

Operative Technique for Calvarial Reconstruction of Sagittal Craniosynostosis

Sagittal Kranyosinostozun Kalvaryel Rekonstrüksiyonunda Cerrahi Teknik

ABSTRACT

AIM: The purpose of this study was to retrospectively evaluate the efficacy of the developed by the authors surgical technique in patients with a radiographically confirmed diagnosis of sagittal craniosynostosis.

MATERIAL and METHODS: 34 children with scaphocephaly underwent surgical treatment with the authors' operative technique. Quantitative assessments of the operative results, based on the preoperative and postoperative (1 year after the procedure) measurements of the cephalic index (cranial width / cranial length x 100), were performed in all patients.

RESULTS: The presented original authors' surgical technique resulted in a significantly good skull shape immediately after the procedure. The mean preoperative cephalic index was 64.5, and the mean immediate postoperative index- 75.0, yielding a mean improvement of 10.5. There were no intraoperative complications. One case required a small postoperative correction.

CONCLUSION: The presented operative technique provides immediate and significant surgical correction of the head shape, demonstrated by quantitative measurements using the cephalic index and by photographs.

KEYWORDS: Sagittal craniosynostosis, Original, Surgical technique, Surgical correction

ÖZ

AMAÇ: Bu çalışmanın amacı radyolojik olarak teyit edilmiş sagittal kranyosinostoz tanısı alan hastalarda yazarlar tarafından geliştirilmiş bir cerrahi tekniğin etkinliğinin retrospektif olarak değerlendirilmesidir.

GEREÇ ve YÖNTEMLER: Skafosefalisi olan 34 çocuk yazarların cerrahi tekniğiyle ameliyat edildi. Cerrahi sonuçların preoperatif ve postoperatif (işlemden 1 yıl sonra) sefalik endeks (kranyum genişliği kyanyum uzunluğu x 100) ölçümlerine bağlı kantitatif değerlendirilmesi bütün hastalarda uygulandı.

BULGULAR: Yazarlar tarafından sunulan orijinal cerrahi teknik ameliyattan hemen sonra kafatası şeklini belirgin biçimde düzeltti. Preoperatif sefalik indeks ortalama 64.5 iken postoperatif sefalik indeks 75 idi ve bu ortalama 10.5 lik bir düzelme gösteriyordu. Herhangi bir intraoperatif komplikasyon görülmedi. Hastalardan biri postoperatif küçük bir düzeltmeye ihtiyaç duydu.

SONUÇ: Burada sunulan cerrahi teknik sefalik endeksle yapılan kantitatif ölçümler ve fotoğraflarla da gösterildiği gibi kafa şeklinde hemen ve belirgin düzelme sağlar.

ANAHTAR SÖZCÜKLER: Sajital kranyosinostoz, Orijinal, Cerrahi tekniği, Cerrahi düzelme

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Received : 09.09.2008

Accepted : 26.10.2008

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INTRODUCTION

The premature synostosis of one or more cranial vault sutures is followed by a compensatory expanding of the skull from the side of the left unchanged sutures. This causes predictable skull deformation and in some cases leads to compression of the brain beneath [2,5,8,11,14-16,18,23,27]. With the growth of the child, this abnormality of the head shape gets worse and may engage even the face, causing severe deformation. That is why the main purpose of the surgical treatment of the craniosynostosis is the "normalization" of the skull shape.

The aim of the present study was to evaluate retrospectively the efficacy of the operative technique applied by the authors for treatment of one of the most frequent craniosynostoses- the sagittal craniosynostosis also known as scaphocephaly.

MATERIAL and METHODS

During the period of 1996-2005, 40 children with the diagnosis "sagittal craniosynostosis" or 56.34% of all 71 patients with craniosynostosis were examined and treated at the Department of Neurosurgery, Medical University - Sofia. 26 (65%) of these children were male and 14 (35%) female, with a median age at the time of the operative procedure of 6.5 months (ranging from 1.5 to 19 months). Extensive linear craniectomies (bilateral bone flaps) were performed in 6 patients while an operative technique for correction of the skull deformation, developed by the authors, was applied in the remaining 34 cases. Actually the fore-mentioned technique for surgical treatment of the scaphocephaly is a modification of the operative methods of Jane et al. [12]. The procedure is divided in two identical stages with surgical duration of 1-2 hours and with a one- or two-week break. Under general anesthesia and with the patient in a supine position and the head rotated to the right or left side, an arched skin incision is performed fronto-parieto-occipito-temporally. In this way the vascular supply of the right or left skin flap by the superficial temporal artery is preserved. Following a single frontal burr hole, by means of a linear craniectomy wide 1 cm, a horseshoe-shaped bone-aponeurotic flap in the same region is modified, with a basis to the skull base. The flap spreads 1-2 cm in front of the coronal suture and backwards- 1-2 cm behind the lambdoid suture. The free bone margin is covered with periosteum, which is fixed to the dura mater.

