Newer Techniques for the Ultrasonographic Evaluation of the Elbow Structures: Distal Biceps Tendon, Lateral Ulnar Collateral Ligament and Radial Nerve

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Abstract

Context: Ultrasound is an excellent modality for the evaluation of the soft tissue structures as well as articular pathologies of the elbow joint. Higher resolution transducers along with the superficial location of the elbow structures make them amenable for easy visualisation However, the long learning curve and the operator dependency can limit its use. **Aims:** The aim of this article is to describe and demonstrate novel techniques to image distal biceps tendon, lateral ulnar collateral ligament and radial nerve at elbow joint with ease. **Design:** Technical advancement. **Methods:** The elbow joint ultrasound examination was performed on ten asymptomatic volunteers, 20–40 years old, using a linear probe of 3–13 MHz frequency. The scanning was started from the anterior elbow, the distal biceps tendon was visualised first with anterior to the medial approach followed by the lateral ulnar collateral ligament with one finger technique and radial nerve with first bone technique respectively. **Conclusion:** We consider our techniques as an easy approach to identify the distal biceps tendon, lateral ulnar collateral ligament and radial nerve.

Keywords: Distal biceps tendon, elbow joint ultrasound, lateral ulnar collateral ligament, radial nerve

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Introduction

Ultrasound is an excellent modality for the evaluation of the soft tissue structures as well as articular pathologies of the elbow joint. The higher resolution transducer along with the superficial location of the elbow structures make them amenable for easy visualisation.[1] The cost-effectiveness, lack of radiation hazard, dynamic evaluation of the structures such as nerves, tendon and ligaments, the possibility of contralateral side comparison and targeted delivery of the drugs under vision makes it a suitable diagnostic as well as therapeutic tool.[2] However, the long learning curve and the operator dependency can limit its use. Magnetic resonance imaging (MRI) has absolute diagnostic superiority among the imaging modalities but ultrasound imaging findings by the experienced operator have yielded the same outcomes.[3] Ultrasound is a boon to claustrophobic patients who cannot tolerate MRI.

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In this article, have described and demonstrated novel techniques to image various structures of the elbow joint with ease to shorten the learning curve.

Methods

The elbow joint ultrasound examination was performed on ten asymptomatic volunteers, 20–40 years old, (five males; five females) using a linear probe of 3–13MHz frequency after obtaining informed consent from them. There is no conflict of interest and overlap in subjects from prior publications described and referenced. The scanning was performed by the author, and she has an experience of 6 years in musculoskeletal ultrasound.

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The scanning was started from the anterior elbow the distal biceps tendon was visualised first followed by the lateral ulnar collateral ligament and radial nerve respectively. We have aimed that the novel technique would ease the identification of the above structures with more certainty.

Distal biceps tendon: ATM approach (anterior to medial elbow approach)

Anatomic consideration

The short and the long head of the biceps muscle joins to form the tendon in the distal part of the arm and it inserts on the medial aspect of the radial tuberosity obliquely. It has a flattened aponeurotic expansion which extends from its myotendinous junction to the flexor-pronator complex lying on the medial side of the elbow joint. The brachial artery and the median nerve lie beneath this aponeurotic expansion also known as lacertus fibrosus. The distal end of the biceps tendon lacks a synovial sheath, but it is covered by an extra-synovial paratenon and is separated from the radial tuberosity by a bicipital-radial bursa.[4,5]

Technique

To evaluate the distal biceps tendon a healthy volunteer was seated in front of the examiner across the table. The shoulder was in forward flexion, elbow in extension, forearm in supination and palm facing upward. The scanning of the elbow joint was started 5 cm distal to the elbow crease with the probe in short axis to the forearm and then the probe was moved upwards toward the elbow crease until the undulating contour of the distal articular surface of the humerus covered by homogeneous hypoechoic hyaline cartilage was seen.[6] The probe was then moved medially to identify the pronator teres muscle in the short axis. Once the pronator teres was identified in the short axis [Figure 1a] the probe was rotated to 90° and was aligned to the long axis of pronator teres [Figure 1b]. At this moment, the footprint of the probe was tilted laterally to the point where we will be able to visualize radio-capitellar joint was visualised. The probe was then moved distally towards the wrist until the radial head was at one end of the screen. The operator started flexing the elbow until the arterial pulsations were seen beneath the pronator teres muscle and were confirmed with colour doppler [Figure 1c]. Once the arterial pulsations were identified, we looked for the hyperechoic fibrillar structure, i.e., distal biceps tendon beneath the arterial pulsations inserting on the radial tuberosity with slight toggling of the probe [Figure 1d].

