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Isolated fracture of the coracoid's process base 9-years after a Latarjet procedure: A novel case report

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Abstract
Coracoid fractures (CF) are relatively uncommon injuries and in most cases are associated with other concomitant lesions to the superior shoulder suspensory complex (SSSC). As far to the authors' knowledge, there are no reports of an isolated acute fracture of the base of the coracoid process, years after Latarjet procedure.
The authors present the case of a 51-year-old male and non-professional cyclist, with a history of left shoulder Latarjet procedure 9-years ago, sustained a high energy trauma to the left anterior shoulder. Imaging studies revealed a non-displaced fracture to the base of the reminiscent of the coracoid's process, without other associated injuries to the SSSC or to the coracoid's graft. A conservative treatment was approached. 1-year after CF, the patient is asymptomatic with CT scan confirming healing of the fracture in an adequate position.
Despite very rare, fracture of the reminiscent of coracoid process should always be ruled out after a direct high energy trauma to the anterior shoulder, in patients with previous Latarjet procedure.

Keywords: Coracoid fracture, Latarjet procedure, occult coracoid fracture

Introduction
Coracoid fractures (CF) are relatively uncommon injuries, with an estimated incidence of 2-13% of all scapular fractures that are reported in the literature [1-4]. These usually result from high-energy trauma to the shoulder girdle and, therefore, in most cases CF are associated with other injuries, including acromioclavicular (AC) or glenohumeral dislocation, clavicular fracture, proximal humerus fracture or rotator cuff tears. Isolated CF are even rarely reported [1-3, 5-7]. Additionally, as far to the authors knowledge, there are no reports of an isolated acute fracture of the base of the coracoid process 9-years after a Latarjet procedure.

Materials and Methods
The authors report the case of a 51-year-old male patient, manual worker, right-handed and non-professional cyclist, with a history of left anterior glenohumeral instability, clinically manifested with recurrent anterior dislocation and surgically treated with an open Latarjet procedure 9-years ago. Post-operative recovery underwent uneventful, with consolidation of the coracoid graft to the glenoid in an adequate position (Fig. 1 A-D). A pain-free, normal range of movement of the operated shoulder was re-established and the patient returned to the usual activities of daily life. There was no relapse of shoulder instability related-symptoms nor another dislocation episode.
5-years after Latarjet procedure, the patient sustained a fall from height, from which resulted a deviated middle third fracture of the left clavicle (Fig.2). There was no clinical or radiographic evidence of any associated injury to the rest of the shoulder girdle, including failure of the transferred coracoid's graft. The fracture was treated with open reduction and internal fixation with a plate and screws. At 3 months post-operative, consolidation of the clavicle fracture was achieved, and the shoulder returned to previous functional level by this time (Fig.3).
9-years after Latarjet procedure, the patient sustained another left shoulder trauma, this time from a fall during cycling, with a direct high-energy impact to the anterior left shoulder. He was observed in Shoulder Surgery outpatient consultation 2 weeks after trauma due to ongoing pain and function limitation of the affected shoulder. At physical examination, the patient present with a limited and painful anterior flexion, abduction and internal and external rotation of the shoulder.

Tenderness at coracoid process reminiscent and AC were present. Neurovascular examination of the left upper limb was normal. True anterior-posterior and scapular-Y views of the affect shoulder were performed. A non-deviated fracture of the base of the coracoid's reminiscent was noticed. No clear signs of osteoarticular injuries to the shoulder girdle were noticed upon radiographic study (Fig.4 A-B). Magnetic Resonance imaging (MRI) was undertaken to exclude acute rotator cuff tears or other associated injuries to the superior shoulder suspensory complex (SSSC) structures. MRI confirmed a minimally deviated fracture of the base of the reminiscent coracoid process, associated with surrounding bone edema, suggesting an acute fracture (Fig.5-A). There was no associated rupture of the CCLs or other lesions to the SSSC (Fig.5-B). There were no abnormal findings regarding the glenohumeral joint nor any associated rotators cuff lesion. There were no traumatic complications to the consolidated coracoid's graft in the glenoid.

Results

The fracture was then classified as an isolated CF Owaga type 1, Eyers type 3. A conservative treatment approach was undertaken. It consisted of 6 weeks in an arm sling, followed by passive and active assisted range of movement. Strength exercises were initiated at 3 months.

