used for fabrication of cranioplasty prosthesis due to certain beneficial properties of the material. High temperature vulcanizing medical grade silicone cranial implant leads to better adaptation with the bone adjacent to cranial defect in comparison to acrylic and metal cranial prosthesis. In this article the key features of the technique for fabrication of cranial implant prosthesis with high temperature vulcanizing high temperature vulcanizing medical grade silicone material have been discussed.

Keywords: Cranial defect; Cranial prosthesis; Medical grade silicone

Introduction

Maxillofacial defects could be correlated with surgical treatments of neoplasms in the maxillofacial region, congenital malformations, or trauma [1]. Despite new developments in esthetic surgery, maxillofacial prostheses are used to restore acquired or developmental defects of the head and neck [2,3]. The craniomaxillofacial rehabilitation is a real challenge to provide an esthetic restoration and promote their well-being, in such cases [4]. The plastic surgeon, and the maxillofacial prosthodontist should cooperate with each other in order to restore the patient's quality of life [5].

The materials used in the fabrication of a maxillofacial prosthesis should have similar physical and mechanical properties to surrounding tissues. A maxillofacial prosthetic material should be noncarcinogenic, compatible with living tissues and cause no inflammation [2]. Recently, different types of reinforcing agents have been added to maxillofacial materials in order to increase physical and mechanical properties [6]. Although various materials such as acrylic resins, acrylic copolymers, polyvinyl chloride and copolymers, and polyurethane-based elastomers have been used in the fabrication of a maxillofacial prostheses, silicone elastomers are most commonly used materials due to their ease of manipulation and polymerization, mechanical properties and strength [2,3,7,8]. Prosthetic rehabilitation is very significant in the management of cranial defect as it shields the underlying bone tissue. Such kind of prosthesis used for rehabilitation of cranial defects is called as cranial prosthesis. It also relieves pain due to improved neurological function and improves cosmetic appearance leading to improved quality of life, as such disfigurement leads to declined psychosocial status of the patient [9-11]. Cranial defects can be managed with two methods namely osteoplastic reconstruction or reconstruction with alloplastic implants. Fabrication of alloplastic implants is done using metal, acrylic resin, polyethylene, and high temperature vulcanizing medical grade silicone [12-17]. Impression of the cranial defect is made to engineer a moulage and this moulage is used for fabrication of prosthesis. Rapid prototyping can be used to generate a model of the cranial defect from the computed tomography images and such models can also be used to fabricate the cranial prosthesis. Major disadvantage of rapid prototyping is associated high cost. Heat polymerizing and auto polymerizing methyl-methacrylate can be used by direct as well as indirect methods. Direct method leads to better adaptation of prosthesis but time available for manipulation of material is not sufficient affecting cosmetic appearance. Indirect method can cause poor adaptation of the cranioplast. High temperature vulcanizing medical grade silicone cranial implant has enhanced adaptation with the bone contiguous to cranial defect compared to acrylic as well as metal cranial prosthesis. Patient having cranial defect with medical history of craniotomy for management of various medical situations are managed with such type of prosthesis. Clinical and radiographic examination by using computed tomography of the cranial defect is essential before fabrication of the prosthesis. This article is an editorial commentary about the procedure for fabrication of cranial prosthesis with high temperature vulcanizing medical grade silicone. In this article the key features of the technique for fabrication of cranial implant prosthesis with high temperature vulcanizing high temperature vulcanizing medical grade silicone material have been discussed.

Method of Fabrication

1. Impression of the cranial defect with irreversible hydrocolloid supported by dental plaster is made and poured with type III stone or dental stone in layers for fabrication of moulage to circumvent distortion of irreversible hydrocolloid.

2. Aluminium foil is adapted as the separating material on the moulage prior to fabrication of the prosthesis. Modeling clay is used for sculpting the cranial prosthesis as clay is simple to manipulate. The trial prosthesis is shaped within the confines of the neighboring surface and in the proportioned manner to that of contra lateral side anatomic contour.

