HAND COMPLEX
CMC, MCP, IPS – Type, Motion & Mechanism

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INTRODUCTION

- The hand consists of 5 digits: 4 fingers and a thumb
- Each digit has a carpometacarpal (CMC) joint and a metacarpophalangeal (MCP) joint.
- Between the phalanges of the fingers, a proximal (PIP) and a distal (DIP) interphalangeal joint are found;

  the thumb has only one interphalangeal (IP) joint.

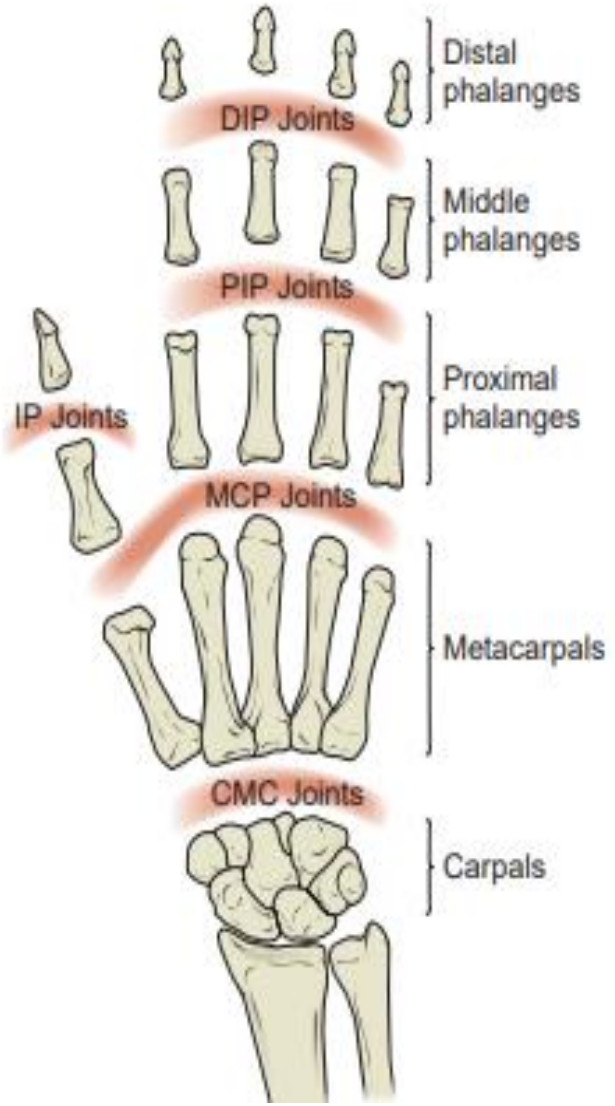


Figure 9–14 Bony anatomy of the thumb and fingers. DIP, distal interphalangeal; PIP, proximal interphalangeal; MP, metacarpophalangeal; CMC, carpometacarpal; M, metacarpal; P1, proximal phalanx; P2, middle phalanx; P3, distal phalanx.

- There are 19 bones and 19 joints distal to the carpals that make up the hand complex.
  - ✓5 metacarpal bones
  - ✓5 proximal phalanges
  - ✓4 middle phalanges and
  - ✓5 distal phalanges

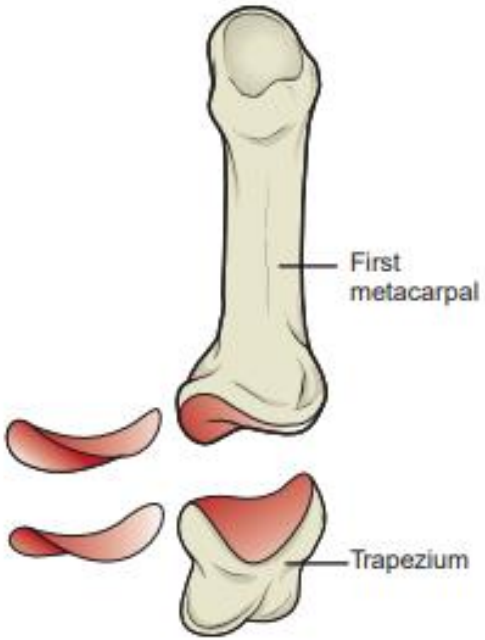
CARPOMETACARPAL (CMC) JOINTS

- There are two CMC joints of the hand
  - ✓one for the thumb and
  - ✓second for the other four digits of the hand.
- Each digital ray articulates proximally with a particular carpal bone to form the carpometacarpal (CMC) joint.
- It is at the CMC joint that the thumb separates from the rest of the hand.

CMC JOINT OF THE THUMB

(Digit1)

- The CMC joint of the thumb is formed by the trapezium and the base of the first metacarpal
- The surfaces of both of these bones are both convex and concave and form a **saddle joint**.
- It has a lax capsule and wide range of motion (ROM), which allows opposition movement in prehension activities.



Thumb motions include

- Abduction (palmar abduction) & Adduction
- Flexion & Extension (radial abduction)
- **Opposition-** net effect at this joint is a circumduction motion known as opposition. The thumb, together with the first metacarpal, is opposed to the other fingers.
- Reposition (the reverse of opposition)
- Rotation

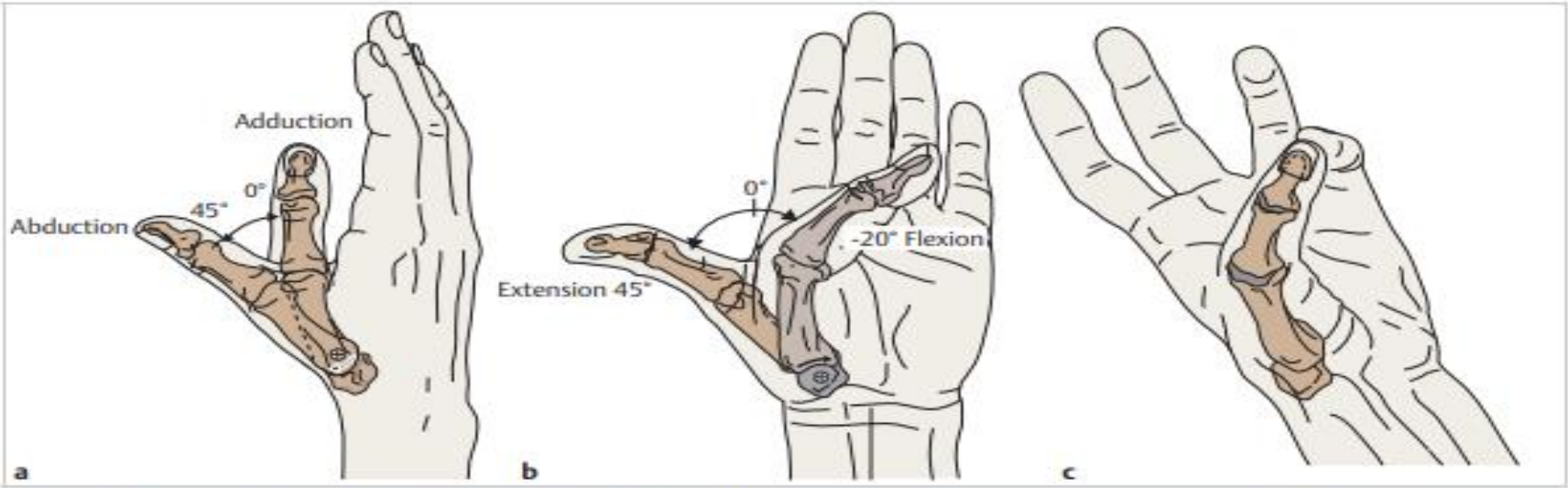
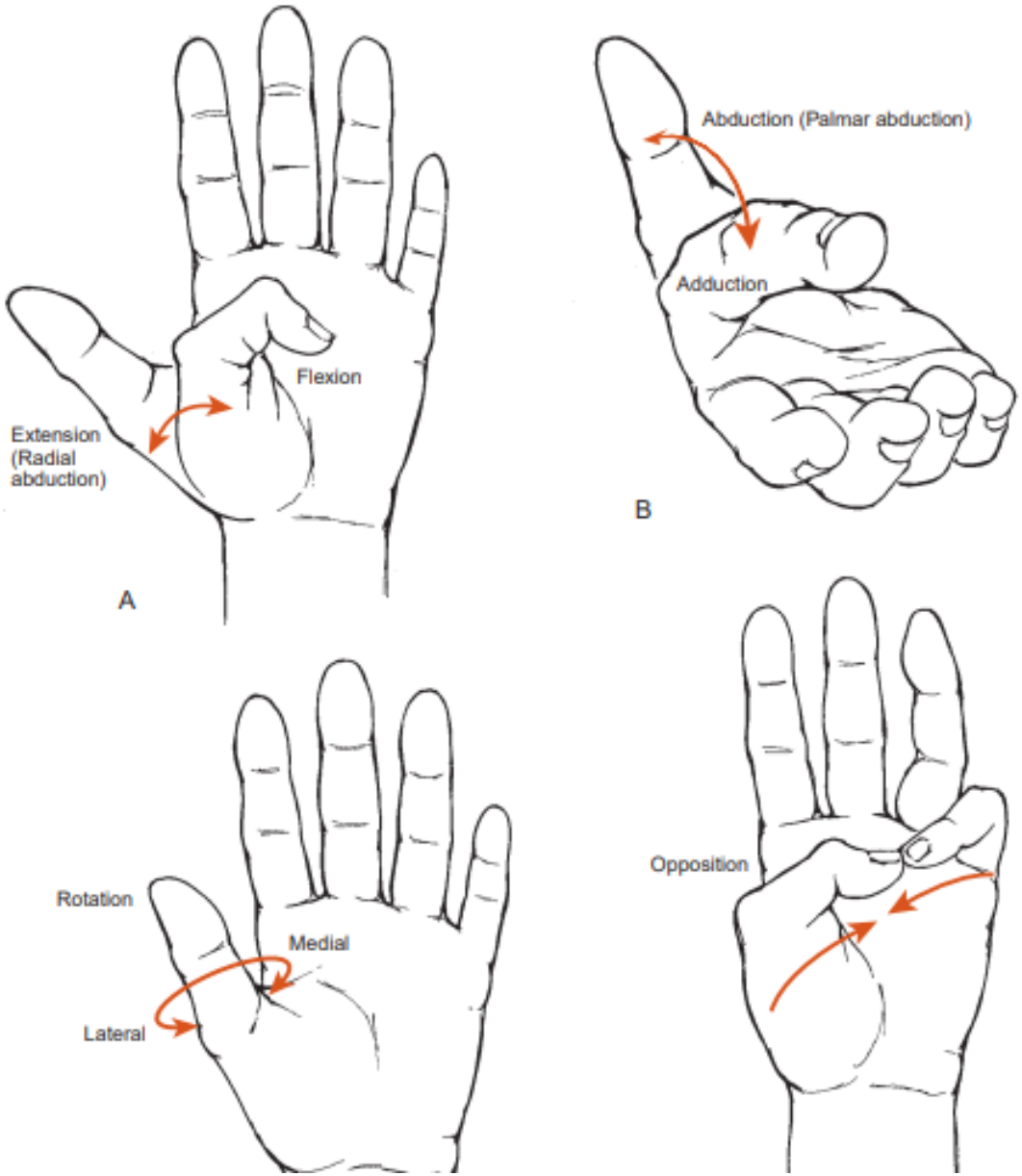


