**Presenter: Carrie E. Zimmerman, BS**

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**BACKGROUND:** The intracranial cavity is composed of brain tissue as well as cerebrospinal fluid (CSF), blood, and air. These fluid components allow volume to be shunted out of the intracranial region in the setting of skull-based compression to minimize the effect of compression on the brain. The degree of change to the intracranial compartment in the setting of craniosynostosis and the speed at which they occur and resolve after surgery are not fully understood. This study sought to rigorously analyze the intracranial volume compositions of patients with craniosynostosis prior to and after CVR.

**METHODS:** The authors compared volume measurements for age-matched patients with unicoronal (n = 4), metopic (n = 4), and sagittal (n = 4) craniosynostosis. Intracranial segmentation and analysis were performed on Materialize Medical 21.0 (Materialise; Leuven, Belgium) using the following segmentation thresholds: bone 226-3066 HU, CSF -281-18 HU, and air 19-225 HU, and then manually edited utilizing typical segmentation techniques. On expert consultation, brain segmentation volumes were determined to be less reliable measurements than intracranial, CSF, and air volumes and were thus calculated by subtracting the other volumes from ICV. Paired t tests, one-way analysis of variance, and multiple regression analyses were performed on STATA 15.1 (StataCorp, College Station, TX).

**RESULTS:** The average age at surgical repair was 8.7 ± 0.83 months. All postoperative imaging was performed between 3 and 5 days postoperatively from one patient with imaging at 19 days postoperatively. There was a significant increase in total ICV (913772.5 ± 102480.5 mm3 versus 1068165 ± 95752.5 mm3; P < 0.001) and intracranial air volume (18608.8 ± 9639.1 versus 53230.2 ± 32607.4; P = 0.001) after CVR. On subgroup analysis by affected suture, there was a significant increase in ICV (1006379 ± 31359.5 versus 1133497 ± 45574.1; P = 0.013) and intracranial air volume (18056.21 ± 5397.63 versus 53230.16 ± 32607; P = 0.001) in the sagittal cohort. The metopic cohort had the largest percent change in intracranial volume (18% ± 3.4%) and CSF volume (28% ± 24%). There were dramatic postoperative increases in intracranial air volumes in all cohorts (percent change: unicoronal 46% ± 16%; sagittal 58% ± 36%, metopic 58% ± 23%) at this postoperative time period. On multiple regression analysis with affected suture, type of CVR, age at repair and time from surgery to postoperative imaging as independent variables, age at repair was the only significant predictor of percent change in ICV (coef, −5.35; 95% CI, −10.2 to −0.51; P = 0.04) at the 0.05 significance level.

**CONCLUSION:** The ICV increase created by CVR allows subsequent increases in brain, CSF, and air volumes in the early postoperative time period. Significant brain tissue volume increases were seen in the metopic cohort with significant intracranial air volume increases in the sagittal cohort. We hope to perform additional analysis with follow-up data to determine if some of the noted air volume increase is redistributed to brain tissue or CSF at a later time.

**Opportunities for Risk Reduction in Pediatric Craniofacial Imaging Protocols**

**Presenter: Hillary E. Jenny, MD, MPH**

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**BACKGROUND:** Imaging-associated radiation exposure is often considered in terms of a single computed tomography (CT) scan’s effect. However, managing craniofacial pathology may require more than 1 CT across the patient’s lifetime. Understanding the impact of these diagnoses therefore requires longitudinal analysis, particularly when considering that the pediatric population has a longer follow-up period and greater potential for development of radiation-associated neoplasia. We aim to quantify the lifetime oncologic risk of the image-related radiation exposure associated with craniofacial diagnoses and discuss ways in which practice patterns might be optimized to mitigate risk.
METHODS: Lifetime radiation exposure associated with specific pediatric craniofacial diagnoses was calculated using standard imaging pathways for these diagnoses and the radiation effective doses (ED) for relevant CT protocols. Eligibility for pediatric protocols is determined by patient size rather than by age. Lifetime risks of radiation-induced cancer incidence (RICI) and fatality (RICF) were calculated using methodology from the Biologic Effect of Ionizing Radiation VII report and are expressed as cases or fatalities/100,000 persons.

