Endobutton-Assisted Repair of Complete Distal Biceps Tendon Rupture in a Woman

Jason C. Eck, DO, MS, and Seth D. Baublitz, DO

Avulsion of the distal biceps brachii tendon from the radial tuberosity is a relatively rare clinical entity. The injury, which accounts for approximately 3% of all biceps tendon injuries, most commonly occurs in the dominant elbow of men who smoke and are in their fourth decade of life.[1] This injury is extremely rare in women. There are several reports of women sustaining partial ruptures of the distal biceps tendon.[2,3] Reports of complete rupture are even less common, and most involve elderly patients.[1,4-6]

Typically, an unanticipated eccentric load applied to the flexed arm immediately produces a sharp pain in the antecubital region. Subsequent clinical findings include swelling and ecchymosis, palpation of a tendon defect or tendon stump, and weakness in supination and elbow flexion.

Although there are reports of successful nonsurgical management and nonanatomical repair, most authors recommend acute anatomical repair to restore flexion and supination strength. Current support for anatomical reattachment of distal biceps ruptures stems from documented deficits in flexion and supination strength after nonoperative and nonanatomical repair. Conservative treatment has been shown to result in a 30% decrease in flexion strength and a 40% decrease in supination strength.[7]

We present the case of a woman with a traumatic distal biceps tendon rupture (but no preexisting risk factors) treated surgically with a single-incision Endobutton technique. The authors have obtained the patient's written informed consent for print and electronic publication of the case report.

Dr. Eck is Assistant Professor, Department of Orthopaedic Surgery, University of Massachusetts, Worcester, Massachusetts.
Dr. Baublitz is Orthopaedic Surgeon, Department of Orthopaedic Surgery, Lancaster Regional Medical Center, Lancaster, Pennsylvania.

Address correspondence to: Jason C. Eck, DO, MS, Department of Orthopaedic Surgery, University of Massachusetts, 119 Belmont Street, Worcester, MA 01605 (tel, 508-334-9764; e-mail, jason.eck@umassmemorial.org).

Am J Orthop. 2009;38(12):626-628.

> "External preparation of the tendon and minimal exposure of the tuberosity minimize the risk for neurovascular injury."

Case Report

A right-hand–dominant woman in her mid-40s presented to our orthopedic clinic with complaints of left elbow pain, weakness, and deformity after an assault. There were no significant findings from past medical history, and no medications were being used. The patient denied any prior injury or complaints related to the left elbow.

On physical examination, the patient had full active range of motion (ROM) in the left elbow, a palpable tendon defect, ecchymosis, tenderness in the left elbow antecubital region, intact skin, no lacerations or abrasions, no instability, and 4/5 weakness with resisted elbow flexion and supination. Magnetic resonance imaging of the elbow showed a complete rupture of the distal biceps tendon from the radial tuberosity with retraction (Figure 1).

After treatment options were discussed, the patient elected to undergo surgical intervention approximately 3 weeks after the reported original injury. A 4-cm transverse incision was made approximately 4 cm distal to the elbow flexion crease. Dissection to the radial tuberosity revealed inflammatory bursal tissue and an absent biceps tendon. Given the extent of tendon retraction, a small proximal incision was made where the tendon stump was palpated in the upper arm. The tendon was identified, mobilized, and delivered external to the distal wound (Figure 2). Beginning approximately 4 cm proximal from the tendon end, a No. 2 Fiberwire suture (Arthrex, Naples,

Figure 1. Magnetic resonance imaging shows complete rupture of distal biceps tendon from radial tuberosity with retraction. Arrow shows empty bicipital sheath.

Figure 2. Because of the retraction, a separate proximal incision was made, and the tendon end was delivered through the wound.

Fla) was used to place a running locking suture in the medial and lateral margins of the tendon. The suture was passed through the central holes of a 4×12-mm Endobutton (Acufex; Smith & Nephew, Andover, Mass), secured 2 mm from the most distal end of the tendon. The running locking stitch was tied proximally, and the Endobutton was fitted with leading and trailing sutures (Figure 3). The central aspect of the radial tuberosity was exposed with the arm in full supination to move the posterior interosseous nerve laterally away from the tuberosity. Small handheld retractors were carefully placed medially and laterally to hold the soft tissues away from the tuberosity.

