NON-STANDARD NEUROSURGICAL MANAGEMENT OF CRANIOSYNOSTOSIS: A CASE REPORT

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Abstract

There are many congenital skull anomalies and among them is craniosynostosis which is due to the early fusion of one or more cranial sutures. However, to avoid skull deformities, raised intracranial pressure, and psychomotor development delay, punctual and proper surgical treatment is needed. Furthermore, open surgical procedure remains the main method for skull reconstruction morphology and symmetry, together with preventing long-term and permanent complications. Traditional surgery requiring cranial reshaping and fixation in craniosynostosis is deemed as a procedure that involves important surgical intervention and is relatively lengthy.

This paper reveals a case managed surgically using a non-standard method contrasted to the frequent applied open surgical approaches. Though, this technique demands a concise operative time and allows satisfactory spontaneous remodeling, guided by gradual brain expansion, without the need for intraoperative remodeling using rigid fixation through sutures or absorbable plates. The presented case was surgically managed at our institution whilst the clinical manifestations, surgical methods, and post-surgical course are described.

Keywords: craniosynostosis, endoscopy, open surgery, pediatric neurosurgery, skull remodeling, intracranial pressure, psychomotor delay.

Introduction

This study case reveals craniosynostosis, a pathology condition in which one or more premature ossification of cranial sutures, limiting normal brain development and resulting characteristic skull abnormalities. The ideal treatment is premature corrective surgery focused on releasing the early fused suture and accomplishing both esthetic and functional remodeling of the skull (1.3).

In isolated forms affecting only one suture, whether unilateral or bilateral, and diagnosed early (at 3–6 months of age), endoscopic treatment may be performed, which is less invasive than open surgery (2,6). Endoscopic treatment is usually followed by postoperative helmet therapy, which guides the necessary skull remodeling and requires prolonged care and professional commitment.

In isolated cases as well as more complex cases involving multiple prematurely fused sutures, especially after 6 months of age and accompanied by progressive skull deformity, treatment is typically performed through open surgery with remodeling (3,5). Open surgery enables the necessary suturectomy and remodeling with fixation of cranial bone segments.

An important condition for adequate response consequences is conducting the surgery before the child turns one year old. After reaching this age, skull flexibility decreases, the hazard of amplified intracranial pressure rises, and aesthetic outcomes tend to be poorer due to lacking of morphological and physiological remodeling. So, exceeding this age restrictions the potential for best surgical outcomes.

Case Presentation

A 7-month-old infant, born at term via normal delivery, presented with craniosynostosis involving two sutures: the sagittal suture and bilateral coronal sutures, which impaired normal

skull development. The child's head had assumed a boat-like shape, known as scaphocephaly (Fig. 1). It was performed a cranial CT scan with three-dimensional imaging to precisely detect the premature fusion of cranial sutures and to arrange the operating technique.

Nevertheless, it is quite vital to state that the craniosynostosis (scaphocephaly) was an isolated anomaly, not related with any syndrome. The patient was still within the best treatment period for surgery, and the skull preserved enough elasticity to enable physiological remodeling post-intervention.

Following imaging analysis and physical examination, a surgical plan was developed that deviated from standard approaches for this type of pathology.

The patient was positioned supine in the operating room, with the head secured in a head holder. The incision was planned as an ear-to-ear zigzag line to allow better cosmetic concealment by hair growth. After scalp reflection, adequate exposure of the cranial vault was achieved. A burr hole was made in the parietal parasagittal region, and using a craniotome, two parallel bilateral bone strips approximately 1 cm wide were removed alongside the superior sagittal sinus, extending to the lambdoid suture, while preserving the sagittal suture to minimize the risk of venous sinus injury (Fig. 2).

Multiple parallel vertical osteotomies were then performed from the midline toward the skull base in the parietal and partially occipital bones to allow gradual and natural skull expansion (Fig. 2).

In the frontal region, bicoronal suturectomy was performed, along with a triangular osteotomy in the frontal bone to facilitate natural remodeling of the frontal deformity (Fig. 2).

