

Delayed diagnosis of isolated coracoid process fractures: results of 9 cases treated conservatively

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Abstract. *Background and aim:* Isolated coracoid process fractures are more frequent than what has formerly been believed. Delayed diagnosis or misdiagnosis are not infrequent as it is difficult to notice this injury using routine radiographic projections of the shoulder. In any event, more specific views are prescribed only when a fracture is suspected. The purpose of this study is to assess the outcomes of 9 cases of isolated coracoid fractures treated conservatively after being undiagnosed and discuss the reasons of these delayed diagnoses. *Materials and Methods:* Between January 1984 and June 2011, 9 out of 19 isolated coracoid fractures received a delayed diagnosis. There were 7 type I fractures and 2 type II. All patients were treated conservatively. *Results:* All fractures, except one, consolidated. The delay of the diagnosis was greater in type II lesions rather than in type I. Differences in clinical outcomes between affected and healthy side were minimal. Delayed diagnosis was overseen by the physician in 8 cases whereas in 1 case the patient underestimated the trauma and left the injury untreated. *Conclusions:* An isolated coracoid fracture should always be suspected after receiving a direct blow on the shoulder or after sustaining a forceful traction of the upper arm. In these events, specific radiographic projections should be performed in order to visualise the entire length of the coracoid process and to avoid oversight, delayed diagnosis or misdiagnosis. In isolated type I undisplaced fractures and in the majority of type II fractures, conservative treatment is indicated. (www.actabiomedica.it)

Key words: coracoid process, scapula, fracture, shoulder, delayed diagnosis

Introduction

The coracoid process represents an anatomical structure that may be considered as the keystone in maintaining the connection between the clavicle and the scapula, and the configuration of the coracoacromial arch. (1, 2). The integrity of this scapular process, on which originate the short head of the biceps, coracobrachial and pectoralis minor muscles as well as the coracoclavicular, superior transverse scapular, coracohumeral and coracoacromial ligaments, allows a normal biomechanics of the shoulder girdle. Historical literature reports consider scapular fractures as uncommon, accounting for 1% of all bone injuries (3-8) and for 3 to 5% of injuries of the shoulder girdle (9).

Of these, only 2-7% involve the coracoid process (10, 11). More recently, fractures of the coracoid process have been recognised as being more frequent than it has been formerly believed (1, 2). Radiographic (x-ray) exploration has become more precise in recent years and the always more frequent use of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) has facilitated the diagnosis of these fractures (2, 12). Nevertheless, these lesions, above all the isolated ones, are frequently overlooked and diagnosed late (1) and are too simply considered as “shoulder contusions” in emergency care units. Based only on the physical examination, it is normally difficult to make a diagnosis of isolated coracoid fracture because the local symptoms of concurrent injuries are similar.

Furthermore, it is difficult to visualise this lesion using routine x-ray projections of the shoulder and seldom the symptomatology justifies a TC in the emergency room. The fracture is often subtle and could be easily confused with an unfused epiphysis, adjacent bone anomalies or secondary ossification centres. However, in the presence of characteristic symptoms, such as tenderness confined to the coracoid and induction of anterior shoulder pain during resistive elbow flexion, forearm supination or on deep breathing, an isolated fracture of the process may be suspected and more specific x-ray projections have to be performed (13-15).

Isolated coracoid fractures most commonly occur through the base of the process (1-3, 13, 16, 17). In these cases the displacement is usually minimal because of the stabilisation provided by the coracoclavicular and coracoacromial ligaments and the tendons of the biceps, coracobrachial and pectoralis minor muscles and, for this reason, conservative treatment is recommended. Conservative treatment is also indicated in the less frequent fractures which occur more distally in the process around its tip (1-3, 13, 16-19). Furthermore, some reports of coracoid fractures in teenagers through centres of ossification (20) and stress fractures in athletes (21) are also described.

Even if the majority of the coracoid fractures are treated with good results in a conservative manner, in cases of isolated displaced fractures of the base or of a combined injury in which the fracture is displaced and associated with dislocation of the acromionclavicular joint or other injuries which have destroyed the scapu-

loclavicular connections (1-3, 13, 15, 18, 22), surgical treatment is indicated. Surgery is needed also in dislocated cases which involve the superior border of the glenoid notch (13, 23) and in cases in which the reduction of an associated shoulder dislocation is not allowed by the interposition of the coracoid process which is detached (24, 25).

