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Review Article

MR anatomy and pathology of the ulnar nerve involving the cubital tunnel and Guyon's canal☆,☆☆,★,★★

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ABSTRACT

Ulnar neuropathy is a common and frequent reason for referral to hand surgeons. Ulnar neuropathy mostly occurs in the cubital tunnel of the elbow or Guyon's canal of the wrist, and it is important for radiologists to understand the imaging anatomy at these common sites of impingement. We will review the imaging and anatomy of the ulnar nerve at the elbow and wrist, and we will present magnetic resonance imaging examples of different causes of ulnar neuropathy, including trauma, overuse, arthritis, masses and mass-like lesions, and systemic diseases. Treatment options will also be briefly discussed.

1. Introduction

Ulnar neuropathy is a common peripheral neuropathy, and in the recent decade, its incidence has increased, mostly due to the overwhelming increase in duration and frequency of computer use and desk jobs. Ulnar neuropathy is most often due to compression at fibro-osseous tunnels at either of two locations: the cubital tunnel of the elbow (more common) or Guyon's canal of the wrist [1]. Diagnosis and evaluation usually starts with a comprehensive history, a thorough physical exam, and then nerve conduction studies. In equivocal, recalcitrant, or cases referred for surgery, imaging may be performed.

There are many causes of ulnar neuropathy. We have categorized them into extrinsic (trauma, overuse, degenerative arthritis, masses, and mass-like lesions) and intrinsic (systemic or metabolic diseases) causes. As secondary causes are excluded, ulnar neuropathy can be idiopathic, with no clinically identifiable etiologic factor in up to 58.2% of cases diagnosed by electrophysiologic testing [2]. Traumatic ulnar neuropathy can result from external compression (e.g., soft tissue hematoma or bone fragments) or simply from direct physical impact (contusion). Degenerative arthritis usually produces osteophytes that narrow the tight space through which the ulnar nerve travels, and the nerve can be externally compressed. Active inflammation of degenerative arthritis can also produce adjacent joint or soft tissue inflammation that involves the ulnar nerve secondarily. Masses and mass-like lesions produce external compression. Systemic/metabolic diseases have different pathophysiology that involve the ulnar nerve and will be discussed separately below. Other causes of ulnar neuropathy include ulnar nerve subluxation or dislocation and snapping triceps syndrome [3,4]. Ulnar nerve subluxation or dislocation can occur when there is congenital absence of the cubital tunnel retinaculum, allowing the nerve to sublux or dislocate over the medial epicondyle with elbow flexion. Snapping triceps syndrome results when the medial head of the triceps dislocates over the medial epicondyle and may occur as a second palpable "snap" with dislocation of the ulnar nerve.

2. Normal anatomy of the ulnar nerve

The ulnar nerve is derived from the C8-T1 nerve roots of the lower cervical spine and is a component of the medial cord of the brachial plexus. It lies posteromedial to the brachial artery in the anterior compartment of the upper arm initially then pierces the medial intermuscular septum at the arcade of Struthers (an aponeurotic band extending from the medial intermuscular septum to the medial head of the triceps) and travels medial to the triceps until it comes close to the medial epicondyle of elbow [5–7]. There is no muscular or sensory innervation of the ulnar nerve in the upper arm.

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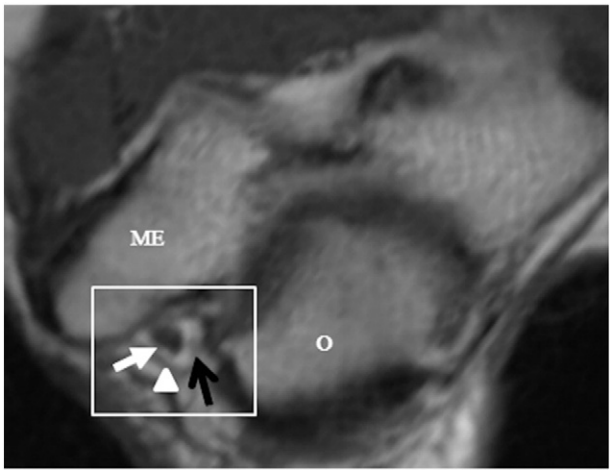

Fig. 1. MR anatomy of the cubital tunnel. Axial T1 of the elbow at the level of humeral epicondyles. Medial epicondyle (ME), olecranon (O), ulnar nerve (white arrow), cubital tunnel retinaculum (arrowhead), posterior ulnar recurrent artery (black arrow), cubital tunnel (box).

