Repair of an Isolated Coracoid Fracture With Suture Anchor Fixation

Nicholas I. Kennedy, M.D., Márcio B. Ferrari, M.D., Jonathan A. Godin, M.D., M.B.A., George Sanchez, B.S., and CAPT Matthew T. Provencher, M.D., M.C., U.S.N.R.

Abstract: Coracoid fractures are rare injuries, which may occur in isolation or in association with other shoulder pathology. The mechanism of trauma consists of a strong contraction of the conjoint tendon as a result of direct trauma. The diagnosis is usually difficult and many times overlooked, thereby requiring a high level of suspicion. In many cases, standard trauma series shoulder radiographs are unable to provide a definitive and reliable diagnosis. Therefore, other imaging modalities may be necessary to confirm the diagnosis. Although uncommon, if left untreated, a coracoid fracture will result in chronic pain and shoulder disability. Both conservative and surgical techniques have been previously reported and shown positive outcomes. In regard to the surgical technique, most reports describe the use of screw fixation, which has been associated with full recovery and high patient satisfaction. Nevertheless, the purpose of this Technical Note is to describe our preferred method to treat an isolated type II displaced coracoid process fracture through suture anchor fixation.

Coracoid fractures are uncommon injuries and usually seen in the setting of a traffic accident or fall. Although isolated coracoid fractures have been reported in the literature, these injuries are often associated with concomitant soft tissue and/or osseous shoulder injuriess.[1] Specifically, coracoid fractures are often accompanied by injuries to the superior shoulder suspensory complex.[2,3]

There are a few classification systems used for coracoid fractures. Eyres et al.[4] classified the coracoid fractures into 5 groups. As part of this system, type I fractures are described as a tip or epiphyseal fracture, type II as a mid-process fracture, type III as a basal fracture, type IV as a fracture extending to the superior body of the scapula, and type V as a fracture that extends to the glenoid fossa. A more commonly used classification system was described by Ogawa et al.,[5] which differentiates fractures according to the relation with the attachment of the coracoclavicular ligaments. A fracture located proximal to the coracoclavicular ligaments is classified as type I, whereas a type II fracture is distal to the coracoclavicular ligaments.[1]

The treatment of a coracoid fracture is dependent on: (1) fracture type and (2) overall instability of the fracture. The majority of type I (Ogawa classification) fractures are associated with a disruption of the superior shoulder suspensory complex, which may cause a delay in healing and typically requires definitive surgical fixation.[2,5] Ogawa et al.[5] showed that these injuries, when treated with open reduction and internal fixation (ORIF), have a contact score ratio of $93\% \pm 7.4\%$.

Although there remains debate regarding the optimal treatment of type II fractures of the acromioclavicular joint,[6,7] the treatment of an isolated type II coracoid fracture features much less debate. Nondisplaced and minimally displaced type II fractures should be treated conservatively,[8,9] whereas displaced fractures often require ORIF. The purpose of this Technical Note is to
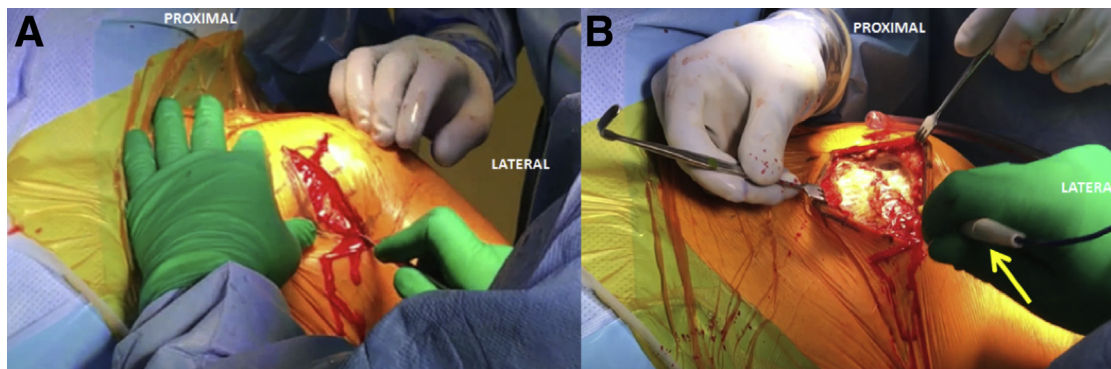
Fig 1. With the patient in a beach chair position, the coracoid process is palpated and a 5- to 7-cm incision is performed following the deltopectoral approach in the left shoulder (A). A coagulator (yellow arrow) and Metzenbaum scissors are used for blunt dissection of the subcutaneous tissue (B).

describe our preferred method to treat an isolated type II displaced coracoid process fracture through suture anchor fixation.[10,11]

Surgical Technique

A video overview of this technique with narration is provided (Video 1).