Lateral ulnar collateral ligament: One finger technique

Anatomic consideration

The lateral ulnar collateral ligament is a part of the lateral ligament complex of the elbow joint. It arises from the lateral epicondyle and merges with the fibres of the annular ligament and attaches to the supinator crest of the ulna.[7,8]

Technique

To evaluate the lateral ulnar collateral ligament a healthy volunteer was seated in front of the examiner across the table. The shoulder was in forward flexion, elbow in flexion, forearm in pronation and palm resting on the table. The lateral epicondyle was palpated, and the transducer was placed in the long axis with the cranial side of the probe on the lateral epicondyle. The lateral epicondyle, radio-capitellar joint, and radial head with the annular ligament over it were identified.[Figure 2a] The cranial end of the transducer was kept fixed and the caudal end of the transducer was rotated towards the finger which was placed at 1.8–2 cm distal to the olecranon process of the ulna [Figure 2b] The lateral collateral ligament appeared as a hypoechoic structure of uniform thickness extending from lateral epicondyle merging with annular ligament and attaching over the supinator crest of the ulna [Figure 2c].

Deep branch of radial nerve

Anatomy consideration

The radial nerve at the elbow is in an oblique fascial plane between the brachialis and the brachioradialis muscle. It divides into superficial and deep branch anterior to the radio-capitellar joint. The superficial branches pass distally

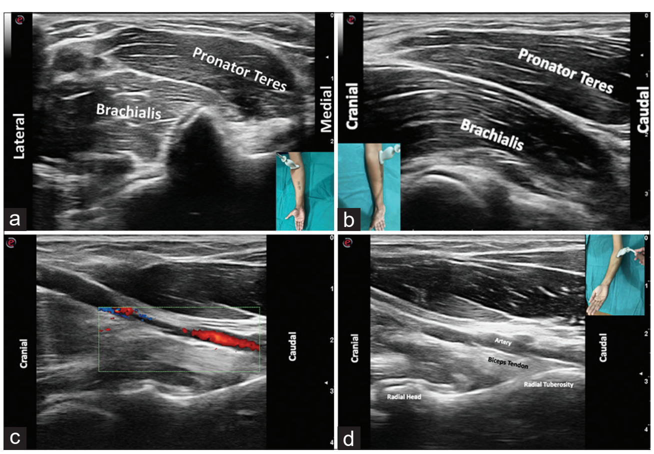

Figure 1: (a) showing the pronator teres muscle in short axis. (b) Pronator teres muscle in longitudinal axis. (c) Hyperechoic Fibrillar pattern of distal biceps tendon in longitudinal axis lying beneath the brachial artery. (d) Colour uptake of the brachial artery

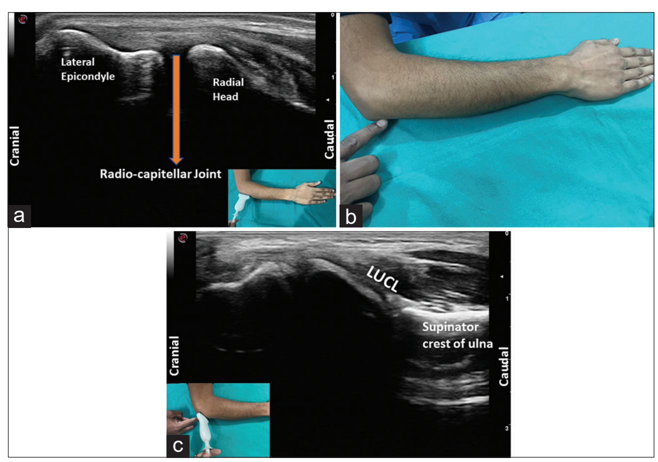

Figure 2: (a) the radio-capitellar joint between the lateral epicondyle and the radial head. (b) the position of the finger toward which the caudal portion of the probe needs to be moved. (c) Depicts the lateral ulnar collateral ligament inserting on the supinator crest of the ulna

beneath the brachioradialis muscle. The deep branch passes distally through the arcade of Frohse between the two heads of the supinator muscle and enters the posterior compartment of the forearm and supplies the muscle of the posterior compartment of the forearm.[9]

