

KEY PROCEDURES

DISTAL BICEPS TENDON ANATOMIC REPAIR

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Published outcomes of this procedure can be found at: *J Bone Joint Surg Am.* 2015 Dec 16;97(24):2014-23, and *J Bone Joint Surg Am.* 2016 Jul 20;98(14):1153-60.

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Abstract

Distal biceps injuries, which usually occur in active middle-aged men, can result in chronic pain and loss of supination and flexion strength^{3,4}. Surgical repair of a ruptured distal biceps tendon can reliably decrease pain and improve strength compared with nonoperative management^{3,4}. However, even following successful healing and rehabilitation of a surgically repaired biceps tendon, full supination strength is rarely restored⁵⁻⁷. The expected outcome following distal biceps repair using a traditional anterior approach is a measurable loss of rotational strength, especially from neutral to supinated positions^{5,7}. This deficit can lead to difficulty with occupational and recreational activities^{5,8}.

The center of an uninjured biceps tendon inserts into the radial tuberosity 6.7 mm anterior to its apex^{9,10}. This posterior location forces the biceps tendon to wrap around the radial protuberance during pronation, thus utilizing the protuberance as a mechanical cam during forceful forearm supination^{10,11}. The distal biceps tendon comprises a medial short head and lateral long head; the 2 heads are continuations of the proximal muscles^{2,20,21}. The short head inserts distal to the long head on their radial attachment site^{2,20,21}. Performing a distal biceps repair via an anterior approach typically places the center of the reattachment site 12.9 mm anterior to its apex or approximately 6 mm anterior to an uninjured control tendon⁹. This shifts the repair site from its anatomic location (posterior to the radial protuberance) to a new nonanatomic location (on top of the protuberance). This anterior reattachment location decreases the cam effect of the radial protuberance, resulting in an average supination loss of 10% in neutral rotation and 33% in 60° of supination^{7,10}.

A posterior approach to the radial tuberosity using 2 separate intramedullary buttons for the short and long heads reliably positions the distal biceps insertion at its anatomic footprint, which is posterior to the radial protuberance^{9,10,11}. This technique has been named the *distal biceps tendon anatomic repair*. Not only does it restore the normal supination cam effect of the radial protuberance, but it also provides superior initial fixation strength, with load to failure strength similar to the native tendon¹.

The distal biceps anatomic repair can be divided into the following 9 key steps: Step 1: Preoperative planning; Step 2: Positioning; Step 3:

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Identifying and retrieving the tendon; Step 4: Preparing the 2 heads of the tendon; Step 5: Posterior exposure of tendon footprint; Step 6: Drilling the short and long-head drill holes; Step 7: Passage of the tendon; Step 8: Unicortical button fixation; Step 9: Alternative fixation: cortical trough; and Step 10: Postoperative management.

