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# Cranioplasty: Indications, Procedure, and Outcome. A Single Institution Experience of Short Term Outcome

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## Abstract

*Background:* Cranioplasty is the process of inserting a device into the skull to correct a deformity. More than 50% of decompressive craniectomies are performed due to trauma and strokes. Patients who survive will require cranioplasty surgery for cosmetic reasons and to protect the brain.

*Aim of Study:* The purpose of this report is to provide our knowledge of the indications, complications, and short-term clinical outcomes of cranioplasty.

*Patients and Methods:* Forty patients who were admitted to our Hospital's Neurosurgery Department between June 2019 and January 2022 were the participants of this retrospective investigation. Those included in the study had undergone cranioplasty for treatment of a defect in the skull vault. All patients were operated upon by autologous or artificial bone cement. The variables age, gender, indication for cranioplasty, kind of graft, timing of operation, and complications were analyzed.

*Results:* This is a single-institutional retrospective study of cranioplasty patients. The study included 40 participants between 2019 – 2022. The average age of the population under study was 36.75 years. The mean duration of an operation was 124.70 minutes. Cranioplasty was done with autologous graft in 26 patients and with artificial graft in 14 patients. The average duration of the surgery ranged from 61 to 120 minutes. As the $p$-value was greater than 0.05, there was no statistically significant difference between operative time and kind of graft. Between craniectomy and cranioplasty, the median time period was 13-24 weeks (18 patients). There was no statistically significant difference between average time interval between craniectomy and cranioplasty and ensuing complications as $p$-value was >0.05.

*Conclusions:* Cranioplasty is a common neurosurgical technique used to help rebuild the skull. Throughout the past decade to fifteen years, advancements in technology, operational practices, and production methods have helped it.

***Key Words:*** *Cranioplasty – Cosmetic –Autologous – Artificial – Craniectomy.*

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## Introduction

**CRANIOPLASTY** is the implantation of an item to fix a defect in the skull vault (bone or synthetic materials such as metal plates or bone cement). Brain coverage and protection in addition to cosmetic purposes are the main indications of cranioplasty which is a very common procedure in daily neurosurgical practice **[1]**. Also cranioplsty decrease the psychological and social drawbacks which may be present due to skull defect. Cranioplasty also restores the dynamics of closed cavity as the atmospheric pressure has effect in absence of bone coverage **[2]**. Rarely can traumatic brain edema cause neurological decline after decompressive craniectomy. Commonly, imaging and neurological abnormalities recover following cranioplasty **[3]**.

More than 50% of decompressive craniectomies are performed due to trauma and strokes. Patients who survive will require cranioplasty surgery for cosmetic reasons and to protect the brain. Early cranioplasty is well known to have good outcome regarding functional and psychological aspects. Cranioplasty in this setting is a planned elective procedure. It also minimizes the chance of falling by restoring balance to the vestibular system **[4,5,6]**. An early surgery is performed in case of pulsatile defects. Infection and untreated hydrocephalus are considered the main contraindications of cranioplasty.

The purpose of this study is to convey our understanding of the short-term clinical result, indications, and consequences of cranioplasty.

## Patients and Methods

Forty patients who were admitted to our Hospital's Neurosurgery Department between June 2019 and January 2022 were the subjects of this retrospective study. Those included in the study

had undergone cranioplasty operation for repair of a defect in the skull vault. All patients were operated upon by autologous or artificial bone cement. Age, sex, cranioplasty reason, graft type, cranioplasty time, and complication rates were all factors that were analyzed.

The research plan and objectives were authorised by our institution's medical and ethical committee. The purpose of this study was to evaluate the appropriate uses and outcomes of cranioplasty and to contrast our findings to the existing literature on cranioplasty.

*Procedure:*

Incision was done over the previous scar. Between the dura and the scalp, underlying muscles were dissected. That was probably the most problematic step of the surgery. Cleansing the edges of the surrounding bone was done. The abdominal pouch was used to acquire a flap of bone, which had its edges retouched and holes drilled.After positioning the preserved bone, vicryl sutures orminiplates were used to fix it (Fig. 1). Considering these difficulties, surgicel was put over the exposed dura during the craniectomy. This procedure diminishes thick adhesions between the dura and the scalp's muscle layer. Dense adhesions facilitate dural tears, which, if they occur during cranioplasty, must be treated in watertight fashion. The data was logged. Age, sex, time of cranioplasty, technique problems such as infection, cosmetic deformity, bone resorption, subdural fluid collection, and mortality were recorded.

