Review

Distal biceps tendon rupture repair using an endobutton technique

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ABSTRACT

Distal biceps brachii tendon ruptures are relatively uncommon. These lesions typically occur in a male population aged between the fourth and fifth decade and result from eccentric contraction of the biceps muscle in a 90 degrees flexion position. Treatment options for distal biceps tendon ruptures include operative and non-operative management. Operative approach with early anatomical reattachment to the radial tuberosity is considered as the gold standard, whereas non-operative treatment is reserved for older and low-demanding patients. We present a straightforward case of a 48-year-old Caucasian male patient, without further objectified risk factors, clinically diagnosed with a distal biceps tendon rupture. The patient was treated with a minimal invasive endobutton fixation technique. Postoperatively a removable soft case was given to prevent full extension of the elbow. Six weeks after surgery the patient showed a pain free and full range of motion of the elbow. Strengthening exercises were allowed ten weeks postoperatively.

KEYWORDS: tendon injury; tendon rupture; biceps tendon, endobutton, repair

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INTRODUCTION

Distal biceps brachii tendon ruptures are relatively uncommon. The majority of biceps tendon ruptures involve the long head of the muscle proximally; only three percent of all biceps tendon injuries are diagnosed at the distal aspect (1). Distal biceps tendon ruptures typically occur in a male population aged between the fourth and fifth decade and result from eccentric contraction of the biceps muscle in a 90 degrees flexion position (2,3). These lesions result in a greater loss of strength and a decreased supination than injuries to the proximal biceps tendon (4). Therefore, operative approach with early anatomical reattachment to the radial tuberosity is considered as the gold standard, whereas non-operative treatment is reserved for older and low-demanding patients or subjects with an unacceptably high surgical risk (1,2,5,6). Several risk factors for a rupture of the distal biceps tendon are described in medical literature such as; male gender, age above 30, smoking and steroid use (7–9).

We present a straightforward case of a 48-year-old male patient, without further objectified risk factors, clinically diagnosed with a distal biceps tendon rupture.

CASE PRESENTATION

A 48-year-old Caucasian male patient without relevant medical history presented at the emergency department with complaints of acute severe pain in the left upper arm after lifting a heavy wooden beam.

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Figure 1. Clinical picture of the Popeye sign on the left upper arm.

The patient described a loss of power in the left arm and experienced pain radiation towards the distal forearm. The pain was scored by a Visual Analogue Scale (VAS) of 7/10. Clinical examination revealed a prominent Popeye deformity by inspection (Figure 1) and a painful flexion and supination at the elbow joint. Palpation of the insertion of the distal biceps tendon was painful. Otherwise a full range of motion of the elbow joint was observed. A rupture of the distal biceps tendon was diagnosed upon these clinical signs. Normal sensation in the fingers and a capillary refill of less than five seconds was documented.

Since the patient profile is a high demanding young man, a surgical repair with anatomical reattachment of the distal biceps tendon was indicated. Reconstruction surgery was planned three days after time of diagnosis. Until operative treatment the elbow should be positioned in a sling of 90 degrees elbow flexion and rest was advised. Pain management consisted of Paracetamol 1g and Ibuprofen 600mg.

On postoperative day one, the elbow was immobilised in a removable soft cast in 30 degrees of flexion to prevent full extension. After a total of two days of hospitalisation the patient was discarded from the hospital in a healthy condition. Physiotherapy in order to enhance mobilisation of the elbow was prescribed. Clinical control evaluation was planned six weeks after surgery. The soft cast was discontinued and the elbow showed a normal and pain free range of motion. Strengthening exercises will start at ten weeks postoperatively.

ANATOMY

The biceps brachii muscle is the most superficial muscle of the anterior compartment of the upper arm. The origin of the biceps brachii muscle consists of two heads, the short head (caput brevis) and the long head (caput longum). The short head originates from the tip of the coracoid process of the scapula. The tendon of the long head originates from the supraglenoid tubercle of the scapula and superior glenoid rim. The tendon passes through the glenohumeral joint over the head of the humerus and enters intertubercular sulcus. The transverse humeral ligament spans the distance between the lesser and greater tubercles and holds the tendon of the long head in position in the intertubercular sulcus. Mostly, both heads of the muscle insert as one single tendon onto the postero-ulnar one-third of the radial tuberosity over an area of three cm2 (2,10,11). Some cadaveric studies have shown that the two heads of the biceps insert in two tendinous parts (12,13). Cho et al. (14) found two separate insertion parts in 48% of the specimens, where the long head inserts more proximal and posterior, and the short head inserts more distal and anterior onto the tuberosity. The biceps brachii muscle functions as a powerful primary supinator of the forearm and a powerful secondary flexor of the elbow joint, apart from the brachialis muscle. The muscle also acts as an accessory flexor of the glenohumeral joint because of the origin on the scapula. The supinator function is more powerful when the elbow is flexed into 90 degrees, and the flexion is more powerful when the forearm is fully supinated (1). The biceps brachii muscle is innervated by the musculocutaneous nerve.