Patient Positioning and Anesthesia

The patient is placed in the supine position on the operating table and general anesthesia is used for induction. Single shot or catheter infusion regional anesthesia may be used as well. The patient is then brought into the beach chair position with care taken to pad all bony prominences. Moreover, the head and neck positioning should be carefully assessed before starting the procedure. We do not use an arm positioner; rather, the operative extremity is draped free with a well-padded Mayo placed under the elbow.

Objective Diagnosis

Preoperative evaluation should start with a thorough history and physical examination. Diagnostic imaging should consist of shoulder radiographs to assess for concomitant osseous abnormality, including fracture extension into the glenoid. Computed tomography scan allows for detailed evaluation of fracture displacement, orientation, and possible comminution. Magnetic resonance imaging of the shoulder is useful to evaluate for any concomitant loose bodies, labral, chondral, or other soft tissue injuries.

Operative Technique

General endotracheal anesthesia may be combined with regional nerve blocks to maximize postoperative pain control. Perioperative antibiotic prophylaxis is administered intravenously before incision. A diagnostic arthroscopy is usually conducted first to directly visualize the chondral surfaces, glenoid labrum, biceps tendon, and rotator cuff. An extensive debridement of the rotator interval, as well as posterosuperior and anterosuperior synovitis, is conducted with a 4.0-mm shaver and radiofrequency device (Coblator Wand, Smith & Nephew, Andover, MA) through a 5-mm cannula (Low Profile Cannula, Arthrex, Naples, FL). Any concomitant arthroscopic procedures are carried out at this time.

The open coracoid fracture fixation is begun with a deltopectoral approach using an approximately 5-cm
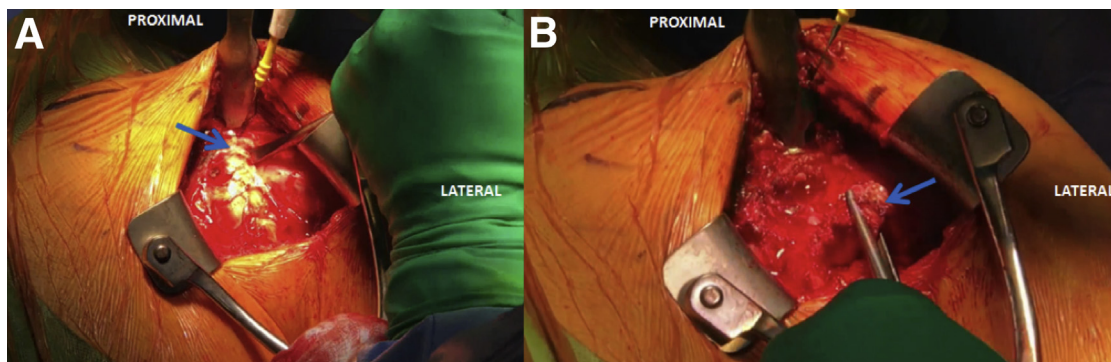

