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Pediatric orbital roof fractures

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Isolated orbital roof fractures are rare. In the pediatric population, however, the lack of pneumatized frontal sinuses makes them more susceptible to such injuries. In evaluating these injuries, maxillofacial computed tomography is a necessary adjunct to a complete history and physical evaluation. Based on the relative position of bone fragments, orbital roof fractures can be classified as non-displaced, blowout, or blow-in. While many patients can be safely managed with careful observation. Symptoms such as extraocular entrapment, vertical dystopia, diplopia, or cerebrospinal fluid leak may require surgery. Many different approaches to the orbital roof are available; selection needs to be made based on surgeon experience and location of injury. Cooperation between neurosurgery, ophthalmology and head and neck surgery are essential to optimize the care for these patients.

Orbital roof fractures are uncommon injuries. It has been estimated that between 1% and 9% of facial fractures involve the orbital roof.[1] Isolated orbital roof fractures are rare in adults. Among pediatric patients, however, because frontal sinuses are not significantly pneumatized before age 7, forces directed at the brow and superior orbital rim cannot be distributed across the forehead and, therefore, orbital roof fractures are more likely to occur.[1-3] Greenwald and coworkers found that all children with isolated orbital roof fractures were younger than 7 years old,[4] and the authors of previous reports of orbital fractures in children found 35% of cases involved the orbital roof.[2]

Although adult orbital roof fractures have a high male predilection (89-93%),[5,6] pediatric population does not exhibit similar trends, and the gender distribution appears equal.[1,2] This distribution is consistent with the accidental nature of these injuries in children, with the most common mechanisms being falls and motor vehicle accidents.[1]

The task of classifying orbital roof fractures has been undertaken by several authors in the past.[7] However, the classification scheme is not yet uniform, and most studies continue to describe fractures by their gross appearance.[1,2] The first type is the nondisplaced fracture. This is by far the most common type in the pediatric population.[1,2,4,7] The fracture can involve one or several bone fragments without displacement (Figure 1). The second type is the blow-out fracture. First coined by Smith and Regan in 1957 to describe orbital floor injuries,[8] these fractures involve bony fragments that are displaced away from the globe. In the context of orbital roof fractures, the fragments are displaced into the anterior cranial fossa, with possible consequence of dural disruption (Figure 2). The third type is the blow-in fracture. The bony fragments are displaced inferiorly into the orbit (Figure 3). Possible consequences include orbital dystopia (vertical displacement of the globe) and exophthalmos or proptosis.

The most common mechanism that causes orbital roof fractures is from direct trauma to the orbital rim (Figure 4).[2] As the force is delivered to the rim, pressure is dissipated along the surrounding bony tissue around the orbit, causing buckling of the orbital walls before the rim itself eventually yields. When the amplitude of the wave of deformation exceeds the compliance of the thin bone, the walls are broken (Figure 5). This mechanism is applicable to floor and wall as well as roof fractures.

Evaluation

Orbital roof fractures may occur in conjunction with injuries of other systems, particularly the central nervous system[1,2]

