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Original Article

Custom made orthotic device for maintaining skull architecture during the postoperative period in infants undergoing craniosynostosis surgery

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ABSTRACT

Aim: To fabricate a cost effective, indigenous and simple orthotics helmet for post-operative cranial molding in patients with craniosynostosis surgery.

Methods: We present a case of 15 month old infant with secondary cranial vault deformity. Cranial vault remodeling surgery involving the posterior skull was planned and executed to increase the posterior gap, so that brain growth would be facilitated towards this empty space. Materials such as thermoplastic sponge, thermoplastic ionomer resin sheet, soft sponge and Velcro straps are used to fabricate a cranial orthotics helmet.

Results: We have successfully used the above materials to fabricate the orthotics helmet for post-operative cranial molding.

Conclusion: The technique described in this article is simple and cost effective. It can be custom made according to the demands of the surgical technique and the type of synostosis. It favors an individualistic prognosis, and proves worthwhile as every synostosis requires a unique treatment plan. It is an excellent adjuvant to craniosynostosis remodeling surgery.

1. Introduction

Craniosynostosis, defined as premature fusion of cranial sutures, was first described in 1830 by Otto.[1] In 1851 Virchow created a classification system for the types of skull deformity observed in craniosynostosis and made an important observation that premature suture fusion of cranial sutures resulted in compensatory growth in other areas of the skull.[2] Craniosynostosis occurs with an incidence of approximately 1:1800[3]

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Reduced or asymmetrical skull growth causes deformity of the skull vault and base. This may result in important functional abnormalities such as mentation, breathing, feeding and vision. This is particularly true in complex multi-sutural synostosis, but is not uncommon in single sutural synostosis. The presentation is often early because of rapid enlargement of brain size in the first year of life and consequent enlargement of the calvarium. The majority of craniosynostosis involves single suture and are non-syndromic. However, multiple sutures may be involved in inherited non-syndromic and syndromic craniosynostoses.[4]

During the first year of life, an infant's head increases in circumference by approximately 9 cm in the first six months and another 3 cm during the next six months.[5] Skull development is reliant on rapid brain growth, which causes the bones to spread apart from each other at the cranial sutures.

Various surgical options include the cranial vault remodeling, fronto orbital advancement, strip craniectomy, endoscopic technique and distraction osteogenesis. Treatment is usually based on the age of the patient, type of craniosynostosis, number of sutures involved and the choice of the surgeon. Helmet therapy (cranial orthotics) plays an important role in post-surgical molding and maintenance of the cranial shape. Molding helmets were first introduced in 1979.[6]

In deformational craniosynostosis, cranial orthotics is the primary choice of treatment. Recently a combination of endoscopic strip craniectomy and cranial orthotics is gaining popularity, because of lesser invasive procedure. In spite of the proposed advantages of cranial orthotics as an adjuvant to cranial vault remodeling surgery it is not widely practiced especially in developing countries due to the lack of technical know-how and the cost involved. The utilization of cranial orthotics is still in infancy.

We hereby posit a simple cost effective method of making custom cranial orthotics helmet, which can be effectively utilized to either maintain the surgical correction or provide ongoing reshaping of the cranial vault structures as a post-surgical cranial form-guiding appliance.

2. Case report

A 15 month old infant has presented to our clinic with secondary cranial vault deformity. Anterior cranial vault remodeling and fronto orbital advancement surgery was carried out 6 months prior, for correcting turribrachycephaly. Cranial orthotics was not used post surgically after the first surgery.

On examination there was evident ridging in the occipital region and a tower shaped deformity of the skull (Fig. 1). Based on anthromorphometric analysis cranial vault remodeling surgery involving the posterior skull was planned. Bifrontal coronal bone flap was taken. Multiple radial osteotomies of the coronal bone flap were carried out to increase the surface area and flexibility. Barrel staving of the posterior cranial vault was done (Fig. 2). With precise horizontal wedge osteotomies on the endocranial side of the barrel staved posterior vault segments, the ridging was removed and in-fracture carried out (Fig. 3). This was done to increase the posterior gap so that brain growth would be facilitated towards this empty space

Fig. 1 – Case of craniosynostosis involving bilateral coronal and sagittal sutures showing tower shaped deformity of the skull.

(Fig. 3). The propulsive brain growth was anticipated to increase the posterior dimension of the skull and a secondary reduction in the vertical dimension. Owing to the positional impact post-surgery during sleep we felt a need to support the posterior cranial vault without causing a premature filling of the bone gap. The anteroposterior alignment of the cranial vault along with the brain was expected.

We utilized a preoperative head moulage made with cranial impression for making the cranial orthotics helmet and we augmented the head moulage posteriorly with wax to accommodate the gap created during surgery (Fig. 4).

3. Method

Hardware involved.

i. Head moulage
ii. Thermoplastic sponge.

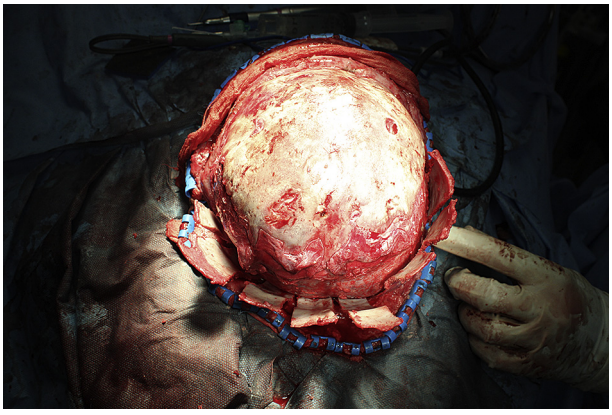

Fig. 2 – Barrel staving of the posterior cranial vault done to create gap posteriorly.