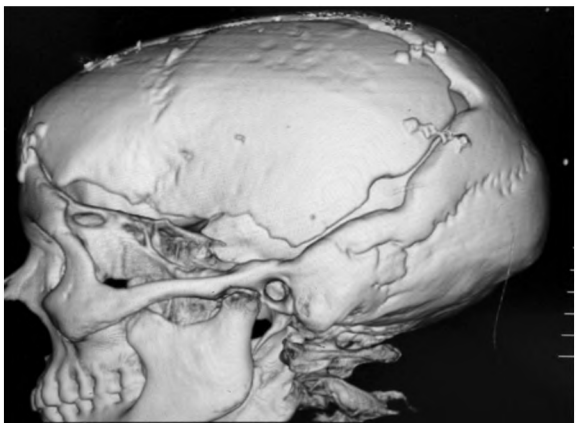

Fig. (1): Bone flap reinsertion secured with miniplates.

## Results

Forty people had the operation. The average age of the population under study was 36.75 years. The mean operative time was 124.70 minutes. Cranioplasty was done with autologous graft in 26 patients and with artificial graft in 14 patients. The most frequent indication for the procedure was trauma in 22 patients. Tumour was the indication in 12 patients and infarction was the indication in 6 patients.

The average duration of the surgery ranged from 61 to 120 minutes (14 patients autologous and 8 artificial). As the *p*-value was greater than 0.05, there was no statistically significant difference between operative time and kind of graft (Table 1).

There were fifteen females and 25 males in our study. Complication rate of 25% was seen in patients who had surgery with time interval between craniectomy and cranioplasty more than 24 weeks. The average duration between a craniectomy and a cranioplasty was 13-24 weeks (18 patients). No statistically significant difference between average time interval between craniectomy and cranioplasty and ensuing complications as *p*-value was >0.05 (Table 2). Reoperation frequency of 16.7% reported in participants who had surgery with elapsed time between the procedures of craniectomy and cranioplasty more than 24 weeks. There was no statistically significantdifference between average time interval between craniectomy and cranioplasty and revision surgery (reoperation) as *p*-value was >0.05 (Table 3).

Concerning the associated complications, 3 patients had wound dehiscence, 2 patients had bone resorption.

*Statistical methods:*

Mean SD, range, or frequencies (number of cases), and percentages were used to statistically describe the data.Chi-square tests ($X^2$) were used to evaluate the differences between the study groups. Two-sided *p*-values under 0.05 were regarded as significant. For all statistical studies, IBM SPSS (Statistical Program for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows was used.

Table (1): Time of surgical procedure.

| | Autologous | | Artificial | |
|---|---|---|---|---|
| | N | % | N | % |
| 60 min | 2 | 7.7 | 1 | 7.1 |
| 61-120 min | 14 | 53.9 | 8 | 57.1 |
| 121-180 min | 6 | 23.1 | 3 | 21.4 |
| 181 min | 4 | 15.4 | 2 | 14.3 |
| *p*-value | 0.998 | | | |

Table (2): Time between craniectomy and cranioplasty and ensuing complications.

| Craniectomy-Cranioplasty interval | Complications | | No complications | |
|---|---|---|---|---|
| | N | % | N | % |
| 12 weeks | 1 | 10 | 9 | 90 |
| 13-24 weeks | 2 | 11.1 | 16 | 88.9 |
| >24 weeks | 3 | 25 | 9 | 75 |
| *p*-value | | 0.509 | | |

Table (3): Time between craniectomy and cranioplasty and ensuing reoperation.

| Craniectomy-Cranioplasty interval | Reoperation | | No reoperation | |
|---|---|---|---|---|
| | N | % | N | % |
| 12 weeks | 1 | 10 | 9 | 90 |
| 13-24 weeks | 2 | 11.1 | 16 | 88.9 |
| >24 weeks | 2 | 16.7 | 10 | 83.3 |
| *p*-value | | 0.87 | | |

## Discussion

Cranioplasty was first done several centuries ago **[7]**. Decompressive craniotomy is known to cause disturbances in cerebrospinal fluid (CSF) circulation **[8,9]**.

