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Nerves that innervate the hand

Muscles of the handMuscles and other structures of wrist and palmDetailsOriginUpper extremityInsertionHand and fingersNerveradial, median, and ulnar nerves (from C5–T1)ActionsFlexion, extension, adduction, abduction of the hand and fingers and opposition of the thumbIdentifiersFMA42368Anatomical terms of muscle[edit on Wikidata]The muscles of the hand are the skeletal muscles responsible for the movement of the hand and fingers. The muscles of the hand can be subdivided into two groups: the extrinsic and intrinsic muscle groups. The extrinsic muscle groups are the long flexors and extensors. They are called extrinsic because the muscle belly is located on the forearm. The intrinsic group are the smaller muscles located within the hand itself. The muscles of the hand are innervated by the radial, median, and ulnar nerves from the brachial plexus.[1] Intrinsic The intrinsic muscle groups are the thenar (thumb) and hypothenar (little finger) muscles; the interossei muscles (four dorsally and three volarly) originating between the metacarpal bones; and the lumbrical muscles arising from the deep flexor (and which are special because they have no bony origin) to insert on the dorsal extensor hood mechanism. Palmaris brevis which is a superficial muscle and adductor pollicis are also intrinsic muscles.[2] Extrinsic Extensor compartments of wrist (back of hand) The fingers have two long flexors, located on the underside of the forearm. They insert by tendons to the phalanges of the fingers. The deep flexor attaches to the distal phalanx, and the superficial flexor attaches to the middle phalanx. The flexors allow for the actual bending of the fingers. The thumb has one long flexor and a short flexor in the thenar muscle group. The human thumb also has other muscles in the thenar group (opponens and abductor brevis muscle), moving the thumb in opposition, making grasping possible. The extensors are located on the back of the forearm and are connected in a more complex way than the flexors to the dorsum of the fingers. The tendons unite with the interosseous and lumbrical muscles to form the extensorhood mechanism. The primary function of the extensors is to straighten out the digits. The thumb has two extensors in the forearm; the tendons of these form the anatomical snuff box. Also, the index finger and the little finger have an extra extensor, used, for instance, for pointing. The extensors are situated within 6 separate compartments. Compartment 1 (Most radial) Compartment 2 Compartment 3 Compartment 4 Compartment 5 Compartment 6 (Most ulnar) Abductor pollicis longus Extensor carpi radialis longus Extensor indicis Extensor digiti minimi Extensor carpi ulnaris Extensor pollicis brevis Extensor carpi radialis brevis Extensor digitorum communis The first four compartments are located in the grooves present on the dorsum of inferior side of radius, while the 5th compartment is in between radius and ulna. The 6th compartment is in the groove on the dorsum of inferior side of ulna. Nerve supply The muscles of the hand are innervated by the radial, median, and ulnar nerves. The radial nerve innervates the finger extensors and the thumb abductor; that is, the muscles that extend at the wrist and metacarpophalangeal joints (knuckles) and abduct and extend the thumb. The median nerve innervates the flexors of the wrist and digits, the abductors and opponens of the thumb, the first and second lumbricals. The ulnar nerve innervates the remaining intrinsic muscles of the hand.[3][4] All muscles of the hand are innervated by the brachial plexus (C5–T1) and can be classified by innervation:[1][4][5] Nerve Muscles Radial Extensors: carpi radialis longus and brevis, digitorum, digiti minimi, carpi ulnaris, pollicis longus and brevis, and indicis Other: abductor pollicis longus, Median Flexors: carpi radialis, pollicis longus, digitorum profundus (half), superficialis, and pollicis brevis (superficial head). Other: palmaris longus, abductor pollicis brevis, opponens pollicis, and first and second lumbricals. Ulnar Flexor carpi ulnaris, flexor digitorum profundus (half), palmaris brevis, flexor digiti minimi, abductor digiti minimi, opponens digiti minimi, adductor pollicis, flexor pollicis brevis (deep head), palmar and dorsal interossei, and third and fourth lumbricals. See also Muscles of the thumb References ^ a b Ross & Lamperti 2006, p. 257 harvnb error: no target: CITEREFRossLamperti2006 (help) ^ "Medical mnemonics". LifeHugger. Archived from the original on 2011-07-13. Retrieved 2009-12-19. ^ Jones & Lederman 2006, pp. 16–18 harvnb error: no target: CITEREFJonesLederman2006 (help) ^ a b Palazzo, J. J.; Galloway, K. (2017-01-01), Placzek, Jeffrey D.; Boyce, David A. (eds.), "Chapter 53 - Nerve Entrapments of the Wrist and Hand", *Orthopaedic Physical Therapy Secrets* (Third Edition), Elsevier, pp. 429–436, doi:10.1016/b978-0-323-28683-1.00053-9, ISBN 978-0-323-28683-1, retrieved 2020-10-24 ^ Jacobson, Mark D.; Raab, Rajnik; Fazeli, Babak M.; Abrams, Reid A.; Botte, Michael J.; Lieber, Richard L. (September 1992). "Architectural design of the human intrinsic hand muscles". *The Journal of Hand Surgery*. 