Proximal Clavicle Physeal Fracture With Posterior Displacement: Diagnosis, Treatment, and Prevention

MATTHEW J. KOCH, MD; LAWRENCE WELLS, MD

abstract

Posterior sternoclavicular fracture displacement can present as a posterior sternoclavicular joint dislocation and is rare in the pediatric population. This article provides an algorithm for evaluation and management.

A 14-year-old boy with a previously undiagnosed posterior sternoclavicular displacement presented with persistent 7/10 shoulder pain extending into his neck after undergoing nonoperative treatment for an unconfirmed diagnosis at another emergency department. Plain radiographs revealed a displacement of the right medial clavicle, and the position of the clavicular head indicated advanced imaging. Computed tomography showed the posterior portion of the clavicular head butting against the left brachiocephalic vein at its confluence with the superior vena cava. The patient underwent open reduction and internal fixation. After exposing the sternoclavicular joint, a Salter-Harris I fracture with no evidence of vascular injury was confirmed. The fracture was reduced and stabilized using figure-eight #5 Ethibond sutures (Ethicon, Somerville, New Jersey), and the patient was placed in an immobilizer for 1 week. At 1 year postoperatively, the patient regained full range of motion and was completely healed.

Posterior clavicle displacements are potentially devastating injuries that are difficult to diagnose. Coordinating operative treatment with orthopedic and general surgery is indicated to manage the fracture or displacement and potential vascular injury. Due to difficulties in maintaining a closed reduction, open reduction and internal fixation is the preferred mode of treatment for the reduction of all posterior clavicular fracture displacements.

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Dr Koch is from the University of Pennsylvania School of Medicine, and Mr Wells is from the Children’s Hospital of Philadelphia, Philadelphia, Pennsylvania.

Drs Koch and Wells have no relevant financial relationships to disclose.

Correspondence should be addressed to: Lawrence Wells, MD, Children’s Hospital of Philadelphia, Wood Bldg, Floor 2, 34th St and Civic Center Bldg, Philadelphia, PA 19104-4399 (wellsl@email.chop.edu).

doi: 10.3928/01477447-20111122-39
Posterior sternoclavicular fracture displacements are among the rarest injuries in the pediatric and adult populations.\(^1,2\) The clavicular physis adjacent to the sternum is one of the last to close, at approximately 21 to 24 years.\(^3\) Injury in this area is more accurately described as a physeal fracture with posterior displacement. Posterior displacement of these fractures can cause injury to the recurrent laryngeal nerve and the innominate veins and arteries.\(^1,4-8\) The history of injury is often nonspecific, and physical examination findings can be subtle. Correct diagnosis requires a high index of suspicion. Advanced imaging aids in the diagnosis and quantifies impairment of other local neurovascular structures.\(^4,9\) Management should include a coordinated team approach of treatment performed by orthopedic and general surgery.\(^4,5,7,8\)

**CASE REPORT**

A 14-year-old boy was lying on his right side when an 81-kg classmate fell on his left shoulder. The patient heard a crack in his right clavicular region. He was immediately taken to another emergency department, where he received posteroanterior radiographs, and an unconfirmed diagnosis, and was discharged with a sling.

Because of the persistence of pain that extended into his neck with movement of either arm, he presented to our emergency department for further evaluation. Physical examination revealed tenderness on the right side of his neck while moving his right arm and a throbbing pain over his right neck, which worsened with movement. The 7/10 pain was localized to his clavicular region. The patient was an otherwise healthy-appearing boy.

The patient’s vital signs were normal, and no obvious deformity existed other than some moderate edema over the right sternoclavicular joint. He had 5+ strength and was neurovasculary intact in both upper extremities. He had no dysphagia, hoarseness, or dyspnea. A single posteroanterior radiograph of the right clavicle did not display a fracture. Plain radiographs showed a dislocation of the right medial clavicle (Figure 1). The right clavicular head was in an inferior position and was overshadowed by the manubrium, which suggested anterior inferior or posterior displacement.

A computed tomography (CT) scan with contrast was ordered to better visualize the injury and assess the status of the local vasculature (Figure 2). The CT displayed the posterior portion of the clavicular head butting against the left brachiocephalic vein at its confluence with the superior vena cava. Although no extravasation of intravenous contrast existed, an intimal injury or a tamponade could not be ruled out.

Orthopedics and general surgery were consulted for the management of the fracture and possible vascular injury. Plans were made for the patient to undergo open reduction and internal fixation.

After exposing the sternoclavicular joint in the operating room, a Salter-Harris fracture in the clavicle was confirmed. The underlying vasculature was intact and without injury. By using longitudinal traction along the clavicle, the fracture was reduced but remained unstable without sustained stress to maintain reduction because the posterior periosteal sling was disrupted and would not stabilize the fracture.

