55 Surgical Anatomy of the Distal Biceps Tendon

Deepak N. Bhatia and Gregory Bain

55.1 Background

The distal biceps tendon (DBT) is often implicated in anterior elbow pain, and open or endoscopic surgery is infrequently necessary to treat biceps pathology. The surgical anatomy of the DBT involves the long and short head muscles; each muscle provides a tendon that originates in the lower arm and crosses the anterior elbow crease and the cubital fossa region, where it is surrounded by several major neurovascular structures. The structural and insertional anatomy of the distal biceps tendon is complex, and recent studies have quantified its morphological parameters and their relation to the dynamic proximal radioulnar space [1]. The advent of biceps endoscopy has changed the management of DBT pathology, and knowledge of the surgical anatomy is crucial to understand portal placement and endoscopic reconstruction techniques [2–5].

D. N. Bhatia (✉)
Sportsmed Mumbai, Mumbai, India

Department of Orthopaedic Surgery, Seth GS Medical College and King Edward VII Memorial Hospital, Mumbai, India

G. Bain
Department of Orthopaedic Surgery, Flinders University and Flinders Medical Centre, Adelaide, SA, Australia

55.2 Structural Anatomy: Dimensions, Extent, and Components

The distal biceps tendon originates in the lower arm at the musculotendinous junction of the biceps brachii and courses through the cubital fossa to insert into the bicipital tuberosity in the forearm. Surface marking of the tendon is important to understand portal placement; the tendon originates approximately 3 cm proximal to the anterior elbow crease and inserts at a point 3–5 cm distal to this crease. The tendon courses for 7–12 cm (mean 9 cm) and is in close contact with several neurovascular structures along its entire length [1, 6]. The lacertus fibrosus is an aponeurosis on the medial aspect of the DBT and divides the tendon into three structural zones (preaponeurotic, aponeurotic, and postaponeurotic) [5]. The aponeurosis protects the medial neurovascular structures in the cubital fossa; additionally, it prevents retraction of the ruptured DBT and is often torn or stretched in retracted DBT tears. The biceps brachii muscle has two distinct muscle bellies that are continuations of the proximal long and short biceps tendons. The bellies may interdigitate proximal to the origin of the DBT and then continue as long and short components within the tendon [1, 5] (Fig. 55.1). The DBT fibers rotate 90°, and the tendon fans out into a broad attachment over the radial bicipital tuberosity (Fig. 55.2). The long head inserts

G. Bain et al. (eds.), *Surgical Techniques for Trauma and Sports Related Injuries of the Elbow*, https://doi.org/10.1007/978-3-662-58931-1_55

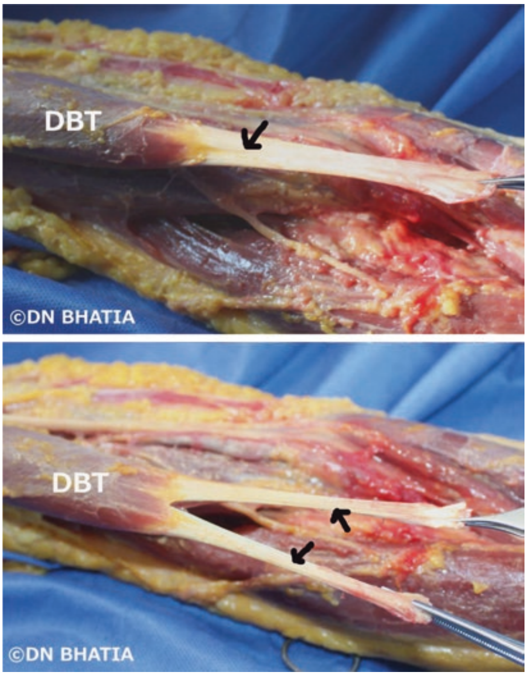

Fig. 55.1 Cadaveric demonstration of the components of the distal biceps tendon (DBT) is shown. The long and short tendons are closely related throughout the course, and the distinction between the two can be seen on closer examination (arrow, top image). The bottom image shows components of the DBT as separate tendons from origin to insertion (arrows)

