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Resorbable distraction of the midface and orbits and frontal bone: Indications and operative technique

Fernando D. Burstein, MD, FACS, FAAP

From the Department of Plastic Surgery, Emory University, Center for Craniofacial Disorders Children's Healthcare of Atlanta, Atlanta, Georgia.

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Distraction osteogenesis has been widely accepted for treatment of facial skeletal deformities. The synthesis of distraction technology and new resorbable materials has resulted in a new class of distraction devices. These single-stage distraction devices have been successfully applied to severe facial skeletal deformities. Simultaneous advancement of the midface and orbits—the monobloc procedure—is necessary in cases involving coronal synostosis and midface hypolasia resulting in malocclusion exophthalmus, obstructive apnea, and frequently increased intracranial pressure. The application of a resorbable midface-orbital-frontal (MOF) distractor for graduated monobloc distraction is presented with indications and techniques.

Distraction of the midface and orbitocranial skeleton may be useful in patients with severe midface hypoplasia and exophthalmus. In addition, patients with bicoronal synostosis accompanying midface hypoplasia and exophthalmus who require frontal bone advancement concurrent with midface and orbital bony distraction may benefit from this technique. Clinical conditions such as Crouzon syndrome, Apert syndrome, Carpenter syndrome, and select patients with severe maxillary hypoplasia secondary to facial clefting are potential distraction candidates (Figures 1 and 2). Many patients with significant midface hypoplasia have associated airway obstruction as a result of narrowing of the nasal airway as well as the nasopharyngeal airway. This effect is caused by both anterior posterior and transverse growth deficiency of the maxilla. The resultant airway compromise can be relatively insidious. This is because of the slowly increasing discrepancy between growth of the nasopharyngeal and oral soft tissues, and the supporting bony skeleton, which do not grow as quickly. Distraction of the midface can significantly improve the patency of the upper airway in these individuals.

Address reprint requests and correspondence: Fernando D. Burstein, MD, Suite 500, 975 Johnson Ferry Road, Atlanta GA, 30342.
E-mail address: E-mail address: FBurstein@aol.com.

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Resorbable distraction

Distraction osteogenesis of the facial skeleton was introduced by McCarthy[1] who applied the principles of distraction osteogenesis, pioneered by Ilizarov,[2] to mandibular distraction. Ilizarov showed that slow gradual distraction of bone segments resulted in bone deposition in the distraction gap, and allowed nerves and blood vessels to be gradually stretched while preserving their integrity. McCarthy's work stimulated others[3,4] to develop several designs of internal and eventually internal bone distraction devices for both maxillary and mandibular distraction. All of these devices required 2 stages, one for application of the device and a second stage for device removal. Our work with resorbable plates and screws led us to develop a series of resorbable distraction devices (Walter Lorenz Surgical, Jacksonville, FL).[5,6] They incorporated a drive screw with resorbable distraction plates to allow for single-stage distraction (Figure 3). The only nonresorbable component is the distraction screw, which is removed in the office.

Technique

The operative technique requires either Le Fort III type osteotomies or monobloc osteotomies, depending on the clinical need. If there is bicoronal synostosis with or without hypertelorbitism, the monobloc type of procedure is indi-

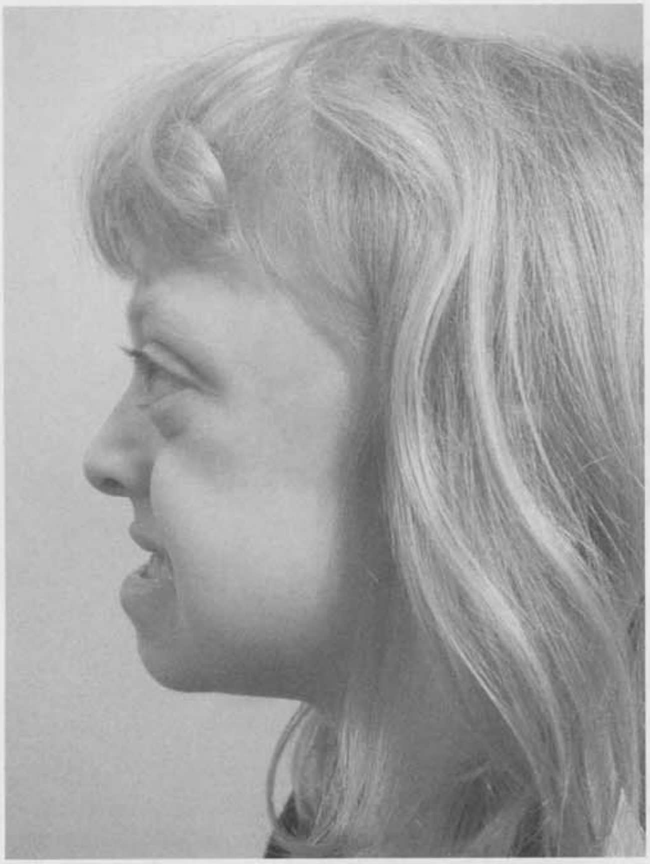

Figure 1 Lateral view of patient with Crouzon syndrome. Note severe midface hypoplasia and exophthalmus.

