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Ipsilateral distal clavicle and coracoid base physeal fractures in a skeletally immature athlete: a case report



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Isolated distal clavicle^{3,5,9,12} and coracoid process^{2,7,10,13} fractures rarely occur in the skeletally immature. In this population, the simultaneous ipsilateral occurrence of these fractures is even less frequent, with the only known reports of this injury profile occurring in adults.^{2,7,13,14} Two mentions of coracoid process fractures with associated acromioclavicular (AC) dislocations exist in the literature, 1 of which was reported in a child⁶ while the other was described in an adult.⁸ The treatment options employed in both these cases differ from ours; neither case utilized screw fixation with concomitant ligament repair to treat their patients.

Although the simultaneous occurrence of distal clavicle and coracoid process fractures is rare, the incidence of this combined injury may be underreported as coracoid process fractures can easily be missed on routine radiographs.^{2,7,10,13} In the skeletally immature, the detection of coracoid process fractures is highly difficult due to the presence of the physis.² Special attention should be paid to coracoid process physeal widening and irregularity on radiographs.¹

Treatment options for simultaneous ipsilateral distal clavicle and coracoid process fractures are not universally agreed upon. Both nonsurgical and surgical options exist. There are reports in the literature of failure of conservative treatment for this injury profile in adults.^{13,14} Kirschner wire and cerclage fixation for the distal clavicle fracture with coracoid process screw fixation,² corrective clavicle and coracoid process osteotomy,¹⁴ and distal clavicle excision with coracoid process screw fixation¹³ are all surgical treatments that have been successfully employed in adults.

Following a hockey injury, a 13-year-old right-hand-dominant male experienced a distal clavicle and a coracoid base physeal fracture, the latter of which was discovered intraoperatively. Seventeen and a half months after distal clavicle open reduction internal fixation (ORIF) and coracoclavicular (CC) ligament repair, the patient reported that he was doing well, and radiographs demonstrated evidence of healing.

Consent was obtained for the publication of case material.

Case report

While playing hockey, a 13-year-old right-hand-dominant male collided into the boards following a backside check with the point of the shoulder absorbing much of the force. The patient was otherwise healthy and presented to us 2 days following this injury. Radiographs taken on the day of the injury revealed a distal clavicle physeal fracture (Fig. 1, A and B). The distal aspect of the medial fragment was posteriorly displaced and likely intussuscepted into the trapezius musculature. On physical exam, the patient was neurovascularly intact but demonstrated tenderness to palpation over his AC joint as well as limited range of motion. There was a clear deformity consistent with the radiographs. Following appropriate preoperative discussion with the patient and his family, consent was obtained, and surgery was performed. Preoperative counseling included that the patient would undergo surgery for reduction and CC ligament repair. This was selected with the belief that the coracoid was intact and that it would provide best options for full return of function for the patient without requiring additional surgery for plate removal as required by hook plate treatment.

For surgery, the patient was in a beach chair position. A 6-centimeter incision was made over the tip of the coracoid, and the deltopectoral groove was identified. Upon palpation of the coracoid, it became clear that it was freely mobile and fractured

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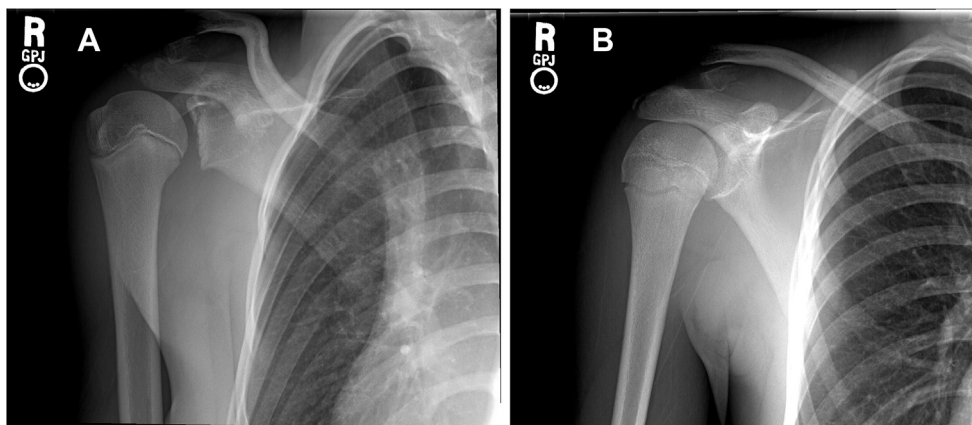


