J Shoulder Elbow Surg (2013) 22, e19-e23

ELSEVIER

Journal of Shoulder and Elbow Surgery

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CASE REPORTS

Open repair of an acute latissimus tendon avulsion in a Major League Baseball pitcher

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Latissimus dorsi (LD) avulsion injuries are rare injuries most commonly diagnosed in competitive athletes. The LD muscle originates from the thoracic spine, thoracolumbar fascia, and iliac crest, converging toward the axilla to insert between the pectoralis major and teres major tendons, just medial to the bicipital groove of the proximal humerus. Functionally, the latissimus adducts, internally rotates, and extends the humerus. It also acts to depress the arm against resistance, compress the inferior scapula when the arm is elevated, and pull the trunk upward and forward when the arms are fixed.[8,9,14,15,21]

In pitchers, the LD exerts minimal activity during the wind-up and early cocking phase of the pitching cycle, increases its activity during the late cocking phase, exerts maximum tension during the acceleration phase, and remains active but relaxes during deceleration and follow-through.[8,9,14,15] Importantly, the LD is relatively more active on electromyography during the acceleration phase of the pitching cycle in professional baseball pitchers compared with nonprofessional and recreational throwers, possibly predisposing professional pitchers to LD injuries.[9]

To date, only 11 case reports have been published in the literature discussing the presentation and management of these injuries. Most cases of acute rupture have been reported in competitive athletes, ranging from steer wrestlers[13] and water skiers[12,17] to rock climbers[18] and professional baseball pitchers.[19,23] For noncompetitive or recreational athletes, nonoperative treatment of LD avulsions will most likely result in satisfactory outcomes because the shoulder compensates for loss of LD strength and function via increased activity in synergistic muscle units. One recent case series supports the use of nonoperative treatment in the management of LD and teres major (TM) injuries in professional baseball pitchers.[19]

However, in throwing athletes with LD avulsion injuries associated with significant tendon retraction, primary surgical repair may offer the benefits of successful return to sport at a high functional capacity with minimal, if any, strength deficits postoperatively. One case of a professional baseball player with a latissimus rupture treated operatively has been published, but no details of the case are available.[2] In this report, we present a professional Major League Baseball player with an acute LD tendon rupture, with subsequent primary anatomic repair of tendon to bone.

Case report

A 29-year-old right-hand-dominant Major League Baseball pitcher (185 cm, 88 kg) experienced a sudden pulling sensation and ''pop'' in his right shoulder while throwing a pitch during the second inning of a professional baseball game in July 2010. The patient reported an acute onset of searing pain in the posterior aspect of his right axilla, specifically during the late cocking phase, after which his arm went ''limp'' through the remainder of the pitch. He was unable to return to the game. He reported mild prodromal symptoms for approximately 1 to 2 days before the injury, with an aching sensation in his upper back.

Investigational Review Board approval was not required for this case report.

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1058-2746/$ - see front matter
http://dx.doi.org/10.1016/j.jse.2013.03.013

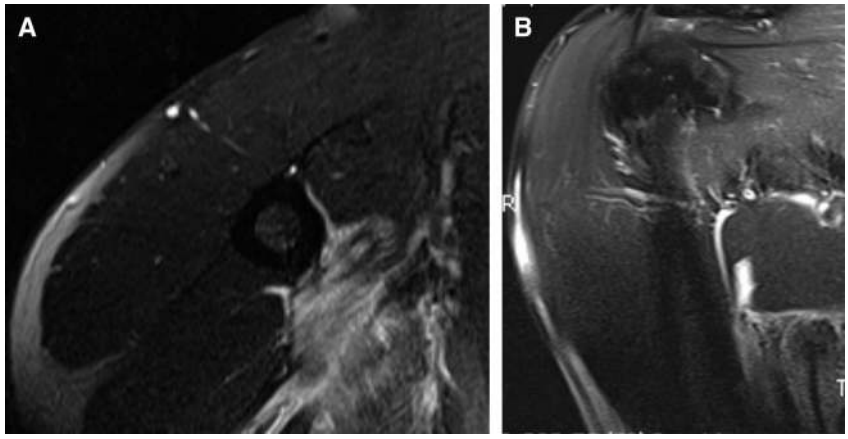

Figure 1 Preoperative (**A**) axial and (**B**) coronal magnetic resonance images show the latissimus dorsi avulsion injury, with tendon retraction of ~4.5 cm from its insertion on the proximal humerus.