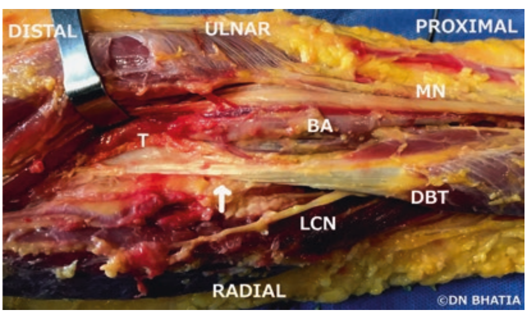

Fig. 55.2 Cadaveric specimen of the distal biceps tendon (DBT) demonstrates the orientation and rotation of tendon fibers along its course. Note that the tendon fibers shift from coronal to sagittal plane (arrow) as the tendon crosses the anterior elbow crease. (*T* tuberosity, *LCN* lateral cutaneous nerve, *BA* brachial artery, *MN* median nerve)

on the proximal aspect of the footprint, and the short head attaches on the distal aspect. In some cases, the DBT may continue as a single tendon that inserts as a single unit on the tuberosity. The attachment of the DBT on the radial tuberosity forms a DBT footprint, and variations of the footprint have been identified.

55.3 Osseous Anatomy: Tuberosity Morphology, Footprint Characteristics, and Radioulnar Space

The bicipital tuberosity (BT) is an ulnar side protuberance, 3–4 cm distal to the radial head. The tuberosity bears a roughened area that marks the insertion of the distal biceps tendon. The BT measures approximately 23 mm in length and 13 mm in breadth and has an average thickness of 16 mm [1]. Mazzocca et al. have documented the presence of variable ridge on the tuberosity in 88% specimen, and the DBT was found to insert ulnar to this ridge [7]. The footprint of the DBT has been described as semilunar or oval by Hutchinson et al. and as “ribbon-shaped” by Mazzocca et al. [7, 8]. Eames and Bain described separate insertion areas of the short and long DBT components [9]. In a recent study, Bhatia et al. demonstrated three DBT footprint variants and a distal biceps footprint index (DBFI) to quantify the attachment areas: type 1 shows an almost equal contribution of the long and short tendons (DBFI 0.57), and type 2 shows a predominant short tendon contribution (DBFI 0.26); a type 3 footprint was found to be a single C-shaped attachment area [1].

Mechanical impingement of the DBT may occur within the narrow radioulnar space during forearm rotation. Postoperative thickening of the tendon and additional fixation/augmentation techniques may predispose the DBT to impingement and possible wear. Bhatia et al. studied the radioulnar space (RUS) and identified that the RUS reduces significantly from the supinated to the pronated position and is most evident in the distal aspect of the tuberosity (Fig. 55.3). In addition, the RUS in pronation is inadequate for incremental increases in DBT thickness. In a clinical scenario, postoperative DBT impingement in the RUS may be prevented by avoiding techniques that increase the thickness of the tendon and by using a reattachment site at the proximal aspect of the tuberosity [1].

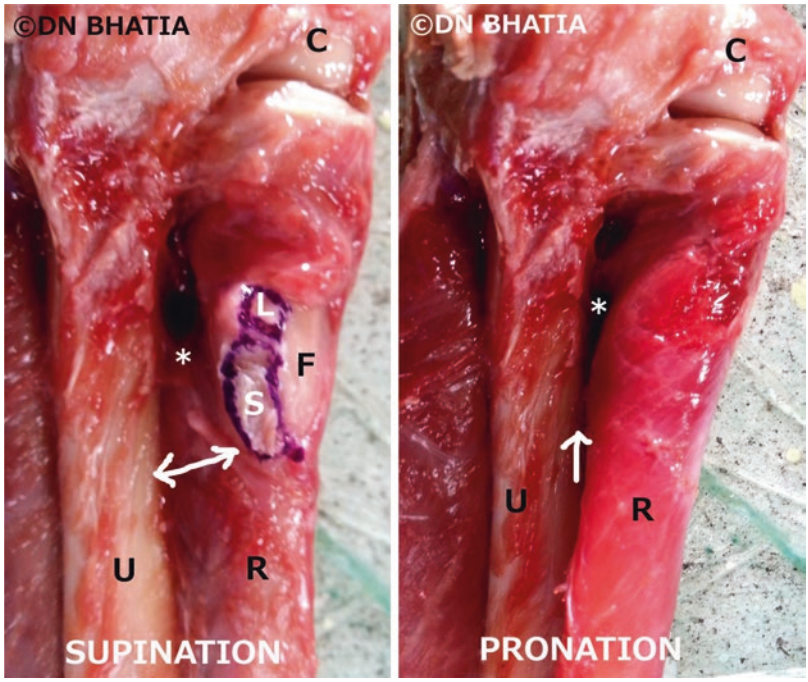

Fig. 55.3 Cadaveric specimen shows the proximal radioulnar space (asterisk *) and the footprint (F) of the distal biceps tendon. The footprint shown is a type 2 footprint with a predominant short head (S) contribution. Not that the long head contributes to a much smaller area (L) over F. The radioulnar space is shown to reduce from supination to pronation, and the significant reduction is seen in the lower part of the space (arrows)