At 1-year after CF, the patient presents with a normal active range of movement (AROM) of the left shoulder, pain-free, and returned to normal activities of daily life (ADL) with CT scan confirming healing of the fracture in an adequate position (Figs. 6 and 7).

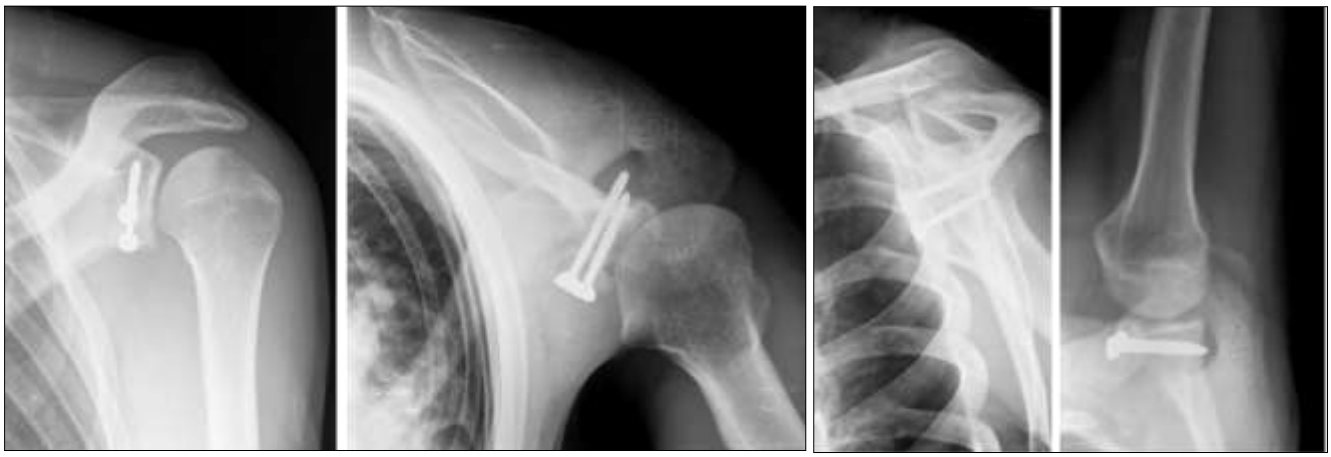

Fig 1 (A-D): Radiographic post-operative evaluation at 3 months after Latarjet procedure. The coracoid's graft has consolidated in adequate position to the anteroinferior glenoid surface. No complications were found. Fig.1-A: true anterior-posterior view. Fig.1-B: Y-scapular view. Fig.1-C: axillary view, Fig.1-D: Lamy view

Fig 2: Middle third fracture of the left clavicle, 5-years after Latarjet procedure. There is no evidence of another osteoarticular lesions to the SSSC.

Fig 3: Radiographic study 3 months after clavicle fracture osteosynthesis showing consolidation of the fracture.

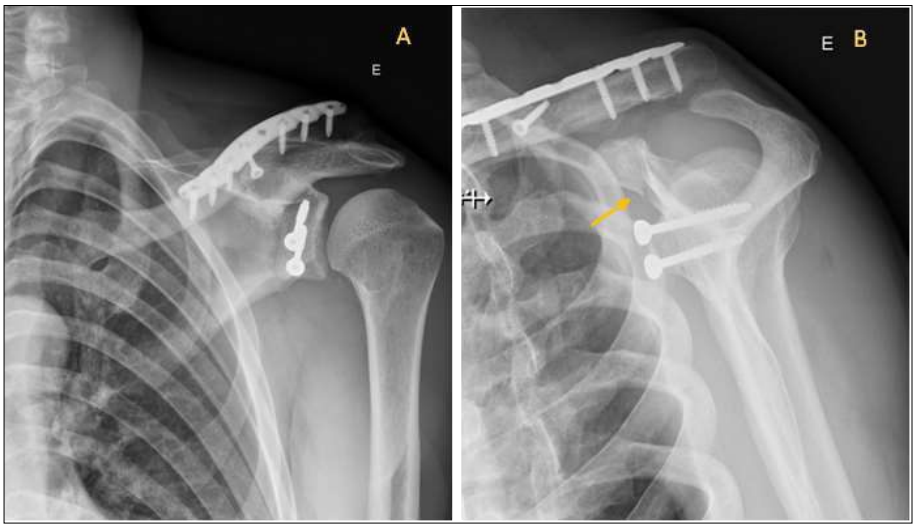

Fig 4: Fracture of the coracoid at the base, Owaga type 1, Eyers type 3 (arrow). Fig 4-A: True Anterior-Posterior View. Fig 4-B: Y-Scapular view.

