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Shoulder impingement in overhead athletes: An uncommon complication of distal clavicle fracture

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ABSTRACT

Impingement syndrome is one of the most common pain disorders of the shoulder. The causes are numerous and most frequently it is due to structural alterations of coracoacromial arch; however, in in rare cases it may be caused by malunion of distal clavicle fractures. We report our experience in the case of a young tennis player with shoulder impingement after a conservative management of distal clavicle fracture.
Keywords: Athlete; Shoulder pain; Shoulder impingement; Distal clavicle fracture; Plain radiographs; Magnetic resonance imaging (MRI).

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INTRODUCTION

Clavicle is one of the most frequently fractured bones. In young individuals, clavicle fracture contributes to approximately 2.6% of all fractures. The non-operative treatment is simple, by applying a standard arm sling as studies have shown that other options like body jacket, cast, brace or figure-of-eight bandage are not superior. The undisplaced fractures of the distal clavicle has a high union rate and the functional outcomes are good when treated conservatively. Most clavicle fractures heal with minimal persistent symptoms or none at all. The potential problems include non-union and malunion of the fractured clavicle, and rarely shoulder impingement. Early identification of bony impingement may prevent unsatisfactory treatments and guide more effective management (Mouzopoulos G et al., 2009).

This case serves to illustrate the occurrence of a shoulder impingement in a young tennis player after conservative management of a distal clavicle fracture, and the importance of early imaging in achieving diagnostic accuracy.

Case presentation

A 25-years-old competitive tennis player who was involved in a motor vehicle accident was admitted to orthopaedic clinic of our hospital. He was diagnosed with a closed fracture of the right clavicle (type 2 according to Neer classification) and given an arm sling. At review three weeks later, he was started on physiotherapy and periodic follow-up.

Approximately 3 months after the trauma, he returned to our centre in view of persistent shoulder pain and inability to completely resume his sporting activity despite the fracture healed. The pain had worsened in the last 4 weeks since he had resumed his training.

Specifically, the pain was focal localized in the anterior and lateral region of the deltoid and in the proximal portion of the upper biceps with an occasional sensation of traction in the distal biceps. The pain worsened during shoulder abduction beyond 90°, and he had begun to note joint crepitus on circumduction. He reported baseline pain of 5-8/10 daily, increasing to 10/10 after a 20 minutes of tennis training. The patient exhibited pain even with activities of daily living such as taking off his shirt and was unable to sleep on right side.

He had been doing competitive activity for about 10 years. Excepting for the clavicle fracture, he had no history of shoulder injuries as well as neck pain or radiculopathy. He had no other pathologies. Laboratory blood tests revealed no abnormalities. Blood pressure was 120/70 mmHg and heart rate 85 bpm.

On clinical evaluation, the patient showed neutral posture. Both shoulders were well muscled bilaterally with no scarring, deformity or atrophy. During the abduction of the left shoulder there was a painful arch with functional block reported at 90°. Hawkin's test was positive. Mill's and Cozen's tests were negative. The left proximal biceps tendon and left medial aspect of the acromial-clavicular joint were focally painful on palpation. The upper limbs had a normal neurovascular system.

The clinical examination suggested the presence of shoulder impingement. Thus, the patient underwent plain X-ray and non-contrast Magnetic Resonance Imaging (MRI) of the right shoulder.

Plain radiographs showed the presence of a sharp bone spur of the distal end of the clavicle secondary to malunion's fracture, which protruded inferiorly from the undersurface (Figure 1). MRI confirmed the presence of impingement by showing the clavicular bone spur, which compressed inferiorly the supraspinatus muscular

belly and reduced the subacromial sliding space. In addition, MRI reported a severe sub-acromial bursitis, a tendinopathy with bursal-side partial thickness tear of the supraspinatus tendon, and a modest amount of fluid in the gleno-humeral joint. No injuries to other tendon structures of the rotatory cuff were evident. The trophism of the cuff muscles was preserved. There was no acromio-clavicular and gleno-humeral arthrosis (Figures 2a-2b).