Fig. 1.47 Movements of the thumb MCP and IP joints. (From Hochschild J. Functional Anatomy for Physical Therapists. Stuttgart: Thieme; 2016.) **(a)** Abduction and adduction of the thumb. **(b)** Extension and flexion of the thumb. **(c)** Opposition of the thumb.


Flexion
Extension
(Radial
abduction)
A
Abduction (Palmar abduction)
Adduction
B
Rotation
Medial
Lateral
Opposition

Arthrokinematics:

- Flexion / Extension:
- ✓ in the **frontal plane**,
- ✓ The surface of the trapezium is convex, and the base of the metacarpal is concave;
- ✓ therefore, its surface slides in the same direction as the angulating bone.
- ✓ The axis for this movement takes a **radiopalmar to ulnodorsal course through the trapezium.**
- ✓ Occurs around a somewhat **oblique A-P axis**


B1


B2

- Abduction / Adduction:
- ✓ In the **sagittal plane**
- ✓ The trapezium surface is concave and the metacarpal slides is convex;
- ✓ therefore, the surface of the metacarpal slides in the opposite direction of the physiological motion.
- ✓ around an axis through the base of the 1st metacarpal that takes a radiodorsal to ulnopalmar course and forms a 45° angle to the plane of the extended hand.
- ✓ Occurs around an **oblique coronal axis**


A1

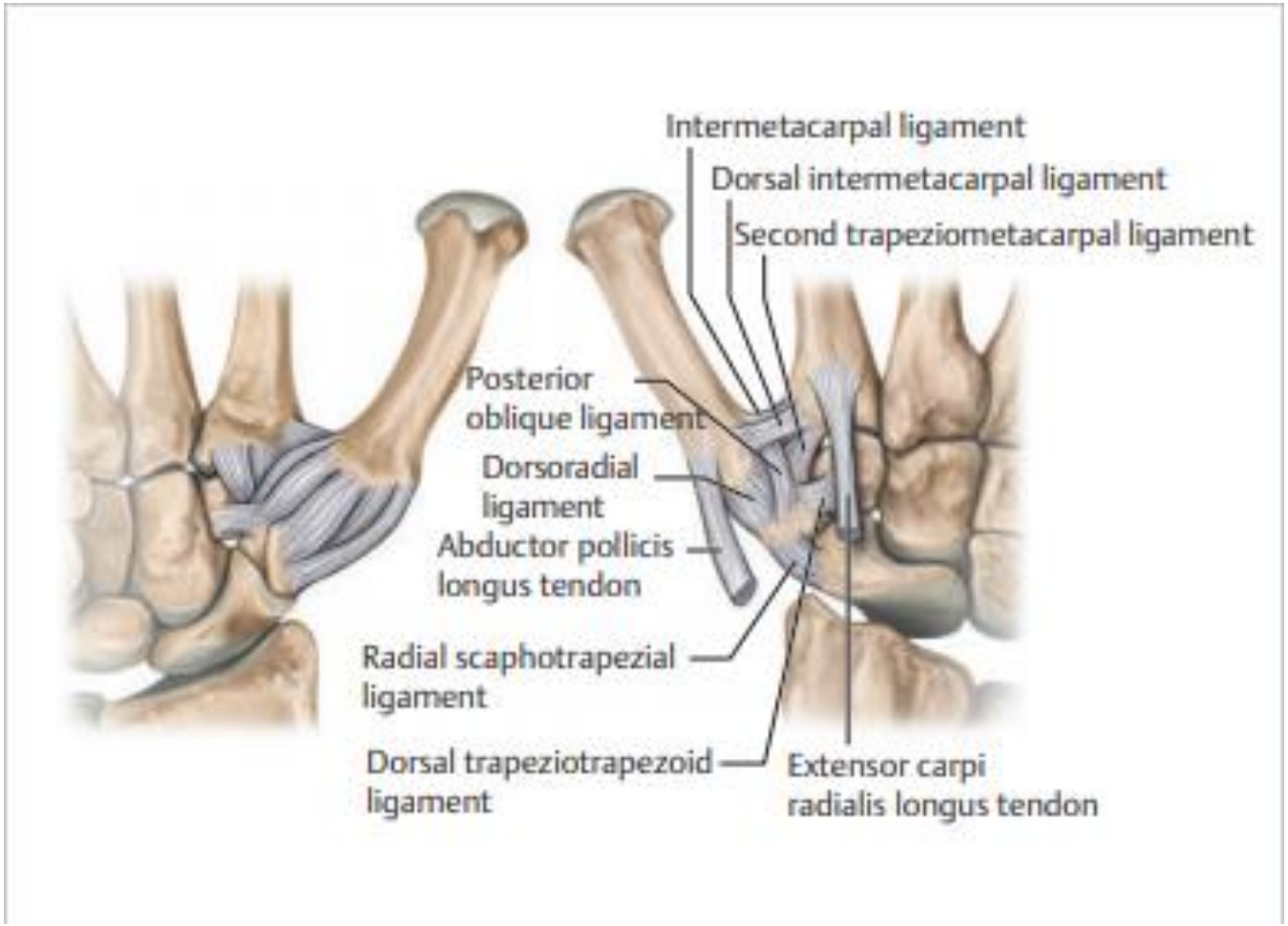

A2

First Carpometacarpal Joint ROM:

1. 42° of abduction and adduction (approx. 35° abduction and approx. 25° adduction)
2. 53° of flexion–extension (approx. 25° flexion and approx. 45° extension)
3. 10° of rotation

- The supporting structures of the CMC joint of the thumb:

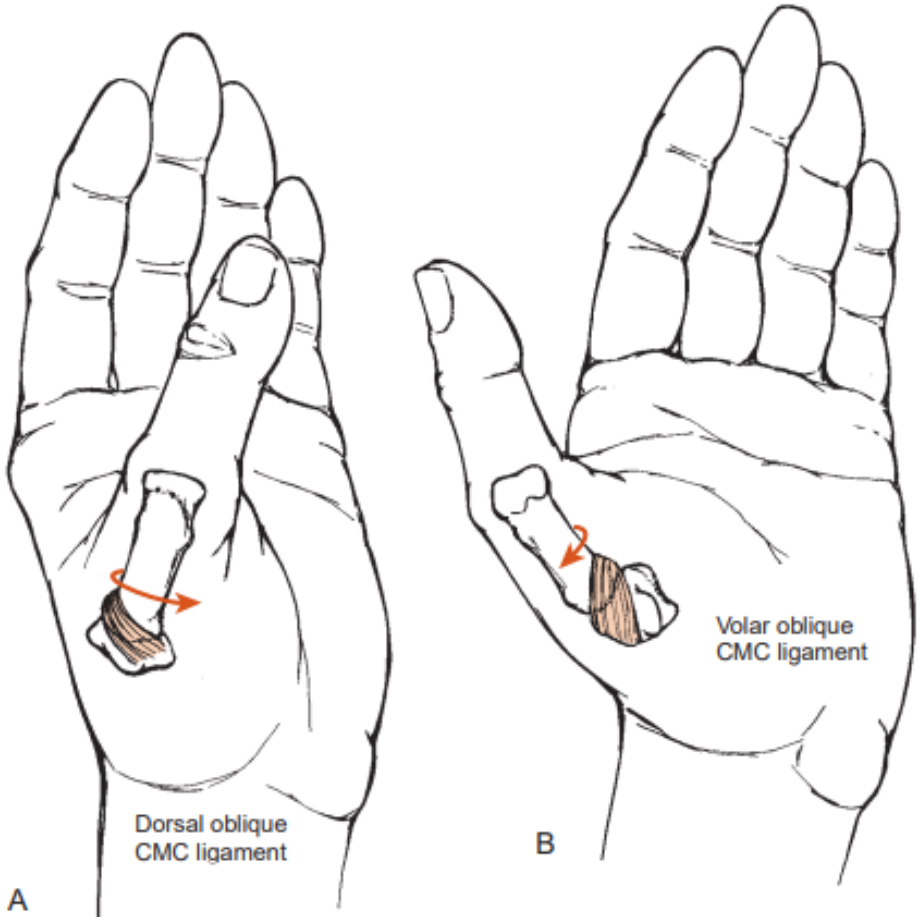
- **The joint capsule** – relatively lax
- **The intraarticular beak ligament** –It is considered as the primary ligamentous stabilizer of the CMC joint of the thumb
- **2 intermetacarpal ligaments -** helps tether the bases of the first and second metacarpals, preventing extremes of radial and dorsal displacement of the base of the first metacarpal joint.
- **Radial CMC ligament**


Intermetacarpal ligament
Dorsal intermetacarpal ligament
Second trapeziometacarpal ligament
Posterior oblique ligament
Dorsoradial ligament
Abductor pollicis longus tendon
Radial scaphotrapezial ligament
Dorsal trapeziotrapezoid ligament
Extensor carpi radialis longus tendon

The dorsal (posterior) and volar (anterior) oblique CMC ligaments

A. The pull of the dorsal oblique CMC ligament rotates the metacarpal in the ulnar direction during flexion and abduction.

B. The pull of the volar oblique CMC ligament rotates the metacarpal radially during extension and adduction.

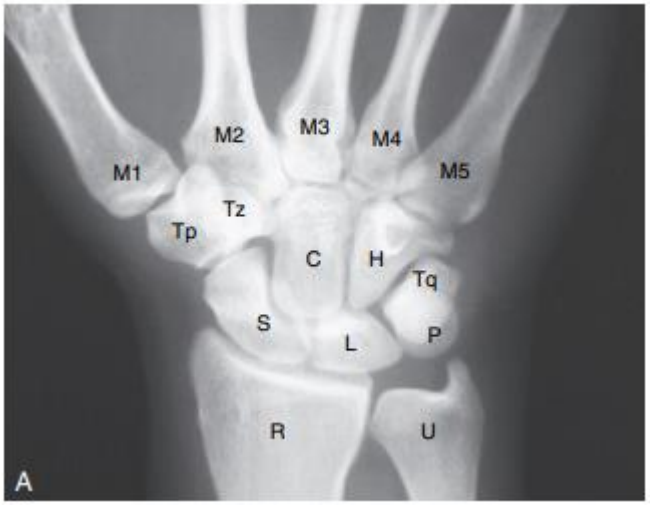


First Carpometacarpal Joint Function:

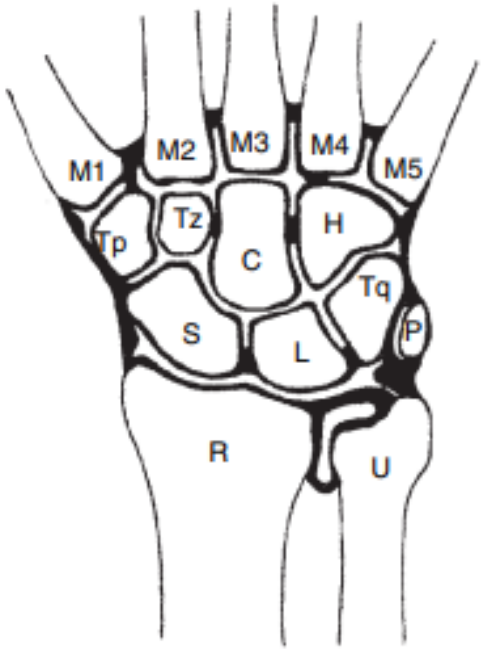
- Thumb is the first and strongest digit of the hand and has special status.
- The thumb's **opposition position** enables the powerful **closing of the fist** and thus acts **as a grasping tool**
- The thumb contributes significantly to **optimizing gross motor and fine motor grasping functions of the hand**
- The functional significance of the CMC joint of the thumb is that the use of the thumb against a finger occurs in almost all forms of **prehension (grasp and dexterity activities).**

CARPOMETACARPAL JOINTS OF THE FINGERS (Digits 2-5)

- Composed of the articulations between the distal carpal row and the bases of the second through fifth metacarpal joints.
- The joints of digits **2,3, and 4 are plane uniaxial** joints, the joint of digit **5 is biaxial**.



- The 2nd metacarpal articulates primarily with the trapezoid and secondarily with the trapezium and capitate.
- The 3rd metacarpal articulates primarily with the capitate
- The 4th metacarpal articulates with the capitate and hamate
- The 5th metacarpal articulates with the hamate.



LIGAMENTS:

- All finger CMC joints are supported by strong transverse and weaker longitudinal ligaments volarly and dorsally.
- The **deep transverse metacarpal ligament** spans the heads of the second through fourth metacarpals volarly.
- It tethers together the metacarpal heads and effectively prevents the attached metacarpals from any more than minimal abduction at the CMC joints.
- Although it contributes directly to CMC stability

- One attribute of the distal carpals that affects carpometacarpal and hand function is the volar concavity, **or proximal transverse (carpal) arch**
- Which is formed by the trapezoid, trapezium, capitate and hamate
- The carpal arch persists even when the hand is fully opened

The ligaments that maintains the arch are the transverse carpal ligament and the transversely oriented **intercarpal ligaments**

- These structures also form the **carpal tunnel**.
- The carpal tunnel contains the median nerve and 9 extrinsic flexor tendons of the fingers and thumb

