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ORIGINAL ARTICLE

Outcomes of distal biceps repair at two-year follow-up

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Abstract

Purpose This single-centre study aimed to review the postoperative outcomes of distal biceps avulsion repair using a single incision with the endo-button technique.

Methods A retrospective cohort study was performed of a single surgeon series of distal biceps repairs performed consecutively from September 2016 to September 2020. At two years, outcome measures included Oxford Elbow Score (OES), range of movement (ROM), complications and ongoing issues.

Results Forty-five distal biceps tendon repairs were performed on 43 patients with a mean follow-up of 3.2 years (1.1–5.3). The average OES was 46 (11–48), and 90% of patients recovered a comparable range of movement to the contralateral side. Two patients developed re-rupture (4%) on days 0 and 9 of surgery, but there were no late re-ruptures of the repair.

Conclusion Short-term outcomes from distal biceps tendon repair show low complication rates, high patient satisfaction and good functional outcomes. The results would support acute surgical treatment of active, working-age, patients with distal biceps tendon ruptures.

Keywords Biceps tendon · Rupture · Radial tuberosity · Bone tunnel · Suture anchor · Interference screw · Endo-button techniques

Introduction

The biceps brachii muscle has two heads proximally; the short head attaches to the coracoid process and the long to the supraglenoid tubercle, while distally, it inserts onto the tuberosity of the radius. Therefore, besides contributing to elbow flexion, it is the main supinator of the forearm [1, 2].

Distal bicep tendon ruptures predominantly occur in men (98.5%) in their forties and in their dominant arm (85%) [3]. It is caused by forced eccentric loading of the biceps tendon and can be a debilitating injury if left untreated. The injury can result in weakness (of supination and flexion of the elbow), fatigue, and a reduced range of movement [4].

Previous studies have shown that although surgery has a relatively high-rate complications, it is superior to non-operative management in terms of restoration of function [4, 5]. Our study aimed to review the postoperative outcomes of a single surgeon series from one centre in a busy district general hospital.

Materials and methods

A retrospective review was conducted of a consecutive single surgeon series performing distal biceps repair procedures on patients with distal biceps ruptures between September 2016 and September 2020. Forty-six patients were identified, and a review was performed of their medical records and radiographs. At a minimum of two years (late 2022), they were contacted for re-evaluation of range of movement, symptoms, and oxford elbow scores. Only three could not be contacted. Therefore, 43 patients were included

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in the study (93% response). Two patients had a bilateral repair making the total number of 45 procedures.

Data collected included patient demographics, mechanism of injury, complications, and any specific comments from patients about their experience were also recorded. Patients were examined regarding the elbow range of movement and asked to answer the Oxford elbow questionnaire.

This study was approved by the quality governance department (Approval No. N5128), and the study was conducted according to the principles of the Helsinki Declaration.

Surgical technique

This is a consecutive series of patients, treated by the same surgeon, using a technique that was first described by Bain et al. [6]. A single-incision technique in the forearm was used to repair the tendon. This was supplemented by a secondary incision in the arm if the tendon stump had retracted proximally.

The patient is positioned supine with their arm on an arm table, and a high arm tourniquet was applied [See Fig. 1]. The area of muscle insertion of the radial tuberosity was palpated and marked, and occasionally, the detached stump of the distal bicep overlying the area it has retracted to more proximally.

A volar longitudinal 5-cm incision was performed over the bicipital tuberosity with care to preserve the lateral antebrachial cutaneous nerve. Blunt dissection was then performed in the gap between brachioradialis and pronator teres down to the radial tuberosity with Langenbeck retractors. In most cases, the leash of Henry can be retracted distally and preserved. In the delayed presentation, tuberosity was confirmed with intraoperative radiographic imaging. The posterior interosseous nerve is protected by keeping the forearm supinated and using Langenbeck retractors for dissection and to view the tuberosity to avoid placing a lever retractor, such as a Homan retractor, around the radial shaft, which would potentially catch the nerve.

