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sectional study done in single centre

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ABSTRACT

Background: Cranioplasty (CP) is a neurosurgical procedure performed after decompressive craniectomy using autologous bone graft or various artificial materials.

Objective: To determine differences in complications between patients who underwent CP using an autologous bone flap versus titanium mesh and to identify significant risk factors for post-CP complications.

Study design: Comparative cross-sectional study.

Methods: A total of 38 patients, 29 males (76.4%) and 9 females (23.6%), were included in this study. All patients underwent cranioplasty with titanium mesh or autologous bone graft.

Results: The results were compared between autografts and titanium implants. Autologous bone graft was used in 76.3% of the patients and titanium implant was used in 23.7%. Different complications occurred in 5.26% of the patients in both groups, 2.63% in the autologous group and 2.63% in the titanium mesh group respectively. Infection occurred in the surgical site in 5.26% of the patients in both groups (similar). Cranioplasty infection occurred in 2.63% of the patients who underwent autologous transplantation. One patient developed a hematoma in both groups. One patient underwent autologous bone graft removal, and one patient underwent mesh removal.

Practical implication: Titanium mesh cranioplasty is an essential procedure for junior neurosurgeons to learn and achieve good results, shorten hospital stays, and save hospital resources.

Conclusion: Titanium mesh cranioplasty has similar complications to autologous bone cranioplasty.

INTRODUCTION

Neurotrauma is a leading cause of death and disability in India¹. Cranioplasty is the treatment of the skull defect after a previous surgery due to trauma. This surgery is performed after treatment and stabilization of the original pathology such as cerebral edema, brain tumor, traumatic brain injury, or infarction leading to craniectomy. This is followed by cranioplasty to protect brain parenchyma, provide cosmesis, and to avoid the effect of atmospheric pressure on cranial

Keywords
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fluid dynamics such as trephine syndrome. The materials used for cranioplasty are divided into two categories: autologous bone or synthetic replacement. Autologous bone grafting uses the patient's own resected skull; it is both cost-effective and a physiological alternative to synthetic products².

Cranioplasty is usually performed 2–3 months after craniectomy, so bone preservation should be considered in advance. Autologous bone flaps can be preserved by cryopreservation (placing the bone flap in a special refrigerator according to a pre-planned protocol) or by placing the bone flap in a subcutaneous compartment in the abdominal wall. Many synthetic materials are available for cranioplasty, such as titanium mesh, polymethyl-methacrylate, hydroxyapatite cement, and polyetheretherketone (PEEK). There is currently no single device that provides all the required features for calvarial substitute. Therefore, neurosurgeons choose materials that are effective and have reduced complications³. Titanium mesh is easily available, strong with malleable properties, has a low infection rate, and facilitates cosmetic restoration.

The purpose of this study is to compare the complications of cranioplasty using autologous bone graft with titanium mesh implants. It also aims to show which cranioplasty method is effective, has the least complications, and provides the best results.

METHODS

This is a comparative cross-sectional study conducted between February 2022 and January 2024 at the Department of Neurosurgery, RNT Medical College, Udaipur. Population Group: Patients over 10 years of age who underwent autologous bone/titanium mesh cranioplasty in our hospital were included. A total of 38 patients were selected, comprising 29 males and 9 females.

DATA COLLECTION PROCESS

After approval by the Research Committee, patients' previous clinical data were collected along with related demographic information and relevant operative characteristics such as cranial defect size and Glasgow Coma Scale score (preoperative and postoperative). Acute surgical complications such as hospital-acquired infection or surgical site infection, hematoma, deep vein thrombosis, cerebrospinal fluid leak, bone resorption, readmissions,

reoperations, cranioplasty flap removal, cranioplasty flap infection, duration of stay in the neurosurgical ward, and discharge were noted.

