Cranioplasty following a decompressive craniotomy

- A core outcome set for cranioplasty following stroke or traumatic brain injury - The COAST study
- Comparison of Complications in Early and Late Cranioplasty Following Decompressive Craniectomy Due to Traumatic Brain Injury: Systematic Review and Meta-Analysis
- Bone Graft Expansion in Cranioplasty Using a Split-Bone Technique
- Pre- and post-cranioplasty hydrocephalus in patients following decompressive craniectomy for ischemic stroke: a systematic review and meta-analysis
- Masquelet induced cranial membrane under silicone layer during cranioplasty: Toward a natural technique for regeneration of meninges after decompressive craniectomy
- Optimal timing for early cranioplasty following craniectomy: A propensity-matched national database study of 3241 patients
- A Randomized Controlled Trial Comparing Subcutaneous Preservation of Bone Flaps with Cryogenic Preservation of Bone Flaps for Cranioplasty in Cases of Traumatic Brain Injury
- Addressing Temporal Muscle Atrophy and Enhancing Cranioplasty Outcome: A Technical Note

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Cranioplasty (CP) after decompressive craniectomy (DC) for trauma is a neurosurgical procedure that aims to restore esthesis, improve cerebrospinal fluid dynamics [1)], and provide cerebral protection. In turn, this can facilitate neurological rehabilitation and potentially enhance neurological recovery. However, CP can be associated with significant morbidity. Multiple aspects of CP must be considered to optimize its outcomes. Those aspects range from the intricacies of the surgical dissection/reconstruction during the procedure of CP, the types of materials used for the reconstruction, as well as the timing of the CP in relation to the DC [2)].

Timing

An early cranioplasty procedure may improve the outcome in selected cases. Prospective, large-scale studies are necessary to outline the actual complication rate, and the neurological outcome, and define the optimal timing for a cranioplasty [3)].

Surgical objectives

a) separate the temporal muscle from where it has scar redon to the dura

b) avoid CSF leak by not violating the dura(or pseudo-dura) or by closing any opening that is identified

c) repair the bone defect with a bone flap

d) replace the temporal muscle outside the bone graft and, if necessary, tack it into position

Risks

see Cranioplasty complications.

Surgical details

The following pertains in particular to decompressive craniectomy defect which extends from the parietal and frontal regions to include varying amounts of bone overlying the middle fossa.

● re-incise the previous skin incision, being careful to stay on bone where possible, and, where the the incision is not over bone by using e.g. a hemostat under the skin to prevent the scalpel from intra-cranial penetration

● starting at a point near the superior most aspect of the defect, begin to separate the scalp flap from where it is scarred to the dura or pseudodura for a short distance (a couple of centimeters or so) inside the bone edges. This is usually easier if a barrier (e.g. Silastic sheet) was placed at the time of the craniectomy. A Langenbeck periosteal elevator may work in areas where the planes separate easily, a #10 scalpel used with the sharp side of the blade pointing up may be used where scarring is more tenacious

● work around the defect in both directions towards the base of the flap, which is where the caudal aspect of the temporalis muscle crosses the edge of the defect to the outside of the skull

● as long as the tissue is thin (i.e., scar only, no temporalis muscle) use monopolar (Bovie) cautery along the bone as close as possible to the bone edge to expose the bone

● when you get to the point where the anterior and posterior aspect of the temporalis muscle pedicle is identified, you can begin to separate the muscle from where it is scarred to the dura/ pseudodura and lift it off the dura along with the scalp

● during the process, some or all of the temporalis muscle will be detached from the dura and the overlying scalp (some surgeons intentionally detach it completely). Later in the case, the muscle may be tacked down to the bone flap (e.g. through perforation holes) or to the underside of the scalp

● the cup end of a Pennfield #1 dissector may be used to free the scar tissue off the bone edge around the entire defect. The dissector need only expose down to the deep edge of the inner table, without separating the scar from the inner table (which could facilitate epidural bleeding/hematoma formation)

● if the flap is not already perforated, on the back table, the flap is multiply drilled to provide a route of drainage for epidural blood

● the bone flap is placed in the defect. If it is riding up at any point, the soft tissue and any irregularities may be corrected with a drill and/or rongeur

● the flap is secured in position, usually with titanium plates and screws

● a subgaleal drain is brought out through a separate stab incision and closure is performed in the usual manner

Consensus methodology research

In a multi-phase consensus methodology including systematic review, qualitative study, two-round Delphi process, and final consensus meeting. Mee et al. from Cambridge, Oulu, Madrid, Ibadan, Bristol, Cali, Winnipeg, Perth, Modena, London, Lund, Worcester (MA), Adelaide, Milan, Norwich published in the **Journal:** *Brain & Spine* to develop an internationally agreed-upon core outcome set (COS) for cranioplasty following a decompressive craniectomy for stroke or traumatic brain injury. The COAST study successfully defined a 20-item core outcome set across four domains (life impact, pathophysiological manifestations, resource use/economic impact, mortality) based on structured consensus among a wide range of global stakeholders. This COS aims to enhance the consistency and comparability of future cranioplasty studies [4].

Critical Review

The COAST study represents an ambitious and commendable effort to bring standardization to an under-structured field—cranioplasty outcomes. By following the COMET methodology and involving a multidisciplinary and international panel, it enhances the legitimacy and breadth of the final COS.

Strengths: - Wide stakeholder inclusion ensures diverse perspectives (patients, surgeons, allied health professionals). - Rigid adherence to established consensus-building methodology. - The scale of participation (153 individuals across 16 countries) and structured Delphi rounds followed by a consensus meeting reflect robust procedural rigor. - A focused categorization of outcomes into clinically meaningful domains is pragmatic.

Weaknesses: - No formal validation of the selected outcomes in prospective cohorts—feasibility and sensitivity remain theoretical. - Regional representation appears skewed toward academic centers in high-income countries; the extent to which the COS reflects the realities of resource-limited settings is unclear. - The study refrains from discussing any potential conflicts between patient-centered outcomes and those favored by clinicians, nor does it address the weighting or prioritization of these 20 outcomes. - Lack of granularity in reporting stakeholder-specific scoring trends reduces interpretability of consensus dynamics.

Final Verdict: Solid methodology but lacks immediate translational validation. It is an important foundational step for future research standardization, though not yet a clinical tool. A validation phase in real-world clinical trials is critical.

Takeaway for Practicing Neurosurgeons: Begin familiarizing yourself with the COAST COS as a reporting standard, especially when engaging in clinical research on cranioplasty. It does not yet influence clinical decision-making directly.

Bottom Line: Methodologically sound initiative establishing a consensus-based framework for cranioplasty outcomes, but clinical adoption will hinge on future validation studies.

Rating: 7/10

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1)

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2)

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3)

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4)

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