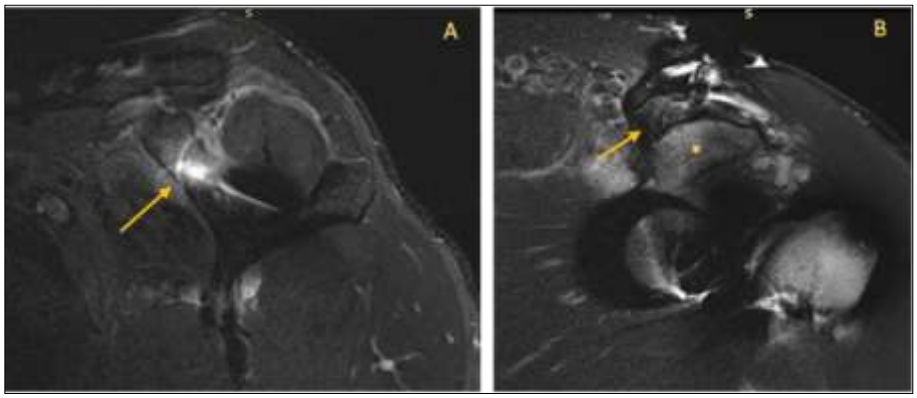

Fig 5: Magnetic Resonance Imaging. Fig. 5-A: acute isolated fracture of the coracoid's reminiscent at the base (arrow), with surrounding bone edema in T2 weighted imaging. Fig.5-B: integrity of coracoclavicular ligaments (arrow), which remain attached to the avulsed fragment (*).

Fig 6: Left shoulder active range of movement 1 year after coracoid's fracture.

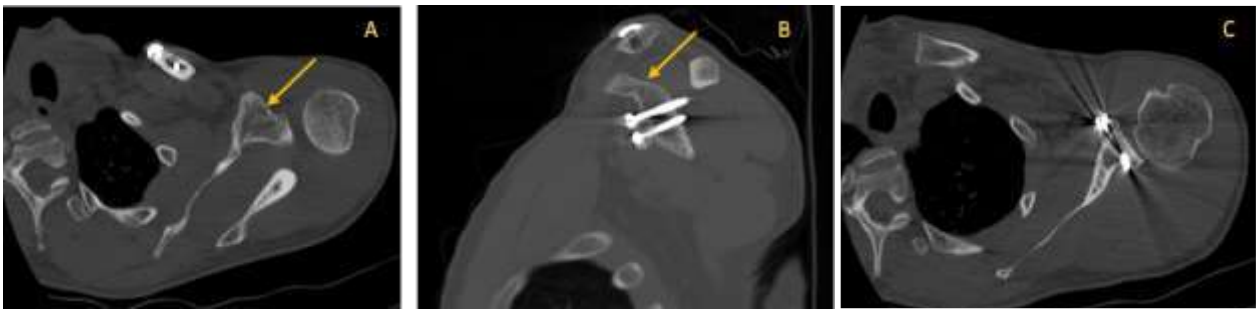

Fig 7: CT scan confirming consolidation of the fracture of the coracoid's reminiscent in an adequate position at 3 months after injury (arrow, A - axial view, B - sagittal view). Bone graft is consolidated in correct position to the glenoid surface, with no associated complications (C).