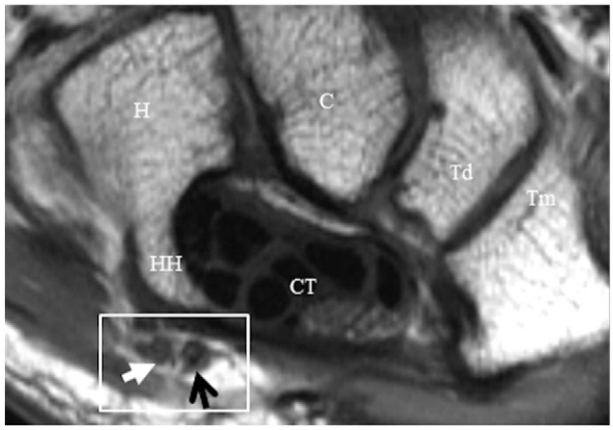

Fig. 3. MR anatomy of Guyon's canal. Axial T1 of the wrist at the level of the hook of hamate. Hook of hamate (HH), carpal tunnel (CT), hamate (H), capitate (C), trapezoid (Td), trapezium (Tm), ulnar nerve (white arrow), ulnar artery (black arrow), Guyon's canal (box).

At the elbow, the ulnar nerve runs behind the medial epicondyle in the cubital tunnel with the posterior ulnar recurrent artery. The anatomy of the cubital tunnel will be studied in detail separately.

In the forearm, the ulnar nerve continues medially between the two heads of the flexor carpi ulnaris, where it joins the ulnar artery, and then between the flexor carpi ulnaris and flexor digitorum profundus before entering the wrist [5–7]. The ulnar nerve innervates the flexor carpi ulnaris and medial half of the flexor digitorum profundus (III and IV that control the 4th and 5th digits).

The ulnar nerve accompanies the ulnar artery at the medial aspect of the wrist and passes superficial to the transverse carpal ligament. Then, it continues through Guyon's canal where it bifurcates into sensory and motor branches. The anatomy of Guyon's canal will be studied in detail separately. The muscular branches innervate the adductor pollicis, deep head of the flexor pollicis brevis, hypothenar muscles (opponens digiti minimi, abductor digiti minimi, and flexor digiti minimi brevis), palmaris brevis, and finger musculature (dorsal and palmar interossei and 3rd and 4th lumbricals). The sensory distribution of the dorsal cutaneous branch, palmar cutaneous branch, and superficial terminal branches of the ulnar nerve includes the 5th digit (little finger) and medial half of the 4th digit (ring finger), medial palmar and dorsal hand, and their corresponding skin [7].

2.1. Elbow: cubital tunnel anatomy

The cubital tunnel is located posterior to the medial epicondyle of the humerus, along the posteromedial aspect of the elbow. The roof consists of the cubital tunnel retinaculum proximally and flexor carpi ulnaris aponeurosis between the humeral and ulnar heads of the flexor carpi ulnaris distally, although these structures are often continuous. The cubital tunnel retinaculum expands from the olecranon to the medial epicondyle and is also known as Osborne's band or ligament and the flexor carpi ulnaris aponeurosis is also known as the arcuate ligament. It may be complete, partial, or absent. The capsule of the elbow and the posterior and transverse portions of the ulnar collateral ligament form

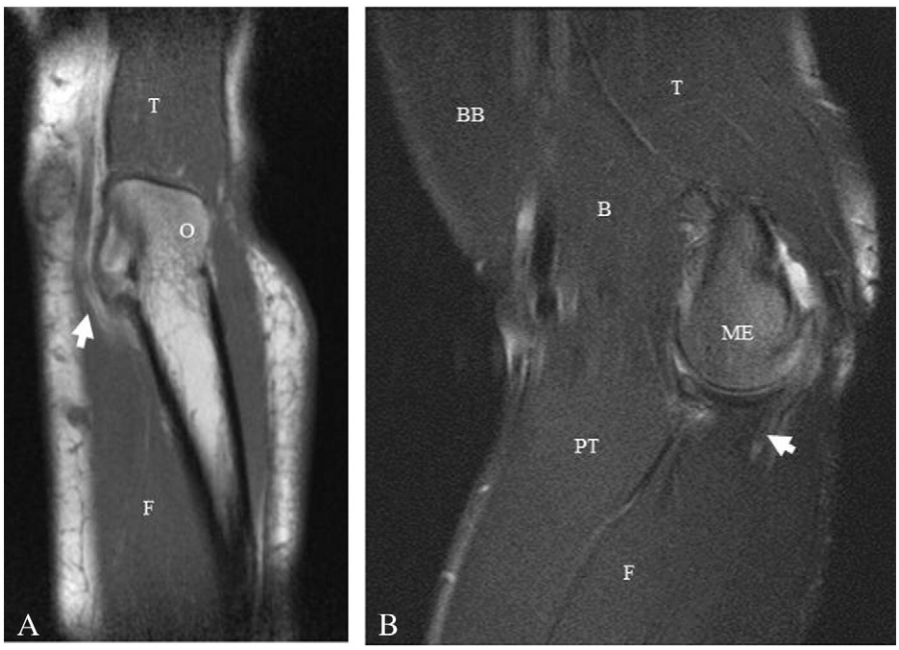

Fig. 2. MR anatomy of the cubital tunnel. Coronal T1 (**A**) and sagittal T2FS (**B**) of the elbow. Triceps muscle (T), biceps brachii muscle (BB), brachialis muscle (B), pronator teres muscle (PT), flexor muscles (F), medial epicondyle (ME), olecranon (O), ulnar nerve (arrow).