**Odontoid Synchondrosis Fracture with Brown Séquard Syndrome in a 2-Year-Old Child: An Under-Recognized Clinical Entity**

Fatima Siddiqui*, Marya Hameed, Samia Abdul Qudoos, Hina Hanif and Suneeta Bansari

National Institute of Child Health, Karachi, PAKISTAN

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*Corresponding author: siddiquifatima198@gmail.com

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**Abstract**

Cervical spine injuries in children can lead to significant morbidity and mortality. Upper cervical spine injuries are more common in children due to incomplete synchondrooses fusion and immature musculature, with C2 being the most commonly injured area. A rare but serious neurological condition that can develop following damage to one half of the spinal cord due to a fracture of the odontoid synchondrosis is Brown-Séquard Syndrome (BSS). A 2-year-old female patient reported with difficulty moving her neck and gait abnormalities. She had a history of fall from the bed three months back, and complaints were associated with weakness of the right side of the body. CT scan and MRI revealed an incomplete fracture of C2 Vertebrae resulting in focal kyphosis and posterior impingement over craniocervical junction along with significant cord thinning. Due to the patients age and incomplete fracture, a conservative approach was taken with the patient undergoing immobilization in a cervical collar for an extended period of time. The patient was subsequently referred to a physical therapy program to manage the gait abnormalities and improve motor function. Early recognition and immediate treatment of cervical spine injuries are crucial to prevent neurological complications in children. Upper cervical injuries, particularly in the C2 area, are more common due to incomplete fusion and immature musculature. Brown-Séquard Syndrome is a rare but serious neurological condition resulting from a fracture of the odontoid synchondrosis. Delayed diagnosis and treatment of cervical spine injuries can have devastating consequences. Therefore, prompt and appropriate management is essential for optimal outcomes.

**Keywords:** Odontoid fracture; Synchondrosis; Brown-Sequard Syndrome.

**Introduction**

Traumatic cervical spine injuries are uncommon in children, with a prevalence of 1.5%. Upper cervical spine injuries are relatively more common when compared to the lower spine. These fractures can be attributed to the cartilaginous end plate between the dens and body axis that ossifies around age of six and the immature cervical spine musculature. Most common cause of injury is high-energy trauma that can lead to significant morbidity and mortality. Due to complex developmental anatomy and morphology of the C2 complex, diagnosis is very challenging and usually missed, which significantly alters patient outcome and subsequent disability. It is also essential to distinguish fractures from the normal anatomical variants and ossification centers following trauma. The optimal treatment strategy for these fractures is usually conservative, but displaced fractures may lead to multiple neurological complications and may require surgery to restore maximum functioning.

Brown-Séquard Syndrome (BSS) is a rare neurological condition that occurs secondary to damage to one half of the spinal cord. This can result in a range of symptoms, including weakness or paralysis on one side of the body, as well as loss of sensation and proprioception. In the case of a fracture of the odontoid synchondrosis, BSS can develop if the fracture damages the spinal cord on one side. This can be a serious condition that requires prompt medical
attention and may require surgery to repair the fracture and relieve pressure on the spinal cord. Previously cases of BSS secondary to odontoid fracture have been reported in adults.  

Herein, we report a case of undiagnosed non treated displaced odontoid synchondrosis fracture in a 2-year-old, who later presented with signs and symptoms of BSS. Early recognition of fracture on imaging with immediate subsequent treatment is the mainstay.

Case Report

A 2-year-old female patient was brought to the OPD in 2022, complaining of difficulty moving her neck and gait abnormalities with an alleged history of fall from the bed three months back. These complaints were associated with weakness of the right side of the body. There was a complaint of concurrent UTI with positive urine culture showing E. Coli. On examination, the patient had restricted neck movement due to severe motor weakness. GCS was 15/15 with decreased tone and power of 2/5 in the right upper and lower limbs. Sensory examination showed ipsilateral loss of touch, vibration, and loss of motor and sensory functions in the right arm and right leg with upgoing Babinski. On ocular examination, eye squint was present. CT scan and MRI of the cervical spine revealed an incomplete fracture of C2 Vertebrae resulting in focal kyphosis and posterior impingement over craniocervical junction along with significant cord thinning [Figures 1 and 2]. The patient belonged to a lower socio-economic class and therefore couldn’t get a timely workup done, resulting in late presentation.