55.4 Neurovascular Anatomy

The neurovascular anatomy of the elbow and cubital fossa is variable, and several structures are at potential risk of injury while performing biceps endoscopy [6]. In the lower arm, the lateral aspect of the DBT is the safe side; however, the cephalic vein and the lateral cutaneous nerve of the forearm are close to the upper lateral aspect of the DBT. The radial nerve is further lateral and is relatively safe in this zone. On the medial side of the DBT are three major neurovascular structures: brachial artery and vein and the median nerve (Fig. 55.4). In the upper forearm, the DBT passes deep, and in close apposition, to the radial vasculature. The superficial radial nerve (SRN) and the posterior interosseous nerve (PIN) are close to the lateral aspect of the DBT, and the ulnar and radial vessels course on the medial aspect (Figs. 55.5 and 55.6). In most specimens, a single radial recurrent artery passes volar to the tendon (mean of 4 mm proximal and 15 mm volar to the tuberosity). In approximately half of the specimens, a smaller recurrent artery that originates from the brachial artery passes dorsal to the DBT [10]. The radial artery itself may run dorsal to the DBT [11].

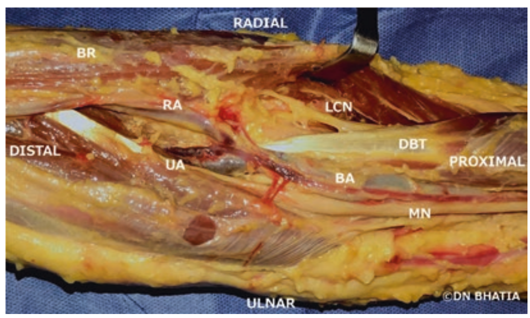

Fig. 55.4 Cadaveric demonstration of neurovascular relationships of the distal biceps tendon (DBT) is shown. The lateral cutaneous nerve exits adjacent to the musculotendinous junction of the DBT and the brachial vessels (BA) and median nerve (MN) course on the medial aspect. Note how the DBT passes dorsal to the bifurcation of the BA and is closely related to the radial (RA) and ulnar arteries (UA). (*BR* brachioradialis)

In a recent study, Bhatia et al. evaluated five potential portal sites above and below the elbow crease for elbow endoscopy [6]. The study showed that the anterior portal placed above the elbow crease (parabiceps portal) was safe, while

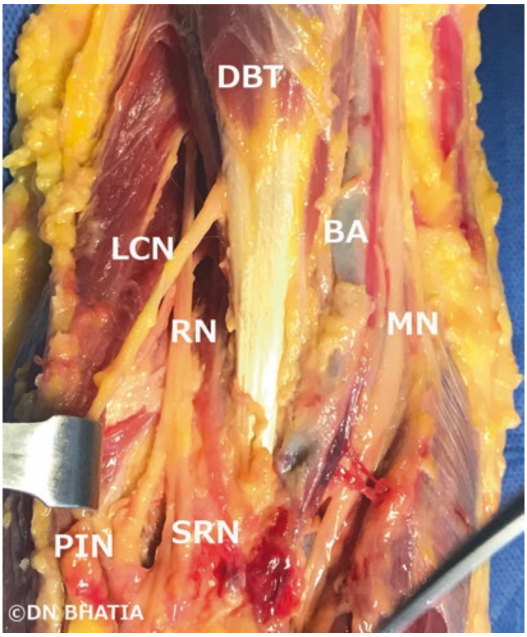

Fig. 55.5 Cadaveric specimen shows the deeper relation of the distal biceps tendon (DBT) with the radial nerve (RN). The lateral cutaneous nerve (LCN) and RN are closely related to the lateral DBT in the arm. The distal course of the DBT is related to the superficial radial nerve (SRN and posterior interosseous nerve (PIN). (*BA* brachial artery, *MN* median nerve)