Throughout the procedure, no sutures, plates, or other fixation materials—absorbable or otherwise—were used. No attempt was made at direct intraoperative remodeling with rigid fixation. The entire technique relied on passive remodeling guided by brain growth. Early results demonstrated noticeable improvement in skull shape without intraoperative or postoperative complications (Figs. 2, 3).

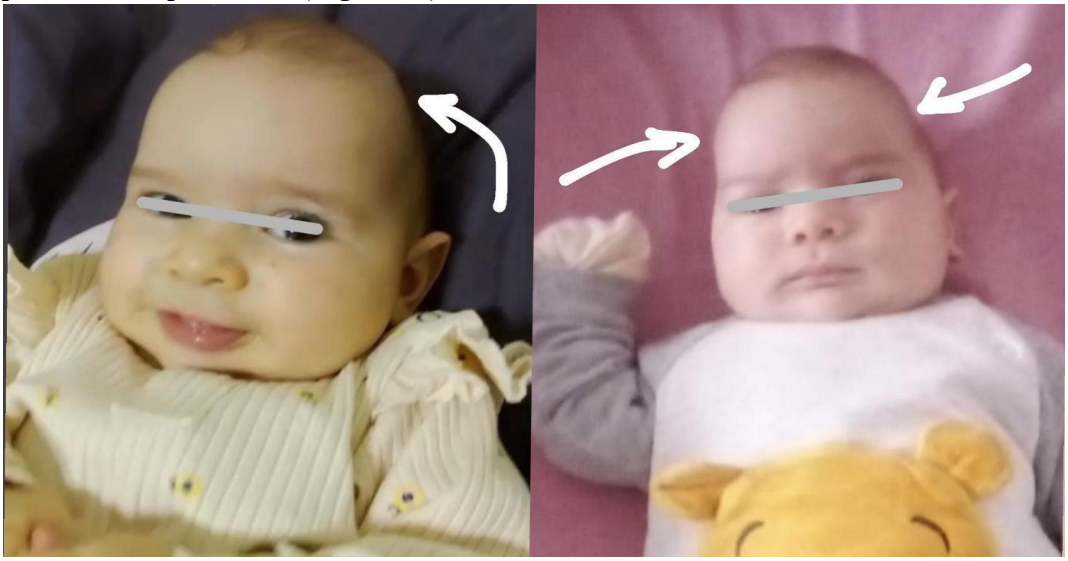

Figure 1. (A)&(B) Images of the infant before surgery.

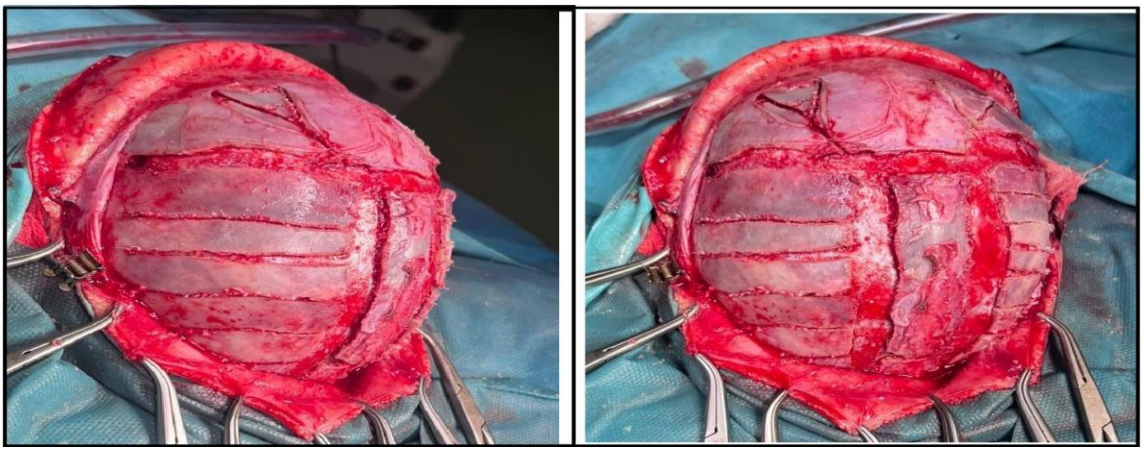

Figure 2. (A) Intraoperative view: (A) lateral view; (B) superior view.