The biceps stump is identified and released. The tendon end was debrided. A running whipstitch (5 Ethibond) was formed in the tendon to achieve proximal fixation, and a shorted Kessler suture to achieve distal fixation and ensure the tendon docks in bone. The two sets of sutures were secured to a Smith and Nephew endobutton to ensure a gap of approximately 10 mm from the tendon end to the button.

A hole is drilled at the landing site of the radial tuberosity insertion point. A 4.5-mm drill was used to make a bicortical hole in the proximal half of the tuberosity, and the proximal cortical hole was widened to 8 mm to allow docking of the tendon. The suture button is passed through the hole and secured tight with the elbow in slight flexion. The button was flipped under radiographic imaging, and care was taken to ensure no tendon gaping.

Postoperative rehabilitation consists of resting the arm in a sling for two weeks. At two weeks, the patients were reviewed by a physiotherapist and a gentle range of movement was commenced. By week six, the normal daily light activity could commence. The patients could return to full activity and heavy lifting at three months. In cases where tendon retraction left the patient with a significant fixed flexion deformity, the muscle stretched out, and near-normal

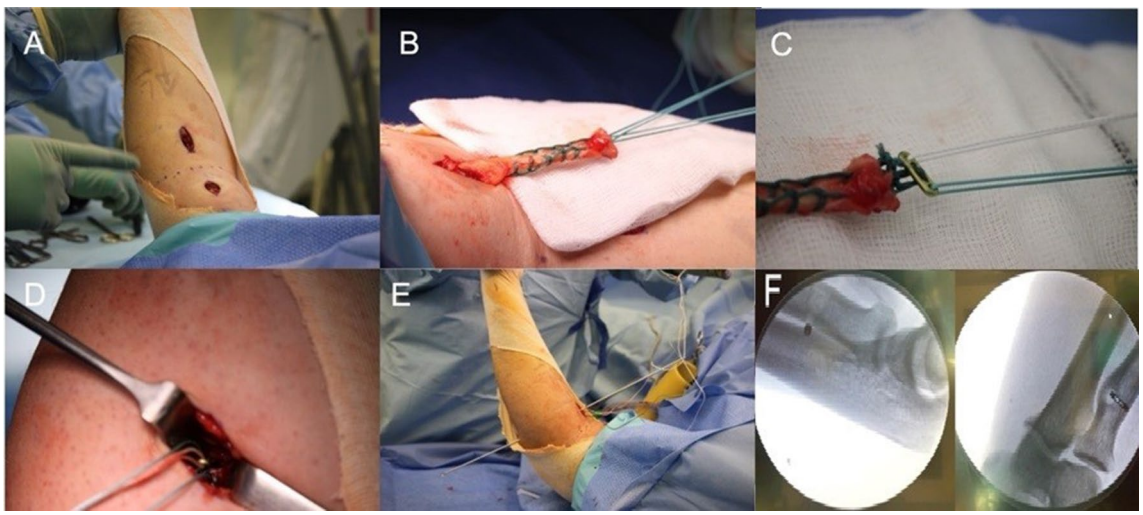

Fig. 1 **A** Small incision is made in the volar aspect of the forearm, and blunt dissection was used to reach the tuberosity (and occasionally in the arm to retrieve the tendon). **B** The distal tendon was secured with two sets of 5 Ethibond whip-stiches. **C** The endo-button was secured to the sutures with a 10-mm gap to allow the suture to flip once through a cortex. **D** The use of Langenbeck retractors to expose the tuberosity. **E** A drill tip passing pin is used to pull the endo-button through both cortices. **F** The Endo-button was flipped via the guide sutures and secured under radiographic guidance

range of movement occurred by 4–6 weeks. Patients were reviewed radiologically and clinically at six weeks and then at three months.

Results

Forty-three patients (45 repairs) were included. All patients were males, and 58% of injuries were on the patients' dominant side (26 out of 45). The average time to surgery was 20 days (range 6–84 days), and the average age at fixation was 47.6 years (32–67 years).

At two years, all patients were satisfied with the results, and OES reflected this. The average OES was 46.2, and 90% of patients had regained a similar range of movement (FROM) compared to the contralateral elbow.

