Latissimus Dorsi Tendon Rupture Repair: A Surgical Technique Video Case Report and Cadaveric Anatomic Demonstration

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Abstract: Isolated latissimus dorsi tendon rupture is an exceedingly rare injury with a paucity of literature available to help guide management. The anatomy of the posterior aspect of the axilla and chest wall is complex. Nonoperative treatment has been described as an acceptable form of management for these injuries. A small subset of case reports and case series also show success with latissimus dorsi repair. We show a one-incision technique for repair of a humeral-sided avulsion of the latissimus dorsi tendon.

Isolated latissimus dorsi tendon (LDT) rupture is an exceedingly rare injury with a paucity of literature available to help guide management. This injury is most described in overhead athletes and the military population. The mechanism of injury can occur when the shoulder is in a hyper-abducted, externally rotated, and hyperextended position. Other mechanisms for rupture could be attributable to eccentric load on the LDT.[1] In professional pitchers, having a greater workload or being a starting pitcher has been shown to increase the risk of LDT tears.[2] The anatomy of the posterior aspect of the axilla and chest wall is complex. The latissimus dorsi has broad origins, including the iliac crest, lumbar fascia, thoracic vertebrae, and lower ribs, and inserts on the floor of the bicipital groove of the humerus after externally rotating 90°.[3]

Although literature on the subject is scarce, nonoperative management of LDT tears has been described as an acceptable form of treatment for some patients, taking into consideration the patient's lifestyle and symptoms.[4] Treatment typically consists of a brief period of rest followed by rehabilitation, focusing on range of motion, and strengthening exercises. A small subset of case reports and case series also show success with latissimus dorsi repair.[5] Surgical treatment may use suture anchors, buttons, acellular dermal allografts, or transosseous sutures[3,6,7] and has shown good results regarding return to play and premorbid level of function. Surgical intervention is usually reserved for high-level competitive athletes or those involved in martial arts and hand-to-hand tactical combat, such as law enforcement and the military. A recent study showed improved outcomes in professional cricket players[8] and performance in professional pitchers with surgical repair compared with nonoperative treatment.[9] Patients may report symptoms including pain in the posterior axilla and loss of motion and strength with isolated LDT injuries. In overhead athletes, such as pitchers, loss of terminal motion is often reported.[1] Provocative testing of LDT injuries with resisted adduction and humerus extension typically reproduces pain as well as clinical deformity. LDT injuries are diagnosed based on clinical suspicion and confirmed with magnetic resonance imaging (MRI).

There are minimal available resources within the literature and online video catalogs to help guide surgical technique for isolated LDT primary repairs. We show a one-incision technique for repair of a humeral-sided avulsion of the LDT (Fig 1). The surgical team had access to a cadaver through a local orthopedic surgery residency program. Prior to the case, the operating surgeon recorded a video of the cadaveric dissection

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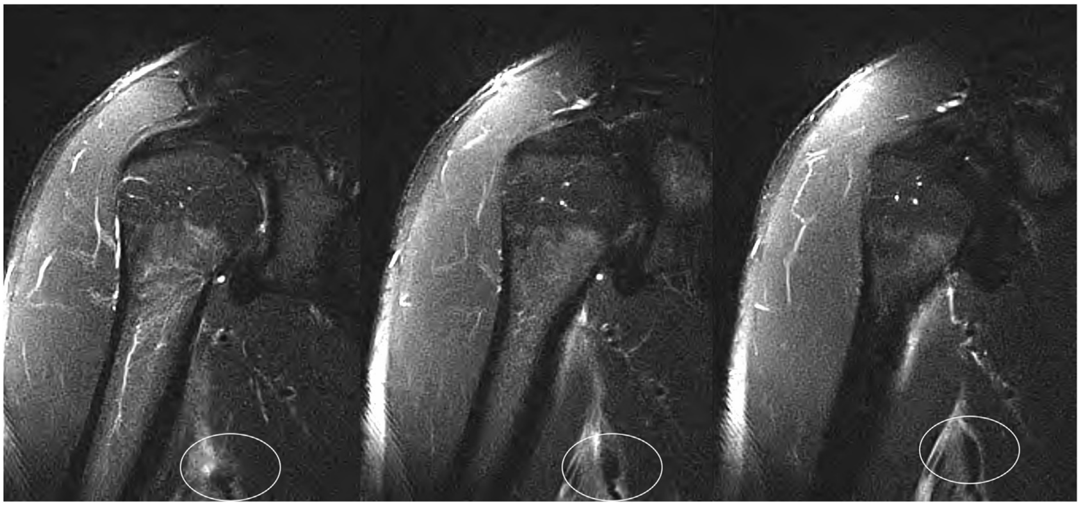

