

## Prosthetic Rehabilitation of Neurosurgical Cranial Defect Using Polymethyl-Methacrylate Material- Case Report

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### Abstract

### Case Report

The defects of the skull cause mechanical vulnerability of the brain, esthetic disfigurement, and transmission of vibrations and pulsation of the brain. Cranioplasty may be required to compensate for the defect and to reduce various signs and symptoms. This case report describes rehabilitation of cranial defect using heat cured polymethyl methacrylate material.

**Keywords:** Cranioplasty, Cranial defect, Reconstruction, Polymethyl, methacrylate material.

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## INTRODUCTION

Cranioplasty is defined as the surgical repair of acquired defects or congenital deformities of the cranium [1]. Cranial defects may develop from various causes such as trauma, surgery, congenital defects, or certain diseases. Such defects are treated with cranioplasty, which shields the underlying bone tissue. It also aids in relieving pain and improving appearance, leading to improved quality of life [2-4]. The indications for cranioplasty include the social stigma due to disfigurement, mechanical vulnerability, painful postsurgical cranial defects, and those defects which cannot be repaired by other surgical techniques [5]. However, Acrylic resin prostheses have been used in cranioplasty for the past 25 years. Gurdjian, Webster, and Brown [6] contoured plexi glass by dry heat, while Kerr [7] and Spence [8] adapted cold-curing acrylic resin directly to bony defects. Elkins and Cameron [9] used a sterile mixture of beeswax and petroleum jelly to make impressions of exposed bony defects from which heat-polymerizing acrylic resin prostheses were fabricated. Also, Titanium has been used recently in fabricating cranial prostheses. This metal is strong, but light material which is soft enough to be swaged in a die-counter-die system [5].

However, polyether ether ketone (PEEK) is a recently introduced material for cranioplasty which is a proved successful implant material in orthopedics as well. In this case report the defect that has to be restored was large in which computer-aided design and computer-aided manufacturing (CAD/CAM) prosthesis would have been the most probable option, but

considering the economical factor and advantages, heat cure acrylic resin cranial prosthesis was planned

## CASE REPORT

A 32 year old male patient reported to the Department of Prosthodontics, Sharad Pawar Dental College & Hospital, Sawangi, Wardha. He was referred from the Department of Neurosurgery, AVBRH Hospital, Sawangi, Wardha for rehabilitation of postsurgical defect on the left side of the head caused due to Falling from terrace (Figure 1&2). This resulted in an open head injury with left temporo-parietal contusion and a fracture of the squamous part of the temporal bone. Postoperatively, it was found that the patient had a large bony defect on the left side of the skull with no sensorineural dysfunctions. On examination, the defect was found to be approximately 15 cm × 12 cm in size. Patient was more concerned about esthetic, as he was a worker so esthetic rehabilitation of the defect, was of utmost challenge. Scalp has been shaved to insure an accurate registration of the borders of the defect. For fabrication of prosthesis, outer and inner margins of the defect were located and marked with indelible pencil before impression making (Figure 3).

A cardboard was adjusted to confine the impression material to the region to be recorded. An adequate margin beyond the borders of the defect was included. Irreversible hydrocolloid impression material was used to make the impression of the scalp area, Cotton gauze was partially embedded in the impression. Quick-setting plaster of Paris was used to reinforce the

hydrocolloid impression. 2-3 layers of plaster was poured to achieve a firm base (Figure 4). Reinforced impression has been removed carefully from the patient's head and poured by vacuum-mixed stone. The marking were transferred from the scalp to the irreversible hydrocolloid impression and then form the impression to the working cast (Figure 5). The cast was then painted with a suitable separating medium and a initial blackout performed. Molten wax was poured over the defect for the fabrication of a wax pattern, and it was carved out from inside to simulate the thickness of the bone. The wax over the defect in a cast model was carefully contoured and tried for bilateral symmetry (Figure 6). Heat polymerizing clear acrylic resin was used for processing of prosthesis. After processing, prosthesis was retrieved, it is then finish and polish, maintaining the thickness of bone of upto 2mm. Perforations were made on the cranial prosthesis to permit fluid exchange and connective tissue ingrowth, and provide a means for securing the prosthesis to adjacent bone (Figure 7).

The Sterilization of prosthesis was done as per the theater sterilization protocol. The patient was under general anesthesia and frequently monitored in the surgical theater preoperatively, after reflection of flap and exposure of the bony defect, the seat of the prosthesis was checked, and was adapted in the defect region (Figure-8). Sutures were removed on the 7th postoperative day, and the patient was discharged with uneventful healing. The reestablished cranial contour was well appreciated during follow-up (Figure 9).

## DISCUSSION

The physical and mechanical properties of materials used for the fabrication of maxillofacial prosthesis influence success of prosthodontic treatment. The materials commonly used for fabrication of this prosthesis are acrylic resins, acrylic copolymers,

various metals, vinyl polymers, polyurethane elastomers, silicone elastomers and PEEK [5]. Recently, CAD/CAM system for fabrication of oral and maxillofacial prosthesis is being used. However, its complexity, cost, and non-availability at many centers is a limitation. Nowadays, both titanium and PMMA are the most widely used alloplastic materials. However, titanium is more expensive and harder to manufacture than PMMA. In this case report PMMA is used. PMMA has the advantages of being inert, radio-transparent, nonmagnetic, simple to shape, relatively inexpensive and with adequate mechanical properties. Prefabrication is technically simpler, and it has the advantage over intraoperative molding of reduced surgical time, blood loss and infection rate; satisfaction of aesthetic result is also greater [1]. One of the most interesting benefits of cranioplasty is the improvement of neurologic function. The improvement of neurologic function is attributed to changes in brain physiology, particularly improvements on cerebral blood flow, cerebrovascular reserve capacity, and even cerebral glucose metabolism. Timing of cranioplasty is still controversial, with evidence showing either a slight decrease in infection rate when performed early (within 3 months of craniectomy) or no particular advantage of early versus delayed surgical repair. We endorse early cranioplasty, trying to diminish infection rates as much as possible [3].

## CONCLUSION

PMMA resin is useful alternative to autogenous bone grafts, titanium material, CAD-CAM for reconstruction of cranial defects. This was a multidisciplinary approach involving coordination between the Departments of Anesthesiology, Neurosurgery, and Maxillofacial Prosthodontics. The surgery was planned and executed by the Neurosurgeon under anesthesia while the prosthodontist was instrumental in the successful fabrication of a well contoured prosthesis.



**Fig-1: Preoperative photographs showing left cranial bone defect (frontal view)**



**Fig-2: Preoperative photographs showing left cranial bone defect (Lateral view)**



**Fig-3: Preoperative photographs showing left cranial bone defect marked with indelible pencil**



**Fig-5: Retrieval of Cast & defect marked with indelible pencil**



**Fig-6: Wax Trial**



**Fig-7: Processed Prosthesis with perforation**



**Fig-8: Postoperative view showing excellent adaptation and symmetry (Front and Top view )**

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