

Kelly D. Carmichael
Anthony Longo
Scott Lick
Leonard Swischuk

Posterior sternoclavicular epiphyseal fracture-dislocation with delayed diagnosis

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K. D. Carmichael (✉) · A. Longo
Division of Pediatric Orthopaedics,
Department of Orthopaedic Surgery
and Rehabilitation,
The University of Texas Medical Branch,
301 University Blvd.,
Galveston, TX 77555-0165, USA
e-mail: kdcarmic@utmb.edu
Tel.: +1-409-7723505
Fax: +1-409-7725243

S. Lick
Department of General Surgery,
Division of Cardiothoracic Surgery,
University of Texas Medical Branch,
Galveston, TX, USA

L. Swischuk
Department of Radiology,
University of Texas Medical Branch,
Galveston, TX, USA

Abstract Posterior sternoclavicular joint dislocations and epiphyseal fractures are relatively rare injuries. We present a case report of a 16-year-old male who presented with a 10-day delay in diagnosis. The medial clavicular fragment was widely displaced and rested against the cervical vertebral body. Despite the degree of displacement, the patient had very few symptoms, and the diagnosis was not appreciated in the emergency department and became apparent at 10-day clinic follow-up. Treatment consisted of attempts at closed reduction, which were not successful. Open reduction was performed and the repair done with strong sutures. At 1-year follow-up the patient is doing well without any symptoms. A literature review consisting of anatomy, ossification patterns, classification systems, diagnosis and associated symptoms, im-

aging recommendations, treatment recommendations, outcomes, and complications is included.

Keywords Posterior sternoclavicular fracture dislocations · Epiphyseal injuries · CT scan · Radiographs

Introduction

Posterior dislocations of the sternoclavicular joint and medial clavicular epiphyseal injuries are relatively rare. In 1998, Ono et al. [1] noted 102 cases described in the English literature in the last 65 years. Since then, about 26 more cases [2–13] have been described, making about 130 reported cases in the last 72 years. Despite the rarity of this injury, it must be considered in the differential diagnosis of shoulder injuries because potentially life-threatening complications and injuries to thoracic structures are common. About 30% of patients with posterior-directed medial

clavicular injuries will have concomitant injuries to thoracic structures such as the trachea, esophagus, or great vessels [1, 14, 15].

Posterior medial clavicle injuries can be difficult to diagnose because the clinical findings and deformity can be subtle [10, 16–18] and the majority (70%) do not have obstructions or damage to other thoracic structures [16]. A delay in diagnosis has been noted in other studies [5, 10, 19, 20]. Most of these injuries seem to occur during sporting events. We present a case of a posterior medial clavicle epiphyseal fracture that occurred in a basketball player. The injury was not appreciated in the emergency

room (ER) despite wide displacement of the medial clavicle. The medial end of the clavicle was resting against the cervical vertebrae, and the patient had no thoracic symptoms. He received treatment 10 days after his injury.

Case report

A 16-year-old male presented to the emergency room after a collision with another player. He recalled the impact on his right lateral shoulder. He stated he had “the wind knocked out of him” for a few minutes, but was subsequently able to catch his breath and complained of global shoulder and clavicle pain. An anteroposterior radiograph of the right clavicle was taken in the ER, and was unremarkable. The medial end of the clavicle was not visualized on the radiograph and even after retrospective review the radiograph was normal. He was given a diagnosis of a possible clavicle fracture in the ER and given a sling for comfort.

He presented to the orthopaedic clinic 10 days after his injury. He had discontinued the use of his sling and complained only of occasional middle-to-medial clavicle pain. He denied any shortness of breath, dyspnea, numbness or tingling, dysphagia, or hoarseness/voice changes. On examination he was a very thin, but healthy male. He had tenderness to palpation over the medial end of his right clavicle. There was no obvious crepitus felt over the sternoclavicular joint with shoulder motion. He lacked about 20 degrees of full abduction in his shoulder secondary to pain. When viewed from the side, he had some swelling and increased prominence in the sternoclavicular joint on his injured side compared to the contralateral side.

Imaging studies obtained in the clinic included three views of the right shoulder followed by a chest radiograph. The shoulder films were unremarkable, but the chest radiograph showed some subtle asymmetry of the medial clavicles. Serendipity views (see discussion) of both clavicles simultaneously showed obvious asymmetry of the medial clavicles (Fig. 1). A CT scan was obtained that demonstrated the clavicle to be displaced in a posterior direction resting against the cervical vertebra (Figs. 2, 3 and 4).