Figure 3.(A) Two days after surgery; (B) and (C) images of the infant several days after surgery.

Figure 4. (A) (B) images of an infant 3 months after surgery.

Discussion

In cases where craniosynostosis involves multiple sutures or when the optimal window for endoscopic intervention (3–6 months) has passed, treatment is typically performed using open surgery (1,3,5). This approach allows for suture release and skull remodeling but requires extensive craniotomy, reshaping of multiple bone segments, and fixation using absorbable plates and sutures.

In most cases, these procedures involve significant manipulation of the cranial vault and may require exposure of critical vascular structures such as the superior sagittal sinus, thereby increasing the risk of intraoperative and postoperative complications (3,5,7).

Standard techniques such as suturectomy and total cranial vault remodeling are associated with risks including venous injury, significant blood loss, and prolonged operative time (3,5,7). These factors are particularly important in pediatric patients, where surgical limits and tolerances are more restricted (2,6).

In the presented case, a modified surgical approach was used, based on preserving the bone segment directly over the superior sagittal sinus**.** Furthermore, as an alternative to a traditional sagittal suturectomy, in both parasagittal regions osteotomies equivalent to the sagittal suture were completed. This represents a deviation from standard techniques and allows controlled, spontaneous skull expansion while preserving midline structural integrity (3,5,7).

Additionally, vertical parallel osteotomies extending from the vertex toward the skull base in the parietal and occipital bones were performed, facilitating gradual skull expansion, in contrast to classical spiral osteotomies.

This procedural technique is based on a different concept compared to traditional remodeling with rigid fixation. It allows passive remodeling driven by brain growth, where intracranial expansion acts as the primary force guiding natural skull correction.

The third step included bicoronal suturectomy combined with a triangular osteotomy, further supporting physiological brain growth and skull expansion.

No fixation materials were used throughout the procedure. The outcome relied entirely on the natural developmental physiology of the brain and the elasticity of the cranial bones.

Early postoperative results showed satisfactory improvement in skull shape (Figs. 3, 4), suggesting that rigid intraoperative fixation may not be necessary in selected cases. This method may decrease operative time, minimize implantation of foreign materials, and reduce risks related to venous sinus exposure, bleeding and infectious complications.

Though, certain limits must be recognized. Furthermore, in patients older than one-year, decreased cranial elasticity, increased bone thickness, and reduced brain growth limit capacity for spontaneous expansion. Ultimate clinical results depend seriously ongoing brain development and skull plasticity. This and a limited number of similar cases are insufficient to establish this technique as a standard procedure.

Advantages of this technique include reduced risk of superior sagittal sinus injury, decreased blood loss, less bone manipulation, avoidance of artificial materials, and shorter operative time.

Disadvantages include lack of standardization, absence of immediate intraoperative shape control due to lack of fixation, and dependence on patient age, brain growth, and bone plasticity.

The presented surgical approach is conceptually closer to cranial expansion techniques than to classical remodeling, relying on brain-driven growth principles described in the literature in the context of less invasive methods (2,6).

Conclusions

Early-stage diagnosis and immediate surgical results favorable practical and cosmetic surgical outcomes with less complications.

Additionally, the above-mentioned case recommends that a more conventional technique, led by natural remodeling due to increased brain expansion, cranial elasticity, and cranial structural integrity, may offer satisfactory aesthetic and useful outcomes.

Whereas early outcomes are favorable, extra studies with larger clinical series and prolonged follow-up are essential to normalize this method. This approached should be taken into

consideration as an alternative rather than a replacement for standard methods. Validation as a standard procedure requires a series of successful cases.

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