Repair of Acute-on-Chronic Subscapularis Insufficiency in an Adolescent Athlete

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abstract

A 13-year-old right-hand–dominant skeletally immature boy presented to the authors’ clinic after being blocked during an overhead dodgeball throw and hearing an abrupt “pop” in the shoulder. He had pain in the subdeltoid region that was most prominent during sports-related activity, particularly throwing. The patient had nonoperative management of a lesser tuberosity avulsion fracture 1 year earlier after a similar injury that occurred during a basketball game. He had returned to normal sporting activity 2 months before the most recent injury. Repeat advanced imaging showed an avulsion fracture of the subscapularis tendon, with a significantly retracted 2-cm component as well as a less retracted component, suggesting acute-on-chronic injury. Given this retraction and the symptoms during throwing, the patient was counseled that surgical management would best facilitate an asymptomatic return to sports-related activity. This case showed acute-on-chronic subscapularis tendon insufficiency with avulsion of the lesser tuberosity and significant retraction of the subscapularis tendon without tearing, a rare injury pattern in adolescents. For fixation of the avulsed lesser tuberosity fracture, an open approach technique was used in which SpeedBridge (Arthrex, Naples, Florida) sutures were passed behind the bone fragment. Four anchors were placed medial and lateral to the subscapularis insertion points to create a knotless double-row footprint. Compared with the published literature, this method of subscapularis fixation offered secure anatomic repair in a time-efficient, user-friendly manner. [Orthopedics. 2015; 38(9):e844-e848.]
Although shoulder injuries are among the most frequent sports-related injuries, subscapularis tendon injuries in adolescents are uncommon. Furthermore, a growing body of literature is pointing to chronic overuse, especially in young, high-level athletes, as a prominent contributing factor to adolescent rotator cuff injuries. Biomechanically, the subscapularis contracts downward and medially when the arm is forcefully abducted while in external rotation. In the case of an acute injury, this contraction in opposite directions can lead to either a tear in the muscle itself or a tear at its insertion into the lesser tuberosity of the proximal humerus. In skeletally immature children, the weakest link is between the physis of the tuberosity and the humerus. Therefore, forced external rotation or hyperextension of the abducted arm of a skeletally immature patient is most likely to cause an avulsion fracture. This injury pattern is prevalent in sports that involve frequent overhead motion, such as baseball, basketball, dodgeball, and wrestling. To the best of the authors’ knowledge, there is no universally accepted surgical technique for fixation of an avulsed lesser tuberosity fracture in children. This article describes a method using suture bridges that provided adequate and secure anatomic repair while maximizing surgeon efficiency.

**Case Report**

A 13-year-old right-hand-dominant skeletally immature boy who played basketball and baseball presented to the authors’ clinic after being blocked during an overhead dodgeball throw and hearing an abrupt “pop” in the right shoulder. Pain in the subdeltoid region was most prominent during sports-related activity, particularly throwing. He had nonoperative management of a full-thickness subscapularis tear with an avulsion fracture 1 year earlier and had returned to normal sporting activity 2 months before the most recent injury. Physical examination showed full painless range of motion and strength, negative findings on stability and anterior apprehension tests, and no weakness on belly-press test. Repeat advanced imaging showed avulsion fracture of the bony fragment from the humerus involving more than three-fourths of the subscapularis tendon, with a significantly retracted component measuring 2 cm as well as a less retracted component. No separate tear was noted (Figures 1A-B). Standard radiographs confirmed bony avulsion in a skeletally immature patient (Figure 1C).

Given the combination of lesser tuberosity avulsion fracture, significant retraction of the subscapularis tendon, and pain with throwing, surgical intervention was recommended. Parental consent was provided, and the patient underwent open repair with an anterior deltopectoral approach from the beach chair position. Standard arthroscopy was performed before the repair. The intact retracted subscapularis tendon and the avulsed fragment of the lesser tuberosity were visualized, carefully delineated, and debrided with a full-radius 4-mm shaver. The labrum was intact (Figures 2A-B).

The arthroscopic equipment was removed, and open repair was begun. The subscapularis fragment was visualized and elevated, and the underside was noted to have cartilage overlying the fragment (Figure 2C). This was carefully curetted to expose viable bleeding bone (Figure 2D). Dissection of the anterior subscapularis was limited to the area under the conjoined tendon and within 1.5 cm medial to the glenoid rim. SpeedBridge Sutures (Arthrex, Naples, Florida) were placed behind the bone fragment, which had retracted medial to the lesser tuberosity, and 4 biocomposite SwiveLock anchors with a closed eyelet (product #AR-2324BCC; Arthrex) were placed on the medial and lateral insertion points of the subscapularis, beginning medially, to construct a knotless double-row footprint (Figure 2E). The sutures were brought directly over the fragment and criscrossed, with care taken to avoid the biceps laterally and to maintain the shoulder in neutral rotation (Figure 2F and Figure 3). Throughout the repair, care was taken to avoid excessive traction on the neurovascular
structures, particularly during anchor fixation. After closure, the patient was placed in a shoulder immobilizer for 6 weeks. Physical therapy was started 6 weeks postoperatively.

