ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 04 | April - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

RETROSPECTIVE COMPARATIVE STUDY OF EARLY CRANIOPLASTY VS. LATE CRANIOPLASTY: A REVIEW OF SURGICAL OUTCOMES AND COMPLICATIONS

Neurosurgery

Anil Kumar* Resident Dr S N Medical College Jodhpur, Rajasthan. *Corresponding Author

Sunil Garg Senior Professor And Unit Head Neurosurgery Department, Dr S N Medical College Jodhpur, Rajasthan.

ABSTRACT

Cranioplasty is a surgical procedure performed to repair a defect in the skull, typically following a traumatic brain injury, tumor surgery, or congenital deformity. The timing of cranioplasty, either early or late, can have a significant impact on outcomes such as brain function, cosmetic results, and complication rates. This paper aims to compare early versus late cranioplasty in terms of surgical efficacy and complication rates.

KEYWORDS

cranioplasty, decompressive craniectomy, postop complication.

INTRODUCTION

Cranioplasty is a common neurosurgical procedure performed to reconstruct a skull defect. It is most commonly performed following a decompressive craniectomy (DC), a procedure performed for raised intracranial pressure (ICP), which can occur following traumatic brain injury (TBI), cerebral infarction, subarachnoid haemorrhage, intracerebral haemorrhage, venous sinus thrombosis, removal of bone-invading tumours or an infected boneflap [4]. An increasing number of cranioplasty procedures have been performed in recent years due to the rising popularity of DC to manage raised intracranial pressure following traumatic brain injury and malignant ischaemic stroke [4] .

The aim of a cranioplasty is to restore cosmetic appearances, protect the underlying brain from further injury and facilitate neurological recovery and rehabilitation. A number of mechanisms have been proposed for reversible neurological disability following craniectomy— this includes cerebrospinal fluid flow disruption, venous sinus congestion, abnormal atmospheric pressures which can lead to 'syndrome of the trephined' and alterations in cellular metabolism [2]. There is evidence for reduction in cerebral blood flow following DC, demonstrated by perfusion CT and transcranial Doppler ultrasound, which is attributed to the effect of atmospheric pressure on the decompressed area of brain [4,8].

There is a considerable variation in practice in terms of timing of cranioplasty following DC . Traditionally, a cranioplasty would be delayed to allow for cerebral oedema to resolve and for the patient's neurological status to improve, and to reduce the chance of wound infection and delayed hydrocephalus [4]. There is evidence from a number of retrospective studies suggesting that an early cranioplasty procedure may lead to similar or reduced complication rates, with an improvement in overall neurological outcome [1,7]. On the contrary, there is also evidence that infection and the development of hydrocephalus are more prevalent when cranioplasty is performed later [6]. Notably, these studies varied in their definition of 'early' cranioplasty ranging from 6 weeks to 3 months, however, both of the systematic reviews used 3 months as the divider between early and late. Another study looked at preoperative CT findings and found that the brain sunken ratio was a stronger predictor of postoperative complications [5], suggesting that cranioplasty timing should take into account individual patient factors rather than having a set time for all patients.

Overall, there does not seem to be a clear consensus on whether cranioplasty can safely be performed early and whether it may confer additional benefits in terms of neuro-logical recovery.

In our neurosurgical unit, a cranioplasty is traditionally performed at 3 to 6 months to allow the wound to heal and for the patient to recover from the acute insult. However, the growing evidence in support of an earlier cranioplasty has led to some surgeons electing to perform the cranioplasties at an earlier date. This allows a direct comparison between the groups to assess outcomes and complications.

We present a retrospective study of patients undergoing cranioplasty following DC.The purpose of the present study is to assess the neurological outcome and postoperative complication rates among patients who underwent early versus late cranioplasty.

METHODS

A retrospective review was performed on all patients who underwent a autologous cranioplasty at a single regional neurosurgical unit over a 3-year period between may 2022 and december 2024. Data was collected from the hospital's electronic database. Individual patient consent and IRB/ethics approval was not required as the study was undertaken as an audit with local institutional approval.

Information analysed included patient age and sex, indication for craniectomy, cranioplasty material, interval between craniectomy and cranioplasty, length of hospital stay, perioperative complications and time to last follow-up. Patients who underwent a cranioplasty following removal of an infected bone flap after a craniotomy were excluded from the study.

Two groups were identified—those who had received an 'early' cranioplasty, defined as less than 3 months from craniectomy, and those who received a 'late' cranioplasty, defined as more than 3 months from craniectomy.

Perioperative complications were compared across the two groups and statistical analysis was performed using a Fisher's exact test. Length of hospital stay was calculated for each admission and compared between the groups.

RESULTS

Fifty patients were included in the study. 35 (70%) were male and 15 (30%) were female. Median age was 43 years, range 16–60 years. Indications for craniectomy included acute subdural haematoma (26 patients), secondary craniectomy for traumatic brain injury with raised intracranial pressure (12 patients), ischaemic stroke (9 patients), intracerebral haemorrhage (2 patients), and aneurysmal subarachnoid haemorrhage (1 patient). All patients received a autologous cranioplasty.

The average time to last follow-up was 6 months (range 0–14). 3 patients did not receive follow-up.

