Advances in operative techniques

Child's Nervous System CNS

Child's Nerv Syst (1991) 7:264–271

Advancement-onlay: an improved technique of fronto-orbital remodeling in craniosynostosis *

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Received September 24, 1990/Revised February 12, 1991

Abstract. Eighteen patients with nonsyndromic craniosynostosis underwent fronto-orbital remodeling with an advancement-onlay technique. The mean age of the infants was 5 months (range = 2–11 months) when the procedure was performed for the following indications: unilateral coronal synostosis ($n=10$); bilateral coronal synostosis ($n=3$); metopic synostosis ($n=2$); and multiple craniosynostoses ($n=3$). The technique consists of (1) unilateral or bifrontal craniotomy, (2) superior orbital rim recontouring and advancement, and (3) frontal bone graft rotation and onlay. Posteriorly, the frontal bone graft is left "floating," while anteriorly, rigid fixation with microplates and screws has supplanted wire osteosynthesis. The use of rigid fixation prevents uncontrolled "float" of the forehead and eliminates the need for temporal struts. Follow-up time ranged from 6 to 60 months (mean = 2.6 years). There were no serious postoperative complications. Surgical results were good to excellent in 94% of cases and poor to fair in 6%. Only 1 patient with a Kleeblattschädel deformity required major revision, while another patient with trigonocephaly underwent a minor, extracranial recontouring procedure. Supraorbital rim and/or forehead recession suggestive of relapse or initial inadequacy of anterior projection occurred in 3 patients (17%). Residual, mild contour abnormalities of the forehead and/or temporal regions were found in 5 cases. To date, no gross disturbances in craniofacial growth related to our method of rigid fixation have been observed and no clinically detectable resynostosis has occurred.

Key words: Advancement-onlay – Fronto-orbital remodeling – Craniosynostosis

Most authors would agree that in the absence of increased intracranial pressure, the goal of treatment of craniosynostosis is to produce normal calvarial shape and facial dimensions [2, 9, 12]. Longitudinal, three-dimensional computed tomography (CT) studies of nonsyndromal solitary and bicoronal synostosis have shown normalization of endocranial anatomy, confirming the efficacy of cranio-orbital operations [5–8]. Lesser degrees of normalization occur in patients with multiple synostoses [5].

Improvement in exocranial or surface anatomy generally accompanies correction of osseous abnormalities. However, precise data quantifying postoperative changes in surface morphology are not yet available, making it difficult to compare the myriad of results reported by different centers [7]. In a two-center study, Bartlett et al. analyzed late results in 48 patients undergoing either unilateral or bilateral fronto-orbital remodeling for unilateral coronal synostosis [1]. Aesthetic outcome was good to excellent in over 75% of patients, regardless of the type of procedure [1]. However, on detailed inspection, they found residual irregularities of the ipsilateral temporal and/or lateral forehead in the majority of cases [1].

We, too, have observed less than ideal results, consisting of supralateral orbital rim and/or forehead recession in selected patients with nonsyndromic craniosynostosis. Concern about possible early relapse or initial inadequacy of anterior projection of the superior orbital bar led to the development of an improved and simplified technique: advancement-onlay.

The technique consists of a (1) unilateral or bifrontal craniotomy, (2) superior orbital rim recontouring and advancement, and (3) frontal bone graft rotation, remodelling, and onlay (see Figs. 2–8). The frontal bone is left "floating," free of any posterior fixation [3]. Anteriorly, where relapse, segment shifts, or cephalic "floating" may occur with closure of the coronal flap, rigid fixation with microplates and screws has supplanted wire osteosynthesis. Midline resection of the deformed metopic suture and cranial vault reshaping are performed for trigonocephaly and multiple synostoses, respectively.

In essence, our technique combines contemporary fronto-orbital remodeling with a "throw-back" to the

* Presented at the 69th Annual Meeting of the American Association of Plastic Surgeons, Hot Springs, Virginia, 1990

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