Fig 2. The identification of the conjoint tendon (A) is key to the localization of the coracoid fragment (blue arrows), especially in chronic cases with significant scar tissue formation. Once identified, the conjoint tendon is released from all adhesions, as shown in the left shoulder (B).
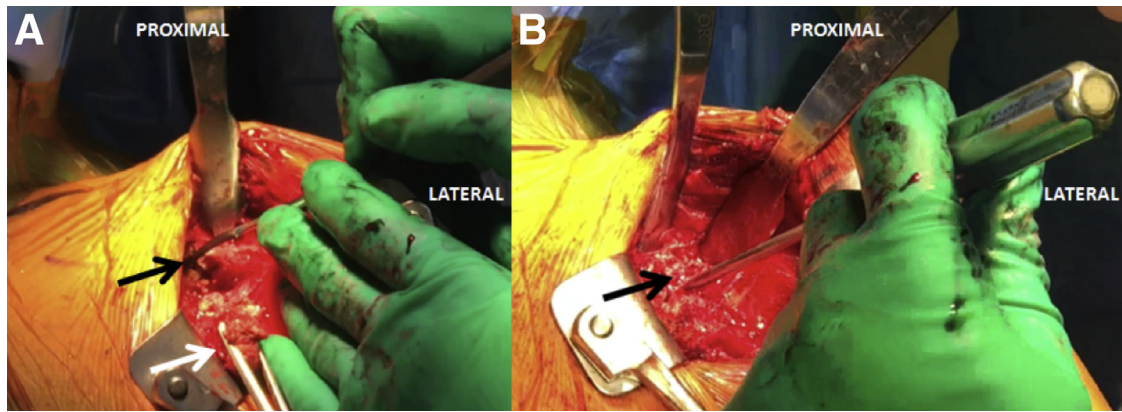
Fig 3. Once the coracoid fragment is identified and prepared, attention is turned to the preparation of the coracoid base (black arrow) in the left shoulder. An osteotome (A and B) is used to remove all bony spikes and scar tissue formation to provide an optimal surface for the coracoid fragment fixation.

skin incision (Fig 1). Subcutaneous flaps are created medially and laterally, and then the cephalic vein is mobilized laterally. The clavipectoral fascia is incised proximally to the coracoid. Throughout the procedure, the axillary and musculocutaneous nerves are protected with careful retraction. In this case, as a chronic injury, the coracoid fracture has healed in a displaced position 3 cm inferior with posterior angulation, thereby leading to impingement on the subscapularis. A combination of a standard bovie and periosteal elevator is used to isolate the fracture fragment, which measures approximately 5 mm of the tip of the coracoid (Fig 2). The fracture ends are subsequently prepared with a combination of an osteotome (Fig 3), rongeur, and bone rasp (Fig 4).

Next, a musculocutaneous nerve neurolysis is conducted with Metzenbaum scissors to free up the nerve from the adjacent scar tissue surrounding the subscapularis, pectoralis minor, and conjoint tendon. Thereafter, a suture anchor (6.5-mm SwiveLock double-loaded with FiberTape, Arthrex) is placed in line with the intramedullary canal of the coracoid. The 2 suture tapes are then whipstitched through the fracture fragment and conjoined tendon and secured using a zip tie technique (Fig 5). Supplemental fixation is then achieved with 2 additional suture anchors (3.0-mm BioComposite SutureTak anchors, Arthrex) loaded with suture tape (FiberTape, Arthrex). One anchor is placed medially on the coracoid, whereas the other is placed laterally. The suture tapes from these anchors are used to reduce the conjoined tendon in a tension slide technique. Once fixation is complete, the coracoid is palpated to verify a strong final fixation (Fig 6). The advantages and disadvantages as well as pearls and pitfalls associated with this technique are listed in Tables 1 and 2, respectively.
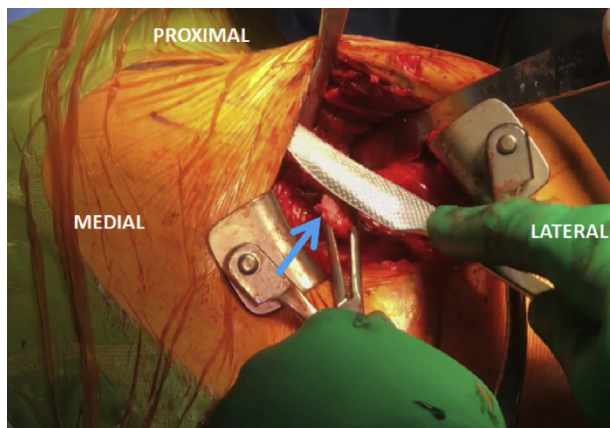