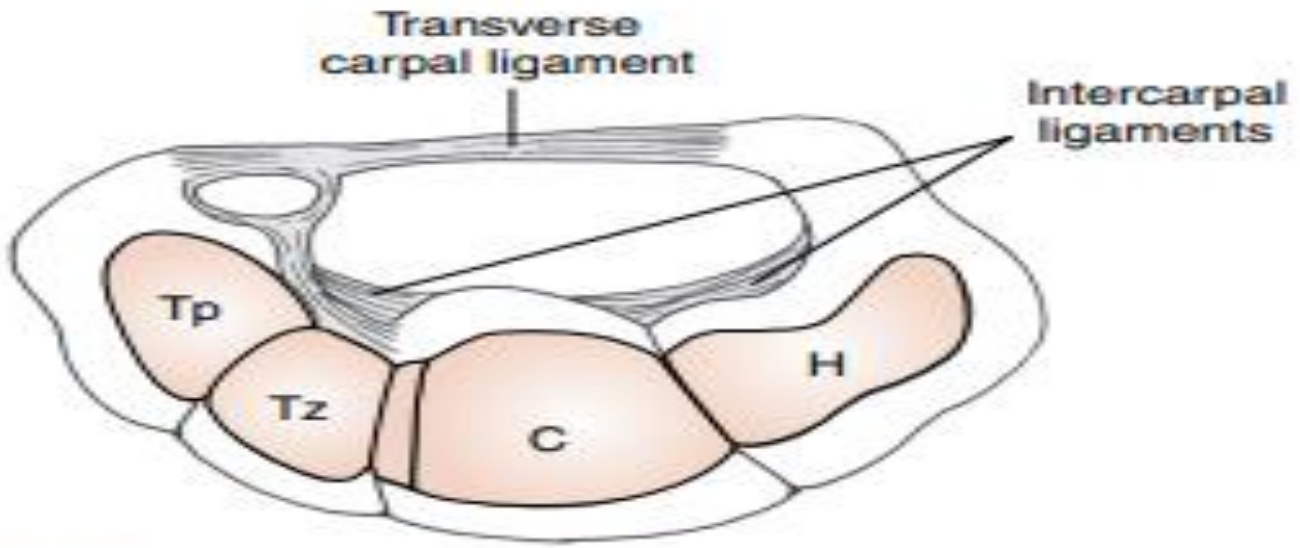


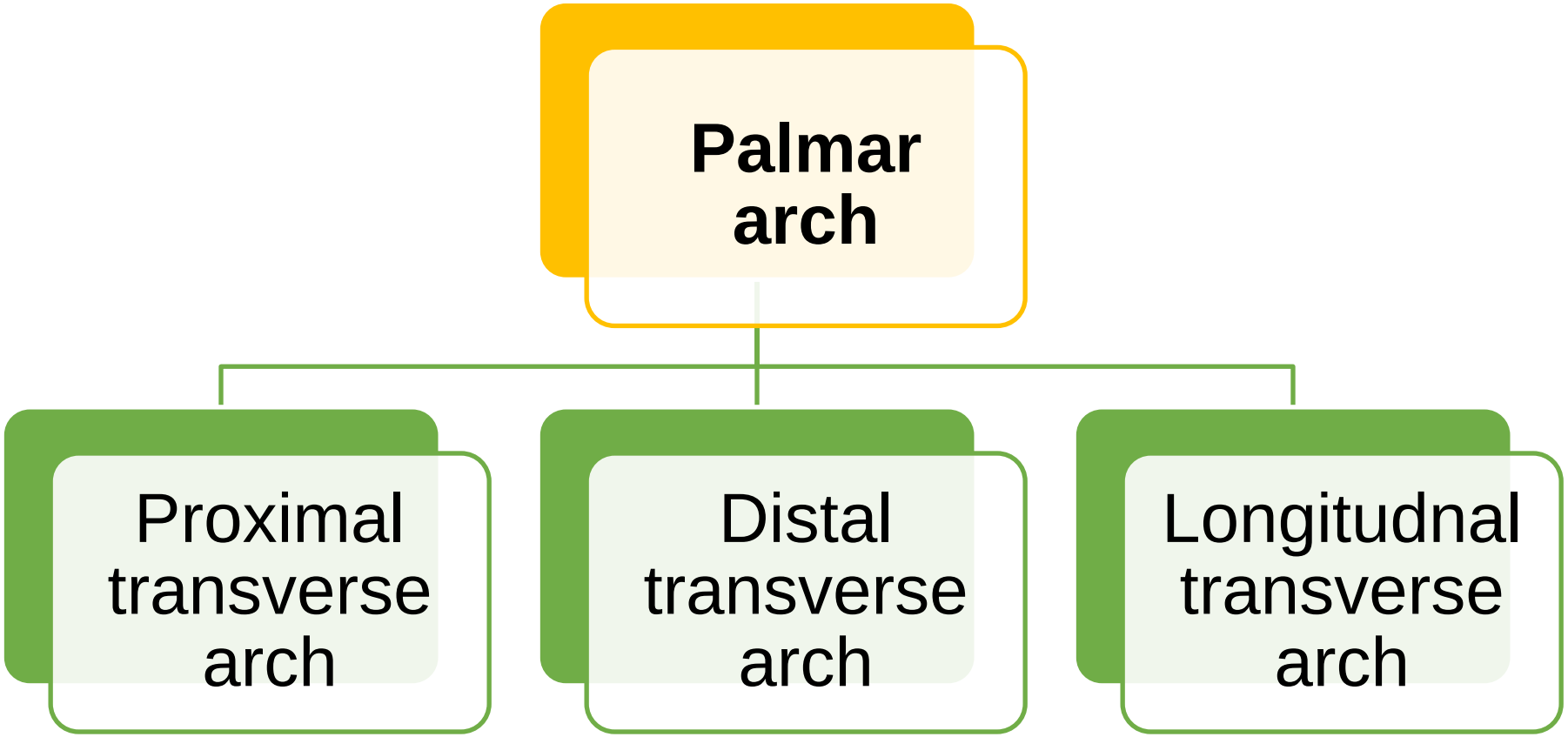
Figure 9–15 The proximal transverse arch, or carpal arch, forms the tunnel through which the median nerve and long finger flexors travel. The transverse carpal ligament and intercarpal ligaments assist in maintaining this concavity. C, capitate; H, hamate; Tp, trapezium; Tz, trapezoid.

CMC joint mobility:

- Mobility increases from radial to ulnar side.
- The motion in the **2nd CMC joint** is **immobile**
- **3rd CMC joint** is **least mobile**, it is the central pillar of the hand around which the rest of the hand rotates.
- **4th CMC joint** is **mobile** (10° to 15° of dorsovolar movement).
- **5th CMC joint** is the **most mobile** with 25° to 30° of motion.

CMC joint range of motion:

- The **2nd -4th CMC joints** are **plane synovial joints**.
- The **2nd and 3rd CMC joints** are immobile **-"zero degrees of freedom"**
- The **4th CMC joint -flexion/extension.**
- The **5th CMC joint** is a **saddle joint**, with **two degrees of freedom- flexion/extension, abduction/adduction, and a limited amount of opposition.**


Palmar arch
Proximal transverse arch
Distal transverse arch
Longitudnal transverse arch

Palmar Arches:

- **Proximal transverse arch**
- Fixed arch
- Formed by concavity of carpal bones
- Maintained by flexor retinaculum.

- **Distal transverse arch**
- Mobile arch
- Formed by metacarpal heads
- Maintained by deep transverse metacarpal ligament.
- Also called metacarpal arch
- 2^{nd} and 3^{rd} metacarpal are stable, 4^{th} and 5^{th} are mobile.

- **Longitudnal transverse arch**
- Transverse the digits from proximal to distal.
- Fixed at proximal end and free at distal end.

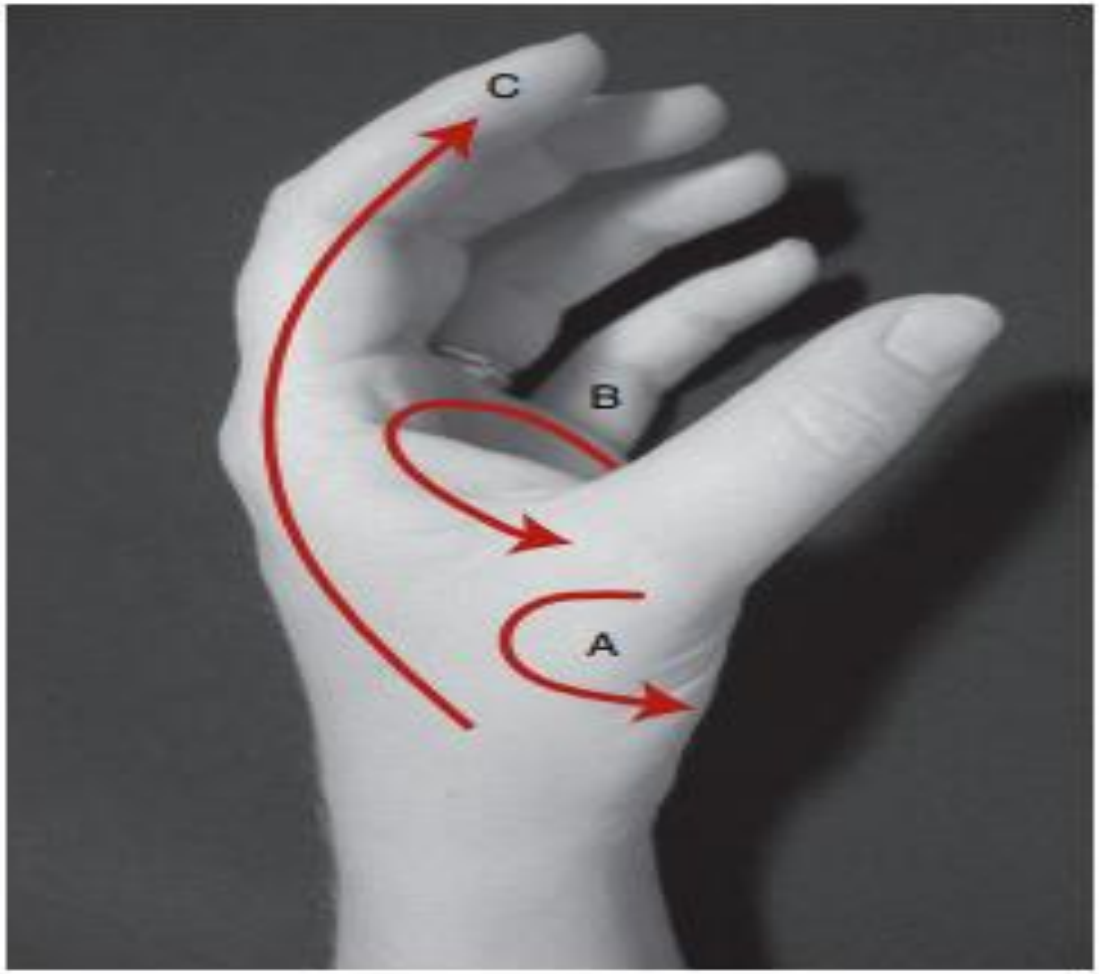


Figure 9–17 The palmar arch system assists with functional grasp. The proximal transverse arch **(A)** is fixed, while the distal transverse arch **(B)** and longitudinal arch **(C)** are mobile.

