Journal of Applied Dental and Medical Sciences
NLM ID: 101671413 ISSN:2454-2288
Volume 2 Issue 2 April - June 2016

Case Report

Esthetic reconstructive cranioplasty for depressed frontal bony contour: A case report

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ARTICLE INFO

Keywords:
Craniofacial abnormalities,
Cranioplasty, Titanium, Prostheses and implants.

ABSTRACT

Cranial vault deformities as a sequelae to trauma may be as high as 70%. This reconstructive cranioplasty requires a multidisciplinary approach. Cranioplasty also improves esthetic appearance by reconstruction of harmonic contours to facilitate psychosocial rehabilitation. Nowadays polymethylmethacrylate (PMMA) and titanium are the most commonly used alloplastic materials for this rehabilitation. Titanium implant has several advantages including biocompatibility, shortening of operative time, and ensuring to achieve improved physical properties, such as compressive, impact and shear strength, acceptable aesthetic result. This article describes both the prosthetic as well as surgical aspects of titanium cranioplasty.

Introduction

Cranial bone loss occurs because of a variety of reasons, including trauma, infection, resection of malignant disease, and congenital malformation. An increasingly common reason for the removal of large cranial bone segments is decompressive craniectomy following trauma or stroke .[1] Cranial vault deformities as a sequelae to trauma may be as high as 70%. The successful management of a case of trauma in an emergency situation, requires quick evacuation of the cerebral haematoma, repair of the durameter and the scalp but not necessarily the calvarial defect as an immediate measure. So the esthetic correction of the calvarial defect is mostly carried out as a secondary procedure.[2]

This reconstructive cranioplasty requires a multidisciplinary approach involving several specialties namely neurosurgeon, general surgeon, oral and maxillofacial surgeon and prosthodontist. Both the esthetic and reconstructive principles had progressed greatly over the past few decades and hence should be considered during cranioplasty.[3]

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Fig. 1: preoperative view.

Fig. 2: preoperative profile view.

Fig. 3: facial moulage made up of dental stone

Fig. 4: wax pattern.

The esthetic aspect is important because these large defects also have a great cosmetic impact. Cranioplasty is reconstructive surgery of calvarial defects of the skull that were caused by trauma or intracranial surgery. Protection of the brain is the main criteria for cranioplasty surgery because if the cranium bones are missing, the only layers left behind is skin, scar tissue, and the meningeal layers to cover the brain. Cranioplasty also improves esthetic appearance by reconstruction of harmonic contours to facilitate psychosocial rehabilitation.[4]

A variety of techniques have been utilized to cover cranial defects including skull reconstructions with graft from the patient's own body (autograft), bone derived from cadavers or live donors(allograft), bone substitutes mostly of bovine origin(xenograft), as well as artificial (alloplastic) substitutes. The various alloplastic materials for skull reconstruction are Titanium, Titanium mesh, Glass-ceramics, Polymethyl-methacrylate (PMMA), Hydroxylapatite, Polyetheretherketone (PEEK).[5]

Fig. 5: titanium implant.

Fig. 7: placement of titanium implant

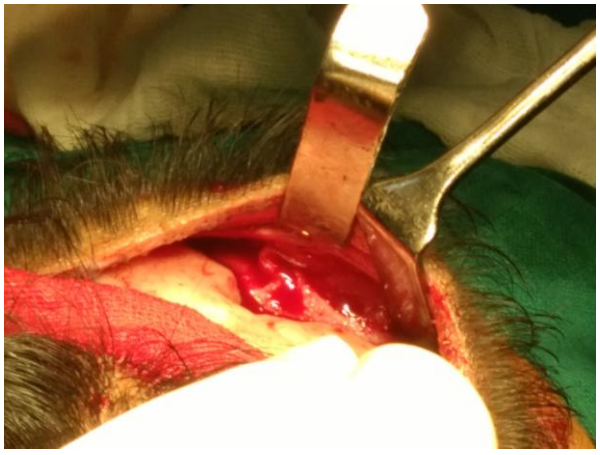

Fig. 6: semicoronal incision was made and full thickness flap was reflected

Fig. 8: titanium implant was fixed with titanium screw.

Nowadays polymethylmethacrylate (PMMA) and titanium are the most commonly used alloplastic materials for this rehabilitation. PMMA is an acrylic-based, biocompatible, nondegradable resin material. Pre-fabricated PMMA prostheses have advantages such as reduction of surgical time, easy technical handling and good esthetic results.[3] Titanium is used in various alloys of iron, vanadium, aluminum, etc. Titanium is the material of choice these days in cranial and spinal prosthesis as it has greater resistance to the same strength as steel and 45% less mass, resistant to mechanical forces and biocompatible and corrosion resistant.[6]

Case report

A 19 years old female patient was referred from Sanjay Gandhi hospital, Bangalore to the Department of Prosthodontics, GDCRI Bangalore with the chief complaint of depression in the forehead region as a result of RTA 4 years ago.

