

[Orthopaedic Surgery]

A Case of Posterior Sternoclavicular Dislocation in a Professional American Football Player

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Sternoclavicular (SC) dislocation is a rare injury of the upper extremity. Treatment of posterior SC dislocation ranges from conservative (closed reduction) to operative (open reduction with or without surgical reconstruction of the SC joint). To date, we are unaware of any literature that exists pertaining to this injury or its treatment in elite athletes. The purpose of this case report is to describe a posterior SC joint dislocation in a professional American football player and to illustrate the issues associated with its diagnosis and treatment and the athlete's return to sports. To our knowledge, this case is the first reported in a professional athlete. He was treated successfully with closed reduction and returned to play within 5 weeks of injury.

Keywords: sternoclavicular dislocation; National Football League; American football; closed reduction; rehabilitation

Sternoclavicular (SC) dislocation is a rare injury of the upper extremity and accounts for 3% of all injuries to the shoulder girdle.²³ Although the majority of these injuries occur anteriorly, the less common posterior SC dislocation carries the most risk and can be a potentially a life- or limb-threatening emergency. Treatment of a posterior SC dislocation ranges from conservative (closed reduction) to operative (open reduction with or without surgical reconstruction of the SC joint). To date, we are unaware of any literature that exists pertaining to this injury or its treatment in the elite athlete. The purpose of this case report is to describe a posterior SC joint dislocation in a professional American football player and to illustrate the issues associated with its diagnosis and treatment and the athlete's return to sports.

CASE REPORT

A 26-year-old right-hand-dominant wide receiver in his fifth season in the National Football League is presented in this case report. He had a history of a left SC contusion in 2009 that was

treated conservatively. MRI performed in 2009 showed both SC joints reduced but with minor irregularities at the clavicular heads, consistent with mild osteoarthritic changes. MRI in 2009 also showed a focal bone bruise at the left first costochondral junction but no marrow edema at the clavicular and sternal sides of the SC joints (Figure 1).

During the fifth game of the 2012 season, he dove to receive a pass and landed on the posterolateral aspect of his right shoulder girdle (Figure 2). He had immediate diffuse discomfort over his right clavicle but did not feel a distinct pop or crepitus. He denied chest pain, dyspnea, dysphagia, or any neurologic symptoms of the right upper extremity. On examination, he had mild swelling and tenderness over his proximal right clavicle but no gross deformity to the clavicle, SC joint, or acromioclavicular joint. He had symmetrical pulses and normal results from a neurologic examination of both upper extremities. Plain anteroposterior (AP) and oblique radiographs of the right clavicle obtained at the stadium were inconclusive for fracture or dislocation (Figure 3). He was unable to continue to play following the injury. The next morning, approximately

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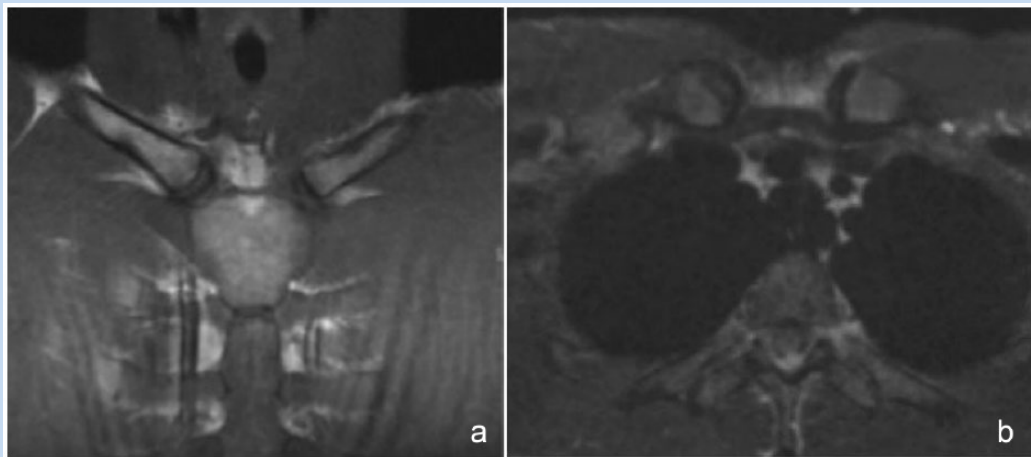


Figure 1. MRI of the sternoclavicular joints taken prior to injury in 2009 demonstrating reduction and symmetry of the bilateral sternoclavicular joints. (a) Coronal view, (b) axial view.



