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PURPOSE: Cephalic index (CI) is the most common measurement to quantify dolicocephaly in sagittal synostosis (SS), but it is considered unreliable as an outcome measure. Posterior skull height (PSH) has recently been suggested as a better outcome measure of SS reconstruction. Posterior vault reconstruction (PVR) addresses the dolicocephaly and skull height deformity observed in SS and thus, is an ideal intervention to compare and contrast PSH and CI as outcome measures. This study aims to define PSH and changes post-PVR by craniometric analysis and measure the correlation to aesthetic improvement in SS patients.

METHODS: Non-syndromic SS patients undergoing PVR from 1994–2017 with pre- and postoperative computed tomography (CT) scans were included. PVR was performed with or without switch cranioplasty. Mimics (Materialise Inc., Leuven, Belgium) was used to measure CI, PSH (defined as opisthion and basion to the cortex orthogonal to the Frankfort horizontal), and posterior bossing angle (PBA) (outer cortex-opisthion-opisthocranion). Surgical residents and laypeople were surveyed to correlate PSH and CI to aesthetic outcomes. Respondents rated patients on the visual analogue scale (VAS) (0 = no deformity; 100 = severe deformity) and recommended surgery if necessary. Independent t-tests and linear and logistic regressions were used as appropriate.

RESULTS: Of 397 SS patients, 87 patients underwent PVR, and 26 met inclusion criteria for CT imaging. Thirteen subjects with adequate photographs were included in the aesthetic assessment survey. Postoperative CI and PSH were significantly increased (CI: 69.55 ± 4.07 to 76.32 ± 4.07; from opisthion: 121.74 ± 7.32 to 125.46 ± 7.04 mm; from basion: 118.85 ± 7.20 to 121.11 ± 6.88 mm; p<0.0001 for all). Postoperative PBA was significantly reduced (47.8°±6.3° to 40.9°±5.3°; p<0.0001). Changes in CI, PSH, or PBA did not vary by surgical technique. Increasing CI was associated with improving VAS (coefficient = -0.97, R²=0.059, p<0.0001). An increase in PSH >5mm measured from the basion was associated with improvements in VAS (ΔVAS=-14.4, R²=0.038, p=0.002).

CONCLUSION: Posterior skull height and cephalic index are significantly increased post-PVR in SS patients. Improvements in PSH and CI are associated with improved aesthetic outcomes. Clinically-relevant assessment of sagittal synostosis likely requires 3D measurements such as the combination of the cephalic index and posterior skull height.

Open Calvarial Vault Reconstruction for Sagittal Craniosynostosis after 1 Year of Age

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OBJECTIVE: Sagittal craniosynostosis remains the most common form of premature single-suture fusion. The primary goals of reconstruction are to relieve growth restriction and improve both biparietal narrowing and frontooccipital bossing. Surgical techniques to correct scaphocephaly have evolved from the strip craniectomy to cranial vault remodeling. Repair is technically more challenging in older patients due to thicker bone requiring more extensive remodeling and need to fill defects. The aim of our study is to assess the safety and efficacy of open repair in patients over 1 year of age.

METHODS: Following IRB approval the authors performed a retrospective chart review of open repairs for nonsyndromic sagittal craniosynostosis between the years of 2004 and 2016 (N = 170). Inclusion criteria required primary calvarial vault reconstruction surgery performed after 1 year of age (N = 20). A combination of subtotal, posterior and clamshell techniques were used. The data associated with length of hospital stay, blood loss, transfusion rates, operative times, cephalic indices (CI), and complications were reviewed. Measurements were taken from available preoperative and 1-year postoperative 3D reconstructed CT scans. All scans were performed using a low-dose radiation protocol. SPSS (v.20 Chicago, IL) was used for statistical analysis. Significance was determined by a value of p = 0.05.

RESULTS: The patients’ mean age (± SD) at surgery was 31 ± 17 months. Of the 20 patients, 10 (50%) were treated...
by subtotal calvarial vault reconstruction, 7 (35%) by clamshell and 3 (15%) by posterior vault only.