Fig 1. Coronal cuts of the shoulder MRI, revealing a retracted LDT tear, circled in white. (LDT, latissimus dorsi tendon; MRI, magnetic resonance imaging.)

that included labeling of all pertinent anatomic structures to help guide other surgeons in this technique (Figs 2-4). We found that a cadaveric dissection may be particularly helpful given that the arm is positioned in a forward flexed, internally rotated position during the procedure, whereas most anatomic drawings are shown with the arm in neutral flexion and rotation. The surgical procedure was also documented in video format.

Evaluation, Imaging, and Indications

Patients may report symptoms including pain and loss of motion and strength with isolated LDT injuries. Pain is typically reported in the posterior axilla. In acute injuries, bruising can be seen along the axilla and chest wall and the medial brachium. In overhead athletes, such as pitchers, loss of terminal motion is often reported.[1] Provocative testing of LDT injuries with resisted adduction and humerus extension typically reproduces pain as well as clinical deformity. Initial imaging in the form of plain films is generally unremarkable. LDT injuries can be confirmed with MRI of the affected shoulder. Depending on the amount of retraction of the tendon, an MRI of the chest wall may be needed. It is the opinion of the authors that active patients, patients who are high-functioning athletes,

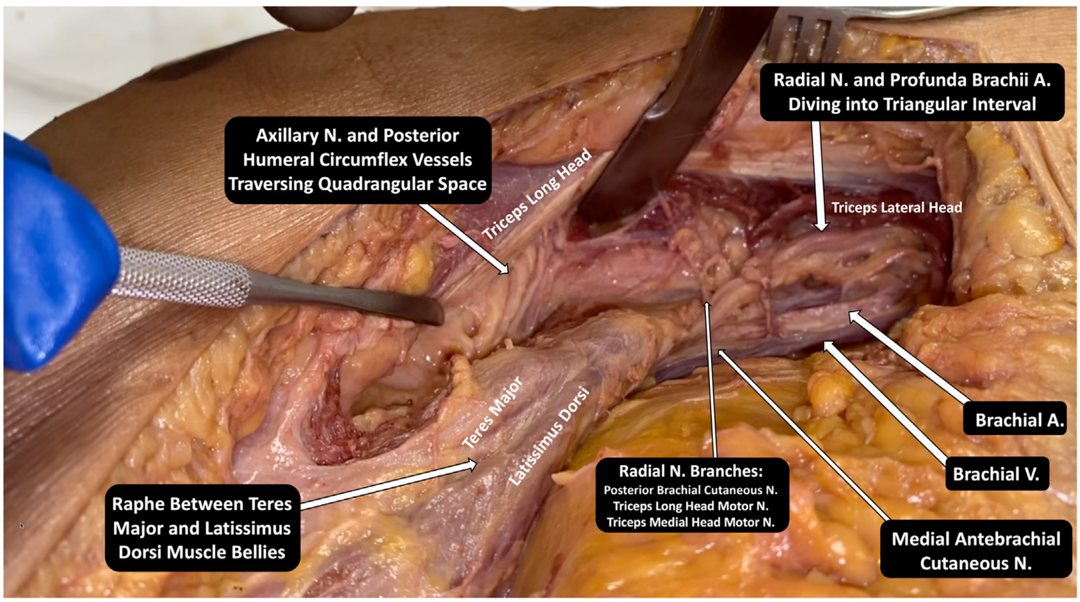

Fig 2. Cadaveric dissection of the latissimus dorsi and teres major muscle and tendon units with surrounding anatomic structures labeled. Triceps long head tendon is retracted here. Note the 90° external rotation torsion of the LDT. (A, artery; LDT, latissimus dorsi tendon; N, nerve; V, vein.)