Functions of Palmar Arches:

- Enable hand to conform the shape of the object.
- Maximizes the amount of surface contact
- Enhances stability
- Increases sensory feedback.

Opponens digiti minimi (ODM) and **deep transverse carpal ligament** – supports the palmar arch.

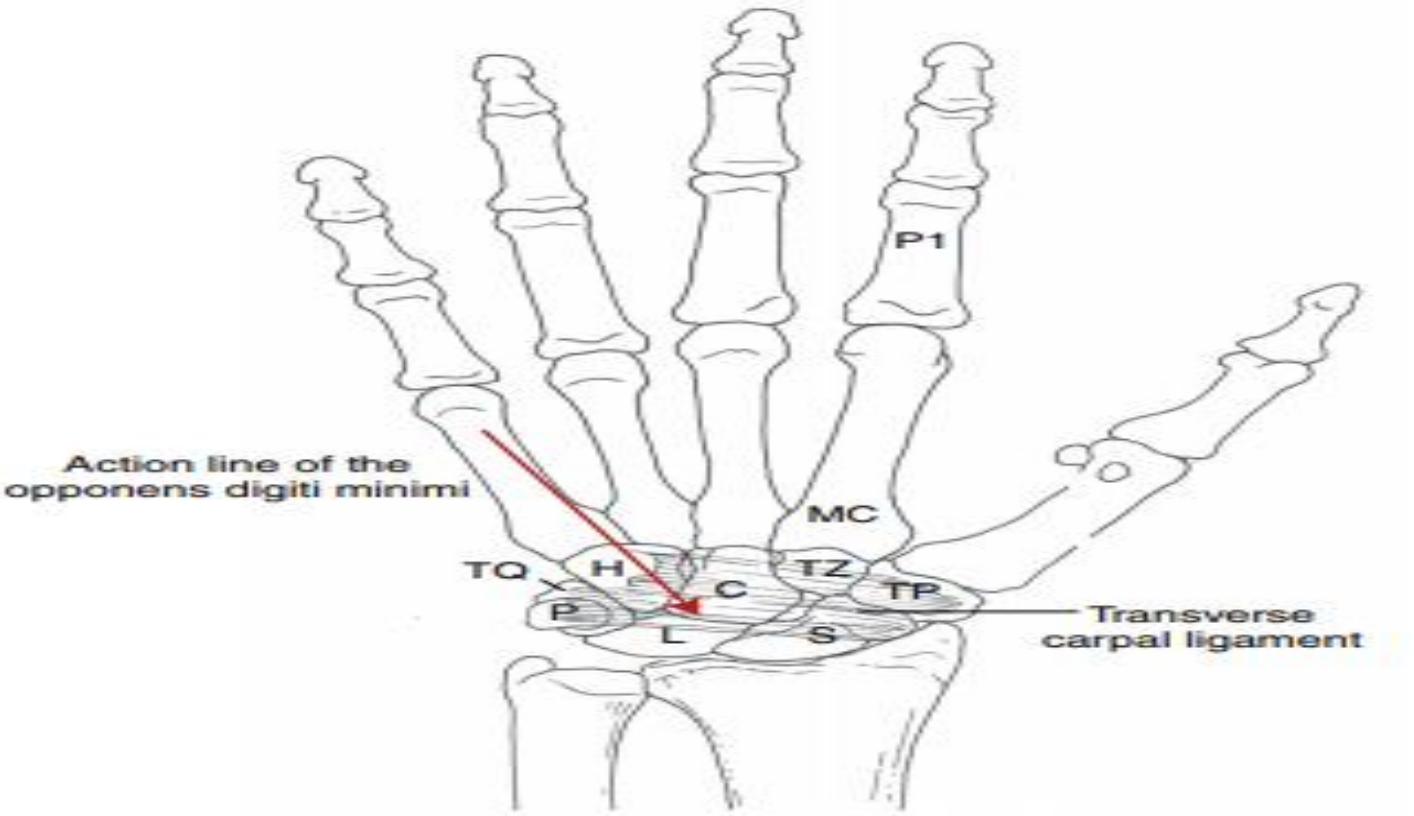


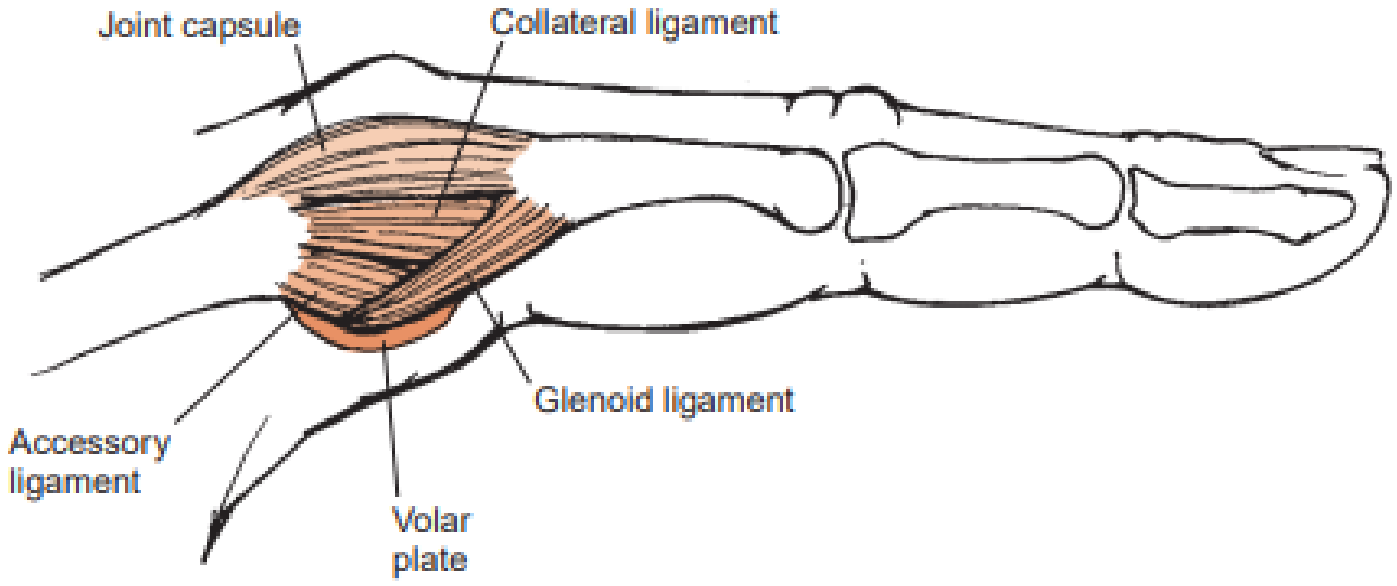
Figure 9–18 The opponens digiti minimi is the only muscle that acts exclusively on a carpometacarpal joint. As indicated by its action line, it is effective at flexion of the fifth metacarpal joint and rotation of the metacarpal joint around its long axis. The opponens digiti minimi muscle's attachment to the transverse carpal ligament may also contribute to supporting the proximal palmar arch.

METACARPOPHALANGEAL (MCP) JOINTS

❖MCP JOINTS OF THE FINGERS:

- Articulation: convex metacarpal head proximally and concave base of the first phalanx distally.
- Condyloid joint- two degrees of freedom: flexion/extension and abduction/adduction

- The supporting structures of the MCP joints of the fingers are:
- capsule, collateral ligaments, the accessory and glenoid ligaments and the volar (palmar) plates.



- The MCP joint **capsule** is lax in extension.
- **Two collateral ligaments-** joint stability.
- At the MCP joint, the **volar plate-** provide stability.