Using a 3.5-mm drill bit (Synthes, West Chester, Pennsylvania), 2 holes were drilled across the medial clavicle and sternum. The fractures were stabilized with a figure-eight #5 Ethibond suture (Ethicon, Somerville, New Jersey) (Figure 3). Following fluoroscopic confirmation of appropriate reduction (Figure 4), the wound was closed and the injured clavicle was confirmed.
The arm was placed in an immobiliar for 1 week. He began formal physical therapy 1 month postoperatively. At 1-year follow-up, the patient had regained full range of motion and displayed a completely healed fracture.

**DISCUSSION**

Posterior clavicular dislocations are rare in the pediatric and adult populations because the sternoclavicular joint comprises the anterior and posterior sternoclavicular ligaments, the interclavicular ligament, and the costoclavicular ligament. The posterior and anterior sternoclavicular ligaments stabilize the articulation of the medial clavicular head with the manubrium. The usual mechanism of dislocation involves frontal high-energy trauma to the clavicle or involvement in high-impact sports.

Because of the relative strength of the joint, many dislocations are actually Salter-Harris I physeal fractures with subsequent displacements in children because the physes of the clavicle are the last to close and usually do not do so until age 22. For this reason, the medial clavicular physis usually fractures before true dislocation occurs in this age group.

On physical examination, patients usually present with tenderness and deformity over the sternoclavicular joint. However, over the course of a few hours, swelling surrounding the dislocated joint can obscure any obvious physical deformity. The dislocation can have an immediate effect on local neural structures, such as the vagus nerve, or, more specifically, the recurrent laryngeal nerve. These complications occur in approximately 30% of dislocations. Patients can present with symptoms of dysphagia and hoarseness. Similarly, the proximity of the great vessels to this joint makes them prone to laceration at injury. The displaced clavicle can irritate local respiratory structures, such as the lungs, lung pleura, and trachea, causing dyspnea. These sequelae may appear on the physical examination and aid in diagnosis.

However, as in our case, these symptoms may not always be present. These factors make this particular injury and complication difficult to distinguish from other clavicular injuries on examination, leading to a reliance on radiographs.

However, as shown in our patient’s experience with an outside hospital, visualization of the sternoclavicular joint is difficult using a single posteroanterior radiograph. Although other methodologies have been described (ultrasound, serendipity view radiograph, or 10°-15° cephalic tilt), CT with contrast is the ideal imaging method because it allows for the visualization of the clavicular head and its relationship to the braciocephalic and subclavian veins.

Because of the proximity of dislocation to the great vessels, coordination between an orthopedic and a general surgeon is paramount for the resolution of this injury. The potential for large vessel damage in this rare injury is present and in need of concurrent repair if found to prevent serious morbidity and mortality.

Unlike the treatment of the vascular injury, the consensus on the treatment of these displacements is unclear. Although some have argued that nonemergent and emergent cases can be treated through closed reduction, we have found that open fixation is the preferred method of reducing and stabilizing this type of fracture. Open reduction provides a more secure reduction than closed reduction and allows for an inspection of the local vasculature. Tamponades on the great vessels are often difficult to ascertain on CT, and a closed reduction in the case of a tamponade could be devastating. Furthermore, although a closed reduction of a true clavicle dislocation is possible, the ligamentous laxity after dislocation precludes the possibility of guaranteed reduction.

In our experiences, these clavicles often dislocate again. This is ineffective and potentially dangerous. A redisplacement could represent as much of a threat to the neurovasculature of the mediastinum as the initial displacement. This is especially dangerous in the pediatric population, where a closed reduction of a fracture is prone to redisplacement after closed reduction. Therefore, we believe that these fractures need to undergo open reduction and fixation as soon as possible after displacement.

Several procedures to secure these fractures exist, including fixing screws, Steinmann pins, Kirschner wires, and suturing. However, many reports present contraindications for the use of Steinmann pins and Kirschner wires because of their propensity to migrate and irritate the local vasculature. Nonabsorbable sutures are preferred because they provide a secure reduction without the use of hardware that may lead to irritation and problems associated with pin migration and further surgery.

**CONCLUSION**

Posterior clavicle displacements are difficult to diagnosis and are potentially devastating. Recognizing the particular characteristics of injury mechanism and findings on physical examination will aid in making the diagnosis. Coordinating operative treatment with orthopedic and general surgery is indicated to manage the fracture or dislocation and potential vascular injury. Due to difficulties in maintaining a closed reduction, we believe open reduction and internal fixation is the preferred mode of treatment for the reduction of all posterior clavicular fracture displacements.

**REFERENCES**


