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Vascular anatomy relevant to distal biceps tendon repair

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Background: Avoiding bleeding and vascular complications in open repair of distal biceps tendon rupture requires knowledge of the local vascular anatomy. This study examined the vascular anatomy relevant to distal biceps tendon repair.

Methods: The antecubital regions of 17 cadaveric upper extremities were dissected using ×2.5 loupe magnification to identify the brachial artery, the radial artery and its recurrent branches, and venous branches crossing the distal biceps tendon. With the elbow in full extension and supination, the position of each vascular structure was measured relative to the most proximal aspect of the bicipital tuberosity.

Results: The most common pattern (13 of 17 specimens) was a single radial recurrent artery (RRA) crossing volar to the tendon at a mean of 4 mm proximal to the tuberosity and positioned 15.4 mm volar to the tuberosity. The RRA bifurcated 2 to 9 mm from its origin in 6 arms and demonstrated a single bifurcation. In 8 of 17 specimens, an additional recurrent branch off the brachial artery traveled dorsal to the intact biceps tendon 16 mm proximal to the RRA. Two arms demonstrated a high brachial artery bifurcation. The crossing veins were venae comitantes of the RRAs and radial and ulnar arteries. They connected to the superficial veins by way of a perforating branch. Most often, 3 transverse veins positioned on average 0.2 mm proximal and 16 mm volar to the tuberosity were seen.

Conclusions: The vascular anatomy encountered during distal biceps repair is variable, and RRAs occasionally travel dorsal to the biceps tendon. Most often, a single RRA on average 4 mm proximal to the tuberosity will branch once.

Level of evidence: Basic Science Study, Anatomy, Cadaver Dissection.

Keywords: Distal biceps repair; radial recurrent artery

Operative repair of distal biceps tendon ruptures using single-incision and dual-incision techniques has become increasingly popular. Exposure of the radial tuberosity often entails ligation of radial recurrent vessels and requires understanding of the local vascular anatomy to avoid vascular injury and bleeding complications. The goal of this study was to delineate the vascular anatomy relevant to distal biceps tendon repair.

Materials and methods

The study used 17 cadaveric upper extremities (11 left arms, 6 right arms). Ten were fresh frozen transhumeral specimens sectioned below the shoulder, and 7 were embalmed specimens with intact shoulder girdles. No specimens had evidence of prior injury or surgery to the elbow region. All dissections were performed with the aid of ×2.5 loupe magnification.

Institutional Review Board approval was not needed for this study.

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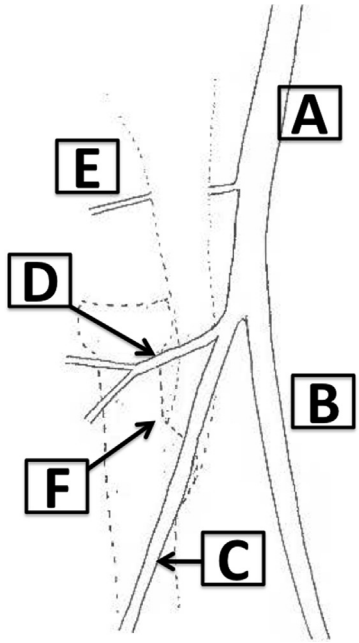

Figure 1 Depiction of the most common arterial pattern encountered during dissection (in a right elbow viewed from the front): a single radial recurrent artery (RRA) crossing over the biceps tendon and branching once, proximal to the bicipital tuberosity. The proximal radius and biceps tendon are depicted by *dotted lines*. *A*, brachial artery; *B*, ulnar artery; *C*, radial artery; *D*, RRA; *E*, dorsal RRA; *F*, proximal-most aspect of bicipital tuberosity. The diagram is oriented such that the top is proximal and the left is lateral/radial.