The authors describe their experience of subacute coracoid process fracture and the outcomes of 9 patients treated conservatively in which the diagnosis was delayed.

Materials and methods

Of 19 isolated coracoid process fractures in 19 patients that the authors encountered between January 1984 and June 2011, 9 patients underwent delayed diagnosis. The mean age was 37 years (range 16-60). There were 7 men and 2 women. The dominant side was involved in 5 cases (Table 1). The diagnosis in 8 patients was done in the outpatient clinic after being misdiagnosed in the emergency care unit using only standard antero-posterior and transthoracic x-ray projections. In 1 other case the diagnosis was done at the first visit in the outpatient clinic because patients did not go at the emergency room, thus leaving the fracture untreated, because of milder, non persistent symptoms following the injury (Table 1).

In all cases except one, specific coracoid x-ray projections (Froimson view, anterior oblique view and scapula Y view) were performed. In only one case a

Table 1. General data and results of the 9 patients of the case series. Fe: female, M: male, L: left, R: right, P: poor, S: satisfactory, G: good, E: excellent

Age	Gender	Year of trauma	Side	Hand dominance	Type of trauma	Type of fracture	Emergency care unit visit	Days between trauma and diagnosis	Treatment/sling	Follow-up (years)	Constant score affected side	Constant score unaffected side	Grading the Constant score	Consolidation
60	M	1985	L	L	Traction	II	No	28	No	26	58 P	71 S	13 G	Yes
16	M	1989	L	R	Direct	I	Yes	8	Yes	22	95 E	96 E	1 E	Yes
42	M	1992	R	R	Direct	I	Yes	7	Yes	19	79 S	84 G	9 E	Yes
32	M	1995	R	L	Direct	I	Yes	7	Yes	16	100 E	100 E	0 E	Yes
37	M	1999	R	L	Direct	I	Yes	9	Yes	12	95 E	95 E	0 E	Yes
50	Fe	2001	R	R	Direct	I	Yes	7	Yes	10	86 G	92 E	6 E	Yes
48	M	2005	L	R	Direct	I	Yes	10	Yes	6	91 E	94 E	3 E	Yes
27	Fe	2007	L	L	Direct	I	Yes	7	Yes	4	100 E	100 E	0 E	Yes
21	M	2009	R	R	Traction	II	Yes	25	No	2	95 E	100 E	5 E	No

TC scan was performed and in another patient a TC scan accompanied the standard x-ray views.

The authors excluded from this study all patients which sustained other fractures or had associated lesions of the shoulder girdle.

Coracoid fractures were divided according to the classification proposed by Ogawa (18). Type I fractures occurred proximal to the coracoclavicular ligaments and type II distal to this attachment. The type of trauma and the delay between the trauma and the moment of diagnosis were recorded. All patients were clinically assessed at follow-up with the Constant shoulder score (26) in both the injured and healthy side as valuated by Boheme (27). The differences between sides were analysed grading the Constant score as suggested by Fabre (28). At the follow-up visit specific Froimson views were always performed in order to evaluate the consolidation of the fracture.

Results

Average follow-up was 13 years (range 2-24). There were 7 type I and 2 type II fractures (table 1). Of the 7 type I fractures all involved the base of the process and never interested the superior part of the glenoid fossa. Both type II fractures occurred at the tip of the coracoid.

Causes of injury (Table 1) differed between types of fractures. Six out of 7 type I fractures were caused by a direct blow on the lateral aspect of the shoulder. One type I fracture was the consequence of a blunt direct blow on the anterior part of the shoulder after a fall against the corner of a table. All type II fractures were caused by violent traction of muscles attached to the coracoid. In one case the traction was the consequence of a sudden bus brake with the superior arm abducted, extended, externally rotated and with the hand hanging on a handle. In the other case the traction was caused by a sudden movement of the upper arm in extension and external rotation during an amateur wrestling match.

