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Rupture of the short head of the biceps brachii and coracobrachialis tendon: repair with semitendinosus allograft

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Ruptures of the tendon of the long head of the biceps brachii are relatively common, but injury to the short head of the biceps (SHB) brachii and coracobrachialis is rare. Isolated SHB muscle belly injuries have been reported in the context of military parachute jumping,[14] gymnastics,[13] water skiing,[3] and blunt trauma.[21] Reports of biceps brachii ruptures occurring specifically at the proximal myotendinous junction are even more sparse, with a spectrum of treatment strategies contingent on the interval between injury and repair. Excellent outcomes have been described for isolated proximal short-head tears treated with surgery within several weeks of injury.[14,18] In these cases, reapproximation to either the coracoid or the intact coracobrachialis was possible. In contrast, Moorman et al[15] described operative treatment for a complete short-head myotendinous tear at 4 weeks after injury. The muscle was found to be necrotic, and the short head was excised. At 1 year postoperatively, the patient had normal supination strength yet markedly decreased elbow flexion. Nonoperative treatment has also been described for a complete SHB rupture and partial coracobrachialis tear, with an excellent outcome.[9] Several cases of isolated coracobrachialis ruptures have been reported, which were repaired with soft-tissue tenodesis to the intact SHB.[19,22]

We report a case of complete rupture of the SHB brachii and coracobrachialis tendons from their shared origin on the coracoid process. Repair with semitendinosus allograft was undertaken at 7 weeks after injury because of continued pain, limited range of motion (ROM), and lack of improvement with physical therapy. Chronic injury is difficult to address because of muscle retraction and tendon degeneration. Three-year postoperative follow-up was obtained.

Case report

A 41-year-old, otherwise healthy, left hand–dominant male patient was wakeboarding when his left arm became entrapped in the rope tow bar as he fell. The left antecubital fossa was ensnared by the rope and rope tow bar, and it absorbed the traction associated with the patient's fall at high speed. He had immediate pain and swelling of the arm and presented to an outside institution on the day of injury. Wrist radiographs identified an isolated ulnar styloid fracture, and the patient was placed in a sugar-tong splint and given a sling for comfort.

The patient presented to our institution's emergency department 2 days later with worsening ecchymosis about the left antecubital fossa and medial upper arm, along with a significant increase in swelling, pain, and tingling in the

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thumb and index finger (Fig. 1). He had weakness with elbow flexion and extension, as well as with pronation and supination. Radiographs of the shoulder, elbow, and forearm showed negative findings for a fracture, and the venous Doppler ultrasound results were negative for deep venous thrombosis. Elbow magnetic resonance imaging (MRI) was performed, and the distal biceps was found to be in continuity; the patient received a diagnosis of a high-grade strain without rupture. He was placed in a splint and observed in the emergency department overnight, given concern regarding his level of pain and swelling. During follow-up 3 days later, the patient was placed in a hinged elbow brace and instructed to begin gentle ROM exercises with supervised therapy.

As the pain and swelling in the forearm and antecubital fossa subsided, the patient described continued shoulder pain throughout supervised therapy. He was referred to the upper-extremity service at 5 weeks after injury, at which time the Subjective Shoulder Value (SSV) was 10%. On examination, a fullness in the anterior aspect of the shoulder was noted, and there was tenderness distal to the coracoid. An MRI study of the shoulder was ordered, which showed a complete tear of the myotendinous junction of the SHB with approximately 12 cm of distal muscle retraction. A complete tear was also found to involve the coracobrachialis muscle, consistent with a tear at the level of the conjoint tendon (Fig. 2). The patient was additionally evaluated for persistent altered sensation in the left thumb

Figure 1 Initial presentation to our institution's emergency department 2 days after injury. Ecchymosis of the elbow **(A)**, posterior shoulder **(B)**, and volar hand **(C)** was noted.

