

# Ipsilateral Nonunions of the Coracoid Process and Distal Clavicle

## A Rare Shoulder Girdle Fracture Pattern

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### Abstract

*Coracoid fractures are uncommon injuries, in isolation or in association with other osseoligamentous injuries about the shoulder girdle. We report a case of successful operative management of symptomatic ipsilateral nonunions of a type I coracoid base fracture and a lateral one-third clavicular fracture, which developed following nonoperative treatment of this exceedingly rare injury pattern. Following open distal clavicle excision and reduction of the coracoclavicular interval with screw fixation, radiographic union and excellent clinical outcome were achieved. This rare and potentially troublesome injury pattern is discussed, and the literature regarding ipsilateral coracoid and osseoligamentous injuries about the shoulder is reviewed.*

A 40-year-old healthy, right-hand dominant female presented to our institution with persistent right shoulder pain 6 months following a low-energy fall at home. Radiographs and computed tomography (Fig. 1) obtained at the time of the initial injury at an outside institution revealed ipsilateral fractures of the lateral one-third of the clavicle and coracoid base. Initial nonoperative treatment

of these shoulder girdle fractures, with sling immobilization followed by a course of physical therapy, had failed to relieve her symptoms. Upon presentation to our institution, she described severe, generalized right shoulder pain, limiting her motion and her ability to perform activities of daily living.

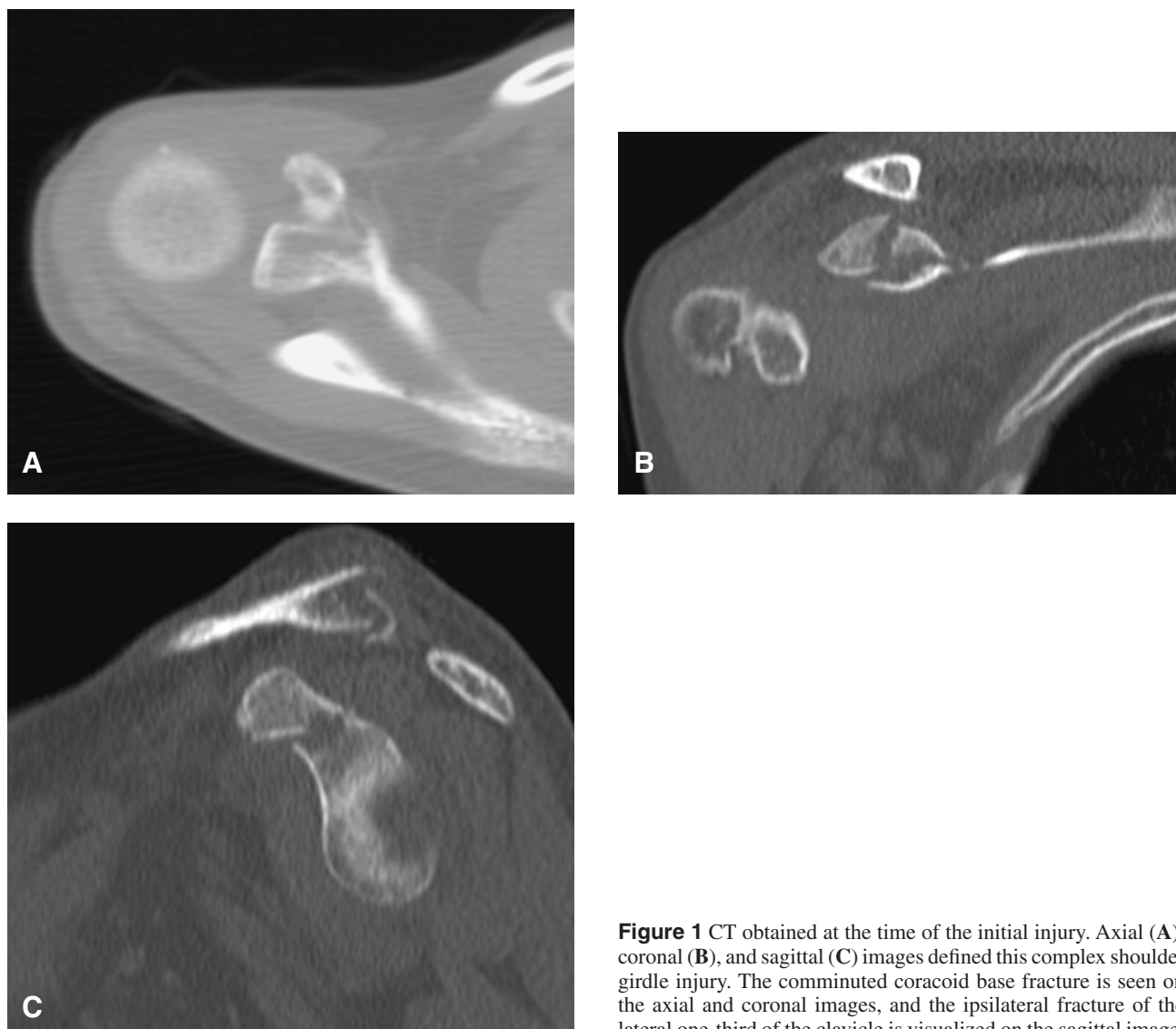
Examination of the right shoulder was significant for tenderness and deformity along the distal clavicle and pain with palpation over the coracoid process. Range of motion, limited by pain in all planes, consisted of 45° of active forward elevation and 95° of passive forward elevation, 45° of active external rotation, and internal rotation to the sacrum. Manual muscle testing of the rotator cuff revealed full abduction and external rotation strength.

