Neurologic Complications of Distal Biceps Tendon Repair With 1-Incision Endobutton Fixation

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Abstract

Functional outcomes of biceps tendon rupture may be optimized with operative treatment.

We conducted a retrospective study to determine the neurologic complications of using 1-incision Endobutton fixation to repair distal biceps tendon ruptures. Patients with distal biceps tendon ruptures treated with a 1-incision technique and Endobutton fixation were included. The primary outcome measure was frequency of neurologic complications.

All 50 patients in the study were men. Mean age was 45 years. Twenty-one patients (42%) had at least 1 complication. Injury to the lateral antebrachial cutaneous nerve (LACN) was the most common (36%). Mean time to diagnosis was 17 days (range, 0 to 40 days). Posterior interosseous, anterior interosseous, and superficial radial nerve palsies each occurred at a 4% rate. Mean follow-up was 133 days.

This study involved the largest cohort of patients with distal biceps tendon rupture repaired with Endobutton fixation using a 1-incision technique. The LACN injury rate (36%) was higher than in other studies using the same technique (0% to 22%). Injury rates for other neural structures near the elbow were comparable to those in the literature.

Rupture of the distal biceps tendon is a relatively uncommon injury and constitutes only 3% of all injuries of the biceps brachii.[1,2] This injury most commonly occurs in the dominant arm of men who are 40 to 60 years old and have had a forced-extension moment about the elbow.[1,3,4] Reports of nonoperative treatment have shown lack of patient satisfaction, and inferior strength and endurance in the injured limb.[1,5,6] The literature that highlights the benefits of surgical repair continues to grow. Several studies have found objective and subjective improvement in strength and function after operative repair.[1,3,4,7,8] Generally accepted surgical treatment involves anatomical reinsertion of the tendon at the radial tuberosity.[3]

Despite being relatively uncommon, distal biceps tendon ruptures have been reported in the literature for more than 100 years,[4,9] and many repair techniques have been described.[5,10-13] The surgeon's challenge is to appraise the literature and select a surgical approach and a tendon fixation method that are appropriate. Two common approaches are the single–anterior incision technique and the 2-incision technique. Fixation methods include suturing tendon to brachialis,[5,12] tying suture over bony bridges,[11] use of suture anchors,[13] and use of the Endobutton implant (Smith & Nephew, Andover, Massachusetts).[10]

The single–anterior incision technique was noted in the early literature as having an unacceptably high incidence of permanent radial nerve damage.[5] In response to that concern, Boyd and Anderson[11] developed an alternative technique using an additional dorsal incision that reduced the likelihood of injury to the nerve. In subsequent studies using this technique, however, there was concern about the risk for heterotopic ossification (HO) and radioulnar synostosis.[14,15] Advances in surgical implant technology have lessened the need to perform extensive surgical dissection to visualize the tendon and restore it to bone—leading to a resurgence in use of the 1-incision approach.[3,10,16]

The Endobutton implant is commonly used to repair distal biceps tendon ruptures and is typically placed with use of the 1-incision technique.[8,10,17-20] Use of this implant is supported by biomechanical studies demonstrating higher load to failure in comparison with other fixation methods, and by evidence that the implant initiates early range of motion and accelerates rehabilitation.[21-23] Despite widespread use of the 1-incision Endobutton technique, its complication profile has not been adequately delineated.

We conducted a study to determine the neurologic complications of distal biceps tendon rupture repair using the 1-incision Endobutton technique. This study's cohort of patients is the largest of its type to date. We hypothesized that lateral antebrachial cutaneous nerve (LACN) palsy would be the most common complication.

Materials and Methods

Between September 2004 and January 2010, 51 distal biceps tendon ruptures (50 patients) were repaired at 2 institutions.

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Table I. Summary of Complications Profile in Patients Undergoing 1-Incision Endobutton Fixation

Complication	No.	
LACN palsy	18	36%
PIN palsy	2	4%
AIN palsy	2	4%
SRN palsy	2	4%
HO	1	2%
Total	25	

Abbreviations: LACN, lateral antebrachial cutaneous nerve; PIN, posterior interosseous nerve; AIN, anterior interosseous nerve; SRN, superficial radial nerve; HO, heterotopic ossification.

All tendons were repaired primarily using 1-incision Endobutton fixation. The technique was individualized to each surgeon but followed the principles described by Bain and colleagues.[10] Six orthopedic surgeons with different subspecialty fellowship training performed the repairs and contributed roughly equal numbers of patients to the study.

After obtaining study approval from the Conjoint Health Research Ethics Board at the University of Calgary, we contacted patients, obtained their consent, and reviewed their charts. Records were retrospectively evaluated for repair timing, mechanism of injury, tourniquet use, involvement in a worker's compensation claim, injury onset, treatment, and resolution of complications. Minimum follow-up was 2 weeks.

All patients were male. Mean age was 45 years (range, 24 to 66 years). Mechanisms of injury were lifting an object (27 patients), sports (12), and miscellaneous activities involving a sudden, forced extension moment about the elbow. Thirty-six patients (72%) underwent repair within 28 days of initial injury. Mean time to surgery was 25.1 days (range, 1 to 232 days). Each surgeon provided postoperative clinical follow-up as per their standard practice pattern; mean follow-up was 132.9 days (range, 15 to 1188 days).