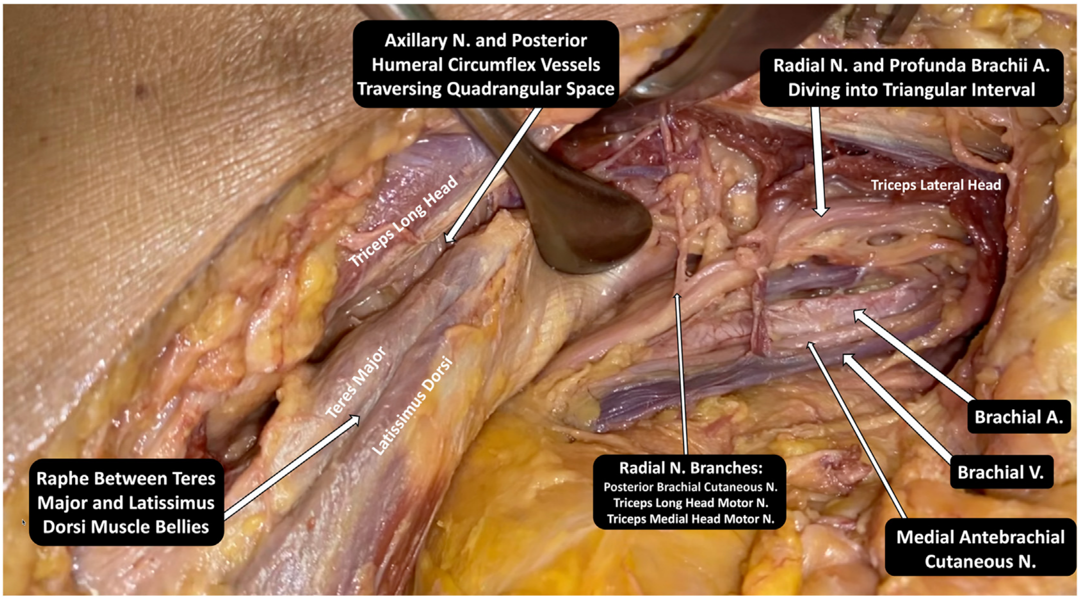

Fig 3. Cadaveric dissection of the latissimus dorsi and teres major muscle and tendon units with surrounding anatomic structures labeled. The triceps long head, teres major, and latissimus dorsi tendons are retracted here to better visualize the underlying neurovascular structures. (A, artery; N, nerve; V, vein.)

and patients who fail a trial of nonoperative management are indicated for LDT repair.

Surgical Technique

As described in Video 1, a hockey stick incision is made along the posterior axillary fold approximately 8 to 10 cm in each direction (Fig 5), adjusting the length caudally based on the degree of retraction noted on the preoperative imaging. Povidone-iodine is used immediately after the incision to help potentially minimize the risk of *Cutibacterium acnes* colonization. Blunt dissection is preferred when possible to help protect branches of cutaneous nerves, including the posterior brachial cutaneous nerve. The superior border of the teres major tendon is then exposed. Fascial bands between the teres major and triceps are encountered during the exposure. Dissection is undertaken adjacent to the lateral edge of the teres major to look for the retracted latissimus tendon

