Endoscopic strip craniectomy case series

The purpose of Rudolph et al. from the Albany Medical Center was to analyze cranial width and length growth curves in the early postoperative period of patients by undergoing endoscopic sagittal strip craniectomy (ESC) to determine the timing of the maximal growth curve change. By analyzing the complex interplay of cephalic length and width measurements, they hoped to better understand the cephalic index (CI) growth curve during this early period. This is the first of a multi-step process to elucidate the ideal cranial remolding orthosis (CRO) treatment duration.

Design: Retrospective review.

Setting: Tertiary academic institution.

Patients: Children with isolated sagittal craniosynostosis.

Interventions: ESC and postoperative CRO treatment (2015-2019).

Main outcome measures: One cranial orthotist obtained preoperative and postoperative measurements. The maximal rate of change of width, length, and CI was compared against the postoperative week these occurred.

Thirteen children (mean age: 3.3 months, average preoperative CI: 73.4) underwent this intervention. CI reached its highest growth rate by 4.9 average weeks postoperatively, which correlated with the maximal width growth rate (5.2 weeks). Length curves reached their maximal growth rate by 15.5 weeks. CI peaked (81.3) by 22.7 weeks postoperatively, a significant increase from baseline.

Following endoscopic sagittal strip craniectomy, in the early postoperative period, the cephalic index growth curve has 4 phases: initial rapid expansion early and late slowed expansion, and plateau, followed by possible regression phases. This highlights the importance of early postoperative cranial remolding orthosis initiation, cranial remolding orthosis compliance, and properly fitting cranial remolding orthosis, especially in the first 2 phases. This data sets the stage for investigating the ideal treatment length [1)]

A retrospective chart review was performed for patients with nonsyndromic craniosynostosis who underwent minimally-invasive nonendoscopic suturectomy between 2019 and 2020.

Thirteen patients (11 males; 2 females) were operated including 5 Metopic, 5 Sagittal, 2 coronal, and 1 lambdoid craniosynostosis. The average age at surgery was 4.35 months. The average length of surgery was 71 minutes. Averaged intraoperative estimated blood loss was 31.54 mL. Eleven patients received a blood transfusion (most before performing the skin incision) with a mean amount of 94.62 mL of blood transfused during surgery. The mean hemoglobin at discharge was 10.38 mg/dL. There was only 1 intraoperative mild complication. The mean intrahospital length of stay was 1.77 days with no postoperative complications noted. All patients initiated remodeling orthotic treatment following surgery. Long-term follow-up scans were available for 8 patients (5 metopic, 2 sagittal, and 1 lambdoid) with an average follow-up of 9 months. In all cases, there was a significant improvement in the skull width at the synostosis location as well as in the skull proportions and symmetry. The above outcomes are similar to those published in the literature for endoscope-assisted strip-craniectomies.

Suturectomies assisted with cranial orthosis remodeling for the treatment of all types of nonsyndromic craniosynostosis can be performed without an endoscope while maintaining minimal-invasiveness, good surgical results, and low complication rates [2].

2017

An IRB-approved retrospective review was conducted on a consecutive series of cases involving ESC for sagittal craniosynostosis at 2 different institutions from March 2008 to August 2014. The patients in Group A underwent ESC and those in Group B had ESC with lateral barrel-stave osteotomies. Demographic and perioperative data were recorded; postoperative morphological outcomes were analyzed using 3D laser scan data acquired from a single orthotic manufacturer who managed patients from both institutions. RESULTS A total of 73 patients were included (34 in Group A and 39 in Group B). Compared with Group B patients, Group A patients had a shorter mean anesthetic time (161.7 vs 195 minutes; $p < 0.01$) and operative time (71.6 vs 111 minutes; $p < 0.01$). The mean hospital stay was similar for the 2 groups (1.2 days for Group A vs 1.4 days for Group B; $p = 0.1$). Adequate postoperative data on morphological outcomes were reported by the orthotic manufacturer for 65 patients (29 in Group A and 36 in Group B). The 2 groups had similar improvement in the cephalic index (CI): Group A, mean change 10.5% (mean preoperative CI 72.6, final 80.4) at a mean follow-up of 13.2 months; Group B, mean change 12.2% (mean preoperative CI 71.0, final 79.6) at a mean follow-up of 19.4 months. The difference was not statistically significant ($p = 0.15$). CONCLUSIONS Both ESC alone and ESC with barrel staving produced excellent outcomes. However, the addition of barrel staves did not improve the results and, therefore, may not be warranted in the endoscopic treatment of sagittal craniosynostosis [3].

2016

Dlouhy et al., evaluated 2 methods for endoscope-assisted correction of sagittal craniosynostosis: wide vertex suturectomy and barrel stave osteotomies (WVS+BSO) and narrow vertex suturectomy (NVS).

The authors evaluated patients with nonsyndromic sagittal synostosis treated with either wide vertex suturectomy (4-6 cm) and barrel stave osteotomies (WVS+BSO) or narrow vertex suturectomy (NVS) (approximately 2 cm) between October 2006 and July 2013. Prospectively collected data included patient age, sex, operative time, estimated blood loss (EBL), postoperative hemoglobin level, number of transfusions, complications, and cephalic index. Fourteen patients in the NVS group were age matched to 14 patients in the WVS+BSO group. Descriptive statistics were calculated, and Student t-tests were used to compare prospectively obtained data from the WVS+BSO group with the NVS group in a series of univariate analyses.