Results

Twenty-one patients (42%) had at least 1 complication. Twenty-five complications were documented (**Table I**). Of the patients with a complication of any kind, 48% had worn a tourniquet during the procedure, and 29% were involved in a worker's compensation claim. There was no standardized postoperative clinical evaluation.

LACN injuries were the most common. Eighteen patients (36%) were diagnosed a mean of 17 days (range, 0 to 40 days) after surgery. Each diagnosis was made on clinical examination and documented in the patient's chart. There was no objective definition (criteria) for LACN injury. Treatment included discussion of the complication with the patient, observation, and serial follow-up examinations. Nine patients' injuries resolved; the other patients were discharged with persistent sensory

deficits in the LACN distribution or did not return for follow-up. No functionally limiting neuropathic pain was reported.

Posterior interosseous (PIN), anterior interosseous (AIN), and superficial radial nerve (SRN) palsies each occurred at a rate of 4%. There were 2 PIN injuries. One was diagnosed 16 days after surgery, and the patient was treated with a wrist splint. The other PIN injury was diagnosed at 250 days; HO was diagnosed at the same clinic visit. The patient's treatment record was not available. This was the only HO case in the study.

Patients with AIN deficits were diagnosed with electromyography 22 and 44 days after surgery. There were 2 SRN palsies, diagnosed 16 and 243 days after surgery. All were treated with observation and had subtle deficits on clinical examination at discharge.

One patient sustained a proximal biceps tendon tear during the postoperative period. Time to diagnosis, subsequent management, and other information were unavailable.

There were no surgical site infections, fixation failures, bone tunnel fractures, or reruptures.

Discussion

Ruptures of the distal biceps tendon have been documented for more than 100 years.[4,9] There has been an evolution in management of these injuries since Dobbie[12] described a technique in 1941. Technological advances have led to the development of implants that require less tissue dissection and to the resurgence in use of a limited, single–anterior incision technique.[3,10,16] Bain and colleagues[10] were the first to describe using a single anterior incision with Endobutton fixation. Their 12 patients' outcomes demonstrated the simplicity and strength of repair, and there were no neurovascular complications or HO. The clinical utility of a 1-incision Endobutton technique is further supported by its successful use in primary, chronic as well as endoscopic repair of distal biceps tendon ruptures.[7,8,17-20,24-26] Despite its popularity of the procedure, however, little has been reported on its rates of neurologic complications.

The 27-patient study by Dillon and colleagues[7] is the largest study of distal biceps tendon ruptures repaired with the 1-incision Endobutton technique. Seventeen acute, 9 chronic, and 1 revision biceps tendon injuries were followed up at a mean of 30.9 months after surgery. LACN palsy occurred in 22% of the patients, and there was 1 rerupture. However, Fox and Fernandez[8] and Peeters and colleagues,[26] who used cohorts of similar size (21 and 23 patients, respectively), reported different results: no neurologic injuries and 1 case of asymptomatic HO.[8,26] The rest of the literature consists of smaller case series or reports and is summarized in **Table II**.

In our study, 21 patients (42%) were diagnosed with at least 1 complication. Overall complication rates in the studies by Peeters and colleagues[26] and Dillon and colleagues[7] were 21.7% and 33%. In the study by Fox and Fernandez,[8] however, there were no complications. (Again, these 3 studies used cohorts of similar size.) In a retrospective study of 53 patients who had biceps tendon repair using suture anchor fixation and a 1-incision technique, McKee and colleagues[3] reported an overall complication rate of 7.5%. This variability in overall

complication rates is substantial. Dillon and colleagues[7] wrote that 4 (44%) of their 9 complications occurred in patients who were operated on more than 4 weeks after injury. This finding potentially suggests that chronicity of repair may be associated with complication rates. In our study, only 6 (29%) of 21 complications arose in patients treated more than 28 days after initial injury.

Thirty-six percent of the complications in our study involved LACN palsy. The LACN, the distal sensory branch of the musculocutaneous nerve, exits proximal to the elbow, between the brachialis and biceps brachii muscles. It continues distally and is commonly encountered in the subcutaneous tissue of the anterior approach.[10,18] Failure to identify the nerve during the approach or excessive soft-tissue retraction can result in injury. Neurapraxia of the LACN may manifest as a sensory deficit or pain along the anterior and lateral aspects of the forearm. Our retrospective analysis of patient records identified only LACN sensory deficits to light touch. The records did not indicate or make note of hyperesthesia or compromised outcomes related to LACN impairment.

The rate of LACN injury is substantially lower (0% to 22%) in other studies that have used Endobutton fixation.[7,8,10,18] Again, LACN injury rate reported in the current literature varies significantly. This variability is difficult to fully explain. One possibility is that patients are not being routinely examined for sensory deficits in the LACN distribution. Our results indicated LACN injury was diagnosed a mean of 17 days after surgery. This corresponds to the standard 2-week postoperative visit at our institutions. In some instances, the incision and distal neurovascular status may take precedence in the clinical examination. Observation tends to be the consensus treatment for LACN injury, and often patients are discharged with slight residual sensory deficit.