Fig 4. To ensure a flat surface in apposition to the base of the coracoid in the left shoulder, a rasp is used to remove all sharp bony structures on the coracoid fragment (blue arrow). It is also important to remove all scar tissue formation to ensure optimal healing to the native coracoid.
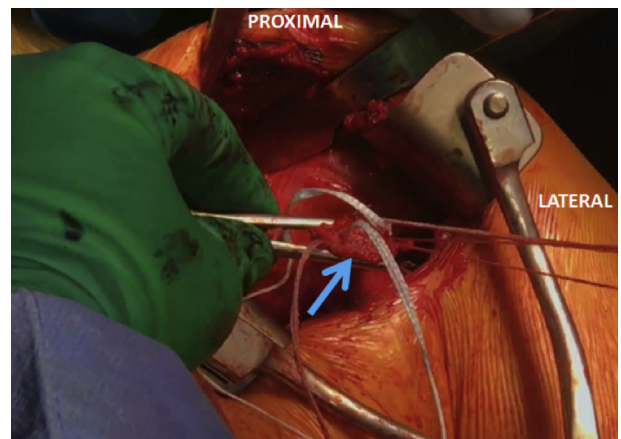

Fig 5. Two FiberTape sutures are used to secure the coracoid fragment (blue arrow) to the base of the coracoid in the left shoulder. The FiberTape sutures are passed into the bony fragment. Care must be taken to avoid a potential fracture of the fragment during suture passage.
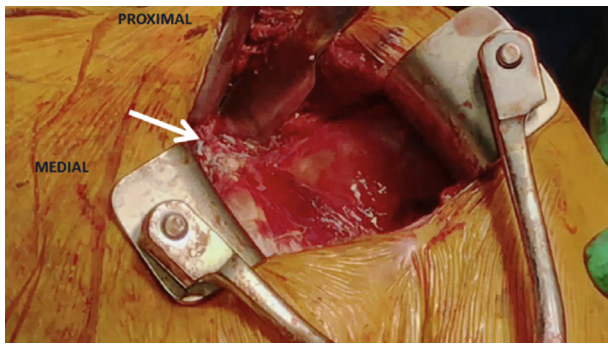
Fig 6. The final fixation of the coracoid fragment (white arrow) in the left shoulder is shown. Note the anatomic fixation to the coracoid base leading to an anatomic restoration.

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
Diagnostic arthroscopy allows for further diagnosis and also debridement before the open approach	Open fixation leads to increased inflammation and swelling and can cause arthrofibrosis and stiffness
Localization and lateralization of the cephalic vein helps to avoid iatrogenic damage and minimize bleeding	Brachial plexus injuries associated with initial injury are usually not able to be improved
Identification and release of the musculocutaneous nerve is paramount to prevent postoperative nerve palsy	

Postoperative Rehabilitation

The patient is placed in a padded abduction shoulder sling at the end of the procedure. The sling, along with limits to 30° external rotation, 60° abduction, and 90° forward flexion, is continued for 6 weeks postoperatively. No resisted elbow flexion or weight bearing is allowed for 6 weeks postoperatively. After 6 weeks, the patient may begin progressive active range of motion without limitations and strengthening. A return to full activity is allowed at 3 to 4 months postoperatively. Postoperative radiographs are taken at 3 to 4 months after surgery to ensure a successful surgical outcome (Fig 7).

Discussion

Coracoid fractures are rare and seen mainly in males; ultimately, these fractures account for roughly 3% to 13% of all scapula fractures and only 2% of all isolated scapula fractures.[12,13] The injury mechanisms described can vary from strong contraction of the conjoint tendon to direct trauma. Although commonly seen in the presence of another shoulder injury, coracoid fractures may also occur in isolation. A coracoid fracture may be overlooked if using only a conventional radiographic examination. Furthermore, recurrent shoulder instability can occur because of coracoid fractures. Ogawa et al. reported a high incidence of associated injuries with coracoid fractures.[1] These associated injuries included acromioclavicular dislocations, fractures of the superior scapular margin, clavicular and/or acromial fractures, scapular spine fractures, rotator cuff tears, anterior shoulder dislocations, and glenoid rim and proximal humeral fractures. Given that a coracoid fracture may be seen in the presence of such a wide variety of other injuries, a high level of clinical suspicion is needed to detect these injuries. Of all these associated injuries, rotator cuff tears and anterior shoulder dislocations were only seen in association with type I fractures only, whereas clavicular fractures were only seen in the presence of type II fractures.