Figure 1: Magnetic resonance imaging (MRI) cervical spine coronal section of a 2-year-old female patient with restricted neck movement and signs and symptoms of brown Sequared syndrome showing abnormal rightward neck tilting due to fracture with gross asymmetry.
The patient's condition was stabilized in the emergency department, and management was initiated. The patient was immobilized and placed in a cervical collar to prevent further damage to the spinal cord. Intravenous antibiotics were administered to treat the UTI, and the patient was started on a course of corticosteroids to reduce inflammation and prevent further damage to the spinal cord. Surgical intervention was discussed, but due to the age of the patient and the incomplete fracture, a conservative approach was taken, with the patient undergoing immobilization in a cervical collar for an extended period of time.

The patient was subsequently referred to a physical therapy program to manage the gait abnormalities and improve motor function. Regular follow-up appointments were scheduled to monitor the patient's progress, and a multidisciplinary approach was taken to provide comprehensive care. Informed consent was obtained from the patient's parents for publication purposes.

Discussion

Cervical spine injury is a rare entity in children; however, among cervical injuries, upper cervical spine injuries are the most common due to elasticity of the ligament, and immature musculature around that area. C2 is the most commonly injured area in children due to incompletely fused synchondroses and is much more common in children <7 years of age. The age variation can be attributed to the sub dental synchondroses fusion by the age of 5 years in children; additionally, these synchondroses disappear by age 9-10. 2,6 Majority of the children present without neurological deficits; however, untreated injuries can lead to malunion resulting in multiple neurological complications; therefore, it is important to recognize and treat these injuries at the earliest possible. Untreated fractures can present with a broad spectrum of symptoms, ranging from transient paresthesia to complete paralysis. If the spinal cord is also involved, it most commonly presents with central cord type syndrome7. Few odontoid fracture cases with associated Brown Sequard syndrome (BSS) have been reported in adults. However, pediatric odontoid fracture with BSS has minimal reported instances and to our knowledge, only one case has been previously reported. 8 BSS occurs due to disruption of the descending lateral corticospinal tract, dorsal column and spinothalamic tract which leads to peculiar findings of ipsilateral motor weakness, loss of vibration and proprioception with contralateral loss of pain and temperature.
These injuries can be easily missed on the initial visit due to subtle clinical findings when compared to the injury severity. Previously, literature has shown that a significant reason for misdiagnosis was that good radiographic imaging was not performed in around 35% of the patients because the injury was not suspected until the manifestation of symptoms. These fractures can be very easily missed on initial evaluation radiographs. Therefore, young children who have suffered from high-energy trauma and present with neck symptoms should be thoroughly reviewed for synchondroses fracture to avoid delayed diagnosis and neurological deficits.

Depending on the surgeon’s preference, the first line treatment for odontoid synchondrosis fracture is immobilization via Halo vest, Minerva cast, or soft collar. Cases that do not heal with conservative management and those that present with malunion, non-union and secondary neurological complications are treated with surgical intervention. Furthermore, odontoid fractures are very uncommon, with limited cases reported. Therefore, treatment options for unstable fractures are debatable. A previous case reported of a patient that presented with neurological complications secondary to dislocated fractures showed significant improvement with transoral reduction and open posterior instrumentation. Other studies suggest stages surgical arthrodesis for severely displaced fractures.

This case could be a positive example of how an increased awareness and early detection can improve outcomes for pediatric patients with BSS. It highlights the importance of considering BSS in the differential diagnosis of neck pain and neurologic symptoms in children, particularly those with a history of connective tissue disorders or other predisposing factors.

In summary, while the literature on pediatric BSS is currently limited, it is expected that more cases will be identified as awareness of this condition grows. With the help of advanced imaging techniques such as MRI, early detection and appropriate management can lead to better outcomes for pediatric patients with BSS.

**Conclusion**

The occurrence of odontoid fracture complicated by BSS is rare in pediatric patients, and very few cases have been reported in the literature before. Due to angulation, odontoid fractures can be missed on initial X-rays leading to lost opportunities for early treatment causing life-debilitating complications such as our patient. Therefore, all children presenting with neck symptoms after high energy trauma should be thoroughly reviewed for these fractures. Supportive management is the mainstay of treatment for uncomplicated fractures, and those that present with displacement or neurological complications should be treated with surgery.

**Disclosure**

The authors declared no conflicts of interest. Written consent was obtained from the father of the patient.

**References**


