

Morton et al., present the largest [study](#) to date on [complications](#) after [cranioplasty](#), focusing specifically on the relationship between complications and the timing of the operation.

They retrospectively reviewed all cranioplasty cases performed at Harborview Medical Center over the past 10.75 years. In addition to relevant clinical and demographic characteristics, patient morbidity and mortality data were abstracted from the electronic medical record. Cox proportional-hazards models were used to analyze variables potentially associated with the risk of infection, hydrocephalus, seizure, hematoma, and bone flap resorption.

Over the course of 10.75 years, 754 cranioplasties were performed at a single institution. Sixty percent of the patients who underwent these cranioplasties were male, and the median follow-up overall was 233 days. The 30-day mortality rate was 0.26% (2 cases, both due to postoperative epidural hematoma). Overall, 24.6% percent of the patients experienced at least 1 complication including infection necessitating explantation of the flap (6.6%), postoperative hydrocephalus requiring a shunt (9.0%), resorption of the flap requiring synthetic cranioplasty (6.3%), seizure (4.1%), postoperative hematoma requiring evacuation (2.3%), and other (1.6%). The rate of infection was significantly higher if the cranioplasty had been performed < 14 days after the initial craniectomy ($p = 0.007$, Holm-Bonferroni-adjusted $p = 0.028$). Hydrocephalus was significantly correlated with time to cranioplasty (OR 0.92 per 10-day increase, $p < 0.001$) and was most common in patients whose cranioplasty had been performed < 90 days after initial craniectomy. New-onset seizure, however, only occurred in patients who had undergone their cranioplasty > 90 days after initial craniectomy. Bone flap resorption was the least likely complication for patients whose cranioplasty had been performed between 15 and 30 days after initial craniectomy. Resorption was also correlated with patient age, with a hazard ratio of 0.67 per increase of 10 years of age ($p = 0.001$).

Cranioplasty performed between 15 and 30 days after initial craniectomy may minimize infection, seizure, and bone flap resorption, whereas waiting > 90 days may minimize hydrocephalus but may increase the risk of seizure ¹⁾.

2016

In 631 [cranioplasty procedures](#) (503 with [autograft](#), 128 with [bone substitute](#)) by using a stepwise multivariable [logistic regression](#) model and discrimination analysis. There was a significantly higher risk for [reoperation](#) after placement of autograft than after placement of bone substitute; [aseptic bone necrosis](#) ($n = 108$) was the major problem (OR 2.48 [95% CI 1.11-5.51]). Fragmentation of the flap into 2 or more fragments, younger age (OR 0.97 [95% CI 0.95-0.98]; $p < 0.001$), and shunt dependent [hydrocephalus](#) (OR 1.73 [95% CI 1.02-2.92]; $p = 0.04$) were independent [risk factors](#) for [bone necrosis](#). According to discrimination analysis, patients younger than 30 years old and older patients with a fragmented flap had the highest risk of developing bone necrosis.

Development of bone flap necrosis is the main concern in long-term follow-up after cranioplasty with autograft. Patients younger than 30 years old and older patients with a fragmented flap may be candidates for an initial artificial bone substitute rather than autograft ²⁾.

2015

A retrospective analysis of 263 patients of all ages and both sexes who had undergone cranioplasty after [craniectomy](#) for traumatic brain injury (including chronic subdural hematoma), subarachnoid hemorrhage (including intracerebral hemorrhage), ischemic stroke, and tumor surgery in one single center in 12 years from January 2000 to March 2012 has been carried out. A multiple logistic

regression analysis was performed to identify potential risk factors (age, gender, used cranioplasty material, initial diagnosis, clipped or coil-embolized subarachnoidal hemorrhage (SAH) patients, time interval, complications especially hydrocephalus and seizures, mobility) upon the prognosis described as a dichotomized Glasgow Outcome Scale. Two hundred forty-eight patients met the study criteria. The overall complication rate after cranioplastic surgery was 18.5 % (46 patients). Complications included: surgical site infection, epidural hematoma, hydrocephalus with or without former SAH, and new-onset seizures. Logistic regression analysis identified significant correlation between a low GOS (2 or 3) and postoperative seizures (OR 2.37, CI 1.35-4.18, $p < 0.05$), shunt-dependent hydrocephalus (OR 5.83, CI 3.06-11.11, $p < 0.05$), and age between 51 and 70 years (OR 2.4, 95 % CI 1.09-5.29, $p = 0.029$). However, gender, time interval between craniectomy and cranioplasty, initial diagnosis, and used cranioplasty material had no significant influence on post-cranioplasty complications as surgical site infections, hematoma, wound healing disturbance, seizures, or hydrocephalus. Evaluation of treatment modality in aneurysmal SAH clip vs. coil showed no significant relation to postoperative complications either. Complications after cranioplastic surgery are a common problem, as prognostic factors could identify a shunt-dependent hydrocephalus and epilepsy to develop a major deficit after cranioplastic surgery (GOS 2 or 3). We detected a significant extra risk of people between the age of 51 and 70 years to end up in GOS level 2 or 3³⁾.

1)

Morton RP, Abecassis IJ, Hanson JF, Barber JK, Chen M, Kelly CM, Nerva JD, Emerson SN, Ene CI, Levitt MR, Chowdhary MM, Ko AL, Chesnut RM. Timing of cranioplasty: a 10.75-year single-center analysis of 754 patients. *J Neurosurg.* 2018 Jun;128(6):1648-1652. doi: 10.3171/2016.11.JNS161917. Epub 2017 Aug 11. PubMed PMID: 28799868.

2)

Schwarz F, Dünisch P, Walter J, Sakr Y, Kalff R, Ewald C. Cranioplasty after decompressive craniectomy: is there a rationale for an initial artificial bone-substitute implant? A single-center experience after 631 procedures. *J Neurosurg.* 2016 Mar;124(3):710-5. doi: 10.3171/2015.4.JNS159. Epub 2015 Sep 25. PubMed PMID: 26406796.

3)

Krause-Titz UR, Warneke N, Freitag-Wolf S, Barth H, Mehdorn HM. Factors influencing the outcome (GOS) in reconstructive cranioplasty. *Neurosurg Rev.* 2015 Dec 1. [Epub ahead of print] PubMed PMID: 26621678.

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