Thomas E. Goodwin, MD
Thomas M. Chopp, MD
Joseph R. Lynch, MD
Jared S. Johnson, MD
Michael R. Nieraeth, PA-C
Kiira Vazales, PA-C
Jeffrey "Jake" Griggs, PA-C

THE SHOULDER CLINIC
OF IDAHO P.L.L.C.

Distal Biceps Rupture and Repair
By Joseph Lynch, MD

Introduction

Distal biceps rupture is a rare injury thought to occur most commonly in the middle-aged male. It represents 3% to 10% of all biceps tendon injuries, and typically occurs as a single traumatic event resulting from an eccentric load placed on the flexed and supinated forearm.[5, 7] Conservative management of these injuries may lead to deficits in both flexion and supination strength. Formal testing typically demonstrates losses of 8% to 36% of forearm flexion strength and losses of 21% to 55% of forearm supination strength.[2, 7, 9]

Historically, distal biceps tendon ruptures were repaired through a single anterior incision.[4] This operative technique required excessive retraction to facilitate the placement of drill holes in the proximal radius through which sutures were passed and then tied. The excessive retraction led to injuries of the radial as well as posterior interosseous nerves and gave the single-incision techniques a poor reputation.

A two-incision technique was subsequently popularized by Boyd and Anderson, however this approach was compromised by an unacceptable rate of heterotopic ossification and radial synostosis leading to the development of a muscle-splitting two-incision technique.[3, 6, 8]

We advocate for a less extensive single-incision anterior technique which has evolved into a more "soft-tissue" friendly approach. It allows for easy preparation of the ruptured tendon and provides excellent terminal fixation. The operative technique utilized is one modified from the original single-incision Endobutton (Acufex Microsurgical, Inc, Mansfield, MA) technique described by Bain et al.[1]

Surgical Technique

The patient is positioned supine on the operating table with a hand table utilized to support the injured extremity. A general anesthetic is administered and the limb prepped in the usual sterile fashion. In the acute setting, (less three weeks from time of injury), a 3 centimeter (cm) incision is made longitudinally on the volar aspect of the forearm,

2 cm distal to the volar elbow skin crease, (Figure 1). The lateral antebrachial cutaneous nerve is identified and protected. The biceps sheath and enclosed tendon are identified by locating the hematoma present in the volar forearm. Often the distal end of the ruptured tendon can be palpated within the sheath. If the sheath remains intact it can be incised longitudinally and the distal end of the ruptured biceps tendon should be readily present.

The distal biceps tendon is delivered through the wound and tagged with a 2-0 non-absorbable suture, which can be used for manipulation purposes. The distal portion of the intact biceps sheath is then followed within the depths of the wound distally to identify the insertion site of the biceps tendon on the radial tuberosity. With the elbow held in extension and the forearm positioned in full supination the radial tuberosity is identified. Soft tissues are retracted gently with the aid of long right-angled retractors to confirm the identification of this osseous landmark.

Gentle traction on the tag suture yielding a mobile tendon, confirms that in the acute setting the distal biceps tendon can be repaired to its insertion site without additional auto- or allograft tissue. The biceps tendon is then prepared external to the volar skin incision. We commonly prepare the biceps tendon with a number 2 high-strength suture in a locking Krakow fashion so that the tendon is strongly secured. Once the distal biceps tendon has been prepared in this fashion, we then shuttle the ends of the suture through a metal cortical button which will provide secure fixation on the far aspect of the radial tuberosity.

The elbow is placed in extension and full supination and the distal portion of the intact biceps sheath is again followed within the depths of the wound distally to identify the radial tuberosity. Soft tissues are retracted gently with the aid of long right-angled retractors taking care to protect the surrounding neurovascular structures. The medial-most aspect of the tuberosity is exposed of any overlying soft tissue. A cortical window is then created into the medullary canal of the proximal radius large enough to receive the distal end of the biceps tendon. Care is taken to create this window as medial as possible on the radial tuberosity as this allows for a more anatomic repair and creates a stronger lever arm allowing the repaired biceps to be a more efficient during forearm supination.