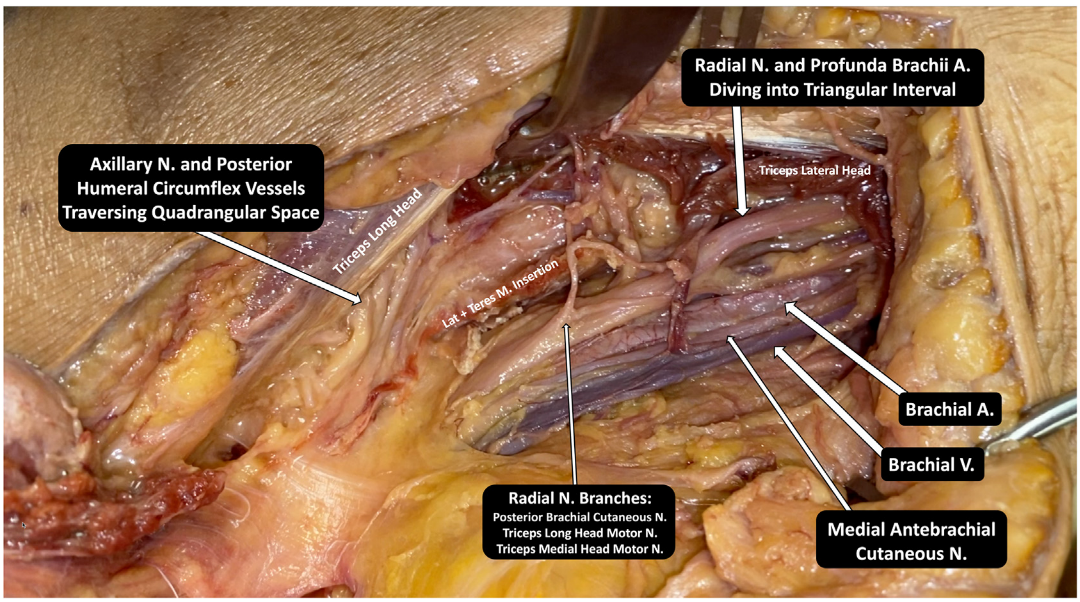

Fig 4. Cadaveric dissection of the latissimus dorsi and teres major muscle and tendon insertion point with the tendons resected from the humeral footprint. Anatomic structures are labeled. Triceps long head tendon is retracted here. (A, artery; N, nerve; V, vein.)

Fig 5. Depiction of the marked out hockey stick incision site for a right latissimus dorsi repair. Patient is positioned in a lateral recumbent position with the arm held at 90° of abduction.

(Fig 6). The injured latissimus dorsi tendon may be found to be scarred to the teres major here. Careful dissection is used to mobilize the ruptured tendon.

The tendon is mobilized and confirmed to have adequate excursion for repair (Fig 7). It is important to note that branches of the radial nerve are often found just distal to and overlying the teres major tendon insertion on the humerus.

Blunt right angle retractors are carefully placed to protect the axillary nerve and posterior humeral circumflex vessels superiorly and the radial nerve and brachial artery inferiorly. A curette is used to abrade the humeral footprint of the latissimus tendon insertion to a fresh bleeding bed (Fig 8). A burr can also be used, but we prefer a curette in the setting of an isolated LDT rupture given the smaller footprint for repair.

The tendon is then prepared for repair, and degenerative tissue is carefully debrided. Arthrex pectoralis buttons are used to repair the tendon to the bone. Parallel Krackow sutures are passed through the tendon using the FiberTape suture that accompanies the button kit (Fig 9). Depending on the width of the tendon, 2 or 3 rows of suture can be passed to prepare for 2 to 3 buttons. It is important to restore the 90° external rotation torsion of the tendon during the repair (Fig 10). The humeral footprint is visualized, and 2 unicortical holes are drilled, spaced approximately 2 cm apart (Fig 11). The Arthrex buttons are then individually loaded onto each row of Krackow suture and clamped. The button corresponding to the inferior tendon fibers is passed first into the proximal hole in the humerus, and the button corresponding to the superior tendon fibers is then passed into the distal hole (Fig 12). This ensures the 90° external rotation torsion of the tendon is restored. Once the buttons are passed and flipped, the tendon is

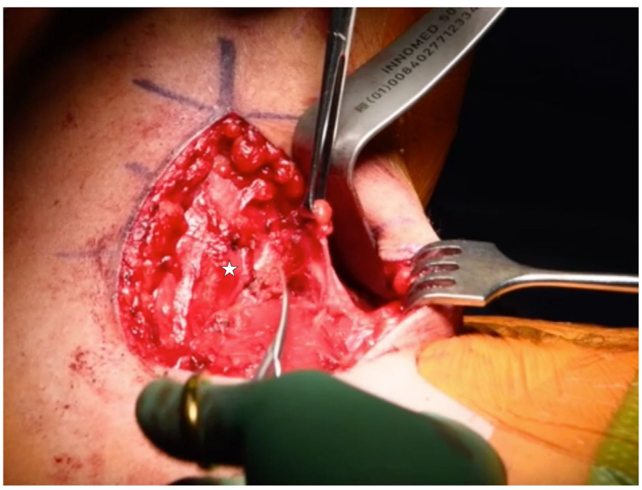

Fig 6. Demonstration of subcutaneous dissection of the right posterior axilla in a patient in a lateral recumbent position with arm held at 90° of abduction. Teres major tendon is marked with a star.

