Blow-out fractures in children: six years' experience

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Objectives. To present and analyze our experience in treating blow-out fractures in children, over a 6-year period.
Study design. The study was retrospective with 16 consecutive cases of blow-out fractures in children aged 5 to 15 years. All patients presented with impairment of eye motility and diplopia together with radiological findings. Treatment included fracture reduction, release of entrapped periorbital soft tissues, and placement of an alloplastic membrane on the orbital floor. Fractures were linear in 11 cases (trapdoor) and severe or comminuted in 5 cases.
Results. Clinical symptoms subsided in all cases. Complete recovery of eye motility was achieved after surgical procedure in 13 cases; 2 patients presented late but had full recovery, and 1 patient, 4 years postoperatively, still had slight motility impairment.
Conclusions. Surgical treatment of blow-out fractures, including periorbital tissue release and placement of a membrane lining on the orbital floor, presented satisfactory results in our cases. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103:757-63)**

Blow-out fractures, where only the thin orbital walls are involved with the orbital rims remaining intact, occur when the eye bulb is suddenly pushed backward in the orbit.[1] The most commonly fractured area is the orbital floor; this allows the intrusion and entrapment of the orbital content, and more specifically, of the inferior rectus and the inferior oblique muscles or their fascial attachments into the fracture lines and toward the maxillary sinus. The mesial orbital wall may occasionally be fractured as well.

Blow-out fractures are not very common in young children probably due to anatomy differences, as the preadolescent child presents craniofacial disproportion with underdeveloped midface, small size of the maxillary sinuses, and protruded cranium and mandible.[2-4] Measurements of the anatomy of the orbit have shown that its size in children is considered to have reached 75% to 85% of its growth by 1 year of age, and 85% to 95% by 5 years of age,[5] so the optic foramen in children and adolescents is expected to be located as in adults—approximately 45 mm behind the suborbital rim along floor[6]–whereas in very young children this distance should be respectively less. In addition, orbital fractures in children and their surgical treatment are not expected to seriously interfere with the growth of the orbit. According to different studies, the cause of blow-out fracture may be sport injury, assault, falls, and car or motor vehicle accident.[3,4,7-9]

A typical diagnostic finding of this type of fracture is clinical evidence of entrapment; that is, the impairment or the limitation of ocular movement, mainly of the vertical, followed by double or blurred vision. Since the globe of the eye should not resist to passive rotation, a positive forced duction test is indicative of an entrapped eye. Another often-reported finding in cases of orbital floor fractures in children with coexisting entrapment of soft tissues is the presence of nausea and/or vomiting, which subside after surgical treatment.[9] The incidence of the symptom varies among authors, ranging from 14.7%[9] to 25%,[10] and even up to 46.6%.[11]

Although radiological findings may occasionally be seen in simple sinus radiographs, radiological diagnosis of blow-out fracture is made mainly by careful evaluation of CT coronal cuts. Trapdoor-type fractures with minimal soft tissue incarceration may sometimes be difficult to be seen, even in CT scans.[9]

Surgical intervention is the treatment of choice of a blow-out fracture whenever restriction of eye movement and diplopia, together with radiological findings, exist.[3] With the exception of very young children, a safe surgical approach to the orbital floor does not differ greatly in children from that used in adults, and may be extended as far as 25 to 26 mm posteriorly from the inferior and the lateral rims.[12,13]

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Table I. Details of operated children

Patient No.	*Gender*	*Age*	*Date of operation*	*Operation site*	*Alloplastic material used*
1	Male	7	Oct 1999	Floor, R	Medpor
2	Male	14	Feb 2000	Floor, R	Dura substitute
3	Male	11	May 2001	Floor, L	Medpor
4	Male	15	July 2001	Floor, L	Dura substitute and antral packing
5	Male	15	Sept 2001	Floor, L	Medpor
6	Female	5	May 2002	Floor, L	Medpor
7	Male	10	June 2002	Floor, R	Medpor (late treatment)
8	Male	14	April 2003	Mesial L and nose	Dura substitute (late treatment)
9	Male	11	April 2003	Floor, R	Dura substitute
10	Male	5	Aug 2003	Floor and mesial, L	Dura substitute
11	Male	10	Sept 2003	Floor, R	Dura substitute
12	Male	10	Jan 2004	Floor, R	Dura substitute (late treatment)
13	Female	13	May 2005	Floor, L	Dura substitute
14	Male	7	July 2005	Floor, L	Dura substitute
15	Male	13	Feb 2006	Floor, R	Dura substitute
16	Female	11	Feb 2006	Floor, L	Dura substitute

R, right; *L,* left.

The "trapdoor" fracture is an intraoperative finding of blow-out fracture often reported in young patients in a percentage ranging from 36% to 93%, in contrast to the "open door" fracture found in adults.[7-9,14,15] Probably, due to its elasticity, the orbital bone in children breaks and bends during injury in a linear pattern, and then it moves back to its position entrapping and strangulating periocular soft tissues.[15] This mechanism probably explains the late recovery of ocular motility in children after surgical treatment, since the strangulation of tissues may cause delay or loss of muscular function. So, a positive forced duction test at the end of the surgical procedure may not guarantee free voluntary movement of the involved eye postoperatively.[3]

Several autogenous grafts or alloplastic materials have been used in similar cases of orbital fractures, to act as a lining over the fractured orbital wall and to prohibit the reentrapment of soft tissues in the fracture lines.[2,3,16-18] In one of these previous studies, the type of graft used was selected according to the size and type of the fracture.[19]

The authors of most studies agree that the appropriate time for surgical intervention should be provided in children as soon as possible, due to the more persistent problems of the trapdoor fracture.[3,20] Bansagi and Meyer[15] suggested treatment within 5 days from injury for patients with severe limitation of ocular motility. In their retrospective study, including both children and adults, Matteini et al.[21] suggested early surgical procedure, within 3 days, in children with diplopia, and McCulley et al.[22] operated urgently on 2 adolescent patients with trapdoor (linear nondisplaced) fractures of the mesial wall with incarceration of the medial rectus muscle. Early surgical intervention in children and adolescents was reported to achieve a more rapid and better postoperative improvement,[9,14] and to avoid late establishment of enophthalmos in cases where symptoms persisted 1 to 2 weeks after injury.[23] Nevertheless, Leitch et al.,[24] in their study of both children and adults, reported a successful outcome in cases of late treatment (up to 6 weeks after injury), but they also found that young patients were more likely to suffer from postoperative residual diplopia than adults.

Postoperative complications of blow-out fractures other than late or incomplete recovery of ocular motility are not often reported. Bodker et al.[25] treated 2 patients with mydriasis that followed posterior orbital floor injuries and repair and was attributed to surgical manipulation of or near the ciliary ganglion.

The aim of the present study was to present our surgical experience in treating blow-out fractures in children. The recent literature on the subject is reviewed, and findings among studies are discussed and compared.

MATERIAL AND METHODS

Sixteen children and adolescents, 13 boys and 3 girls, aged from 5 to 15 years of age (mean age 10.7 years), with true blow-out fractures, and who had been treated surgically from October 1999 until February 2006, were included in this retrospective study (Table I). Four children were 5 to 7 years old, 3 were 8 to 10 years old, 5 were 11 to 13, and 4 were 14 and 15 years old.

Preoperatively, all 16 children presented severe impairment of the eye movement and persistent diplopia together with radiological findings verifying the pres-