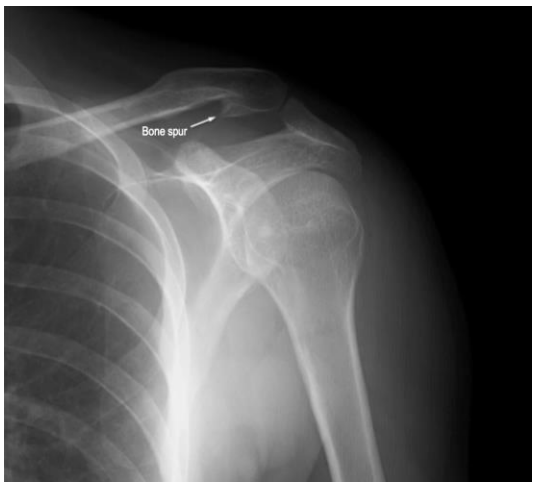


Figure 1. Acromioclavicular view showing a sharp bone spur of the distal end of the clavicle secondary to secondary to malunion's fracture, which protrude inferiorly from the undersurface (arrow).

(A) (B)

Figure 2. Coronal (a) and sagittal (b) MRI showing a severe sub-acromial bursitis (asterisk), a tendinopathy with bursal-side partial thickness tear of the supraspinatus tendon (arrow), and a modest amount of fluid in the gleno-humeral joint.

The patient underwent arthroscopic surgery to remove the clavicular bone spur and repair the supraspinatus tendon. He began immediate physical therapy. He resumed daily activity within 15 days months after surgery. However, the prognostic discussion convinced the patient of the importance to alter the intensity of his upper body training activities. By simply reducing repetitive overhead activities and modifying the intensity of his

upper body exercise program, at the 6-month follow-up the patient showed normal scapular kinesia and had no signs of impingement or pain in the shoulder.

DISCUSSION

Shoulder pain is the third most common musculoskeletal disorder in clinical practice and impingement syndrome is one of the most common diagnoses. Although the peak of incidence occurs during the sixth decade of life, a homogeneous distribution in the patient population of the syndrome is reported due to the several causes that generate the disease (Garving C et al., 2017).

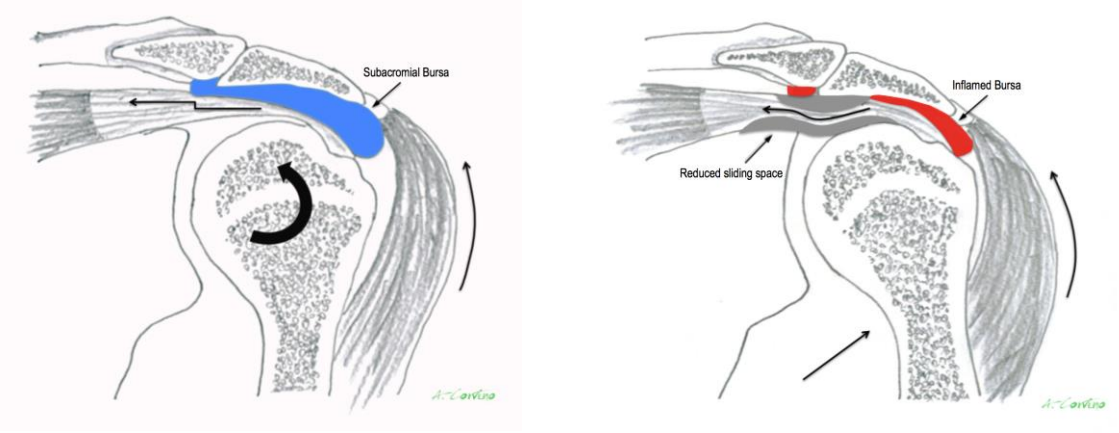
Primary subacromial impingement is due to structural changes that mechanically narrow the subacromial space reducing the sliding space of the muscle-tendon structures; these include bony narrowing on the cranial side (outlet impingement) or increase in the volume of the subacromial soft tissues due, e.g., to subacromial bursitis or tendinopathy on the caudal side (non-outlet impingement) (Garving C et al., 2017; Raiola, Lipoma & Tafuri, 2015; Corvino A et al., 2020).

Advanced subacromial impingement syndrome is associated with rotator cuff defects. The relation between these two entities is a controversial matter. Rotator cuff defects have been attributed to both extratendinous (extrinsic) factors and intratendinous (intrinsic) abnormalities. The extrinsic compression theory postulates pressure damage due to pathological contact of the shoulder roof with the supraspinatus tendon. In contrast, the intrinsic compression theory postulates degenerative processes in the supraspinatus tendon itself, leading to defects. It is now thought that both of these pathological mechanisms are active, and that they reinforce each other (Alrabaa RG et al., 2020).