17 (5): 804–809. doi:10.1016/0363-5023(92)90446-v. ISSN 0363-5023. Retrieved from "This article provides an overview of the anatomy of the hand, part of the Geeky Medics series covering the anatomy of the upper limb." For an overview of clinical examination of the hands, see the Geeky Medics guide to hand and wrist examination. Bones of the hand To understand the anatomy of the hand we first must understand the anatomy of the forearm and wrist. The forearm consists of two bones, the radius and the ulna. Both forearm bones articulate with the carpal bones of the wrist distally. The radius articulates with the cashew shaped scaphoid bone, and the croissant or moon-shaped lunate bone. The ulna articulates with the triquetrum, through a pad of intervening cartilage known as the triangular fibrocartilaginous complex. These three bones make up the proximal carpal row. Five further carpal bones form the distal carpal row. The trapezium articulates with the first metacarpal, i.e. the thumb metacarpal (hence "trapezium with the thumb"). Adjacent to this we have the trapezoid, which articulates with the second metacarpal. Superficial to the triquetrum, we have the pisiform, a pea-shaped sesamoid bone that lies within the tendon of flexor carpi ulnaris. The capitate is adjacent and articulates with the third and fourth metacarpals. Finally, the hamate articulates with the fifth metacarpal. The hamate is easily identifiable by its 'hook' like volar projection. The metacarpals articulate with the proximal phalanges, which articulate with the middle phalanges, which finally articulate with the distal phalanges. The thumb has only a proximal and distal phalanx. It opposes the tips of the other fingers and is essential for precision grip. The thumb constitutes 70% of hand function, and a thumb injury can leave the patient debilitated, particularly if the dominant hand is injured. For more information, see the Geeky Medics guide to the bones of the hand. Figure 1. Bones of the hand. Muscles of the hand Interossei muscles The interossei muscles are intrinsic hand muscles that originate from the intermediate surfaces of the metacarpals. There are four dorsal and three palmar interossei muscles. They insert onto the proximal phalanx and extensor hood of each finger. Palmar interossei ADduct the fingers, and dorsal interossei ABduct the fingers (hence PAD/DAB). The radial artery enters the hand by passing between the two heads of the first dorsal interosseous. Figure 2. Dorsal interossei Figure 3. Palmar interossei Lumbricals The four lumbricals are thin worm-like muscles that flex the metacarpophalangeal joints and extend the interphalangeal joints. They arise from the tendons of flexor digitorum profundus and are the only muscles in the human body to arise from the tendons of another muscle. Figure 4. Lumbricals of the hand Thenar and hypothenar eminence Thenar eminence (radial side) There are three muscles that make up the thenar eminence. Opponens pollicis is deep and helps the thumb in opposing the other digits. Flexor pollicis brevis is on the ulnar side of the eminence and flexes the metacarpophalangeal joint of the thumb. Abductor pollicis brevis is on the radial side of the eminence and works in conjunction with the abductor pollicis longus to abduct the thumb. Hypothenar eminence (ulnar side) In a similar fashion to the thenar eminence, the hypothenar eminence is formed by three muscles. Opponens digiti minimi is deep and helps the little finger oppose the thumb. Flexor digiti minimi is on the radial side of the eminence and flexes the metacarpophalangeal joint of the little finger. Abductor digiti minimi is on the ulnar side of the eminence and abducts the little finger. Nerves of the hand The ulnar nerve (C8-T1 nerve roots) arises from the medial cord of the brachial plexus and supplies all of the intrinsic muscles of the hand with a few exceptions. These are the muscles of the thenar eminence and the radial two lumbricals, which are supplied by the median nerve (C5-T1). The median nerve supplies sensation to the radial three and a half fingers on the palmar aspect and the nail beds dorsally. This is through the proper digital nerves that run on either side of the fingers. The median nerve also supplies the radial two-thirds of the palm through the palmar cutaneous branch. This nerve branches off before the median nerve passes through the carpal tunnel and is hence spared in carpal tunnel syndrome. Sensation to the palmar and dorsal side of the ulnar one and half fingers is supplied by the sensory branches ulnar nerve. The radial nerve supplies sensation to the radial 3 and a half fingers and dorsal surface of the hand through its dorsal sensory branch. For more information, see the Geeky Medics guide to the nerve supply of the upper limb. Figure 5. Hand dermatomes (dorsal) Figure 6. Hand dermatomes (palmar) Blood