Cranioplasty case series

2022

Of 188 patients undergoing cranioplasty during the study period, 106 (56%) patients were in the N group, and 82 (44%) were in the N+P group. Patient demographics were similar between the 2 groups. For the primary outcome, a total of 20 (18.9%) reoperations were seen in the N group, and 13 (15.9%) in the N+P group (P = 0.708). However, the median time to reoperation was slightly longer in the N+P group in the survival analysis. Wound dehiscence (1.9% vs. 3.7%, P = 0.454), surgical site infection (5.7% vs. 9.8%, P = 0.289), and complication rate (30.2% vs. 32.9%, P = 0.688) did not differ between the 2 groups. Furthermore, the N group had less Jackson-Pratt drain use (58.5% vs. 85.4%, P < 0.001), earlier drain removal (1.9 ± 1.6 vs. 3.4 ± 3.9 days, P < 0.001), and shorter LOS (3.8 ± 5.9 vs. 4.7 ± 3.9 days, P < 0.001). On multivariate regression analysis controlling for age, body mass index, smoking, craniectomy type, the reason for craniectomy, and graft type, N+P was associated with increased drain use (odds ratio = 4.90, 95% confidence interval 2.28-11.30, P < 0.001) and longer drain duration (β = 1.50, 95% confidence interval 0.43-2.60, P = 0.007).

Despite similar complications and reoperation rates between groups, reoperations in the N group occurred sooner, whereas the N+P group more commonly used drains and kept drains in for longer [1].

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149 cranioplasty implants were included. Younger age (6 years old or under), a diagnosis of craniosynostosis as a reason for an implant, use of autologous bone, and shorter times to cranioplasty were predictive of the need for revision surgery. No factors studied had a statistically significant impact on the rate of removal of an implant at the time of revision surgery.

Autologous and alloplastic cranioplasty materials both have good outcomes with low rates of revision surgery in the pediatric population. Alloplastic implants may be considered in the setting of infection as the reason for craniectomy given the lower rate of revision surgery and the need for removal. Patients with craniosynostosis as the reason for cranioplasty have a higher risk of requiring revision or additional surgeries, regardless of the implant used [2].

Wesp et al. aimed to evaluate the feasibility and safety of biocompatible calcium-phosphate (CaP) implants for cranioplasty compared to polymethylmethacrylate (PMMA) implants. In this retrospective, observational cohort study, the medical records of all patients who underwent cranioplasty between January 1st, 2015, and January 1st, 2022, were reviewed. Demographic, clinical, and diagnostic data were collected. Eighty-two consecutive patients with a mean age of 52 years (range 22-72 years) who received either a PMMA (43/82; 52.4%) or CaP (39/82; 47.6%) cranial implant after DC were included in the study. Indications for DC were equally distributed in both groups. Time from DC to cranioplasty was 143.8 ± 17.5 days (PMMA) versus 98.5 ± 10.4 days (CaP). The mean follow-up period was 34.9 ± 27.1 months. Postoperative complications occurred in 13 patients with PMMA and 6 in those with CaP implants (13/43 [30.2%] vs. 6/39 [15.4%]; p = 0.115). Revision surgery with implant removal was necessary for 9 PMMA patients and in 1 with a CaP implant (9/43 [20.9%] vs. 1/39 [2.6%]; p = 0.0336); 6 PMMA implants were removed due to surgical site infection (SSI) (PMMA 6/43 [14%] vs. CaP 0/39 [0%]; p = 0.012). In this study, a biocompatible CaP implant seems to be superior to a PMMA

implant in terms of SSI and postoperative complications. The absence of SSI supports the idea of the biocompatible implant material with its ability for osseointegration [3].