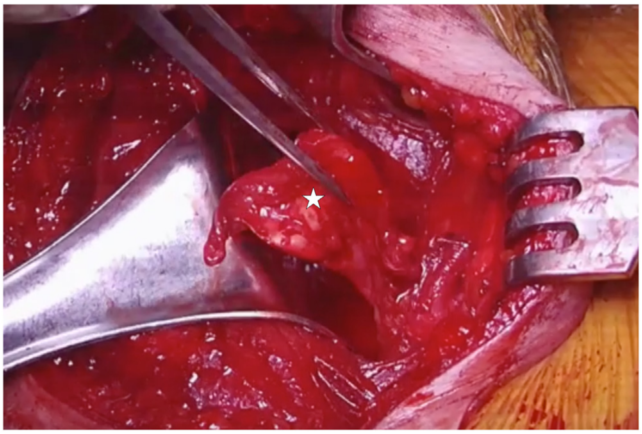

Fig 7. Demonstration of the right isolated LDT (starred) after it is dissected from the surrounding tissues. The tendon is shown to have adequate excursion. The patient is in a lateral recumbent position with the arm held at 90° of abduction. (LDT, latissimus dorsi tendon.)

Fig 8. The native latissimus dorsi footprint is exposed. A curette is used to abrade the humerus to prepare the bone to facilitate healing of the tendon repair. The humerus is marked with a star. The patient is in a lateral recumbent position with the arm held at 90° of abduction.

Fig 9. The LDT is shown with two FiberTape sutures placed through it in standard Krackow fashion. The LDT is marked with a star. The patient is in a lateral recumbent position with the arm held at 90° of abduction. (LDT, latissimus dorsi tendon.)

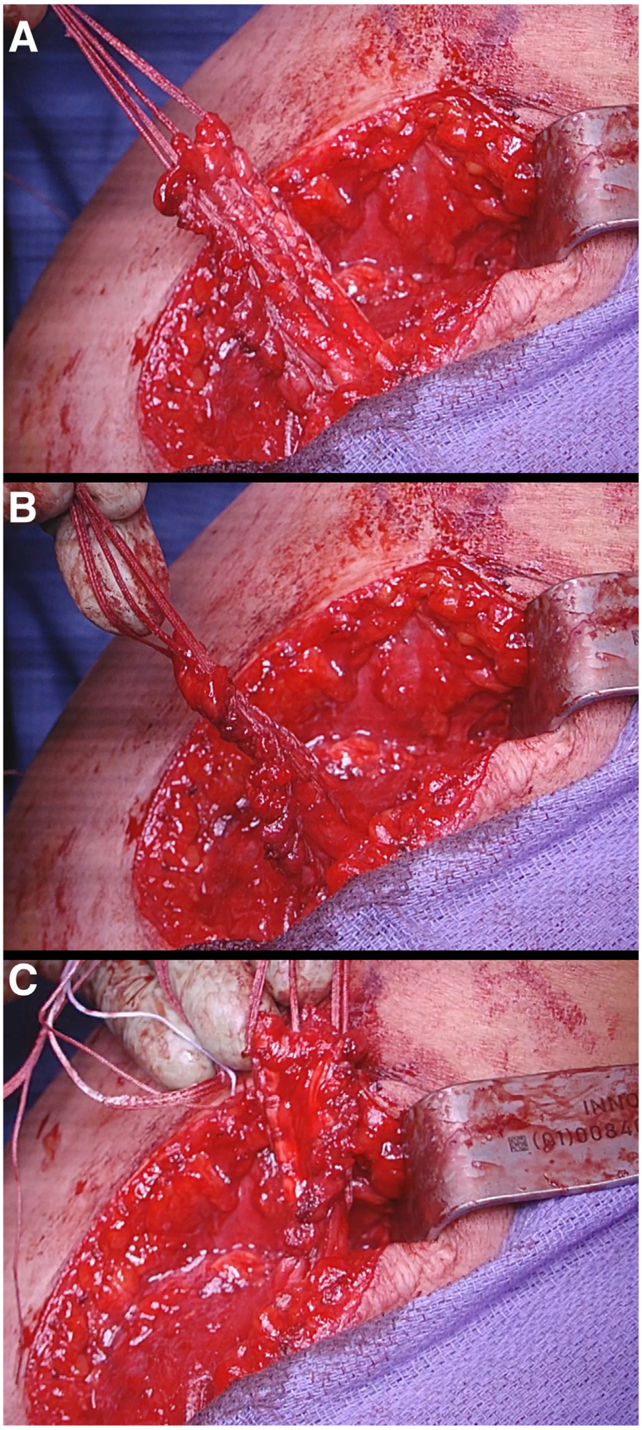

Fig 10. (A-C) Demonstration of the 90° external rotation torsion of the LDT. The patient is in a lateral recumbent position with the arm held at 90° of abduction. (LDT, latissimus dorsi tendon.)