Time between trauma and diagnosis averaged 12 days (range 7-28). This datum was different in the two types of fracture. In all type I fractures the cause for chronicity was an oversight of the emergency or-

thopaedic surgeon who discharged all patients with a generic diagnosis of "contusion with posttraumatic shoulder pain". The true diagnosis was reached after a mean period of 7.8 days (range 7-10) when patients returned with persistent shoulder pain. In one of the 2 type II fractures the patient did not seek care and the fracture was found 28 days later during a visit for a mild, improving and non specific symptomatology in the shoulder. The outclinic orthopaedic surgeon suspected the fracture and made the diagnosis through specific radiographs. In the other patient (Figure 1) affected with an antero-inferiorly dislocated type II fracture of the tip of the coracoid, the diagnosis was delayed by 25 days. The fracture was initially mistaken for "shoulder pain due to periarticular calcifications". At the follow-up visit a TC scan was performed and a dislocated fracture of the tip of the coracoid process was observed.

As for the treatment for the type I fractures (Figure 2), all of the patients received conservative treatment (arm sling for a total period of 4 weeks and subsequent 5 weeks of active and passive progressive mobilisation) because no marked displacement or instability was noted at the injury site. The 2 patients with type II fractures diagnosed more than 25 days after incurring injury were not immobilised in a sling because of progressive improvement of pain and range of motion, and were referred immediately to rehabilitation.

The mean Constant shoulder score (26) for the affected side was 88.77 (range 58-100) (6 excellent results, 1 good, 1 satisfactory and 1 poor) and 92.44 (range 71-100) (7 excellent results, 1 good and 1 satisfactory) for the healthy side. The mean difference between the 2 sides was 4.11 points (range 0-13). In 3 cases no differences were observed. The Constant score comparison between both sides as suggested by Fabre (28) was excellent in 8 cases and good in 1 and independent from the coracoid fracture (Table 1).

The poor result observed in this study (figure 3) was the first of the case series. The patient was a 60 years old male who fractured his coracoid bone in 1985 and was 86 years old at the time of his follow-up visit. In this case, the Constant score was similar and low for both sides, related most likely to age, osteoarthritis and rotator cuff tears.