Figure 2. Injury photo showing the player landing on the posterolateral aspect of the right shoulder.

12 hours after the injury, his pain was localized to the medial clavicle. A CT scan was obtained to rule out an occult clavicle fracture. This showed an isolated right posterior SC dislocation with a small mediastinal hematoma (Figure 4). A contrast-enhanced CT scan with 3-dimensional reconstruction was also performed once the injury was diagnosed (Figure 5). There was no evidence of injury to, or pressure on, the mediastinal structures. Upon repeat physical examination, he was tender to direct palpation over the right SC joint, but again, dislocation was not clinically evident. After informed consent was obtained, he was urgently taken to the operating room for an attempted closed reduction. He was apprised of the potential for a possible open reduction and/or operative reconstruction of the SC joint depending on the joint's stability following reduction. Cardiothoracic surgical consultants were available to

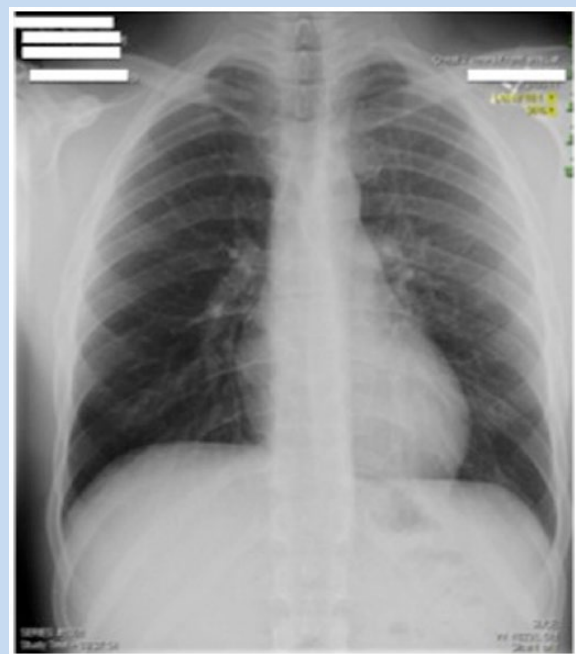


Figure 3. Anteroposterior chest radiograph taken on the day of injury. This radiograph was read as normal, with no evidence of fracture or dislocation.

provide emergent backup in case open reduction was needed or cardiovascular compromise was encountered.

In the operating room, the patient was intubated and placed on a radiolucent table with a towel bolster between his scapulae. Prereduction “serendipity” (Rockwood) and AP chest fluoroscopic views were obtained, and gentle traction was applied to the right upper extremity in line with the