Once the tunnel is adequately prepared and the biceps tendon suture successfully passed through the cortical button; the button is then introduced into the cortical window and "deployed" on the far aspect of the radius. The sutures previously passed through the cortical button can then be sequentially tightened to draw the ruptured biceps tendon into the prepared cortical window and medullary canal of the proximal radius. The sutures are then tied to firmly secure the tendon in the cortical window and medullary canal of the radius for anatomical healing. Fluoroscopic images, or plain radiographs, are obtained throughout the procedure to confirm the construct's location, (Figure 2).

After confirming proper placement, the forearm is taken through a range of motion including flexion, extension, pronation, and supination. Care is taken to note the extreme of extension which seems to place undo stress on the repair such that the rehabilitation can be modified as deemed necessary. The longer the delay to surgery the more likely that the arm will not easily acheive full extension at the time of primary repair. Gradual return of normal motion can be achieved safely during the rehabilitation process in such cases.

The incision is closed with buried absorbable suture and a sterile dressing is applied. The wound is inspected one week post-operatively and the patient is taught passive flexion/supination and active extension/pronation exercises. Active range of motion exercises are instituted 6 weeks post-operatively. Use of a hinged elbow brace with lock-outs to prevent inadvertent full extension loading can be used on a case by case basis. Lifting, flexing, and supinating against resistance is prohibited for the first 8 to 12 weeks. Full recovery is typically achieved by four months postoperatively.

Repairing A Chronic Rupture

In the setting of a chronic distal biceps rupture, (greater than 4 weeks), tendon retraction can be a formidable problem if reconstruction is attempted. MRI can be a useful adjunct in this setting, not only to confirm the diagnosis of a distal biceps rupture, but more importantly, to assess the severity of the retraction, (Figure 3).

In chronic situations where the patient elects to attempt a reconstruction and graft augmentation is thought to be necessary, it is the author's preference to use allograft achilles tendon as the graft of choice. The potential need for graft is discussed with the patient preoperatively, however, the determination of whether or not the graft is actually needed is made intra-operatively once the tendon has been mobilized and it's tissue quality and excursion in relation to the radial tuberosity have been determined.

The surgical incision is modified into a lazy "S" incision with the proximal limb coursing medially and the distal limb coursing laterally. This allows for greater exposure and isolation of appropriate neurovascular structures. During tendon mobilization care is taken to identify and protect the musculocutaneous nerve which should be lying on the superficial surface of the brachialis muscle. On occasion, it can be adherent to the undersurface of the ruptured and retracted biceps tendon, therefore, care should be taken during tendon mobilization.

The ruptured tendon may retract into the belly of the muscle and become adherent to itselft and require dissection to adequately prepare and mobilize the tendon for formal repair. One may consider using the lacertus fibrosis to augment the construct if it appears robust enough. If a graft is needed, it is prepared after assessment of the tendon quality and tendon excursion. The achilles tendon is first secured to the radial tuberosity as described in a primary repair with a cortical button and high strength suture. The proximal aspect of the achilles graft is then laid on top of the biceps muscle belly and sequentially tied on its periphery to the musculotendinous junction of the native biceps tendon. The repair is purposefully performed in 45 to 90 degrees of flexion so as to re-establish the native muscle-tendon length required for adequate strength and mobility. The arm is splinted following surgery to prevent motion until the first post-operative visit.

Rehabilitation following an allograft reconstruction for a chronic retracted repair will require the use of a hinged elbow brace. This brace is adjusted weekly for safe range of motion and to prevent undue tension on the repair which may compromise proper healing. Full extension is typically achieved six weeks post-operatively. Resistance exercises are then taught at the 8 to 12 week mark postoperatively. Full recovery commonly occurs between the 4 and 6 month mark postoperatively.

About the Author: Joseph Lynch, M.D., is certified by the American Board of Orthopaedic Surgery (ABOS), possesses a Certificate of Added Qualification in Sports Medicine from the ABOS, and maintains a full-time surgical practice. Dr. Lynch is a graduate of Harvard University, finished first in his medical school class at Oregon Health Sciences University, and completed a shoulder & elbow fellowship at the University of Washington. He has published numerous peer-review articles and has spoken nationally on a variety of topics concerning orthopaedic surgery.

