Nonoperative management of a displaced cartilaginous avulsion fracture of the inferior aspect of the scapula

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Scapular fractures are rare, representing 0.5%-1% of all skeletal fractures4,7,8 and 3%-5% of shoulder girdle fractures.1,11,20 Fractures of the inferior aspect of the scapula (IAS) are similarly uncommon, with few cases reported in the orthopedic literature.2,6,10,16,17

Thought to be a consequence of periscapular muscles such as the serratus anterior10 and latissimus dorsi16 avulsing from the inferior tip of the scapula, patients with IAS fractures typically present with pain over the fracture site, loss of shoulder range of motion, weakness, and winging of the scapula.3 Although ossification of the scapula is typically complete in adults by about 20 years of age, ossification centers in the acromion, medial border of the scapula, and IAS are not usually closed until age 14-20 years.15

Both operative and nonoperative treatments for IAS fractures have been documented in case reports to be of varying success. Despite limited available data, it has been suggested that displaced IAS fractures are unlikely to heal and therefore should be treated operatively, whereas nondisplaced fractures have varying outcomes when treated nonoperatively.3 We describe what we believe to be the first successfully nonoperatively treated displaced fracture of the IAS in a pediatric patient. This case of a uniquely treated IAS fracture is important because it may justify initial conservative management for this rare fracture type.

Case report

A 12-year-old male patient presented to the office with a 3-day history of pain over the posterior aspect of the scapula and loss of motion in the right shoulder after sliding down a waterslide. The patient and his parents denied any history of trauma to the right upper extremity. Physical examination revealed swelling and tenderness to palpation at the inferior medial aspect of the right scapula, as well as slight medial winging. Full passive range of motion was maintained with moderate pain, but severely limited active flexion and abduction were noted. The findings of the neurologic examination were normal, with no deficits in sensory or motor testing. Radiographs taken at the patient’s initial visit demonstrated open growth plates with no evidence of a fracture or dislocation (Fig. 1). The patient was placed in a sling, and advanced imaging of the scapula and shoulder was ordered. Our initial differential diagnoses included an acute brachial plexus injury or a soft-tissue injury involving the serratus anterior.

Magnetic resonance imaging (Fig. 2) obtained the following day demonstrated a displaced fracture of the inferior aspect of the scapular body not appreciated on the initial radiographs. Also noted was significant edema within the surrounding musculature. To better identify any potential additional bony detail of the avulsion, a computed tomography scan of the right scapula was obtained (Fig. 3). Sagittal reformatted images (Fig. 3, B) demonstrated a 1.8-cm comminuted fragment displaced along the anterior margin of the inferior border of the scapula with up to 1.1 cm of superior displacement. The fracture involved the cartilaginous portion of the inferior margin of the scapula with a minimal amount of ossified tissue avulsed from the scapular body (Figs. 3 and 4).
On the basis of the patient’s examination findings and imaging studies, an inferior-angle cartilaginous avulsion fracture of the scapula was diagnosed. At 1 week after the injury, the patient demonstrated significant improvement in pain and active motion. Although he continued to show difficulty initiating forward flexion and abduction, he was able to fully elevate and abduct the injured arm without pain. Because of his significant clinical improvement and the apposition of the cartilage fragment to the scapular body, we elected to monitor the injury closely.

By 2 weeks after the injury, the patient reported minimal tenderness at the posteromedial scapula and had significant improvements in strength and range of motion in the right shoulder. Physical examination revealed a minimal lag in initiation of abduction as well as active forward elevation to 160°. Medial scapular winging was still evident but reduced. On the basis of the patient’s continued improvement and shared decision making with the parents, we elected to perform treatment without surgery. Sling use was discontinued 1 week later, and physical therapy was initiated. By 1 month following the injury, the patient had regained nearly complete active range of motion (160° of forward flexion, 90° of external rotation with the elbow at the side, and internal rotation to the mid scapula) and demonstrated no measurable deficits in any strength test. The scapular winging had resolved nearly completely. Radiographs demonstrated healing of the fracture with callus formation and early remodeling (Fig. 5).