Discussion

Coracoid process fractures represent approximately 1% of all fractures, 3%-5% of fractures of the shoulder girdle and specifically 2–13% of all scapula fractures [1, 2, 6, 7]. These incidences may be underestimated since specific coracoid process views at plain radiographs and/or computed tomography and magnetic resonance imaging are required for the diagnosis and, therefore, a high index of suspicion is necessary upon initial evaluation [2, 3, 6]. Ogawa *et al*. 2019, conducted the largest systematic review on the subjected, including 97 articles (197 patients). It was verified that CF usually occurs in younger active patients (average age of 37.0±16.9 years (12– 85 years, n=164), and commonly result from high energy trauma, including traffic accidents (41%, n=67), fall/fall from a height (34%, n=55), and sports activities (15%, n=24). According to different series, acute CF occur mostly in male patients (80-84%) [2, 6].

The most used classification of CF is the Ogawa's functional classification which divides CFs in 2 types regarding their relationship to the coracoclavicular ligaments insertion site at the coracoid process. A fracture located proximal to the coracoclavicular ligaments is classified as type I, whereas a type II fracture is distal to the coracoclavicular ligaments. An atypical pattern is an avulsion-fracture at the angle of the coracoid (at the insertion foot print of CC ligaments). Avulsion-fractures at the angle are functionally classified as type I CF as there is a disruption of the scapuloclavicular connection [3, 5, 6].

According to Owaga *et al*. (2019), the Ogawa type 1 CFs are the most commonly found, occurring in 77% of the cases. The prevalence of type 2 CF and avulsion-fractures were 19% and 5%, respectively [3]. Depending on the type of CF fracture, there may be high risk of associated injuries to the SSSC. The most frequently associated injury is AC dislocation (17.6-33%), followed by clavicle fracture (17%) and, more infrequently, scapular neck fracture, acromion/scapular spine fractures and CCL tear [2, 3, 5, 6]. The disruption of the SSSC may be isolated, double or at multiple sites. Anterior glenohumeral dislocation, proximal humerus fracture and rotators cuff tears occurring in association to CF have also been reported [2, 3]. Regardless of the type, in most cases CF are associated with other injuries to the shoulder girdle, up to 66% [2, 6]. Owaga type 1 and avulsion-fractures at the angle were the most associated with concomitant injuries to the SSSC (up to 70%), especially AC injury [2-4 6]. Therefore, CF must be excluded whenever an AC injury is diagnosed [4]. More infrequently, CF may occur in isolation and, in this instance, most are Ogawa type 2 fractures. However, when associated with other shoulder girdle injuries, Ogawa type 2 CF more frequently occur in the context of anterior glenohumeral instability. Anterior glenohumeral instability is present in approximately 8% of CF, and only 28% are Owaga type 1 CF. [2 3].

The mechanism of CF is poorly understood. The most accepted is eccentric forceful traction force due to muscle (conjoint tendon and pectoralis minor) and/or CCL attachments pull, or due to high-energy direct impact, with the first one often being isolated CF and the last one being more associated with other concomitant SSSC injuries. It is believed that fractures at the angle depend more on forceful traction of CCL, whereas fractures at the base or tip are more associated with forceful traction from the attached muscles, with CCL traction playing a more secondary role. [3, 6].

Due to the high prevalence of associated shoulder girdle injuries, CF are frequently overlooked [1, 2, 6]. Physical examination findings may be nonspecific and are often masked by associated injuries. Isolated CF typically present with pain and tenderness to palpation over the coracoid

process [1, 2, 6]. Shoulder movements may also be actively limited and painful. Neurovascular examination is usually normal [6].

In suspicion of an acute CF, true anterior-posterior, scapular-Y, and axillary lateral views are mandatory. Oblique views are necessary to visualize fracture of the base of the coracoid (Eyers type 3). MRI or CT scan are necessary to diagnose occult fractures, for fracture characterization and for non-union diagnosis [5, 6].

There is paucity in literature regarding the treatment of CF and, therefore, there is no established treatment algorithm. The treatment of CF is dependent on the fracture type and the overall instability of the fracture [2, 3, 5, 6].

It has been generally accepted that isolated non-displaced or minimally displaced (<1cm) CF fractures, regardless of the Owaga type, should be treated conservatively [1, 6].