tensioned (Fig 13). A reasonably forceful pull on the buttons confirms excellent fixation. A free needle is used to pass a limb of suture through the tendon. The sutures are then tied using an arthroscopic knot pusher and cut flush with the knot (Fig 14). The wound is then irrigated and closed in a layered fashion, protecting the posterior brachial cutaneous nerve, which is located on the posterior aspect of the triceps long head (Fig 15). A postoperative radiograph is obtained to evaluate for appropriate suture button placement and to ensure there are no iatrogenic humeral fractures (Fig 16).

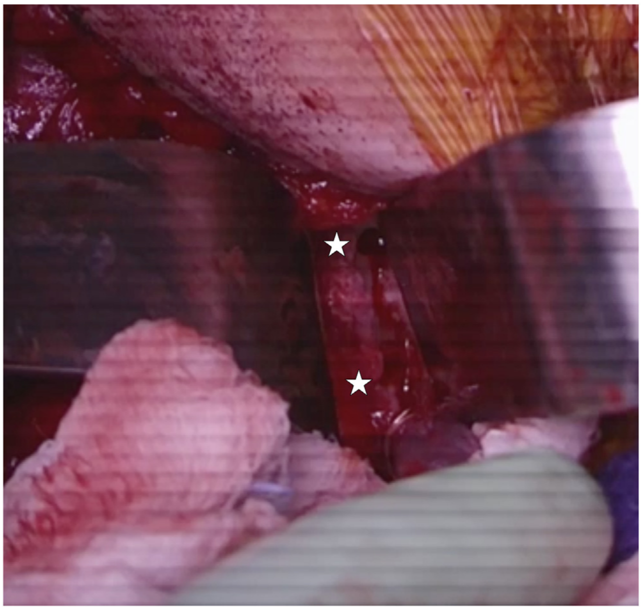

Fig 11. The humerus is shown with two unicortical drill holes placed approximately 2 cm apart. Drill holes are adjacent to the stars. The patient is in a lateral recumbent position with the arm held at 90° of abduction.

Discussion

The treatment of isolated LDT tears can be a challenging task for the surgeon and a difficult decision for the patient. Because of the rare nature of LDT injuries,

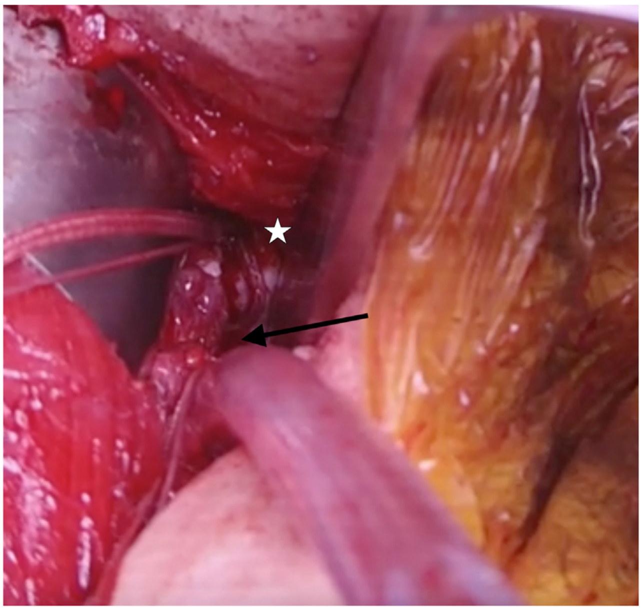

Fig 12. FiberTape suture from the inferior aspect of the tendon is shown inserted into the proximal drill hole. FiberTape suture from the superior aspect of the tendon is shown inserted into the distal drill hole. Proximal drill hole is marked with a star, and distal drill hole is marked with an arrow. The patient is in a lateral recumbent position with the arm held at 90° of abduction.

