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Cadaveric Analysis of Dynamic Rotational Relationship of Distal Biceps Tendon with Neurovascular Structures and Proximal Radioulnar Space

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Summary:
This cadaveric study identifies neurovascular structures at-risk in different rotational positions during distal biceps repair, and quantifies the alteration in proximal radioulnar space during dynamic rotation. The results have implications for neurovascular safety and postoperative rotational impingement after distal biceps repair.

Abstract:

Background

The relationship of the distal biceps tendon insertion with the adjacent neurovascular structures may change with rotational movement at the elbow, and thereby predispose to intraoperative neurovascular injury. Moreover, the reattachment site on the tuberosity may predispose to postoperative rotational radioulnar impingement and re-rupture. The purpose of this study was to assess the dynamic rotational excursion and proximity of major neurovascular structures to distal biceps insertion with forearm rotation, and to quantify the relationship between distal biceps tendon and radioulnar space in 3 rotational positions.

Methodology

Twenty-one fresh frozen cadaveric upper limbs were used in 2 groups. Group 1 cadavers (n=10) were dissected to expose the distal biceps tendon (DBT) and 5 major neurovascular structures (Ulnar artery UA, Radial artery RA, Median nerve MN, Superficial radial nerve SRN, Posterior interosseous nerve PIN). The distance between each neurovascular structure and the DBT insertion was measured with the elbow in (a) full supination (90), (b) neutral rotation (0), and (c) full pronation (80). Group 2 cadavers (n=11) were dissected to expose the proximal radioulnar space (RUS) with the interosseous membrane intact. DBT dimensions and bicipital tuberosity measurements were performed and insertional footprints were quantified. The RUS was measured at 3 levels of the bicipital tuberosity and in 3 positions of forearm rotation. Statistical analysis was performed to determine significant changes in neurovascular and DBT relationships in forearm rotation, and to analyze differences in RUS (positional and inter-level). In addition, significant differences between DBT thickness (native and incremental) and RUS were analyzed to identify potential sites of radioulnar impingement.

Results

RA was closest to the lateral border of DBT in supination, and UA was in close proximity in neutral and pronated positions. The medial surface of the DBT insertion was in contact with the UA in supination, and the the RA was in contact with the upper DBT just distal to the bifurcation of brachial artery. UA moved significantly closer to DBT when rotated from supination to neutral ($p<0.0001$) and pronated ($p<0.0018$) positions. RA and MN moved significantly away from DBT in these positions ($p<0.05$). SRN and PIN were the farthest from DBT in each position as compared to other structures. The radioulnar space (RUS) reduced significantly from a supinated to a pronated position at each of 3 bicipital tuberosity levels; this rotational reduction in RUS was greatest (45%) at the lower aspect of the tuberosity and least (20%) at the upper level ($p<0/05$). Pronation RUS distance was adequate for native

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DBT thickness and was significantly less when DBT thickness increased by 2 and 3 mm.

Conclusions

Neurovascular relationships of UA, RA, and MN, and distal biceps tendon are altered significantly with dynamic forearm rotation. Proximal radioulnar space reduces significantly from the supinated to the pronated position and is most evident in the lower aspect of the tuberosity. In addition, radioulnar space in pronation is inadequate for incremental increases in DBT thickness. Clinical relevance: The ulnar artery may be at-risk of injury during pronation repair techniques, and the radial artery and median nerves may be potentially injured during supination repair techniques. Postoperative DBT impingement in the proximal radioulnar space may be prevented by avoiding augmentation techniques that increase the thickness of the tendon and by using a reattachment site at the proximal aspect of the tuberosity.