Dorsal forearm muscles: US anatomy Pictorial Essay

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KEYWORDS

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Abstract The dorsal compartment of the forearm contains nine muscles: four belong to the superficial group (extensor digitorum communis, extensor digiti minimi, extensor carpi ulnaris and anconeus) and five to the deep group (supinator, abductor longus, extensor pollicis brevis, extensor pollicis longus, and extensor indices). Of these nine muscles the following details are considered: origin, course, distal insertion and their anatomical connection with those structures which are most often affected by pathologies. The radiologist must have a thorough knowledge of this complex topographic anatomy in order to perform ultrasound (US) and magnetic resonance imaging (MRI) examinations and correctly interpret the images.

Sommario A livello della parte dorsale dell'avambraccio sono presenti nove muscoli, quattro superficiali (estensore comune delle dita, estensore proprio del mignolo, estensore ulnare del carpo e anconeo) e cinque profondi (supinatore, abduttore lungo ed estensore breve del pollice, estensore lungo del pollice, estensore proprio dell'indice).

Dei nove muscoli vengono considerati: origine, decorso, inserzione distale e rispettivi rapporti anatomici con le strutture maggiormente interessate da patologia.

Si tratta di un'anatomia topografica complessa la cui conoscenza è però necessaria per la corretta esecuzione ed interpretazione di esami di imaging quali l'ecografia e la risonanza magnetica.

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Introduction

There are nine muscles located in the dorsal forearm (Figs. 1–5) [1–5], four belong to the superficial group (extensor digitorum communis, extensor digiti minimi, extensor carpi ulnaris and anconeus) and five to the deep group (supinator, abductor pollicis longus, extensor pollicis brevis, extensor pollicis longus and extensor indices) (Figs. 1–3). They are

enclosed by the antebrachial fascia which thickens distally to form the ligament of the palm, the transverse carpal ligament and the dorsal carpal ligament. The two groups of superficial and deep muscles are separated by a transverse fibrous septum. The dorsal forearm muscles are also separated from the anterior compartment by the radioulnar interosseous membrane [1–3.5]. All are innervated by the radial nerve (C6–C8) [1,2].

Superficial muscles

The four muscles belonging to the superficial group arise from the epicondyle through a robust and short common

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Fig. 1 Proximal portion of the forearm, dorsal compartment: MRI (a) and US (b) evidence from lateral to medial: extensor carpi radialis longus and extensor carpi radialis brevis on the outside of radius; extensor digitorum communis, the extensor digiti minimi and extensor carpi ulnaris in the superficial layers; abductor pollicis longus and extensor pollicis brevis in the deep layers.

tendon shared with extensor carpi radialis brevis. Proceeding from lateral to medial direction there are extensor digitorum communis, extensor digiti minimi, extensor carpi ulnaris and anconeus (Figs. 1–3) [1–4]. Extensor digitorum communis originates from the posterior fascia of the epicondyle, the antebrachial fascia and the fibrous septa which divide it from extensor carpi radialis brevis and extensor digiti minimi. Superficially it is attached to the antebrachial fascia and in the deep layers to the supinator muscles, extensor pollicis brevis, extensor pollicis longus and abductor pollicis (Figs. 1–3) [1–3,5,6]. Half way down the forearm it divides into three fascias: the lateral fascia from which two tendons arise, and the other two fascias which give rise to a tendon each. The four extensor tendons traverse the fourth dorsal osteofibrous tunnel to reach the fingers. At the level of each proximal phalanx, the tendon is divided into three portions: the central portion inserts to the base of the middle phalanx and the lateral ones to the distal phalanx. Extensor digiti minimi arises from the posterior fascia of the epicondyle, the antebrachial fascia and the fibrous septa which separate it from the adjacent muscles. Approximately half way down the forearm, a long tendon traverses the fifth osteofibrous tunnel, and distally, at the level of the metacarpal, it fuses with the extensor tendon of the fifth finger coming from the fourth osteofibrous tunnel [1–3,5,6].

Extensor carpi ulnaris arises from the epicondyle, the radial collateral ligament of the elbow, the antebrachial fascia, the posterior margin of ulna and the contiguous intermuscular fibrous septa. At the lower third of the forearm it continues into the homologous tendon that traverses the sixth osteofibrous tunnel to insert to the basis of the fifth metacarpal [1–3,5,6]. The anconeus muscle arises from the posterior fascia of the epicondyle and travels in distal-medial direction to insert to the lateral margin of the olecranon; its deep surface is connected to the supinator muscle, the elbow joint and the ulna [1–3,5,6].

Deep muscles

The deep group consists of five muscles. In the latero-medial direction, the supinator (Fig. 2), abductor longus, extensor pollicis brevis and extensor pollicis longus and extensor indices are evidenced (Figs. 1 and 3) [1–4].