Imaging obtained (Fig. 2) 3 months following the initial injury revealed ipsilateral nonunions of a comminuted type I coracoid base fracture (i.e., primary fracture line extending behind the origin of the coracoclavicular ligaments)<sup>1</sup> and the lateral one-third clavicular fracture. Superior displacement of the medial clavicular fracture fragment persisted and the distal clavicular nonunion was located distal to the insertion of the coracoclavicular ligaments (Neer type III fracture).<sup>2</sup>

Given persistent pain, limitations in activities of daily living, and radiographic evidence of ipsilateral distal clavicle and coracoid base nonunions with disruption of the coracoclavicular interval, the patient was indicated for operative intervention. A strap incision extending from the distal clavicle to the coracoid process was utilized. The deltoid-trapezial interval was incised longitudinally over the superior surface of the clavicle and the coracoid base was exposed with deltoid retraction. Operative findings included fibrous nonunion, with gross motion at the distal clavicle and intact coracoclavicular ligaments. Stable union of the coracoid fracture site was noted. Open distal clavicle resection was performed utilizing an oscillating saw, as the fragment was too small for fixation. As this

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**Figure 1** CT obtained at the time of the initial injury. Axial (A), coronal (B), and sagittal (C) images defined this complex shoulder girdle injury. The comminuted coracoid base fracture is seen on the axial and coronal images, and the ipsilateral fracture of the lateral one-third of the clavicle is visualized on the sagittal image.

Neer type III distal clavicle fracture<sup>2</sup> nonunion was functionally equivalent to a persistent acromioclavicular joint separation, stabilization of the coracoclavicular interval was performed, utilizing a 4.0 mm partially-threaded cannulated lag screw (Synthes, Paoli, Pennsylvania) between the distal one-third of the clavicle and the coracoid base to fix and maintain reduction of the coracoclavicular interval.

Sling immobilization was discontinued at 6 weeks postoperatively. At 3 months postoperatively, active shoulder range of motion consisted of 120° of forward elevation and 60° of external rotation. Radiographs demonstrated normal alignment of the clavicle with respect to the acromion, a reduced coracoclavicular interval, and a healed coracoid fracture (Fig. 3). At 6 months postoperatively, the patient underwent removal of hardware to allow for normal motion between the clavicle and scapula. Intraoperative examination demonstrated clavicular stability to both horizontal and vertical stress maneuvers. At 1-year follow-up, the patient

demonstrated 150° of forward elevation, 50° of external rotation, and internal rotation to the L4 vertebral body. The coracoclavicular interval remained reduced and symmetric with the contralateral side (Fig. 4).