In our cohort, three patients (6.6%) complained of ongoing fatigability, and four patients (8.9%) had some ongoing reduction in their ROM, however, do not affect their activities. Nine patients (20%) complained of an area of numbness postoperatively, six of which had resolved by three months, and one patient developed a superficial wound infection.

On radiographic assessment at the six-week mark postoperatively, eleven repairs (24.4%) displayed some traces of heterotopic ossification (Brooker grade 1, discrete islands of bone) [7]. All occurred with complete tears, and all patients restored a comparable range of movement to the contralateral sides; only one patient with heterotopic ossification felt fatigability, which was detrimental to his golf swing; however, he continued to play golf.

Two patients had a re-rupture (4%) and underwent a revision; one secondary to a fall on the bus on the way home from his operation and was repaired after four days of the primary surgery, and the other re-ruptured after the patient suffered from severe cramping in the arm on the day nine after surgery, while not wearing his sling at night, was subsequently found to have a re-rupture, and he was operated after one week of re-rupture. Nevertheless, the OES scores for revision patients were 47 and 43, respectively, and both had a full range of movement.

Seven patients were operated on over three weeks after their initial injury, mean time of 59 days' post-rupture (36–84 days), and despite this, the average OES was still 45.8, re-enforcing the success of this operation.

Discussion

Multiple surgical techniques have been described for the repair of distal biceps tendon avulsions. The double-incision technique was described by Boyd and Anderson using suture fixation through bone tunnels [8]. However, there is an increase in the popularity of single-incision techniques using suture anchors, intra-osseous screws or cortical buttons. Biomechanical strength, outcomes and complication rates were compared between different techniques. Mazzocca et al. [9] found that the endo-button technique had the highest load to failure among the compared four techniques for repairing distal biceps tendon ruptures (bone tunnel technique, suture anchor repair, interference screw, and endo-button techniques). Therefore, Mazzocca suggests that the construct can tolerate an early postoperative active range of motion. Despite the biomechanical superiority of the cortical button with interference screw fixation, many studies found no difference in clinical outcomes. Lang et al. [10] found no differences in functional outcome measured by DASH score between cortical button, trans-osseous fixation and suture anchor. Additionally, there are no differences in strength of supination, flexion and pronation, as well as the ability to return to work and sports activity. Similarly, Olsen et al. [11] compared cortical button with interference screw versus suture anchor techniques and found comparable clinical results, with similar complication rates between both techniques.

Dunphy et al. [12] analysed the complications in 784 surgical repairs of distal biceps tendon. They compared the double-incision and single-incision techniques and found that a double-incision repair using bone tunnel–suture fixation led to a statistically higher rate of posterior interosseous nerve palsy (3.4%), heterotopic bone formation (7.6%) and reoperation (8.3%) compared to 0.8%, 2.7% and 2.3% retrospectively in a single-incision technique. The lateral antebrachial cutaneous nerve palsy was much more common in a single-incision technique (24.4%) than in a double-incision technique (4.1%). Dunphy's review reported no significant differences in rates of motor neurapraxia, infection, rupture, and reoperation, regarding the surgeon's years of practice, fellowship training or case volume. Additionally, patients treated with cortical buttons with interference screws were released earlier from medical care compared to other fixation methods (retrospectively, 13.1 ± 8.01 weeks, 14.2 ± 7.97 weeks).

Other reported complications included stiffness (4%), weakness (15%–50%), wound infections (2% of acute repairs and up to 33% in chronic and revision repairs), re-rupture (1.6–2%), complex regional pain syndrome (2%), median (4%) and ulnar nerve (< 2%) injuries, brachial artery injury, proximal radius fracture and hardware failure (0%–20%) [13–18]. An early passive range of motion is crucial to reduce postoperative stiffness, and splinting should not exceed three weeks postoperatively. Most patients regained a functional elbow and forearm motion postoperatively. Even repairs where the elbow was in a high degree of flexion (> 60°) secondary to tendon retraction had similar outcomes with those repaired in less than 60° [19].