Preparation of the radius began with bicortical passage of a 1.5-mm guide pin followed by a 4.5-mm reamer. The anterior cortex was overreamed with a 7-mm reamer, thus creating an osseous socket. A suture was passed through each of the outer holes of the Endobutton. Two different types of sutures can be used to better identify one as the leading suture and the other as the trailing suture. The leading and trailing sutures from the Endobutton were passed through the tunnel drilled through the radius, across the posterior radial cortex, and through the posterior forearm skin using the guide pin. With the arm in flexion, the Endobutton was vertically guided through the osseous tunnel under direct visualization. The leading suture was used to pull the tendon through the tunnel. After the Endobutton cleared the posterior cortex of the radius, it was turned horizontal by pulling simultaneously on the leading and trailing sutures. After the surgeon released the tension on the leading and trailing sutures, the Endobutton relaxed flush against the posterior cortex of the radius. By alternating gentle pulls on the leading and trailing sutures, the surgeon felt the Endobutton rocking against the posterior cortex of the radius. The tendon was adequately engaged in the osseous tunnel, and ROM testing confirmed stability of the repair; however, tension prohibited terminal elbow extension by approximately 30°. A layered closure was performed, and a long arm posterior splint was applied with the elbow at 90° of flexion and the wrist in a neutral position.

One week after surgery, the splint was replaced with a hinged elbow brace, and the patient began supervised rehabilitation allowing active and active-assisted ROM from 30° to full flexion with weekly increases in extension. Full flexion and forearm rotation were regained by 6 weeks; however, the elbow lacked 20° of extension. Protective bracing was discontinued and rehabilitation resumed. Full ROM was observed 2 months after surgery, and progressive strengthening was permitted. Three months after surgery, full return of elbow flexion and forearm rotational strength prompted authorization to return to unrestricted activity.

Discussion

In this report, we present the case of a woman in her mid-40s who sustained a complete rupture of the distal biceps tendon during an assault. The rarity of the injury in women is well known, but reasons for the sex bias remain unclear. Previous anatomical studies have reported that, compared with men, women have a 45% smaller cross-sectional area of the biceps brachii and 52% of the strength.[8] In addition, a higher percentage of type I, fast-twitch muscle fibers are present in the biceps of males as compared with females.[8] It has been hypothesized that the increased muscle forces generated in men may account for the male predominance of these injuries.[6] Previous reports have identified this injury in older patients (age range, 50-83 years).[1,4,6] Often these patients are treated conservatively, and results are satisfactory. Given our patient's age and activity level, we recommended surgical intervention.

Numerous anatomical repair methods have been described, and techniques continue to evolve. Boyd and Anderson[9] popularized using a 2-incision approach to decrease the incidence of nerve injury in initial repairs performed through a single anterior incision. The advantages of limited dissection were offset by findings of decreased motion, heterotopic ossification, and radioulnar synostosis.[10] Morrey and colleagues[7] introduced a muscle-splitting modification of the 2-incision technique to avoid subperiosteal exposure of the ulna, thus lessening the likelihood of proximal synostosis. In a retrospective review of 78 consecutive repairs performed using a muscle-splitting 2-incision technique for acute distal biceps ruptures, Kelly and colleagues[11] reported a 24% complica-

Figure 3. Beginning approximately 4 cm proximal from the tendon end, a running locking suture was passed along the margin of the tendon. The suture was passed through the central holes of an Endobutton, which was secured 2 mm from the most distal end of the tendon. The running locking stitch was passed along the opposite margin of the tendon and tied proximally.

tion rate. They observed no radioulnar synostosis and attributed most complications, primarily heterotopic ossification and nerve injury, to a delay in surgical timing and extensive anterior exposure.

Recently, some investigators have advocated single limited-incision biceps repair techniques.[12-14] Cited advantages include performance ease, avoidance of radial nerve, direct access to tuberosity, and improved cosmesis. Implantable devices, such as suture anchors, interference screws, and internal buttons, have facilitated decreased surgical exposure and morbidity through a single anterior incision.

Suture anchor repair techniques have gained popularity largely because of predictable clinical success. Most studies echo the findings of John and colleagues,[14] who recently reported on 53 patients who had undergone acute suture anchor repair through a limited antecubital incision. The authors documented 46 excellent and 7 good results (Andrews-Carson scores). Complications included heterotopic ossification (2 patients) and temporary radial nerve palsy (1). Several biomechanical studies have demonstrated inferior strength and stiffness of suture anchor repair compared with other fixation methods.[15-17] Although of unknown clinical significance, gapping may occur with cyclic loading in which the tendon is sutured to the cortex of the bicipital tuberosity.[18]

Many surgeons favor interference screw fixation for biceps tendon reattachment. The growing popularity of this surgical technique stems from biomechanical analysis demonstrating superior failure strength and lack of gapping at the bone–tendon interface.[16,17] Although the technique has been well described, and successful results reported, clinical studies are needed to corroborate the track record established in the cadaveric model.[19,20]

Endobutton-assisted repair of distal biceps ruptures has been previously described.[12,13] The documented safety and clinical efficacy of this technique have expanded the applications of the Endobutton, a 4×12-mm flat titanium implant widely used in knee ligament reconstruction.[12,13] External preparation of the tendon and minimal exposure of the tuberosity minimize the risk for neurovascular injury. Direct visualization of the radial tuberosity eliminates the need for fluoroscopy during this procedure. As in anterior cruciate ligament surgery, the tendon is secured in an intramedullary position allowing for bone-to-tendon healing. The strength of the fixation has been well validated in multiple laboratory studies.[13,19,20] Mazzocca and colleagues[18] recently demonstrated that the Endobutton had a statistically higher load to failure in comparisons with bone tunnel, suture anchor, and interference screw. There have been no reports of proximal radius fracture caused by a stress riser from this procedure. There was no statistical difference in tendon displacement under cyclic loading.