Figure 1 (A, B) Day-of-injury Grashey and anteroposterior radiographs demonstrating a distal clavicle fracture with the medial component superiorly subluxated 1 cm over the distal clavicle component. This fracture is the equivalent of a bony physeal injury of a type IV acromioclavicular separation.

at its base. With the assistance of intraoperative anteroposterior (AP) and orthogonal axillary lateral images, 3 cannulated guide pins were placed in the coracoid. Three screws were used because it was believed intraoperatively that the first 2 screws were not adequately spread on imaging. Because of the need for support of the entire shoulder girdle on the coracoid with the planned repair technique, 3 cannulated screws were inserted with washers from the tip of the coracoid into the body of the scapula (Fig. 2, A–C). Through an interval made by releasing a small portion of the coracoacromial ligament, a gloved finger verified that the screws were not transversing the inferior aspect of the coracoid.

It was necessary to support the scapula using the tapes to address the disruption of the CC ligaments and to create a steady construct for the repair of the clavicular fracture. Polypropylene tapes were passed underneath the coracoid, and the fracture was reduced through the dissection of the superficial plane of the clavicle. Medial and lateral holes were drilled into the clavicle a centimeter apart, and the tapes were passed in a loop and figure-of-eight fashion. Both were tied after intraoperative AP and longitudinal traction fluoroscopic views demonstrated the coordinated movement of the AC joint and scapula. Anatomical reduction of the scapula was verified through AP and axillary intraoperative fluoroscopy. Next, the trapezial fascia was irrigated and reapproximated over the repair, and closure was initiated. A sling was placed.

At the 5-week postoperative visit, the sling was discontinued, and he began activities of daily living. Six months following the patient's surgery, he underwent hardware removal for the previously placed screws and washers. Just under 18 months postoperatively, the patient had returned to all activities, including soccer and hockey, and reported no pain and normal range of motion. Eight-month (Fig. 3, A–C) and 17.5-month (Fig. 4, A–C) postoperative radiographs demonstrated routine healing with closure of the coracoid physis.

Discussion

The few reports in the literature of the simultaneous occurrence of ipsilateral distal clavicle and coracoid fractures have only been in adults.^{2,7,13,14} To the best of our knowledge, our patient is the first report of this injury pattern in the skeletally immature.

Although clavicle injuries are common in the pediatric population,^{3–5,9} injuries of the distal clavicle are very rare^{3,5,9,12} and often occur due to high-energy trauma directly to the shoulder.^{5,12} It is

important to consider the ways in which the anatomy of the growing bone contributes to distal clavicle fractures in the skeletally immature. In the skeletally immature, the lateral clavicle physis exists until the age of 18 or 19 years.^{3,5,9,12} At this point, the lateral clavicle's ossification center emerges although complete ossification is not typically achieved until an individual's mid-twenties.⁵ Ligamentous structures are much stronger than the open physes present in growing bone, and it is this strength imbalance that makes growing bone more vulnerable to injury.^{4,5,10} In the shoulder specifically, the relative durability of the CC ligaments may contribute to metaphyseal or physeal disruption leading to distal clavicle fractures that resemble adult type IV AC joint dislocations,⁵ as was seen in our patient. In the case we have described, the fracture fragments were separated by the trapezial fascia requiring dissection to reduce them adequately. Prior to physeal closure, fractures of the distal clavicle typically look like AC joint separation and have thus been referred to as pseudodislocations.^{3,5,9,12} Treatments for distal clavicle fractures range from nonoperative^{5,11,12} to fixation with Kirschner wires,^{3,5,9} Kirschner wire with tension band wiring,¹¹ double-button suture fixation,³ cerclage wiring,³ hook plates,^{3,11} intramedullary fixation,¹¹ interfragmentary fixation,¹¹ and CC screw fixation.^{3,11} Given the rarity of distal clavicle fractures, there is currently no consensus regarding the treatment.^{3,5,9,11}

Coracoid process fractures occur infrequently^{2,6–8,10,13} and are often associated with other shoulder girdle injuries.^{2,10,13} In the growing skeleton, the most common location of coracoid injury is the physeal base.^{4,6,10} During a child's first year of life, the primary ossification center of the coracoid process emerges. As the coracoid's primary ossification center enlarges, it will directly about the physeal cartilage of the scapula. Closure of the coracoid process's primary ossification center occurs at approximately 14 or 15 years of age. A second physis that allows for longitudinal growth exists at the end of the coracoid process.¹ Simultaneous injuries to the primary coracoid ossification center and to the subcoracoid ossification center may lead to a fracture of the articular surface as well.¹⁰ In pediatric patients, acute coracoid process physeal injuries often happen while participating in contact sports, such as hockey^{1,4,10}; however, some authors note that these injuries may occur in an acute-on-chronic fashion secondary to athletics-related overuse.¹⁰ No clear consensus regarding the treatment of coracoid process fractures exists.^{4,6,7} Some literature suggests that isolated coracoid process fractures—that have not gone on to nonunion—can be treated nonoperatively.¹⁰ On the other hand, it is also thought that coracoid

