The hand

it's the most important subject of the upper limb because it has a clinical importance .

the palm of the hand**

-the palmar aponeurosis located in the palm of the hand which is a deep fascia and it's a fibrous connective tissue which is triangular in shape

- functions of palmar aponeurosis :
- 1- -protection of deep structures (tendons, arteries, nerves)
- 2- -it helps in hand grip(when you hold something, when you do a fist, it will concave).

*Boundaries of palmar aponeurosis :

1-apex: attached to flexor retinaculum& gives insertion to palmaris longus tendon

2-edge on the lateral side : gives attachment to the fibrous septa Which is the lateral fascial space that comes the extensor retinaculum this space surrounds the thinner muscles so it's called thinner fascial space

3-edge on the medial side :the medial fascial space is located here and it's related to the hypothinner muscles(muscles of the little finger) so it's called hypothinner space

4-deep the palmar aponeurosis there is an intermediate fascial space which is between the medial and lateral fascial spaces -this means that the palm of the hands contains 3 fascial spaces 1-lateral (thinner) fascial space

2-medial (hypothinner)fascial space

3-intermediate fascial space

*the importance of these spaces is that they contain deep structures (tendons and muscles) in the palm and also it's very important for preventing the spreading of infection in the palm of the hand For example : if there was an infection in the hypothinner muscles in the medial side it will be localized there and it will not spread to other spaces

* palmer aponeurosis distaly gives slips of fibers attached to the transverse ligament of the palm and also it gives attachment to the fibrous flexor sheath (sheath in front of the fingers).

**palmaris brevis muscle:

- origin: flexor retinaculum & the edge of palmar aponeuroses
- insertion: the skin of the palm medialy
- function: it helps in the grip of the palm with the help of palmar aponeurosis

thinner muscles :

they are 4 muscles related to the thumb :

1-abductor pollicis brevis

2-flexor pollicis brevis

3-apponens pollicis : it helps for counting with other fingers

4-adductor pollicis : it's special because it has 2 heads (oblique and transverse)

All these muscles are innervated by the median nerve expect the adductor polices it's innervated by the ulnar nerve

hypothinner muscles :

on the medial side :abductor digiti menimi

on the lateral side: flexor digiti minimi

deep to the flexor digiti minimi is opponens digiti minimi

*all these muscles are innervated by the deep branch of ulnar nerve carpal tunnel :

this tunnel is deep to flexor retinaculum and contains the median nerve and the tendons of flexor digitorum superfescialis and profundus this tunnel is also anterior to the concavity of the carpal bones because the superfescial surface of the carpal bones is concaved.

*the median nerve is comprised between the long tendons of superfescialis and profundus on the medial side and comprised by the flexor carpi radialis and flexor polices longus on the lateral side *but be aware that the tendons with direct adherent with the median nerve are the tendons of superfescialis mediay and flexor carpi radialis laterally

carpal tunnel syndrom

this syndrome is characterized with a pressure on the median nerve from daily work and life processes and excessive use of the wrest joint which leads to inflammations in the carpal tunnel ,this inflammations leads to edema there which increases the pressure on the median nerve , and that will cause weakness in the 5muscles innervated by the median nerve in the hand .

*the moves that the patient will hardly be able to do :1- apponens 2flexion 3-abduction on the fingers

* the patient will be able to adduct the thumb because the adductor pollicis is innervated by the ulnar nerve

patient will have tingling and numbness to the lateral 3 and a half fingers because of the injury to the median nerve

QUESTION : will the sensation of the lateral 2 thirds of the palm be affected by this syndrome ?

answer:no,The sensation will be normal because the lateral two thirds of the palm is innervated by the palmar branch of median nerve which pass superficial to flexor retinaculum and not through the carpal tunnel

*there is also an injury to the median nerve called the Ape hand syndrome and the sings of this syndromes are :

• The thumb is adducted because it's innervated by ulnar nerve NOT median nerve so when the median nerve has an injury automatically the thumb adducts by ulnar nerve.