Both conservative treatment and surgical treatment have been previously described in the setting of a coracoid injury with each treatment type showing positive outcomes. Martin-Herrero et al.[8] described 7 cases in which conservative treatment was successful with high patient satisfaction. Eyres et al.[4] also found a return in normal shoulder function after conservative treatment through the use of a broad arm sling and early shoulder mobilization, thereby suggesting that even displaced type I, II, or III may be treated conservatively. Ogawa et al. treated almost all type I fractures through ORIF using a malleolar screw, whereas type II fractures were treated through conservative measures.[1]
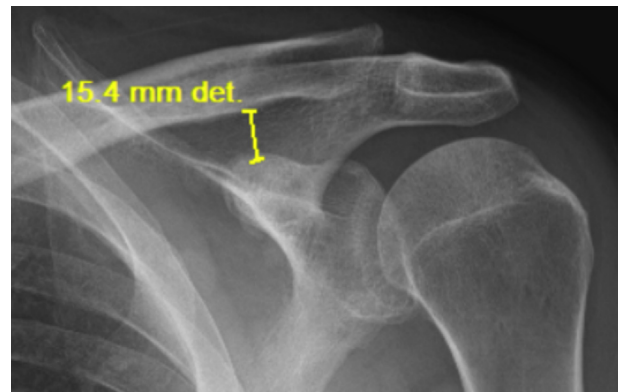
Table 1. Advantages and Disadvantages

Advantages	Disadvantage
Addresses the pain and instability associated with a displaced fragment	May lead to arthrofibrosis and stiffness
Helps to increase function	

Fig 7. Postoperative anteroposterior radiograph of the left shoulder at approximately 4 months after surgery, showing appropriate reincorporation of the coracoid process. An approximate distance of 15.4 mm between the coracoid process and clavicle is measured.

The authors found no statistical significant differences between conservative and surgical treatment with an overall reported "excellent" result in 87% patients at a mean follow-up of 37 months. Given these findings, the authors suggest that conservative treatment should be especially considered in type II fractures. Although conservative treatment has shown positive outcomes, indications for surgery include ≥ 1 cm displacement, nonunion, and gross instability.

The described technique is based on the use of suture anchor fixation instead of screw fixation to successfully complete the reattachment of the displaced coracoid fragment. Although we recommend the above technique, future long-term studies involving patient-reported outcome measures after surgery are necessary for the assessment and validation of the technique.

References

1. Ogawa K, Yoshida A, Takahashi M, Ui M. Fractures of the coracoid process. *J Bone Joint Surg Br* 1997;79:17-19.
2. Goss TP. Double disruptions of the superior shoulder suspensory complex. *J Orthop Trauma* 1993;7:99-106.
3. Goss TP. The scapula: Coracoid, acromial, and avulsion fractures. *Am J Orthop (Belle Mead NJ)* 1996;25:106-115.
4. Eyres KS, Brooks A, Stanley D. Fractures of the coracoid process. *J Bone Joint Surg Br* 1995;77:425-428.
5. Ogawa K, Matsumura N, Ikegami H. Coracoid fractures: Therapeutic strategy and surgical outcomes. *J Trauma Acute Care Surg* 2012;72:E20-E26.
6. Smith D. Coracoid fracture associated with acromioclavicular dislocation. *Clin Orthop Relat Res* 1975;108:165-167.
7. Wilber MC, Evans EB. Fractures of the scapula. An analysis of forty cases and a review of the literature. *J Bone Joint Surg Am* 1977;59:358-362.
8. Martin-Herrero T, Rodriguez-Merchan C, Munuera-Martinez L. Fractures of the coracoid process: Presentation of seven cases and review of the literature. *J Trauma* 1990;30:1597-1599.
9. Carr AJ, Broughton NS. Acromioclavicular dislocation associated with fracture of the coracoid process. *J Trauma* 1989;29:125-126.
10. Subramanian AS, Khalik MA, Shah MM. Isolated fracture of the coracoid process associated with unstable shoulder. *ANZ J Surg* 2007;77:188-189.
11. Guiral J, Real JL, Curto JM. Isolated fracture of the coracoid process of the scapula. *Acta Orthop Belg* 1996;62:60-61.
12. McGinnis M, Denton JR. Fractures of the scapula: A retrospective study of 40 fractured scapulae. *J Trauma* 1989;29:1488-1493.
13. Gil JF, Haydar A. Isolated injury of the coracoid process: Case report. *J Trauma* 1991;31:1696-1697.