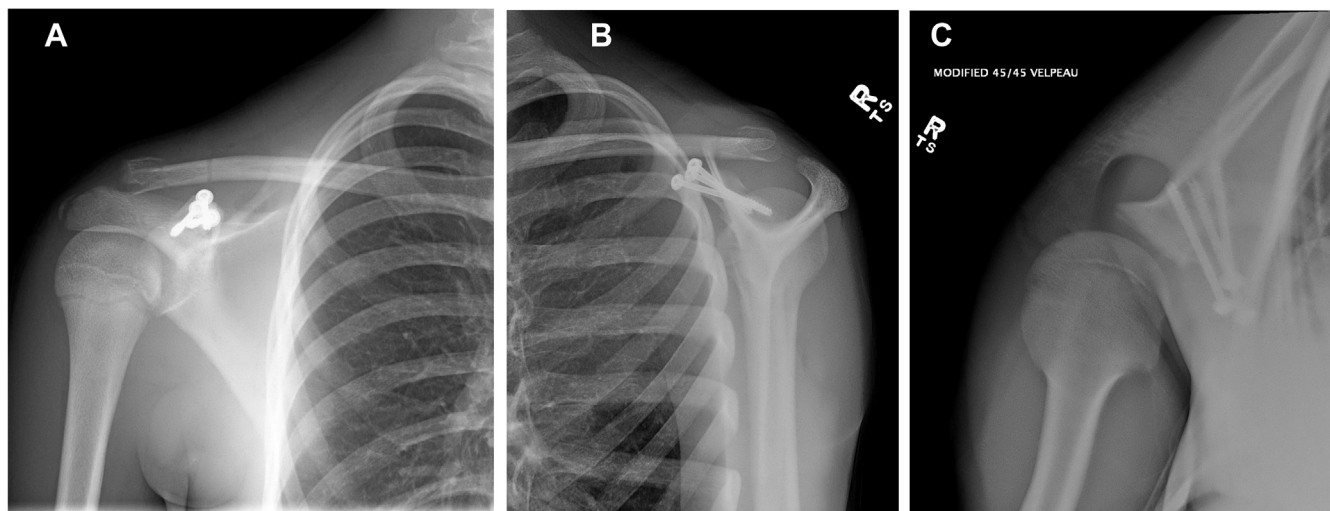


Figure 2 (A-C) One-week postoperative anteroposterior and Velpeau axillary X-rays demonstrating the spatial orientation of the 3 cannulated screws from the coracoid process into the scapula with no evidence of hardware failure.