3. Trial of the prosthesis is done on the patient and essential changes are made in the extent of the border and contour of the prosthesis. Discussion with the operating surgeon is important to modify the border configuration. All the modifications should be done before investing the sculpting.

4. Modeling clay sculpting is invested in the lower part or drag of the special flasks (The Hanau recon Flask, Buffalo, New York, U.S.A.) with the help of dental stone. Sodium alginate is applied as separating medium when dental stone in lower part of the flask will set.

5. Upper part of the flask i.e. cope is fitted with the lower part of the flask using the attachments of the flask. Dental stone is poured in upper part of the flask through the holes present in the upper part of the flask and dental stone is allowed to set completely.

6. After the stone has set, the upper and lower parts of flask are seperated. Clay is removed properly without leaving any residual material. Paraffin dissolved in xylene solution is applied as separating medium after removal of the clay.

7. Appropriate quantity of High Temperature Vulcanizing medical grade high temperature vulcanizing medical grade (Dow Corning, Michigan, U.S.A.) silicone material MDX 4-4515 is cut and placed in the flask. The closure of the flasks is carried out under the force of few thousands pounds [18]. Trial closure or packing of the flasks is done to remove excess silicone. The flasks are closed to approximate them in proper manner at a pressure of around 800 pounds.

8. Closed flasks are cured in hot air over at a temperature of 235^{o}C for 1.5 hour and at a temperature of 150^{o}C for 4.5 hours. After completion of curing, the flasks are cooled under cold water.

9. The flasks are opened and the prosthesis is retrieved. Finishing and polishing of the cranial prosthesis is completed with special stones and burs. Dacron mesh is secured on the borders of the prosthesis with the help of high temperature vulcanizing medical grade silicone adhesive (Silastic, Dow Corning, U.S.A.). Adhesive creates strong mechanical bonding between the Dacron mesh and silicone prosthesis which is sufficient enough to tolerate any impact on the prosthesis. Dacron mesh provides a means for securing the prosthesis to adjoining bone.

10. Prosthesis is sterilied by autoclaving or with ethylene oxide, followed by adequate ventilation.

Discussion

Alloplastic implants are considered important as they are readily available, simple to handle and minimal resorption is seen after the cranioplasty procedure. Even though acrylic resins are considered cost effective cranioplasty prosthesis in the management of cranial defects, it shows high chances of allergic reactions compared to high temperature vulcanizing medical grade silicone. High temperature vulcanizing medical grade silicone is a proven biocompatible material and has been used in array of situations [19]. Prefabrication of the prosthesis before surgery saves very important time during cranioplasty surgery. It also leads to improved cosmetic appearance after surgical reconstruction of the cranial defect. Drawback associated with silicone prosthesis is vulnerability for fungal infection. CAD-CAM generated prosthesis by rapid prototyping is an advanced treatment option for reconstruction of these defects. But elevated cost limits its employment due to financial constraint of the patient. Apart from that titanium plates are also having better adaptation, but high cost is the major drawback with titanium plates [20]. Besides, the frequency of epilepsy is seen to be reduced after cranioplasty treatment [21]. Silicone is having the following properties which are essential for a cranioplasty material i.e. biocompatibility, low heat conduction, non-magnetic, radiolucent, durable and shapeable [22]. After surgical reconstruction of the cranial defect, the patient should be called for regular follow up visits. The cosmetic result of surgical reconstruction with high temperature vulcanizing medical grade silicone is satisfactory.

Summary

This article is an editorial commentary about the procedure for fabrication of cranial prosthesis with high temperature vulcanizing medical grade silicone. This technique allows trial of temporary prosthesis leading to better cosmetic appearance. Prefabrication of the prosthesis before surgery saves very important time during cranioplasty surgery. Adaptation of custom made high temperature vulcanizing medical grade silicone cranial prosthesis is better due to its flexible properties leading to adequate bone closure.

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