Fig. 1 AP (serendipity view) of the clavicles. Note the markedly displaced medial end of the right clavicle (*arrow*). The soft tissues above are edematous and the clavicle itself is slightly bent

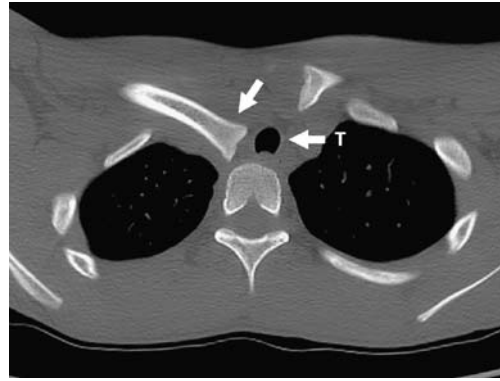


Fig. 2 Axial CT view. Note the posteriorly displaced right clavicle (*arrow*) causing some displacement and encroachment on the trachea (*arrow T*)

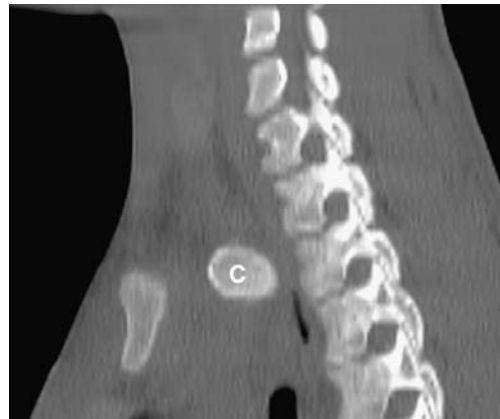


Fig. 3 CT, sagittal reconstruction. Note the posteriorly displaced medial end of the right clavicle (*C*). Note how it compresses the airway posterior to it and how close it lies to the vertebral column



Fig. 4 A 3D reconstruction graphically demonstrates the posteriorly displaced medial end of the right clavicle (*arrow*). The left clavicle is normal and articulates normally with the sternum (*S*). The right clavicle also is somewhat bent

The patient was admitted to the hospital for overnight observation and scheduled for reduction the following morning. Arrangements were made for a cardiothoracic surgeon to be immediately available for the case. The patient was given general endotracheal anesthesia in the operating room. The method of reduction described by Rockwood was used. None of the closed maneuvers could affect a reduction, and the decision was made to proceed

with open reduction. The clavicle had not adhered to the great vessels, and the reduction was without complications. The reduction was stabilized using #5 fiber wire (Arthrex Corporation, Naples, FL, USA) passed from the manubrium/epiphyseal piece into the medial clavicle through bone tunnels. At his 1-year follow-up he was doing well, without symptoms, and had full use of his shoulder.

Discussion

Dislocations and epiphyseal fractures to the sternoclavicular joint are uncommon injuries making up 1.2% to 4% of shoulder injuries [4, 7, 21, 22]. Posterior sternoclavicular dislocations make up less than 1% of all dislocations [6, 20]. Less than 1% of children's fractures involve the medial end of the clavicle [8, 23]. The majority of sternoclavicular injuries result in anterior displacement of the clavicular fragment with posterior injuries being rare [4, 11, 18, 21–24]. As much as a 20:1 ratio of anterior to posterior injuries has been noted [11]. Much is written about these rare posterior dislocations because of the possible life-threatening complications.

The anatomy of the sternoclavicular joint does little to explain the rarity of this injury, as it is considered an unstable articulation. The osseous structure of the sternoclavicular joint is described as one of the most unstable of the major joints [16, 25]. The joint is a diarthrodial joint with a saddle shape described as concave from anterior to posterior and convex vertically. Less than half of the medial clavicle actually articulates with the sternum [16, 20, 26]. An intra-articular disk separates the joint into two compartments. Ligaments are found between the sternum (manubrium) and the clavicle, the first rib and clavicle and between both clavicles, and are named correspondingly [3, 16, 18, 26, 27]. These ligaments provide the stability to the joint; the posterior ligaments are the strongest, perhaps explaining the rarity of dislocations in the posterior direction [3, 17, 27]. The capsular ligaments are located both anterior and posterior; they are thickenings of the joint capsule, and provide much of the ligamentous stability to the joint [27]. The costoclavicular ligament attaches from the first rib/sternum to the medial clavicle; the insertion is on the epiphysis, which leaves the physis relatively unprotected [15]. An interclavicular ligament is found superiorly connecting the superior aspects of both clavicles to the sternum [3, 16, 18, 26, 27]. Injuries to the sternoclavicular joint are uncommon, probably because of the location in the midline region of the body and not because of the joint's stability.

