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Atlantooccipital dislocation in pediatric age: History of a survivor patient

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Abstract
Introduction: Atlantooccipital dislocation (AOD) is a rare but fatal injury, representing only 1% of cervical trauma cases, more common in children due to anatomical and physiological factors. Prompt diagnosis and timely treatment are crucial for favorable outcomes.
Case Description: We present the case of a six-year-old male involved in a motor vehicle accident, presenting with quadriplegia and fluctuating levels of consciousness. Initial CT scans revealed subarachnoid hemorrhage and abnormal radiological indices. MRI confirmed damage to critical ligaments and medullary contusion. The patient was immobilized using a halo vest and later underwent successful occipitocervical fusion (OCF).
Discussion: AOD diagnosis is challenging due to its rarity and variable clinical presentation. Standard radiological indices may not always be indicative. MRI is essential for evaluating ligamentous and medullary involvement. While OCF remains the standard treatment, halo vest immobilization can be a viable option in select cases, particularly in pediatric patients.
Conclusion: High suspicion is necessary for diagnosing AOD in pediatric trauma cases. OCF is the standard treatment, but halo vest immobilization may be considered in certain scenarios.

Keywords: Atlantooccipital dislocation, Pediatric trauma, cervical spine injury, Occipitocervical fusion, Halo vest immobilization, Radiological diagnosis

Introduction
Atlantooccipital dislocation (AOD) is a traumatic lesion of cervical spine and fatal injury. It's present in only 1% of patient presenting with cervical trauma [1]. This entity is more common in children due more flat atlantooccipital joints, ligament laxity, disproportionate head-to-neck ratio [2]. The mechanism of injury most common accepted is high energy trauma in combination with hyperextension and extreme lateral flexion. These events lead to disruption of tectorial membrane and alar ligaments [3]. Others ligaments of craniocervical junction (CCJ) may be also compromised. The result is instability of CCJ. Prompt diagnosis of AOD and treatment instituted in timely fashion are crucial for good clinical outcomes.

Case description: A six years-old male restrained passenger in a boost seat in a motor vehicle accident. It was noted fluctuation of level of conciseness and quadriplegia at scene. The patient was intubated for airway protection and transferred to a nearby hospital. At receiving hospital, the CT scan shows subarachnoid hemorrhage and widening of distance of basion to dens. Because of the necessity of possible surgical treatment, the patient was transferred to a trauma center. Of classic radiological measurements, Power ratio index and Wholey Basion-dens interval (BDI) were abnormal. Additionally, the Condyle-C1 interval (CCI) was also altered [Fig 1]. A cervical RMI scan was performed. There is lesion of tectorial membrane, alar ligaments, retroclival hematoma and medullary contusion from C2 to C6 [Fig 2].
The patient was immobilized with halo vest [Fig 3]. He was extubated 24 hours after halo vest stabilization. We noted recuperation of motor neurological level to C6 on his right upper limb and C7 on his left. The patient was put in corticoid therapy protocol for 24 hours. The patient underwent to definitive surgical treatment after 80 hours of injury. The surgical procedure consisted of occipitocervical fusion (OCF) C0-C3 with posterior pedicle screws placed in C2, screws in lateral mass of C3 and an occipital plate. The patient was positioned in prone position with the head held in neutral position by Mayfield positional device. We used a standard posterior approach [Fig 4].

The patient had a favorable post-operative period. He was extubated after the surgery. He kept the same neurological examination after halo vest immobilization. At fourth mouth after surgery, the patient had Glascow score of 15, motor neurological level at C7 bilaterally. He kept the same neurological examination at 1st and 2nd year of post-operative.

