strabismus, both of which have been shown to be lessened by fronto-orbital distraction. This study will describe our current experience with distraction osteogenesis (DO) in the treatment of UCS with regards to perioperative morbidity and the resultant development of new-onset strabismus (are we sure they didn’t have strabismus preoperatively?).

METHODS: All patients undergoing DO for isolated UCS at our institution (13 patients) were examined and compared to the most recent 11 patients undergoing traditional FOA for UCS. Patient age, operative time, blood loss, blood replacement, technical details of the surgery, length of stay (LOS), complications, and the development of new onset strabismus following surgery were documented and compared statistically.

RESULTS: A chi-square analysis and student’s t test with a significance value of .05 was utilized for analysis. Mean follow-up time was 21.7 months in the DO group and 31 months in the FOA group (p=0.32). Patients undergoing DO compared to FOA trended towards being younger (6.3 and 9.1 months, p = 0.05), experienced significantly less operative time for the initial procedure (115 vs 192 minutes, p < 0.01), significantly less blood loss (26 vs. 55 % of total blood volume, p < 0.05), and significantly less blood replacement (40 vs. 63 % of total blood volume, p < 0.05). DO also trended towards a decreased LOS (3.1 and 4.5 days, p = 0.10). The mean age of distractor removal was 8.9 months with a mean operative time of 32 minutes, blood loss of 18cc, and length of stay of 24 hours. The mean distance distracted was 36mm. One patient in the DO group experienced a new-onset strabismus postoperatively compared with 5 in the FOA group (p < 0.05). There were no complications requiring a return to the operating room in either group.

CONCLUSION: DO for the treatment of isolated UCS provides a favorable perioperative morbidity profile and decreased incidence of post-operative strabismus compared with traditional FOA. These positive factors are tempered by the need for an additional procedure for removal of the device and lack of long-term follow-up data on the stability of the advancement. Further investigation is warranted on both of these fronts.

**Functional Network Development in Sagittal Craniosynostosis Treated with Whole Vault Cranioplasty**

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**PURPOSE:** The purpose of this study is to understand the neurological changes before and after (infants and adolescents) whole vault cranioplasty (WVC) for patients born with sagittal craniosynostosis, by studying aberrations in functional brain connectivity and white matter microstructure utilizing functional MRI (fMRI) and diffusion tension imaging (DTI), respectively.

**METHODS:** A case control study was performed that included thirty fMRI scans, from twenty-five individual patients. Five infant patients before (5 ± 2 months of age) and after (9 ± 2 months of age) underwent data collection by fMRI and DTI data in WVC for patients born with sagittal craniosynostosis. Patients on average were operated on at age 6 ± 2 months. Ten adolescent patients (12.1 years of age) that have been diagnosed with sagittal craniosynos- tosis and treated with a whole vault cranioplasty and ten age-matched controls were also scanned. fMRI data was analyzed with BioImageSuite (Yale University, USA). The fMRI images were registered to Montreal Neurological Institute (MNI) space. All nine functional networks were analyzed with appropriate regions of interest were utilized for analysis. For the DTI data, three diffusion runs were averaged, processed utilizing FMRIB Software Library (Oxford University, UK).

**RESULTS:** Comparing the infants after WVC vs. infants before WVC group, after WVC demonstrated a increased connectivity in the left frontoparietal (LFPN) in the right (MNI: 37,6,2) and left (MNI: -35,9,3) insula, right putamen (MNI: 32,3,2), and inferior frontal gyrus (MNI: -39,5,8) (p<0.001). The right frontoparietal (RFPN) had decreased connectivity despite surgery in the left dorsal (MNI: -6,-53,39) and ventral (MNI: -2,-53,26) posterior cingulate (p<0.001). The secondary (V2) and third (V3) visual network has increased connectivity despite surgery in the insula (MNI: 37,-2,10), inferior frontal gyrus (MNI: -42,9,7), and right putamen (MNI: 30,-6,7) (p<0.001). There is also a decrease and increase in anisotropy, measure of brain maturity, in the cingulum and precuneus after
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

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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