SURGICAL TECHNIQUE

Surgical treatment options include a one-incision approach or a two-incision technique. In both treatments the aim is to anatomically reattach the loose distal tendon end to the radial tuberosity.

Nowadays, bone tunnel fixation is the most referred technique as a two-incision approach whereas suture anchors, biotenodesis screws, endobutton fixation or hybrid systems are the most used techniques for single incision approaches.

In 1961, Boyd and Anderson (15) popularized a two-incision technique to minimize the risk of nerve injury since earlier distal biceps tendon repair resulted in a high rate of radial nerve palsy (16). Although this technique led to an increase in radioulnar synostosis due to heterotopic ossification (17), the two-incision approach is still frequently used by upper-extremity surgeons after a history of modifications and amelioration of the technique.

Development of new tendon fixation materials and methods facilitating the attachment of the loose tendon end to the bone led to the use of a one-incision approach. Suture anchors, biotenodesis screws and endobuttons are easy to use, demand a less invasive single incision approach and are extremely strong to resist pull-out forces. Based on multiple biomechanical studies (18–24), the endobutton construct is the strongest tendon fixation tool and allows therefore early aggressive rehabilitation (25). Clinical studies have shown excellent results concerning range of motion and strength (23,26,27).

One-incision endobutton fixation technique

The skin is longitudinally (or transversally) incised over the brachioradialis starting from the antecubital flexion crease following the proximal part of the Henry approach (28). Further dissection until the muscular interval of the brachioradialis and brachialis muscle proximally is performed. The interval between the brachioradialis and the pronator teres is searched in the distal part of the incision.

Since the lateral antebrachial cutaneous nerve (LACN) is located in the subcutaneous fat tissue along the lateral border of the distal biceps tendon, care must be taken not to injure this sensory branch of the musculocutaneous nerve (29). At the surgical procedure, the LACN is usually protected using the lateral skin flap between the instrument and the nerve during the retraction manoeuvre. If the radial tuberosity is encountered during dissection, the distal biceps tendon insertion is located closely. An uninjured lacertus fibrosis may avoid proximal retraction of the biceps tendon.

The distal biceps tendon is identified and retracted with a clamp instrument e.g. Kocher. The stump is sutured with strong wire starting in the healthy tendon tissue to obtain a solid grip on the biceps tendon. The damaged portion of the tendon is resected.

Furthermore, the endobutton is fixed to the ruptured distal biceps tendon and two additional sutures are placed in the end holes of the endobutton used for later positioning on the radial cortex. With the arm in full supination, the posterior interosseous nerve (PIN) moves away from the surgical zone. A Beath pin is drilled through both cortices of the radial tuberosity and through the dorsal skin. Hereafter the pin is over drilled bicortically. A unicortical hole is reamed taking the diameter size of the suture-tendon complex into account. The distal radial cortex should be unbroken. Finally, the Beath pin is pulled through the radius with the endobutton and positioning string sutures. The side sutures are used to position the endobutton transversely to the distal radial cortex. If necessary, a unicortical interference screw can be placed into the radial tuberosity adjacent to the distal biceps tendon.

SUMMARY

Operative anatomical reattachment to the radial tuberosity is the gold standard for distal biceps brachii tendon ruptures in most patients. Nonoperative treatment is reserved for elderly patients, low demand patient or patients with unacceptably high surgical risk. Single incision endobutton fixation is considered one of the best options for reattachment proved in multiple biomechanical studies.

CONFLICT OF INTEREST STATEMENT

The authors declare to have no conflict of interest.

ETHICAL APPROVAL

A written informed consent was signed by the patient.