INSTRUMENT DEVELOPMENT

Decompressive craniectomy in patients with severe head trauma caused significant midline shift due to hematoma, contusion, tumor, or stroke causing intracranial pressure despite adjuvant medical treatment. In patients who underwent unilateral frontotemporoparietal craniectomy with durotomy or duroplasty, the bone flap edges were smoothed and placed in the subcutaneous abdominal compartment. The material used for CP depends on the surgeon's preference and the duration of DC and CP. In this study, we used titanium mesh plates in cases with a duration of 1.5 months to 22.5 months. We used a sterile clipper to remove the patient's hair before performing CP. The previous skin scar was reopened, and dissection was done in fibrous tissue between the dura and galea for the placement of the titanium mesh or autologous bone graft. In the case of using a bone flap, the flap was washed with normal saline solution. The flap was placed and fixed with multiple mini plates and screws in its original position using titanium plates and screws. The galea was then closed using vicryl, and skin closed with silk sutures.

DATA ANALYSIS

Frequencies or percentages of variables and means and standard deviations for continuous variables were used to present data.

RESULTS

A total of 38 patients were selected to compare the results of autologous bone graft and titanium implants, comprising 76.4% male and 23.6% female. In 76.3% of patients, autologous bone graft was used, while titanium implant was used in 23.7% of patients. The overall complication rate was 5.26%, with 2.63% in the autologous group and 2.63% in the titanium mesh group. The incidence of surgical site infection was the same in both groups at 5.26%. Hematoma occurred in one patient of each group. Removal of the autologous bone graft was performed in one patient, and mesh removal in one patient in the other arm of the study. Bone resorption was observed in 5 patients, all of whom had autologous bone graft.

Table 1. Gender distribution

Gender	Frequency	Percentage
Male	29	76.4
Female	9	23.6
Total	38	100.0

Table 2. Frequency of autologous and titanium implant used

Type of Implant	Frequency	Percentage
Autologous Bone Graft	29	76.4
Titanium Implant	9	23.6
Total	38	100.0

Table 3. Indications

Indication	Frequency	Percentage
Traumatic Brain Injury	28	73.69
Stroke	3	7.89
Haemorrhage	5	13.15
Tumour	2	5.27
Total	38	100.0

Table 4. Postoperative complications

Complication	Frequency	Percentage
No Complication	36	94.72
Surgical Site Infection	1	2.64
Cranioplasty Infection	1	2.64
Total	38	100.0

DISCUSSION

This comparative cross-sectional study compares autologous cranioplasty with titanium implants. Titanium mesh serves as an alternative to autologous bone flaps, offering advantages of bioinertness and less tissue reaction, especially in large bony defects.

In this study, one case of surgical site infection was observed in a patient with autologous cranioplasty and one case in a patient with titanium implants, resulting in rates of 2.63% for both. According to a study by Conen et al., the incidence of infection in implants ranges from 3-15%^{4,5}. In our study, two patients (5.26%), one from each group, underwent cranioplasty removal due to infection.

Other studies suggest that debridement and bone preservation with intravenous and oral antibiotics are effective in 91% of patients⁶. These small studies confirm that implant retention or immediate exchange is an alternative to removal.

Overall, the results suggest no significant

advantage of using autologous bone compared to titanium mesh after decompressive craniectomy. However, autologous cranioplasty often provides better cosmetic results and has evidence of bony fusion on radiographic examination of reconstructed anterior segment⁷. Some studies indicate problem is around 58.3% when autologous bone flap are used and 55% with titanium mesh⁸. In our study, equal complication rates were observed between the two materials.

CONCLUSION

In our study, cranioplasty using titanium mesh demonstrates complication rates similar to those associated with autologous bone grafting. Additionally, employing autologous bone, when feasible, can lead to reduced medical costs.

STUDY LIMITATIONS

This study has several limitations. First, it includes data from a single tertiary care institution. Furthermore, obtaining patient consent may depend on the nature of the neurotrauma, making it difficult in some cases due to differences in GCS scores when caregiver consent was required.

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