Figure 2 Frontal view of patient with Crouzon syndrome. Note severe exophthalmus resulting in corneal exposure.

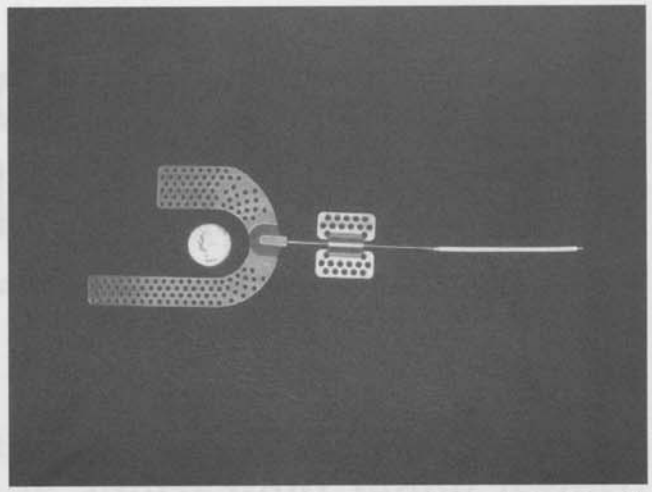

Figure 3 Mandibular orbital frontal resorbable device. Metallic screw is backed out at end of consolidation period.

cated (Figure 4). The Le Fort III osteotomy does not require intracranial exposure, while the monobloc procedure requires a bifrontal craniotomy. Both procedures require a coronal as well as buccal incisions for exposure. In general, patients 5 years or older will have sufficient bone mass to support the midface-orbital-frontal (MOF) device. Besides the bone being hard enough to hold a screw easily, the eyes have finished growing, and the procedure will usually last until skeletal maturity, when a maxillary procedure alone can be contemplated. Monobloc osteotomies are possible in children as young as 18 months, with severe upper airway obstruction, but the procedure is more technically challenging.

Key technical points include making certain that all osteotomies are complete before mobilizing the midface. The most difficult osteotomies are between the midface and base of skull at the pterygoid plates, and behind the nasofrontal complex through the perpendicular ethmoid plate and vomer. Once all the osteotomies are completed, the bony segments are slowly mobilized using disimpaction forceps

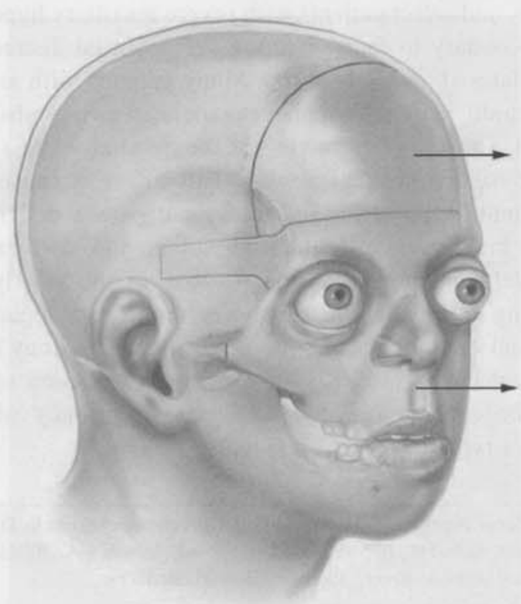

Figure 4 Distraction vectors in relation to bony and soft tissues.