From the bone-aponeurotic flap, subsequent to coupled wedge-like cuttings (behind the coronal suture and in front of the lambdoid one), a flap is shaped with an outwards convexity, corresponding to the missing parietal bossing. The flap formed in this way is repositioned. Between the 2 bone defects, perpendicularly to the midline, the skin over the coronal suture is cut and retracted in direction of the forehead. Immediately behind or in front of the coronal suture, a linear craniectomy with 1 cm wide is performed. By means of single sutures between the neo-sutured suture and the frontal bone, a reduction of the anterior-posterior diameter of 1 cm is achieved, creating by this way an acceptable head shape (reduced anterior-posterior diameter and increased biparietal diameter) (Figure 1A,B,C), (Figure 2A,B).

The procedure-related morbidity and mortality was zero in the series. Postoperative moulding-helmets were not applied. All the patients were followed-up with photographic and radiographic (craniographies or CT scans) examinations (perioperatively and 1 year after the procedure, and in some cases 3 (2 pts.) or 5 (1 pts.) years later).

Based on the performed examinations, the pre-, the peri- and post-operative cephalic indexes of all children were calculated. The cephalic index was used for quantitative assessment of the applied operative correction of the skull deformation. The cephalic index in the cases with 3- or 5-year follow-up was not calculated, because of their limited number and the resulting statistical unreliability.

RESULTS

The purpose of the applied operative corrections of the dismorphic patients is the "normalization" of the head shape. The pre- and postoperative photographic and radiographic examinations demonstrated this "normalization". The operative technique suggested by us, contribute to achieve very acceptable shape of the head (reduced anterior-posterior diameter and increased biparietal diameter) immediately in the early postoperative period (Figure 3A,B), (Figure 4A,B).

Based on the radiological examinations, we calculated the cephalic indexes of the children before the procedures, immediately postoperatively and one year later. The median values preoperatively of the cephalic indexes were 64.5 (from 63 to 68), significantly below the normative values for the age