Athletes, particularly those who are involved in sporting activities requiring repetitive overhead use of the arm (for example, tennis players, pitchers, quarterbacks, and swimmers), not infrequently develop impingement syndrome and painful shoulder (De Micco et al, 2014; Hawkins RJ et al, 1980; Raiola & Tafuri, 2015). The serve and overhead involved in tennis, the throwing motion in pitching and quarterbacking, and the motions in swimming, particularly free style and butterfly, are examples of those especially susceptible to develop this overuse syndrome (Hawkins RJ et al, 1980). Specifically, shoulder pain in overhead athletes has been correlated with a variety of conditions or dysfunctions such as: internal impact (more often involved in overhead athletes), gleno-humeral instability, subacromial impact, contracture of the posterior capsule, medial rotation deficit, humeral retroversion, dysfunction of the trunk, scapula and shoulder musculature and biomechanical disorders (Economopoulos KJ et al., 2012; Corvino A et al., 2020).

Our patient suffered from subacromial impingement secondary to malunion's fracture: the clavicular bone spur "*impinged*" inferiorly the supraspinatus muscular belly reducing the subacromial sliding space.

During overhead sport activity, in fact, the soft tissue contents of the subacromial space including the tendons of the rotator cuff must pass under the coracoacromial arch for the athlete to elevate the arm at greater than 90. These actions require maximal abduction with external rotation. Thus, the subacromial bursa and rotator cuff tendons are subjected to wear below the coracoacromial arch as the arm accelerates forward. The bursa is a reactive tissue, and this external mechanical stimulus may initiate a response of inflammatory factors, leading to shoulder pain (Figures 3a-3b) (Economopoulos KJ et al., 2012). This is the biomechanical explanation for the severity of clinical scenario in our case: the early resumption of sporting activity (approximately already 3 months after the trauma) in a patient with malunion's fracture and bone spur on the undersurface of clavicle.



(A) (B)

Figure 3. Schematic biomechanical overview of the shoulder showing the mechanism of subacromial impingement with painful entrapment of soft tissues on elevation and abduction of the arm, due to pathological contact of the humeral head with the roof of the shoulder joint.

In shoulder impingement, a patient's medical history and a complete physical examination of the shoulder are the basis of the diagnostic evaluation. The reported diagnostic sensitivity of the clinical examination is 90-92% (Alrabaa RG et al., 2020). However, the role of diagnostic imaging is indispensable: in our case, it confirmed the clinical suspicion and made it possible to exclude other pathologies.

The standard X-ray series of the shoulder consists of a true antero-posterior (AP) view in the neutral position or with the arm internally or externally rotated, a transaxillary view, and a Y (outlet) view. These three views enable the display of the bony structures so that the physician can assess the state of the coracoacromial arch, the acromio-clavicular joint, the centring of the head of the humerus, the greater tubercle, arthritic changes, and normal anatomic variants. Injury to the acromio-clavicular articulation is better evaluated on the antero-posterior view obtained with a 15-degree cephalad tilt of the radiographic tube (Garving C et al., 2017; Panzetta et al, 2017), as in our patient in Figure 1.

Ultrasound has also been shown to be an effective tool in diagnosing both partial- and full-thickness rotator cuff tears. A recent meta-analysis showed a sensitivity and specificity of 0.84 and 0.89, respectively, for partial-thickness tears and 0.96 and 0.93, respectively, for full-thickness rotator cuff tears using ultrasound. Although there are several benefits to the use of ultrasound in the diagnosis of rotator cuff tears in athletes, including its ability to dynamically assess the cuff, patient tolerance, and cost, it is highly operator dependent. Because of this key limitation, ultrasound remains primarily used only in certain centres (Economopoulos KJ et al., 2012; Corvino A et al., 2019).

MRI is used to assess the soft tissues, including the bursae and the rotator cuff, and to determine the degree of muscle atrophy and fatty infiltration. The method allows also to study the gleno-humeral and acromio-clavicular joints. It is acquired on the axial, coronal, and sagittal oblique planes. Generally, T1, DP and DP FAT-SAT sequences with a thickness of 3 mm are performed. Administration of contrast medium is not routinely indicated. The reported sensitivity and specificity of noncontrast MRI are 92% and 93%, respectively (Sandomenico F et al., 2019).

CONCLUSION

Shoulder impingement is an uncommon complication of distal clavicle fracture. Careful clinical assessment is required to establish the diagnosis to prevent delayed treatment. Arthroscopic decompression is a recommended method of treatment and shows good early clinical outcome.

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