Peripheral neuropathies of the upper extremities in sport: A soft tissue perspective

By Stuart Hinds

Nerve entrapments of the upper extremity are common in sports related to excessive traction around a joint, as in throwing, which in turn leads to compression, inflammation, and adhesions from repetitive stress. The nerve may also become subluxed due to laxity from repetitive stress or trauma to the region. Athletes that commonly develop peripheral neuropathies include:

- Baseball pitchers (cubital tunnel);
- Tennis players (radial tunnel – backhand, pronator teres syndrome – forehand);
- Golf (pronator teres – overgrip);
- Rowing (pronator teres/flexor digitorum);
- Javelin (cubital tunnel); and
- Weight training (all of the above).

The main nerve entrapments in the upper extremity involve the median nerve, ulnar nerve, or radial nerve.

NEUROANATOMY OF THE PERIPHERAL NERVES

The median nerve

The median nerve forms the junction of the lateral medial cords. It travels laterally to the brachial artery to approximately the mid humerus. At this level, the median nerve crosses over the brachial artery to lie in a more medial anatomic position.

The nerve is superficial to the brachialis muscle and usually lies in a groove with the brachial artery, between the brachialis and biceps muscle. It travels across the antecubital fossa, underneath the bicipital aponeurosis, and between the biceps tendon and the pronator teres. At this level, the median nerve is on the distal aspect of the brachialis muscle. The nerve then travels underneath the two heads of the flexor digitorum sublimis (FDS) muscle to lie between this muscle and the flexor digitorum profundus (FDP) muscle. The median nerve emerges between these two muscles in the distal forearm to then travel ulnar to the flexor carpi radialis and radial to the sublimis tendons, usually directly underneath the palmaris longus tendon, and enters the carpal tunnel in a more superficial plane to the flexor tendons.

The motor branch emerges at variable sites but most frequently at the distal aspect of the carpal ligament to service the thenar musculature. Just beyond the end of the carpal ligament, the median nerve trifurcates to become the common digital sensory nerves to the fingers. The palmar cutaneous branch of the median nerve is a sensory branch that comes from the main body of the nerve approximately six inches above the rest of the nerves and services an elliptical area at the base of the thenar eminence. This superficial nerve does not lie within the carpal tunnel.

Just distal to the antecubital fossa, the median nerve branches into the anterior interosseous nerve, which travels on the interosseous membrane and innervates the flexor pollicis longus (FPL), the FDP to the radial two digits, and the pronator quadratus at its termination. The nerve innervates the pronator teres, flexor capri radialis, the FDS, and the two radial FDP tendons. It also supplies the FPL and the pronator quadratus.

Within the hand, the motor branch of the median nerve supplies the opponens pollicis, the flexor pollicis brevis, and the abductor pollicis brevis musculature. It also supplies the two radial lumbrical muscles in the hand. The median nerve supplies sensation to the 3.5 digits on the radial aspect.

The ulnar nerve

The ulnar nerve arises from the medial cord of the brachial plexus. The ulnar nerve travels posterior to the brachial artery and remains within the flexor compartment of the upper extremity until it reaches the medial epicondyle. The nerve travels behind the medial epicondyle back into the flexor compartment underneath the flexor musculature. Above the elbow, the ulnar nerve lies on the long head and then the medial head of the triceps muscle, directly posterior to the medial intermuscular septum between the brachialis and the triceps muscles.

The fascial bands over the median nerve constitute the Struthers arcade. The nerve passes within the cubital tunnel posterior to the medial epicondyle. It is directly underneath a tight fascial roof known as the Osborne band, which is contiguous with the leading fascial heads of the flexor carpi ulnaris (FCU) muscle. Just above the elbow branches, the nerve branches to the superficial head of the FCU. The nerve lies directly over the top of the FDS muscle and beside the FDP muscle at the elbow.

As the ulnar nerve travels down the forearm, it is wedged between the FDS and the FDP muscle bellies to exit in the distal forearm just ulnar to the ulnar artery and the FDP tendons. The FCU tendon protects the nerve on its ulnar aspect. The ulnar nerve travels within the Guyon canal at the wrist to supply the hypothenar muscles, including the opponens digiti quinti and the abductor digiti quinti. It also supplies the two ulnar lumbrical muscles and the interossei to the hand and the deep branch to the flexor pollicis brevis muscle. The ulnar nerve supplies sensation to the 1.5 digits of the ulnar aspect. The dorsal cutaneous branch of the ulnar nerve supplies sensation to the dorsal ulnar half of the hand and fingers. This nerve arises from the main ulnar nerve approximately 6cm proximal to the wrist.

