vault remodeling by establishing a pathway, based on published literature and that of other institutions, that begins preoperatively and continues until discharge. This study highlights the critical aspects and modifications of the pathway over time at our institution.

METHODS: A retrospective chart review of children undergoing cranial vault remodeling for craniostenosis from August 2009 to December 2020 at Akron Children’s Hospital was conducted. IRB approval was obtained. Children who underwent minimally invasive surgery were excluded. Major changes to the pathway were implemented in December 2013 and included routine use of recombinant erythropoietin for children less than 18 months, cell saver, increasing transfusion threshold to 6.5 g per dL hemoglobin, and increasing the use of non-narcotic analgesics. Over the years, additional changes implemented included routine use of Ketorlac in 2016 and tranexamic acid in 2018.

For those children who met the inclusion criteria, charts reviewed for demographics, medical history, laboratory data, hospitalization records, narcotic use, length of stay (based on nights in the hospital), anesthesia records, blood transfusion, and estimated blood loss (EBL). Blood transfusion was defined as an allogenic product not autologous transfusion using cell saver.

RESULTS: We identified 60 children in the control group (before December 2013) and 100 in the pathway group. Demographics were similar between the groups, but the preoperative hemoglobin was higher in the pathway group (13.3 versus 11.9 g/dL, $P < 0.001$) as a result of epoepoietin use. As expected, EBL was lower in the pathway group (26.9 mL/kg versus 48.2 mL/kg, $P < 0.001$). Considering the higher starting hemoglobin, lower EBL, and use of TXA, in the pathway group, only 21 children (21%) received intraoperative transfusion compared with 100% in the control group ($P < 0.001$), and when required, were transfused less (18.6 mL/kg versus 49.8 mL/kg, $P < 0.001$). Intraoperative cell saver use averaged 7.6 cm³ per kg in the pathway group. In the pathway group, only 4% received postoperative transfusions compared with 25% in the control, and when required were transfused less volume (0.6 mL/kg versus 4.5 mL/kg, $P < 0.001$). There were no transfusions of FFP, cryoprecipitate, or platelets in the pathway group. Because the transfusion threshold was 6.5 g per dL, the nadir and discharge hemoglobins were lower in the pathway group (8.3 g/dL versus 9.9 g/dL, $P < 0.001$ and 8.6 g/dL versus 11.0 g/dL, $P < 0.001$, respectively), but were well above our threshold for transfusion.

Finally, length of stay was lower in the pathway group (2.16 versus 3.22 days, $P < 0.001$) and continued to improve when the pathway group was reviewed in 2-year increments (2.45 to 2.06 to 1.97).

CONCLUSION: A data-driven and formalized perioperative pathway can decrease blood transfusions and narcotic requirements, and improve length of stay, but requires vigilant upkeep and modification.

Craniopagus Separation using a Novel Tissue Expander Design

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PURPOSE: Craniopagus twins (conjoined twins connected at the cranium) occur at an estimated incidence of 1 in 1.6–2.5 million births. Very few of these twins bear the anatomy permissive of cranial separation and reconstruction. The authors present their successful surgical approach to cranial separation of craniopagus twins.

METHODS: Twins A and B are female craniopagus twins identified on prenatal ultrasound at 11 weeks gestation. They were born to a 34-year-old mother at 35-weeks’ gestation by C-section, 5 hours after spontaneous rupture of membranes. Physical examination, MRI, and CT angiography confirmed a diagnosis of angular partial craniopagus. The occipital region of Twin A was joined to the left parietal region of Twin B. They demonstrated connection of the scalp, calvaria, and dura; they also had a venous fistula connecting the two sinus systems (Twin A’s left lateral transverse sinus to Twin B’s superior sagittal sinus). There was no arterial communication, nor was there any fusion of brain parenchyma; however, there were many smaller bridging vessels. Twin B’s left parietal lobe did reside within her sister’s posterior cranial fossa.

Superiorly, the fused calvaria was a thick, rigid strip of bone, which was selected as a base for tissue expansion.
The senior author designed a novel wedge-shaped tissue expander with a thin crescentic base, placed at the cephalad bony fusion point to gain soft tissue for reconstruction once divided. The tissue expander was engineered such that the pressure of tissue expansion could be concentrated on this region of thick bone and spare the neighboring calvaria of deformational forces. The tissue expander was placed in the subgaleal plane at 6 months of age and expanded fully (daily) over the next 4 months.

Once expanded, a combination of novel virtual and physical soft tissue modelling methods were used to both verify adequate scalp expansion and plan the incision lines and flap designs. At 10 months of age, the infants underwent cranial separation, including venous fistula ligation, duraplasty, cranioplasty (with resorbable polylactic acid mesh), and successful soft tissue closure using only native expanded scalp.

RESULTS: The twins underwent tissue expansion without cranial deformation or pressure injury; they had successful cranial separation at 10 months of age. Scalp flaps were of the exact shape and dimension required for soft tissue coverage and an aesthetically pleasing result was achieved.

Both infants experienced postoperative cerebrospinal fluid leak, necessitating return to the operating room for revision duraplasty. Since then, they have exhibited no neurological abnormalities and continue to achieve developmental milestones at the expected ages.

CONCLUSIONS: Craniopagus twin anatomy should be closely studied, not only to assess candidacy for cranial separation, but also to determine what anatomic traits may be leveraged for reconstruction. In the presented case, the interplay between bony anatomy and tissue expansion allowed for novel tissue expansion at a young age, without complication, thereby expediting definitive separation.

Orthognathic Surgery for Craniofacial Microsomia: Outcomes following Mandibular Distraction

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PURPOSE: Surgical interventions for patients with craniofacial microsomia at the time of skeletal maturity can include orthognathic surgery (OGS). The purpose of this study was to evaluate the outcomes of orthognathic surgery in patients with craniofacial microsomia who have previously undergone mandibular distraction osteogenesis (MDO).

METHODS: A retrospective cohort study was performed, including all patients with craniofacial microsomia who were treated with orthognathic surgery at a single institution between 1996 and 2019. The clinical records, operative reports, and cone beam computed tomography scans were reviewed. The study required CT scans before OGS (T1), immediately after OGS (T2), and at long-term follow-up (T3). Patients were excluded if OGS or MDO was performed at another institution or if the patient had insufficient images. Cone beam computed tomography data at T1, T2, and T3 were superimposed in Dolphin 3D software using the cranial base and superior orbital rims as reference regions. Cant was measured comparing the angle of the maxillary first molars with the angle of the orbital rims. Chin point deviation was measured as a distance from upper facial midline. Statistical analysis was performed in IBM SPSS Statistics. Comparisons were made between patients who underwent OGS without prior MDO with those who underwent OGS with prior MDO. Nonparametric tests were performed to evaluate for statistical significance between groups.

RESULTS: The study included 12 patients with craniofacial microsomia who underwent orthognathic surgery (seven underwent OGS without MDO and five underwent OGS after MDO). In the group without prior MDO, five had a sagittal split osteotomy (71%) on the affected side and two (29%) had inverted-L osteotomies. In the group with prior MDO, one (20%) had a sagittal split osteotomy and four (80%) underwent other types of osteotomies. Two patients in the MDO group underwent prior mandibular reconstruction with bone grafting. There was a statistically significant improvement in cant and chin point deviation postoperatively. Between T2 and T3, cant relapsed by a median of 0.3 degrees in the group without distraction and the median change was an improvement of 0.1 degrees in the group with distraction. There was no statistically significant difference between the groups ($P = 0.755$).

CONCLUSIONS: Orthognathic surgery after mandibular distraction osteogenesis is able to produce stable results.