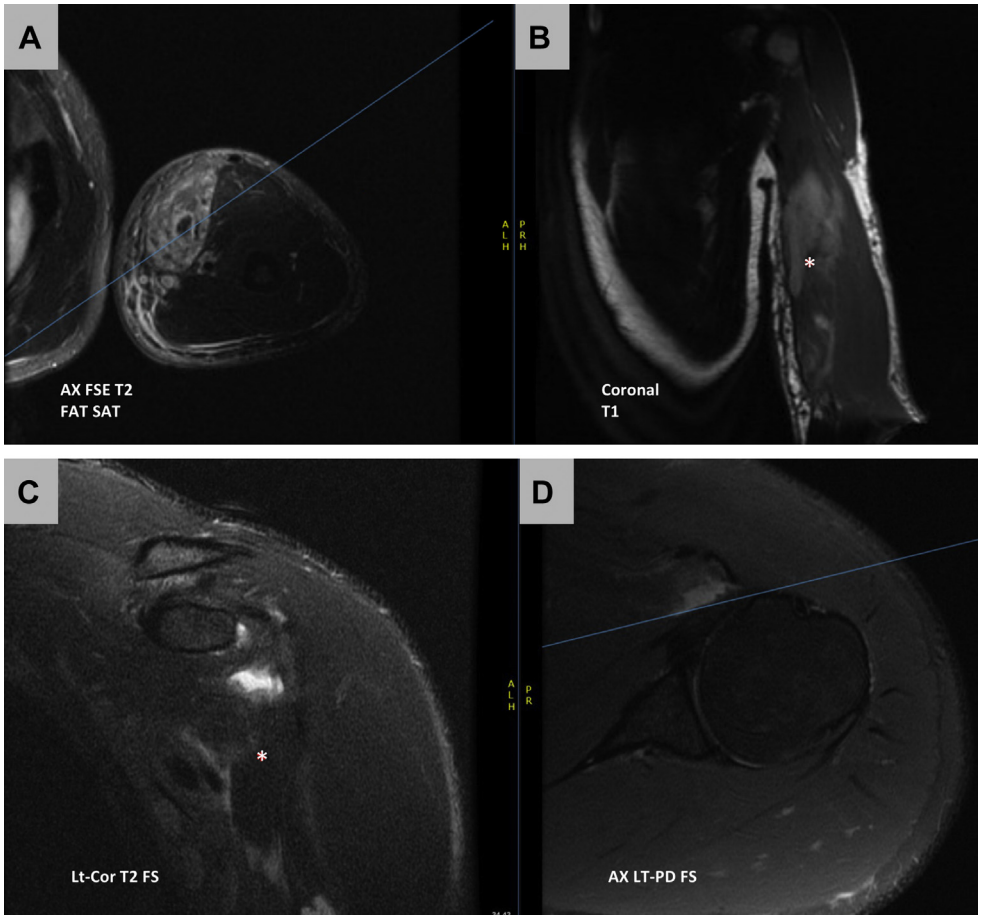

Figure 2 **(A-D)** Edema and retracted tear of short head of biceps tendon (*) noted on magnetic resonance imaging to anteromedial aspect of arm. One should note the denuded coracoid in **C**. Ax, Axial; FSE, Fast Spin Echo; FAT SAT, Fat Saturation; FS, Fat Suppression; Lt-Cor, Left- Coronal; LT-PD, Left- Proton Density. The *blue line* in 2A represents the anatomic plane of the corresponding coronal cut in 2B. The *blue line* in 2D represents the anatomic plane of the corresponding coronal cut in 2C.

and index finger, with concern for possible brachial plexus injury given the mechanism. The findings of neurodiagnostic tests were negative for any brachial plexus or peripheral nerve injury.

The patient elected to undergo surgical repair given his continued pain, limited ROM, and lack of improvement with physical therapy. At the preoperative appointment, he demonstrated shoulder forward flexion and abduction to 30°. His elbow flexed against gravity to 130° and extended to 30°, and he had forearm pronation to 80° and supination to 0°.

Surgical technique

Surgery was undertaken 7 weeks after the original injury. The biceps muscle belly and the musculocutaneous nerve were identified through the Henry approach. The nerve was carefully dissected as it passed into the muscular portion of the SHB. A 1.3-cm (0.5-inch) Penrose drain was passed around both heads of the pectoralis major for retraction (Fig. 3).

