



## CLINICAL OBSERVATIONS OF CALVARIAL BONE AFTER SURGICAL DECOMPRESSION: A PROSPECTIVE CLINICAL STUDY

<b>Dr Anand Prakash</b>	Hod & Additional Professor, Department Of Neurosurgery, Rims, Ranchi, Jharkhand
<b>Dr Md Habibullah Ansari*</b>	Senior Resident, Department Of Neurosurgery, Rims, Ranchi, Jharkhand *Corresponding Author
<b>Dr Manjar Ali</b>	Senior Resident, Department Of Neurosurgery, Rims, Ranchi, Jharkhand
<b>Dr Deepak Kumar</b>	Senior Resident, Department Of Neurosurgery, Rims, Ranchi, Jharkhand

**ABSTRACT** **Introduction:** Cranioplasty is a surgical operation on the repairing of cranial defects caused by previous injuries or operations, such as decompressive craniectomy. It is performed by filling the defective area with a range of materials, usually a bone piece from the patient or a synthetic material. The autologous bone is kept in the subcutaneous plane in anterior abdominal wall. **Methods:** It was a Prospective study with a total 26 patients were included after inclusion and exclusion criteria were met between Sept 2022 to August 2023. Gross changes in the bone were noted. **Results:** Men constituted 88% of the study group. There is statistically significant reduction in length, width and thickness measured in patients who underwent cranioplasty 4 months after initial surgery. Only 6% of patients showed necrotic changes. **Conclusion:** There is significant reduction in length, width, thickness and weight of bone measured in patients who underwent cranioplasty 4 months after initial DC.

**KEYWORDS :** Cranioplasty, Decompressive Craniectomy, Traumatic Brain Injury, Calvarial bone

### INTRODUCTION

Decompressive craniectomy (DC) is surgical procedure in which the part of the skull bone removed and surgically expanding the dural sac to allow the brain to swell without raising the intra cranial pressure (ICP)<sup>1,2</sup>. It is performed on victims of traumatic brain injury, stroke and other conditions associated with raised intracranial pressure. Traumatic Brain injury is associated with significant morbidity and mortality. DC technique has been reported to be beneficial in a number of conditions, like traumatic brain injury, hemispheric ischemia stroke and ICP associated with aneurysmal subarachnoid hemorrhage, brain tumor<sup>3-6</sup>. Cranioplasty is defined as the restoration of a defect in the cranial bone or correction of a deformity of the bone. Reconstruction of the cranial vault is often needed for protective and cosmetic reasons. The goals are to protect the brain and restore the normal contour with as few complications as possible. Other controversial goals are eliminating headache, apprehension, avoiding cerebral palsy, decreasing vibration, motion intolerance, overcoming fatigue<sup>7</sup>, insecurity and post-traumatic epilepsy. An enormous range of materials has been employed for the repair of cranial defects. These may be an autografts, xenograft and sometime using material other than the bone. In autograft part of the skull bone removed and is placed in subcutaneous plane of anterior abdominal wall & then repositioned back in its original place in skull after brain edema subsides & increased ICP settles down<sup>6</sup>. Storing the bone flap in the abdominal wall until it was required for the cranioplasty was first described by Kreider (1920)<sup>8</sup>. There are only very few studies which were done to see histopathological changes in the skull bone before cranioplasty. Our study had been done to assess the gross changes in the calvarial bone retrieved from abdomen after 4 months.

### MATERIAL AND METHODS

The study was conducted in the department of Neurosurgery RIMS, Ranchi. It was a Prospective study with a total 26 patients were included after inclusion and exclusion criteria were met between September 2022 to August 2023.

Inclusion criteria: Acute TBI patients admitted in the department and those planned for surgery. Criteria for decompressive craniectomy will depend upon pre operative imaging, Glasgow Coma Scale & intra operative findings. Any patient with hemispheric ischaemia stroke, aneurysmal bleed, subarachnoid haemorrhage, brain tumour with increased ICP refractory to medical management.

### Exclusion Criteria:

- Patients with skin lesion or any infection over anterior abdomen.
- Osteomyelitis of the skull bone placed in abdomen.
- Skull bone involvement due to other disease.
- Patient with hemodynamic instability who are unfit for surgery.
- Decompressive craniectomy within 4 weeks.

- Refusal to participate in the study. After taking consent, a complete history, clinical examination, routine and special investigation (if required) were done.