Perioperative data were as follows. Mean operative time was 265 ± 50 minutes; mean estimated blood loss was 328 ± 206 ml; and mean length of stay was 3.8 ± 0.8 days. 85% of patients required intraoperative transfusions while 40% required postoperative transfusions. Mean pre- and postoperative CI values were 67.8 ± 3.7 and 73.7 ± 4.5, respectively.

Within the first 30 postoperative days there were no readmissions, medical or surgical complications, additional surgery, or mortality.

Preoperative CIs for subtotal (69.2), clamshell (67.2) and posterior vault (64.7) were equivalent (p = 0.15). Postoperative CIs for the three techniques were 75.8, 72.0 and 70.4, respectively (p = 0.08). There is a trend towards less improvement in CI with increasing age at surgery.

**CONCLUSION:** Open calvarial vault reconstruction is a safe method to correct sagittal craniosynostosis in older children. Despite the safety profile, our series suggest that earlier intervention is better. As children age, the calvarium becomes more rigid and the rate of brain expansion is less, both of which make it difficult to attain ideal aesthetic outcomes (eg, CI>75). In subgroup analysis, subtotal resulted in the best results, followed by clamshell and posterior technique.

**Leveling the Maxillary Occlusal Plane without Orthodontic Appliances in Patients with Hemifacial Microsomia Using Unilateral Vertical Mandibular Distraction Osteogenesis**

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**PURPOSE:** Internal distraction for mandibular lengthening using a vertical vector (vMDO) has been shown to be a stable procedure in the mixed dentition stage for patients with hemifacial microsomia (HFM). Orthodontic appliances have historically been employed to improve the occlusal plane and stability of the maxillary dentoalveolar unit after distraction, but these devices require considerations of cost and patient compliance. The purpose of this study was to evaluate the ability to align the maxillary occlusal plane using vMDO without orthodontic appliances in patients with HFM.

**METHODS:** This was a retrospective evaluation of consecutive patients over an 18-month period who underwent unilateral vMDO for the correction of vertical mandibular asymmetry secondary to HFM with Kaban-Pruzansky type II mandibular deformities. Patients were included if they had complete records and at least one year of clinical follow-up post-consolidation. Preoperative PA cephalograms were analyzed using known landmarks for vertical and horizontal reference lines to record ramus height, maxillary height, dentoalveolar height, chin point deviation, occlusal height, and occlusal plane cant. These values were compared to post-distraction measurements from PA cephalograms taken at a minimum of 3 months after consolidation.

**RESULTS:** Over an 18-month period, 5 patients met inclusion criteria; 3 subjects were female, median age was 12.6 years. Median distraction length was 21.3 mm. Median radiological follow-up was 6 months (range 4 to 38 months) post consolidation. There were no major complications during the study period. Ramus height on the distracted side was increased a median length of 12.0 mm (range 6.2 to 18.6 mm), corresponding to a median ramus height differential (non-distracted minus distracted side) improvement of 98%: median ramus height differential 15.0 mm (range 7.4 to 22.4 mm) preoperatively and 0.25 mm (range 0.2 to 13.1 mm) at follow-up. The chin point distance from vertical midline was improved by 29.1%: median chin point deviation of 7.35 mm (range 4 to 11.6 mm) pre-operatively and 5.55 mm (range 2.7 to 7.8 mm) post-operatively. The maxillary height differential (non-distracted minus distracted side) leveled by a median of 55%: median maxillary height differential 3 mm (range 1.8 to 4.2 mm) pre-operatively and 2.1 mm (0.3 to 2.8 mm) at radiological follow-up. The maxillary occlusal height differential (non-distracted minus distracted side) was decreased by a median of 44.7%: median occlusal height differential of 3.8 mm (range 1 to 5.9 mm) preoperatively and 2.11 mm (0.3 to 2.8 mm) at radiological follow-up. The occlusal plane cant angle was decreased by a median of 84.6% toward neutral: median occlusal cant of 8.5 degrees (range 7.4 to 10.1 degrees) preoperatively and 1.3 degrees (0.8 to 2.8 degrees) at radiological follow-up.