At the 12-month follow-up visit, the patient reported no pain or associated symptoms from his previous injury. He had returned to all sports, including full seasons of lacrosse and basketball. Physical examination demonstrated that the patient had regained full active range of motion (180° of forward flexion, 90° of external rotation with the elbow at the side, and internal rotation to the mid scapula) and showed 5 of 5 strength on manual muscle testing in resisted scaption (ie, scapular-plane elevation), external rotation, shoulder shrug, and internal rotation (Fig. 6, A). There was no indication of scapular winging or scapulothoracic crepitus (Fig. 6, B). Patient-reported outcome scores at final follow-up had returned to normal. The American Shoulder and Elbow Surgeons score improved from 22 at initial presentation to 95, and the Single Assessment Numeric Evaluation score improved from 15 to 99. Radiographs demonstrated healing of the fracture with good remodeling (Fig. 7).

Discussion

Cartilaginous avulsions of the inferior angle of the scapula are extremely rare and have only been documented 3 times in the pediatric population.2,12,13 Heyse-Moore and Stoker12 suggested 3 possible mechanisms of injury: (1) uncoordinated muscle contracture due to electroconvulsive therapy, electric shocks, or epileptic seizures in the presence of abnormal bone; (2) resisted muscle pull as a result of trauma or unusual exertion; and (3)
Figure 2 Magnetic resonance imaging scans of right scapula. (A) Coronal T2 image with fat saturation. (B) Sagittal T2 image with fat saturation. (C) Axial STIR (short tau inversion recovery) image T2 with fat saturation. P, posterior.

Figure 3 Computed tomography scans of right scapula. (A) Axial view. (B) Sagittal view. The displaced fragment is barely visible lateral and anterior to the inferomedial border of the scapula (←→).
avulsion of a ligamentous attachment. Scapular fractures occur more frequently through direct trauma, whereas avulsions are rarely seen. Moreover, the etiology of scapular winging from a traumatic injury is most commonly an injury involving the long thoracic nerve. However, in 1930, Fitchet reported the first case of medial scapular winging from a traumatic injury to the serratus anterior muscle, and this has since been reported as a less common cause of scapular winging.

Given the different mechanisms for inferior scapular angle (ISA) fractures, no one presentation dominates. However, certain symptoms are more common than others. Ogawa et al. noted that the acute phase of an ISA fracture has symptoms comparable to most bony fractures, including pain with movement and swelling around the injury site; typical symptoms during the chronic phase of an ISA fracture are weakness, periscapular pain, and decreased range of motion with arm elevation. In addition, a winged scapula can be another presenting symptom from injury to the serratus anterior muscle.

To our knowledge, there are 17 previously reported cases of ISA fractures with detailed descriptions of treatments and outcomes (Table I). Although these fractures can occur at any age, most reported cases (14 of 17) have been in the adult population. The mechanism of injury for 10 of the reported cases was direct trauma, whereas 6 were the result of an indirect trauma.

A review of ISA fractures by Chang et al. suggested that displaced fractures of the inferior angle of the scapula treated non-operatively are unlikely to heal and should therefore be treated operatively. Of the 10 reported cases, 7 were displaced ISA fractures. Of these, 2 underwent surgical treatment and 5 received conservative treatment. All 5 conservatively treated patients later...
experienced a painful nonunion with shoulder weakness and scapular winging. However, those in whom conservative treatment was initially trialed and who later chose operative fixation had complete resolution of their symptoms. In summary, all patients undergoing surgical intervention had complete resolution of pain with good range of motion 4 months after surgery. This led to the recommendation to treat displaced ISA fractures with suture fixation; however, the generally good results following delayed treatment of these fractures reported by the authors would suggest that a trial of conservative care is not contraindicated.

