AJSM PreView, published on February 3, 2009 as doi:10.1177/0363546508326985

Repair of Distal Biceps Tendon Rupture Using a Suture Anchor

Description of a New Endoscopic Procedure

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Background: Repair of a distal biceps tendon rupture is a challenging procedure and, to date, there is no consensus as to which technique should be used because of the specific complications reported for each.

Purpose: A new endoscopic technique is described that uses a suture anchor to repair distal biceps tendon ruptures.

Study Design: Case series; Level of evidence, 4.

Methods: The results of a cohort of 23 patients (25 elbows) are reported with a median follow-up of 26 months. All patients were male and their median age was 44 years (range, 30-58). Ten of the patients (12 ruptures) were professional athletes or had a high level of physical activity. All repairs were performed via a 3-cm incision made in the "safe area" of the anterior crease of the forearm. The whole procedure was performed within the tendon sheath. The tendon was reinserted using a single anchor.

Results: Of the 23 patients, 22 were satisfied and 20 patients returned to their preinjury sports and jobs. There was a mean loss of 8.6° of pronation and 5° of supination. A single severe neurologic complication, which required a second surgical procedure, was reported. There were also 2 ectopic ossifications without clinical consequences and a transitory radial nerve paralysis.

Conclusions: This study clearly demonstrated that endoscopic repair of the ruptured distal biceps tendon is safe, effective, and reproducible. It provides good functional outcome and early recovery with few complications. Postoperative median nerve palsy due to edema is a possible concern for patients involved in athletic activity and with a history of nerve entrapment; thus this technique should be used with caution in this group of patients.

Keywords: biceps brachii tendon; distal rupture; endoscopic repair; suture anchor

Distal ruptures of the biceps tendon are rare when compared with proximal ruptures and only occur in about 3% of all biceps tendon ruptures,[6] for an overall incidence of 1.2 per 100000 per year.[16] The distal tendon is avulsed from its radial insertion. In the majority of cases, the injury is sustained in the dominant elbow of men who are in the fourth decade of life, who smoke and/or partake in sports or regular demanding physical activity involving the upper limbs.[16] Professional athletes carry high risk of this injury.[16]

There is a general consensus that a complete distal rupture should be reattached to the radial tuberosity as soon as possible.[1,4,13,15] Earlier procedures tended to be nonanatomic reinsertions, suturing the distal biceps tendon to surrounding structures (either the lacertus fibrosis or the brachialis).[8,10] The tendon is anatomically reattached to the radial tuberosity in the most current techniques. Presently, there is a large range of open techniques reported in the literature using several different incisions, different sites of tendon reattachment, and different types of fixation devices. There is no consensus as to which one is the best, probably because specific complications have been reported for each technique: decrease in the range of pronation and supination movement due to radioulnar synostosis or ossification when a 2-incision technique is used,[9] or increase in the risk of neurovascular injury because of the extensive anterior dissection required for

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No potential conflict of interest declared.

The American Journal of Sports Medicine, Vol. X, No. X
DOI: 10.1177/0363546508326985

anterior approach.[8,13,16] To avoid these complications, Sharma and MacKay[19] have described an endoscopic technique for repairing distal biceps brachii rupture using EndoButton (Smith & Nephew Endoscopy, Andover, Massachusetts) fixation. However, this is a single anterior incision technique requiring the passing of a guidewire through the forearm for tying the EndoButton. Furthermore, early clinical results of only 2 cases have been reported.

We presently report a new endoscopic technique using an anchor for tendon fixation. We describe the operative procedure and its specific advantages. The procedure was performed in 23 consecutive patients, 10 of whom were professional athletes or those with a high level of physical activity.

MATERIALS AND METHODS

Patient Population

From September 2000 to December 2005, 23 consecutive patients (25 repairs) underwent surgical repair of the distal biceps tendon for complete rupture in our institution. Patients with partial tears were excluded from this retrospective analysis. All patients were men, with a median age of 44 years (range, 30-58). Fourteen (61%) injured the dominant arm, 7 (30.5%) injured the nondominant arm, and the 2 remaining patients had biceps tendon ruptures in both arms. Three patients (4 repairs) were international rugby players, 6 carried out high-level weight training (7 repairs), and 1 was a mountain guide. The mean time from injury to repair was 14 days (range, 5-21). Seventeen patients were smokers but none of the patients had used anabolic steroids.