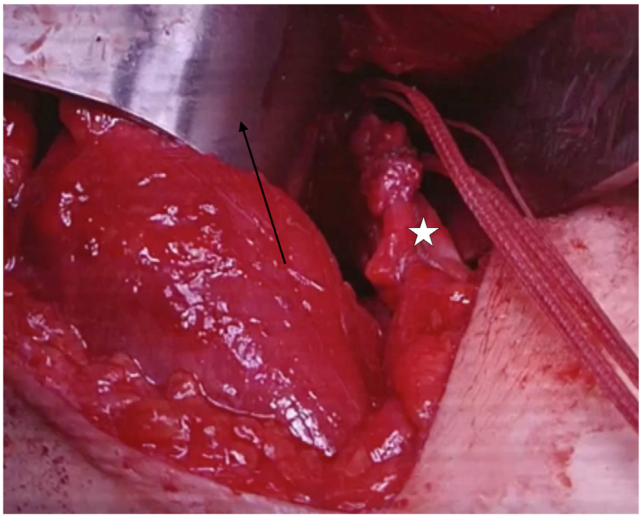

Fig 13. The LDT is shown repaired to the humeral footprint, paralleling the teres major insertion. The LDT is marked with a star, and the teres major tendon is marked with an arrow. The patient is in a lateral recumbent position with the arm held at 90° of abduction. (LDT, latissimus dorsi tendon.)

guidance as far as treatment has generally been limited to case reports or case series. Erickson et al.[3] have reported the largest surgical case series of these injuries and found excellent results, with return to the same level of competition. Nonsurgical treatment is the most commonly described treatment, with the exception being overhead athletes and those in need of optimal strength for work or competition. In the nonsurgical setting, patients may report discomfort in the posterior aspect of the shoulder and weakness with arm

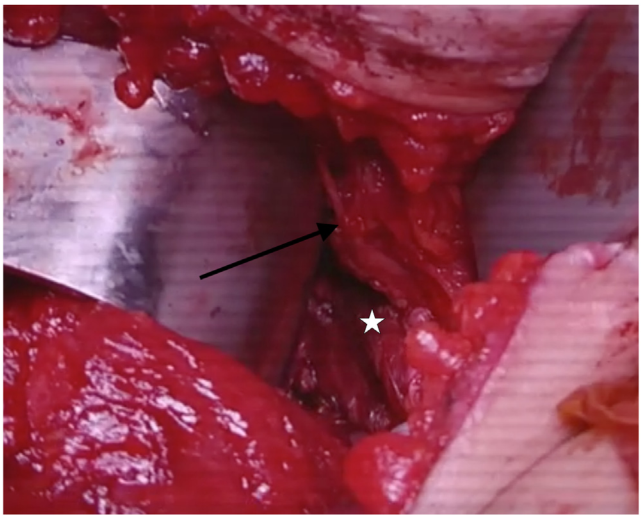

Fig 14. Repaired LDT (marked with a star). FiberTape sutures have been cut. Branches of the radial nerve are shown adjacent to the tendon (marked with an arrow). The patient is in a lateral recumbent position with the arm held at 90° of abduction. (LDT, latissimus dorsi tendon.)

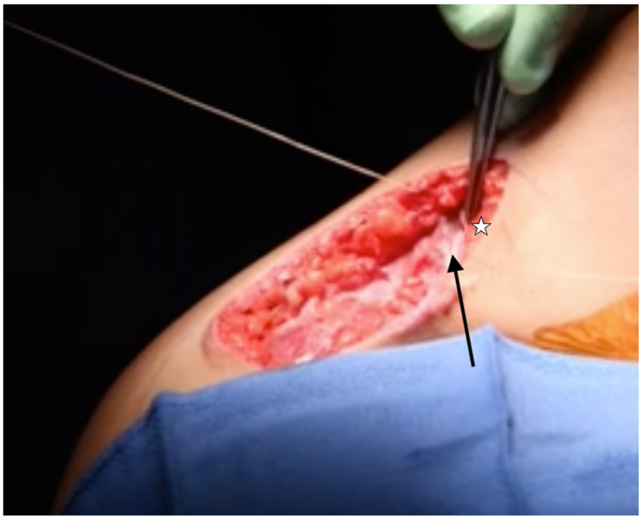

Fig 15. The wound is shown being closed in a layered fashion with care to protect the posterior brachial cutaneous nerve (star) along the posterior aspect of the long head of the triceps (arrow).