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References

1. Siebenlist S, Buchholz A, Zapf J, Sandmann GH, Braun KF, Martetschläger F, Hapfelmeier A, Kraus TM, Lenich A, Biberthaler P, Elser F. Double intramedullary cortical button versus suture anchors for distal biceps tendon repair: a biomechanical comparison. *Knee Surg Sports Traumatol Arthrosc.* 2015 Mar;23(3):926-33. Epub 2013 Jul 6.
2. Jarrett CD, Weir DM, Stuffmann ES, Jain S, Miller MC, Schmidt CC. Anatomic and biomechanical analysis of the short and long head components of the distal biceps tendon. *J Shoulder Elbow Surg.* 2012 Jul;21(7):942-8. Epub 2011 Aug 3.
3. 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 Mar;67(3):418-21.
4. Baker BE, Bierwagen D. Rupture of the distal tendon of the biceps brachii. Operative versus non-operative treatment. *J Bone Joint Surg Am.* 1985 Mar;67(3):414-7.
5. Hansen G, Smith A, Pollock JW, Werier J, Nairn R, Rakhra KS, Benoit D, Papp S. Anatomic repair of the distal biceps tendon cannot be consistently performed through a classic single-incision suture anchor technique. *J Shoulder Elbow Surg.* 2014 Dec;23(12):1898-904. Epub 2014 Sep 11.
6. Cil A, Merten S, Steinmann SP. Immediate active range of motion after modified 2-incision repair in acute distal biceps tendon rupture. *Am J Sports Med.* 2009 Jan;37(1):130-5. Epub 2008 Oct 28.
7. Schmidt CC, Diaz VA, Weir DM, Latona CR, Miller MC. Repaired distal biceps magnetic resonance imaging anatomy compared with outcome. *J Shoulder Elbow Surg.* 2012 Dec;21(12):1623-31. Epub 2012 Jun 11.
8. Olsen JR, Shields E, Williams RB, Miller R, Maloney M, Voloshin I. A comparison of cortical button with interference screw versus suture anchor techniques for distal biceps brachii tendon repairs. *J Shoulder Elbow Surg.* 2014 Nov;23(11):1607-11. Epub 2014 Sep 11.
9. Schmidt CC, Brown BT, Qvick LM, Stacowicz RZ, Latona CR, Miller MC. Factors that determine supination strength following distal biceps repair. *J Bone Joint Surg Am.* 2016 Jul 20;98(14):1153-60.
10. Schmidt CC, Weir DM, Wong AS, Howard M, Miller MC. The effect of biceps reattachment site. *J Shoulder Elbow Surg.* 2010 Dec;19(8):1157-65. Epub 2010 Oct 8.
11. Schmidt CC, Brown BT, Williams BG, Rubright JH, Schmidt DL, Pic AC, Nakashian MR, Schimoler PJ, Miller MC. The importance of preserving the radial tuberosity during distal biceps repair. *J Bone Joint Surg Am.* 2015 Dec 16;97(24):2014-23.
12. Grewal R, Athwal GS, MacDermid JC, Faber KJ, Drosdowech DS, El-Hawary R, King GJ. Single versus double-incision technique for the repair of acute distal biceps tendon ruptures: a randomized clinical trial. *J Bone Joint Surg Am.* 2012 Jul 3;94(13):1166-74.
13. Miller SL, Hausman M. Distal biceps repair: a consistent and safe approach to the radial tuberosity. *Orthopedics.* 2001 Feb;24(2):113-6.
14. Morrey ME, Abdel MP, Sanchez-Sotelo J, Morrey BF. Primary repair of retracted distal biceps tendon ruptures in extreme flexion. *J Shoulder Elbow Surg.* 2014 May;23(5):679-85.
15. Jobin CM, Kippe MA, Gardner TR, Levine WN, Ahmad CS. Distal biceps tendon repair: a cadaveric analysis of suture anchor and interference screw restoration of the anatomic footprint. *Am J Sports Med.* 2009 Nov;37(11):2214-21. Epub 2009 Jul 21.
16. Forthman CL, Zimmerman RM, Sullivan MJ, Gabel GT. Cross-sectional anatomy of the bicipital tuberosity and biceps brachii tendon insertion: relevance to anatomic tendon repair. *J Shoulder Elbow Surg.* 2008 May-Jun;17(3):522-6. Epub 2008 Mar 6.
17. Hasan SA, Cordell CL, Rauls RB, Bailey MS, Sahu D, Suva LJ. Two-incision versus one-incision repair for distal biceps tendon rupture: a cadaveric study. *J Shoulder Elbow Surg.* 2012 Jul;21(7):935-41. Epub 2011 Aug 3.
18. Prud'homme-Foster M, Louati H, Pollock JW, Papp S. Proper placement of the distal biceps tendon during repair improves supination strength—a biomechanical analysis. *J Shoulder Elbow Surg.* 2015 Apr;24(4):527-32. Epub 2014 Dec 3.
19. Diliberti T, Botte MJ, Abrams RA. Anatomical considerations regarding the posterior interosseous nerve during posterolateral approaches to the proximal part of the radius. *J Bone Joint Surg Am.* 2000 Jun;82(6):809-13.

20. Athwal GS, Steinmann SP, Rispoli DM. The distal biceps tendon: footprint and relevant clinical anatomy. *J Hand Surg Am.* 2007 Oct;32(8):1225-9.
21. Eames MH, Bain GI, Fogg QA, van Riet RP. Distal biceps tendon anatomy: a cadaveric study. *J Bone Joint Surg Am.* 2007 May;89(5):1044-9.
22. Zeltser DW, Strauch RJ. Vascular anatomy relevant to distal biceps tendon repair. *J Shoulder Elbow Surg.* 2016 Feb;25(2):283-8. Epub 2015 Nov 24.
23. Jones JA, Jones CM, Grossman MG. Effect of elbow flexion on the proximity of the PIN during 2-incision distal biceps repair. *Orthopedics.* 2013 Jul;36(7):e931-5.
24. Hinchey JW, Aronowitz JG, Sanchez-Sotelo J, Morrey BF. Re-rupture rate of primarily repaired distal biceps tendon injuries. *J Shoulder Elbow Surg.* 2014 Jun;23(6):850-4. Epub 2014 Apr 26.
25. Schmidt CC, Savoie FH 3rd, Steinmann SP, Hausman M, Voloshin I, Morrey BF, Sotereanos DG, Bero EH, Brown BT. Distal biceps tendon history, updates, and controversies: from the closed American Shoulder and Elbow Surgeons meeting-2015. *J Shoulder Elbow Surg.* 2016 Oct;25(10):1717-30. Epub 2016 Aug 10.
26. Schmidt CC, Brown BT, Sawardeker PJ, DeGravelle M Jr, Miller MC. Factors affecting supination strength after a distal biceps rupture. *J Shoulder Elbow Surg.* 2014 Jan;23(1):68-75.
27. Schmidt CC, Jarrett CD. Distal biceps tendon repair and reconstruction. In: Ring D, Steinmann S, editors. *Advanced reconstruction: elbow.* 2nd edition. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2016. p 180-94.
28. Schmidt CC, Jarrett CD, Brown BT. The distal biceps tendon. *J Hand Surg Am.* 2013 Apr;38(4):811-21; quiz 821.