Technical consideration

To evaluate the radial nerve the volunteer forearm was in the semi-prone position. The transducer was placed in the short axis of the radius at the proximal 1/3rd of the forearm and the hyperechoic inverted "U"-shaped of the radius was identified [Figure 3a]. The probe was then moved proximally until a hyperechoic oblique structure was seen emerging from the one edge of the inverted "U"-shaped structure [Figure 3b]. Further proximal movement of the probe brought the two heads of the supinator muscle on both side of the hyperechoic line with a black hypoechoic dot in between [Figure 3c]. This hypoechoic dot corresponds to the deep branch of the radial nerve. The two muscles were the superficial and deep head of the supinator. The probe was then moved proximally and the hypoechoic dot was seen entering into the oblique fascia between the brachialis and the brachioradialis muscle behind the pulsatile radial recurrent artery [Figure 3d].

Discussion

With the availability of the high-frequency probes, it has become much easier to visualise the articular as well as para-articular structures of the elbow joint.

Different authors have listed various approaches to visualize the distal biceps tendon such as the anterior approach,[6] lateral approach,[10] medial approach,[11] and the posterior approach.[12]

It is challenging to visualise the distal biceps tendon with the anterior approach because of refraction and artifacts.[13,14] In the lateral approach, the edge of the supinator muscle forms a small area of refraction artifact. The distal few millimetres of the distal biceps tendon fibres are difficult to evaluate because of the interposition of the radius with the lateral approach.[11]

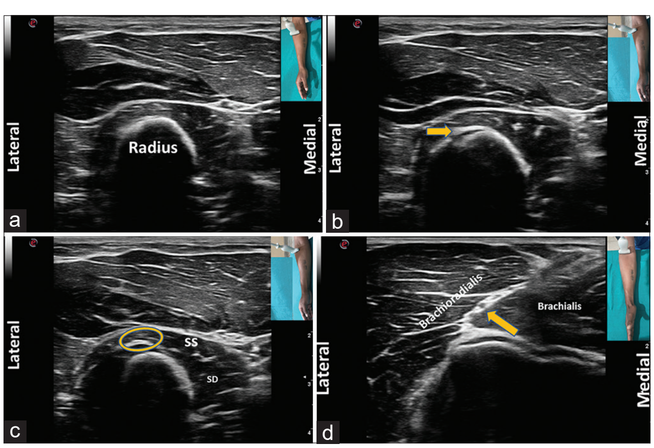

Figure 3: (a) Radius in short axis. (b) Hyperechoic band over the radius indicated by an arrow. (c) Supinator muscle superficial9SS and deep head standard deviation with a hypoechoic dot in between indicated by the circle. (d) Deep Branch of the radial nerve in the oblique fascia between the brachialis and brachioradialis indicated by an arrow

Some aspects of our ATM approach are like the medial approach[11] where the pronator acoustic window was used to visualise the biceps tendon. However, we differ from them in the probe positions, elbow flexion endpoints. The brachial artery improved the contrast for the visualisation of the distal biceps tendon as reported by Smith J *et al* in their medial approach as well.[11]

The lateral ulnar collateral ligament plays an important role as a lateral stabiliser of the elbow joint. Teixeira *et al*.[15] have identified the lateral collateral ligament in elbow flexed to 90°–120° by identifying the lateral epicondyle then rotating the caudal portion of the probe 80°–90°. One finger technique by us is unique to ease out the identification of the supinator crest.

The radial nerve at the elbow joint appears as black hypoechoic dot in the oblique fascia along with the recurrent radial arteries.[16-18] It is a little difficult to identify as to which hypoechoic dot is the deep branch of the radial nerve. With our bone first technique, we can easily identify the radial nerve between the two heads of the supinator muscles and tracing it to the oblique fascia is also very much simplified.

We scanned on ten healthy volunteers of both sexes. We found it very easy to scan all these three structures in both male and female sexes.