**Discussion**

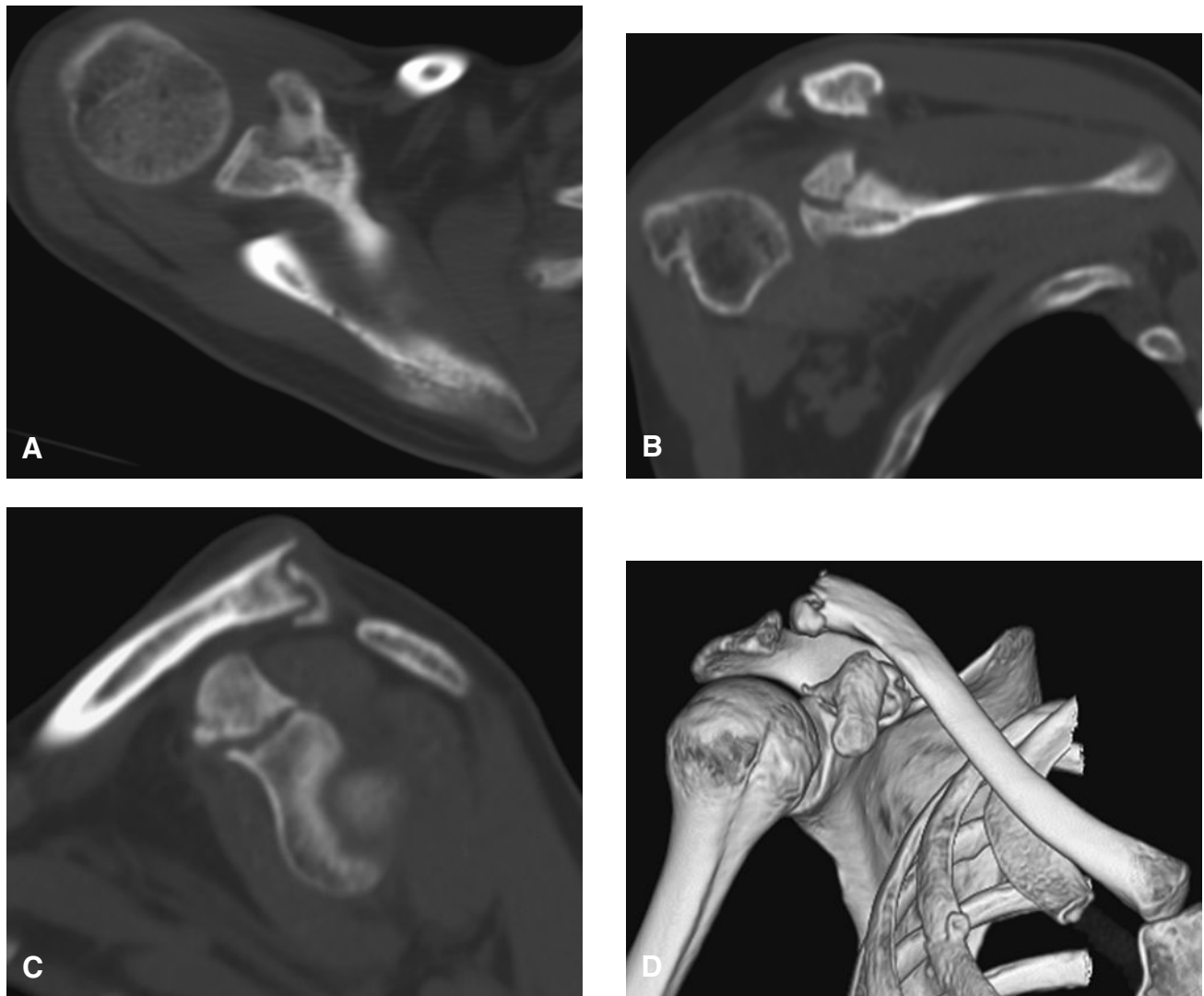
Coracoid fractures are uncommon injuries, in isolation or in association with other osseoligamentous injuries about the shoulder girdle, and comprise 3% to 13% of all scapular fractures and 5% of all shoulder fractures.<sup>3</sup> Several classification systems exist in the literature.<sup>1,4,5</sup> Most recently, Ogawa and colleagues divided these fractures into two types, based on the anatomical relationship of the primary fracture line relative to the attachment of the coracoclavicular ligaments. Specifically, type I fractures are located behind the attachment of the ligaments, and type II fractures represent coracoid tip avulsions anterior to the ligamentous origins. While 36 of 53 type I fractures were located at the

