



**ORIGINAL RESEARCH PAPER**

**Neurosurgery**

**A STUDY ON CRANIOPLASTY USING AUTOLOGOUS BONE FLAP PRESERVED IN ABDOMINAL WALL**

**KEY WORDS:**

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**ABSTRACT**

**Aim and objective :**

The aim of the present clinical study is to evaluate the efficacy of preservation of calvarial bone in an abdominal pouch for being used later for cranioplasty.

**Materials and Methods**

All stroke and TBI patients with refractory raised ICP operated with an emergency decompressive craniectomy between July 2007 and Jan, 2017 at a single hospital, were included. After exclusion, a total of 211 patients were taken for consideration and analysis. For the retrospective analysis of the efficiency of autologous bone graft preserved in the abdominal wall, for cranioplasty, All decompressive craniectomy patients who underwent subsequent cranioplasty were identified, and a database was created with relevant variables, including post-operative complications. Age, gender, co-morbidity, indication for Decompressive craniectomy, method of implanting in abdomen, Operating time, cranial surgery prior to Decompressive craniectomy time between Decompressive craniectomy and Cranioplasty, complications like implant rejection, SSI, Osteomyelitis, and abdominal wound complications if any, have all been recorded and studied.

**Conclusion:**

We from our retrospective analysis, conclude that storage of the patients own bone flap in the abdominal pocket is a safe, easy, cheap, sterile, histocompatible, and better cosmetic results. When replacement the bone removed at craniectomy, a fresh skull autograft is superior to all alternative forms of cranioplasty such as methylmetacrylate or metallic prosthesis. When compared to the use of synthetic cranioplasty materials, a personal bone flap has very low percentage of inflammatory complications.

**Background**

The use of emergency decompressive craniectomy for life-threatening raised intracranial pressure in traumatic brain injury and stroke patients is still the surgical procedure of choice. Over many years, this remains the single big hope in saving many lives. But the craniectomy leaves the patient with an unacceptable cost of cranial vault defect and hence the procedure needs to be later followed by a cranioplasty procedure with reinsertion of the autologous bone flap or a synthetic implant. Various preservation techniques include deep freezing, preservation in bactericidal solutions, sterilization, and preservation in a subgaleal or abdominal pouch. The cosmetic outcome of autologous bone though a properly fitting one can at times be deleterious because of the adverse effects of the technique on graft preservation. It was in 1920, when Kreider in a 4-year-old boy who had sustained a compound skull fracture, reported the first case of preservation of calvarial bone in the anterior abdominal wall pouch. This became a commonly used procedure for cranioplasty in the initial days. But because of increased reports of complications, including surgical site infection and bone flap resorption, autologous bone flap has lost its way with time and the present decade era dwells on synthetic material cranioplasty. This study is a retrospective, single-institution survey of all stroke and traumatic brain injury patients undergoing acute decompressive craniectomy and subsequent cranioplasty over a 10-year period with a focus on analysing the post-operative complications following autologous bone flap cranioplasty with bone flap being preserved in the abdominal wall.

**Aim and objective :**

The aim of the present clinical study is to evaluate the efficacy of preservation of calvarial bone in an abdominal pouch for being used later for cranioplasty.

**Materials and Methods:**

All stroke and traumatic brain injury patients with refractory raised intracranial pressure operated with an emergency decompressive craniectomy between July 2007 and June 2017 at a single hospital, were included. The group of patients included acute traumatic subdural hemorrhages, traumatic intracerebral hemorrhages and cerebrovascular accidents with either intracerebral hemorrhages or cerebral infarctions. Patients undergoing craniectomies for tumors and paediatric population were excluded from the study.

After exclusion, a total of 211 patients were taken for consideration and analysis. For the retrospective analysis of the efficiency of autologous bone graft preserved in the abdominal wall, for cranioplasty, all decompressive craniectomy patients who underwent subsequent cranioplasty were identified, and a database was created with relevant variables, including post-operative complications. Age, gender, co-morbidity, indication for decompressive craniectomy, method of implanting in abdomen, Operating time, cranial surgery prior to decompressive craniectomy, time between decompressive craniectomy and cranioplasty, complications like implant rejection, surgical site infections, Osteomyelitis, and abdominal wound complications if any, have all been recorded and studied.