Heterotopic ossification (HO) can be asymptomatic and can be an isolated radiographic finding. However, it may present with a lump and cause pain, nerve irritation, and affect movement. In severe cases, this may progress to radioulnar synostosis [20]. Many studies reported different incidences of HO, from 4 to 36% [21, 22]. However, not all surgeons obtain a radiograph at follow-up postoperatively. Radiographic evaluation is routine in our practice at six weeks and occasionally repeated at three months. In our series, around a quarter of patients (24.4%) developed grade 1 heterotopic ossification, but it was asymptomatic and did not require any treatment. This does raise the question: should patients undergoing a distal biceps repair receive prophylaxis for heterotopic ossification? Since it is asymptomatic and self-limiting, we do not routinely prescribe non-steroidal anti-inflammatory medication for our patients.

Caekebeke et al. [23] conducted a clinical and radiological evaluation by computed tomography scanning of the proximal radius after a minimum follow-up of two years for the trans-osseous cortical button technique in distal biceps tendon repair. They showed an average closure of the radial bony tunnel of 64% (range, 31–94%) when compared to the initial tunnel volume. Functional outcomes in cortical button fixation were comparable to other fixation techniques. Partial tunnel closure may have the advantage of reducing the risk of potential complications due to osteolysis, such as fracture or hardware failure.

Our series used a single incision and endo-button technique to repair distal biceps tendon avulsions, giving near-normal functional results and high patient satisfaction with a low complication rate. Therefore, we will continue and recommend utilizing the same technique.

Conclusion

Our results would support the view that short-term outcomes from distal biceps tendon repair show low complication rates, high patient satisfaction and good functional outcomes. The results would support acute surgical treatment of active, working-age, patients with distal biceps tendon ruptures.

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Declarations

Conflict of interest None of the authors or the institution have any conflicts of interest to declare in relation to this study.

References

1. Sarmento M (2015) Long head of biceps: from anatomy to treatment. Acta Reumatol Port 40(1):26–33
2. Boyle AB, Uri Ke J, Ragg A, MacLean SB (2022) Anatomy of the distal biceps tendon: an in vivo 3-T magnetic resonance imaging study. J Shoulder Elbow Surg 31(6):1316–22. https://doi.org/10.1016/j.jse.2021.11.015
3. Völk C, Siebenlist S, Kirchhoff C, Biberthaler P, Buchholz A (2019) Rupturen der distalen Bizepssehne [Rupture of the distal biceps tendon]. Unfallchirurg 122(10):799–811. https://doi.org/10.1007/s00113-019-00717-1. (**German**)
4. Looney AM, Day J, Bodendorfer BM, Wang D, Fryar CM, Murphy JP et al (2022) Operative vs. nonoperative treatment of distal biceps ruptures: a systematic review and meta-analysis. J Shoulder Elbow Surg 31(4):e169-89. https://doi.org/10.1016/j.jse.2021.12.001
5. Cuzzolin M, Secco D, Guerra E, Altamura SA, Filardo G, Candrian C (2021) Operative versus nonoperative management for distal biceps brachii tendon lesions: a systematic review and meta-analysis. Orthop J Sports Med 9(10):23259671211037310. https://doi.org/10.1177/23259671211037311
6. Bain GI, Prem H, Heptinstall RJ, Verhellen R, Paix D (2000) Repair of distal biceps tendon rupture: a new technique using the Endobutton. J Shoulder Elbow Surg 9(2):120–126. https://doi.org/10.1067/2000.102581
7. Ohlmeier M, Krenn V, Thiesen DM, Sandiford NA, Gehrke T, Citak M (2019) Heterotopic ossification in orthopaedic and trauma surgery: a histopathological ossification score. Sci Rep 9(1):18401. https://doi.org/10.1038/s41598-019-54986-2
8. Mercurio M, Castioni D, Cosentino O, Fanelli D, Familiari F, Gasparini G, Galasso O (2022) Double-incision technique for the treatment of distal biceps tendon rupture. JBJS Essent Surg Tech 12(3):e2100033. https://doi.org/10.2106/JBJS.ST.21.00033
9. Mazzocca AD, Burton KJ, Romeo AA, Santangelo S, Adams DA, Arciero RA (2007) Biomechanical evaluation of 4 techniques of distal biceps brachii tendon repair. Am J Sports Med 35(2):252–8. https://doi.org/10.1177/0363546506294854
10. Lang NW, Bukaty A, Sturz GD, Platzer P, Joestl J (2018) Treatment of primary total distal biceps tendon rupture using cortical button, transosseus fixation and suture anchor: a single center experience. Orthop Traumatol Surg Res 104(6):859–63. https://doi.org/10.1016/j.otsr.2018.05.013
11. Olsen JR, Shields E, Williams RB, Miller R, Maloney M, Voloshin I (2014) A comparison of cortical button with interference screw versus suture anchor techniques for distal biceps brachii tendon repairs. J Shoulder Elbow Surg 23(11):1607–1611. https://doi.org/10.1016/j.jse.2014.06.049
12. Dunphy TR, Hudson J, Batech M, Acevedo DC, Mirzayan R (2017) Surgical treatment of distal biceps tendon ruptures: an analysis of complications in 784 surgical repairs. Am J Sports Med 45(13):3020–9. https://doi.org/10.1177/0363546517720200
13. Karunakar MA, Cha P, Stern PJ (1999) Distal biceps ruptures a followup of Boyd and Anderson repair. Clin Orthop Relat Res 363:100–107
14. Prud'homme-Foster M, Louati H, Pollock JW, Papp S (2015) Proper placement of the distal biceps tendon during repair improves supination strength—A biomechanical analysis. J Shoulder Elbow Surg 24(4):527–32. https://doi.org/10.1016/j.jse.2014.09.039
15. Banerjee M, Shafizadeh S, Bouillon B, Tjardes T, Wafaisade A, Balke M (2013) High complication rate following distal biceps refixation with cortical button. Arch Orthop Trauma Surg 133(10):1361–1366. https://doi.org/10.1007/s00402-013-1819-1