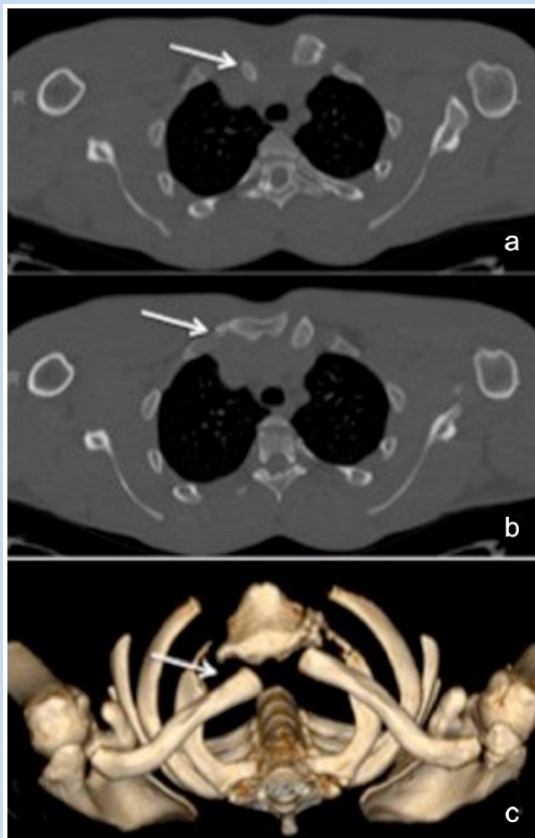


Figure 4. Postinjury axial CT images. (a) Axial cut depicting the posteriorly displaced right medial clavicle (white arrow). (b) Right sternoclavicular dislocation as evidenced by absence of the right medial clavicle at the level of the sternoclavicular joint (white arrow). (c) Three-dimensional reconstruction clearly demonstrating the right posterior sternoclavicular joint dislocation (white arrow).

clavicle. Countertraction was applied by an assistant with a sheet around the patient's upper torso in the axillary space. The patient's right shoulder was gradually extended while traction was applied. No confirmatory "pop" or "click" was felt at the SC joint. Postreduction AP and oblique fluoroscopic images were inconclusive for a reduction of the SC joint (Figure 6). Therefore, we obtained an intraoperative CT scan using an O-arm Surgical Imaging System (Medtronic, Minneapolis, Minnesota). This imaging modality confirmed the reduction of the SC joint (Figure 7). The joint was stressed by pushing posteriorly on the right medial clavicle as the shoulder was adducted across the chest. There was no clinical evidence of a redislocation, and repeat intraoperative CT imaging confirmed that the joint remained reduced. The patient's right shoulder was placed in a standard shoulder sling. He was woken and taken to the recovery room in stable condition.

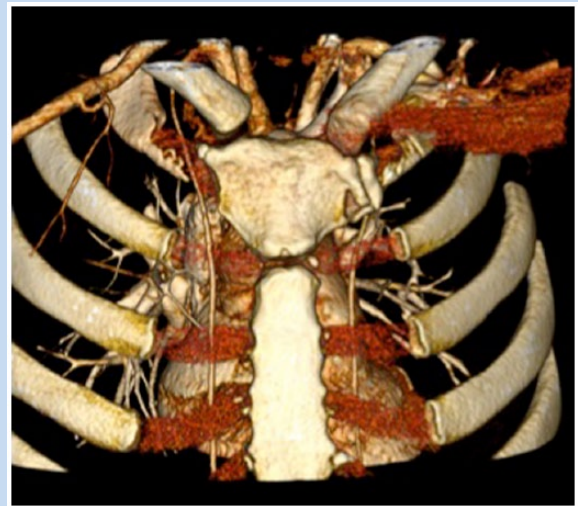


Figure 5. Contrast-enhanced coronal 3-dimensional reconstruction CT showing right posterior sternoclavicular dislocation.

Postoperative days 1 to 14, his right arm remained in a sling with local ice, high-voltage stimulation, and pulsed ultrasound used for edema control. Nonsteroidal anti-inflammatory medication was used for pain, though he had minimal discomfort after 1 week and essentially no pain 2 weeks following the injury. From postoperative days 15 to 21, gentle active-assisted range of motion in the scapular plane was initiated. Internal and external rotation was kept below 90° of shoulder abduction. Internal and external isometrics and active biceps and triceps motion were also started. Stationary bike riding and nonweightbearing pool running was used for aerobic conditioning. From postoperative days 22 to 28, open-chain progressive resistance exercises in the form of Therabands and dumb bells were initiated, and running was progressed as tolerated. On postoperative day 29, he began preparation for return to play with closed-chain progressive resistance exercises, such as rhythmic stabilization, early plyometrics, and sports-specific training. He progressed to football-related field drills 4 weeks following the injury without contact and returned to full competition 5 weeks after the injury. A CT scan was obtained before release back to full activity and confirmed that the SC joint reduction was maintained (Figure 7). Early heterotopic bone formation was also evident on the repeat CT, as was the resolution of the mediastinal hematoma. The patient played in 6 games following injury in the 2012 season and had no further symptoms involving the right SC joint. We did not perform any shoulder or upper extremity-specific rating scales either before or after his return to play. He left the team 5 months postinjury as a free agent and signed with another National Football League team.