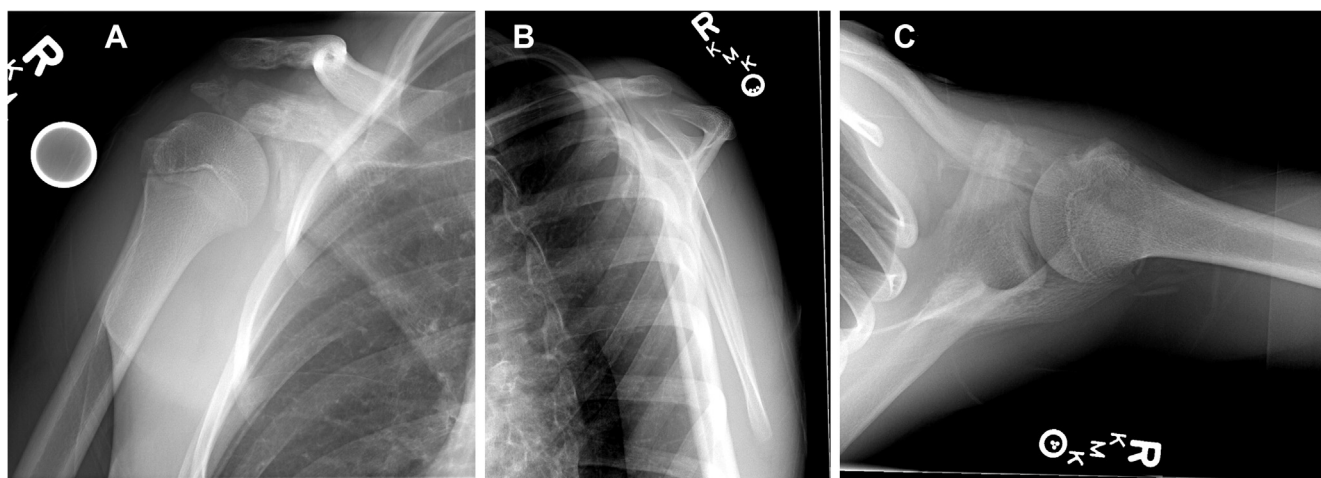


Figure 3 (A-C) Eight-month postoperative Grashey, scapular Y, and axillary X-rays demonstrating routine healing of the distal clavicle and coracoid base fracture.

process fractures that occur in conjunction with other injuries, including clavicle fractures, should be treated operatively.²

The diagnosis of simultaneous ipsilateral coracoid process and distal clavicle fractures is often missed on radiographs.⁷ While the clavicle fracture is more easily recognizable, it is the radiographic appreciation of the coracoid fracture that is often missed. The anatomic orientation of the coracoid process relevant to other structures in the shoulder makes the diagnosis of coracoid process fractures on standard radiographs, especially on AP views, difficult.^{2,7,10,13} Because of this, additional imaging such as axillary,^{2,13} cephalic-angulated,^{2,13} Stryker,⁷ angle-up,¹⁰ anterior oblique,¹⁰ and scapular Y¹⁰ views have been recommended. Even with an axillary view, the diagnosis can be missed as in this case. In cases where physical examination and radiographs appear inconsistent with one another, computed tomography or magnetic resonance imaging may be indicated.^{1,7} Diagnosis of coracoid process fractures is particularly difficult in the skeletally immature as it can be challenging to discriminate a fracture of the coracoid process from that of the growth plate.² The intraoperative identification of our patient's coracoid base fracture triggered reevaluation of his preoperative radiographs; upon reinspection, the patient's

preoperative radiographs demonstrated an asymmetric widening of the growth plate that was suggestive of a fracture (Fig. 5, A and B). Physeal widening and irregularity should trigger concern for coracoid base injury.¹

The few mentions in the literature of simultaneous ipsilateral distal clavicle and coracoid process fractures exist only in adults, and the treatment options are not agreed upon, ranging from nonoperative to surgical. Two instances of nonoperative treatment resulted in malunion and nonunion, which then necessitated surgical intervention.^{13,14} Surgical options include Kirschner-wire and cerclage fixation for the distal clavicle fracture with coracoid process screw fixation,² combined corrective clavicle and coracoid process osteotomy,¹⁴ and distal clavicle excision with coracoid process screw fixation.¹³ Additionally, 2 cases of concomitant coracoid process fracture and AC dislocation—1 in a child⁶ and 1 in an adult⁸—exist in the literature. However, the treatment methods described in these reports vary from ours as neither approach use both screw fixation and ligamentous repair to treat their patients. Ultimately, as ORIF of both the distal clavicle and coracoid process fractures with CC ligament repair contributed to positive postoperative results in our skeletally