Owaga *et al*. (2019) stated that 71% (n=19) out of 27 conservatively treated isolated Owaga type 1 fractures achieved good to excellent results, even in the presence of a established non-union. In most non-union cases, these were asymptomatic [3]. These findings are in line with those found by van Doesburg *et al*. (2020) after systematically reviewing 110 CF. In their study, 11 patients with Owaga type 1 fractures conservatively treated (4 of them had multiple disruptions of the SSSC), with all patients achieving coracoid fracture consolidation and excellent functional results. In those 4 cases of Owaga type 1 fracture associated with multiple SSSC disruption conservative treatment was decided if no marked displacement or instability was present [2].

Since the vast majority of CF are Ogawa type I and most of these are associated with double or multiple disruptions of the SSSC, it has become more recently recommended in literature a surgical approach to such injuries, as in the absence of an adequate internal fixation, there is a high risk of a painful and debilitating coracoid's non-union, especially in those engaging in heavy lifting or overhead work [2, 3]. According to Owaga *et al.* (2019), 73% of Owaga type 1 with double or multiple SSSC disruptions were surgically treated, and almost all patients were classified with excellent and good outcomes at follow-up [3]. Also, van Doesburg *et al.* (2020) reported in their systematic review that 73 cases (66%) of Owaga type 1 were associated with multiple disruptions of the SSSC, being most of them surgically treated, with good clinical results at follow-up [2]. In contrast, it has also been described an algorithm that first addresses the stabilization of other SSSC disruptions in acute setting. This strategy allows an indirect reduction of CF throw ligamentotaxis. If the coracoid's fragment remains deviated, open reduction with internal fixation is warranted. If non-displaced or minimally displaced, CF may not be fixated and surgical treatment of CF is only indicated if symptomatic nonunion subsequently occurs [3]. In fact, in Owaga *et al*. study (2019), 4 patients with a nondisplaced Ogawa type 1 fracture and a double disruption of the SSSC were treated conservatively, with excellent outcomes in all at follow-up [3]. Therefore, a conservative treatment may be appropriate in specific cases of Ogawa type 1 fracture with nondisplaced double disruptions of the SSSC [2, 3].

Regarding Owaga type 2 fractures, Owaga *et al*. (2019) reported good results with conservative treatment even if the fracture is deviated, provided that subscapularis/subcoracoid impingement is excluded [1, 3]. In van Doesburg *et al*. (2020) study, 14 patients were classified as Owaga type 2 fracture (with only 2 of them having multiple SSSC disruption) and 64% (n=9) were treated conservatively. All but 1 patient had good clinical results. Out of the 9 patients conservatively treated, 5 non-unions were reported, but all were asymptomatic [2].

Based on both large reviews, a conservative treatment approach appears to be an adequate strategy for the treatment of all Ogawa type II fractures and isolated type I fractures without associated disruptions of the SSSC. Surgical treatment is reserved to type 1 fractures with double or multiple disruptions of SSC or symptomatic non-unions [1-3, 6].

To our knowledge there are no reports in the literature of an acute isolated Ogawa type 1 fracture at the base of coracoid years after a Latarjet procedure. Coracoid fractures associated with Latarjet procedure usually occur intra-operatively and are associated with graft preparation [8].

As said, fractures at the base of the coracoid process (Ogawa type 1, Eyers type 3) are believed to occur due to forceful eccentric contraction of the conjoint tendon. Because our patient had a previous Latarjet procedure, this may not be the actual mechanism of this specific lesion. Our hypothesis is a direct high-energy impact over the anterior shoulder after fall during cycling and, to a lesser degree, from CCL forceful pull (which MRI confirmed to be intact). The fact that there are no muscle insertions to the coracoid in our patient might explain the minimal deviation of the fracture and the higher exposition of the coracoid reminiscent to direct impact.

There was no evidence of associated disruptions of SSSC at another site upon imaging studies. Also, the patient was not a heavy manual worker nor a professional athlete. The fracture was classified as an isolated Owaga type 1 fracture. Therefore, conservative treatment was undertaken with fracture healing and excellent clinical results at 1-year follow-up.

Conclusion

In conclusion, although extremely rare, fractures at the base of the reminiscent coracoid process may occur in patients submitted to Latarjet procedure after a high energy direct impact to the anterior shoulder. This type of injury may be overlooked, since standard shoulder radiographic views may appear normal. If high index of suspicion at clinical examination, special coracoid radiographic views, MRI and/or CT scan in acute setting should be performed.

Conflict of Interest

Not available

Financial Support

Not available

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