The mechanism of injury was playing sports in 7 cases (28%), lifting in 11 cases (44%), pulling in 2 cases (8%), and miscellaneous causes in the remaining 5 ruptures. All patients demonstrated reverse Popeye muscle deformity with palpable tendon in the antecubital fossa, bicipital tuberosity tenderness, and weakness of elbow flexion and forearm supination. All these signs are diagnostic of distal biceps tendon rupture. The diagnosis was confirmed with MRI in all cases.

Operative Technique

This technique was carried out as an outpatient surgery under regional anesthesia. The patient was placed in a supine position with the hand on an arm table. A tourniquet was applied. The surgeon was situated on the medial side of the forearm. A 3-cm incision was made in the "safe area," located in the medial part of the transverse anterior elbow crease. The safe area is situated just proximal to the convergence of the distal biceps brachii tendon (Figure 1), with the surrounding neurovascular structures (lateral cutaneous nerve of the forearm, ulnar artery, and median and radial nerves) being distal to it. The tendon sheath was identified and longitudinally incised for evacuation of the hematoma and saline lavage of the tendon tract to prevent heterotrophic ossification. The retracted proximal end of the tendon was grasped from inside the proximal sheath using a clip and pulled out of the portal (Figure 2). The ruptured tendon end was freshened. The lateral cutaneous nerve of the forearm was identified and protected as it came in contact with the bicipital aponeurosis (Figure 3). Next, with the elbow in flexion and forearm in supination, the endoscopic sheath was introduced in the distal tendon tract up to the radial tuberosity, followed by a 4.5-mm endoscope in air (without fluid) placed in flexion-supination at this step. Before the endoscope insertion, the tendon sheath was properly cleaned with a sterile pad. The absence of soft tissue interposition and the correct positioning of the planned reinsertion area on the radial tuberosity were checked (Figure 4). A GII Anchor (Mitek Products, Norwood, Massachusetts) was inserted into the radial tuberosity (Figure 5). The distal end of the tendon was brought out of the surgical incision and 1 limb of the suture anchor was passed through the distal 2 to 4 cm of the tendon and reinforced with a modified Kessler stitch technique. As the knot was tied, the tendon was pulled down and secured to the floor of the radial tuberosity. During this step, the forearm should be in maximum supination. A drain was inserted and the wound was closed in layers.

Postoperative Treatment

An above-elbow cast with the elbow in 90° of flexion and forearm in supination was applied for 3 weeks. Nonsteroidal anti-inflammatory drugs were prescribed for 5 days after the procedure (diclofenac, 100 mg/d). The rehabilitation was progressively started after 3 weeks. Resistance exercises were started at 6 weeks and patients were allowed to return to full activities 3 months after the endoscopic repair.

Outcome Evaluation

All the patients were seen in outpatient clinic at 3 weeks, 6 weeks, 3 months, 1 year, and annually to assess their progression. At each follow-up evaluation, a subjective assessment of satisfaction with current function of the injured arm and data from the complete physical examination were collected: measure of flexion/extension and pronation/supination range of motion on both elbows via a standard goniometer, and biceps flexion strength with the elbow positioned at 90° of flexion in forearm neutral position via a Peson 235-6M-25 dynamometer (with a total of 3 repeated values). The 2 patients with bilateral injury were excluded in the side-to-side assessment.

RESULTS

The median follow-up was 26 months (range, 19-60). There were no reruptures. The results are reported in Table 1. All patients but 1 reported that they were satisfied with their postoperative results. The unsatisfied patient had a postoperative paralysis of the median nerve, described below, and stiffness of the elbow joint at the last follow-up evaluation. Of the 23 patients, 22 returned to their preinjury activity with the same level (20 patients) or with a slightly decreased level (2 patients). Compared with the other side,

Figure 1. Short anterior incision in the safe area.