All the fractures except one consolidated and

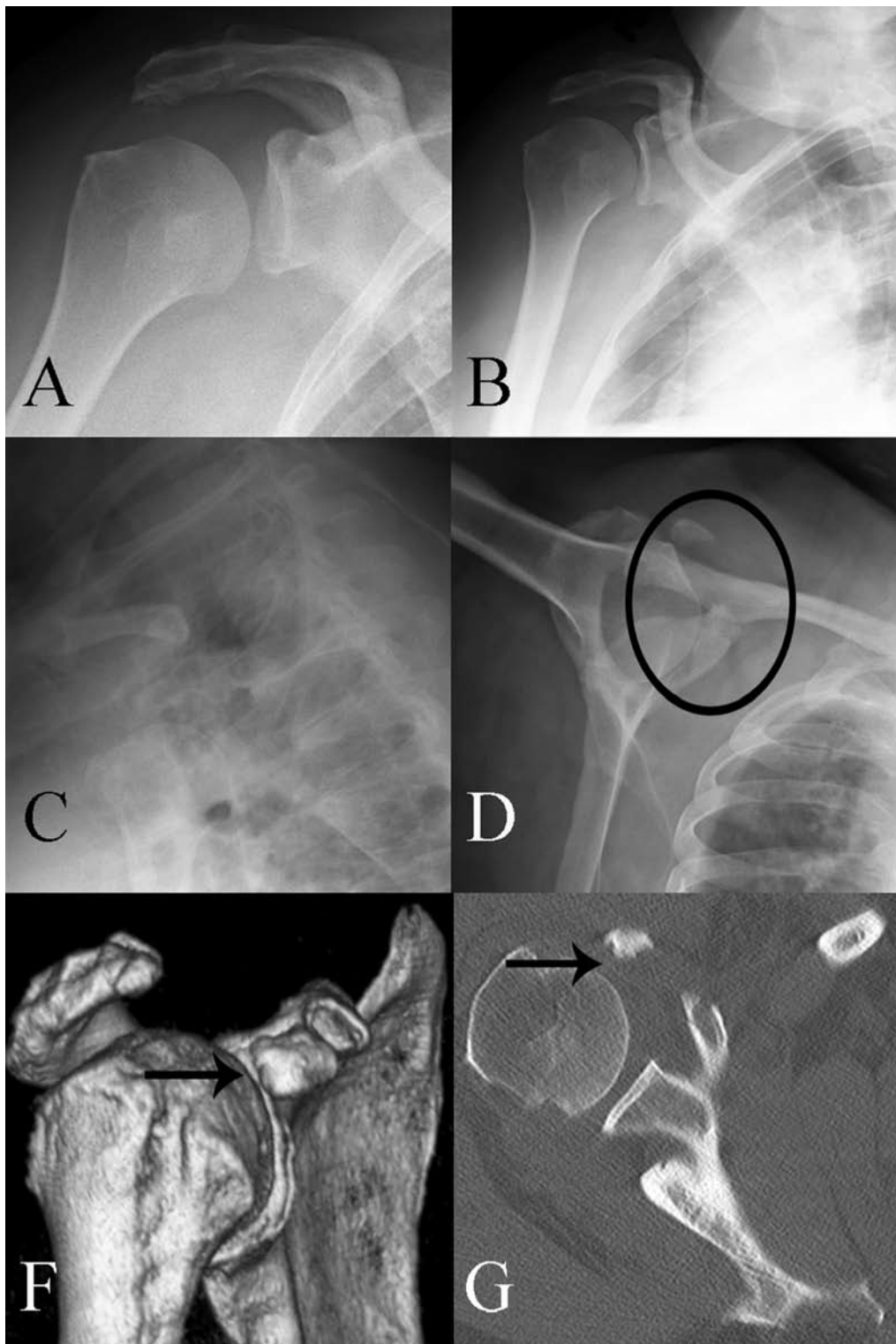


Figure 1. Type II right isolated coracoid fracture. A ,B, C, D: x-ray projection performed in the emergency care unit. In the circle fracture fragment considered as a calcification. E, F: TC scan performed after 25 days from traumatic event which demonstrated the fracture dislocated antero-inferiorly (arrows)