The long head of the biceps was isolated, and the conjoint tendon was identified distally in the presence of a large volume of scar tissue. The conjoint tendon comprised the myotendinous junctions of both the coracobrachialis and the SHB. An Allis clamp was placed on the remnant of the conjoined tendon distally, and No. 2 FiberWire sutures (Arthrex, Naples, FL, USA) were passed in Krackow fashion into the myotendinous junction. A 6 × 260–mm semitendinosus allograft was brought to the field. The allograft was woven in a Pulvertaft fashion into the proximal tendon (Fig. 4). Tension was placed on the muscle belly for a total of 15 minutes. The muscle tension was reasonable, allowing for the muscle to be advanced proximally an additional 3 cm. The proximal end of the graft was passed posteriorly to the pectoralis major tendon to reach the coracoid process. At the coracoid process, a limited remnant stump of conjoint tendon was visualized and defined. The proximal end of the graft was secured to the conjoint remnant using a Pulvertaft weave and thick nonabsorbable sutures (Fig. 5). The operative technique is demonstrated in Video 1.

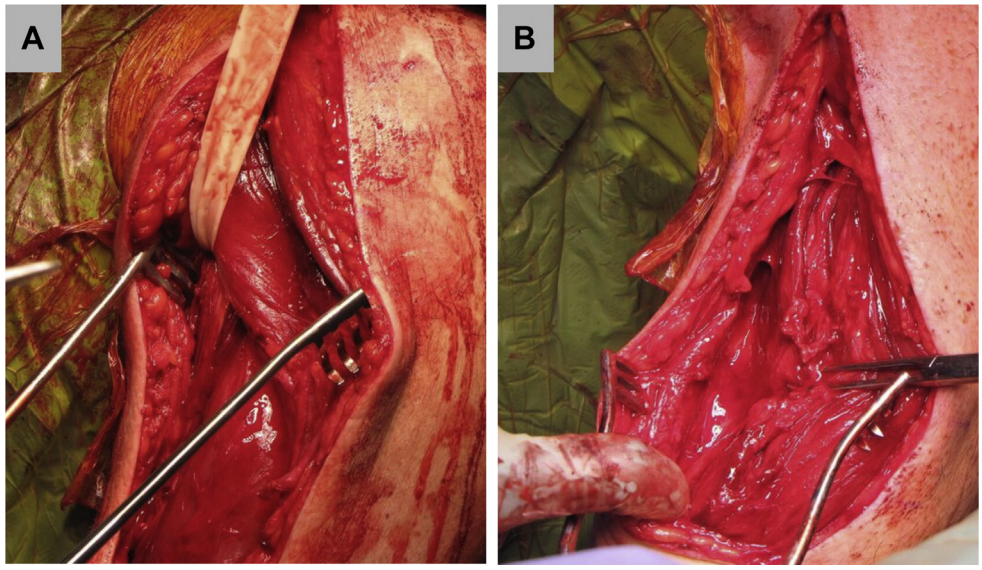

Figure 3 Proximal **(A)** and distal **(B)** exposure of torn short head of biceps tendon. The pectoralis tendon is retracted superiorly.