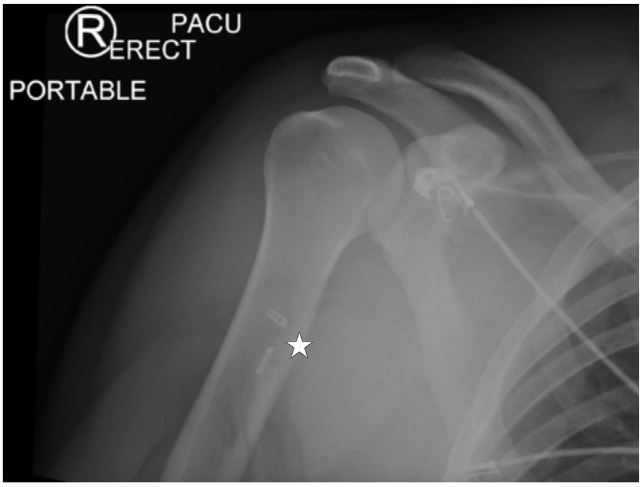

Fig 16. Postoperative AP radiograph of the right shoulder revealing two suture buttons in the humerus (marked with a star). (AP, anteroposterior.)

Table 1. Pearls and Pitfalls of LDT Repair

Pearls	Pitfalls
Use of a mobile arm holder is helpful for positioning.	Failure to carefully prepare and treat the skin edges during the approach can place the patient at higher risk of *Cutibacterium acnes* infection.
In the setting of an intact teres major tendon, the tendon can be traced and used as a landmark to find the humeral insertion as well as the torn end of the LDT.	Use of sharp retractors can place surrounding neurovascular structures at high risk during the procedure.
It is critical to restore the 90° external rotation torsion of the LDT.	A chronic LDT rupture may be more difficult to identify on MRI, as the hyperintense edema surrounding the injury will no longer be present and the tendon is quite thin.
Adhesions between the teres major tendon and LDT may be found and should be released to ensure adequate excursion for repair.	
When ready to insert the buttons, start with the more proximal button and progress distally to prevent the view of the footprint from being obscured.	

LDT, latissimus dorsi tendon; MRI, magnetic resonance imaging.

Table 2. Advantages and Disadvantages of Our LDT Repair Technique

Advantages	Disadvantages
We are able to use a single-incision approach. After review of the relevant clinical anatomy through the cadaver dissection, we are able to minimize the risk to critical neurovascular structures. Unicortical suture button allows strong fixation without the need for bicortical drilling.	Inherent risk to critical neurovascular structures because of the anatomy surrounding the LDT.

LDT, latissimus dorsi tendon.

adduction or extension; however, an appropriate rehabilitation program can achieve acceptable outcomes in certain patient populations. That said, we surmise that some of the tendency to treat these injuries nonoperatively may be in part attributable to an unfamiliarity with the surgical anatomy of the posterior axilla, which results in an intimidating approach to surgical repair. Frequently, these injuries are missed, resulting in a delayed diagnosis. In the Erickson et al.[3] case series, only 36% of patients underwent surgical intervention by 6 weeks. The mean time to surgery was 389 ± 789 days. However, even in the face of delayed intervention, good outcomes can be obtained. In instances where primary repair cannot be achieved, repair augmentation has been described with good success.[10]

In patients who are deemed surgical candidates, careful discussion of the risks and benefits should be undertaken, especially given the complex anatomy and associated neurovascular risks. An understanding of the course of the delicate anatomic structures adjacent to the repair is paramount to avoid iatrogenic injury. Furthermore, restoring appropriate orientation of the disrupted tendon fibers and keeping in mind the 90° external rotation of the tendon are critical to anatomic repair. Patient positioning, number of surgical incisions, surgical approach, tendon augmentation, and tendon fixation are just a few of the many considerations that must be weighed prior to entering the operating room.

Pearls and pitfalls are listed in Table 1. We show a single-incision posterior midaxillary approach performed with the patient in the lateral decubitus position. Our access to a cadaver was instrumental in defining the critical neurovascular structures within the surgical field. We recognize that most surgeons do not have the privilege of a cadaver, and there is potential for significant neurovascular risk to the structures shown in Figure 14 during this procedure. The advantage (Table 2) of this technique is a single incision and extended access to the latissimus muscle belly and tendon as well as the humeral insertion. With this exposure and meticulous dissection and judicious retraction, these risks can be minimized.

Disclosures

The authors report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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