• The hand is extended because the extensor muscles are innervated by radial nerve and because of the weakness of the flexor muscles due to the injury of median nerve so the extension of the hand will be stronger the the flexion

• deviation happens to the hand to the ulnar side because it's innervated by ulnar nerve while the median nerve innervates the radial side

*snaff box

boundaries :

- Anterior : abductor pollicis longus, extensor pollicis brevis
- Posterior : extensor pollicis longus
- Base : 2 bones, scafoid & trapezium
- Roof : skin (superficial fascia)
- It content : radial artery ,cephalic vein , superficial branch of radial nerve

*Fibrous flexor sheath or Fibrous digital sheath:

- It's called flexor because flexor tendons pass deep to it.
- Location: In front of the fingers.
- It's surrounded by fat and because of that it's soft
- It protects the deep tendons like flexor digitorum superfacialis, and between them the flexor digitorum profundus tendons pass. They are surrounded by synovial sheath.

Fibrous flexor sheath is :

- Proximaly is open for the tendons to pass through it
- Distaly is closed

*synovial sheath

- Synovial sheath is inside the fibrous sheath.
- It secretes the synovial fluid to lubricate the tendon and facilitate their movement to prevent friction and infection to those tendons

• Location of some synovial sheaths

1. Around flexor policies longus there is a synovial sheath (this sheath is called radial perca)

2. Arround the long tendon of four medial tendons, superfacialis and profundus there is a synovial sheath (it's called ulnar perca)

** the ulnar perca extends with the little finger only with full cover, it stop and don't cover the area after the beginning of the proximal phalanx of the index, middle and ring fingers So the next space after the proximal phalanx of these fingers lacks synovial sheath.

** Sometimes there is a connection between the ulnar perca and the radial perca on about 50% of the palm

the radial perca is longer than the ulnar perca

The Insertion of Long Flexor Tendon

*Remember flexor digitorum superfacialis tendon do 2 slits or 2 slings to the 2 sides of middle phalanx to allow the long tendon of flexor digitorum profundus to pass through them and insert in the base of distal phalanx. And these 2 muscles help in the flexion of the 4 medial fingers.

Small Muscles of the Hand

1) The eight interossei muscles (between metacarple bones)

- 4 palmar interossei muscles > adduction of fingers
- 4 dorsal interossei muscles > abduction of fingers

2) Four Lumbrical muscles

- Lateral 2/3 muscles innervated by the Median nerve
- Medial 1/3 muscles innervated by the Ulnar nerve
- 3) Short muscles of the thumb

- Adductor Pollicis
- Abductor Pollicis Brevis
- Flexor Pollicis Brevis
- Opponens Pollicis
- 4) Short muscles of the little finger
- Abductor Digiti Minimi
- Opponen Digiti Minimi
- Flexor Digiti Minimi

Key :

MCP= metacarpophalangial joints > between metacarples and phalangles

>> It's important in the writing position, that's include flexion of metacarpophalangial joint and extention of the proximal and distal interphalangial joints.

*Palmar Interossei

- Four muscles
- Origin:

 1^{st} – medial side of the base of 1^{st} metacarpal

2nd – medial side of the base of 2st metacarpal

3rd & 4th- the adjacent or the lateral side of metacarpals

** The middle finger lack of origin of palmar interossei because the action of these muscles is the adduction toward the middle finger to these it no need for the middle finger to have an origin of palmar interossei

• Insertion

 $1^{st} \& 2^{nd}$ – to the medial side of dorsal digital expansion

 3^{rd} & 4^{th} – to the lateral side of the ring and little finger

• Innervation

Deep branch of ulnar nerve

Action : adduction of the fingers toward the middle finger

*Dorsal Interossei

• Origin :

 1^{st} – between the metacarples of the tumb and index

2nd - between the metacarples of the index and middle

3rd – to the Middle finger

Notice that the middle finger is the most finger that adducts and also extends during adduction so there are tendons insert in both sides, lateral and medial.

4th – Medial side of the ring

** Dorsal is the opposite of the palmar

** Extensor digitorum, extensor indicis, extensor digiti minimi are muscles in the the dorsum and are the opposite of flexor muscles such as flexor digitorum superfacialis and flexor digitorum profundus and they all do a balance and a coordination (توافق في so that lumbericals and interossei muscles can do their function in the writing position

*Lumbricales

- 4 muscles
- Origin: tendons of flexor digitorum profundus in the palm

 1^{st} & 2^{nd} from lateral side of pronfundus tendon of the index and middle > innervated by median nerve.

 3^{rd} & 4^{th} adjacent tendons to middle & ring ,ring& little > innervated by ulnar nerve.