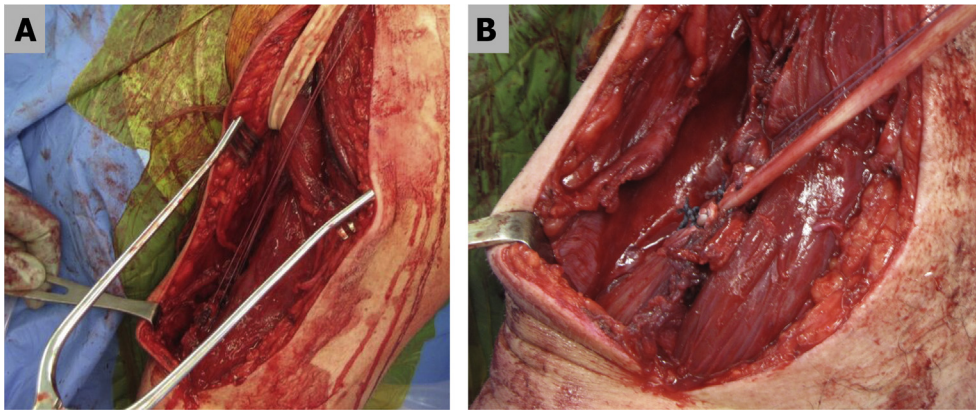

Figure 4 Retracted short head of biceps after Krackow suture placement **(A)** and after attachment of allograft tendon **(B)**.

Rehabilitation

The patient was maintained in a sling for 6 weeks. Active ROM with supervised therapy was initiated at 6 weeks. The patient progressed with gradual ROM and strengthening exercises between postoperative weeks 6 and 11. At 11 weeks postoperatively, he demonstrated progress with ROM of the elbow but had some symptoms of adhesive capsulitis. The glenohumeral joint was injected with a 9:1 mixture of 1% lidocaine and betamethasone. At 6 months postoperatively, the patient had regained full elbow flexion-extension and pronation-supination symmetrical to the contralateral side (Fig. 6). He ceased supervised physical therapy and returned to activities such as skiing.

At 7 months postoperatively, the patient reported an American Shoulder and Elbow Surgeons shoulder function score of 91.66, describing both lifting 4.5 kg (10 lb) above shoulder level and participating in usual sports as ''somewhat difficult.'' The SSV was 85%, with a visual analog scale pain score that ranged from 0 to 1 depending on activity level. The left upper extremity had a QuickDASH (short version of the Disabilities of the Arm, Shoulder and Hand questionnaire) score of 6.8, with the patient expressing difficulty with recreational activities in which some force or impact was taken by the affected arm.

At 36 months after surgery, the patient's American Shoulder and Elbow Surgeons shoulder score and SSV remained 91.66 and 85%, respectively. He indicated that his usual sports, golfing and mountain biking, are ''somewhat difficult.'' The visual analog scale pain score ranged from 0 to 1—with the higher score primarily following exercise.

