The carpal tunnel

Definition

The carpal bones are deeply convex anteriorly. This bony gutter is converted by the flexor retinaculum into a tube – the carpal tunnel, which conveys the median nerve, together with the long flexor tendons of the fingers and thumb, into the hand. It is of special interest to the surgeon because it is the site of a common nerve entrapment, the carpal tunnel syndrome.

Anatomy

The bones of the carpus are arranged in two rows (*Figure 1*).

Proximally, from the radial to the ulnar side lie the scaphoid (boat-shaped), lunate (half-moon) and triquetral, with its three articular facets. The pisiform ('pea-shaped') sesamoid bone articulates with the anterior face of triquetral and lies in the tendon of flexor carpi ulnaris. The distal row is made up, again from the radial to ulnar borders, of the four-sided trapezium, marked by a deep longitudinal groove, trapezoid, capitate, which is the largest of the eight, and the hamate, with its diagnostic hook.

The flexor retinaculum is a tough fibrous sheet (*Figure 2*) attached on the ulnar side to the hook of the hamate and the pisiform and on the radial side to the tubercle of the scaphoid and to the two ridges on each side of the groove of the trapezium. This produces a fibro-osseous tunnel which transmits the tendon of flexor carpi radialis as this passes to its insertion to the bases of the second and third metacarpals, thus excluding this tendon from the carpal tunnel proper.

The ulnar nerve, with the ulnar artery and its venae comitantes on its radial side, crosses the retinaculum immediately radial to the pisiform and then lies against the hook of the hamate. A slip of the retinaculum, together with the fibres of palmaris brevis, passes superficial to this neurovascular bundle to form Guyon's canal, an occasional site for nerve entrapment. Palmaris brevis arises from the flexor retinaculum and passes in the ulnar direction to insert into the skin of the palm – press your thumb against your little finger and you will see how this slip of muscle wrinkles the skin over the base of the hypothenar eminence.

The palmar branch of the median nerve, sensory to the palmar skin, arises just proximal to the flexor retinaculum and crosses it superficially.

The contents of the canal, as already noted, are the long flexor tendons of the fingers and thumb, together with the median nerve (*Figure 3*).

The median nerve passes beneath the flexor retinaculum immediately adjacent

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Figure 1. The bones of the hand.