RESULTS: A majority of patients evaluated for craniosynostosis repair receive a preoperative cranial protocol CT; some may also receive a postoperative scan. Two-scan protocols give the diagnosis of craniosynostosis a lifetime radiation ED of 1.8 mSv, with a statistical lifetime risk of RICI of 14.7 and RICF of 7.4/100,000 persons. Similarly, pediatric and adult patients with craniofacial trauma undergo a preoperative CT maxillofacial protocol for diagnosis and operative planning, but some additionally undergo a postoperative CT to check reduction and plate placement. Two scans expose patients with craniofacial trauma to a lifetime ED of 0.34 mSv (pediatric) or 1.4 mSv (adults). This exposure is associated with a lifetime risk of RICI of 2.7 and 11.4/100,000 persons and a lifetime risk of RICF of 1.4 and 5.7/100,000 persons in pediatric and adult patients, respectively. In both craniosynostosis and trauma scenarios, lifetime cancer risk is dose-dependently halved by omitting postoperative scans. Further risk may be avoided for conditions with practice patterns that vary by more than 1 scan. For example, a majority of patients with micrognathia presenting for mandibular distraction undergo a preoperative CT. Some patients may also undergo two additional CTs after distractor placement: immediately postoperatively and before distractor removal. Therefore, the lifetime radiation ED associated with micrognathia diagnosis is 2.8 mSv for a 3-scan pathway and 0.9 mSv for 1 scan. Adopting a preoperative-only imaging protocol avoids an additional lifetime risk of RICI of 14.7 and RICF of 7.4/100,000 persons.

CONCLUSIONS: CT scans are often critical for craniofacial operative planning. However, plastic surgeons have not yet adopted a standard of care for craniofacial imaging, which has a dose-dependent oncologic risk that is particularly relevant considering that many surgeons may obtain multiple images when managing these conditions. This is the first study to quantify oncologic risk associated with different imaging pathways for specific craniofacial diagnoses. We encourage open relative risk and benefit discussions with patients and families, as well as critical assessment of the need for routine postoperative scans obtained outside the context of approved research protocols.

Novel Surgical Treatment Algorithm for the Treatment of Temporomandibular Joint Disease

Presenter: Ludmila Chandler, BS

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BACKGROUND/PURPOSE: The treatment of temporomandibular joint (TMJ) disease is highly variable, from nonsurgical management to salvage procedures like joint replacement. Long-term outcomes data are limited, and there is no consensus for an optimal treatment algorithm. A relatively new and minimally invasive treatment includes fat grafting to the TMJ performed with or without open TMJ reconstruction. We aimed to study the safety, efficacy, and indications for this new approach in patients with TMJ disease.

METHODS/DESCRIPTION: A retrospective chart review was performed on all patients who underwent a non-salvage procedure under general anesthesia for the relief of TMJ disease by a single surgeon from 2011 through 2019. Patients with minimum 12-month clinical follow-up were included. Patient demographics, diagnosis, pre- and postoperative symptoms, procedure details, complications, and additional interventions for TMJ disease were recorded. Patients were asked to complete a survey elaborating on their symptoms (TMJ pain on 0–10 Likert scale, other symptoms 0–5 scale) before surgery and at their final follow-up. Wilcoxon signed rank test and repeated-measures analysis of covariance were performed to compare pre- and postoperative symptoms ($P < 0.05$ for significance).

RESULTS: Forty patients were included in the study, 71% female, mean age 34 (range, 10–65) years, mean clinical follow-up 4.3 (range, 1.6–9.0) years. The prevalence of procedures that patients underwent was 90% TMJ fat injection, 90% masticatory Botox injection, 80% Kenalog injection, 36% open TMJ arthroplasty, and 3% concurrent orthognathic surgery. Twenty-six (65%) patients completed the pre- and postoperative surveys. Overall, there was a statistically significant improvement in mean Likert scores at final follow-up versus preoperatively for: trismus (0.46 versus 1.63; $P = 0.003$),