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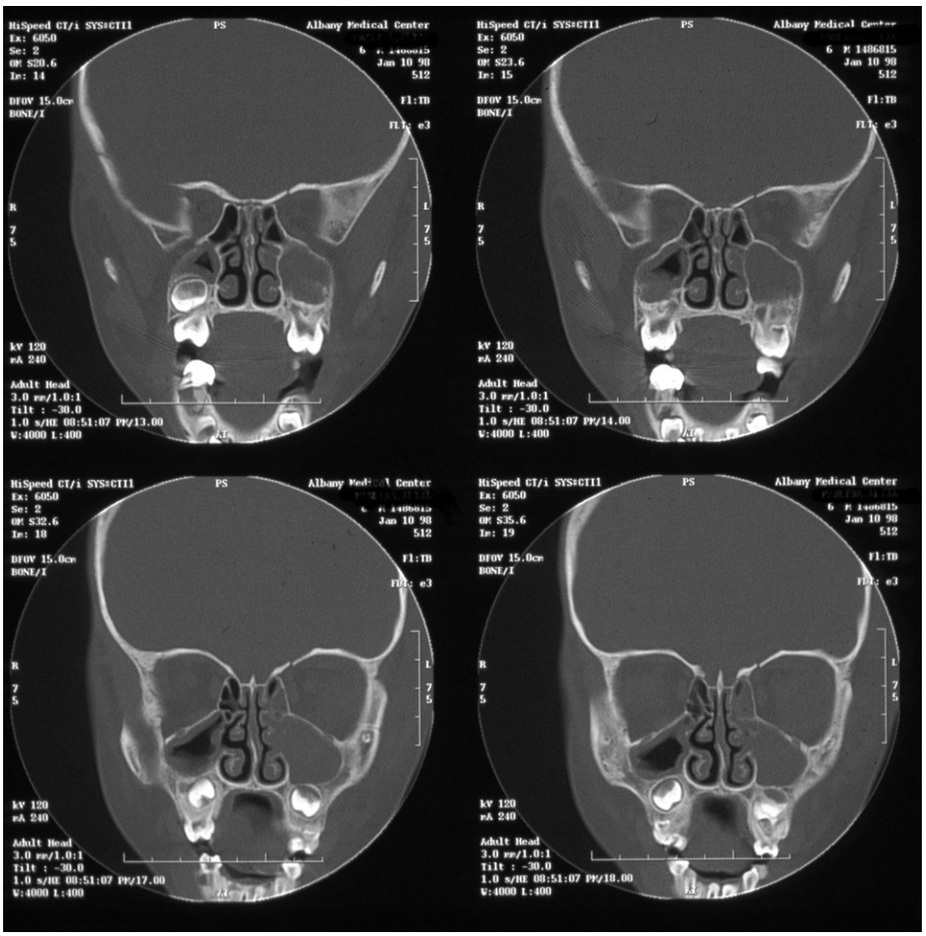

Figure 1 Left undisplaced orbital roof fracture in a 3-year-old child.

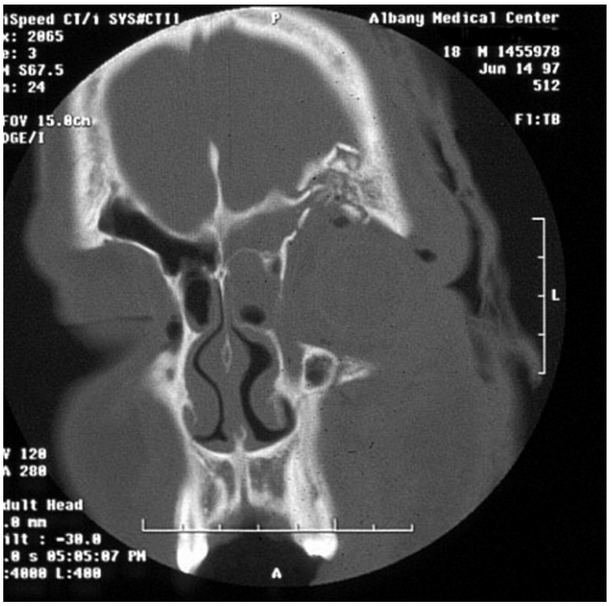

Figure 2 Left "blow-out" fracture of the orbital roof in a 15-year-old patient.

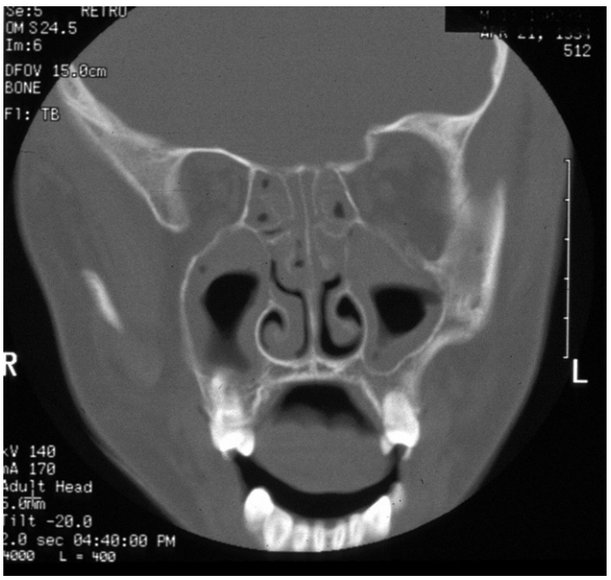

Figure 3 Left "blow-in" fracture of the orbital roof in a 13-year-old patient.