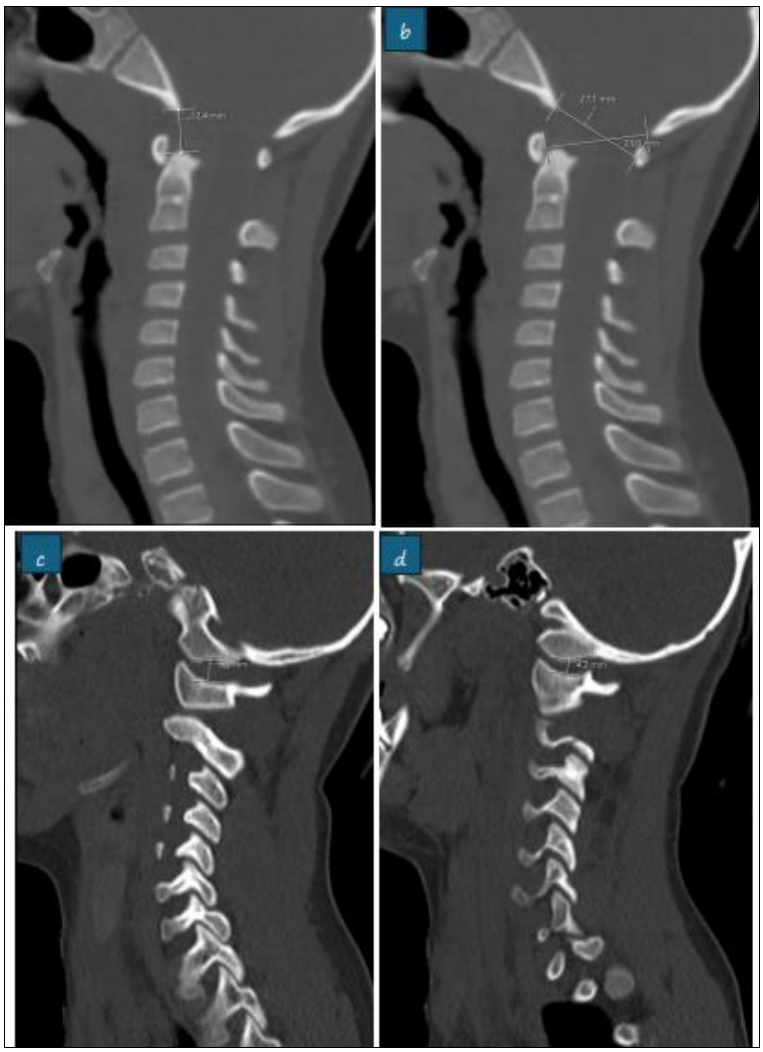
Discussion

AOD is a rare injury and its diagnosis is challenging. In necropsies studies, around 30% of patients presenting with fatal cervical trauma had AOD1, 2, 4. As a rare entity it can be easily missed [5, 6]. Failure to diagnose AOD is main predictor of mortality [7]. Clinical presentation of AOD can be extremely variable. The patients may present signs of brainstem compression (such as cardiorespiratory arrest, hemodynamic instability, lesion of cranial nerve) upper cervical spine symptoms, fluctuations of level consciousness. Besides, most patients come to emergency room after orotracheal intubation and many or all these symptoms may be overlooked3,8. It is necessary high index of suspicion in all pediatric with history of motor vehicle collision involving high energy trauma.

Classically, AOD is diagnosed by radiological measurements in plain radiograph or cuts of CT scan. The standard radiological index such Powers ratio, Harris rule of 12, Wholey DBI, Sun's of interspinous C1-C2/C2-C3 ratio may be normal in a patient presenting with AOD8–10. Since the patient is lying down, the lesion can be reduced due the movement of the head and the measurements of several index can be normal. Pang, 2007, studied AOD in 16 patients. They concluded that CCI criterion has the highest diagnostic sensitivity and specificity for diagnosis of AOD among all other radiodiagnostic criteria and indicators. It can´t be affected by the position of the head [8, 10, 11].

The MRI scans are essential for the diagnosis. It enables the clinician evaluate the status of ligaments in the CCJ, medullary involvement and neck vessels [10].

The standard treatment for AOD is OCF. Regardless of good clinical results reported, a patient that undergo to surgical treatment lose 30-40% of cervical mobility10. In the case of a child it may be too much. As alternative, some studies report good outcomes using halo vest has definitive treatment [12, 13]. There are some drawbacks as pin intrusion through the inner table of the skull, pin infection and loss of reduction despite the immobilization system [3, 14, 15]. In our case, we used halo vest as temporary measure. The surgical team in that day had no routine in performing OCF. There was an improvement in the clinical picture. The halo vest when used correctly, it may a good solution for a select group of patients (toddler, infants, and patients with partial lesion). It requires a close monitoring with imaging studies. Loss of reduction is not acceptable [13, 15].