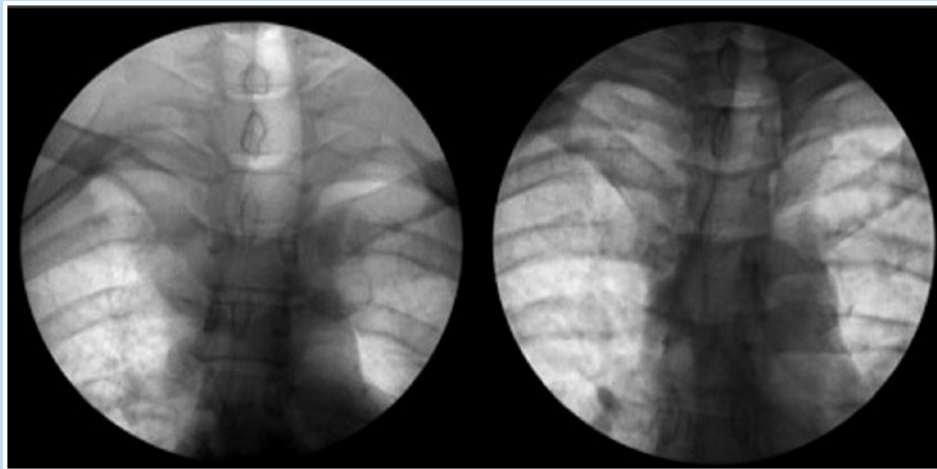


Figure 6. Intraoperative fluoroscopic “serendipity” view was unable to definitively depict the status of the sternoclavicular joint following the reduction maneuver.

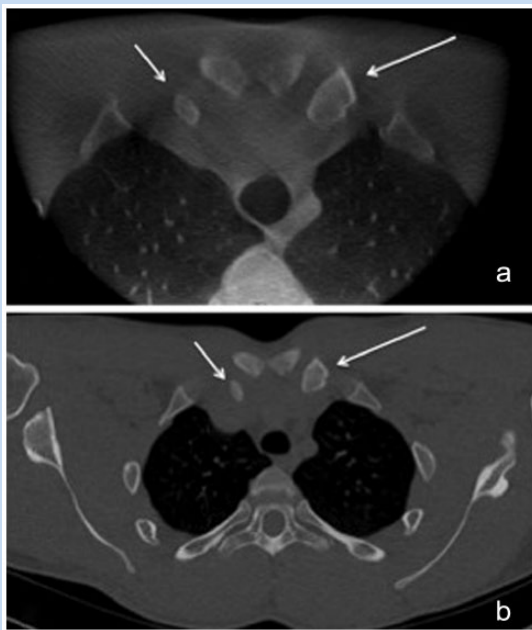


Figure 7. Intraoperative CT images. (a) Axial CT image showing reduction of the right medial clavicle (short white arrow) and relative symmetry with the left medial clavicle (long white arrow). (b) Axial CT image obtained 5 weeks following injury depicting unchanged position of the right sternoclavicular joint.