Gross appearance of bone like maximum length, maximum width, thickness measured with Vernier calliper were noted. All information was kept confidential. Statistical Analysis: The data analysis was done using Statistical Package for Social Sciences (SPSS) version 22.0. Qualitative variables were correlated using Chi-Square test.

### RESULTS:

Men constituted 88% of the study group. Head injury (82%) was the most common indication for decompressive craniectomy. RTA (Road traffic accident) was most common mode of injury accounting 79% of total patients. Among women the most common mode of injury was fall from bike (sitting behind without helmet) followed by fall from height. Trauma patients more commonly needed decompressive craniectomy as compared to tumour and cerebrovascular diseases. 19 (74%) patients had trauma, 6 (23%) had tumour and 1 (3%) had cerebrovascular diseases. Severe trauma (GCS 3 to 8) patients formed the major bulk in the group constituting 14 (74%) followed by 3 (16%), 2 (10%) were in moderate (GCS 9 to 12) and mild (13-15) trauma patients respectively.

### DISCUSSION

Decompressive craniectomy (DC) has been used as an effective treatment for raised ICP for several years<sup>11</sup>. Many randomized trials were conducted in order to ascertain whether DC can improve clinical outcomes and to better define its role in the treatment<sup>2,5,6,12</sup> algorithms for patients with severe TBI. However, in decompressive craniectomy three main procedures performed for TBI are hemicraniectomy (large unilateral fronto-temporoparietal flap), bilateral hemicraniectomy, and bifrontal DC (bone flap extending from the floor of the anterior cranial fossa anteriorly to the coronal suture posteriorly and to the middle cranial fossa floor bilaterally). Various studies showed this removed bone may be then preserved in alcohol, formalin and cryopreserved. To maintain sterility boiling and autoclaving methods had been employed<sup>13-15</sup> without much interfering with osteogenic potential of the bone. Storing the bone flap in the abdominal wall until it was required for the cranioplasty was first described by Kreider in 1920<sup>8</sup>. But this necessitates another operation and produces an unsightly scar and there is little evidence for better osteogenic potential of the bone. It is known that bone removed from its blood supply and replaced in fresh tissue dies, with the exception of a layer of superficial cells less than a millimetre in depth.

The present study was conducted to assess gross changes in calvarial bone placed in abdomen after decompressive craniectomy done in patients admitted in Neurosurgery department. There are many studies

which shows the effectiveness of DC, but there are no clear guidelines about timing of cranioplasty, the risk-benefit, cost-benefit and lack of standard comparisons between studies especially assessing the gross and microscopic changes. Twenty-five patients were included after the inclusion and exclusion criteria. All were operated for cranioplasty after 4 months of decompressive craniectomy. Men (n=22) were more commonly involved than women (n=4) and the results were similar to other studies<sup>17</sup>. Head injury (82%) was the most common indication for decompressive craniectomy. RTA (Road traffic accident) was most common mode of injury accounting 79% of total patients.

Among women the most common mode of injury was fall from bike. 74% patients had severe head injury where as 16%, 10% patients had moderate and mild head trauma respectively. This is comparable to general distribution of patients according to severity of TBI<sup>18</sup>. In gross examination of bone it was found that there was statistical significant reduction of bone length 16% in patients who underwent cranioplasty after 4 months. There was significant reduction of bone width 11% in patients who underwent cranioplasty after 4 months. It was found that there was significant reduction in bone thickness 18.2% in patients. Our results are similar to other studies which also showed<sup>19</sup> reduction in volume of the bone. On microscopic examination, only 6% patients had shown some mild degenerative changes and necrotic foci. Remaining 94% patients had shown normal bone histology with normal lamellar structure. Our findings are comparable to study by Singla N et al<sup>9</sup> who also found that in microscopic examination presence of osteocytes in 86 %, osteoblastic activity in 38 % and angiogenesis in 14 % of bone respectively. But it was not significant correlation. Subcutaneously preserved bone remains viable and retains its osteogenic potential and is simple, cost-effective option with negligible infection rate.

## CONCLUSION

We from our 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. There is statistically significant reduction in length, width, thickness measured in patients who underwent cranioplasty 4 months after initial surgery. So preservation of bone in the abdominal wall keeps the bone viable and a good cost effective alternative with minimum reduction in size of the bone if it is done within 4 months of DC.

**Limitation Of The Study:** In our study sample size was small, so study with large sample size should be done to make more conclusive results.

**Financial Support And Sponsorship:** Nil

**Conflicts Of Interest:** There are no conflicts of interest.

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