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Biomechanical Point of View of Craniofacial Growth Associated with Craniosynostosis

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Abstract: ***Craniosynostosis is well known medical condition. It had many serious sequalae. Precise determination of its pathway could pave the way to better treatment establishment. Our model had been utilized model of previous papers. The results clearly indicate the defective strain distribution within the skull due to this tethering.***

Keywords: craniosynostosis, numerical simulation, biomechanics, craniofacial growth

1. Introduction

craniofacial growth associated with Craniosynostosis had distinctive patterns of growth [1]. Many studies have been done on the numerical simulation, but none had addressed the main event stand behind this phenomenon [2].

My paper about growth associated with endochondral ossification and the paper about craniofacial simulation with opened sutures should be reviewed before this paper as they represent the basis for understanding the current work. The movement of the calvarial bone induced by the skull intrinsic muscles (mainly the muscle of mastication) and extrinsic muscle (mainly paravertebral, SCM and trapezius) will produce this movement.

The current work is to demonstrate this movement and demonstrate the effect of absence on the performance of the bony domain.

2. Methods

The current model had been developed based upon the previous model in the paper about model with opened sutures. The only difference is that the subdomain that represents the prematurely closed suture had been assigned with stiffer material [3].

Figure 1 The craniosynostosis has a unique deformation pattern that could be recognized clinically or radiographically. In order to demonstrate the effect of presence of a rigid connection on the mechanical behavior of the skull we had built this model. The orange region represents the prematurely fused suture. This is anterior unicolonial craniosynostosis.

3. Results and discussion

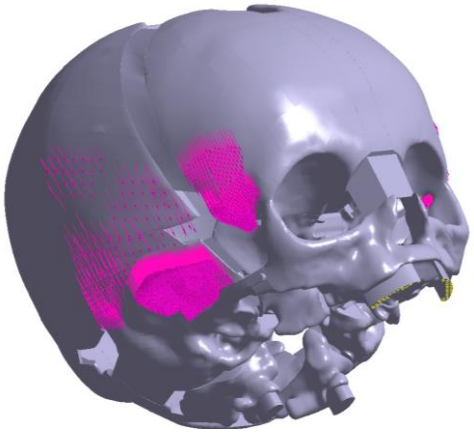

Figure 2 We will review this pattern of boundary condition first, where the red arrows represent a downward force, and the yellow crosses represent the fixed region.

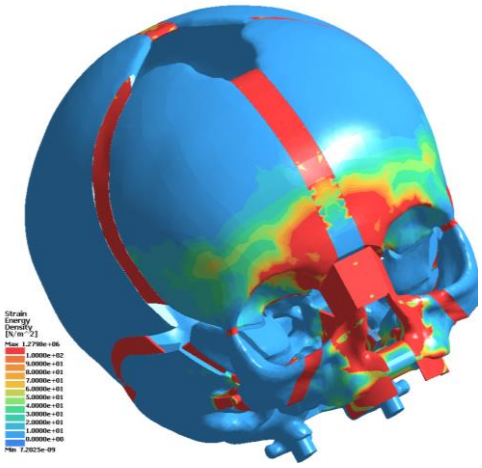

Figure 3 This is the pattern of strain energy density in the normal skull anatomy. The distribution of the strain indicates how the response is being toward the linear forces.

This disturbance in the distribution is responsible for the growth and bone remodeling. Values could give an insight into possible resemblance to the natural model.

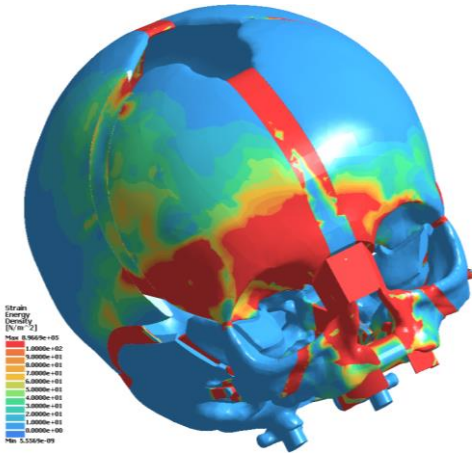

Figure 4 This is the strain energy density pattern in the defective skull. The disturbed strain energy pattern is very interesting in the case of the virtual craniosynostosis model. We suggest that the increased strain energy at the side of fused suture is behind the limited growth at that site.