The physical examination revealed ecchymosis and a soft tissue prominence in the right posterior axilla, and significant weakness with resisted adduction with the arm at 90° of abduction. Magnetic resonance imaging demonstrated complete avulsion of the distal LD tendon from its insertion on the humerus with approximately 5 cm of retraction, with increased fluid signal intensity extending from the insertion site on the humerus to the retracted LD muscle belly (Fig. 1). The pectoralis major and teres major tendons appeared intact.

Treatment options were discussed with the patient, and multiple expert consultations throughout the United States were obtained. Nonoperative management with a brief period of immobilization, followed by rehabilitation with range of motion exercises and progressive strengthening, was discussed with the patient. A surgical option was also discussed, including primary open repair of the LD tendon back to its anatomic insertion on the proximal humerus. The risks and benefits of operative vs nonoperative management were discussed at length, and given the patient's desire for an expeditious return to pitching at a preinjury functional level, he consented to the surgical intervention with anatomic repair of tendon to bone.

Eight days after the injury, the patient was taken to the operating room for primary repair of the LD avulsion injury.[6] Briefly, he was placed in a semimodified beach chair position. A 4-cm anterior axillary incision was made in the subpectoral area approximately 1-cm medial to the bicipital groove and parallel with the axillary fold to avoid scarring and minimize cosmetic deformity.

The interval between the pectoralis major and the short head of the biceps was used to allow for visualization of the normal LD insertion site along the medial border of the bicipital groove, taking care to avoid the radial nerve. The bare insertion of the LD on the proximal humerus was identified (Fig. 2). A finger was then slipped over the TM tendon and traced proximally and posteriorly in an attempt to retrieve the LD tendon edge from within the axilla. With retraction >5 cm from its insertion, direct visualization of the retracted tendon edge was not possible, despite a palpable tendon edge with the finger.

Given concern that blindly clamping the tendon might place the radial nerve at risk, a second posterior axillary incision was made for tendon retrieval. With the patient's arm abducted overhead by an assistant, a 3-cm incision was made directly overlying the palpable edge of the LD tendon in the posterior axillary fold, and sharp dissection was used to reach the tendon edge. The tendon was then secured with two No. 2 Ethibond sutures (Ethicon, Somerville, NJ, USA) in a running Krackow fashion and passed from the posterior to anterior axillary incisions using a clamp (Fig. 3).

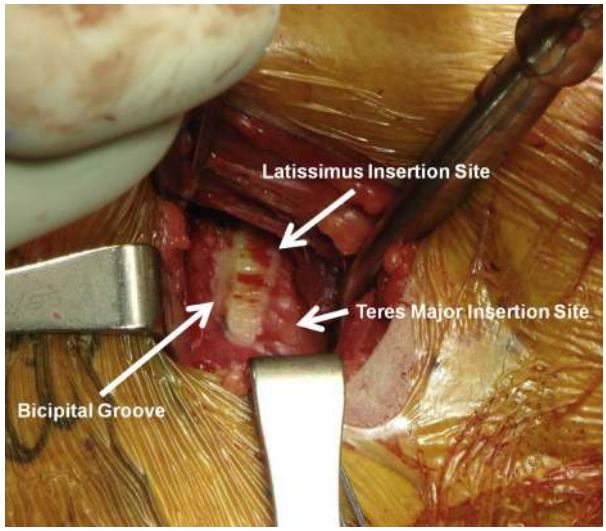

Figure 2 Dissection through an anterior axillary incision to the proximal humerus reveals the bare area of latissimus tendon avulsion from its insertion on the bone.