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conducted a nationwide retrospective study of the patients who underwent cranioplasty. Patients who underwent cranioplasty by the Neurosurgical Department from January 2014 to June 2019 were included. Patients were excluded if they did not have a minimum of 30-days follow-up or the initial cranioplasty was performed elsewhere. Outcomes including complications post cranioplasty and 30-day and 1-year failure rates were assessed. All statistical analyses were performed with SPSS version 20 (IBM Corporation, Armonk, New York, USA). The χ 2 test, Student's t -test, and the Mann-Whitney U test were performed for nominal, normally, and non-normally distributed variables, respectively. Multivariate logistic regression was used to assess predictors for complications and cranioplasty failure. Results Seventy-seven patients with a median age of 48 (interquartile range, 37-61) years were included. Most cranioplasties used autologous bone (70/77, 90.9%). Infection and overall complication rates were 3.9% and 15.6%, respectively. Cranioplasty failure (defined as removal or revision of cranioplasty) rate was 9.1%. Previous cranial site infection post craniectomy was associated with cranioplasty failure (odds ratio: 12.2, 95% confidence interval [1.3, 114.0], p =0.028). Conclusions Cranioplasty is generally associated with significant complications, including reoperation for implant failure. We highlighted that autologous bone cranioplasties can be performed with an acceptable low rate of infection, making it a viable first option for implant material [4].

This study included 104 patients. Complications after decompressive craniectomy were significantly frequent in patients with a hypertension history (p=0.03). In contrast, complications of cranioplasty were significantly frequent in patients with a history of diabetes mellitus, hepatic failure, or trauma (p=0.03, p<0.01, and p=0.01, respectively). Artificial bones were used more frequently than autologous bones in patients with trauma (p=0.03); however, there was no difference in the incidence of complications between them (p=0.64).

Conclusion: Hypertension is a significant risk factor for decompressive craniectomy complications, especially rebleeding. Diabetes, hepatic failure, and trauma are significant risk factors for cranioplasty complications. There was no statistical difference in the incidence of complications between the use of autologous and artificial bones [5]

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a retrospective observational study conducted at a tertiary care center between 2015 and 2021. Adults with autologous cranioplasty (n = 132) were recruited from procedure logs and the hospital electronic health record. Clinicodemographic parameters, risk factors, and complications were recorded. Neurologic outcomes were measured using the dichotomized Glasgow Outcome Scale (GOS). Primary outcome measure was pre- and post-cranioplasty GOS at the last follow up. Secondary outcome measures were the predicting factors that contributed to enhanced neurologic outcome post-cranioplasty.

Results: Mean age was 41.4 (standard deviation ± 13.5) years with male predominance (12.2:1). Complications developed in 12.9% (n = 17), with infections in 3.8% (n = 5) and hydrocephalus in 2.3% (n = 3). In bivariate analysis, pre-cranioplasty GOS good grades 4 and 5 (P < 0.001), trauma as an indication for decompressive craniectomy (DC) (P < 0.001), and early cranioplasty ≤12 weeks (P = 0.023) were statistically significant predictors for post-cranioplasty neurologic recovery at follow-up.

In a multiple logistic regression model, adjusted odds ratio for pre-cranioplasty GOS was 28.77 (95% confidence interval [CI] 7.21-114.74, P < 0.001), for trauma as indication for DC was 5.15 (95% CI 1.65-16.05, P = 0.003), and for early cranioplasty ≤12 weeks was 3.04 (95% CI 1.12-8.27 P = 0.029).

Conclusions: Autologous cranioplasty contributes to a quantifiable neurologic outcome. Pre-cranioplasty neurologic status, cranioplasty done for traumatic DC and early cranioplasty may have potential for enhanced neurologic recovery. Further clinical studies with better evidence may expound upon these findings [6)].

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present a consecutive series over a 10-year period of nine patients treated for hydroxyapatite cranioplasty infection. Clinical and radiological data from admission and follow-up, photo and video material documenting the different phases of infection assessment and treatment, and final outcomes were retrospectively reviewed in an attempt to identify the best options and possible pitfalls in a case-by-case decision-making process.

