Neruocognitive Effects of Metopic Synostosis Based on Severity of Deformity

Jenny F. Yang, BS; Eric D. Brooks, MD; Peter W. Hashim, MD; Roberto Travieso, MD; Jordan Terner, MD; Hannah S. Reuman, BA; Sarah M. Persing, MD, MPH; Elizabeth G. Zellner, MD; Rajendra Martinez-Sawh, MD, MBA; Emily J. Levy, BA; Karen Law, BA; Linda C. Mayes, MD; Charles Duncan, MD; Derek M. Steinbacher, MD, DMD; John A. Persing, MD; James C. McPartland, PhD.

Disclosure/Financial Support: Supported by ASRM grant R10445 (to Dr. John A. Persing). None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this abstract.

INTRODUCTION: In recent years, metopic synostosis (MSO) has represented up to 25% of all non-syndromic craniosynostosis cases,[1] manifesting with varying degrees of trigonocephaly, bitemporal narrowing, and orbital deformity. The severity of MSO can be classified as moderate or severe based on the endocranial bifrontal angle (EBA), and degree of orbitofrontal deformity.[2] However, it is unknown whether the degree of severity of anterior dysmorphology is proportionate to neurological dysfunction.

Recent research has found atypical auditory processing in a group of infants with different types of single-suture craniosynostosis, including sagittal, metopic, and unilateral coronal synostosis.[3] Given the reported correlation of abnormal auditory processing with future language dysfunction and poorer academic performance,[4,5] the present study aims to evaluate auditory processing in untreated patients with moderate and severe MSO, as well as in control infants, to discern the neurological risk carried by different severities of trigonocephaly.

MATERIALS AND METHODS: Forty-one infants underwent evaluations of auditory processing: 9 patients with severe MSO, 7 with moderate MSO, 3 with MR without MSO, and 22 controls (Table 1). Brain activity was recorded by electroencephalography (EEG) while the participants passively listened to auditory presentations of speech syllables. EEG data over the frontal and temporal-parietal regions was analyzed to extract event related potentials (ERPs) evoked by the speech sounds.

RESULTS: Severe MSO patients demonstrated significantly attenuated ERP responses in the left frontal scalp region overlying the left frontal lobe compared to controls ($p < 0.05$). The moderate MSO patients did not show significantly different language processing compared to the control infants or the severe MSO patients in the frontal scalp region (Figure 1). No differences were found in the temporal-parietal regions overlying Wernicke's area between any of the three groups.

CONCLUSION: Results suggest that untreated severe MSO is associated with reduced language response in the frontal cortex but not the temporal-parietal regions. These abnormalities may be related to the pronounced orbitofrontal deformity associated with this condition.

REFERENCES:

1. Kolar JC. An epidemiological study of nonsyndromal craniosynostoses. *J Craniofac Surg*. 2011;22:47-49.
2. Beckett J, Chadha P, Persing JA, Steinbacher DM. Classification of trigonocephaly in metopic synostosis. *Plast Reconstr Surg*. 2012;130:442e-447e.
3. Hashim PW, Brooks ED, Persing JA, et al. Direct brain recordings reveal impaired neural function in infants with single-suture craniosynostosis: A future modality for guiding management? *J Craniofac Surg*. 2015;26(1):60-3.
4. Guttorm TK, Leppänen PH, Hämäläinen JA, Eklund KM, Lyytinen HJ. Newborn event-related potentials predict poorer pre-reading skills in children at risk for dyslexia. *J Learn Disabil*. 2010;43:391–401.
5. Molfese DL. Predicting dyslexia at 8 years of age using neonatal brain responses. *Brain Lang*.

2000;72:238–245.

FIGURE LEGEND:
Table 1. Participant demographics.
Figure 1. Mean P150 peak amplitude over the frontal scalp region in infants with Severe MSO, Moderate MSO, MR without synostosis, and controls. Initial cortical response to speech is attenuated in patients with severe MSO, but not in moderate MSO or MR patients.