This case report is the first to describe a complete distal biceps tendon rupture repaired with the Endobutton technique in a female patient. In our experience, this repair can be accomplished through a limited anterior incision without prolonged or excessive retraction. Like other authors, we allow early active ROM and aggressive rehabilitation. In this case, we opted for protective bracing only because of the degree of tension on the repair. As expected, full activity was tolerated without difficulty 3 months after surgery.

Although complete rupture of the distal biceps tendon is very rare in women, it should be considered in patients with limited ROM, weakness, and tenderness in the antecubital fossa. Given its substantial amount of clinical and biomechanical data, the Endobutton technique is an attractive option for repair of distal biceps tendon ruptures.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

References

1. Safran MR, Graham SM. Distal biceps tendon ruptures: incidence, demographics, and the effect of smoking. *Clin Orthop.* 2002;(404):275-283.
2. Bourne MH, Morrey BF. Partial rupture of the distal biceps tendon. *Clin Orthop.* 1991;(271):143-148.
3. Vardakas DG, Musgrave DS, Varitimidis SE, Goebel F, Sotereanos DG. Partial rupture of the distal biceps tendon. *J Shoulder Elbow Surg.* 2001;10(4):377-379.
4. Bauman JT, Sotereanos DG, Weiser RW. Complete rupture of the distal biceps tendon in a woman: case report. *J Hand Surg Am.* 2006;31(5):798-800.
5. Ryhanen J, Kaarela O, Siira P, Kujala S, Raatikainen T. Recovery of muscle strength after late repair of distal biceps brachii tendon. *Scand J Surg.* 2006;95(1):68-72.
6. Toczylowski HM, Balint CR, Steiner ME, Baordman M, Scheller AD. Complete rupture of the distal biceps brachii tendon in female patients: a report of 2 cases. *J Shoulder Elbow Surg.* 2002;11(5):516-518.
7. 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(3):418-421.
8. Miller AE, MacDougall JD, Tarnopolsky MA, Sale DG. Gender differences in strength and muscle fiber characteristics. *Eur J Appl Physiol Occup Physiol*. 1993;66(3):254-262.
9. Boyd HB, Anderson LD. A method for reinsertion of the distal biceps brachii tendon. *J Bone Joint Surg Am.* 1961;43(7):1041-1043.
10. Failla JM, Amadio PC, Morrey BF, Beckenbaugh RD. Proximal radioulnar synostosis after repair of distal biceps brachii rupture by the two-incision technique. Report of four cases. *Clin Orthop*. 1990;(253):133-136.
11. 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(11):1575-1581.
12. 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(2):120-126.
13. Greenberg JA, Fernandez JJ, Wang T, Turner C. Endobutton-assisted repair of distal biceps tendon ruptures. *J Shoulder Elbow Surg*. 2003;12(5):484-490.
14. John CK, Field LD, Weiss KS, Savoie FH 3rd. Single-incision repair of acute distal biceps ruptures by use of suture anchors. *J Shoulder Elbow Surg.* 2007;16(1):78-83.
15. Pereira DS, Kvitne RS, Liang M, Giacobetti FB, Ebramzadeh E. Surgical repair of distal biceps tendon ruptures: a biomechanical comparison of two techniques. *Am J Sports Med.* 2002;30(3):432-436.
16. Idler CS, Montgomery WH 3rd, Lindsey DP, Badua PA, Wynne GF, Yerby SA. Distal biceps tendon repair: a biomechanical comparison of intact tendon and 2 repair techniques. *Am J Sports Med*. 2006;34(6):968-974.
17. Krushinski EM, Brown JA, Murthi AM. Distal biceps tendon rupture: biomechanical analysis of repair strength of the Bio-Tenodesis screw versus suture anchors. *J Shoulder Elbow Surg.* 2007;16(2):218-223.
18. Mazzocca AD, Burton KJ, Romeo AA, Santangelo S, Adams DA, Arciero RA. Biomechanical evaluation of 4 techniques of distal biceps brachii tendon repair. *Am J Sports Med.* 2007;35(2):252-258.
19. Spang JT, Weinhold PS, Karas SG. A biomechanical comparison of Endobutton versus suture anchor repair of distal biceps tendon injuries. *J Shoulder Elbow Surg.* 2006;15(4):509-514.
20. Khan W, Agarwal M, Funk L. Repair of distal biceps tendon rupture with the Biotenodesis screw. *Arch Orthop Trauma Surg*. 2004;124(3):206-208.