At 9 months postoperatively, the patient had returned completely to full-time sporting activity without symptoms or limitations. Physical examination showed full painless range of motion and complete strength.

**DISCUSSION**

In the evaluation of potential subscapularis injuries, it is important to use the history, physical examination findings, and preoperative imaging results to make a timely and accurate diagnosis. If symptoms do not resolve within 6 weeks, magnetic resonance imaging and/or arthrography may be indicated. It is also important to consider nonsurgical management. For atraumatic injuries or chronic degenerative tears, activity modification, anti-inflammatory drugs, and physical therapy are viable alternatives to surgery. However, in acute traumatic tears, prompt surgical management is associated with better outcomes. Furthermore, improvement in outcome scores is inversely proportional to the delay between initial diagnosis and final surgical treatment. This delay suggests that adequate use of advanced imaging may be more helpful at the early stage, particularly in pediatric athletes who desire a full, asymptomatic return to sports. Unfortunately, most patients do not receive an accurate diagnosis until both conservative measures and physical rehabilitation have failed. Specifically, in a literature review of isolated subscapularis tendon injuries in children, Gouron et al reported a mean lag time of 8.5 months between initial injury and diagnosis. To guide the decision-making process, Levine et al identified a number of widely accepted indications for surgical management of fractures of the lesser tuberosity, including fracture displacement (>5 mm or 45° of angulation), mechanical block of motion, injuries that limit function or result in disability, and failure of nonoperative management.

After the decision has been made to proceed with surgery, the surgeon must consider whether to use an arthroscopic approach or an open approach. These approaches have been extensively reviewed in the literature. Initial diagnostic arthroscopy may be used to confirm the absence of additional intra-articular pathology and weigh the possibility of arthroscopic repair. In the current patient, because the injury was chronic, an open approach was expected to facilitate adequate ten-
The offisication center of the lesser tuberosity develops at 4 to 5 years, fuses with the greater tuberosity during the fifth year, and later fuses with the humeral head in the seventh year. Therefore, the epiphysis of the lesser tuberosity is well fused in adolescents and is unlikely to play a role in avulsion injuries. However, recent reports suggested that fusion between the tuberosities and the humeral head may extend into adolescence. Because cartilage was seen on the underside of the avulsed fragment, this patient’s condition may be consistent with previous reports of relative weakness at the lesser tuberosity in adolescents. Additionally, the decision to avoid compressive screw fixation was based on the finding of a thin wafer of bone on the underside of the fragment and further consideration for the proximal humeral physis and potential growth arrest. Consequently, the knotless double-row SpeedBridge technique described in this report was used as a physeal-sparing means of fracture fixation to reapproximate the avulsed lesser tuberosity and the intact retracted subscapularis tendon to the proximal humerus to facilitate subsequent healing.

The pediatric literature reported wide variation in surgical techniques for similar subscapularis injuries. In 2 high-level adolescent athletes with subscapularis tendon avulsion, Polousky and Harms described the use of suture anchors and a mattress suture. Garrigues et al. reported 6 skeletally immature patients who underwent treatment of isolated lesser tuberosity avulsions with a lasso technique with suture anchors and sutures to loop over the fragment. Gouron et al. used 2 suture anchors in an 11-year-old hockey player, and Provanec and Polousky described the use of corkscrew suture anchors in a 13-year-old after a dodgeball injury. Sikka et al. performed anatomic repair in a wrestler by placing sutures through the base of the tuberosity defect and directly reattaching the muscle and its capsule to the lesser tuberosity. Levine et al. used a combination of sutures passed through drill holes in the proximal humerus and bioabsorbable suture tacks. Regardless of the technique described, all of these authors reported good outcomes, with eventual full return to sports activity.

Overall, this variation in technique suggested that there are many adequate methods for securely reattaching an avulsed lesser tuberosity fragment and its associated subscapularis tendon to the proximal humerus. Furthermore, in respecting the anatomic differences between adults and children for surgical planning, Levine et al. cautioned that the apophysis of the lesser tuberosity remains a concern in children. Therefore, care should be taken in choosing fixation to minimize trauma to open growth plates.

This report introduced another method for physeal-sparing repair of an avulsed lesser tuberosity that provided secure anatomic repair in a more time-efficient and user-friendly manner than many techniques described earlier.

**REFERENCES**