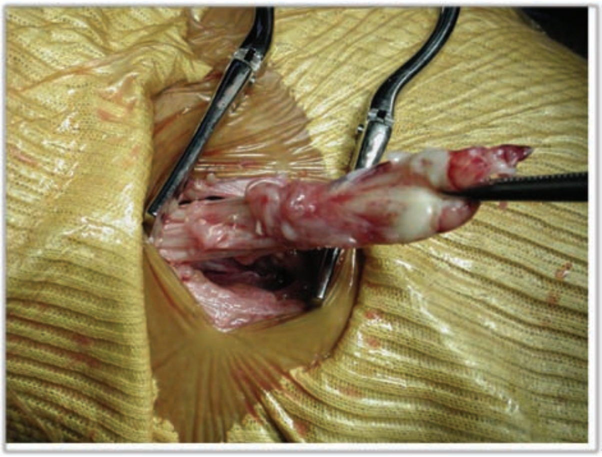

Figure 2. Retrieval of the avulsed distal biceps tendon.

there was a mean loss of extension of 2.9° (range, 0°-10°; standard deviation [SD], 4.63°). The mean loss of flexion was 2.9° (range, 0°-15°; SD, 4.05°). Of the 25 elbows, 17 achieved full extension. There was a mean loss of 8.6° of pronation (range, 0°-30°; SD, 12.06°) and of 5° of supination (range, 0°-30°; SD, 11.29°). One patient had slightly more pronation in the operated elbow. This patient had previously sustained a radial head fracture in the contralateral elbow, leading to a lack of 20° of pronation and of 30° of supination. The strength ratio of the injured side compared with the uninjured side is reported in Table 1. On day 1 after the surgery, 1 patient was noted to have posterior interosseous nerve palsy that was transient in nature and fully recovered after 3 weeks. This patient was a high-level weight trainer.

At 1-month follow-up, 1 patient was noted to have median nerve palsy (motor weakness grade 3/5, and severe hypoesthesia in the territory of the median nerve). The diagnosis of median nerve entrapment was made with nerve conduction and electromyographic studies performed in the following week after diagnosis. This patient had

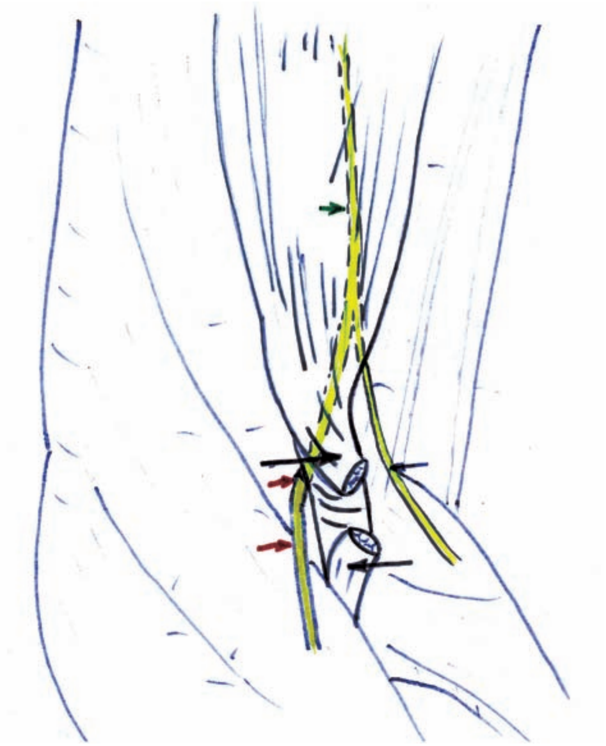

Figure 3. The contact between the lateral cutaneous nerve of the forearm (red arrows) and the biceps tendon rupture (black arrows). Green arrow, musculocutaneous nerve; blue arrow, medial cutaneous nerve of the forearm