Five unilateral and four bifrontal implants became infected. Wound rupture with cranioplasty exposure was the most common presentation. At revision, all implants were ossified, requiring a new craniotomy to clean the purulent epidural collections. The cranioplasty was fully saved in one hemispheric and 2 bifrontal implants and partially saved in the remaining 2 bifrontal implants. A complete cranioplasty removal was needed in the other 4 cases, but immediate cranial reconstruction was possible in 2. Skin defects were covered by free flaps in 3 cases. Four patients underwent adjunctive hyperbaric therapy, which was effective in one case.

In our experience, infected hydroxyapatite cranioplasty management is complex and requires a multidisciplinary approach. Salvage of a hydroxyapatite implant is possible under specific circumstances [7)].

A single-center, retrospective cohort study of patients undergoing first alloplastic cranioplasty at a tertiary neuroscience center (01 March 2010-01 September 2021). Patient demographics and craniectomy/cranioplasty details were extracted. The primary outcome was all-cause explantation. Secondary outcomes were explantation secondary to an infection, surgical morbidity, and mortality. Multivariable analysis was performed using Cox proportional hazards regression or binary logistic regression.

Results: Included were 287 patients with a mean age of 42.9 years [SD = 15.4] at the time of cranioplasty. The most common indication for craniectomy was traumatic brain injury (32.1%, n = 92). Cranioplasty materials included titanium plate (23.3%, n = 67), hydroxyapatite (22.3%, n = 64), acrylic (20.6%, n = 59), titanium mesh (19.2%, n = 55), hand-molded PMMA cement (9.1%, n = 26) and PEEK (5.6%, n = 16). Median follow-up time after cranioplasty was 86.5 months (IQR 44.6-111.3). All-cause explantation was 12.2% (n = 35). Eighty-three patients (28.9%) had surgical morbidity. In multivariable analysis, the risk of all-cause explantation and explantation due to infection was reduced with the use of both hydroxyapatite (HR 0.22 [95% CI 0.07-0.71], p = .011, HR 0.22 [95% CI 0.05-0.93], p = .040) and acrylic (HR 0.20 [95% CI 0.06-0.73], p = .015, HR 0.24 [95% CI 0.06-0.97], p = .045), respectively. In addition, risk of explantation due to infection was increased when time to cranioplasty was between three and six months (HR 6.38 [95% CI 1.35-30.19], p = .020). Mean age at cranioplasty (HR 1.47 [95% CI 1.03-2.11], p = .034), titanium mesh (HR 5.36 [95% CI 1.88-15.24], p = .002), and use of a drain (HR 3.37 [95% CI 1.51-7.51], p = .003) increased risk of mortality.

Conclusions: Morbidity is high following cranioplasty, with over a tenth requiring explantation. Hydroxyapatite and acrylic were associated with reduced risk of all-cause explantation and explantation due to infection. Cranioplasty insertion at three to six months was associated with an increased risk of explantation due to infection [8].

2019

A retrospective cohort study was conducted to investigate the predictors of infection among patients who underwent cranioplasty from subcutaneously preserved bone flaps in abdominal pockets between January 2005 and December 2018 at a level l trauma center.

A total of 103 cases of cranioplasty from subcutaneously preserved bone flaps were included in the study. The mean age of the patients was 31 ± 14 years old (range: 5-67 years old). The median interval between DC and cranioplasty was 115 days. The most frequent indication for cranioplasty was traumatic brain injury (63.7%). The incidence of SSI was noted in 15.7%. The most common predictors of infection in patients requiring cranioplasty were blood glucose levels and a large defect size (p=.030 and p=.023) respectively.

The incidence of SSI in cranioplasty was associated with modifiable risk factors, i.e., blood glucose levels and skull defect size. Storing bone flaps in subcutaneously preserved abdominal pockets was cost-efficient and carried no additional risk of infection [9].

A prospective cohort study of patients from August 2015 to December 2017, who had undergone decompressive craniectomy followed by cranioplasty after 6 weeks at our institution. All patients were followed up to 6 months after cranioplasty and complications were recorded both by imaging and clinically. The complications were classified as minor (subgaleal collection, seizures) did not require the second surgery, and major (hydrocephalus, bone flap infection) who required the second surgery. To find out neurological outcomes, the Glasgow coma score (GCS) and Glasgow outcome scale extended (GOSE) were recorded at 1 month, 3 months, and 6 months.