Before repair, the bony insertion site was lightly decorticated using a bur to create a bleeding bed for healing, and the tendon was repaired using 3 points of bony fixation with supplemental soft tissue fixation. Three suture anchors (Mini G2 Anchor, Mitek Surgical Products, Westwood, MA, USA) were placed, 1 each at the superior, middle, and inferior border of the footprint, respectively. The tendon was then secured to bone using a combination of simple, mattress, and Mason-Allen type suture configurations, along with supplemental soft tissue fixation of the LD to the TM tendons (Fig. 4).[6] The arm was taken through a gentle

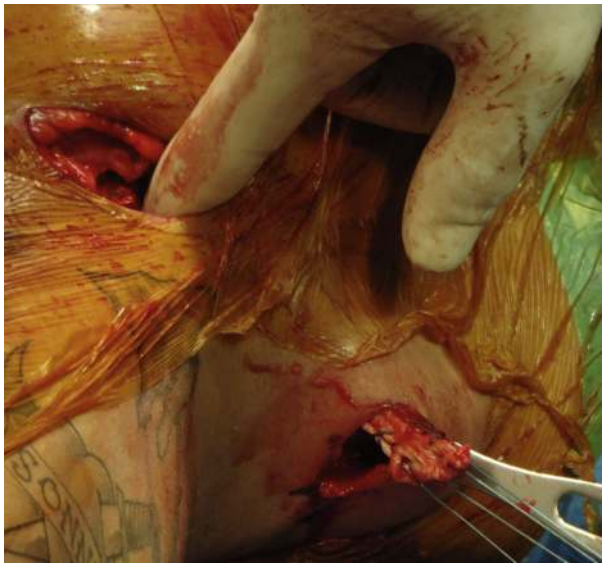

Figure 3 Latissimus tendon retrieval from a posterior axillary incision demonstrates a clean, smooth, tendon edge, with minimal fraying; The tendon was secured with two No. 2 Ethibond sutures to facilitate passing of the tendon from the posterior to anterior incisions.

range of motion to confirm that the repair was adequate before closure.

Postoperative course

Postoperatively, the patient followed rehabilitation principles similar to those outlined in Table I. At the 6-week visit, range of motion testing with the patient supine demonstrated passive and active forward elevation to 150°, external rotation (at 90° of abduction) to 50°, and internal rotation to 20° without pain. By the time of spring training in April 2011, 30 weeks after repair, he was fully participating in throwing activities and pitching in spring training games.

Two-year follow-up

By the start of the following season (8 months after surgery), the patient had regained full preinjury strength, velocity, and control, and resumed his role as a starting pitcher in Major League Baseball. There were no structural abnormalities of his latissimus tendon throughout the season, and magnetic resonance imaging at the 1-year follow-up demonstrated an intact tendon without evidence of tear, edema, or fatty infiltration (Fig. 5).

Individual statistics compiled during the 2012 baseball season (2 years after surgery) include a win-loss record of 11-12, an earned run average (ERA) of 3.37, 4 complete games, and 1 shutout in 32 starts, and 194 strikeouts in 219.0 innings pitched. The patient's pitching statistics are comparable to his overall career numbers (120-93 with a 3.46 ERA over his 11-year professional career). Further, the pitcher was named to the All-Star Team for the 83rd Major League Baseball All-Star Game in July 2012.