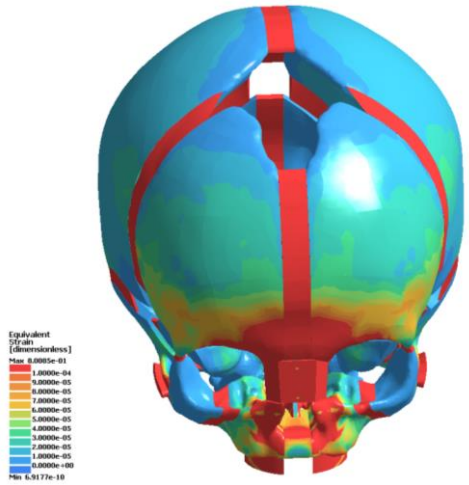

Figure 5 the strain is evenly distributed.

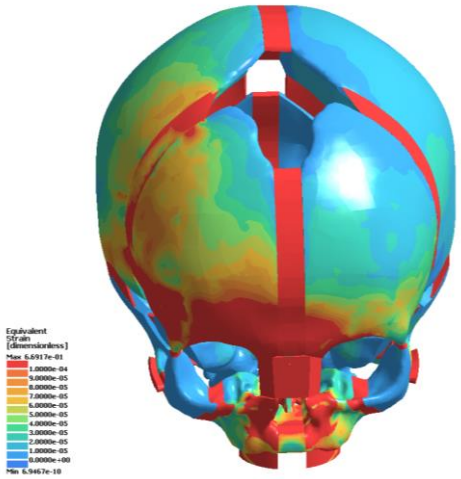

Figure 6 The strain had also disturbed pattern of distribution.

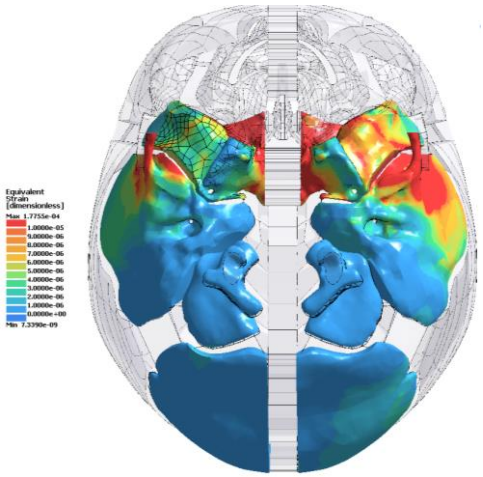

Figure 7 the strain will involve the base of the skull.

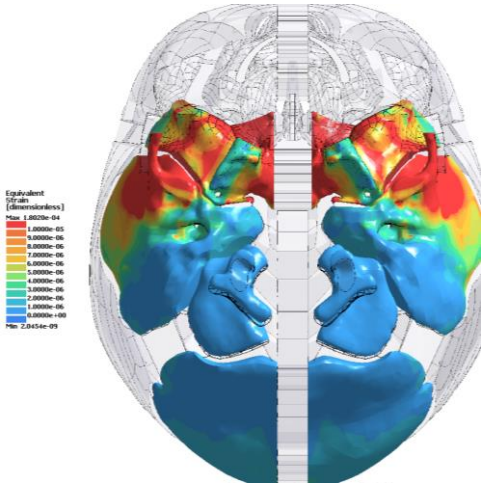

Figure 8 normal model shows clearly symmetry in the distribution.

Even the effect of the craniosynostosis according to the virtual model will be extended to the base of the skull. The halting of the growth could be due to some sort of disturbance in endochondral ossification in the base of skull which originally resulted from defective intramembranous

ossification. The endochondral route stands behind the growth in the lower parts of the skull where effect will encompass the orbit and downward structures.

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Author Profile

Mohammed Zahid Saadoon BDS–FKHCMS (Maxillofacial Surgery). During 2014-2024 he was involved in may researches in biomechanics and biomechatronic. He developed many theories in maxillofacial traumatology, craniofacial growth and dental implantology. He developed a unique dental implant system. He has a special interest in mechanical engineering applications in the medical and dental specialties as well as in forensic medicine. He is now working as maxillofacial surgeon in Ashty teaching hospital, largest secondary referral centers in Soran discrete at Kurdistan region / Iraq.