

Epidural Hemorrhage After Removal of a Rigid External Distraction Device

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The use of a rigid external distraction device for the treatment of severe maxillary deficiency was popularized by Figueroa and Polley.¹ Using a halo device adapted from the halo vest described by Perry and Nickel² over 45 years ago to immobilize the cervical spine, constant traction is placed on an osteotomized maxilla to position it in a desired plane of space. While no complications from this specific halo device were described in Figueroa and Polley's original series, complications have been reported, including intracranial migrations of pins³⁻⁵ and traumatic depressed skull fracture from falling on the device.⁶ We report a case of epidural hemorrhage after removal of an external distraction device.

Report of a Case

A 27-year-old woman with a bilateral cleft lip and palate was being treated for severe maxillary deficiency. She had undergone previous Le Fort I advancement with significant relapse and was then offered distraction osteogenesis with a rigid external device. After an uneventful Le Fort I downfracture, the halo device was placed parallel to the Frankfort Horizontal Plane, torquing the 6 pins to 8 inch-pounds of torque. Initially, there was difficulty in placing the pins at the desired level of 3 cm above the pinnae because the pins would slip superiorly with tightening. Thus, they were placed at a slightly inferior

position. The patient had an uneventful postoperative course and distraction. No pin site infection or pin loosening was noted. After 3 months of consolidation, the patient was sedated with Versed (Roche, Basel, Switzerland) and Alfenta (Janssen-Ortho, Ontario, Canada) for halo removal. All screws were removed, after which some oozing was noted from the left anterior pin site. It was stopped with direct pressure to the area. The patient had prolonged emergence from seemingly light sedation, never becoming fully alert. She soon began vomiting, and was administered flumazenil and odansetron without relief of vomiting or improvement in level of consciousness. Initially, she developed dysconjugate gaze, and then her eyes remained closed and did not open even to painful stimulus. Her pupils were midrange and poorly responsive to light. She was not responding to commands and remained nonverbal. She withdrew to painful stimulus with the left side only. An emergent head computed tomography (CT) revealed a 3 cm left-sided acute temporal epidural hematoma with midline shift and compression of the brain stem (Fig 1). Emergent neurosurgery consultation was obtained. The patient was intubated, hyperventilated, given furosemide and mannitol, and taken emergently to the operating room for craniotomy and evacuation of hematoma. The main source of bleeding appeared to arise from within the lateral aspect of the middle fossa, likely a middle meningeal branch. Four hours elapsed from the time of pin removal to the evacuation of the clot. On postoperative exam, both pupils were brisk. The patient exhibited purposeful movements to pain with the left upper extremity greater than the right upper extremity. She withdrew her legs to pain, left greater than right. She was extubated immediately postoperatively and taken to the neurosurgical intensive care unit in stable condition. One day postoperatively, the patient had regained full consciousness and was at her baseline neurologic exam, with the exception of a slightly dilated left pupil, which was reactive. One week later, her pupils were equally reactive to light and she remained at her baseline neurologic exam.

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Discussion

Many complications have been reported with halo devices. Garfin et al,⁷ in a review of 179 patients who received a halo device, identified pin loosening (36%), pin site infection (20%), pressure sores under the vest (11%), nerve injury (2%), dural penetration (1%), dysphagia (2%), objectionable scars (9%), and severe pin discomfort (18%). In another retrospective review of



FIGURE 1. A–C, CT scans of the epidural hemorrhage.

Lypka et al. Hemorrhage from External Distraction Device. *J Oral Maxillofac Surg* 2007.

37 children managed by a halo,⁸ 65% had complications similar to those described by Garfin. The higher complication rate in children with the use of a halo device is further substantiated by Baum et al,⁹ in which 39% of children suffered complications versus 8% of adults. However, there was no incidence of bleeding, nerve injury, dural penetration, dysphagia, pin discomfort, or psychologic reaction in this series. Other complications described include osteomyelitis,¹⁰ epidural abscess,¹¹ brain abscess,¹² and delayed onset tonic/clonic seizures.¹³ Specific to the halo device used in midfacial distraction, Le et al,³ Van der Muellen et al,⁴ and Brown et al⁵ discuss cases of intracranial migration of fixation pins, and Reiger et al⁶ report a case of traumatic cranial injury sustained from a fall on a rigid external distraction device. We describe a case of epidural hemorrhage after removal of a halo fixation device, a unique complication not yet to be described in the literature.

In reviewing the case described, it is important to discuss pin placement. Garfin et al,¹⁴ in their study of 27 cadaver skulls and 20 head CT scans of randomly selected patients, have outlined the relative thickness of different areas of the skull as it relates to halo pin placement in adults. At a level just below the greatest diameter (equator) of the skull, the thickest areas of the skull are in the anterolateral and posterolateral positions. The temporal fossa and frontal sinus areas are the thinnest, the temporal fossa often with fused inner and outer cortices and an absent marrow space. It is therefore recommended that halo pins be placed in the antero- and posterolateral portions of the skull, avoiding the thin temporal fossa. Furthermore, pins placed in the temporal fossa traverse the temporalis muscle resulting in pain on mastication. Garfin et al¹⁵ report similar data in an analysis of pediatric skulls. In contrast, Wong et al,¹⁶ in their CT scan analysis of 48 pediatric skulls (less than 10 years of age), report variable thickness in standard halo pin positions and that no safe positions can be recommended in children.

The halo device adapted for midfacial distraction has 3 pins per side, all placed behind the hairline in the temporal fossa. In the adult patient, this violates the recommended safe zones for pin placement. In our patient, difficulty was incurred in placing the pins at the recommended 3 to 4 cm above the pinnae because this was above the equator of the skull and in combination with the patient's thick, coarse hair, pins were displaced superiorly when attempts were made at engagement. Therefore, the halo was placed slightly inferior to this position, placing the pins more perpendicular to the skull. At the time of craniotomy, the temporal bone in which the pins were placed was exceedingly thin. During tightening of the pins to 8 inch-pounds of torque, one of the pins may have

penetrated the inner table, disrupting a middle meningeal vessel but tamponading it. Alternatively, the pin may have migrated intracranially during the course of the distraction process and eroded a middle meningeal vessel. When the pin was removed, the tamponade effect was released and bleeding occurred intracranially, resulting in mass effect and the physical findings described earlier.

Epidural hemorrhage is a life-threatening complication after the removal of an external halo device. Fortunately, the patient in this case was in a controlled setting that allowed for prompt identification and treatment of the problem. Migration of halo pins intracranially, especially in children, is clearly a problem as others¹⁷ have modified the external distraction device by placing stoppers on the pins. Copley et al¹⁸ studied new wide-flanged, short-tipped pins in an attempt to design a better halo pin in the pediatric population. Van der Muellen et al⁴ recommend increasing the number of pins placed to reduce the force at each individual pin site. As recommended by others,^{3,4} we also recommend preoperative head CT before halo placement to assess skull thickness and postoperative CT scan to assess pin placement. A specially designed marker ring may be used to better plan pin placement.⁴ We would also recommend routine head shaving in the area of halo pin placement for ease of halo pin placement. Postoperatively, pin sites must be assessed for signs of loosening and infection. Removal of the device should be completed in a controlled setting. During removal, a special setscrew to prevent frame in-bending as well as a gradual release of pins in a sequential manner should reduce pressure on the skull by individual pins and thus prevent inadvertent skull penetration by pins.⁴ The external distraction device is not a benign device and its use requires careful preoperative planning and vigilant postoperative care. With strict attention to detail, hope-

fully future complications from the use of external distraction devices can be avoided.

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