Abbreviations: BDI = Basion-Dens Interval; CCI = Condyle-C1 interval

Fig 1. a): Wholey BDI>12 mm; b) Powe Ratio Index= 1,1; c-d) right and left CCI. 6 and 4, 3 mm respectively

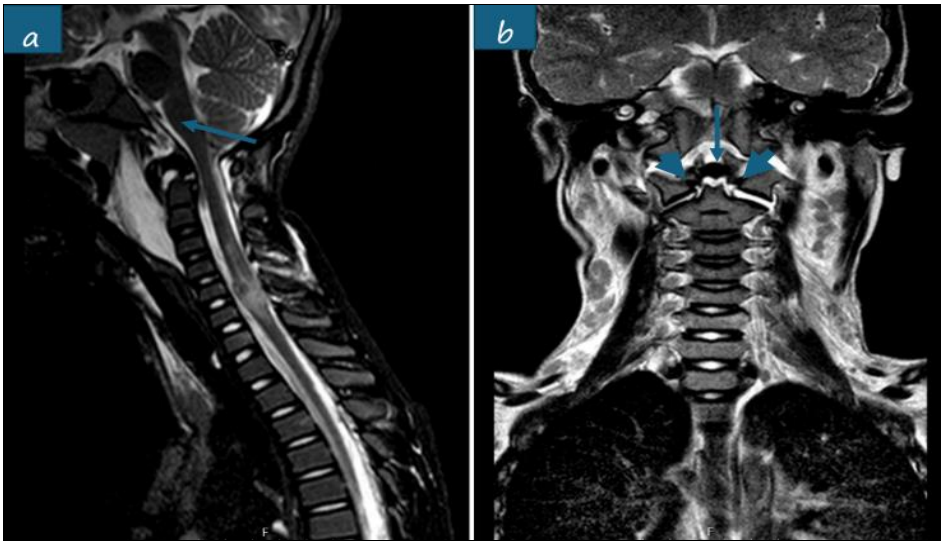


Fig 2: a) Sagittal cut of MRI presence of retroclival hemato ma, b) Arrow indicates lesion of tectorial membrane, arrow head indicates lesion of alar ligaments

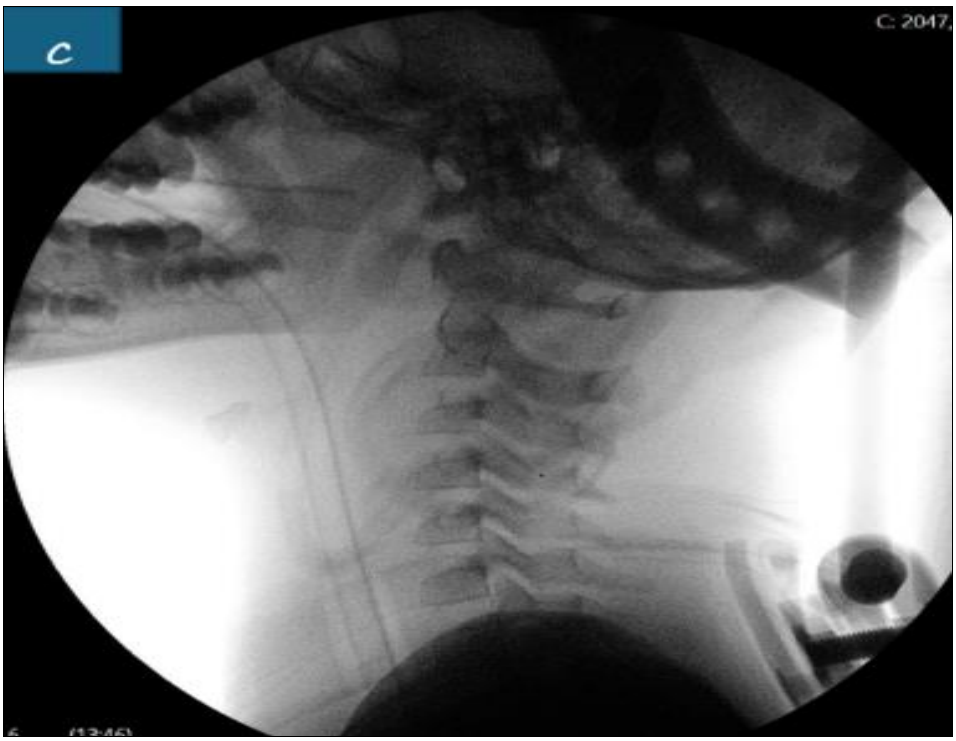
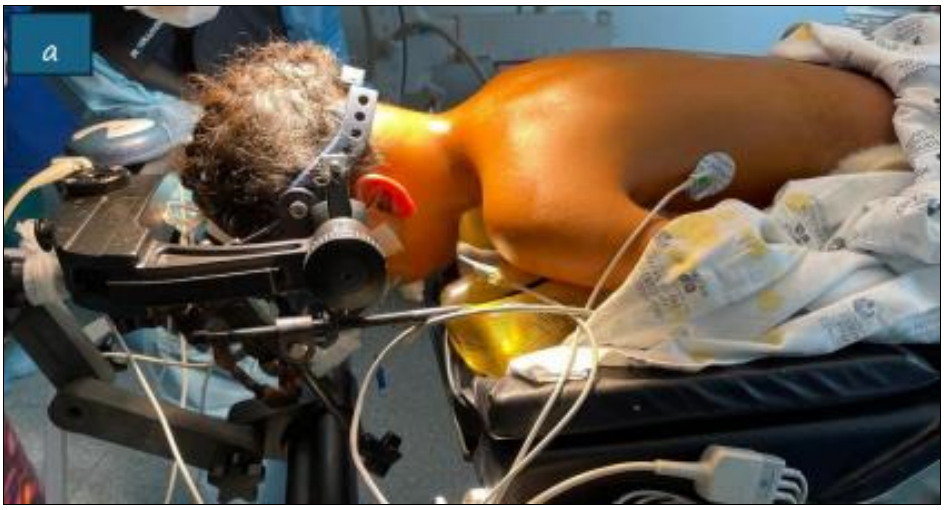