Our initial literature review at the time of the injury suggested that operative intervention resulted in an improved outcome over conservative care in patients with these injuries. Our patient, however, displayed significant improvement in pain and function during the first week after the injury as we pursued a diagnosis. Accordingly, the patient and his family were disinclined to proceed operatively, and it was difficult to recommend surgery at that point. We agreed to close observation so that we could convert to operative fixation if the patient did not continue to improve. However, nearly complete resolution of pain and functional deficits in the initial 2-3 weeks following the injury made this unnecessary. By 3 months, the patient had regained normal use and function with no symptoms or deficits. Although individual patient characteristics will be critical in determining optimal treatment, conservative care of displaced ISA avulsion fractures in pediatric patients can be successful despite reports to the contrary in the literature. Our result, as well as the success of delayed operative treatment in patients initially treated without surgery, would suggest that a nonoperative approach should be considered first.

Conclusion

Cartilaginous avulsion, and fracture in general, of the inferior angle of the scapula is a rare injury. Conservative care of a displaced fracture can be successful and can be trialed with close follow-up in the pediatric population despite recommendations to the contrary based on previous case reports.

Disclaimer

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Figure 7 Radiograph of right shoulder 12 months after injury: lateral scapular view. R, right; PA, posteroanterior.

Table I
Summary of previous IAS fracture case reports

| Case No. | Year | Author                  | Patient age, yr/sex | Mechanism                                      | Displaced | Treatment/outcome          |
|----------|------|-------------------------|---------------------|------------------------------------------------|-----------|-----------------------------|
| 1        | 1924 | Longabaugh              | 26/M                | MVA                                            | Unknown   | Operative                   |
| 2        | 1981 | Hayes and Zehr          | 25/M                | NA                                             | Yes       | Nonoperative/failed         |
| 3        | 1982 | Heyse-Moore and Stoker  | 13/F                | Direct trauma: toboggan accident              | No        | Nonoperative/successful     |
| 4        | 1982 | Heyse-Moore and Stoker  | 70/M                | Fall                                           | Unknown   | Nonoperative                |
| 5        | 1982 | Heyse-Moore and Stoker  | 23/M                | MVA                                            | No        | Nonoperative                |
| 6        | 1998 | Brindle and Coen        | 17/M                | Indirect trauma                               | No        | Nonoperative/successful     |
| 7        | 2010 | Mansha et al            | 31/M                | Direct trauma: thrown from car                | Yes       | Nonoperative/failed         |
| 8        | 2004 | Franco et al            | 47/M                | Prolonged cough                               | No        | Nonoperative/failed         |
| 9        | 2014 | Min et al               | 41/M                | Direct trauma                                 | Yes       | Nonoperative/failed         |
| 10       | 2014 | Min et al               | 39/M                | Indirect trauma: fall on outstretched hand    | Yes       | Operative/successful        |
| 11       | 2014 | Min et al               | 55/M                | Indirect trauma: fall on outstretched hand    | Yes       | Operative/successful        |
| 12       | 2015 | Chang et al             | 43/M                | Direct trauma                                 | Yes       | Nonoperative/failed         |
| 13       | 2015 | Chang et al             | 65/M                | Direct trauma                                 | Yes       | Nonoperative/failed         |
| 14       | 1998 | Gupta et al             | 54/M                | Direct trauma: pallet of bricks fell on patient| Unknown   | Operative/successful        |
| 15       | 2002 | Kaminsky and Pierce     | 16/M                | Indirect: football tackle                      | Unknown   | Operative/successful        |
| 16       | 2016 | Speigler et al          | 51/M                | Fall down stairs                               | Unknown   | Operative/successful        |
| 17       | 2019 | Ogawa et al             | 20/F                | MVA                                            | No        | Nonoperative                |

IAS, inferior aspect of scapula; M, male; MVA, motor vehicle accident; NA, not applicable; F, female.

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