PIN, AIN, and SRN palsies each occurred at a 4% rate. According to our literature review, no other Endobutton studies reported the incidence of these neurologic injuries. The incidence of PIN injury in the study by McKee and colleagues,[3] in which patients were treated with suture anchor fixation, was 1.8%. In their original description of the Endobutton technique, Bain and colleagues[10] also conducted a cadaveric study that detailed the anatomy of the PIN, a safe zone for guide-wire placement, and advocated use of handheld retractors when exposing the radial tuberosity. The relatively low incidence of PIN injury in subsequent studies using the Endobutton technique may be attributed to the instruction provided in that article. One of the PIN injuries in the present study was attributed to aberrant placement of a small retractor during exposure of the radial tuberosity. The second PIN injury was diagnosed 250 days after surgery. Our only case of HO was diagnosed in the same patient at the same visit. Rather than an acute surgical insult, the delayed-onset PIN palsy was likely the result of a mass of heterotopic bone growing slowly and eventually compressing the nerve. Katzman and colleagues[15] described a similar phenomenon in a case report of a patient

Table II. Complications in Studies Using 1-Incision Endobutton Fixation

Study	Year	No. of Patients	Complication(s)
Bain et al[10]	2000	12	1 infection
Fox & Fernandez[8]	2003	21	0
Hallam & Bain[19]	2004	7	0
Agrawal & Stinson[24]	2005	1	1 HO
Sharma & MacKay[20,a]	2005	2	0
Peeters et al[26]	2009	23	1 HO 3 malpositioned implants
Arbuthnot et al[17,b]	2009	6	0
Greenberg[18]	2009	N/A	5% LACN palsy
Desai et al[25]	2010	1	1 suture rupture
Dillon et al[7]	2011	27	22% LACN palsy 1 rerupture
Dillon & Lepore[27]	2011	1	1 HO
Vidal et al[28]	2012	4	4 HO

Abbreviations: HO, heterotopic ossification; N/A, not applicable; LACN, lateral antebrachial cutaneous nerve.
[a]Approach was made endoscopically. [b]Intramedullary fixation was used.

who had a distal biceps repair performed using the method described by Boyd and Anderson.[11] Four months after surgery, the patient was found to have a delayed-onset PIN palsy, which was attributed to a segment of the nerve being entrapped in scar tissue.

In several larger studies in which patients were treated with 1-incision Endobutton fixation, the reported rates of symptomatic heterotopic bone were low,[7,8,10] and the complication may be considered rare. The HO rate in our study was 2%. This supports the rarity of the complication in patients treated with Endobutton fixation through a single anterior approach. However, the extent of HO in our study was not quantified using formal grading systems, and whether HO was present was not routinely investigated, using postoperative radiography. The overall rate of HO may therefore be underestimated.

Our review of 50 patients (51 distal bicep tendon repairs) revealed no reruptures, fixation failures, bone tunnel fractures, or surgical site infections. In the literature, the incidence reported for rerupture, fixation failure, and bone tunnel fracture was zero. Desai and colleagues[25] reported on 1 patient who slipped and sustained suture failure in the early postoperative period. Three patients described by Peeters and colleagues[26] had malpositioned Endobuttons. Aside from 1 Endobutton causing local subcutaneous skin irritation, the malpositioned implants resulted in no significant clinical impairment. Wound complications were reported only in the original description by Bain and colleagues.[10] In that study, 1 patient developed an abscess 6 months after surgery and required incision, drainage, and antibiotic therapy.

The present study had limitations related to its retrospective design. Inherent in studies of this type is their reliance on contributing surgeons' accurate patient evaluation and documentation of clinical findings. Individual differences in record keeping cannot be controlled for, and omission of pertinent findings is a potential source of error. The diagnosis of sensory deficits, such as those in LACN injury, was not standardized and was based on the treating surgeon's clinical examination. Examination techniques and impressions of what constitutes a clinically significant neurologic deficit differ among surgeons. Such differences influence reported rates of complications and are limitations of this study. Duration of follow-up varied, and patients with a minimum 2-week follow-up were included in the study. We wanted to characterize postoperative complications, and this inclusion criterion allowed us to identify most patients. The drawback is that information related to the clinical course was limited. Whether HO was present was not routinely investigated, using postoperative radiographs. Therefore, we may have misestimated results. Nevertheless, we reviewed the practices of 5 orthopedic surgeons, and we think our study's findings accurately reflect what occurs in everyday practice.

Conclusion

Our study's results highlight the risks associated with use of 1-incision Endobutton fixation in treating distal biceps tendon ruptures. Thirty-six percent of the patients who underwent this procedure sustained an LACN injury. This injury is most commonly treated with observation, and it improves with time. Transient PIN, AIN, and SRN palsies occurred in about 4% of patients. Our results also highlight the importance of identifying and protecting the LACN during the procedure and provide the clinician with valuable information that can be used when discussing relative surgical risk with patients.

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