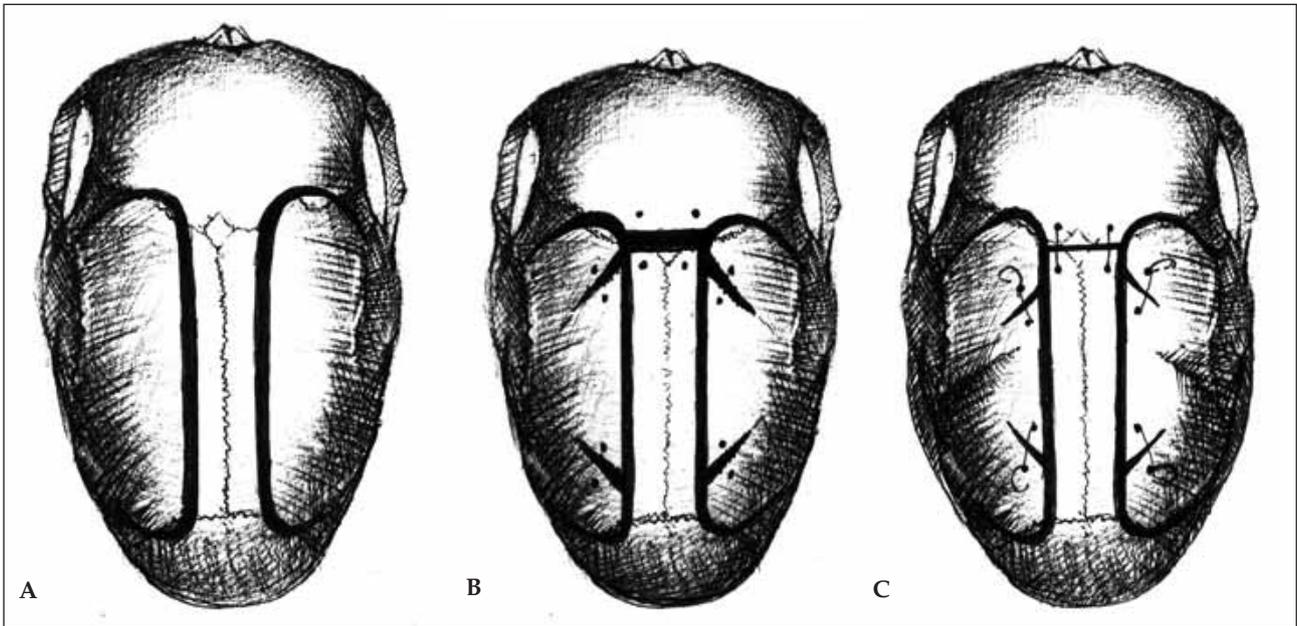


Figure 1 A, B, C: Schematic representation of the authors' proposed operative technique.

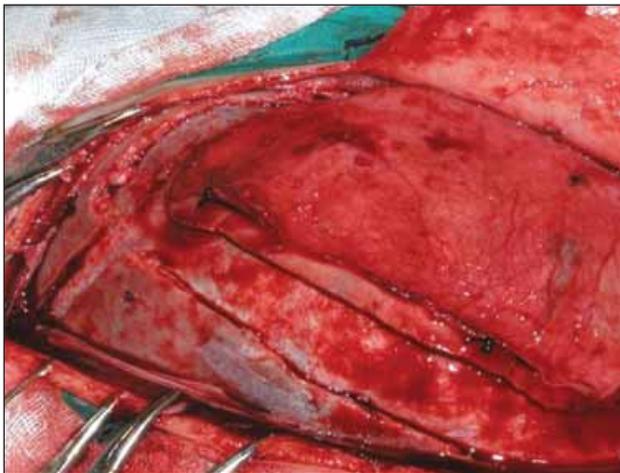


Figure 2 A,B: Intraoperative images of the stage of reducing the anterior-posterior diameter.

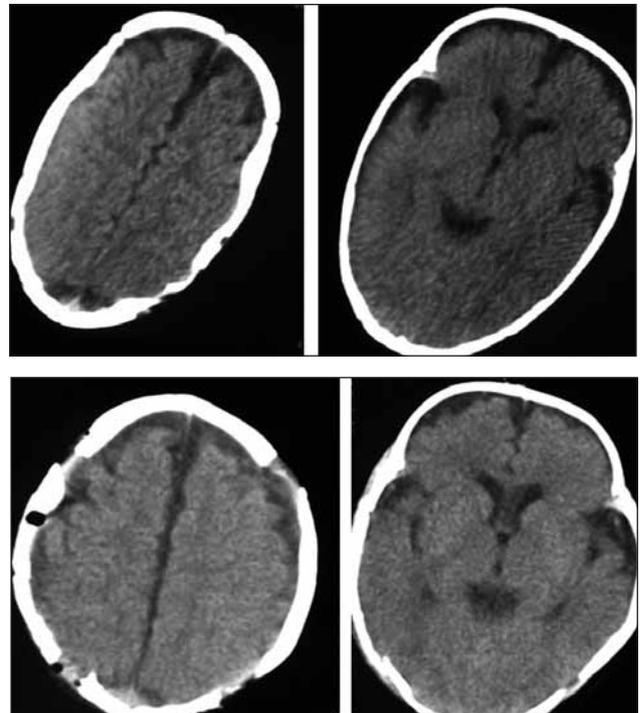


Figure 3 A,B: Preoperative (a) and postoperative (b) CT scans after successful correction of a sagittal craniosynostosis with the described technique.

group. Instantly in the early postoperative period the cephalic indexes increased to 75 (72-77) and were in the range of the accepted as normal values. The normal values were achieved in all but two patients. One year postoperatively the cephalic indexes

reached 76.79 (75-78) (in the normal ranges for the age), and it is important to mention that the cephalic indexes normalized in all patients (Figure 5).