Fig 3: Temporary spine stabilization with Halovest



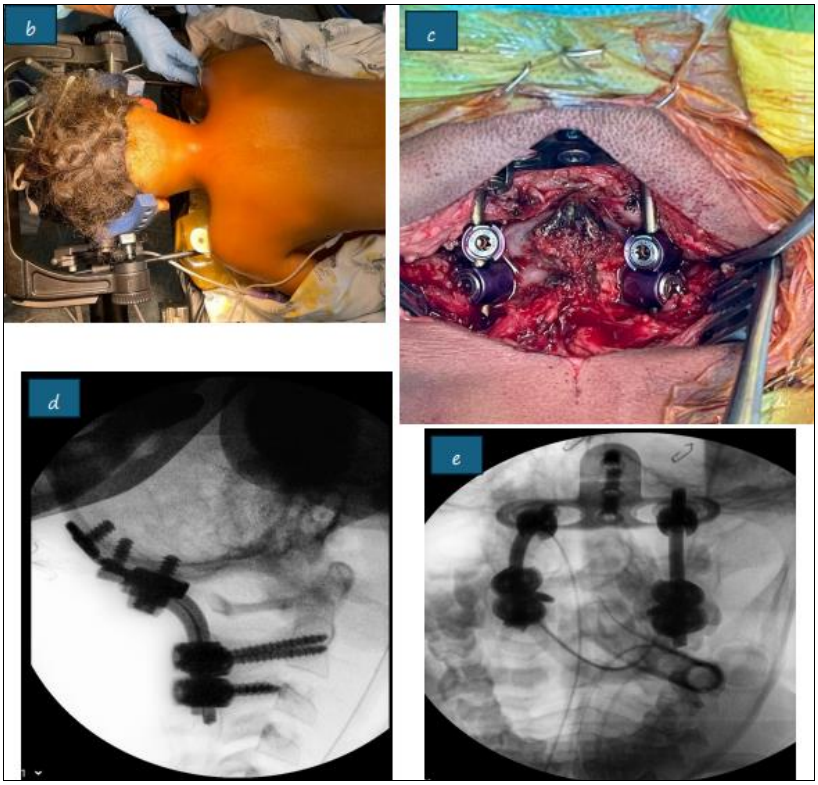


Fig 4. a-b: Patient positioning in Mayfield device; c) Standard posterior approach and C0-C3 fusion; d-e) control Rx of the surgery

Conclusion

AOD is a rare lesion. It is necessary high index of suspicion in pediatric population when there are history of high energy trauma. It is important to keep in mind that normal radiographic index does not exclude AOD.

The standard treatment for AOD is occiptocervical fusion, but halovest immobilization may be a good solution in select cases as temporary or definitive treatment.

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