The supinator muscle arises from the epicondyle, the radial collateral ligament of the elbow, the radial annular ligament and the supinator crest of the ulna. It encloses the proximal third of the radius and is inserted to the anterior and lateral profile of the radius. Superficially it is connected to the muscles of the dorsal compartment and in the

Fig. 2 The supinator muscle arises from the epicondyle, the radial collateral ligament of the elbow, the radial annular ligament and the supinator crest of the ulna. It encloses the third proximal of the radius and is inserted to the anterior and lateral profile of the radius. The muscle belly is traversed by the posterior interosseous nerve, a branch of the radial nerve, which perforates it proximally passing through the fibrous arch of Frohse to emerge in the deep layers and reach the back of the elbow (a: MRI; b: US).

Fig. 3 Middle-distal third forearm, dorsal compartment: MRI (a) and US (b) show from lateral to medial: extensor carpi radialis longus and extensor carpi radialis brevis on the outside of the radius (a, b); abductor pollicis longus and extensor pollicis brevis originate in the deep layers and rise to the superficial layers (a, c); extensor digitorum communis, extensor digiti minimi, and extensor carpi ulnaris in the upper layers and extensor pollicis longus in the deep layers (a, c).

deep layers to the lateral part of the elbow joint, the radius and the interosseous membrane [1–4]. The belly of the supinator muscle is traversed by the posterior interosseous nerve (Fig. 2), a branch of the radial nerve which perforates it proximally, travels through the fibrous arcade of Frohse to emerge in the deep layers and reach the posterior part of the elbow [6,7,9].

Abductor pollicis longus arises from the posterior surface of the radius and ulna and from the interosseous membrane. It descends along the lateral surface of the radial diaphysis. At the distal third it gives rise to a tendon. Together with extensor pollicis brevis situated proximally in relation to the dorsal carpal ligament, it travels laterally in the superficial layer and crosses over the tendons of extensor carpi radialis longus and extensor carpi radialis brevis (Fig. 4) [1–3,5,6]. Still accompanied by the tendon of extensor brevis the tendon of abductor longus traverses

the first osteofibrous tunnel and inserts to the side of the base of the first metacarpal.

Extensor pollicis brevis lies on the medial side of abductor longus. It arises from the posterior surface of the radius and from the interosseous membrane and travels parallel with abductor longus crossing over the second osteofibrous tunnel (Fig. 4) and inserts to the dorsal side of the base of the proximal phalanx of the thumb [1–3,5,6].

Extensor pollicis longus arises from the middle third of the posterior surface of the ulnar diaphysis and the interosseous membrane. It travels laterally and gives rise to a tendon which traverses the third osteofibrous tunnel superficially crossing over extensor carpi radialis brevis and extensor carpi radialis longus (Fig. 5) to insert to the basis of the distal phalanx of the thumb. At the wrist, the tendon of extensor pollicis longus medially delimits the anatomical snuffbox which is then limited externally by the tendons of

Fig. 4 In the proximal forearm abductor pollicis longus and extensor pollicis brevis are located in the deep layers on the ulnar side; to reach the first osteofibrous tunnel they travel on the radial side rising to the upper layers and then cross over extensor carpi radialis brevis and extensor carpi radialis longus (proximal intersection) (a: MRI, b: US).

Fig. 5 Extensor pollicis longus arises from the middle third of the posterior surface of ulnar diaphysis and the interosseous membrane; it travels laterally and gives rise to a tendon which traverses the third osteofibrous tunnel and crosses over extensor carpi radialis longus and extensor carpi radialis brevis (distal intersection) (a: MRI, b: US) and inserts to the basis of the distal phalanx of the thumb.

abductor pollicis longus and extensor pollicis brevis. The radial artery is situated at the floor of the snuffbox, which consists of extensor carpi radialis brevis and extensor carpi radialis longus (the second osteofibrous tunnel) [1–3,5,6].

Extensor indicis arises from the posterior surface of the ulnar diaphysis and the interosseous membrane. At the proximal part of the fourth osteofibrous tunnel it gives rise to a tendon which traverses it together with the tendons of extensor digitorum communis. It then travels externally to join the tendon of extensor digitorum communis of the index finger at the level of the second metacarpophalangeal joint [1–3,5,6].

Conclusions

In the various pathologies that can affect the dorsal compartment of the forearm, whether muscles, tendons or nerves, the role of diagnostic imaging and particularly US and MRI is increasingly essential for a correct diagnosis and therapy [8]. For this reason, a thorough knowledge of the compartmental anatomy of the forearm and any possible anatomical variants such as the presence of accessory muscles, is essential to perform US examination satisfactorily, make a correct diagnosis and be able to answer the still more detailed questions posed by the clinician.

Conflict of interest statement

The authors have no conflict of interest.

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