surgery, respectively (p<0.05). Adolescents treated with WVC compared to controls, demonstrated an increased connectivity in the salience network in the left insula (MNI: -37,6,-6) and decreased connectivity in the RFPN network in the right BA7 (MNI: 32,-44,55), right sensory association cortex (MNI: 24,-44,51), and right primary sensory cortex (MNI: 24,-41,44) relative to adolescent controls.

CONCLUSION: Patients born with sagittal craniosynostosis have abnormal connections in infancy in most of the neural networks compared to controls. There are specific connectivity changes that occur in the RFPN, LFPN, V2, and V3 networks, areas associated with executive function and emotional control, three months after surgery. Changes in anisotropy, measure of white matter tract microstructure, correlate with changes in functional connectivity of areas of the brain connected by white matter tracts after surgery relative to before. Surgery may produce positive changes in the brain microstructure, which could be leading to changes in neural connectivity in the brains of children born with craniosynostosis. As the child develops into adolescence, much of the abnormal network connections seen in infancy correct compared to age-matched controls. However some aberrancies remain in the SA and RFPN network and these residual irregularities may be best handled by other medical therapies.

PERIOPERATIVE MORBIDITY IN 71 MIDFACIAL DISTRACTION PROCEDURES IN SYNDROMIC CRANIOSYNOSTOSIS: A COMPARISON OF TRANSCRANIAL AND SUBCRANIAL PROCEDURES

**Presenter:** Rosaline S. Zhang, BA

**Co-Authors:** Lawrence O. Lin, BS; Ian C. Hoppe, MD; Jordan W. Swanson, MD, MS; Scott P. Bartlett, MD; Jesse A. Taylor, MD

**Affiliation:** Children’s Hospital of Philadelphia, Philadelphia, PA

**PURPOSE:** Patients with syndromic craniosynostosis and midface hypoplasia often undergo midface advancement to improve respiratory function, orbital relationships, and facial appearance. This study compares the perioperative morbidity of a large cohort of subjects who underwent transcranial or subcranial midface distraction.

**METHODS:** Demographic and perioperative data were compared between those who underwent transcranial or subcranial midface DO between July 1999 and December 2017. Univariate analysis was conducted using chi-square and Fisher exact tests for categorical variables, and Mann-Whitney U test for continuous variables. Multivariate analysis was conducted using logistic regression modeling. Complications were graded using the Clavien-Dindo classification.

**RESULTS:** Sixty-four subjects (34 female, 30 male, age 8.5±4.0yrs) underwent a total of 71 midface distraction procedures (26 transcranial, 45 subcranial, follow up 106±52 days). There was a total of 28 (39%) complications. The transcranial cohort had a significantly higher frequency of complications (58%) compared to the subcranial cohort (29%, p=0.017), with a significantly greater proportion of infection-related complications in the transcranial cohort (80% vs 54%, p=0.028). Transcranial complications included cranial contamination, whereas most subcranial cohort infections were superficial or limited facial abscesses. The only significant predictor variable for complications in a multivariate analysis was whether the osteotomy approach was transcranial as opposed to subcranial, with an odds ratio of 5.44 (p=0.017). Transcranial procedures had significantly longer mean operating time (351±66 minutes) compared to subcranial procedures (299±80 minutes, p=0.003), and required significantly higher weight-adjusted volume of blood transfusion (81±60 vs 57±47 mL/kg, p=0.010). There was a trend towards the transcranial cohort having longer mean length of hospital stay (9±9 vs 7±6 days, p=0.071).

**CONCLUSION:** Complication rates in midface distraction remain high, with transcranial procedures having significantly higher complication rates, infection-related complications, and severity of complications. Compared to subcranial midface distraction, transcranial procedures required significantly longer operating times and greater volume of weight-adjusted blood transfusion. While the goals of surgery often dictate choice of osteotomy, a thorough understanding of the risks associated with transcranial procedures must be understood by surgeon and patient alike.

POSTERIOR SKULL HEIGHT FOLLOWING POSTERIOR VAULT REMODELING: A COMPLEMENT TO CEPHALIC INDEX TO ASSESS SAGITTAL CRANIOSYNOSTOSIS

**Presenter:** Lawrence O. Lin, BS
Co-Authors: Rosaline S. Zhang, BA; Ian C. Hoppe, MD; Jordan W. Swanson, MD, MS; Jesse A. Taylor, MD; Scott P. Bartlett, MD

Affiliation: Children’s Hospital of Philadelphia, Philadelphia, PA

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; 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

Presenter: Dennis C. Nguyen, MD

Co-Authors: Austin Ha, MD; Danielle Cooper, MD; Gary B. Skolnick, BS; Sybill D. Naidoo, PhD, RN, CPNP; Matthew D. Smyth, MD; Kamlesh B. Patel, MD

Affiliation: Washington University School of Medicine, St. Louis, MO

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: 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; 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.