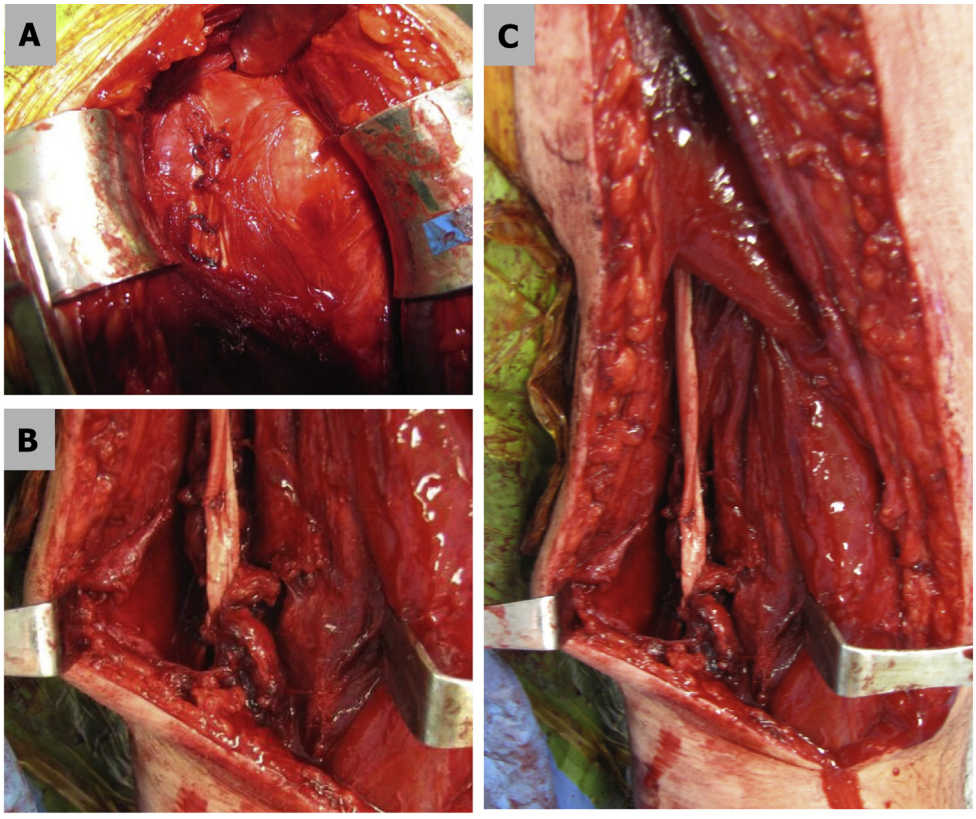

Figure 5 **(A)** Reapproximation of graft to coracoid. **(B)** Distal short head of biceps stump after appropriate tensioning. **(C)** Distal arm after tendon reattachment.

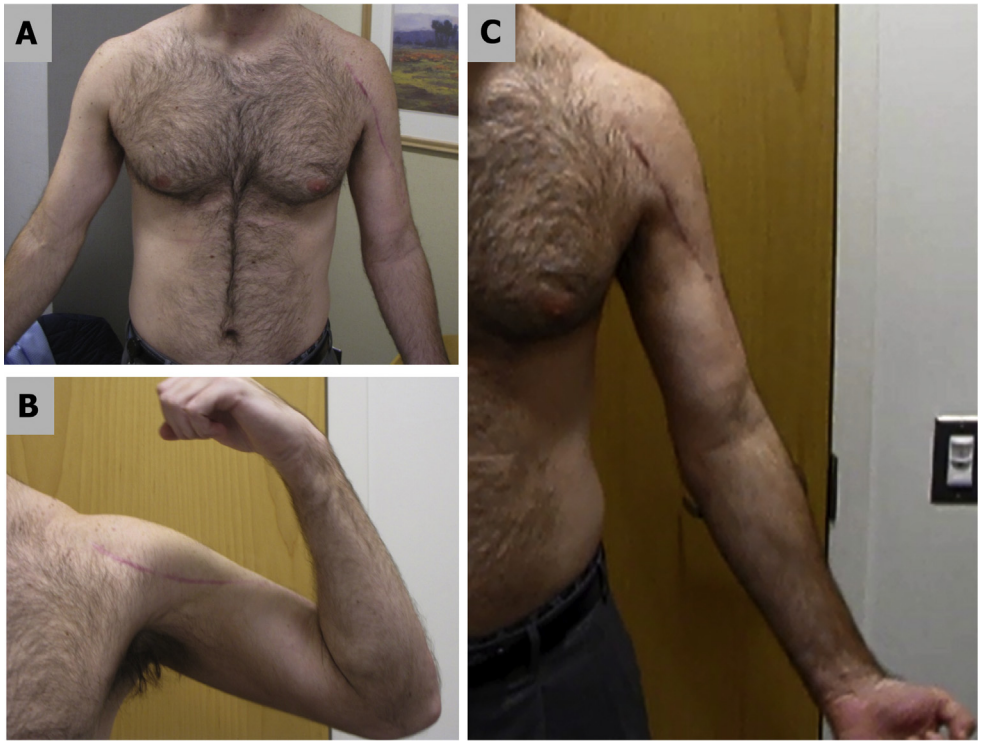

Figure 6 **(A-C)** Surgical scar and appearance of biceps contour at 23 weeks after surgery.

His only weight and activity limitation was his self-imposed avoidance of pull-ups or push-ups owing to his concern for the repair. The QuickDASH score remained 6.8. He had full strength and ROM with the extremity.