All procedures were performed as standard hemispheric craniectomies with or without duroplasty, pre operative intravenous antibiotics and without post-operative drains. During decompressive craniectomy itself, the precautions to avoid a disproportionate bone flap were taken, by taking the bone flap as a single intact fragment and by avoiding nibbling too much to increase the defect size. The bone flaps were cleaned of soft tissue, without the application of local antibiotics/antiseptic solutions or autoclaving. We performed a linear horizontal incision with length between 8 and 12 cm (depend on the size of bone graft). With surgical scissors, we prepare the so-called abdominal pouch. After meticulous surgical hemostasis, we placed the bone graft with the convex part on upper site, because the bone edges can injure the skin. Under skin and skin are sutured with interrupted sutures. The day for cranioplasty is dictated by the progress in the primary condition and the skin flap tension over the vault defect. Cranioplasty was performed with reinsertion of autologous bone and stabilised by ties across the bone, without employing plates and screws. Post operative antibiotics given for all the patients for one week.

**Results**

A total of 211 patients underwent an autologous bone cranioplasty following the emergency decompressive craniectomy during the specified time period. Trauma was the most common indication for decompressive craniectomy (151/211 patients). The median age of the was 32 years (19 to 64 years). For trauma, the median age was 28 years (19 to 52 years), for stroke it is 46 years

(37 to 64 years). Overall male to female ratio is 3:1 (152 vs 59), in trauma nearly the same ratio 3:1 (112 vs 39) in stroke 2:1 (40 vs 20). The average operating time (including harvesting the bone from abdominal wall, placing it in the calvarial defect, wound closure) is 90 (65-190) minutes. Overall, median time between decompressive craniectomy and ABG-CP was 88 (55-214) days. Among the 151 trauma patients, 21 patients underwent bilateral decompressive craniectomy and bilateral autologous bone cranioplasty.

Parameter	CP
Median age (years)	32 (19-64)
Male-n (%)	152 (72%)
Reason for decompressive craniectomy	
- Trauma	151 (72%)
- Stroke	60 (28%)
Median operating time	90 mins (65-190)
Median interval between decompressive craniectomy and autologous bone cranioplasty	88 days (55-214)
Bilateral cranioplasty	21 (10%)
Complications	1) SSI 6
2) osteomyelitis requiring bone flap removal	1
3) bone flap resorption requiring bone flap removal	1
4) abdominal wound complications	4

**DISCUSSION**

Early decompressive craniectomy is a therapeutic option in the management of the patients with acutely increased intracranial pressure in cases of traumatic brain injury or cerebrovascular accident. It helps as an acute venting for the pressure constantly raising within the calvarium, which without decompression can result in brain parenchymal edema, brainstem herniation and eventually death. But it has to be done under the cost of a big calvarial defect. At the same time, the size of craniectomy is of critical importance. Small craniectomies risk brain herniation with venous infarction and increased edema at the bone margins.

Brain protection and cosmetic aspects are the major indications of cranioplasty. Replacement of the bone removed at craniectomy sounds still as the most compatible replacement to perform the cranioplasty. Boneflap preservation can be performed in many ways; abdominal wall, subgaleal space, cryopreservation or autoclaving. While cranioplasty with a frozen or freeze-dried craniectomy graft results in an initial perfect reconstruction, it is subject to a high rate of graft resorption after replacement. In Hauptli and Segantini's series of 143 craniectomy grafts undergoing cryogenic preservation, 86 (60%) had osteolysis significant enough to produce instability or unsatisfactory cosmetic results and 23 patients (16%) required surgical revision. In contrast, they reported that only 3 of 42 (7%) of subcutaneous preserved grafts required revision cranioplasty. Recently, custom alloplastic implants prefabricated from computed tomography data have made alloplastic reconstruction of these large defects more precise and less time consuming. However, the risks of complications related to a large foreign body remain and the cost factor also has to be addressed seriously.

We in our study at a single institution, with our retrospective analysis on 211 patients of cranioplasty done over the past 10 years, found nine of our patients experience some discomfort from the stored graft in abdominal pouch, four of them had wound complications and only two patients mandated bone flap removal. And we found it gives big psychological comfort for the patients as in having their own bone for the purpose of cranioplasty. We conclude autogenic bone flap is alive, not expensive, and perfectly fit with the size of the defect.

**CONCLUSION**

We from our retrospective analysis, conclude that storage of the patients own bone flap in the abdominal pocket is a safe, easy, cheap, sterile, histocompatible, and better cosmetic results. When replacement the bone removed at craniectomy, a fresh skull autograft is superior to all alternative forms of cranioplasty such as methylmetacrylate or metallic prosthesis. When compared to the use of synthetic cranioplasty materials, a personal bone flap has very low percentage of inflammatory complications.

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