The mean age at surgery was 3.9 months for WVS+BSO and 3.8 months for NVS. The mean operative time for patients undergoing NVS was 59.0 minutes, significantly less than the 83.4-minute operative time for patients undergoing WVS+BSO ($p < 0.05$). The differences in mean EBL (NVS: 25.4 ml; WVS+BSO: 27.5 ml), mean postoperative hemoglobin level (NVS: 8.6 g/dl; WVS+BSO: 8.0 g/dl), mean preoperative cephalic index (NVS: 69.9; WVS+BSO: 68.2), and mean cephalic index at 1 year of age (NVS: 78.1; WVS+BSO: 77.2) were not statistically significant. C

The NVS and WVS+BSO produced nearly identical clinical results, as cephalic index at 1 year of age

was similar between the 2 approaches. However, the NVS required fewer procedural steps and significantly less operative time than the WVS+BSO. The NVS group obtained the final cephalic index in a similar amount of time postoperatively as the WVS+BSO group. Complications, transfusion rates, and EBL were not different between the 2 techniques [4].

2014

Le et al, compared children with surgically corrected sagittal craniosynostosis to their age-matched control subjects to assess the longevity of their corrections. Furthermore, the outcomes of open repairs were compared with endoscopic repairs.Following institutional review board approval, three-dimensional photographs of patients who underwent surgical reconstruction for nonsyndromic sagittal synostosis were analyzed to determine biparietal and anterior-posterior diameter, circumference, cephalic index, cranial vault volume, cranial height, and forehead inclination. Thirteen patients who had undergone open repair, including 6 total cranial vault and 7 modified-pi procedure reconstructions, and 6 patients who had undergone endoscopic strip craniectomy with barrel-stave osteotomies and postoperative helmeting were compared with nonsynostotic age-matched control subjects. Mean follow-up was 97.5 months after open and 48.9 months after endoscopic repair. Student t tests were used for analysis. In the second arm of this study, 33 patients who had undergone endoscopic repair were compared with the 13 patients who had undergone open repair; mean follow-up was 24.8 months after endoscopic repair. Linear regression models were used to adjust for age and sex.After comparing three-dimensional photographs of children who were more than 3 years postoperative from surgical correction for sagittal synostosis with their age-matched control subjects, no statistically significant differences were found in any of the measured parameters. In addition, no differences were detected between open reconstruction versus endoscopic repair, suggesting equivalence in final results for both procedures [5].

The surgical management of infants with sagittal synostosis has traditionally relied on open cranial vault remodeling (CVR) techniques; however, minimally invasive technologies, including endoscope-assisted craniectomy (EAC) repair followed by helmet therapy (HT, EAC+HT), is increasingly used to treat various forms of craniosynostosis during the 1st year of life.

In a retrospective case-control analysis of 21 children who had undergone CVR and 21 who had undergone EAC+HT. Eligibility criteria included an age less than 1 year and at least 1 year of clinical follow-up data. Financial and clinical records were reviewed for data related to length of hospital stay and transfusion rates as well as costs associated with physician, hospital, and outpatient clinic visits. Results The average age of patients who underwent CVR was 6.8 months compared with 3.1 months for those who underwent EAC+HT. Patients who underwent EAC+HT most often required the use of 2 helmets (76.5%), infrequently required a third helmet (13.3%), and averaged 1.8 clinic visits in the first 90 days after surgery. Endoscope-assisted craniectomy plus HT was associated with shorter hospital stays (mean 1.10 vs 4.67 days for CVR, $p < 0.0001$), a decreased rate of blood transfusions (9.5% vs 100% for CVR, $p < 0.0001$), and a decreased operative time (81.1 vs 165.8 minutes for CVR, $p < 0.0001$). The overall cost of EAC+HT, accounting for hospital charges, professional and helmet fees, and clinic visits, was also lower than that of CVR ($37,255.99 vs $56,990.46, respectively, $p < 0.0001$).

Endoscope-assisted craniectomy plus HT is a less costly surgical option for patients than CVR. In addition, EAC+HT was associated with a lower utilization of perioperative resources. Theses findings suggest that EAC+HT for infants with sagittal synostosis may be a cost-effective first-line surgical option [6].

2011

One hundred seventy-three patients (61 females and 112 males) were treated between July 2004 and March 2011 with endoscope-assisted strip craniectomy and postoperative helmet therapy (EASC + PHT). The mean operative time was 46.30 minutes. Eight (4.6%) of the 173 patients received blood transfusions. The average length of hospital stay was 1.35 days, with the majority of patients being discharged the day after surgery. All complications and any patient who required additional craniofacial reconstructions are discussed. In addition, a subgroup analysis was done for patients who had undergone surgery and had longer than 1 year of follow-up. The authors' growing database of patients supports the experiences described by others that early treatment of craniosynostosis with an EASC + PHT is a safe and efficacious technique. In addition, cost reduction due to decreased hospital stay and limitation of blood transfusions are demonstrable benefits associated with the use of this technique [7].

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