COLLATERAL LIGAMENTS

Radial and Ulnar Collateral ligaments

- Collateral ligament proper
- Accessory collateral ligament

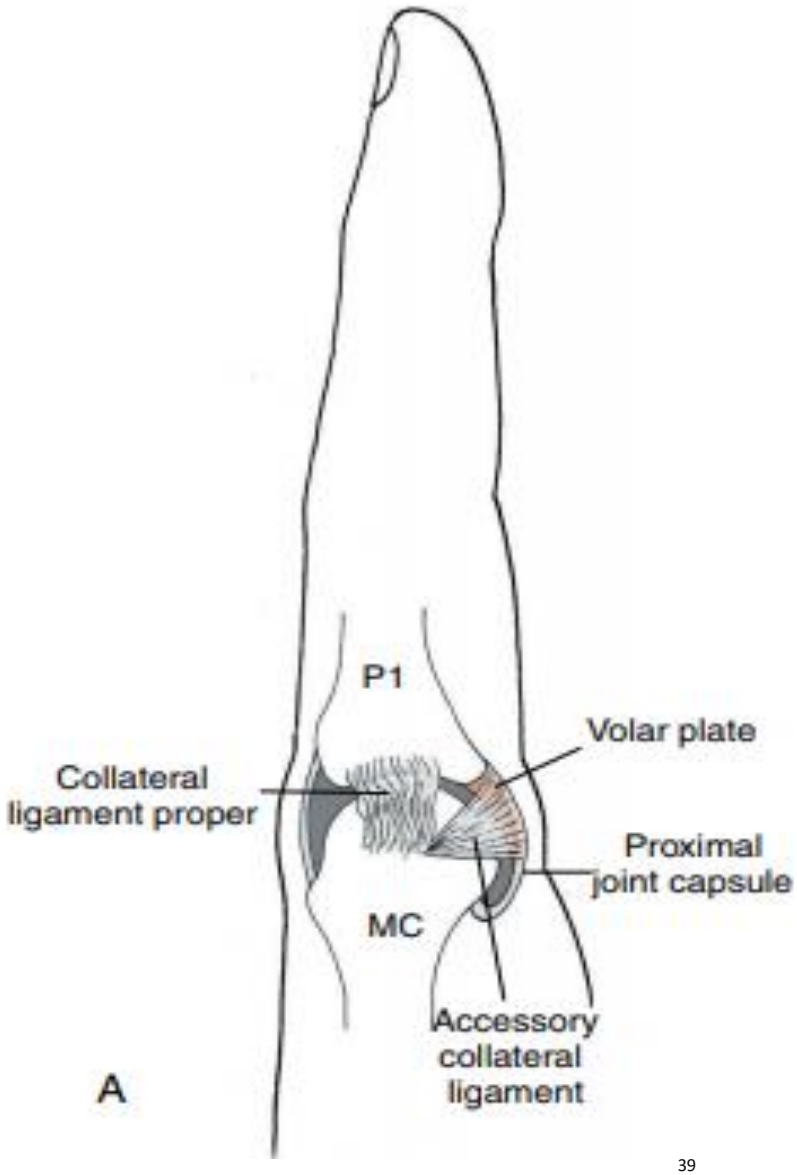
- CL Proper- Dorsally located.
- Accessory CL- Volarly located.
- **MCP joint flexion:**
- CL Proper- lengthens, accessory CL – shortens
- **MCP Joint extension:**
- The collateral ligament proper is loose ,whereas the accessory collateral ligament is taut.

- Tension in the collateral ligaments at full MCP joint flexion (the close-packed position for the MCP joint) limits MCP joint abduction/ adduction in full flexion.
- Provides stability throughout the MCP joint ROM

Volar Plate or Palmar Plate:

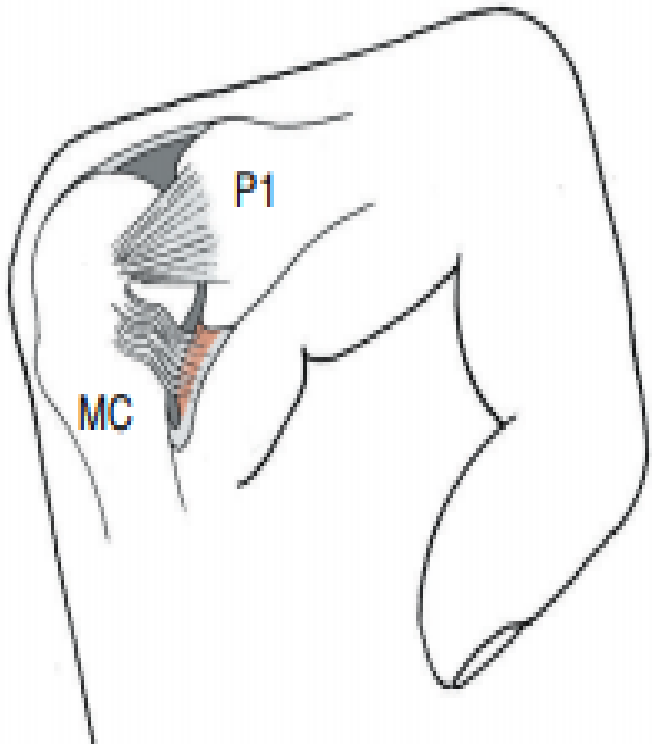
- The volar plate is composed of fibrocartilage.
- The volar plate at each of the MCP joints is a unique structure that increases joint congruence.

- The volar plate at the MCP joint attaches to the base of the proximal phalanx distally.
- The plate blends with MCP joint capsule and then attaches to metacarpal head proximally.



- Provides stability to the MCP joint by **limiting hyperextension**
- **provides indirect support to the longitudinal arch.**
- **Increases joint congruency.**

- In MCP joint flexion, the flexible attachments of the plate allow the plate to slide proximally on the metacarpal head without impeding motion.
- The collateral ligament proper is loose in MCP joint extension, whereas the accessory collateral ligament is taut.
- The reverse occurs in MCP joint flexion.



- The four volar plates and their respective capsules of the MCP joints of the fingers blend with and are interconnected superficially by the deep transverse metacarpal ligament.
- That tethers together the heads of the metacarpals of the four fingers

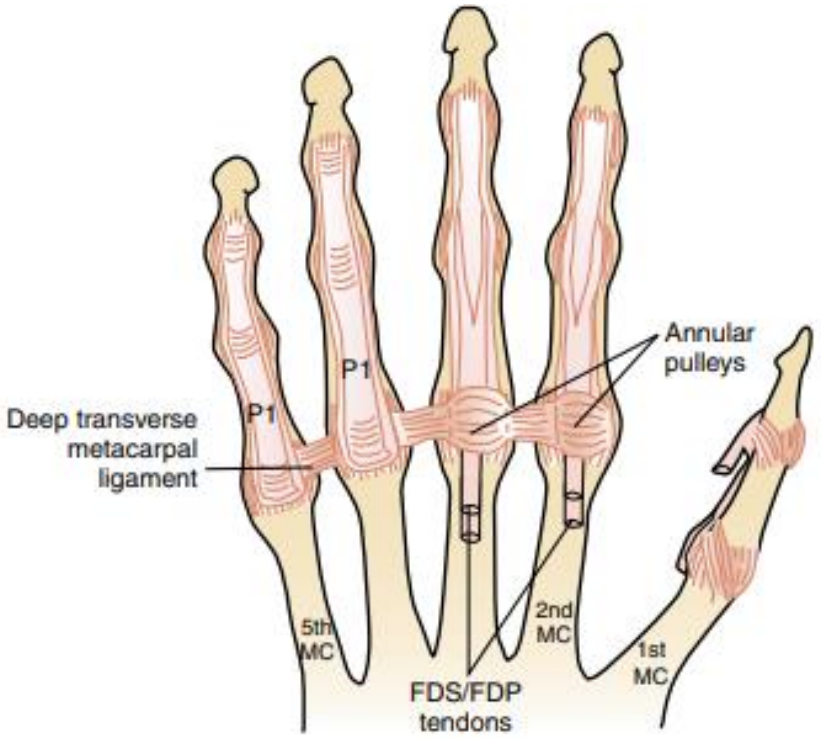


Figure 9–20 The deep transverse metacarpal ligament runs transversely across the heads of the four metacarpophalangeal joints of the fingers. The fibers of the transverse metacarpal ligament blend with each metacarpophalangeal joint capsule and with the deeper volar plates. The superficial aspect of the transverse metacarpal ligament at each metatarsal head is grooved (shown on fourth and fifth metacarpophalangeal joints) for the long finger flexors that pass over the transverse metacarpal ligament and through the annular ligaments (shown on second and third metacarpophalangeal joints).

- **Sagittal bands:**
- Dorsal to the deep transverse metacarpal ligament are **sagittal bands** on each side of the metacarpal head that connect each volar plate to the extensor digitorum communis tendon and **extensor expansion.**
- The sagittal bands help stabilize the volar plates over the four metacarpal heads.