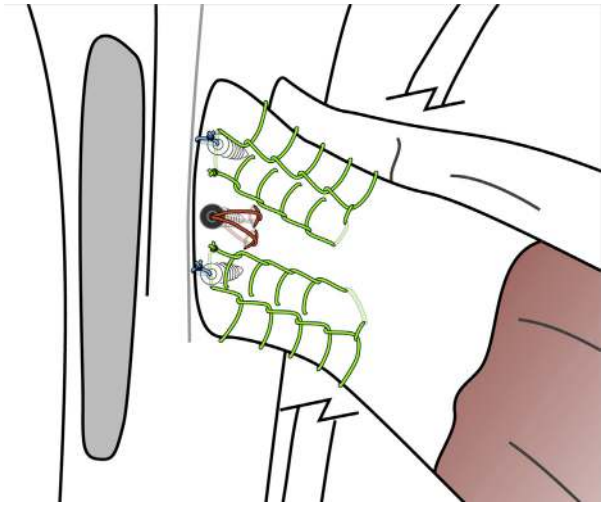

Figure 4 Anatomic illustration shows primary repair using 3-point bone-to-tendon fixation.

Table I Rehabilitation schedule after primary open repair of acute latissimus dorsi avulsion

Weeks postsurgery	Rehabilitation
0-2	Sling with abduction pillow; no shoulder ROM
2-6	Sling with abduction pillow; progressive passive ROM shoulder only
6-12	No sling; progressive passive and active ROM exercises, isometric and light stretching exercises initiated
12-16	Light throwing program
20-30	Spring training; full return to pitching

ROM, range of motion.

Discussion

Avulsion injuries of the LD tendon typically present in an acute fashion in throwing athletes. The pitcher may describe a sudden, severe onset of pain in the upper arm and posterior axilla, usually occurring during the late cocking or acceleration phases of the throwing cycle, with persistent symptoms during release and follow-through.[23] This may or may not be associated with prodromal symptoms.

Previous published reports are mixed with regard to how to treat these injuries. A number of case reports document successful short-term outcomes with nonoperative management in nonthrowing athletes.[1,4,24] Others have reported successful outcomes with operative repair of acute LD tears in nonthrowing athletes such as competitive water skiers,[12,17] professional wrestlers,[11] steer wrestlers,[13] and rock climbers.[18] Barnes et al[2] were the first to report a latissimus rupture in a professional baseball player treated operatively, but no specific details of the case are provided

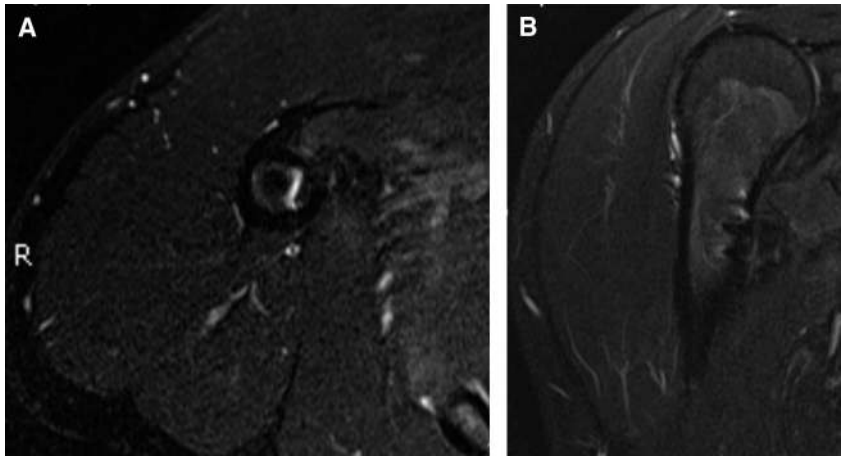

Figure 5 Postoperative (**A**) axial and (**B**) coronal magnetic resonance images of the latissimus dorsi avulsion injury demonstrate anatomic repair of the tendon to the bone.

in their report. Schickendantz et al[23] were the first to report 5 cases of acute isolated latissimus injuries in Major League Baseball pitchers treated nonoperatively. All athletes returned to pitching within 1 year, with 1 rerupture of the latissimus tendon after 6 months. The post injury velocities, strength assessment, and longevity in the Major Leagues for each pitcher were not presented.