coracoid base, 17 fractures involved the superior glenoid (i.e., type 3 glenoid fracture as described by Ideberg and coworkers).<sup>6</sup> These investigators recommend operative treatment of the unstable type I fracture to reestablish the scapuloclavicular connection. In contrast, excellent results were reported with nonoperative management (i.e., sling and early physiotherapy) of type II fractures. Eyres and associates<sup>4</sup> divided coracoid fractures into five types based on their anatomic location and subdivided these groups based on the presence of an ipsilateral clavicle fracture or coracoclavicular ligamentous disruption.

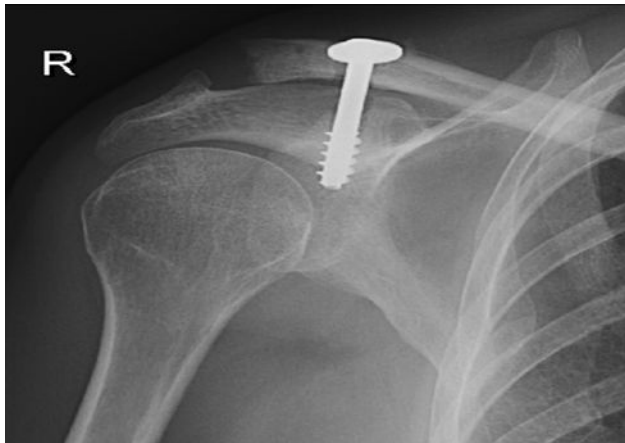
Direct and indirect mechanisms of injury to the coracoid and distal clavicle have been proposed. Direct trauma to the anterior surface of the shoulder may result in comminuted coracoid fractures. The coracoclavicular and coracoacromial ligaments, as well as the coracobrachialis, short head of the biceps, and pectoralis minor have all been implicated in coracoid avulsion fractures through

indirect mechanisms. Coracoid fractures also have been reported in association with glenohumeral dislocation.<sup>1,4,7</sup> The projection of the coracoid process makes the diagnosis of fracture challenging on anteroposterior radiographs. An axillary image may allow better visualization of the coracoid fracture,<sup>8</sup> but requires a compliant patient in the acute setting. An anteroposterior view with 45° to 60° cephalad angulation has been advocated.<sup>9</sup> We routinely use axial plane computed tomography with sagittal and coronal-plane reconstructions to evaluate fractures of the coracoid process and shoulder girdle in order to define the extent of osseous injury (i.e., disruption of the osseoligamentous ring and glenoid extension).

Coracoid process fractures more often occur in association with other shoulder girdle injuries.<sup>1,4,10-13</sup> In the largest published series of coracoid fractures, Ogawa and colleagues<sup>1</sup> reported concomitant shoulder girdle injuries in 60 of 67 patients. Acromioclavicular dislocation was the



**Figure 2** Repeat CT obtained 3 months post-injury. Axial (A), coronal (B), sagittal (C), and three-dimensional reconstruction (D) images revealed ipsilateral nonunions of the coracoid base (A-D) and the lateral one-third clavicular fractures (C and D).



