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C3-C4 Unilateral Facet Fracture Dislocation with Vertebral Artery Injury in an Adolescent: A Case Report, Review of the Literature, and Suggested Management Protocol

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Introduction

Unilateral facet fracture dislocations of the cervical spine with a jump-locked facet are a rare injury in adolescents. The infrequency of the injury can result in delayed diagnosis and treatment. Significantly, these fractures can be associated with a neurologic complications and vascular injuries to the adjacent vertebral artery. A thorough investigation is needed to identify these associated injuries and to achieve a timely diagnosis. This case report describes our experience with an adolescent who presented with a jump-locked facet at C3-C4 and vertebral artery injury. We provide a discussion of problems related to the injuries and the potential for delay in their recognition. We also suggest a rational plan for investigation and treatment.

Case History

A twelve year-old male presented to his primary care physician with neck pain and headache following an accidental injury two days prior. At that time, the patient had been involved in a pillow fight with a friend that resulted in a fall to the ground with the friend landing on his head. He did not lose consciousness and was able to stand without assistance. At his primary care physician's office, the patient was offered symptomatic treatment. Despite oral analgesics, the patient experienced persistent neck pain, prompting presentation to our institution's emergency department. Careful evaluation revealed that he was alert and oriented, followed commands well, and had normal motor function in all four extremities. There were no signs of concussion or spinal cord injury; however, radiographs revealed a unilateral fracture dislocation with a jump-locked facet at C3-C4 on the left (Figure 1).

Computed tomography (CT) scan confirmed the fracture of the C4 superior facet and rotatory dislocation of the C3 vertebral body on C4. Also, the scan identified a fracture of the posterior arch of C3 on the left that extended through the adjacent intravertebral foramen. Magnetic resonance imaging (MRI) confirmed the malalignment of the cervical spine, the jump-locked facet, anterior–rotatory dislocation, and mild wedging of the C4 vertebra without evidence of disc injury or herniation (Figure 2). MRI also revealed an injury to the left vertebral artery as seen by a high intensity signal on the T2 weighted image.

To further evaluate vascular injury, magnetic resonance angiography (MRA) was ordered and confirmed that the left vertebral artery was smaller than the right (Figure 3). Although this indicated partial obstruction, reduced blood flow and risk for developing thrombosis, MRA of the brain demonstrated no areas of reduced perfusion, indicating less risk for an acute intracranial ischemia.

With confirmation that the intervertebral disc was intact, closed reduction of the locked facet

Figure 1. Lateral radiograph of the cervical spine showing facet dislocation of C3-4 and anterior translation of C3 on C4.

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Figure 2. Sagittal MRI showing C3-4 ventral subluxation, intact interverterbral disc and mild wedging of C4 vertebra.

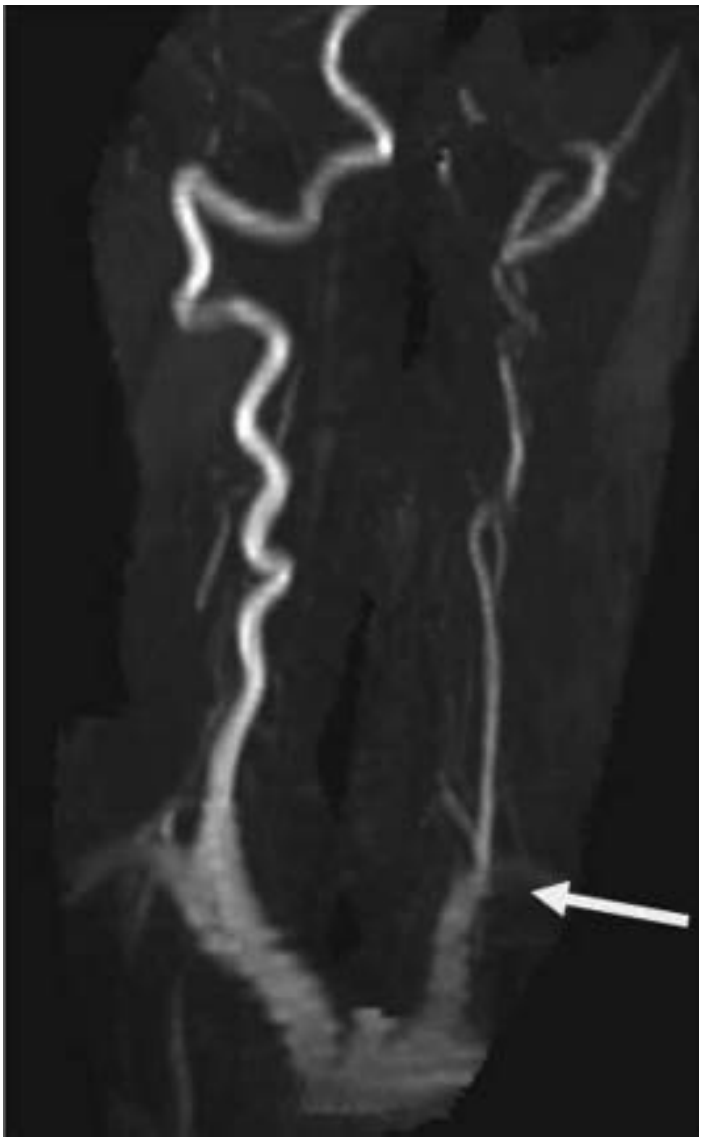

Figure 3. MR angiographic image demonstrating partial obstruction of the left vertebral artery.

was attempted using the Gardner-Wells traction technique with application of gradual incremental weights.[1] A 10 lb weight was applied initially and sequential 5 lb weights were added. With each change in traction weight, lateral radiographs were performed. After applying a total of 31 lbs, the lateral radiograph revealed an over distraction of the cervical spine without improvement in alignment. At this time, the traction was stopped and open reduction was deemed necessary.