The radial nerve

The radial nerve emerges from the posterior aspect of the humerus in the spiral groove between the brachialis and brachioradialis muscles above the elbow. It leaves the extensor compartment to travel in front of the elbow underneath the brachioradialis muscle, sending branches of innervation to it just above the elbow. The radial nerve divides at the level of the radial capitellar joint into the posterior interosseous nerve and the superficial

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radial nerve. At this point, it branches to the extensor carpi radialis brevis.

The superficial radial nerve continues to travel underneath the brachioradialis muscle to ultimately emerge between that muscle and the extensor carpi radialis longus tendon. The superficial radial nerve supplies sensation to the radial half of the dorsum of the hand. The posterior interosseous nerve travels within the fat pad and runs below the supinator muscle to emerge in the distal dorsal aspect of the forearm. The posterior interosseous nerve travels at the level of the interosseous membrane to ultimately provide sensation to the posterior aspect of the wrist. This nerve innervates the extensor indicis proprius, extensor digiti quinti, extensor carpi ulnaris, abductor pollicis longus, extensor pollicis brevis, and extensor digitorum communis muscles.

ENTRAPMENT

The phrase 'compressive neuropathy' implies that the peripheral nerves are being impinged upon by adjacent anatomical structures. The resultant injury is assumed to be related to reduced epineural blood flow. The relative ischemia decreases axonal transport and, in turn, the nerve's ability to conduct impulses

DOUBLE CRUSH THEORY

The double-crush theory predicts that a compressive lesion at one point along a peripheral nerve lowers the threshold for occurrence of compression at another site secondary to internal derangement of nerve cell metabolism.

ASSESSMENT

Neurodynamic testing

Median nerve bias
Ulnar nerve bias
Radial nerve bias

Median nerve

- Pronator teres syndrome
- Anterior interosseous syndrome
- Carpal tunnel syndrome

Ulnar nerve

- Cubital tunnel syndrome
- Ulnar tunnel syndrome

Radial nerve

- Radial tunnel syndrome
- Posterior interosseous syndrome

Median nerve entrapments

Pronator teres syndrome

Signs and symptoms: The athlete complains of pain in the anterior aspect of the forearm that is exacerbated with activity and relieved by rest; decreased sensation in the thumb, index finger, long finger, and radial side of the ring finger; weakness of thenar muscles; and a positive Tinel or Phalen sign in the proximal forearm.

Sites of compression

These include the:

1. Lacertus fibrosus (bicipital aponeurosis, superficial forearm fascia).
2. Struthers ligament (thickened or aberrant origin of pronator teres from distal humerus).
3. Pronator teres (musculofascial band or compression between two muscular heads).
4. FDS proximal arch or the flexor digitorum superficialis.

Testing

- Bicipital aponeurosis compression – resisted elbow flexion and forearm supination.
- Pronator teres compression – resisted forearm pronation and flexion.
- Flexor digitorum superficialis compression – resisted flexion of the interphalangeal joint of the middle finger.

Soft tissue treatment

Clear CERVICAL/SHOULDER soft tissue restriction
Myofascial tension techniques applied to MEDIAN NERVE NEURODYNAMIC testing restrictions.

Active or latent trigger point activity

Pronator teres
Flexor digitorum superficialis

Anterior interosseous syndrome

Symptoms: These include vague pain in the proximal forearm which mimics pronator syndrome and weakness of the Flexor Pollicus Longus and Flexor Digitorum Profundus to the index finger. The anterior interosseous nerve is purely motor there is no sensory change. Affected persons cannot form a circle by pinching their thumb and index finger (i.e., hyperextension of index distal interphalangeal joint and thumb interphalangeal joint).

- Nerve anatomy: The anatomy includes the branch of the median nerve arising approximately 6 cm below the elbow and supplying motor function from the FPL, pronator quadratus, and FDP to the index finger.
- Etiology: Causative factors include tendinous bands, a deep head of the pronator teres, accessory muscles (including the Gantzer muscle, which is the accessory head of the FPL), aberrant radial artery branches, and fractures.

Testing

- Resisted muscle tests of the flexor pollicus longus and flexor digitorum profundus to the index finger.
- Resisted forearm pronation with the elbow in complete flexion.