DISCUSSION

Since initially described by Sir Astley Cooper in 1824, only 120 cases of posterior SC dislocation have been reported in



Figure 8. The “serendipity” view is obtained with an anteroposterior-directed x-ray beam angled at 40° cephalad, centered on the manubrium.

the literature.²⁰ The relative rarity of this injury combined with the subtle physical findings can make diagnosis difficult.¹⁶ It is not uncommon for these injuries to be missed on initial evaluation. Unfortunately, the consequences of this injury can be devastating given the potential for significant neurologic and vascular compromise of the mediastinal structures that can occur with posterior dislocation of the SC joint.^{3,21,25,29}

The most common mechanism of SC injury is from motor vehicle accidents, but several sport-related collision injuries have been reported in youth and collegiate rugby and football players.²⁰ Two distinct patterns of posterior SC dislocation exist: a direct posterior force to the medial clavicle with the arm in an adducted and internally rotated position and an indirect



Figure 9. Hobbs view obtained with the patient sitting and leaning face down over the x-ray cassette so that the chest is nearly parallel to the table. The x-ray beam is then directed from behind the patient's neck, centered on the manubrium.

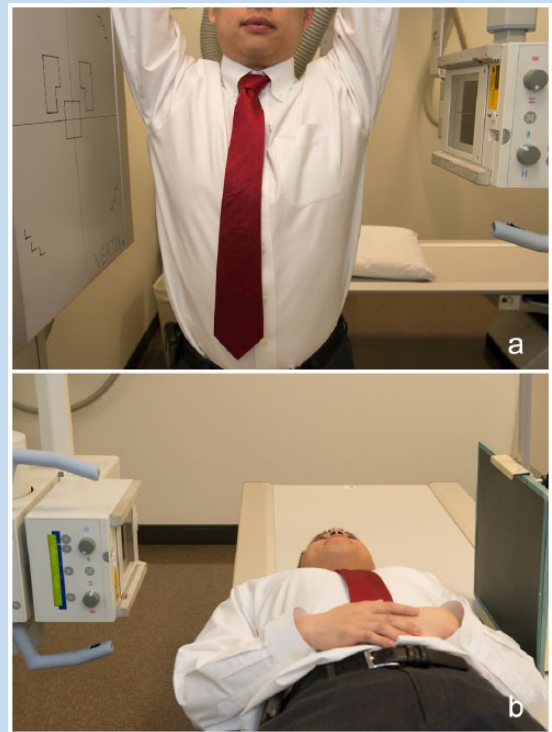


Figure 10. Heilig views. (a) The standing Heilig view is obtained by having the cassette placed perpendicular to the contralateral shoulder with the x-ray beam tangential to the ipsilateral SC joint and parallel to the opposite clavicle, centered to the manubrium. (b) The modified Heilig view is obtained in a similar fashion except that the patient lies supine.

anterior force to the posterolateral shoulder, usually as a result of a fall.^{13,20,21} In our case, the player sustained a fall and landed on the posterolateral aspect of the shoulder.

The most popular diagnostic modalities for a posterior SC dislocation include plain radiographs and CT imaging.²³ The best images to visualize the SC joint are the AP and "serendipity" (Rockwood) views. The serendipity view is performed with the x-ray beam angled at 40° cephalad, centered on the manubrium (Figure 8). Two other plain radiographic views have been described in the literature: the Hobbs and Heilig views.^{12,14} The Hobbs view is performed with the patient sitting and leaning face down over the x-ray cassette so that the chest is parallel to the table. The x-ray beam is then directed from behind the patient's neck, centered on the manubrium (Figure 9).¹⁴ The Heilig view is less commonly obtained; in this view, the cassette is placed across the contralateral shoulder with the x-ray beam tangential to the ipsilateral joint and parallel to the opposite clavicle, centered to the manubrium (Figure 10).¹² However, questions

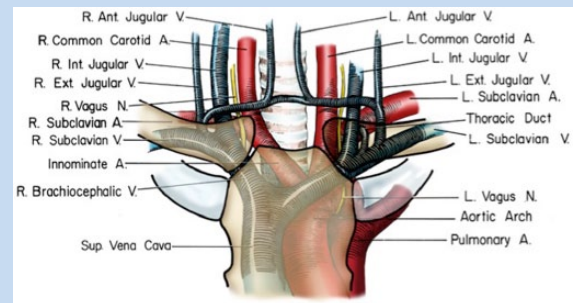


Figure 11. Illustration showing the mediastinal contents directly posterior to the sternoclavicular joint.