The specimen was positioned with the forearm in full supination and the elbow extended. We used the extensile Henry approach (internervous plane between brachioradialis laterally and pronator teres and flexor carpi ulnaris medially). The skin incision was made from midbrachium to midforearm to provide a more generous exposure than would be obtained during biceps repair surgery. Full-thickness subcutaneous flaps were raised, and superficial veins, including the basilic, cephalic, and median veins, were divided.

We identified the biceps tendon, brachial artery and its bifurcation, radial and ulnar arteries, radial recurrent arteries (RRAs), and any deep veins crossing the distal biceps tendon. The radial artery was positively identified by tracing its course distally to the wrist in the interval between flexor carpi radialis and brachioradialis tendons. Care was taken during dissection to preserve all vascular branches. Once the number and location of structures were determined, a diagram similar to Figure 1 was created. To measure the location of vascular structures crossing the biceps tendon relative to a stable bony landmark, we chose the proximal-most aspect of the bicipital tuberosity of the proximal radius, which can be conceptualized as the ''axilla'' where the radial neck and tuberosity meet (Fig. 2). The quality of preservation of fine venous structures in the embalmed specimens (7 of our 17 specimens) was poor compared with the fresh frozen specimens; therefore, data regarding venous structures were derived only from the fresh specimens.

Digital calipers were used to measure the distance of each structure from the proximal aspect of the biceps tuberosity by placing the tip of a 0.045-inch Kirschner wire on the bony landmark and holding it perpendicular to the fully supinated forearm. The proximal-to-distal distance between each structure and the Kirschner wire was measured. The volar-to-dorsal distance of each structure relative to the proximal aspect of the tuberosity was similarly measured. This measurement can be thought of as the depth of the proximal tuberosity from the structure. Higher values indicate more superficial structures and lower values deeper structures. Measurements were tabulated in an Excel 2008 spreadsheet (Microsoft, Redmond, WA, USA). Mean values and ranges were determined.

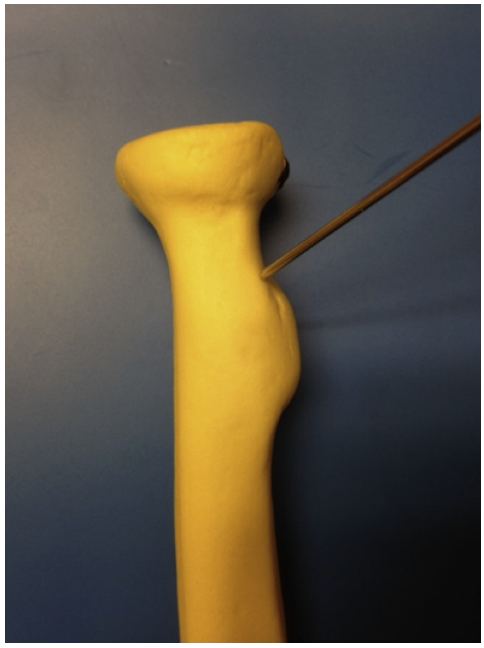

Figure 2 Sawbones model demonstrates the ''axilla'' position from which measurements were taken.

Results

The radial artery was always ulnar to the distal biceps tendon at the level of the brachial artery bifurcation. Although the radial artery travels somewhat diagonally to reside on the radial side of the volar forearm distally, the RRA always crossed the biceps tendon more proximally than the radial artery. Similarly, the ulnar artery was always ulnar and deep to the radial artery. The brachial artery bifurcation occurred an average of 14.5 mm proximal to the proximal portion of the tuberosity (range, 0-23 mm). Two arms, both left-side specimens, demonstrated a high brachial artery bifurcation. The main RRA in 1 arm originated from the ulnar artery and anastomosed with a small branch off the radial artery (Fig. 3). However, recurrent branches did not become dominant vessels in the studied specimens.

At least 1 RRA was identified in all specimens. The RRA was defined as a branch from a major artery (radial, ulnar, or brachial artery) traveling radially and oriented