**Figure 3** Radiograph obtained 3 months postoperatively demonstrated maintenance of the acromioclavicular and coracoclavicular relationships and a healed coracoid fracture.

most commonly associated injury and was evident in 39 of their patients. The association of coracoid fracture and ipsilateral acromioclavicular dislocation has been reported by several other groups.<sup>4,12,14-24</sup> As published series are limited to small cohorts, a consensus does not exist as to the optimum treatment strategy for this rare injury pattern. Recommendations for operative intervention for this injury pattern may follow those used when treating isolated type III acromioclavicular dislocations. Concomitant fracture of the acromion<sup>1,4,13</sup> and scapula spine<sup>1</sup> have also been reported.

Concomitant ipsilateral coracoid and clavicular fractures remain an exceedingly rare injury pattern. Latarjet and coworkers<sup>11</sup> first reported two cases of ipsilateral coracoid avulsion fractures associated with clavicular fractures. Baccarani and associates<sup>10</sup> reported a single case of a concomitant displaced coracoid fracture and diaphyseal clavicular fracture, sustained during a roll-over motor vehicle accident. Percutaneous fixation of the coracoid fracture with two percutaneous Kirschner wires yielded painless, full glenohumeral motion at 4-month follow-up. In a series of seven coracoid base fractures reported by Martin-Herrero and colleagues,<sup>12</sup> one patient sustained an ipsilateral clavicle fracture. Nonoperative treatment resulted in a satisfactory clinical outcome in all cases. In contrast, Eyres and coworkers<sup>4</sup> performed open reduction and internal fixation of a coracoid fracture with glenoid fossa extension and an ipsilateral displaced diaphyseal clavicular fracture. Full glenohumeral motion was reported at 9 weeks postoperatively. In a series of 67 consecutive coracoid fractures, Ogawa and associates<sup>1</sup> reported 14 cases of ipsilateral clavicle fracture. Interestingly, 12 of these 14 clavicular fractures were isolated to the lateral end, but all were associated with a type II coracoid fracture.

We describe symptomatic nonunion following nonoperative treatment of an ipsilateral type I<sup>1</sup> coracoid base



**Figure 4** Radiographs 1-year postoperatively demonstrated maintenance of the coracoclavicular interval.

fracture and a type III<sup>2</sup> lateral one-third clavicular fracture associated with superior displacement of the medial clavicular fracture fragment. DeRosa and Kettlekamp<sup>25</sup> published a single case of symptomatic nonunion of an isolated coracoid fracture following nonoperative management. Intraoperatively, they noted that the coracoacromial ligament, conjoint tendon, and pectoralis minor remained attached to the coracoid fracture fragment. It is unclear whether these soft-tissue attachments produced clinically significant motion to have delayed fracture union. Our case is the first reported case of nonunion following nonoperative treatment of ipsilateral coracoid base and distal clavicle fractures, a rare entity in and of itself. An open distal clavicle resection was performed, followed by reduction of the coracoclavicular interval with a 4.0-mm partially-threaded cannulated lag screw (Synthes, Paoli, Pennsylvania). Our operative indications for fixation of coracoid fractures include displaced base fractures (i.e., Ogawa and colleagues,<sup>1</sup> type I; Eyres and coworkers,<sup>4</sup> types III to V), and those with associated type III or greater acromioclavicular dislocation, coracoclavicular ligament disruption, distal clavicle fracture, and significant intra-articular involvement of the glenoid fossa.

This report highlights the need for a high index of suspicion for associated uncommon injuries, such as coracoid fractures, when evaluating and treating common injuries such as clavicle fractures and acromioclavicular joint dislocations. While initial diagnostic and therapeutic modalities remain the same, awareness of the coincidence of rare shoulder girdle injury patterns associated with clavicular trauma allows for earlier recognition. In the appropriate clinical scenario (i.e., persistent shoulder girdle pain), advanced imaging of the shoulder should be obtained.

#### *Disclosure Statement*

None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but

not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

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