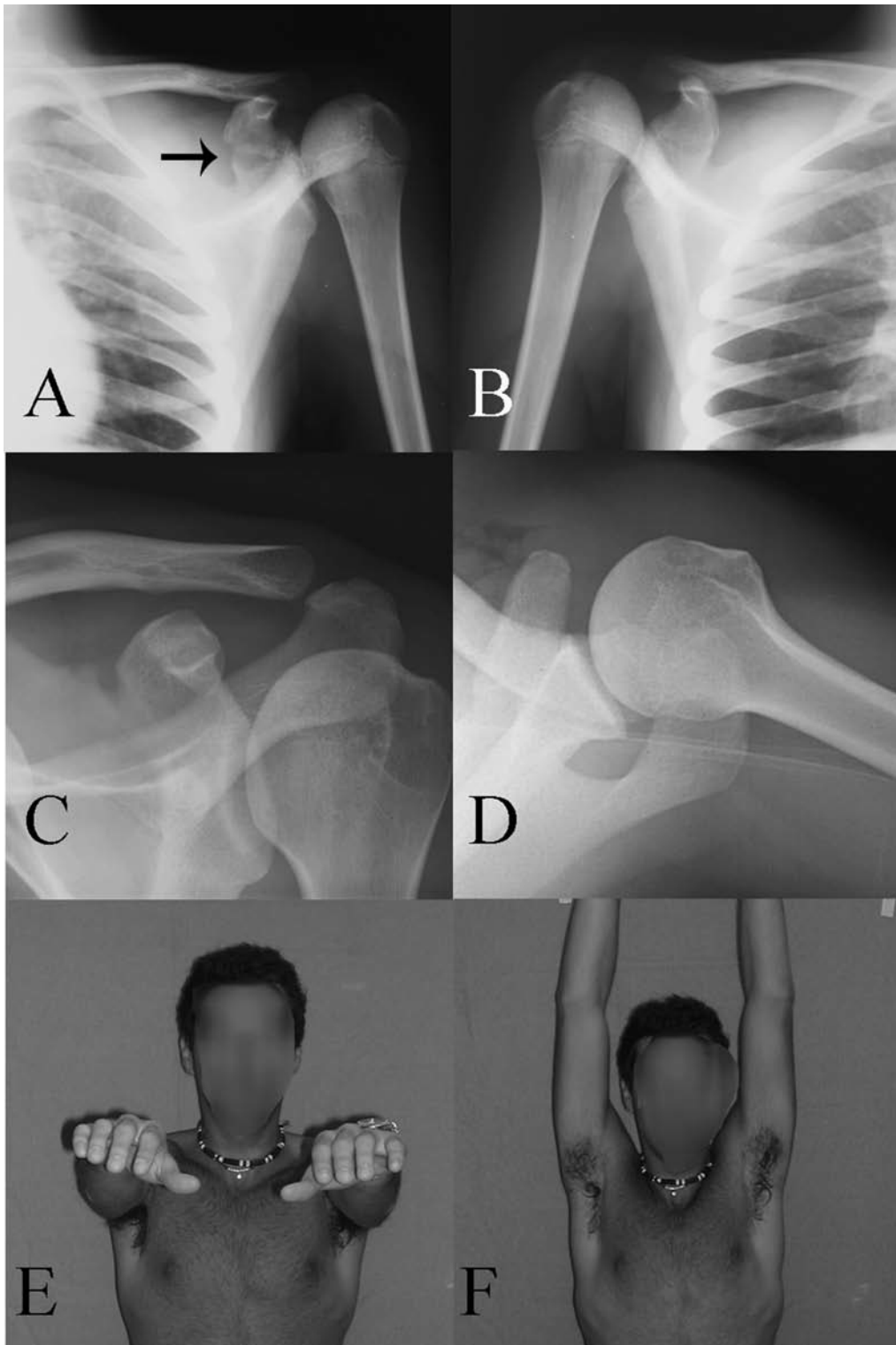


Figure 2. Type I left isolated coracoid process fracture in a 16 years old man. A: fracture of the basis diagnosed 8 days after trauma through Froimson coracoid view (arrow). B: contralateral x-ray. C, D: x-ray 22 years after trauma with fracture's consolidation. E, F: clinical outcome. Excellent result