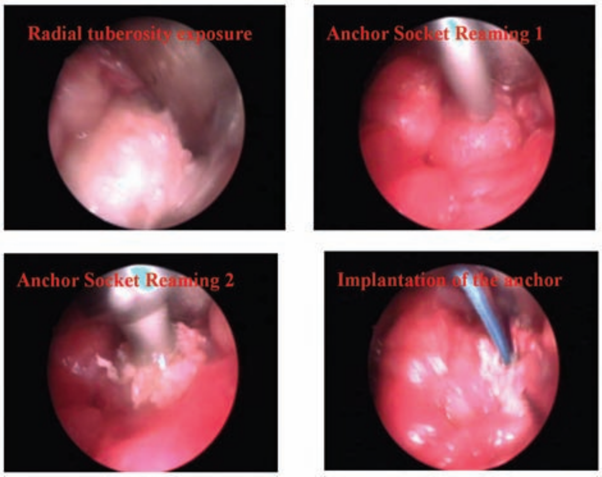

Figure 4. Endoscopic reinsertion of the distal biceps tendon.

immediate exploration of the median nerve and a hypertrophic scar of the medial epicondyle aponeurotic expansion was found to be compressing the nerve, which was excised. In spite of the release, there was incomplete sensory recovery with residual discrete hypoesthesia and finger numbness. This complication also led to difficulty in the

Figure 5. Postoperative radiograph of the reinserted tendon with metal suture anchor on the radial bicipital tuberosity.

physiotherapy with residual lack of motion (Table 1, patient no. 5). This patient had had anterior interosseous nerve syndrome 2 years previously, which spontaneously recovered in 4 months. At further follow-up, 2 patients were noted to have ectopic ossifications but without any clinical consequences.

DISCUSSION

Many open techniques for distal biceps brachii tendon injury reinsertion have been described in the literature. However, to date, there is no consensus as to which technique should be used, mainly because of the specific complications reported for each. The use of a mini-invasive procedure has been proposed to reduce the risk of ectopic ossification or neurovascular injury.[1,3,7,22] Sharma and MacKay[19] used an endoscopic technique for repairing distal rupture of the biceps brachii tendon in only 2 patients, and used a EndoButton for the tendon fixation.

We used a metallic suture anchor to repair the ruptured distal biceps tendon and had 23 patients with a mean follow-up of 26 months. To our knowledge, this study is the first to give a detailed description of endoscopic repair of the ruptured distal biceps tendon.

In this study, we found the use of the endoscope beneficial as it allows direct visualization of the footprint of the reinsertion site and also helps in prevention of soft-tissue interposition.

Studies of open repair technique of distal biceps tendon rupture also report nerve palsies after the procedure. Dobbie[8] had 2 of 51 patients whereas Moosmayer et al[14] had 2 of 9 patients with nerve palsy. Boucher and Morton[5] found the retractors placed around the radial tuberosity to be the cause of the nerve compression. The minimally invasive anterior approach is located in the safe area, the surrounding neurovascular structures being distant and therefore decreasing the risk of the complications mentioned above. Once the tendon sheath is reached, the operative maneuvers are done within the sheath and subsequently are safe. Nevertheless, we advise the systematic location and preservation of the lateral cutaneous nerve of the forearm as it comes into contact with the aponeurosis of the biceps tendon. This is very important because anatomic variations have been described in the musculocutaneous nerve piercing the distal biceps tendon.[21] In our series, we report 2 nerve palsies in athletes, a radial nerve transient palsy that fully recovered after 3 weeks, and a patient with median nerve palsy who in the past was diagnosed with anterior interosseous nerve syndrome and spontaneously recovered. After electromyographic study confirmation, the median nerve was explored and released from the scar tissue but the recovery was incomplete. In this study, the postoperative edema may have contributed to the 2 nerve palsies. In the open techniques, the operative edema resolves through the operative scar, which is not the case in an endoscopic technique. In this study, we also found that the high incidence of nerve palsy in athletes may be due to the vigorous use or overuse of their upper extremities.[2,15,17] In these cases, postoperative edema can decompensate a nerve entrapment so far without clinical consequences. However, the described procedure is safe with regard to the surrounding neural structures.