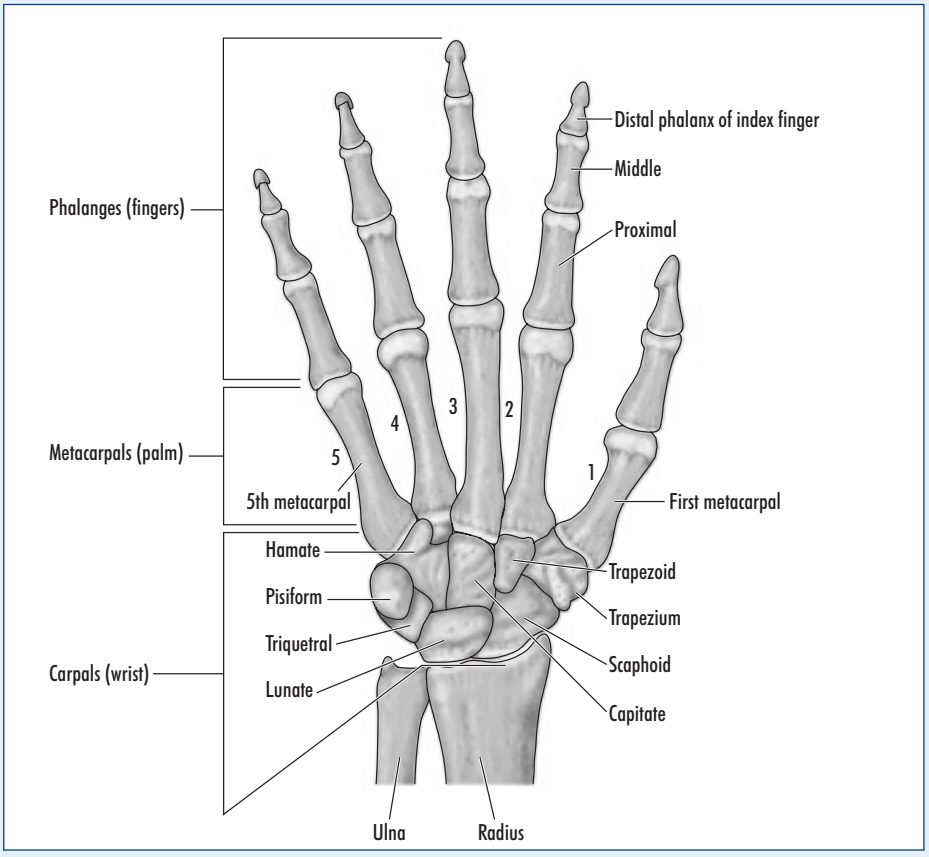
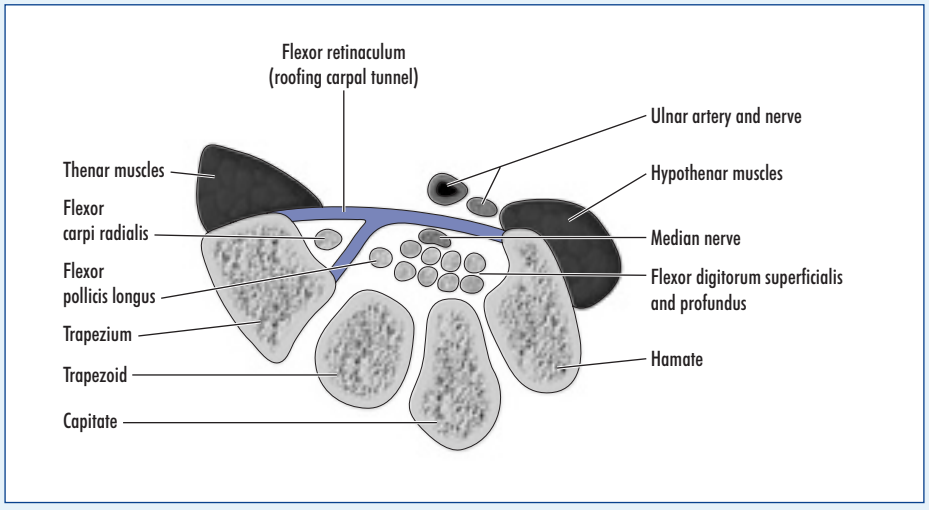


Figure 2. The carpal tunnel in cross section.



to the flexor superficialis tendon to the middle finger, pretty well in the median line of the wrist, hence its name. Immediately on leaving the tunnel distally, the median nerve gives off its important recurrent branch, which contains all its motor fibres. These supply the three muscles of the thenar eminence – abductor pollicis brevis, flexor pollicis brevis and opponens pollicis – together with the two radial lumbrical muscles.

Surface markings of the carpal tunnel

The bony margins of the carpal tunnel are readily palpated – indeed, in the thin subject, some are visible. The scaphoid tubercle is the bony prominence which can be felt at the base of the thenar eminence just distal to the distal skin crease of the wrist. In a thin subject, especially female, it may be seen in the extended wrist.

On the ulnar side of the wrist, the pisiform is easily felt, and the tendon of flexor carpi ulnaris traced to it when the wrist is flexed. Again, it is often visible in thin subjects, especially female, with the wrist extended. The hook of the hamate lies 2 cm distal and slightly radial to the pisiform and can be felt on deep pressure. Pressure with the finger nail just to the radial side of the pisiform and also immediately over the hook of the hamate elicits paraesthesia – you are immediately over the ulnar nerve (*Figures 2* and *3*).

The surface marking of the median nerve nerve is the mid point of the distal wrist skin crease.