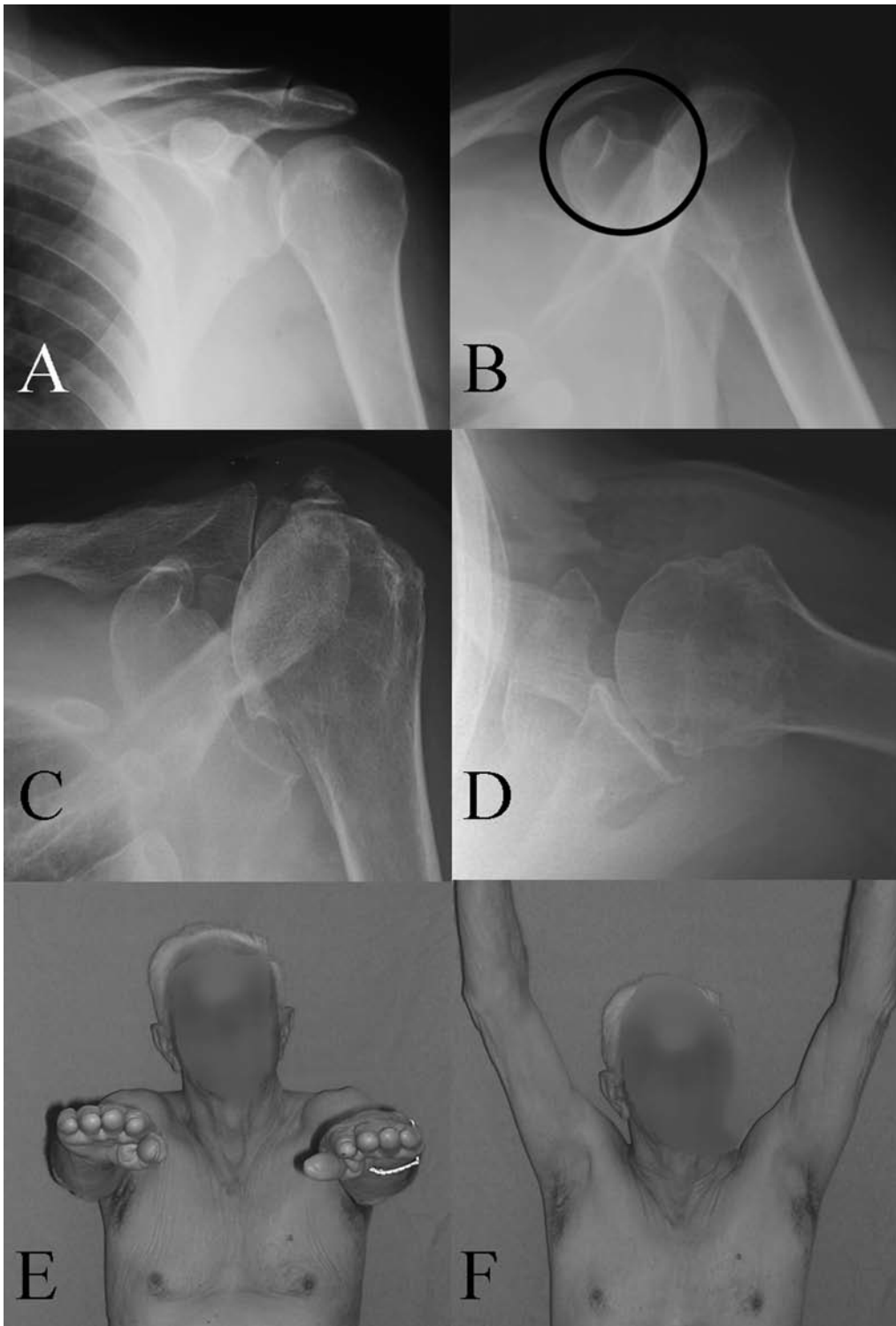


Figure 3. Type II left isolated coracoid process fracture in a 60 years old man. A, B: antero-posterior projection without evident fractures and fracture of the tip diagnosed 28 days after trauma through Froimson coracoid view (circle). C, D: x-ray after 26 years with fracture's consolidation and severe osteoarthritis. E, F: clinical outcome. Poor result according to HHS on the affected side despite good range of motion. Similar result was observed in the healthy side.

healed (Table 1). One type II dislocated fracture of the tip (Figure 1 and Table 1) diagnosed 25 days after trauma did not heal and evolved in non-union. In this case, despite the unsatisfactory orthopaedic result, the clinical outcome assessed 2 years after trauma was excellent with optimal shoulder function and without residual pain.

Discussion

The coracoid process is a fundamental component of the shoulder joint, as it unites the scapula to the clavicle and receives many of the upper limb and rib cage muscles.

Of all classifications of coracoid fractures (13), Ogawa's (18) represents the simplest and most frequently used. These fractures are divided in 2 types according to the location of the fracture in relation to the insertion of the coracoclavicular ligaments (CCL).

Type I fractures (proximal to the CCL) are seldom isolated and are more frequently associated with disruption of the relationship and function between the scapula and clavicle in one or more elements of the superior shoulder suspensor complex (SSSC) (29). It is believed that type I fractures usually occur following a blow to the lateral side of the shoulder even if direct impact of the humeral head on the coracoid process was never truly demonstrated (30). Instead, isolated fractures of the base can occur after a sudden muscular traction, while ligament avulsion mechanisms prevail in fractures associated to acromio-clavicular detachments or to fractures of the most lateral portion of the clavicle (31). Rarely isolated fractures of the coracoid are the consequence of an anterior direct trauma on the shoulder (14) or caused by a blunt object initially breaking the clavicle and ending its course on the coracoid process (32).

Type II fractures (distal to the CCL) are on the other hand rarer, always isolated and caused by muscle traction mechanisms.

There are also reports of stress fractures of the coracoid process in athletes of various sports (21) and of detachments of this process in young patients through centers of ossification (20), proving this shoulder structure to be highly solicited.

Coracoid fractures have been considered rare, representing only 2 to 7% of all scapular fractures (10, 11).

In reality, it is widely believed that isolated coracoid fractures are more frequent than what was believed in the past (1, 2) mainly due to improved diagnostic instruments and medical knowledge. Nonetheless, a good number of these isolated fractures remain undiagnosed or diagnosed during a second visit, as demonstrates the present study with 9 out of 19 cases of delayed diagnoses, considering that pain is low and unspecific, and also because these lesions are difficult to diagnose using routine radiographs.

Delayed diagnosis and treatment can lead to non-union or malunion resulting in unsatisfactory functional outcomes (2). On the exception of direct blunt trauma which leave a skin lesion over the site of fracture, most fractures of the coracoid process do not present superficial signs or symptoms that lead the physician to make the correct diagnosis, thus shifting it towards a more generic one of shoulder contusion. The deep location of the coracoid process and the body size of the patient can mislead the physician during examination. Although in isolated fractures localized swelling, provoked pain during resistive flexion and supination of the forearm and upon deep inspiration can all lead towards a correct diagnosis, much is left to the experience and intuition of the visiting physician. Additionally, type II fractures, which are usually isolated, are caused by smaller trauma events, and symptoms and dysfunction are seldom significant. In these cases, patients underestimate the gravity of the injury and seek treatment days or week later once the modest symptomatology becomes persistent such as 1 of the 2 cases of type II fractures which came to our attention after more than 25 days from injury.