have been raised over the accuracy and reliability of plain radiographs, especially in obese patients or in those patients with more subtle degrees of instability.^{4,15,21,26} These views can also be technically difficult to obtain and interpret, especially intraoperatively, which limits their utility and reproducibility.^{2,7}

CT imaging is preferred because of its excellent skeletal detail of the involved and uninvolved joints, its ability to distinguish among subtle degrees of ligamentous instability, its excellent bony detail that will potentially identify associated medial clavicle fractures, and its relative speed of image acquisition.^{7,9} A drawback to CT imaging is the degree of ionizing radiation compared with other imaging modalities. Because of the high cost of owning and operating such machines (estimated at \$1.5 million), only a small number of centers around the country have access to this technology (personal communication, Medtronic, Minneapolis, Minnesota). In this case, however, it was crucial in our decision not to perform an open reduction and may have saved the patient from unnecessary surgery.

MRI is also a useful imaging modality, especially in children and young adults, to rule out a physal injury to the medial clavicle and to provide enhanced soft tissue detail to not only the SC structures but also the mediastinal contents.⁷ However, the limited availability at some institutions, based on available technicians and duration of the examination, limits MRI use in the acute setting.^{7,9}

The challenge in our case was confirming whether our attempted closed reduction was successful, since the physical palpation of the joint was not helpful and multiple fluoroscopic images, including serendipity views, were inconclusive. Sullivan et al described the use of an intraoperative CT for 2 cases of posterior SC dislocation that required closed reduction.²⁹ In both cases, fluoroscopic images were not helpful in confirming reduction, and the intraoperative CT showed that closed reduction was successful. This problem has also been described by Siddiqui and Turner, who recommended the use of intraoperative ultrasound to aid in the diagnosis.²⁷ Unfortunately, diagnostic ultrasound is operator dependent and has not been rigorously tested in terms of accuracy and predictive value for this specific condition.

Historically, the treatment of contact athletes with posterior SC dislocation has varied between simple closed reduction to open reduction and reconstruction of the SC ligamentous restraints (Table 1). The common pathway to treatment begins with thorough physical examination of the cardiopulmonary systems to rule out life-threatening conditions.¹⁶ Assessment of the neurologic and vascular supply to the ipsilateral upper extremity is also mandatory.⁵ Plain radiographs are routinely used as the initial diagnostic modality but, in our experience, are not sensitive enough to reliably confirm the presence of a posterior SC dislocation.^{4,6,7,15} CT imaging is imperative to delineate the injury and rule out concomitant vascular, tracheal, or esophageal compression.^{7,9,15} The patient is usually taken to the operating room within 24 hours of injury, though significant cardiopulmonary compromise warrants emergent reduction.^{13,20,21}

Definitive treatment consists of an initial attempt at closed reduction with axial traction to the involved upper extremity while extending the shoulder. Placement of a sandbag or

roll between the scapulae can facilitate reduction by causing a levering effect to the medial clavicle. A sterile clamp can also be used to grasp the medial clavicle to aid in the reduction.^{10,17,18} The success of closed reduction has been directly associated with time from injury to treatment. In a series by Groh et al, 7 of 9 patients presenting with posterior SC dislocations within 24 hours were successfully closed reduced, whereas 11 of 12 patients presenting more than 24 hours from injury had unsuccessful closed reductions and underwent open reduction with and without ligamentous reconstruction.¹⁰ In the largest series to date on treatment of posterior SC dislocation in contact athletes, Laffosse and colleagues attempted closed reduction in 9 dislocations presenting within 48 hours of injury and were successful in 6 patients (66%).¹⁷ One patient developed subsequent anterior instability and underwent a successful SC joint reconstruction.