Figure 4 A,B: Preoperative (a) and postoperative (b) photographs after successful correction of a sagittal craniosynostosis with the described technique.

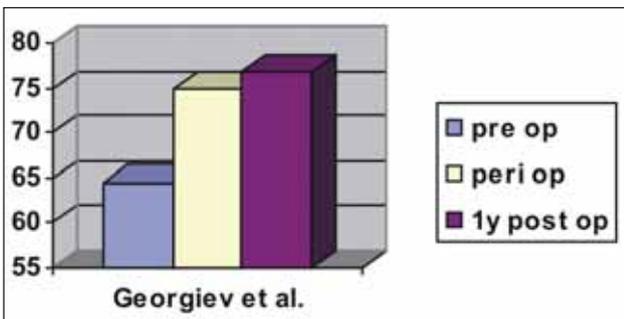


Figure 5: Dynamics of the cephalic index with the proposed technique.

DISCUSSION

The premature synostosis of some of the cranial vault sutures causes expectable skull deformation and in some cases produces compression of the brain beneath. Different configurations of the skull are observed depending on the engaged suture. Precisely this unusual shape of the newborns' head forces the parents and the general practitioners to refer the child to medical specialists.

The premature synostosis of the sagittal suture or the sagittal craniosynostosis is the most frequent

reason for a calvarial dimorphology, requiring operative correction. Its incidence varies between 26.1% [4,6,18,19,24] and 45-60% [1,7,9,10,13,15,17, 26, 28] from all types of craniosynostosis, and 70-80% of the patients are males [1,9,15,17,18,22,26,28]. Our data (scaphocephaly patients represented 56.34% of all surgically treated craniosynostoses, as 65% of these children were male) are identical with the abovementioned data.

The premature synostosis of the sagittal (interparietal) suture produces the typical scaphocephalic configuration with frontal and occipital bossing and small biparietal distance (reduction of the normal calvarial wide and a compensatory anterior-posterior extension). Ordinary, these deformations get worse with time. That is why the purpose of the applied treatment is "normalization" of the head shape. Great numbers of operative techniques have been used for the treatment of the sagittal craniosynostosis. In the operative correction of the skull deformation suggested by us, the head shape is moulded immediately in the early postoperative period (Figure 4).

In comparison with the other techniques in the literature, the advantages of our technique are the fast and easy realization, the small risks of bleeding and operative shock at its both stages, as well as the retaining of the bone protection of the sagittal sinus.

The indisputable drawbacks are the two stages of the procedure with the resulting hazards from repeated anesthesia.

The evaluation of the operative corrections of the head shape is extremely difficult. Most of the authors comment on the outcome of one or other operative technique with the terms "optimal appearance" or "superior results" [3,8,12,15,20-22,25]. This assessment is based on the performed preoperative and postoperative radiographic and photographic examinations. There are few reports in the literature with a quantitative definition of the assessment of the operative results. The cephalometric studies are the most simple and the only methods with a broad base normative data. The cephalometric parameters can be achieved as from direct antropometric examinations, as well as from measurements on the craniographies and CT scans with a bone window. Their advantages are the simplicity of execution, the good reproduction and the facilitated statistical analysis. We documented the change of the

aesthetical appearance of our patients by means of the cephalic index. The assessment of the efficacy of the operative correction proposed by us was achieved by a comparison of the preoperative, perioperative and postoperative (after 1 year) measurements for every patient. The preoperative mean value of the cephalic index was 64.5 (63-68) and in the perioperative period it increased to 75 (72-77). In the postoperative period the cephalic index reached 76.79 (75-78) ($p < 0.001$). In this way the average peri- and postoperative indexes of our patients are in the range of the age normative values.

With this index, however, we are not able to identify which part of the sagittal suture is affected, neither to discuss the psycho-social state of the patients. In spite of all, being simple and fast this method for quantitative assessment of the accomplished operative correction of the sagittal craniosynostosis is still a method of first choice.

CONCLUSION

If normalization of the head shape is the primary goal of the performed operative treatment, we consider that the proposed by us operative correction of the scaphocephaly may become a part of the management of the sagittal craniosynostosis. The efficacy of the authors' technique is supported by the accomplished assessments of the cephalic index and by the presented postoperative radiographic and photographic studies.

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