• Insertion: All tendons of muscles pass lateral side the medial 4 fingers and pass to the dorsal digital expansion where they insert

Important function: writing position by flextion of MCP joints interphalangial joints

*Palmari Brevis (if present)

- Origin: flexor retinaculum (ulnar side)
- Insertion: the skin of the palm of ulnar side
- Innervation: superfacial branch of ulnar nerve
- Function: helps in the grip of the hand

* Thinner muscles

• 3+1 (they are already mentioned)

• these muscles caused Swelling of metacarples and it's called thinner swelling

**In More Details

*adductor pollicis

- Origin: 2 heads
- 1- Transverse : anterior surface of shaft of the 3rd metacarple
- 2- Oblique: shaft of metacarple and hamate (from carple bones)

- Insertion: Ulnar side of the base of proximal phalanx of the thumb
- Action: make adduction of the thumb
- Innervations: by the ulnar nerve

*abductor pollicis brevis

• Origin: radial end of flexor retinaculum which make the attachment with scafoid and trapezium and between them there is a ligament

- Insertion: base of the proximal phalanx of the thumb (radial side)
- innervation by the median nerve.

*flexor pollici brevis

- Origin: radial side of flexor retinaculum
- Insertion: base of the proximal phalanx of the thumb (ulnar side)
- innervation by the median nerve. (don't care about what is written in the slides about the innervations of this muscle)

*apponens pollicis

• Insertion: 1st metacarpale bone of thumb

• We can know the injury of the median nerve by test this muscle, we ask the the patient to do the shape of litter O r C by his thumb and index or for example to pick up a pencil and if he couldn't do that that's will be a sign for median injury

** the opposite if there is an deep branch of ulnar nerve injury, here the patient can't hold anything between his index and middle for example a cigarette because there is NO adduction action by Palmar Interossei because it's innervated by ulnar nerve.

*Short muscles of little fingers

Hypothinners

- * abductor digiti menimi
 - Origin: ulnar side of flexor retinaculum which is attaches to the pisiform and the hook of hamate
 - Insertion: ulnar side of base of 5th of proximal phalanx
 - Innervations: deep branch of ulnar nerve

*flexor digiti minimi

- Origin: hamate, transverse carpal ligament
- Insertion: ulnar side of base of 5th of proximal phalanx
- Innervations: deep branch of ulnar nerve
- Action: flextion of little finger

*opponens digiti minimi

- Origin:hooke hamate, transverse carpal ligament
- Insertion: anterior surface of 5th metacarple
- Innervations: deep branch of ulnar nerve

*Fascial Spaces of the Palm

- Palm spaces and fibrous septa between them
- There is a fat between the spaces and the deep fascia
- * artries of the palm : Ulnar & radial

• Ulnar artery>> superfacial palmar arch (deep to palmar aponeurosis and superfacial to flexor digitorum superfacialis) It gives 3 palmar digital arteries, each one>> pass through space between 2 fingers and give digital of the 2 sides to 2 adjacent finger

• Branch palmar digital little finger to one side and extend to one side of index

** because of that we use the 3 fingers to know the pulsation of radial artery of the palm

• In thumb we find artery continuous it's called prencsis pollicis come from radial artery so radial make deep palmar arch then it continuous superfacial giving superfacial palmar artery

*Study the last minutes in lecture from the slide,, there are more detailes.

Deep palmar arch give 3 common metacarpal bones and do anstomosis with superficial common digital (connection between deep palmar arch and superficial) and gives digital arteries

* Allen's test (from slides)

* veins :

- cephalic & basilic veins
- both begins from the dorsum of the hand

*lymph driange:

- lateral side>> infraclavicular lymph nodes
- medial side>> supratrochlear and end in the lateral pectoral lymph nodes

*Nerves

- ulnar nerve >> innervates
- 1- 15 muscles in the hand(deep branch of ulnar nerve)
- 2- skin of medial 1.5 finger (superfacial branch of ulnar nerve)
- 3- medial 1/3 of the palm (palmar cutaneous)
- median nerve>> innervates
- 1- 5 muscles in the hand
- 2- skin of the lateral 3.5 fingers
- 3- Lateral 2/3 of the palm (palmar branch of median nerve)

• Radial nerve: pass to the dorsum of the hand by winding around the wrest joint under the cover of brachoradialis tendon and gives cutaneous branches there

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*Best of luck in the anatomy exam doctors we are going to need it !! :P