It also causes marked changes in the dynamics of local blood flow as well as the metabolic rate of glucose and oxygen **[8,10]**. The cranioplasty operation is thought to repair the changed circumstances and improve the patient's neurological status.

In 1939, Grant and Norcross **[7]** described a disorder involving severe headache, pain at the craniectomy site and dizziness. It also includes changes in cognitive state. Despite the clinical improvement brought on by the craniectomy and cranioplasty, many symptoms persist for weeks to months.

The term "syndrome of trephined" should only apply if clinical symptoms improve after cranioplasty. The term "sunken flap syndrome" is more appropriate previously to cranioplasty. In daily medical use, any phrase can be used in interchangeable. The negative pressure gradient between the outside air and the skull is what causes the neurological symptoms (sunken flap) **[11]**.

The majority of operations were completed in 61-120 minutes (53.9%, N=14), followed by 121-180 minutes (23.1 %, N=6), with a mean operating time of 124.70 minutes. Similar to our study was one by Al Shalchy in which 90 percent (N equal 18) of patients had surgery in 1-3 hours **[12]**. When compared to our results, the results from the study by Basheer et al., which indicated a mean operating time of 143±28 minutes, are slightly greater **[13]**.

To determine when it is safe to do cranioplasty after a craniectomy, we analyzed the current literature. The results of a cranioplasty performed sooner rather than later have been shown to be better. Several researchers found that patients who had craniotomies at an early age (less than 12 weeks) had superior functional outcomes. In terms of complications, there was no difference between immediate and delayed cranioplasty **[14,15]**. Additional research suggests that early cranioplasty following decompressive craniectomy can help reduce postoperative problems **[16]**. The time it takes to do a cranioplasty might be cut down if the procedure is performed as soon as possible after a skull fracture. This also reduces possible complications such as blood loss, subdural hygroma, infection and brain parenchyma damage **[17]**.

*Conclusions:*

Cranioplasty is a common neurosurgical treatment that aids in skull repair and has a high rate of success. Advancement in production techniques and manufacturing technology added many benefits for the surgical procedure in the past 10-15 years. When indicated, all variables such as cosmesis, timing and complications should be addressed.

Additional prospective trials are needed, ideally with a greater variety of patients and more factors.

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## رأب القحف المؤشرات والإجراءات والنتائج
## تجربة مؤسسة واحدة بنتائج قصيرة المدى

رأب القحف هو عملية إدخال جهاز فى الجمجمة لتصحيح التشوه، يتم إجراء أكثر من ٥٠٪ من عمليات استئصال الجمجمة لإزالة الضغط بسبب الصدمات والسكتات الدماغية، المرضى الذين ينجون سيحتاجون إلى جراحة رأب القحف لأسباب تجميلية ولحماية الدماغ، الغرض من هذا التقرير هو تقديم معرفتنا عن المؤشرات والمضاعفات والنتائج السريرية قصيرة المدى لعملية رأب القحف، شارك فى هذا البحث أربعون مريضاً تم إدخالهم إلى قسم جراحة المخ والأعصاب بالمستشفى بين يونيو ٢٠١٩ ويناير ٢٠٢٢، خضع أولئك المرضى لعملية رأب القحف لعلاج عيب فى قبو الجمجمة، تم إجراء العمليات الجراحية لجميع المرضى بواسطة الأسمنت العظمى الاصطناعى أو عظام الجمجمة المحفوظة من قبل، كان متوسط عمر المرضى قيد الدراسة ٣٦.٧٥ سنة، كان متوسط مدة العملية ١٢٤.٧٠ دقيقة ، تم إجراء رأب القحف باستخدام عظام ذاتية فى ٢٦ مريضاً وبأسمنت اصطناعى فى ١٤ مريضاً، تراوح متوسط مدة الجراحة من ٦١ إلى ١٢٠ دقيقة، كان متوسط الفترة الزمنية بين استئصال القحف ورأب القحف ١٣–٢٤ أسبوعاً (١٨ مريضا)، لم يكن هناك فرق معتد به إحصائياً بين متوسط الفترة الزمنية بين استئصال القحف ورأب القحف والمضاعفات اللاحقة، رأب القحف هو أسلوب جراحى شائع يستخدم للمساعدة فى إعادة بناء الجمجمة وقد ساعدت التطورات فى التكنولوجيا على ذلك خلال العقد الماضى.