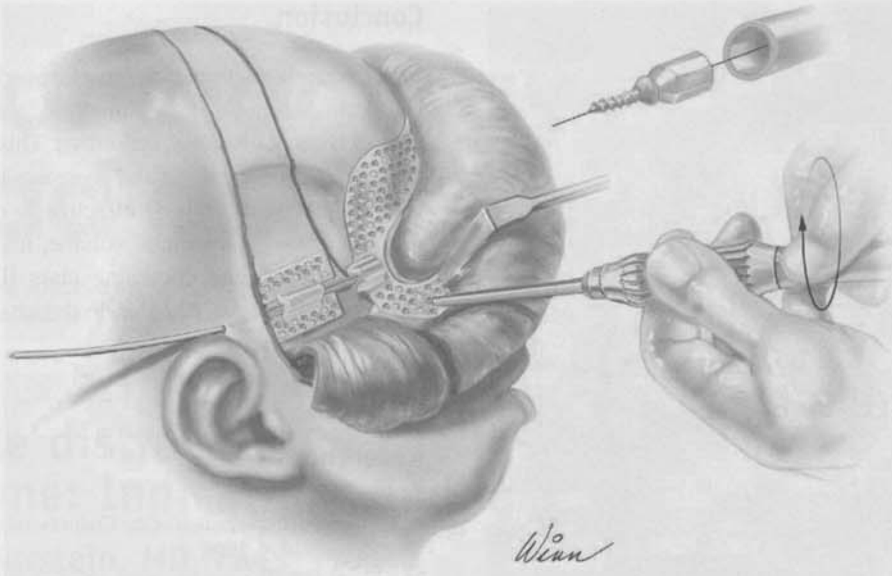

Figure 5 Application of MOF device through coronal approach. Device is heat contoured and trimmed to follow bony contours. Distraction screw is shown passing out through separate scalp incision.

and bone spreaders as necessary. The midface and, if applicable, frontal orbital complex must be freed as a single unit to allow for monobloc distraction (Figure 5). Failure to complete the osteotomies can result in uncontrolled fractures and mechanical failure of the distraction devices. The proximal and distal distractor components are thermally contoured to fit the skeletal framework. Once mobilization has been achieved, the MOF device can be applied (Figure 6). The appropriate distraction vector should be chosen before application of the distractor. Typically, a vector paralleling the occlusal plane is optimal. A minimum of 4 proximal and 4 distal screws are used to attach the plates to the skeleton. The distraction drive screw is applied and turned at least 5 mm to ensure full mobilization of the osteotomies. Standard closing techniques are used, and postoperative antibiotics are recommended.

The distractor is activated after 48 hours. There should be 2 mm/day of distraction used until the desired advancement has been achieved (Figures 7 and 8). After 4 weeks of consolidation, the drive screw is backed out in the office. The resorbable attachment plates begin to resorb by 2 months and are usually completely resorbed within 9 months.

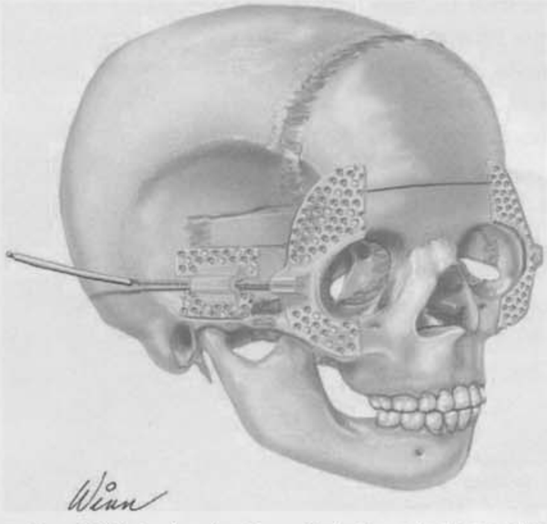

Figure 6 MOF device in place. Note the osteotomy sites and bone gaps created by activating the device. Distraction vector parallels the occlusal plane.

Figure 7 Lateral view of patient in Figure 1 after approximately 35-mm distraction of frontal bone, midface, and orbits (monobloc procedure). Note correction of exophthalmus and midface hypoplasia.

Figure 8 Frontal view of patient in Figure 2 after monobloc distraction. Note correction of globe proptosis.

Conclusion

Resorbable distraction of the midface, orbits, and frontal bone is indicated in cases of exophthalmus, and midface hypoplasia with or without bicoronal synostosis. This technique eliminates the need for bone grafting and decreases the risk of intracranial fluid collections. It can be effective in correcting exophthalmus, increasing intracranial volume, improving the nasopharyngeal airway, and correcting class III malocclusion. The resorbable nature of the MOF device eliminates a second procedure for device removal.

References

1. McCarthy JG: Distraction of the Craniofacial Skeleton. New York, NY, Springer-Verlag, 1999
2. Ilizarov GA: The tension-stress effect on the genesis and growth of tissues. Part I. The influence of stability of fixation and soft-tissue preservation. Clin Orthop Relat Res 238:249-254, 1989
3. Molina F: Mandibular elongation and remodeling by gradual distraction. An experience of 277 cases. Ann Chir Plast Esthet 46:505-511, 2001
4. Denny AD, Kalantarian B, Hanson PR: Rotation advancement of the midface by distraction osteogenesis. Plast Reconstr Surg 111:1789-1799, 2003
5. Burstein FD, Williams JK: Resorbable bone distraction: Current status and future directions. Clin Plast Surg 31:407-414, 2004
6. Burstein FD, Williams JK: Mandibular distraction osteogenesis in Pierre Robin sequence: Application of a new internal single-stage resorbable device. Plast Reconstr Surg 2005;115:61-67, 2005