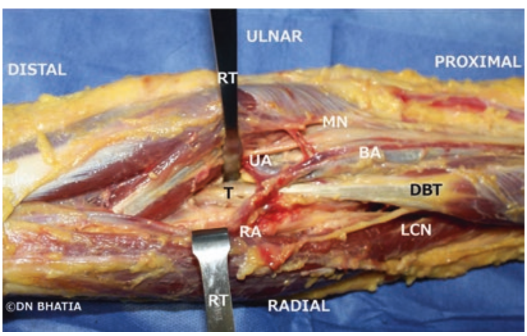

Fig. 55.6 Cadaveric specimen shows the relations of the insertion of the DBT on the radial tuberosity (T). Note that the tendon passes dorsal to the radial (RA) and ulnar arteries (UA). Retractors (RT) placed adjacent to the tuberosity protect the vascular structures; however, excessive retraction during open surgery may result in vascular injury. (*BA* brachial artery, *MN* median nerve)

the three anterior portals placed at different levels below the elbow crease were significantly closer to the neurovascular structures. The parabiceps portal was close to the lateral continuation of the musculocutaneous nerve (mean 5 mm), while the cephalic vein (16 mm) and radial nerve (12 mm) were further lateral. During its course into the forearm, the parabiceps portal was close to the recurrent radial leash of vessels (7 mm).

In the forearm, portals are placed at three levels of the DBT; the upper two portals are potentially risky for the SRN and PIN, while the distal-most anterior portal placed the radial artery at risk. The posteriorly placed portal at the level of the tuberosity should be safe [6]. This is the same concept as is used to advance the DBT when performing the Boyd-Anderson 2-incision technique. The portal can be created with a Wissinger rod from an anterior elbow incision [4].

In summary, endoscopic and open surgery around the DBT require an in-depth knowledge of the tendon and its surrounding neurovascular structures. Variations in anatomy must be anticipated and recognized during surgery. Potential neurovascular risks should be considered when endoscopic procedures are performed.

Acknowledgment *Conflict of Interest*

Each author certifies that he has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article. The author retains the copyright to the images, videos, and content in this chapter.

References

1. Bhatia DN, Kandhari V, DasGupta B. Cadaveric study of insertional anatomy of distal biceps tendon and its relationship to the dynamic proximal radioulnar space. J Hand Surg Am. 2017;42(1):e15e–e23.
2. Bhatia DN. Endoscopic distal biceps repair: endoscopic anatomy and dual-anchor repair using a proximal anterolateral "parabiceps portal". Arthrosc Tech. 2015;4:e785–93. https://doi.org/10.1016/j.eats.2015.07.031.
3. Bhatia DN. Endoscopic repair of acute and chronic retracted distal biceps ruptures. J Hand Surg Am. 2016;41(12):e501–7. https://doi.org/10.1016/j.jhsa.2016.09.008.
4. Phadnis J, Bain G. Endoscopic-assisted distal biceps footprint repair. Tech Hand Up Extrem Surg. 2015;19:55–9.
5. Eames MJ, Bain GI. Distal biceps tendon endoscopy and anterior elbow arthroscopy portal. Tech Shoulder Elbow Surg. 2006;7:139–42.

6. Bhatia DN, DasGupta B, Panjwani T. Cadaveric study of anterior and posterior elbow endoscopy portals for endoscopic distal biceps repair: comparative anatomy-at-risk. Surg Radiol Anat. 2016;38(7):781–91. https://doi.org/10.1007/s00276-016-1637-6. Epub 2016 Feb 9
7. Mazzocca AD, Cohen M, Berkson E, et al. The anatomy of the bicipital tuberosity and distal biceps tendon. J Shoulder Elb Surg. 2007;16(1):122–7.
8. Hutchinson HL, Gloystein D, Gillespie M. Distal biceps tendon insertion: an anatomic study. J Shoulder Elb Surg. 2008;17(2):342–6.
9. Eames MH, Bain GI, Fogg QA, et al. Distal biceps tendon anatomy: a cadaveric study. J Bone Joint Surg Am. 2007;89(5):1044–9.
10. Zeltser DW, Strauch RJ. Vascular anatomy relevant to distal biceps tendon repair. J Shoulder Elb Surg. 2016;25:283–8. https://doi.org/10.1016/j.jse.2015.08.042.
11. Honma S, Tokiyoshi A, Kawai K, Koizumi M, Kodama K. Radial artery running beneath the biceps tendon and its interrelation between the radial recurrent arteries. Anat Sci Int. 2008;83(4):232–8.