Results: The overall complication rate in this study was 22.4% (16/72). Subgaleal collection was the most common complication (5.6%), followed by hydrocephalus (4.2%), seizure (4.2%), bone flap infection (2.8%), intracerebral hematoma (2.8%), empyema (1.4%), and subdural hematoma (SDH) (1.4%). Of these, 8.4% (n = 6/72) were major complications (hydrocephalus n = 3, bone flap infection n = 2, and SDH n = 1) which required the second surgery. GCS and GOSE were assessed preoperatively and in the postoperative period at 1 month, 3 months, and 6 months. Both mean values of GCS and GOSE showed a significant improvement at 3 and 6 months after cranioplasty.

Conclusion: Cranioplasty after decompressive craniectomy is associated with a higher complication rate, but good neurological outcome after surgery always outweighs the complications.

Key message: Cranioplasty after decompressive craniectomy is associated with a higher complication rate, but good neurological outcomes after surgery always outweigh the complications. However, the complication rate can be brought down by meticulous timing of cranioplasty in a patient with well-controlled comorbidities and precise surgical techniques. However, storing bone in the bone bank is not an additional factor for any post cranioplasty complications which was considered previously [10]

2016

Paredes et al., prospectively studied cranioplasties performed at a hospital over a 5-year period. The National Institute of Health Stroke Scale and Barthel index were recorded prior to and within 72 h after the cranioplasty. A perfusion computed tomography (PCT) and transcranial Doppler sonography (TCDS) were performed prior to and 72 h after the surgery. For the PCT, regions irrigated by the anterior cerebral artery, the middle cerebral artery (MCA), the posterior cerebral artery, and the basal ganglia were selected, as well as the mean values for the hemisphere. The sonography was performed in the sitting and the supine position for the MCA and internal carotid. The velocities, pulsatility index, resistance index, and Lindegaard ratio (LR) were obtained, as well as a variation value for the LR (ΔLR = LR sitting - LR supine). Fifty-four patients were included in the study. Of these, 23 (42.6%) patients presented with objective improvement. The mean cerebral blood flow of the defective side (m-CBF-d) increased from 101.86 to 117.17 mL/100 g/min ($p = 0.064$), and the m-CBF of the healthy side (m-CBF-h) increased from 128.14 to 145.73 mL/100 g/min ($p = 0.028$). With regard to the TCDS, the ΔLR was greater on the defective side prior the surgery in those patients who showed improvement (1.295 vs. -0.714; $p = 0.002$). Cranioplasty resulted in clinical improvement in 40% of the patients, with an increase in the post-surgical CBF. The larger variations in the LR when the patient is moved from the sitting to the supine position might predict the clinical improvement [11)].

2013

Wachter et al., performed a retrospective chart analysis of patients that underwent DC and subsequent bone flap reimplantation between 2001 and 2011 at the Department of Neurosurgery, Georg-August-University Göttingen, Göttingen, Germany.

They registered demographic data, initial clinical diagnosis and surgery-associated complications.

They identified 136 patients that underwent DC and subsequent reimplantation. Forty-one patients (30.1%) had early or late surgery-associated complications after bone flap reimplantation. Most often, bone flap resorption and postoperative wound infections were the underlying causes (73%, n=30/41). Multivariate analysis identified age (p=0.045; OR=16.30), GOS prior to cranioplasty (p=0.03; OR=2.38) and nicotine abuse as a prognostic factor for surgery-associated complications (p=0.043; OR=4.02). Furthermore, patients with early cranioplasty had a better functional outcome than patients with late cranioplasty ($p<0.05$).

Almost one-third of the patients that are operated on for bone flap reimplantation after DC suffer from surgery-associated complications. Most often, wound healing disorders as well as bone flap resorption lead to a second or even third operation with the need for artificial bone implantation. These results might raise the question, if subsequent operations can be avoided, if an artificial bone is initially chosen for cranioplasty [12)].

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