Open reduction is warranted if closed reduction is not successful. A cardiothoracic surgeon should be immediately available in the event of acute cardiopulmonary compromise because of the close proximity of the mediastinal vascular structures (Figure 11).¹⁹ Although the literature is controversial with regard to the optimal surgical treatment for this injury^{1,8,22,23} (repair vs reconstruction of the SC ligaments and capsule), the authors' preference is for reconstruction using a hamstring autograft in a figure-of-8 weave, as described previously.^{27,30}

Rehabilitation following treatment of this injury is based on the definitive method of treatment, concomitant injuries, and patient symptoms. Following a closed reduction, most authors have advocated at least 3 to 4 weeks of immobilization in a brace or sling and then gradual return to play.^{9,11,13,20,21} However, the literature shows a wide range of time lost from athletic activity,^{9,10,13,20,21} which makes prognostic estimates of return to play difficult. It must be emphasized that prior treatment and rehabilitation recommendations are based on Level V evidence (expert opinion) and depend, in large part, on the nature of the athletic event, position played, level of competition, handedness, and timing of the season. In the only study to examine return-to-play rates after posterior SC injury, 18 of 30 patients were able to return to their previous level; however, none of the patients were professional athletes.¹⁷ Six patients had changed their sport to one involving either lesser contact or use of the opposite extremity. The cohort described by Lafosse et al was also a mixed-patient population with differing times to presentation and varying diagnoses that included both SC dislocation and epiphyseal separation.¹⁷ It is also unknown at what level these patients were performing before their injuries.¹⁷

Our patient was able to return to professional American football 5 weeks following his injury. The decision to allow him to return was based on his lack of symptoms, full range of shoulder motion, normal strength of the upper extremity, and ability to perform his sport-related tasks without difficulty. Before return to play, athletes must be apprised of the as-yet-undefined potential for recurrence of injury.

Table 1. Review of reported posterior sternoclavicular joint dislocation in contact athletes

	Patient	Mechanism	Imaging Modality	Concomitant Finding on Imaging	Treatment
Buckley et al ³	Football player, 16 y	Fall directly onto affected posterior shoulder	Plain films, CT scan	Compression of brachiocephalic vein	Open reduction
Laffosse et al ¹⁷	7 rugby players, 1 ski, 1 judo	8 indirect and 1 direct injury, acute injury presenting within 48 hours	Plain films, CT scan	Dyspnea, dysphagia in 2 patients	5 had successful stable closed reduction; 1 had successful closed reduction but had instability; 3 had failed closed reduction and then open reduction and reconstruction with a variety of techniques
Marker et al ²⁰	Football player, 15 y	Direct blow to affected shoulder	Plain films, CT scan	Mediastinal hematoma	Closed reduction, figure-of-8 brace for 6 weeks
Mirza et al ²¹	Rugby player, 19 y	Tackled from behind while carrying a ball, falling directly on chest	Plain films, CT scan	Abutment of aortic arch and brachiocephalic vein	Attempted closed reduction, open reduction, and reconstruction using sutures; sling postoperatively for 3 to 4 weeks
Salgado et al ²⁵	Rugby player, 16 y	Collision with another player	Plain films, CT scan	Epiphyseal separation, compression of brachiocephalic vein	Operative treatment
Siddiqui et al ²⁷	Rugby player, 20 y	Knee directly into chest anterior to posterior	Plain films, CT scan, ultrasound	None	Attempted closed reduction, open reduction, and direct repair of sternoclavicular ligament and capsule; figure-of-8 brace postoperatively
Williams et al ³²	College football player, 21 y ^a	Fell on affected shoulder with arm flexed and adducted	CT scan	Compression of brachiocephalic vein	Closed reduction, figure-of-8 brace for 4 weeks, avoidance of contact sports for 6

^aQuit football and lost to follow-up.

CONCLUSION

This case is the first reported posterior SC dislocation in a professional athlete. Issues relevant to our patient included the lack of definitive diagnosis from accepted plain radiographs in addition to the benefits provided by intraoperative CT imaging. These issues have received little attention in the orthopaedic literature. Finally, our patient was able to return to professional American football within 5 weeks of injury following a successful closed reduction. This case provides useful information to health care professionals treating this uncommon yet dangerous injury.

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