Coracoid fractures, especially isolated and undisplaced ones, are seldom observable on routine plane radiographs performed in the emergency unit. Also, the presence of pain in the acute phase limits the number of optimal x-ray projections not allowing, for instance, to lift the arm above the head which exposes the coracoid process in radiograph views. Only some specific views (Froimson, anterior oblique and Y-scapular), which are normally obtained at a second vis-

it, allow to visualize the entire aspect of the coracoid process (14, 15, 33, 34).

Diagnosis is easier when coracoid fractures are associated to other lesions of the shoulder girdle. On x-ray projections, the normal spacing between the coracoid process and clavicle in the presence of an acromio-clavicular dislocation gives the physician the suspicion of a coracoid fracture, except in rare cases where there is also CCL rupture (1, 2). In these cases, an MRI or TC scan (35) are indicated in order to confirm the diagnosis of these complex combined injuries as well as to assess associated rotator cuff tears. Moreover TC-scan is used to confirm the diagnosis of isolated undisplaced fractures which are uncertain on conventional x-ray views (1, 2, 23, 29).

Conservative treatment is suggested for type II fractures and undisplaced or minimally displaced type I fractures, immobilizing the upper limb into adduction and with the elbow flexed at 90° using a gravity-free splint (1, 4, 23). Displaced Type I fractures and those associated to other lesions require surgery to re-establish the continuity between the clavicle and scapula and to restore the coraco-acromial arch (1).

Following these criteria, diagnosed lesions treated early result in good functional recovery (1, 2). The present series includes 9 cases of isolated coracoid fractures, diagnosed with a mean delay of 12 days from injury in the 7 cases of type I fractures and with a delay of more than 25 days in the 2 cases of type II fractures. In all cases patients requested medical attention with persistent local pain and limited range of motion, and all but 2 cases (TC-scan was needed) were diagnosed through specific coracoid radiograph views. Conservative treatment was used in all cases. The type I cases were immobilized in a gravity-free splint for 4 weeks followed by 2 weeks of gentle passive mobilization ending with active exercises. The 2 cases of type II fractures that came to our attention after 25 days from injury had a progressive spontaneous improvement, and considering the delay from injury, were not immobilized but immediately began rehabilitation. In the second of these type II cases (amateur wrestler), the diagnosis was initially a generic one of shoulder pain related to periarticular calcification. The fracture seemingly occurred proximally to the coraco-acromial ligament and produced a fragment which was then

pulled laterally and antero-inferiorly thus creating a conflict between the supraspinatus tendon, the small tuberosity and the sub-scapular tendon, generating symptoms typically related to sub-acromial conflicts (1, 2). This case was successfully treated with rehabilitation thus avoiding fragment removal. With the exception of the 2 cases of Type II fractures, all fractures in this series healed in its normal anatomical position. Functional recovery at mean follow-up of 13 years was satisfactory in all cases (mean Constant score: 88.77 vs 92.44 for the healthy side) except one, which was the first case of this series, with a low Constant score bilaterally, most likely due to the old age at the follow-up visit and development of osteoarthritis and rotator cuff tear independently from the coracoid fracture.

Conclusions

Isolated coracoid process fractures are more frequent than previously believed. Poor clinical examination, unspecific symptoms and non-prescription of specific coracoid radiographs can lead to a misdiagnosis or delayed diagnosis. In some cases the patient seeks medical attention only after several days or weeks of persistent symptoms, underestimating the gravity of the injury. Despite this, Type II fractures and Type I undisplaced fractures can be successfully treated conservatively even when the diagnosis is delayed. On the other hand, displaced Type I fractures require surgery whether they are treated acutely or chronically in order to re-establish the SSSC and the coraco-acromial arch which are mandatory for good functional recovery. When faced with a shoulder injury, the visiting physician must always suspect a coracoid process fracture and prescribe specific radiograph views to establish the correct diagnosis.

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