Fig. 9: postoperative view.

Fig. 10: postoperative profile view.

According to the history given by the patient, emergency treatment was given at the time of RTA. After the regression of the swelling, she observed a depression on her face in the forehead region. Clinical and radiographic examination showed that the facial trauma had caused a fracture with frontal bone depression(measuring 5cm×4cm×1cm). After a period of 4years, a bone consolidation in mal-position had occurred and a facial depression in the forehead had affected facial esthetics. Discussions with the surgeons led to the conclusion that the consolidated mal-united frontal bony fragments cannot be brought back into the normal position, hence, it was decided to camouflage the defect with titanium implant.

Facial moulage was made using alginate impression material(Algitex dental products, India) and model was poured with dental stone(Gemstone, Shruti dental products, India). The defect was deep(1cm) so block-out was done with plaster of paris to reduce the bulk of the metal casting and margin of the defect was scrapped 1.5mm-2mm with BP handle blade(No.15) for the better fit of implant over bony surface. Wax separator was applied and wax pattern was fabricated using modeling wax. Try-in of the wax pattern was done and necessary correction was carried out. Multiple holes of 2 mm diameter were made over the entire plate at a distance of 2 mm to 4 mm from each other and the wax pattern was invested and casting was done with titanium alloy. Fit of the casting was evaluated over the defect before surgical procedure.

Surgical procedure

All the surgical procedures were carried out in Sanjay Gandhi hospital, Bangalore. Preoperative examination was carried out and surgical procedure was done under general anesthesia. After proper scrubbing of operating field and draping, 2% lignocaine with 1:200000 adrenaline was infiltrated in the surgical area to achieve vasoconstriction and to get fluid dissection. The defect was exposed using the same incision that was made at the time of trauma. It was a depressed comminuted fracture of frontal bone.

The outer table of the bone was fractured, inner table was intact. Since it was not associated with any head injury, the defect was flushed and dried to make it ready to receive the titanium implant. Titanium implant was sterilized using autoclave prior to surgery. Implant was positioned over the defect and fixed using titanium screw (2mm×6mm). Finally the flap was closed in two layers, inner layer was sutured with vicryl suture material (polyglactin) and skin was sutured with prolene (polypropylene) suture material.

Results

Patient recovered from anesthesia uneventfully. Post operative broad spectrum antibiotics were given for five days. The wound healed very well and there was no sign of infection or any other complication at the time of discharge. Suture removal was done on seventh day post-operatively. Patient was happy and satisfied with the result. Evaluation at 15 days post-surgery showed that the wound healed well with an acceptable cosmetic outcome and without any complications. The patient returned after1, 3 and 6 months for follow up, the patient was happy and presented good clinical response.

Discussion

Appropriate treatment outcome depends on an accurate diagnosis, focusing on the physical examination and data from proper investigations. It is common for post craniofacial trauma patients to require reconstruction of depressed craniofacial skeleton. To achieve acceptable aesthetic outcome is a great challenge to the clinician. Various alloplastic materials have been in use for this purpose i.e. Titanium, Titanium mesh, Glass-ceramics, Polymethyl-methacrylate (PMMA), Hydroxylapatite, Polyetheretherketone (PEEK). All materials and grafts have merits and demerits in their use.

Advantages of alloplast are easy availability, nonresorbability, shortening of operative time, excellent post operative cosmetic result and reliable reconstructive materials. Disadvantages include foreign body reaction, potential for infection which may produce fistula, extrusion, slippage, erosion and granuloma.

However, prefabricating titanium implant has several advantages including biocompatibility, shortening of operative time, and ensuring to achieve improved physical properties, such as compressive strength, impact strength and shear strength, acceptable aesthetic result. To obtain the impression of the bony defect, we used alginate impression material commonly used in dentistry.[3] The methodology involved is simple and easily accessible.[6]

Historically the reconstructive cranioplasty has been done with numerous metals and alloys. Ideally the metal should be of low molecular weight, strong enough to resist trauma, biocompatible, non-carcinogenic and sterilizable. Previously, tantalum was most commonly used among various metals but presently titanium has been widely accepted because of its properties like biocompability, higher strength, resistance to corrosion, low molecular weight, considerably malleable to conform to the anatomic contours and MRI compatibility.[10] The modulus of elasticity of pure titanium is close to bone which helps in even distribution of stress at the bone implant

interface. However the high cost of titanium and high thermal conductivity are limiting factors.[2]

Summary

Titanium cranioplasty is relatively simple but requires a well set up infrastructure and obviously a degree of skill. Titanium implant is preferable because ease of implantation process, perfectly biocompatible, significantly reducing operator time and duration of hospital stay. Predictable aesthetic results can be achieved with this technique.

Acknowledgment

We are thankful to Dr. Vijay Reddy, Sanjay Gandhi Hospital, Bangalore for providing his support for surgical procedures

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Source of support: Nil Conflict of Interest: None

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