Most recently, Nagda et al[19] retrospectively reviewed 16 professional baseball pitchers diagnosed and treated with a LD or TM strain or avulsion between 2002 and 2008, comprising 2 isolated LD avulsions, 3 isolated TM avulsions, 1 combined injury, and 10 LD or TM muscle strains. All patients were treated nonoperatively with rest, rehabilitation, and return to pitching after a throwing program, with successful return to play in 15 of 16 pitchers (94%) and a mean time to throwing of 35.6 days. The authors concluded that nonoperative treatment of LD and TM injuries was successful in allowing professional pitchers to return to high-level activity. Interestingly, however, their data grouped isolated LD avulsion injuries with isolated TM injuries, combined injuries, and muscle strains, making it difficult to extrapolate their conclusions to isolated LD injuries alone. For example, the authors presented 2 athletes with isolated LD avulsion injuries treated nonoperatively. One sustained a reinjury, with a subsequent TM avulsion, 13 months after the primary LD rupture, and the other returned to throwing activities at 120 days (compared to average return to throwing of 35.6 days for the group), suggesting that return to play after LD avulsion injuries may be longer than for TM avulsions and muscle strains. Muscle strains are different injuries with respect to energy, soft tissue damage, edematous changes, and healing potential, and grouping these injuries may underestimate the necessity for more aggressive intervention with LD avulsion injuries. Finally, the amount or degree of tendon retraction after avulsion injuries was not reported, potentially confounding the results because this may significantly affect the ability of a tendon to heal nonoperatively without functional or strength limitations.

One potential risk of treating isolated LD avulsions nonoperatively includes the possibility of strength deficits after the injury. The literature is replete with studies reporting a loss of latissimus muscle strength after takedown for use as a free flap or pedicle flap in reconstructive surgery, most notably with shoulder extension and adduction, as strength deficits of up to 20% have been reported.[3,7,22] In noncompetitive or recreational athletes, these functional deficits may go unnoticed and play a minimal role in everyday activities; however, this deficit may be more pronounced in the competitive throwing athlete with high functional shoulder demands.

Another risk of nonoperative repair of LD avulsion injuries is the potential compromise of a future operative intervention. Many authors have advocated early anatomic repair of these injuries,[10,11,16,20] whereas others treat latissimus ruptures in a conservative manner initially, and if it fails, proceed to delayed repair or reconstruction. In recreational athletes with latissimus avulsion injuries, Cox et al[5] reported good results with surgical repair of 2 subacute (>6 weeks) LD tendon ruptures through a single-incision posterior axillary approach; however, they suggested that surgical intervention occurring more than 2 months after injury could potentially preclude anatomic restoration of the tendon, most likely due to retraction of the tendon and buildup of subsequent scar tissue.

Operative intervention is not without risk as well. The technique reported here theoretically minimizes the risk for nerve injury (ie, radial nerve), but there is a potential for neurologic damage with any open procedure close to the axilla. A thorough knowledge of anatomy is required to perform the procedure, and ideally, it should be performed by a surgeon comfortable with open shoulder techniques. Further surgical risks, such as vascular compromise, infection, persistent pain and functional limitations,

risk of rerupture, and the buildup of scar tissue, may potentially inhibit clinical outcomes and increase the difficulty of revision surgery, if required. The prevalence of these risks after surgical treatment is currently unknown.

Conclusion

There have been few reports in the literature on acute LD avulsion injuries in pitchers, with previous case studies supporting the use of nonoperative management in these patients. However, primary open repair of acute LD avulsion injuries may allow for successful return to play at a high level in professional throwing athletes, with potentially lower risks of recurrence or functional deficits, or both. This case demonstrates that, in high-level throwing athletes with an acute avulsion of the LD tendon treated surgically with direct anatomic repair using suture anchors, one may achieve excellent clinical and functional outcomes and successful return to play at a preinjury level. Further studies are warranted to better elucidate the advantages and disadvantages of nonoperative vs operative treatment of these injuries in elite athletes.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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