Soft tissue treatment

Clear CERVICAL/SHOULDER soft tissue restrictions
Myofascial tension techniques applied to MEDIAN NERVE NEURODYNAMIC testing restrictions.
Trigger point therapy:
Flexor pollics longus
Pronator teres
Flexor digitorum profundus

Ulnar nerve entrapment

Cubital tunnel syndrome

Signs and symptoms: These include pain in the forearm, which radiates in the distribution of the ulnar nerve; numbness; tingling in the 1.5 fingers of the ulnar aspect; wasting or weakness of intrinsic hand muscles; a positive compression test result at the elbow; recurrent subluxation of the nerve over the epicondyle; and the reproduction of symptoms with elbow flexion, with or without wrist extension.

- Anatomy: The ulnar nerve runs adjacent to the medial head of the triceps into the groove behind the medial epicondyle of

the humerus. It passes beneath the fascia joining the two heads of the FCU and lies on the superficial surface of the FDP.

Sites of compression

These include the:

1) Struthers arcade.
2) Anconeus epitrochlearis.
3) Intermuscular septum.
4) The Osborne band.
5) The aponeurosis of the Flexor Carpi Ulnaris.

Testing

- Palpation of the cubital tunnel and flexor carpi ulnaris reproduces tenderness.
- Elbow flexion test: Elbows fully flexed and wrists fully extended for 3 minutes. Positive sign is pain or paraesthesia.
- Tinel`s sign over the cubital tunnel will be positive.

Soft tissue treatment

Clear CERVICAL/SHOULDER Soft tissue restrictions

Myofascial tension techniques applied to ULNAR NERVE NEURODYNAMIC testing restrictions

Trigger point therapy

Flexor Carpi Ulnaris

Flexor digitorum superficialis

Triceps medial head

Radial nerve entrapment

Radial tunnel syndrome

Symptoms: These may include pain in the upper extensor forearm; dysesthesia in a superficial radial nerve distribution; and weakening of the extension of the fingers, thumb, or wrist.

- Anatomy: Compression neuropathy of the radial nerve is considered somewhat more rare than the other compression neuropathies of the upper extremity. The radial tunnel proper is somewhat ill defined, but it is usually considered the area where the radial nerve exits between the brachioradialis and the brachialis muscles to where it derives below the supinator muscle (Frohse arcade).
- Etiology: The deep branch of the radial nerve can be compressed by five structures within the radial tunnel.

Sites of compression

1. The proximal fibrous edge of the supinator muscle, known as the arcade of Frohse.
2. The most proximal structure that can compress the deep branch of the radial nerve is the fibrous fascia over the radiocapitellar joint.
3. The next structures that can compress the deep branch of the radial nerve are the radial recurrent artery and the venae comitantes, known as the leash of Henry, although this is uncommon.
4. Lastly, the deep branch of the radial nerve can also be compressed by the distal edge of the supinator muscle, which is known to be fibrous in 50-70 per cent of patients.

Testing

- Tenderness on palpation along the radial nerve, anterior to the radial head, distinguishes it from an extensor tendonosis (tennis elbow).
- Pain on stretching the extensor muscles and resisted finger extension.
- Resisted middle finger extension.

Posterior interosseous syndrome

Symptoms: Like radial tunnel syndrome, posterior interosseous syndrome can also often mimic lateral epicondylitis.

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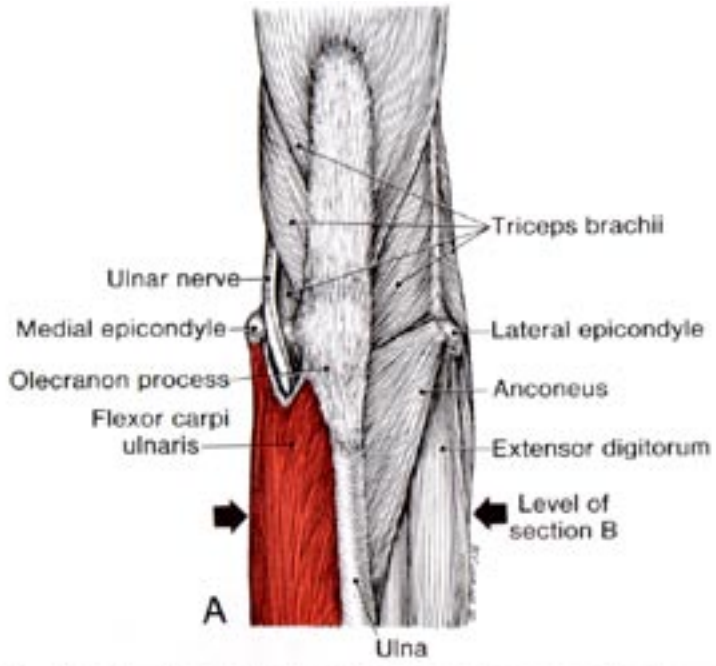