For more information please visit: www.shoulderclinicofidaho.com
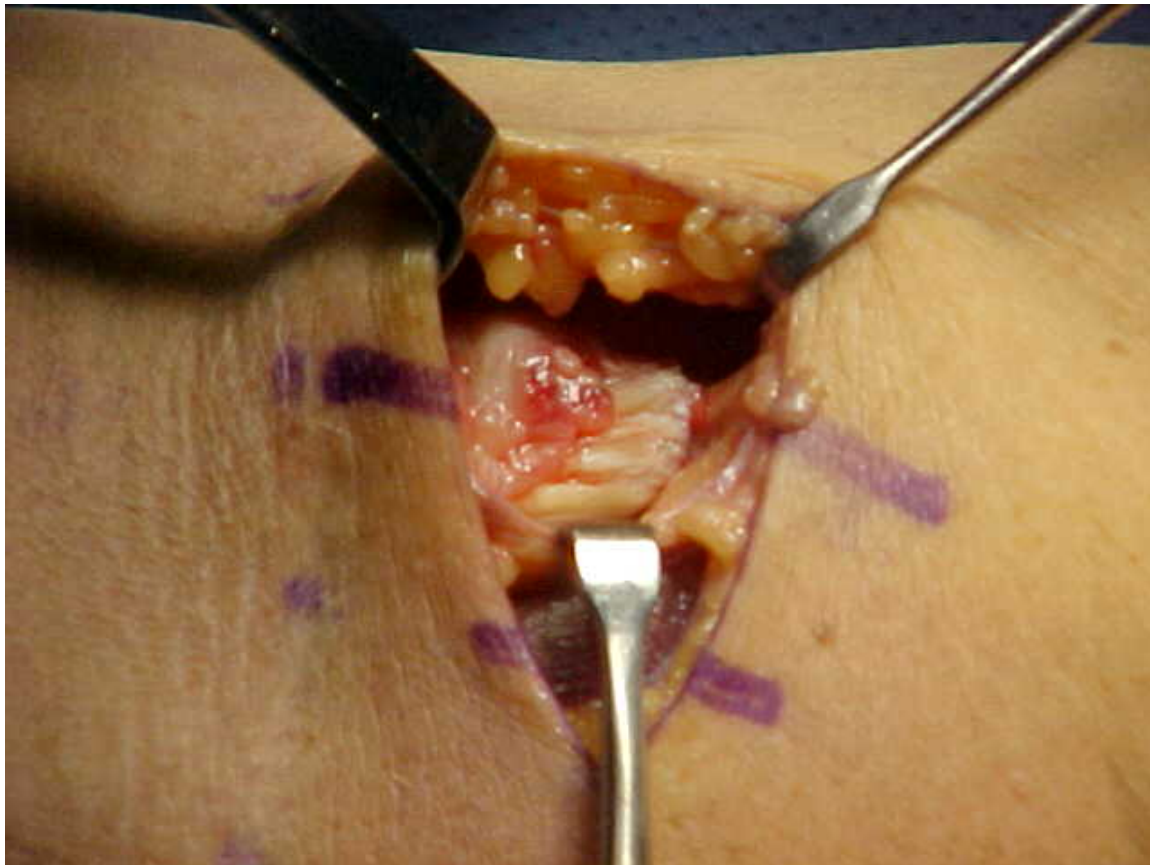
Figure 1 The incision is made 3 cm in length, two centimeters distal to the volar elbow skin crease. The ruptured biceps tendon, in the acute setting, can be visualized through this wound.