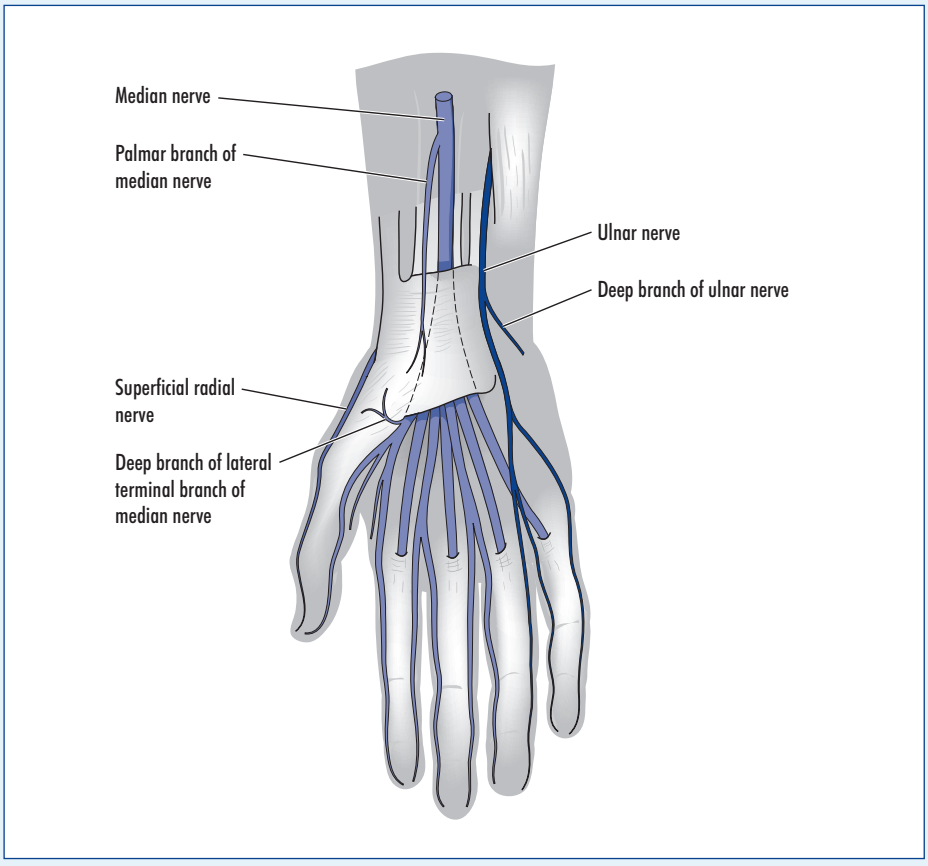
The carpal tunnel syndrome

This common clinical condition was described by Russell Brain and his colleagues in 1947 in six middle-aged or elderly women with bilateral compression and flattening of the median nerve within the tunnel accompanied by pain, paraesthesiae and sensory loss in the distribution of the nerve and with partial atrophy of the muscles of the thenar eminence. All were relieved by surgical division of the flexor retinaculum. This was the first nerve entrapment syndrome to be documented.

Compression of the median nerve in the carpal tunnel may be idiopathic, where it is especially likely to be seen in middle-aged or elderly women, in pregnancy, perhaps as a result of fluid retention, or may be produced by some space-occupying condition, such as a ganglion, rheumatoid arthritis, gout or previous injury to the carpal bones. Often there are no physical signs, only the complaint of numbness and tingling in the distribution of the median nerve in the hand – typically the thumb, index, middle and radial side of the ring finger, but never the little finger, which has an invariable ulnar sensory supply. The symptoms tend to wake the patient in the middle of the night, from sleeping with the wrists flexed in the 'fetal position', and are relieved by hanging the hand out of the bed. When physical signs are present, these may comprise objective sensory changes in the affected digits (the thenar eminence itself is supplied by the superficial palmar branch of the median nerve), together with wasting and weakness of the muscles of the thenar eminence. This is best tested by abduction of the thumb (raising it at right angles to the palm) against resistance, which is a pure abductor pollicis brevis action.

If symptoms are not relieved by conservative measures, the flexor retinaculum is divided longitudinally, care being taken to avoid the palmar cutaneous branch of the median nerve. BJHM

Figure 3. The relationships of the median and ulnar nerves to the flexor retinaculum.



Figures 1 *and* 2 *are reproduced from Ellis H (2006)* Clinical Anatomy. *11th edn. Blackwell Publishing, Oxford by kind permission, and* Figure 3 *is reproduced from Ellis H, Feldman S, Harrop-Griffiths AW (2004)* Anatomy for Anaesthetists. *Blackwell Publishing, Oxford, by kind permission.*
Conflict of interest: none.

Brain R, Dickson W, Wright A, Wilkinson M (1947) Spontaneous compression of the median nerve in the carpal tunnel - six cases treated surgically. *Lancet* **i:** 277–83

KEY POINTS

- The carpal tunnel conveys the long flexor tendons of the fingers and thumb together with the median nerve.
- Its roof is formed by the flexor retinaculum.
- Compression of the median nerve within the tunnel produces the carpal tunnel syndrome.