Conclusion

We consider our techniques as an easy approach to identify the distal biceps tendon, lateral ulnar collateral ligament and radial nerve. Further studies are needed to compare the ease of the identification of the above-mentioned structures in obese as well as older individuals. Further studies are also needed to compare the ease of the identification of the above-mentioned structures with the standard scanning protocols of these structures with various operators.

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Conflicts of interest

There are no conflicts of interest.

References

1. El-Deek AM, Dawood EM, Mohammed AA. Role of ultrasound versus magnetic resonance imaging in evaluation of non-osseous disorders causing wrist pain. Egypt J Radiol Nucl Med 2019;50:8.
2. Daniels JM, Dexter WW. Basics of Musculoskeletal Ultrasound. Berlin: Springer; 2013. p. 57-8.
3. Brandão AT, Amaro Junior E, Francisco Neto MJ, Tanaka RM, Santos DD, Miranda FC, *et al.* Ultrasonography and magnetic resonance imaging of elbow ligaments: A comparative study. Einstein (Sao Paulo) 2019;17:eAO4579.
4. Eames MH, Bain GI, Fogg QA, van Riet RP. Distal biceps tendon anatomy: A cadaveric study. J Bone Joint Surg Am 2007;89:1044-9.
5. Cho CH, Song KS, Choi IJ, Kim DK, Lee JH, Kim HT, *et al.* Insertional anatomy and clinical relevance of the distal biceps tendon. Knee Surg Sports Traumatol Arthrosc 2011;19:1930-5.
6. Beggs I, Bianchi S, Bueno A, *et al*. Musculo- skeletal ultrasound technical guidelines. II. Elbow. European Society of Musculoskeletal

Radiology, 2006. Available from: http://www.essr.org/html/img/pool/elbow.pdf.Published2006. [Last accessed on 2014 Jan].

7. Camp CL, Fu M, Jahandar H, Desai VS, Sinatro AM, Altchek DW, *et al.* The lateral collateral ligament complex of the elbow: Quantitative anatomic analysis of the lateral ulnar collateral, radial collateral, and annular ligaments. J Shoulder Elbow Surg 2019;28:665-70.
8. Tokunaga K, Sato K, Tajima G, Yan J, Mimata Y, Tajima K, *et al.* Reinvestigation of the morphological characteristics of the lateral ulnar collateral ligament in humans. Okajimas Folia Anat Jpn 2017;93:147-52.
9. Sawyer FK, Stefanik JJ, Lufler RS. The branching and innervation pattern of the radial nerve in the forearm: Clarifying the literature and understanding variations and their clinical implications. Diagnostics (Basel) 2020;10:366.
10. Kalume Brigido M, De Maeseneer M, Jacobson JA, Jamadar DA, Morag Y, Marcelis S. Improved visualization of the radial insertion of the biceps tendon at ultrasound with a lateral approach. Eur Radiol 2009;19:1817-21.
11. Smith J, Finnoff JT, O'Driscoll SW, Lai JK. Sonographic evaluation of the distal biceps tendon using a medial approach: The pronator window. J Ultrasound Med 2010;29:861-5.
12. Mautner K, Stafford CD 2nd, Nguyen P. Ultrasound-guided distal bicep tendon injection using a posterior approach. PM R 2015;7:1007-10.
13. Belli P, Constantini M, Mirk P, Leone A, Pastore G, Marano P. Sonographic evaluation of distal biceps tendon rupture: A prospective study of 25 cases. J Ultrasound Med 2001;20:587-95.
14. Miller TT, Adler RS. Sonography of tears of the distal biceps tendon. AJR Am J Roentgenol 2000;175:1081-6.
15. Teixeira PA, Omoumi P, Trudell DJ, Ward SR, Lecocq S, Blum A, *et al.* Ultrasound assessment of the lateral collateral ligamentous complex of the elbow: Imaging aspects in cadavers and normal volunteers. Eur Radiol 2011;21:1492-8.
16. Xiao TG, Cartwright MS. Ultrasound in the evaluation of radial neuropathies at the elbow. Front Neurol 2019;10:216.
17. Suk JI, Walker FO, Cartwright MS. Ultrasonography of peripheral nerves. Curr Neurol Neurosci Rep 2013;13:328.
18. Djurdjevic T, Loizides A, Loscher W, Gruber H, Plaikner M, Peer S. High resolution ultrasound in posterior interosseous nerve syndrome. Muscle Nerve 2014;49:35-9.