16. Watson JN, Moretti VM, Schwindel L, Hutchinson MR (2014) Repair techniques for acute distal biceps tendon ruptures: a systematic review. J Bone Joint Surg Am 96(24):2086–2090. https://doi.org/10.2106/JBJS.M.00481
17. Amarasooriya M, Bain GI, Roper T, Bryant K, Iqbal K, Phadnis J (2020) Complications after distal biceps tendon repair: a systematic review. Am J Sports Med 48(12):3103–3111. https://doi.org/10.1177/0363546519899933
18. Huynh T et al (2019) Outcomes and complications after repair of complete distal biceps tendon rupture with the cortical button technique. J Bone Joint Surg 4(3):e0013. https://doi.org/10.2106/JBJS.OA.19.00013
19. Morrey ME, Abdel MP, Sanchez-Sotelo J, Morrey BF (2014) Primary repair of retracted distal biceps tendon ruptures in extreme flexion. J Shoulder Elbow Surg 23(5):679–685. https://doi.org/10.1016/j.jse.2013.12.030
20. Casavant AM, Hastings H 2nd (2006) Heterotopic ossification about the elbow: a therapist's guide to evaluation and management. J Hand Ther 19(2):255–66. https://doi.org/10.1197/j.jht.2006.02.009
21. Greenberg JA, Fernandez JJ, Wang T, Turner C (2003) EndoButton-assisted repair of distal biceps tendon ruptures. J Shoulder Elbow Surg 12(5):484–490. https://doi.org/10.1016/S1058-2746(03)00173-3
22. John CK, Field LD, Weiss KS, Savoie FH 3rd (2007) Single-incision repair of acute distal biceps ruptures by use of suture anchors. J Shoulder Elbow Surg 16(1):78–83. https://doi.org/10.1016/j.jse.2006.03.002
23. Caekebeke P, Vermeersch N, Duerinckx J, van Riet R (2016) Radiological and clinical evaluation of the transosseous cortical button technique in distal biceps tendon repair. J Hand Surg Am 41(12):e447–e452. https://doi.org/10.1016/j.jhsa.2016.08.014