**HUMAN FUNCTIONAL ANATOMY 213**

**Finger Movements**

**Outcomes**
1. To know the joints and movements of fingers
2. To understand the mechanism of extensor expansion
3. To appreciate the contributions of the lumbricals and interossei to finger control
4. To be able to explain the result of an ulnar nerve lesion

**In this lecture:**
- Joints of the hand
- Extrinsic flexors and extensors
- Lumbricals and interossei

**Readings**
1. Stern – Core concepts – sections 84 and 85 (plus appendices)
2. Faiz and Moffat – Anatomy at a Glance – Sections 37, 38 and 39
3. Grants method – The Hand, and Joints of the upper limb

*Other good anatomy texts – sections on the hand*

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**HAND FUNCTION AND THE PROXIMAL JOINTS**

**The Shoulder (Flexion and Extension, adduction and abduction, plus rotations) can direct the arm in any direction**

**The Elbow (Flexion and Extension) is important for lengthening and shortening the arm**

Just imagine the difficulties you’d have eating or scratching yourself

**The Forearm (Supination and Pronation) is vital for orientating the hand**
1. The hand can be made to face away from, or towards the body.
2. Pronation and supination can also be used to impart rotary forces.
3. Occurs in the proximal and distal radio ulnar joints

**The Wrist (Flexion and extension, plus Adduction and abduction) optimises the position of the hand for action**
1. Usually extended when away from the body but flexed when close to the body.
2. Adduction (ulnar deviation) is used to grasp an object and hold it in the forearm axis.
3. Extension of the wrist increases the strength of the digital flexors.

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**MUSCLES OF THE PROXIMAL JOINTS**

**ELBOW Flexion and extension**
- Triceps
- Biceps
- Brachialis
- Brachioradialis
- Plus Pronator teres (PT), extensor carpi radialis longus (ECRL) and brevis (ECRB), flexor digitorum superficialis (FDS)

**FOREARM Pronation and supination (all insert on the radius)**
- Supinator
- Biceps
- Brachioradialis
- Pronator teres
- Pronator quadratus.

**WRIST Flexion and extension plus adduction and abduction (All insert on metacarpals)**
- Flexor carpi ulnaris (FCU)
- Flexor carpi radialis (FCR)
- Extensor carpi radialis longus (ECRL)
- Extensor carpi radialis brevis (ECRB)
- Extensor carpi ulnaris (ECU)
- Adlexion involves the use of ulna side carpal muscles
- Abduction involves radial side carpal muscles

**NERVE SUPPLY**
- Muscles in posterior compartments and extensors and are supplied by the radial nerve (dorsal)
- Muscles in anterior compartments are flexors and pronators and are supplied by the median and ulna nerves (ventral)

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**JOINTS OF THE HAND**

**Carpometacarpal (CMC) joints**
- Digit 1 (thumb or pollex) has a freely movable saddle joint
- Digits 2 & 3 (Index and long fingers) have fixed CMC joints
- Digits 4 & 5 (ring and little fingers) have more flexible CMC joints

**Metacarpophalangeal (MP) joints.**
- Digit 1 has a bicondylar (uniaxial) joint (flex - extend)
- Digits 2 to 5 have condylar (biaxial) joints (flex – extend, adduct - abduct)

**Interphalangeal (IP) joints (proximal and distal PIP & DIP)**
- Same as MP joints but bicondylar (only flexion - extension)
- The thimb has only one IP joint
DIGITAL FLEXORS AND EXTENSORS
Extrinsic muscles

Flexor digitorum superficialis (FDS) inserts on the middle phalanx
Flexor digitorum profundus (FDP) inserts on the distal phalanx
Tendons are bound to the bones by a flexor sheath.
They tend to move their most distal joint first.

Palmaris longus (PL) inserts on the proximal phalanx and act on the MP joint but it is very weak in humans. Its broad tendon is the palmar aponeurosis.

Extensor digitorum (ED) inserts into all the phalanges via the extensor expansion. Strongest connection is to the proximal phalanx, and act primarily on the MP joint.

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The extrinsic muscles acting alone (“intrinsic minus hand”)
1. Extension of the MP joints
2. Flexion of the IP joints
The extrinsic muscles are mostly supplied by the radial (ED) and Median nerves (PL, FDS and FDP). The ulnar nerve supplies part of FDP.

THE EXTENSOR EXPANSION
Balancing the action of the extrinsic muscles

LUMBRICALS and INTEROSSEI
Cross the palmar side of the MP joints- - cause flexion of MP joints
They join the lateral bands of the extensor expansion over the proximal phalanx
They pull on the extensor expansion as it crosses the dorsal side of the IP joints- - cause extension of IP joints

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Interossei and Lumbricals
The Lumbrical and interossei are supplied by the ulnar nerve (except for the first 2 lumbricals – median nerve) – so the ulnar nerve is very important for finger movements.

Co-ordination of MP and IP movements
The lateral bands of the extensor expansion link the MP and IP joints
1. If you passively extend the MP joint, that pulls on the lateral bands and extends the IP joints.
2. If you passively flex the IP joint, that pulls on the lateral bands and flexes the IP joints.
3. This relies on the resistance to stretch of the lumbricals and interossei.

OBLIQUE RETINACULAR LIGAMENT
Co-ordination of DIP and PIP movements

It is difficult to flex the DIP and leave the PIP extended. (or extend the PIP and leave the DIP flexed)
The oblique retinacular ligament links these joint so that:
1. When the DIP joint flexes it pulls on the ligament and flexes the PIP joint.
2. When the PIP joint extends it pulls on the ligament and extends the DIP joint.
3. If you hold the PIP in flexion, you can voluntarily extend the DIP but it is very loose if you move it passively.

This ligament and the lateral bands of the extensor expansion. Act to co-ordinate the movements of the 3 finger joints – and produce a smooth digital sweep.

DIGITAL ADDUCTION AND ABDUCTION
Every digit has an adductor and an abductor

Adduction and abduction is relative to the middle finger
Palmar interossei
Adduct digits 2, 4 & 5
Digit 3 can only abduct
Digit 1 has adductor pollicis

Dorsal interossei
Abduct digits 2, 3 & 4
Digits 1 and 5 have special abductors
1. Abductor pollicis longus and brevis
2. Abductor digitii minimi

Lumbricals attach to the radial side of each extensor expansion so can abduct or adduct the fingers (digits 2 to 5)

The primary function of the lumbricals and interossei is to coordinate and control flexion and extension of the fingers

In the foot the lumbricals and interossei have the same arrangement except that adduction and abduction in the foot are relative to the 2nd toe.
Palmar interossei adduct toes 3, 4 & 5
Dorsal interossei abduct toes 2, 3, 4
THENAR AND HYPOTHENAR MUSCLES
Opposition, flexion and abduction of digits 1 & 5

Opposition is a Carpo
metacarpal joint motion so
opponens muscles attach to
metacarpals.
The other muscles attach to
phalanges.

Thenar muscles
1. Opponens pollicis -
2. Flexor pollicis brevis
3. Abductor pollicis
All supplied by the median nerve

Hypotenar muscles
1. Opponens digiti minimi
2. Flexor digiti minimi
3. Abductor digiti minimi
All supplied by the ulnar nerve

The anatomical snuff-box. Three tendons that cross the wrist at the
base of the thumb
1. Extensor pollicis longus
2. Extensor pollicis brevis
3. Abductor pollicis longus

Other muscles of the hand (extrinsic)
Flexor pollicis longus
Extensor indicis
te
Extensor digitii minimi

Most muscle of the hand have corresponding muscles in the foot.