supply and drainage of the hand The superficial palmar arch is the main continuation of the ulnar artery. It receives a small superficial branch from the radial artery and supplies the fingers with blood via the common digital, and the distal 'proper digital arteries' which run on either side of the finger. The thumb and radial side of the index finger are exceptions, as they receive branches directly from the radial artery before it forms the deep palmar arch in the hand. The deep palmar arch is the main branch of the radial artery and supplies the deep hand structures. Paired veins accompany the arterial arches and share the same names (i.e. radial and ulnar). The more superficial cephalic and basilic veins drain the dorsal venous network of the hand. Figure 7. Blood supply of the hand Clinical relevance Carpal tunnel syndrome If the median nerve becomes compressed within the carpal tunnel, there is paraesthesia in the radial three and a half fingers as well as thenar muscle wasting in late-stage disease. Patients will often complain of tingling in the hand, and pain after using their affected hand. Treatment options include steroid injections, physiotherapy, and carpal tunnel release. For more information, see the Geeky Medics guide to carpal tunnel syndrome. Ulnar paradox Usually, the more proximal a nerve injury, the worse the resulting function of the body. The opposite is true when we consider the ulnar nerve. This is because one of the muscles that flexes the fingers (flexor digitorum profundus, which lies in the forearm) is partially innervated by it. Hence a proximal injury will remove innervation to the forearm muscles and the hand muscles. A distal injury only takes out the hand muscles; hence the still functioning finger flexors give the patient a clawed appearance in the ring and little finger. With a proximal injury leading to an open palm, there is more capacity for functional grip and use of the hand. Dupuytren's contracture The palmar aponeurosis is a thick area of fascia that is tightly attached to the skin. Dupuytren's contracture is caused by a proliferation of type three collagen within the palmar fascia. It causes the palmar aponeurosis to thicken and contract, causing the little and ring finger to flex abnormally. Treatment of Dupuytren's contracture includes physiotherapy and splinting with steroid injections if still in its initial stages, and surgical excision of the bands for advanced cases. Hand fractures Fractures involving the bones of the hand can result in significant dysfunction. The decision on whether to treat conservatively or with surgery is dependent on both the appearance of the hand due to the injury, as well as the function of the hand as a motor and sensory unit. If a fracture results in rotation of a finger to an unacceptable degree or is unstable due to its very nature (e.g. an oblique fracture or fracture involving the endplate of the bone within a joint), it is likely to require repair. An example of a fracture that is usually managed conservatively, is the 'boxer's fracture', a transverse fracture of the distal fifth metacarpal shaft. Editor Dr Chris Jefferies Volume 31, Issue 51, p. 748.1-748.1 The median and ulnar nerves carry cutaneous sensory fibers for the skin of the palmar side of the hand. The distribution of cutaneous nerves on the dorsum varies according to authors of anatomy textbooks and atlases, Gray's Anatomy, Moore's Clinically Oriented Anatomy, Grant's Atlas of Anatomy, and Netter's Atlas cite variations of cutaneous nerve distribution on the dorsum of the hand. Description of the cutaneous distribution on the palmar side of the hand does not vary between these different sources. The median nerve supplies the palmar side of fingers 1–3 and the lateral side of finger 4, while the ulnar nerve supplies the palmar side of finger 5 and medial side of finger 4. This project examined the palmar cutaneous distribution of both left and right hands in a group of cadavers and did not discover any variations from the typical description. Future studies will explore cutaneous distribution on the dorsum of the hand. Support or Funding InformationSupported and funded by the Department of Biology and Mathematics of D'Youville College, Buffalo, NY © 2021 Federation of American Societies for Experimental Biology (FASEB) All the intrinsic muscles of the hand are innervated by the ulnar nerve, except four muscles which are supplied by the median nerve and are easily recalled with the mnemonic:Mnemonic ProCite RefWorks Reference Manager 2Born T. & Mahoney J: Cutaneous distribution of the ulnar nerve in the palm: does it cross the incision used in carpal tunnel release?. Ann Plast Surg 35:23–25, 1995Born T, Mahoney J: Cutaneous distribution of the ulnar nerve in the palm: does it cross the incision used in carpal tunnel release?. Ann Plast Surg 35:23–25, 1995[falseSearch Google ScholarExport Citation 3Carroll RE. & Green DP: The significance of the palmar cutaneous nerve at the wrist. 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