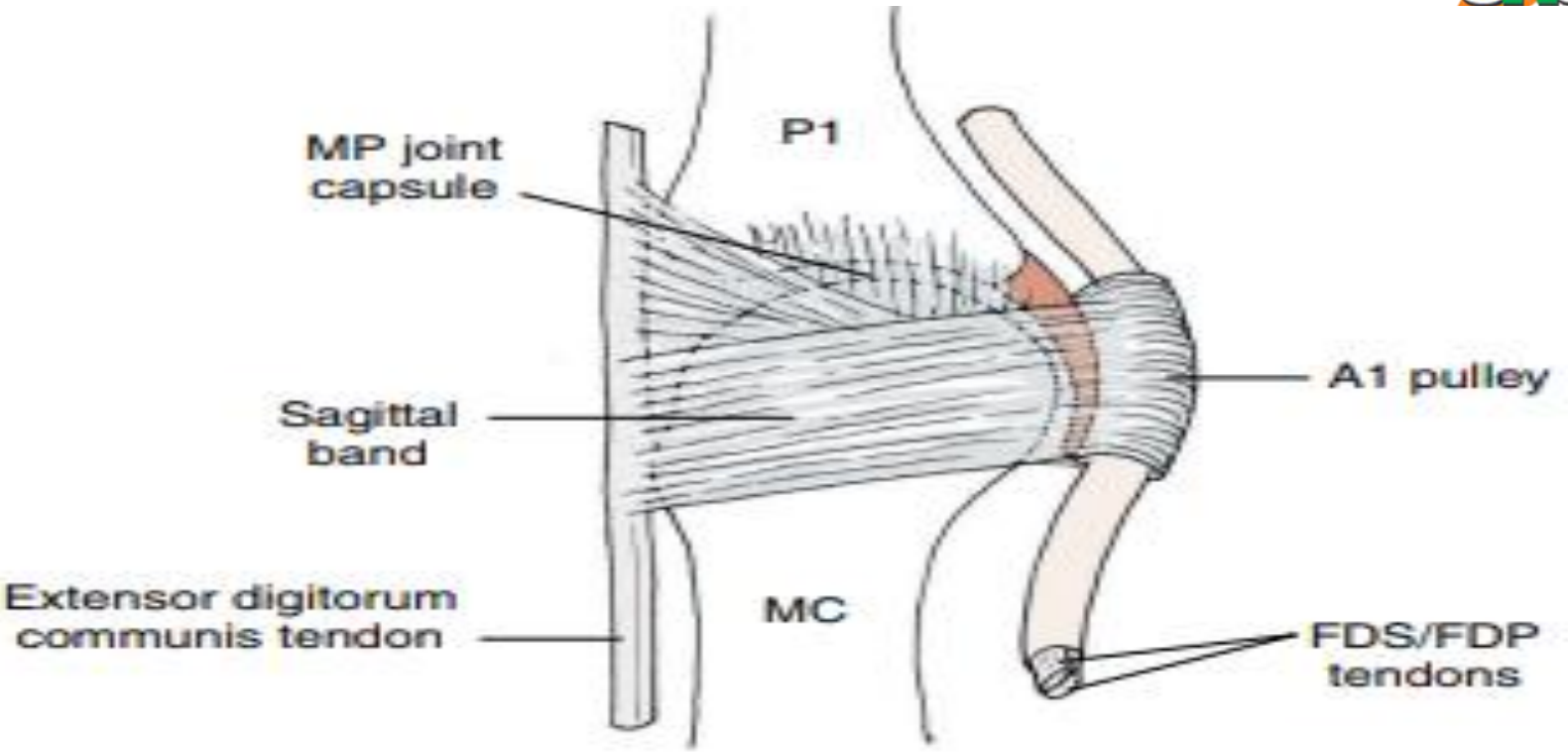


Figure 9–21 The connections of the sagittal bands to each side of the volar plate, the collateral ligaments of the metacarpophalangeal joint (via the capsule), and the extensor digitorum communis muscle via the extensor expansion help stabilize the volar plates on the four metacarpal heads volarly and the extensor digitorum communis tendons over the metacarpophalangeal joints dorsally.

Arthrokinematics:

- The distal end of each metacarpal is convex and the proximal phalanx concave.
- The proximal surface of the phalanx rolls and slides in the same direction.

Range of Motion:

- The total ROM available at the MCP joint varies with each finger.

- Flexion/extension increases radially to ulnarly
- **Index finger-** approx 90° of MCP joint flexion
- **Little finger** -110° flexion.
- Hyperextension is fairly consistent between fingers but varies widely among individuals

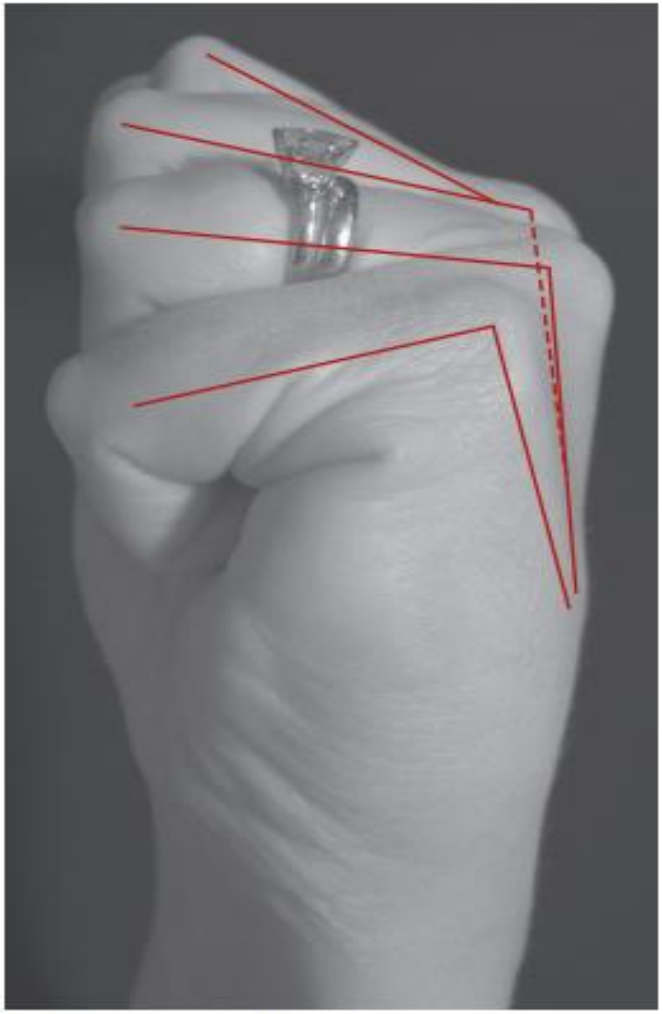


Figure 9–22 The available range of motion at the metacarpophalangeal joints of the fingers increases from the radial to the ulnar side, with the greatest metacarpophalangeal finger range at the fifth metacarpophalangeal joint.

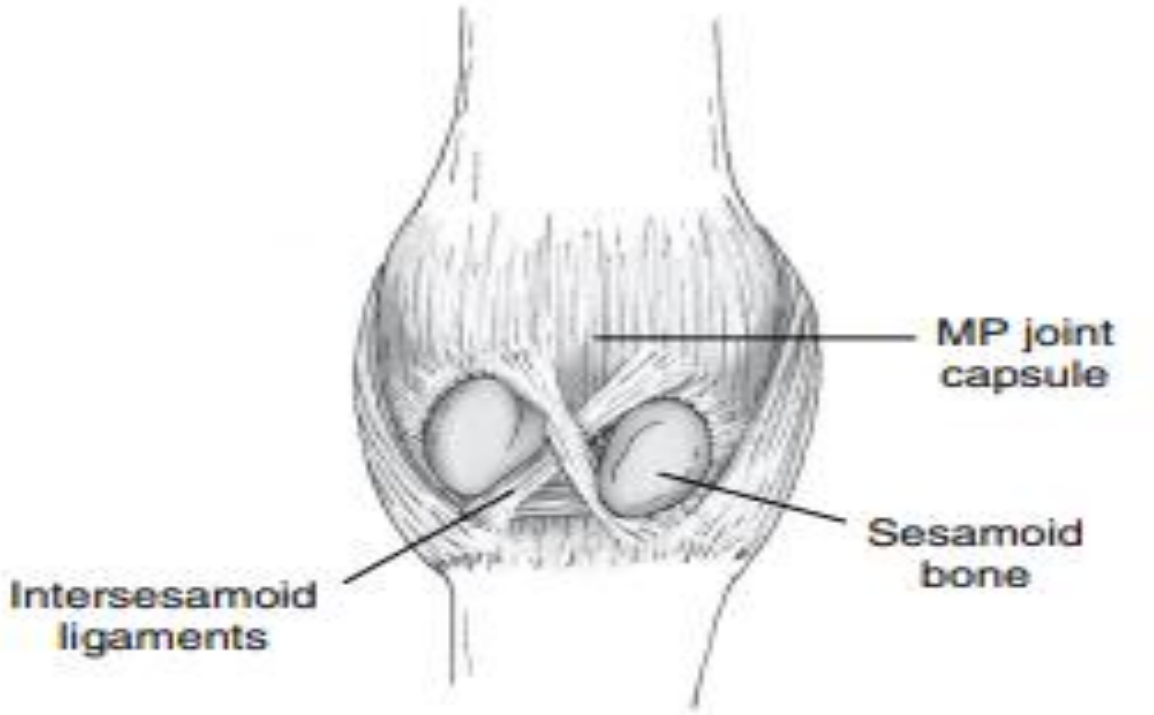
MCP JOINTS OF THUMB

- Articulation between the head of the first metacarpal and the base of its proximal phalanx.
- Condyloid joint
- **2 degrees of freedom: flexion/extension and abduction/adduction**
- The main functions:

➢ to provide additional flexion range to the thumb in opposition

➢ to allow the thumb to grasp and contour to objects

- The 1st MCP joint is far more restricted in motion than those of the fingers.
- The 1st MCP joint is reinforced by 2 sesamoid bones and are maintained in position by intersesamoid ligaments.



