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Case Report

Triple injury to the superior shoulder suspensory complex

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ABSTRACT

The superior shoulder suspensory complex is a key structure in maintaining the biomechanics of the shoulder. Injuries to this complex, depending on their severity, usually require surgical intervention. Although double disruption of this structure has been well documented, cases of triple disruption have been relatively rare as only three case reports have been published in the literature. We report a 44-year-old man who suffered such an injury involving fractures of the coracoid process and acromion combined with dislocation of the acromioclavicular joint. This patient then underwent surgical intervention via open reduction and internal fixation. After 6 months of follow-up, radiographs revealed proper reduction and alignment of the scapuloclavicular connection. The patient was asymptomatic; he could move his shoulder freely and achieve a full range of motion. Triple injury to this structure definitely warrants surgical intervention. As presented, reduction and fixation aimed at reconstruction and restoration of the three aforementioned structures was performed with a good functional result and satisfactory outcome.
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1. Introduction

The superior shoulder suspensory complex (SSSC) includes the bone and soft tissue ring that suspends the upper extremities laterally to the shoulder girdle and the struts that support this ring. The ring is composed of the glenoid process, coracoid process, coracoclavicular ligament, distal clavicle, acromioclavicular (AC) joint, and acromial process. The superior and inferior struts are the middle third of the clavicle and the lateral aspect of the scapula, respectively.[1] The SSSC represents an important mechanical structure because it serves as the point of attachment for various muscles and tendons that allows significant movement and maintains functional stability between the upper arm and the axial skeleton.[2]

A single injury to this complex is common, though usually its stability remains intact. Depending on the severity of the injury, surgical treatment may or may not be indicated. When a double disruption of the SSSC occurs, however, its stability is breached and surgical intervention gives the best functional outcome. However, a triple injury to this complex is rare, as only three case reports have been published in the literature.[3–5] We present a triple injury to the SSSC involving the coracoid process, acromial process, and AC joint treated via open reduction and internal fixation (ORIF) with excellent results.

2. Case report

A 44 year-old man was thrown off a moped and landed on his right shoulder. He came to the emergency department with multiple abrasions and severe pain in his right shoulder. Physical examination revealed evident bruising, tenderness, and a limited range of motion in the right shoulder. No neuromuscular abnormalities were found.

An initial radiograph of the patient's right shoulder revealed a coracoid process fracture, an acromial process fracture, and a dislocated AC joint (Fig. 1). To further determine the extent of the injuries, three-dimensional computed tomography (CT) was performed and an Ogawa type I fracture of the coracoid process,[6] a Kuhn type IB fracture of the acromion,[7] and a Rockwood type II injury to the AC joint were confirmed (Fig. 2).[8] Individually, these injuries would probably heal if adequate stabilization and immobilization were provided. Collectively, however, simultaneous injury involving all three structures caused extreme instability to the shoulder; therefore, surgical intervention was deemed necessary.

After anesthesia, the scapular spine was identified; by moving around the shoulder anterolaterally, the acromion was located and designated as a landmark. To gain better exposure and direct access to all three structures, a swoosh-shaped incision was made beginning at the acromion, curving anteriorly along the clavicle,

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Fig. 1. Preoperative radiograph of the right shoulder demonstrating coracoid process and acromion fractures combined with an acromioclavicular joint dislocation.

Fig. 3. Postoperative radiograph of the right shoulder with fixations via Kirschner wires and tension band wires on the acromion and acromioclavicular joint.

and extending to the proximal end of the coracoid process. ORIF of the acromion was performed first with two 1.8-mm Kirschner wires (K-wires; Mizuho Co Ltd, Tokyo, Japan) and tension band wiring. Then, the AC joint was treated the same way using two 1.8-mm transacromial K-wires and tension band wiring. After fixation of the aforementioned structures, the stability of the shoulder girdle was tested under direct vision and fluoroscopic view. The coracoid process appeared stable and its displacement minimal as the scapuloclavicular connection was well aligned. In addition, no marked impingement was noted because the shoulder had unrestricted ranges of motion. Thus, it was determined that surgical intervention was not necessary for this fracture as the wound was closed and a shoulder sling placed for immobilization.

Postoperatively, radiographs showed good fixation and alignment (Fig. 3) as gentle mobilization of the right shoulder (i.e., abduction over 90°) began after 4 weeks. After 3 months, the patient had nearly recovered the full range of shoulder motion with minimal discomfort. At 6 months, the patient was asymptomatic and could move his shoulder freely with a full range of motion.

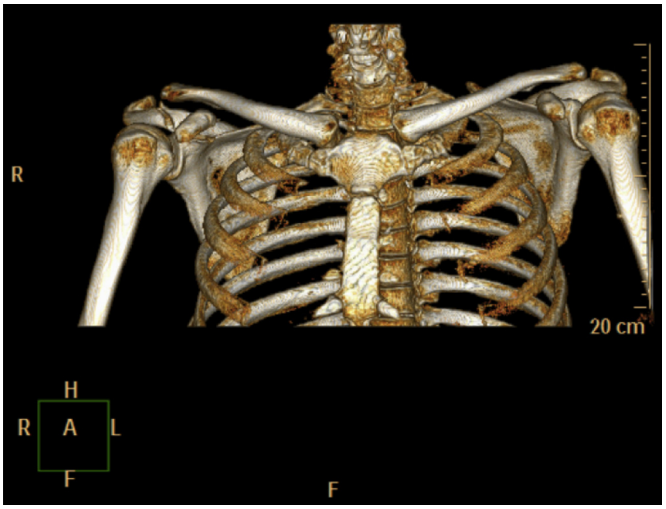

Fig. 2. Reformatted computed tomography scan confirming a type I coracoid process fracture, a type IB acromion fracture, and a type II acromioclavicular joint injury.