Figure 2 Anteroposterior and Lateral images of the proximal forearm in neutral rotation confirm the placement of the Endobutton on the dorsolateral cortex of the proximal radius. Note the close interposition of the Endobutton the radial cortex confirming the absence of soft tissue interposition.
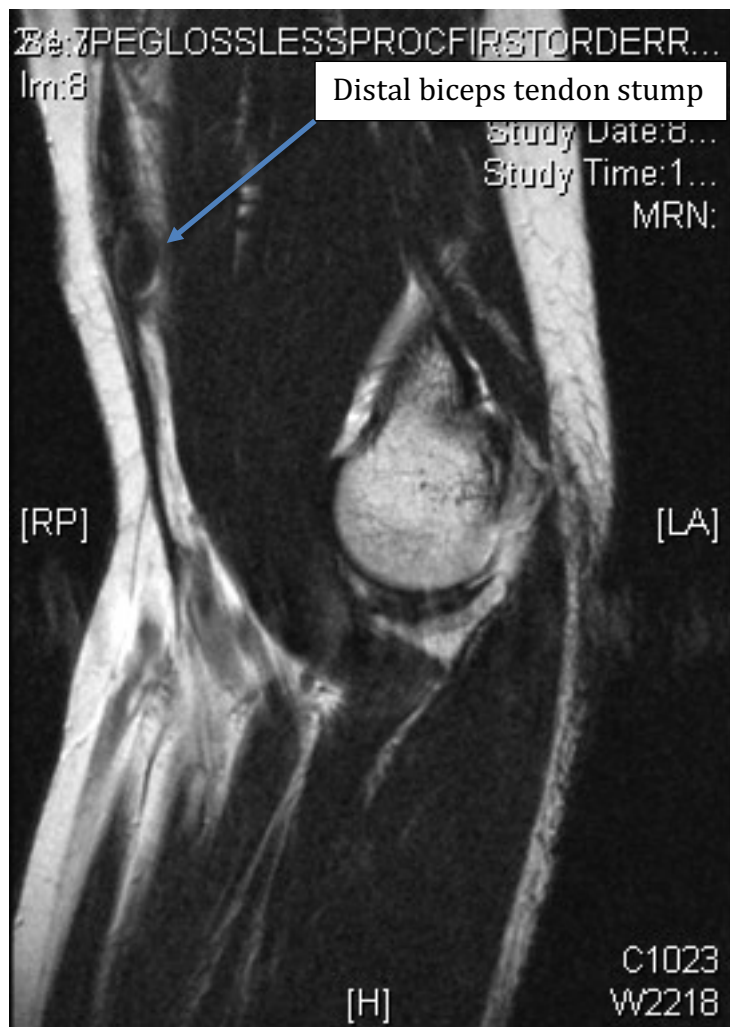
Figure 3 T1-weighted sagittal image demonstrating a chronic rupture of the distal biceps tendon with retraction proximal to distal humerus.

References

1.   Bain GI, Prem H, Heptinstall RJ, Verhellen R, Paix D: Repair of distal biceps tendon rupture: a new technique using the Endobutton. *J Shoulder Elbow Surg* 2000:9:120-126.
2.   Baker BE, Bierwagen D: Rupture of the distal tendon of the biceps brachii. Operative versus non-operative treatment. *J Bone Joint Surg Am* 1985:67:414-417.
3.   Boyd HB, Anderson LD: A method for reinsertion of the distal biceps brachii tendon. *J Bone Joint Surg Am* 1961:43A:1041-1103.
4.   Dobbie RP: Avulsion of the lower biceps brachii tendon. Analysis of fifty-one previoulsy unreported cases. *Am J Surg* 1941:38A:662-683.
5.   Greenberg JA, Fernandez JJ, Wang T, Turner C: EndoButton-assisted repair of distal biceps tendon ruptures. *J Shoulder Elbow Surg* 2003:12:484-490.
6.   Kelly EW, Morrey BF, O'Driscoll SW: Complications of repair of the distal biceps tendon with the modified two-incision technique. *J Bone Joint Surg Am* 2000:82-A:1575-1581.

7.	Mariani EM, Cofield RH, Askew LJ, Li GP, Chao EY: Rupture of the tendon of the long head of the biceps brachii. Surgical versus nonsurgical treatment. *Clin Orthop Relat Res* 1988:233-239.

8.	Moosmayer S, Odinsson A, Holm I: Distal biceps tendon rupture operated on with the Boyd-Anderson technique: follow-up of 9 patients with isokinetic examination after 1 year. *Acta Orthop Scand* 2000:71:399-402.

9.	Morrey BF, Askew LJ, An KN, Dobyns JH: Rupture of the distal tendon of the biceps brachii. A biomechanical study. *J Bone Joint Surg Am* 1985:67:418-421.