The ossification pattern of the medial clavicle is unique. The clavicle is the first long bone to ossify, occurring during the 5th week of intrauterine life. The medial end of the clavicle is the last epiphyseal center to appear and the last to fuse. It generally ossifies around 18 to 20 years of age, and fuses to the clavicle metaphysis around 23–25

years of age [16, 18, 23, 28]. Many injuries to the medial clavicle take place during sporting events [10, 17] in young people, so growth plate/epiphyseal fractures should be considered in those less than 25 years of age. The mechanism of injury can be direct or indirect. A direct anterior-to-posterior directed blow to the anteromedial clavicle can result in posterior displacement. No such direct mechanism exists for anterior dislocations. An indirect mechanism occurs when the lateral shoulder is struck. Blows that are directed in an anteromedial direction onto the posterolateral tip of the shoulder can result in posterior sternoclavicular dislocations. In contrast, an anterior sternoclavicular dislocation can occur when a posteromedially directed force is applied to the anterolateral shoulder [16, 18].

The diagnosis of sternoclavicular injuries, especially posterior-directed injuries, often requires a high index of suspicion. The clinical deformity in posterior dislocations is often subtle, as was the case with the patient in this case study. Despite being very thin, the medial contours of his clavicle looked relatively normal except for some mild to moderate swelling. A history of trauma with pain in the clavicle region or chest is common [3–6, 8, 9, 11, 12, 16–19, 24, 28]. Pain radiating to the neck or neck motion abnormality can also occur [3, 9], and the patient may support the injured side across their chest with their contralateral arm [16]. The sternoclavicular area is usually tender to palpation, and some have described being able to feel a step-off, which was consistent with our findings [12, 16, 18]. It may, however, not be possible to differentiate anterior from posterior dislocations on the basis of the clinical exam, as swelling and tenderness can be noted in either direction [18].

Standard radiographs will occasionally show no injuries (look normal) even when using the specialized views of Rockwood (serendipity) [4, 29] or of Heinig [8, 30]. The serendipity view is one in which the X-ray beam is tilted 40° cephalic off vertical, allowing a view of the bilateral sternoclavicular joints. However, standard radiographs will sometimes give an indication of injury to the area. When both clavicles are viewed together asymmetry of the two medial clavicles indicates injury to the area. The direction of the dislocation is confirmed by CT scan in most cases. There are numerous reports of missed or delayed diagnosis using only conventional radiographs, and CT scans are recommended by most authors if medial clavicular injury is suspected [1, 3–5, 9–12, 16–18, 24, 28]. Ultrasound has been shown to be of benefit both in the diagnosis of injury and in judging the adequacy of closed reductions [19].

Concomitant injuries are common with posterior sternoclavicular dislocations. About 30% of posterior fractures or dislocations will have other thoracic injuries [1, 14, 15, 31]. These injuries include compression of thoracic or mediastinal structures. The structures that can be injured include the trachea, esophagus, great vessels, and brachial plexus. Of the 102 cases reviewed by Ono et al. [1] there

was a 30% rate of concomitant injuries, and three deaths. Because concomitant injuries are common, associated symptoms should be considered. The symptoms of mediastinal compression might include hoarseness, voice changes, dyspnea, dysphagia and neurological changes, depending on what structures are compressed [14, 15, 25, 32, 33].

Treatment of posterior sternoclavicular dislocations usually involves attempts at closed reduction. Rockwood has described an often-quoted method of closed reduction [29, 34]. The reduction should be done with cardiothoracic surgeons present or at least aware of the procedure, because of the proximity of vital structures [5, 10, 35]. Open reduction is used if closed reductions fail. Open reduction is also recommended after 7–10 days by some authors, because fracture end adhesions to mediastinal structures may form during this time [16, 18, 28]. Water et al. [10] recommended open reduction, because post-reduction CT scans showed continued instability in their patients treated with closed reductions.

Posterior sternoclavicular injuries are rare, but not unique. The case described in this report had a series of

factors that, taken in combination, made it unique. The patient presented over 8 days after injury. The degree of displacement was pronounced, despite lack of examination findings; in fact, the swelling in the area made anterior sternoclavicular displacement seem most likely. When viewed on CT scan, the medial clavicle was resting on his cervical vertebrae, and had pushed the artery and vein apart. Despite this degree of deformity, he was without thoracic symptoms. The open reduction was standard, and fixation was achieved with fiber wire. This case points out the need to be aware of this injury when patients have shoulder trauma, and that even very wide displacement may not result in thoracic or mediastinal symptoms. This injury was a physeal injury, but the authors believe remodeling would not have occurred because of the pronounced displacement. Wide displacement even without obvious thoracic compression is an operative indication.

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