3. Discussion

To date, the condition in which three or more concurrent injuries within the SSSC has been described to be rare, but it is actually more common. In addition to the aforementioned published literature, studies by Ogawa et al[9] and Nakagawa et al[10] reported that 28% and 13% of their respective patients suffering from complex injuries of the SSSC had disruptions or fractures at three or more sites.

Although various mechanisms can cause SSSC injuries, the most common explanation is forceful impaction on the lateral aspect of the shoulder. According to Scarlat et al,[11] this lateral impaction force is transmitted medially and distributed in two directions: (1) anterosuperiorly, involving the AC joint, clavicle, and sternoclavicular and costoclavicular joints; and (2) posteroinferiorly, involving the glenohumeral joint, scapula, and scapulothoracic joint. Because all the aforementioned structures are connected by the SSSC, it is reasonable to conclude that an immense force aimed at both directions can cause multiple injuries. Clearly, structures most adjacent to the impact would absorb the majority of the force

and sustain more damage. Therefore, the triple injury suffered by our patient could have resulted from a direct impact causing fracture of the acromion with concurrent AC joint dislocation. Subsequently, the upward migration of the clavicle would cause traction of the coracoclavicular ligament, resulting in a coracoids fracture.[9]

Despite knowing the area of injury, it is still difficult for physicians to make a correct diagnosis of SSSC injuries based only on physical findings because symptoms of concurrent injuries within the same area are not only similar but also masked. Therefore, radiographic evaluation is invaluable for definitive diagnosis of such injury. In addition to the anteroposterior, lateral, Y, and Stryker notch views of the injured shoulder, some have suggested different degrees of cephalic-tilt views. In addition, the usefulness of CT may be essential in providing better visualization of the fracture pattern and involvement. The exact shape and size of the fracture fragments are well demonstrated on CT, which can be useful to surgeons when surgical intervention is deemed necessary.[12,13] Even though the diagnosis of a triple injury to the SSSC was made in our patient, a three-dimensional CT scan allowed better preparation during our preoperative routines.

When Goss[1] proposed the concept of injuries to the SSSC, he warned that complex damage to this structure frequently results in adverse functional consequences. Although conservative treatment has yielded satisfactory outcomes,[14] it can also result in nonunion or malunion with persistent pain or dysfunction of the shoulder girdle.[10] For example, complex injuries are unstable due to the loss of suspensory function of the shoulder, thereby resulting in a drooping of the shoulder.[1,2,15] In addition, a high incidence of rotator cuff dysfunction has been reported due to the loss of the normal lever arm of the rotator cuff.[16] Therefore, current studies have advocated the need for ORIF with complex and unstable injuries, especially when patients want to begin early rehabilitation and return to their daily activities.[1,9,10,17]

A fragment from a type I coracoid process fracture is usually rotated and displaced inferolateroposteriorly. Consequently, both the scapuloclavicular connection and coracoacromial arch are altered and damaged, leading to subacromial impingement.[14] Because these structures must be restored, the order of reduction and fixation must be prioritized. ORIF begins with injury of the supporting struts. Once they are reduced and stabilized, each component within the ring structure of the SSSC is evaluated. According to Ogawa et al,[9] fracture of the acromion is first reduced and immobilized. Then, fixation of AC joint dislocation or distal clavicle fracture follows. As subsequent unstable sites other than the coracoid process are reduced and immobilized, the scapuloclavicular connection should be stable and well aligned as the coracoid fracture is reevaluated.

Although Goss,[1,2] Kim et al,[17] and Butters[18] all believe that if the displacement of the coracoid fracture is significantly improved, fixation is not to be performed, Ogawa et al[9] disagree. These authors state that even if the displacement of the coracoid process fracture improves, there remains the risk of subacromial impingement between the coracoacromial ligament and the rotator cuff. Thus, Ogawa et al[9] firmly believe that the coracoid process must be fixated after the correction of its rotation and displacement. In treating our patient, we followed the steps outlined by Ogawa et al[9]: first the acromion and then the AC joint. However, under direct vision and fluoroscopic view, we manipulated the patient's shoulder through various ranges of motion and were assured of its function and stability. We therefore decided that the coracoid process did not require surgical management.

The SSSC is important biomechanically because it maintains a normal, stable relationship between the upper extremity and the axial skeleton. A single injury to this ringlike structure can either be stable or unstable. A double injury, however, usually causes instability such that reduction and fixation are necessary. A triple injury, therefore, definitely warrants surgical intervention. As presented, reduction and fixation aimed at reconstruction and restoration of simultaneous injury to the coracoid process, acromion, and AC joint was performed with a good functional result and satisfactory outcome.

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