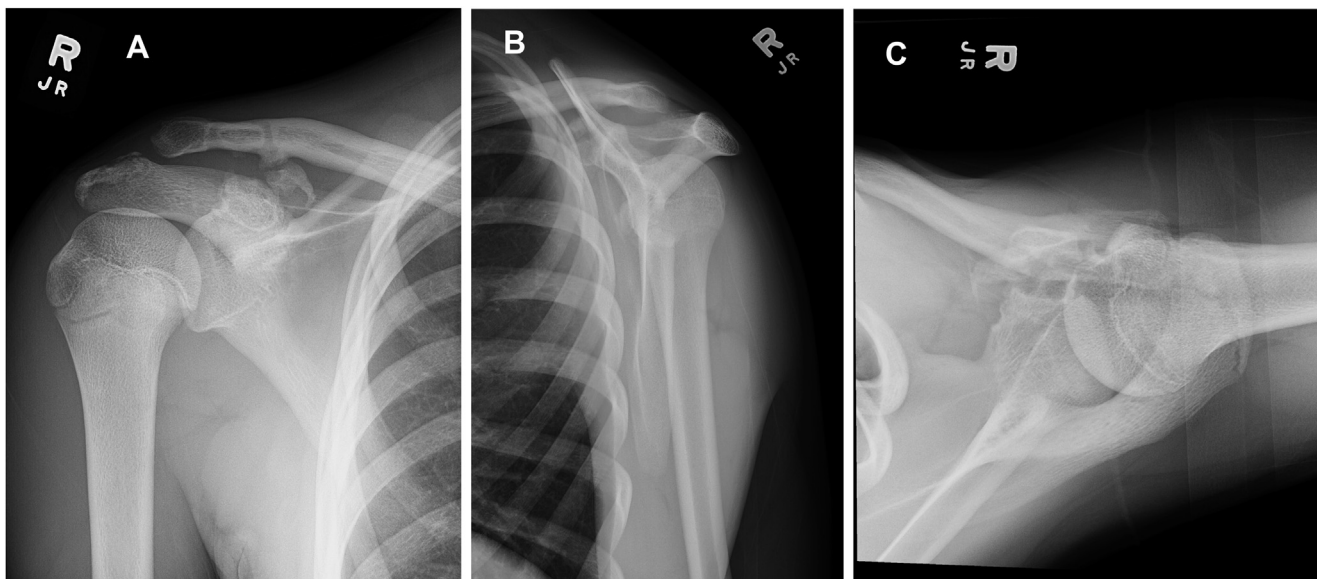


Figure 4 (A-C) Seventeen-and-a-half-month postoperative Grashey, scapular Y, and axillary X-rays demonstrating bony union of the distal clavicle and the coracoid process with no evidence of residual fracture or loose bodies.

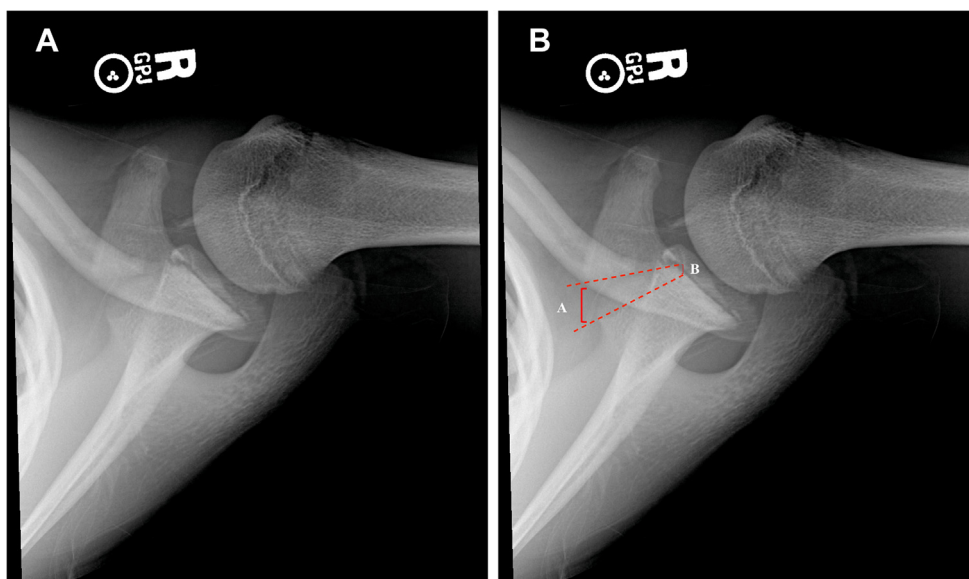


Figure 5 (A) Day-of-injury axillary X-ray demonstrating asymmetric widening of the coracoid process physis. In addition, this image demonstrates the anterior subluxation of the lateral clavicular fragment relative to the medial one. This resulted in the medial fragment being incarcerated into the trapezius similar to a type IV acromioclavicular separation. (B) Fracture of the coracoid base physis is labeled with a red dashed line. The asymmetric widening of the coracoid physal base—as evidenced by the fact that length A is greater than length B—should serve as an indication that a fracture of the physis exists.

immature patient, we propose this as a viable treatment option for this exceedingly rare injury in the pediatric population. To reduce the likelihood of missing an injury to the physis of the coracoid, we recommend thoroughly reviewing axillary radiographs—paying particular attention to the coracoid base and physal asymmetry—in skeletally immature patients with concern for high-energy trauma.

Conclusion

The ipsilateral and simultaneous occurrence of distal clavicle fractures and coracoid process fractures in the skeletally immature is rare. In fact, the few reports of this combined injury have only

been in adults, and treatment options are not agreed upon. We offer CC ligament repair and ORIF of both the distal clavicle and coracoid process fractures as an effective treatment option for this rare injury pattern in the skeletally immature. We also recommend that clinicians carefully examine axillary radiographs for coracoid physis asymmetry in this population.

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