REFERENCES

1. Quach T, Jazayeri R, Sherman OH, Rosen JE. Distal biceps tendon injuries--current treatment options. Bull NYU Hosp Jt Dis. 2010;68(2):103–111.
2. Ward JP, Shreve MC, Youm T, Strauss EJ. Ruptures of the distal biceps tendon. Bull Hosp Jt Dis. 2014;72(1):110–119.
3. Gerhardt C, Thiele K, Scheibel M. Distale Bizepssehnenruptur. Orthopade. 2016;45(10):878–886.
4. Storti TM, Paniago AF, Faria RSS. Reconstruction of the distal biceps tendon using triceps graft: a technical note. Rev Bras Ortop. 2017;52(3):354–358.
5. Nesterenko S, Domire ZJ, Morrey BF, Sanchez-Sotelo J. Elbow strength and endurance in patients with a ruptured distal biceps tendon. J shoulder Elb Surg. 2010;19(2):184–189.

6. Hinchey JW, Aronowitz JG, Sanchez-Sotelo J, Morrey BF. Re-rupture rate of primarily repaired distal biceps tendon injuries. J shoulder Elb Surg. 2014;23(6):850–854.
7. Guglielmino C, Massimino P, Ioppolo F, Castorina S, Musumeci G, Di Giunta A. Single and dual incision technique for acute distal biceps rupture: clinical and functional outcomes. Muscles Ligaments Tendons J. 2016;6(4):453–460.
8. Safran MR, Graham SM. Distal biceps tendon ruptures: incidence, demographics, and the effect of smoking. Clin Orthop Relat Res. 2002;(404):275–283.
9. 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.
10. Sobotta J, Becher H. Regions, Skeleton, Ligaments, Joints and Muscles. Atlas of Human Anatomy. 9th ed. 1974. p 196–7.
11. Drake R, Vogl W, Mitchel A. Gray's Anatomy for Students. 2nd ed. 2009. p 694.
12. Eames M, Bain G, QA F, Van Riet R. Distal biceps tendon anatomy: a cadaveric study. J Bone Jt Surgery, Am. 2007;89(5):1044–1049.
13. Athwal G, Steinmann S, Rispoli D. The distal biceps tendon: footprint and relevant clinical anatomy. J Hand Surg. 2007;82(8):1225–1229.
14. Cho C, Song K, Choi I. Insertional anatomy and clinical relevance of the distal biceps tendon. Knee Surg Sport Traumatol Arthrosc. 2011;19(11):1930–1935.
15. Boyd H, Anderson L. A method for reinsertion of the distal biceps brachii tendon. J Bone Jt Surg. 1961;43A:1041–1043.
16. Meherin J, Kilgore E. The treatment of ruptures of the distal biceps brachii tendon. Am J Surg. 1954;88:657–659.
17. 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 Relat Res. 1990;253:133–136.
18. Spang JT, Weinhold PS, Karas SG. A biomechanical comparison of EndoButton versus suture anchor repair of distal biceps tendon injuries. J shoulder Elb Surg. 2006;15(4):509–514.
19. Peeters T, Ching-Soon NG, Jansen N, Sneyers C, Declercq G, Verstreken F. Functional outcome after repair of distal biceps tendon ruptures using the endobutton technique. J shoulder Elb Surg. 2009;18(2):283–287.
20. 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.
21. King J, Bollier M. Repair of distal biceps tendon ruptures using the EndoButton. J Am Acad Orthop Surg. 2008;16(8):490–494.
22. Kettler M, Lunger J, Kuhn V, Mutschler W, Tingart MJ. Failure Strengths in Distal Biceps Tendon Repair. Am J Sports Med. 2007;35(9):1544–1548.
23. Greenberg JA, Fernandez JJ, Wang T, Turner C. EndoButton-assisted repair of distal biceps tendon ruptures. J shoulder Elb Surg. 2003;12(5):484–490.
24. Chavan PR, Duquin TR, Bisson LJ. Repair of the Ruptured Distal Biceps Tendon. Am J Sports Med. 2008;36(8):1618–1624.
25. Greenberg JA. Endobutton Repair of Distal Biceps Tendon Ruptures. J Hand Surg Am. 2009;34(8):1541–1548.
26. Ranelle RG. Use of the Endobutton in repair of the distal biceps brachii tendon. Proc (Bayl Univ Med Cent). 2007;20(3):235–236.
27. Bain GI, Prem H, Heptinstall RJ, Verhellen R, Paix D. Repair of distal biceps tendon rupture: a new technique using the Endobutton. J shoulder Elb Surg. 2000;9(2):120–126.
28. Henry A. Extensile exposures. Edinburgh: Churchill Livingston. 1973. p 19.
29. Alentorn-Geli E, Assenmacher AT, Sánchez-Sotelo J. Distal biceps tendon injuries: A clinically relevant current concepts review. EFORT open Rev. 2016;1(9):316–324.

