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Cranial reshaping employing distraction and contraction in the treatment of sagittal synostosis☆

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Summary We treated four patients with scaphocephaly using a combination of distraction and contraction techniques and achieved satisfactory results. Radial osteotomies in the frontal and occipital bones flattened these abnormal bossing bones and accelerated the disappearance of bony bumps created by distraction. This technique facilitates the achievement of the desired shape of the skull through fine adjustments of the distraction and contraction devices.

Several reports have recently been published on distraction osteogenesis in the treatment of craniosynostosis. Expansion of the biparietal width by distraction,[1] reduction of the anteroposterior length by contraction (reverse distraction),[2] and a combination of both procedures[3] have been reported in the treatment of sagittal synostosis. Sagittal synostosis is a good candidate for distraction osteogenesis because the cranial shape seen in scaphocephaly is relatively symmetrical and the deformity is relatively simple compared to other types of craniosynostosis. A new operative technique is described herein for skull reshaping employing distraction and contraction techniques using distraction and compression devices respectively. A radial osteotomy was also performed on the frontal and occipital bones to facilitate flattening. The results obtained in four cases are presented herein.

Patients and methods

Four patients with scaphocephaly have been treated using distraction and contraction osteogenesis together with a radial osteotomy in our department between May of 2001 and December of 2002. The patients ranged in age from 5 to 23 months (mean 14.8 months). All patients were clinically diagnosed with isolated premature synostosis of the sagittal

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suture and the diagnosis was confirmed through plain X-P, CT scan and 3D CT scan. No clinical signs of increased intracranial pressure were observed in any of the patients.

Surgical techniques

A bicoronal incision was made to expose the skull from the supraorbital to occipital region with the patient in a modified prone position.[4] An osteotomy was then performed using the modified pi-procedure introduced by Persing.[5] Bilateral parasagittal osteotomies were performed in the parietal region while preserving the central portion above the sagittal sinus. The bilateral squamoparietal bones were osteotomised in a rectangular fashion. An inferior sagittal osteotomy was performed in the temporal bone at the most laterally protruding point. A vertical slit was made in the mid portion of the temporal muscle and the periosteum was elevated along the osteotomy to leave attachments of temporal muscles to the temporal bones intact and a tunnel was created. After an osteotomy was performed through this tunnel, plates with hinges or absorbable plates (in last two cases) were applied. Craniectomies were performed at the pterion and the greater wings of sphenoid bones were resected with rongeurs when a constriction ring was observed.

A bony strip of 15–25 mm in width was excised just behind the coronal suture bilaterally. A groove was made with a surgical burr 5-mm above the orbit to allow for the posterior slope of the forehead during contraction of the anteroposterior dimension. Radial-oriented osteotomies were performed on the frontal and occipital bones and greenstick fractures were made in the outward direction to flatten the bones. None of the osteotomised bones were detached from the underlying dura except for the radial osteotomised portions. Two distraction devices (Keisei Medical Co., Tokyo, Japan) were placed bilaterally in the parasagittal region. Two contraction devices (Keisei Medical Co., Tokyo, Japan) were placed along the removed coronal suture to reduce the anteroposterior skull length (Figs. 1 and 2).

Distraction and contraction were initiated on the 5th day postoperatively. The rate of distraction and contraction was 1 mm per day (rhythm: twice a day). After completion of distraction and contraction, the protruding bars of the devices were cut at the point that they came out from the skin. The distraction and contraction process was completed in approximately 2 weeks, the devices were left in place for a further 8 weeks at which the patient underwent surgery again and they were removed.

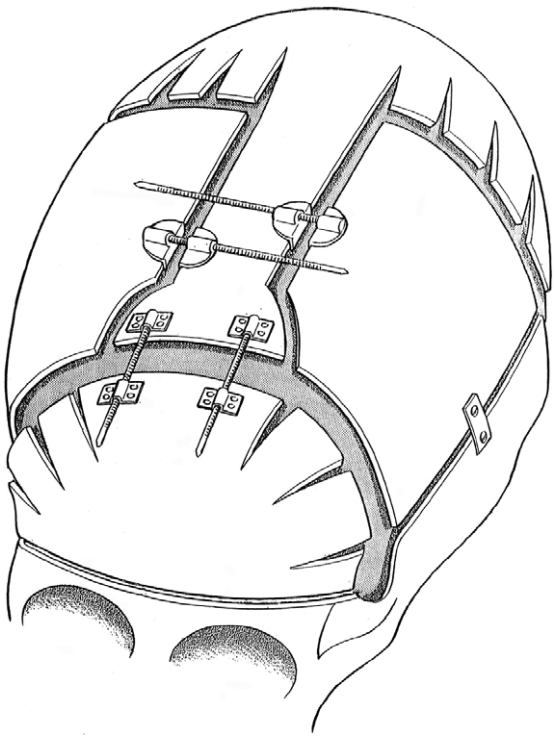

Figure 1 Schematic diagram of cranial reshaping with distraction and contraction for the treatment of scaphocephaly. Two distraction devices are applied to bilateral parietal regions and two contraction devices are applied across to the gap that is created by removing the bony strip along the coronal suture to reduce the anteroposterior skull length. Radial osteotomies are performed to flatten the deformed frontal and occipital bones.

Results

The postoperative course was uneventful and a good cranial shape was obtained in each patient. Bony bumps between distraction gaps were conspicuous early after completion of distraction. These bony protrusions disappeared within 6 months postoperatively. No relapses were noted after a mean follow-up period of 12 months (range, 6–24 months). Clinical data are summarised in Table 1.

Case 1

A 23-month boy presented with sagittal synostosis. The procedure described above was carried out. The temporal and parietal bones were expanded laterally 22 mm to both sides, for a total of 44 mm. A 15-mm bony strip was removed along the coronal