The use of an EndoButton for the tendon fixation requires drilling through the radial tuberosity and exiting the guidewire through the extensor aspect of the forearm. In a cadaveric study, Bain et al[3] calculated that the mean distance from the posterior interosseous nerve to a Steinmann pin, used to thread the EndoButton, was 14 mm. Nevertheless, other authors have described anatomic variations of the posterior interosseous nerve,[11,18] which could in consequence possibly be damaged in this step of the EndoButton positioning.

In our technique, we have found it preferable to use a metallic suture anchor for the distal biceps tendon fixation. Anchors have been shown to have inferior[12] or equal[20] fixation strength compared with EndoButton, but without any risk of posterior interosseous nerve injury. However, anchors have been shown to have higher fixation strength compared with bone tunnel technique[12] or interference screws.[12]

The feasibility of this original technique was demonstrated in 23 patients with good early results in almost all cases. This study clearly demonstrated that endoscopic repair of the ruptured distal biceps tendon is safe, effective, and reproducible. However, nerve palsy can occur after the procedure due to postoperative edema in athletic

TABLE 1
Results in Terms of Patient Activity, Range of Motion, and Strength in the Injured and Uninjured Elbow

Case No.	Activity	Age (y)	Time From Injury to Surgery (d)	Follow-up (mo)	Level of Activity at 6 Months Compared With Preinjury Level	Range of Motion (deg) of Injured Side/Uninjured Side		Strength in Flexion: Ratio = Injured Side/ Uninjured Side (%)
						Extension/ Flexion	Pronation-Supination	
1	Weight lifting	37	21	42	Equal	5-140/0-140	60-80/90-80	97%
2		50	5	25	Equal	0-130/0-140	80-80/80-80	103%
3		58	12	25	Equal	5-130/0-140	60-65/80-90	93%
4		55	21	36	Inferior	0-130/0-130	80-65/80-75	77%
5	Mountain guide	41	3	25	Poor	15-120/0-130	55-70/75-85	59%
6		48	14	26	Equal	0-130/0-130	90-90/90-90	107%
7		49	15	19	Equal	0-140/0-140	90-90/70-60	111%
8	Professional rugby player	30	5	24	Equal	5-130/0-130	70-90/90-90	94%
9	Professional judo athlete	36	1	24	Equal	0-135/0-135	90-70/95-80	84%
10		52	4	54	Inferior	5-130/0-140	70-60/90-80	73%
11		43	21	28	Equal	0-140/0-140	90-70/90-95	109%
12	Professional rugby player	33	21	22	Equal	0-130/0-130	90-90/80-90	92%
13	Professional rugby player	31	7	44	Equal	0-130/0-130	80-90/90-90	108%
14		50	21	48	Equal	0-130/0-140	90-90/90-90	107%
15	Professional dancer	47	15	23	Equal	5-140/0-140	85-80/85-80	91%
16		59	4	23	Equal	0-130/0-130	70-90/90-90	112%
17		40	8	60	Equal	0-130/0-130	80-60/90-80	89%
18	Professional boxer	42	21	27	Equal	0-135/0-135	80-70/80-80	105%
19	Professional rugby player	32	21	26	Equal	0-135/0-135	70-85/90-90	99%
20		29	12	28	Equal	5-130/0-130	70-75/85-85	108%
21		47	9	22	Equal	0-130/0-130	90-90/90-90	82%
22		56	15	26	Equal	5-135/0-135	70-90/90-90	58%
23	Professional rugby player	31	21	23	Equal	0-130/0-140	85-80/85-80	105%
24	High-level weight training: triathlon	44	21	31	Equal	0-140/0-140	60-80/70-80	93%
25	High-level weight training: triathlon	45	21	23	Equal	0-140/0-140	70-80/60-80	107%

patients with a history of upper limb nerve entrapment. Hence, in these cases, this endoscopic technique should be used with caution.

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