The open reduction was done through the posterior approach utilizing spinal cord monitoring throughout. With surgical exposure, the ventral and rotational deformity was confirmed, the posterior longitudinal ligament (PLL) was disrupted from the vertebral body of C3, and the ligamentum flavum and the inter spinal ligaments were also both torn.

Gentle reduction under direct visualization was achieved after partial facetectomy of the C4 facet. The reduction and arthrodesis were stabilized with lateral mass screws and titanium rods (Figure 4). Following the procedure, the neck was immobilized in a cervical collar, which was discontinued after four weeks. Postoperative aspirin therapy was used as thrombosis prevention. An angiogram at one month continued to show reduced but unchanged blood flow. There was no clinical or radiologic evidence of neurologic injury at that time.

Discussion

Cervical injuries in children often present late due to a delay in diagnosis that often results from difficulty of reading the radiographs.[2-4] Incomplete ossification of the cervical vertebrae, presence of multiple growth centers and physiological hypermobility all contribute to these difficulties in radiographic recognition and achieving a diagnosis.[5]

In this case, injury was caused by distraction and a lateral flexion/rotation force and, thus, was classified as an Allen-Ferguson distraction-flexion stage II type.[6] With distraction, the

Figure 4. AP and lateral views of the cervical spine after reduction and C3-4 posterior fusion with lateral mass fixation.

facet joint was vertically separated, and with flexion, an anterior dislocation of the left C3-C4 facet resulted. The intact right facet joint served as a fulcrum around which the left side of the C3 vertebral body displaced anterior and rotated to the right. When these forces of dislocation ceased, the facet joint settled in the dislocated position and muscle contraction fixed the facet joint in the jump-locked position.[7] These injuries present with pain, restricted motion and with or without neurologic involvement. Also, because of the acute distraction and flexion forces associated with the injury, the ipsilateral vertebral artery may also be at risk. Finally, cervical spine and head injuries often present simultaneously; thus, careful examination for head injury is required when there is a serious neck injury.

On presentation to the emergency department, these patients should be evaluated and closely monitored for evolving neurologic or vascular injuries. The injuries should be investigated utilizing a range of imaging modalities, including radiographs, CT scan and MRI.[8] CT may provide a clearer view of the facets to better understand the jump-locked joint and discover fractures of the ipsilateral transverse process that can extend laterally and injure the vertebral artery.[9] MRI is useful for detection of any intervertebral disc pathology that may increase the potential for associated spinal cord injury.[10-13,15] In the adult literature, reported rates of traumatic disc herniation with this injury range from 15% to 54%.[11,12,14,16] No specific rate has been reported for pediatric cohorts; this is possibly due of the rarity of this injury in children. In addition to disc herniation, other pathology can be detected by MRI, including rupture of the posterior longitudinal ligament and posterior annulus, as well as injury to the posterior vertebral vessel on the ipsilateral side. MRA may be needed to confirm the vertebral artery injury, determine the extent of injury and evaluate the blood perfusion to the brain.[16-18] In patients without a reliable clinical examination, MRI should be performed prior to attempting closed reduction. Patients with subluxation within the cervical spine may suffer neurologic deterioration during closed reduction in the presence of an associated herniated disc.[10,13,19] With this situation, closed reduction is contraindicated and open reduction and spinal stabilization becomes the procedure of choice. Closed reduction with traction is also contraindicated

in the presence of fracture of the cranium. In the absence of these associated injuries, closed reduction may be attempted. Craniocervical traction should be applied incrementally in all patients.[20-23] With the Gardner-Wells Technique, incremental weights are added beginning with 10 pounds. Weights are gradually added while the patient's neurologic status is closely monitored. Serial lateral radiographs are performed after each change in weight to observe alignment, monitor for possible concomitant atlanto-occipital dissociation, and avoid over distraction. With any of these problems, traction should be discontinued and open reduction performed. If closed reduction is achieved, a halo vest or other type of external bracing may be utilized for immobilization.

Open reduction can be performed by anterior, posterior, or combined approaches,[22-24] though the posterior approach is used most commonly.[25-31] One advantage of the posterior approach is that the reduction is performed under direct visualization. The procedure consists of partial or complete facetectomy followed by reduction and instrumentation to maintain the correction and facilitate arthrodesis. Various techniques have been described to achieve fixation and fusion including facet wiring, interspinous wiring, and lateral mass plates or rod-screw constructs.[8,23,25-32] The anterior approach is used less frequently but is useful when there is an associated disc injury or herniation. If an indirect reduction can be safely achieved following anterior discectomy and decompression, then an anterior cervical fusion can subsequently be performed.[33]

Traumatic unilateral vertebral artery injury with cervical fracture is frequently asymptomatic.[34] Therefore, a high index of suspicion must be maintained and imaging carefully reviewed to detect these injuries. The vascular injury frequently heals after reduction and stabilization of the facet joints.[34-37] As a result, in the setting of normal perfusion to the brain, the vascular injury can be treated with reduction, stabilization and observation.[35-37] Postoperative monitoring is controversial, though CT angiography or MRA may be employed. Consideration should also be given to the prevention of thrombosis by supplemental antiplatelet or anticoagulation therapy.[37]

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