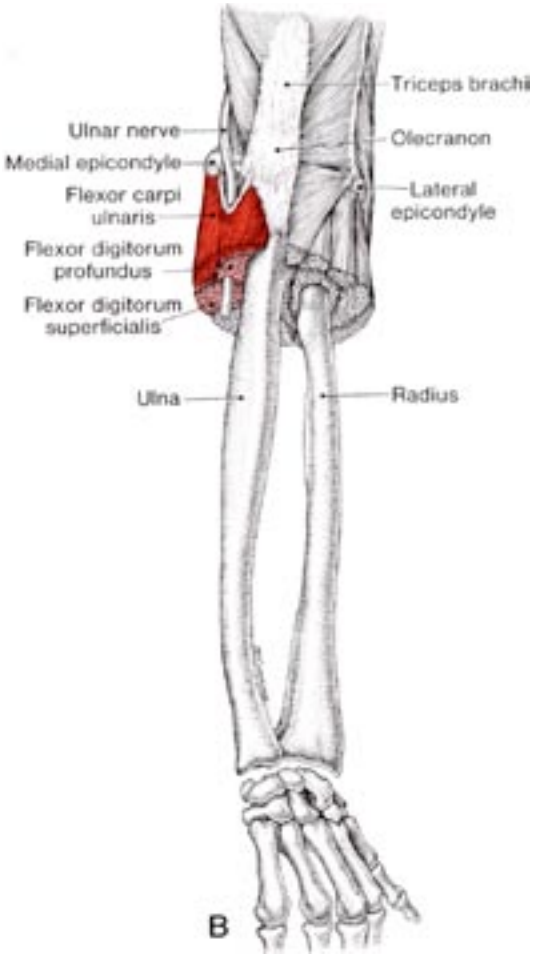

Figure 38.4. Dorsal view of the normal relation between the right ulnar nerve and the flexor carpi ulnaris muscle (*dark red*) *A*, tendinous arch between the muscle's humeral and ulnar heads, through which the ulnar nerve passes. *B*, cross section showing the relation of the ulnar nerve to the flexor carpi ulnaris (*dark red*), flexores digitorum superficialis and profundus muscles (*light red*), several centimeters below the elbow in the region of the trigger points that may cause the nerve entrapment.

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Patients may report proximal forearm pain. No sensory deficit is described, because the posterior interosseous nerve but partial-to-complete motor paralysis of the extensors is reported. Often, the brachioradialis and extensor carpi radialis brevis/extensor carpi radialis longus, which are innervated by more proximal branches, are spared. Therefore, any remaining wrist extension also displays radial deviation.

- Etiology: Causes may include entrapment of the nerve in a supinator, fracture or dislocation of the radial head, tumors (e.g. ganglion, lipoma), and iatrogenic causes resulting from open reduction/internal fixation of proximal radius fractures.

Soft tissue treatment
Clear CERVICAL /SHOULDER Soft tissue restrictions
Myofascial tension technique applied to NEURODYNAMIC TESTING restrictions.

Trigger point therapy
Supinator
Extensor carpi radialis brevis
Biceps brachii
Brachoradialis

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Stuart Hinds is a practicing soft tissue therapist with 18 years' experience. He currently lectures at Victoria University, Melbourne, where he is the practical coordinator for physical assessment and soft tissue techniques. Stuart has been involved with elite cycling (national and international) and a range of athletes from all professional levels of sport. Stuart was a part of the IOC massage services for the 2000 Sydney Olympic Games, and was a member of the Soft Tissue service for the Australian Olympic Team at the 2004 Athens and 2008 Beijing Olympic games. He presented at the 2003 Australian Conference of Science and Medicine in Sport on the practical dynamics of soft tissue therapy for post acute Adductor strains, and was keynote speaker at the 3rd Joint Sportex and Sports Massage Association Conference, Loughborough University, Leicstershire UK on Musculoskeletal flexability screening as a treatment tool for soft tissue therapists. Stuart has consulted to the South African Cricket Team and the Scottish Commonwealth Team. He runs a successful private practice in Geelong and is a contract soft tissue therapist for the Geelong Football Club.