Timing Of Cranioplasty

Of 50 patients, 36 patients (72%) received a late cranioplasty and 14 (28%) received an early cranioplasty. The median interval between craniectomy and cranioplasty was 8 months [range 3–20] in the late group vs. 60 days [range 33–90] in the early group.

The early group is defined as time interval less than 3 months, and the late group is defined as greater than 3 months. Two patients were noted to have developed 'syndrome of the trephined' and 'abnormal CSF dynamics'. One received a cranioplasty at 8 months and was included in the late cohort, the other received a cranioplasty at 46 days and was included in the early cohort. There was no significant difference in preoperative clinical condition in the two groups.

Complications

Overall, complications were seen in 13 patients (26%). This included wound or cranioplasty infection (5 patients), hydro-cephalus (3

patients), symptomatic pneumocephalus (2 pa-tients), acute post-operative haematoma (2 patients), and cosmetic issues (1 patient).

The complication rate was 3/14 in the early group (21%) and 10/35 in the late cranioplasty group (28%). There was no significant difference between the two groups (P = 0.46, Fisher's exact test). Overall rate of infection occurred in 8% of the early group and 13% of the late group (no significant difference, p > 0.99, Fisher's exact test). Infection which required bone flap removal occurred in 8% of the early and 11% of the late group (no significant difference, p > 0.99, Fisher's exact test). Hydrocephalus requiring ventricular shunting occurred in 8% on the early group and 8% of the late group (no significant difference, p >0.99, Fisher's exact test)

Length Of Stay

All patients attended preoperative assessment clinic prior to their admission. Patients who underwent an early cranioplasty had a median length of stay of 7 days (range 5–9 days). Patients who underwent a late cranioplasty had a median length of stay of 5.5 days (range 4–8 days). This difference in length of stay is not statistically significant (P= 0.28), suggesting that performing an early cranioplasty does not necessarily prolong the length of stay for patients.

DISCUSSION

This study provides further evidence that early cranioplasty performed at less than 3 months post-craniectomy does not lead to an increased risk of complications.We chose 3 months as the cut-off between early and late, as this is consistent with the recent major systematic reviews on this topic [1,6,7].

In our study, there was no significant difference in compli-cation rate between the early and late cranioplasty groups (20 and 28% respectively, P= 0.46). There was similarly no signif-icant difference in the rate of specific complications between the two groups. We have deliberately collected thorough and comprehensive data on complications in order to accurately reflect the morbidity associated with cranioplasty. The complication rate may appear high due to the inclusion of superficial wound infection, symptomatic pneumocephalus and cosmetic issues—none of these complications required reoperation.

Our study did not show a significant increase in the risk of hydrocephalus with early cranioplasty. Hydrocephalus requiring ventricular shunting occurred in 8% on the early group and 8% of the late group in our study. An additional benefit to an early cranioplasty procedure is the neurological improvement that is associated with cranioplasty. Several studies and a systematic review have demonstrated an improvement in neurological function following cranioplasty [3,7] Proposed mechanisms for improvement in neurological function following cranioplasty include the restoration of normal CSF dynamics and normal cerebral blood flow following reconstruction of the skull defect [2, 3, 7].

CONCLUSION

We propose that early cranioplasty performed less than 3 months from decompressive cranioplasty can be a safe alternative to delayed cranioplasty. Other benefits would include completing their treatment early, reducing the risk of further injury to the cranial defect and improving cosmesis. The differences in the rates of overall postoperative complications between early versus late cranioplasty were statistically insignificant.

These findings are consistent with the previous published literature. Future studies should focus on refining patient selection criteria and examining the long-term outcomes of both early and late cranioplasty in terms of brain function, cosmetic results, and quality of life. By considering these factors, surgeons can better tailor cranioplasty procedures to individual patient needs, ensuring optimal outcomes

REFERENCES

1. Anna Bjornson, Tamara Tajsic & Angelos G. Kolias A case series of early and late autologous cranioplasty—comparison of surgical outcomes.Acta Neurochirurgica (2019) 161:467–472
2. Ashayeri K, Jackson M, Huang J et al (2016) Syndrome of the trephined: a systematic review. Neurosurgery 79:525–534
3. Halani SH, Chuh JK, Malcolm JG et al (2017) Effects of cranioplasty on cerebral blood flow following decompressive craniectomy: a systematic review of the literature. Neurosurgery 81(2):204–216
4. Kolias AG, Kirkpatrick PJ, Hutchinson PJ (2013) Decompressive craniectomy: past, present and future. Nat Rev Neurol 9(7):405– 415
5. Lee JM, Whang K, Cho SM et al (2017) Factors affecting optimal time of cranioplasty: brain sunken ratio. Korean J Neurotrauma 13(2):113–118
6. Malcolm JG, Rindler RS, Chu JK et al (2016) Complications following cranioplasty and relationship to timing: a systematic review and meta-analysis. J Clin Neurosci 33:39–51
7. Malcolm JG, Rindler RS, Chu JK et al (2018) Early cranioplasty is associated with greater neurological improvement: a systematic review and meta-analysis. Neurosurgery 82(3):278–288
8. Song J, Liu M, Mo X et al (2014) Beneficial impact of early cranioplasty in patients with decompressive craniectomy: evidence from transcranial Doppler ultrasonography. Acta Neurochir 156(1): 193–198