Discussion

This case of conjoint tendon rupture shares a similar mechanism with previously described biceps injuries: Biceps injuries occur at relatively high frequency during water sports involving the use of tow lines to pull athletes behind speedboats.[1,3,15,16] The anatomy of the SHB and coracobrachialis must be appreciated for diagnosis and treatment. Cadaveric study has described the SHB and coracobrachialis origins on the coracoid as a shared attachment in which the 2 muscles are largely indistinguishable, apart from lateral vs. medial positioning and diverging paths distally.[2] At the coracoid, tendon fibers from both muscles directly attach homogeneously to the shared conjoint tendon, which comprises a thick, ribbonlike tendinous aponeurosis over the anterior surface.[2] This reinforced origin may explain the proximal strength of these muscles and the rarity of myotendinous rupture.

For cases in which surgical treatment is elected, acute direct repair or tenodesis of the short head to the coracobrachialis tendon is recommended. Postacchini and Ricciardi-Pollini[18] reported that when retraction of the short-head tendon stump prevents coracoid reattachment, the short head can be attached to the remainder of the intact coracobrachialis tendon. Moon et al,[14] describing a short-head musculotendinous lesion sustained by a military paratrooper, reported that reattachment to the proximal stump was possible despite a 3-week interval between injury and repair. The distal end of the biceps was reattached to the proximal stump with No. 2 nonabsorbable sutures through the muscle belly and fascia.[14] The coracobrachialis in this case was again found to be intact.

In isolation or in conjunction with SHB pathology, coracobrachialis ruptures are exceedingly rare. Saltzman et al[19] described the case of an anterior shoulder dislocation in a 57-year-old female patient after a fall from standing height, with MRI demonstrating a full-thickness coracobrachialis tendon rupture at the coracoid with medial and distal retraction. On exploration 2 weeks after injury, tenodesis to the lateral border of the SHB was performed with several No. 2 mattress sutures and a running baseball whipstitch.

An excellent result has been described with nonoperative management in the setting of a full-thickness rupture of the proximal SHB, with a concurrent partial tear of the coracobrachialis.[9] This injury was caused by a paratrooper's static line, which was inadvertently routed between the thorax and upper extremity. When the patient exited the plane, the arm was forced into abduction and external rotation. He was treated with a sling that maintained shoulder internal rotation and 90° of elbow flexion for 3 weeks, with increasing ROM and strengthening exercises. At 6 months' follow-up, symmetrical ROM was noted in all planes, with no pain. Strength was normal with the exception of weakened supination and deficits in peak elbow flexion torque.[9]

A high index of suspicion for a short-head rupture and possible coracobrachialis involvement should exist for injuries involving traction—from water sports involving tow lines, parachuting, or other activities. Blunt trauma directly to the arm also causes biceps injuries, although these injuries tend to cause damage to the muscle belly.[3,8,10,13,21] Although the patient may complain of distal symptoms, it is important to evaluate the shoulder and the cervical spine when this mechanism of injury occurs. Physical findings may include a palpable gap or defect in the medial upper arm, tenderness distal to the coracoid process, and fullness in the anterior aspect of the arm tender to palpation. The tingling and numbness in our case may have been due to a neurapraxia injury that had largely resolved by the time neurodiagnostic testing was performed.

Although an excellent outcome has been described with conservative management in a high-demand paratrooper,[9] surgical intervention should be considered for patients with persistent pain, continued deficits in ROM, or lack of improvement with physical therapy. If detected within several weeks of injury, myotendinous disruptions of the SHB or coracobrachialis can typically be repaired directly or via tenodesis.

In this case, the interval between injury and repair prohibited mobilization and reattachment to the coracoid, whereas the complete disruption of the conjoint tendon prohibited tenodesis. Allograft tendon reconstruction is an option for chronic tears of the hamstring, distal biceps, patellar tendon, and quadriceps.[4-7,11,12,17,20,23] Retraction and tendon degeneration are often encountered in chronic tears, further supporting the indications for allograft repair.

Conclusion

Our unusual case of rupture of the conjoint tendon highlights the severity of this injury. Although acute repair may allow for direct repair or tenodesis, chronic injuries may require additional reconstruction on account of tendinous retraction and degeneration. Principles of allograft tendon reconstruction were applied to this case, with a modest outcome.

Disclaimer

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Supplementary Data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jse.2020.01.104.

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