IP JOINTS OF FINGERS

- Each of the digits 2 through 5 has two interphalangeal (IP) joints, referred to as the proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints.
- All of the IP joints are **hinge joints with one degree of freedom**.
- The IP joints possess volar plate mechanisms similar to the MCP joints with the addition of check rein ligaments, which prevent hyperextension

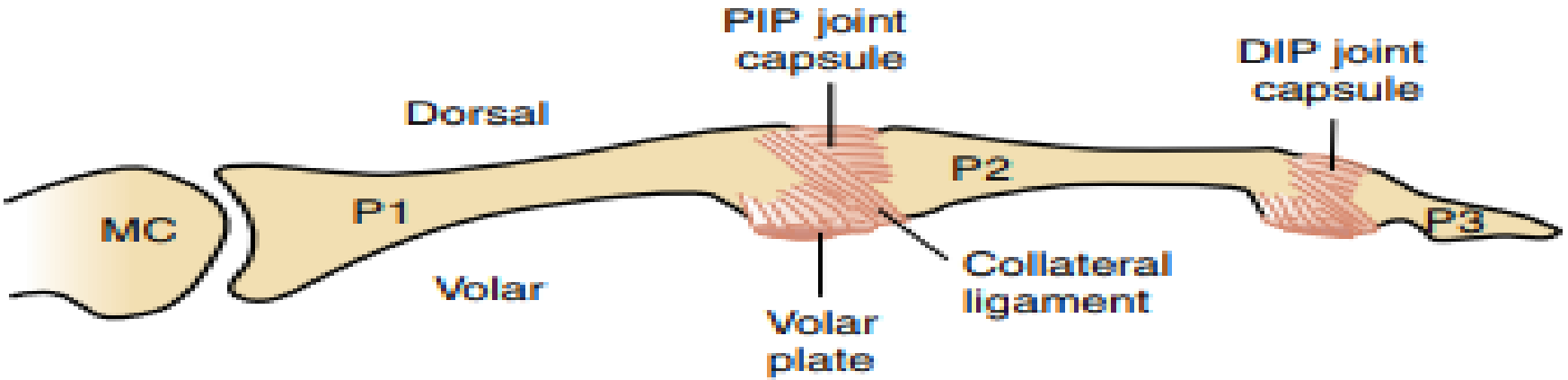


Figure 9–23 The proximal interphalangeal and distal interphalangeal joints, like the metacarpophalangeal joints, have volar plates that blend with the volar capsule portion of the capsule. The orientation of the collateral ligaments at the proximal and distal joints, however, differs from the orientation of the collateral ligaments at the metacarpophalangeal joints.

IP JOINTS OF THUMB

- The interphalangeal joint of the thumb is the articulation between the head of the proximal phalanx and the base of the distal phalanx.
- The thumb has only one IP joint.
- Pure hinge joint, which allows for extension, flexion, and opposition.
- It is structurally and functionally identical to the IP joints of the fingers.

Extrinsic finger flexors

- Flexor digitorum superficialis.
- Flexor digitorum profundus.
- Flexor digitorum superficialis: primarly flexes PIP, MCP joint
- FDP: Flexion MCP, PIP, DIP.
- Gentle pinch , grasp – FDP muscle is alone active.
- Greater flexor force is needed when finger flexion with wrist flexion at that time FDS,FDP act together.

CAMPERS CHIASMA

- At the level of PIP joint two slips of each FDS tendon reunite to form a tendinous chiasma.
- When FDS tendon is absent forceful pinch activity of FDP muscle create PIP extension with DIP flexion.

Mechanism of finger flexion

- Function of FDS,FDP:
- Stabilisation
- Smooth flexor gliding mechanism.
- Gliding mechanism consists of:
- Flexor retinacula,bursa, tendon, digital tendon sheath.
- Bursa, tendon sheath facilitate friction free gliding of tendon on the fibrous retinacula.

- Retinacula- prevent bowstringing of the tendons.
- Ulnar and radial bursa;
- Friction between tendons and friction of tendon overlying transverse carpal ligament prevented by radial and ulnar bursa.

- The tendon of FDS, FDP through carpal tunnel is enclosed In ulnar bursa.
- The tendon of flexor pollicis longus through carpal tunnel is enclosed in radial bursa.
- Ulnar bursa is continuous with tendon sheath of little finger.
- For other fingers its ends at proximal palmar crease.

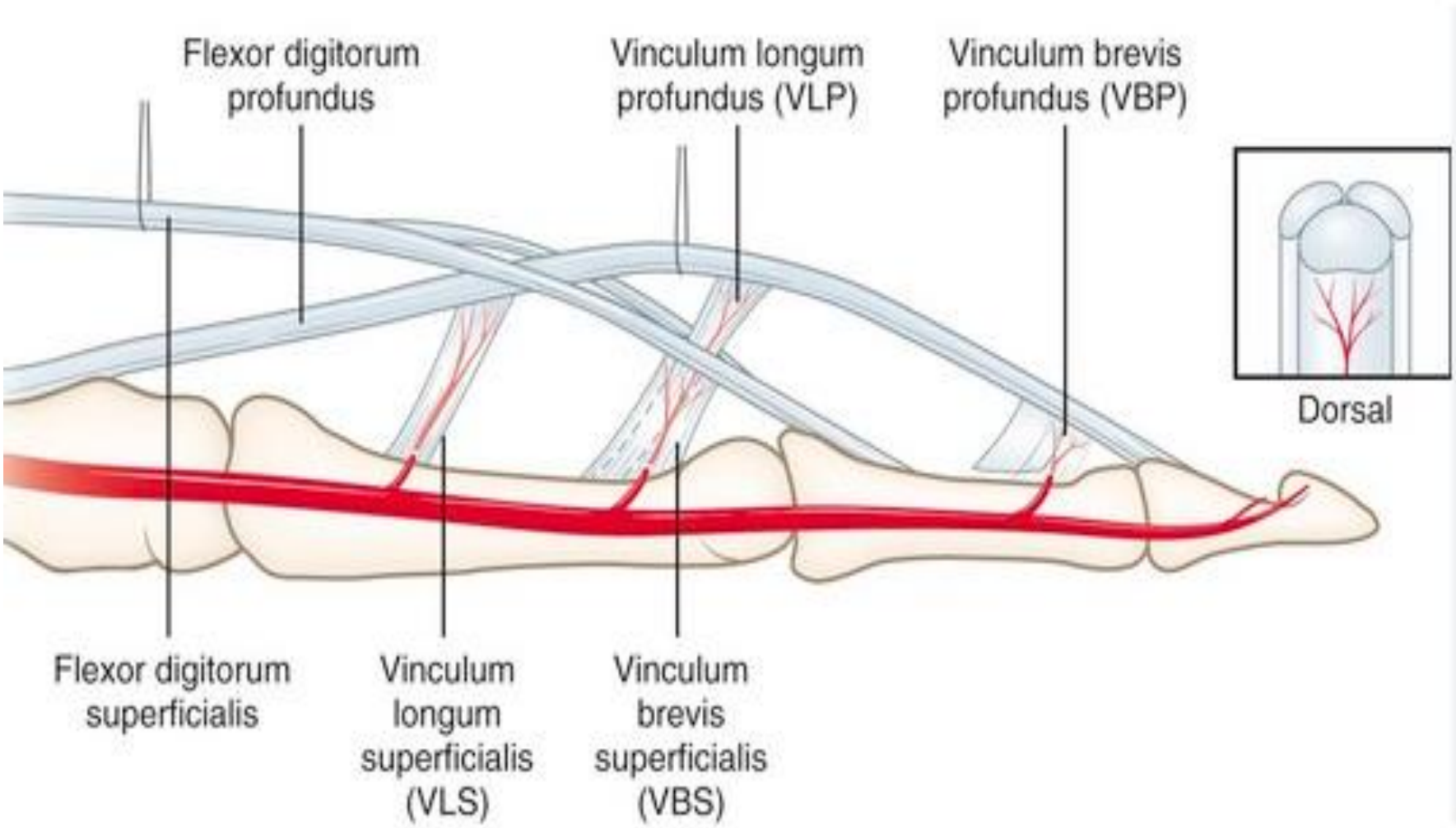
- Radial bursa is continuous with the tendon sheath.
- The tendon sheath for each finger ends at distal aspect of middle phalanx.

Annular and cruciate pulley

- FDS, FDP of each finger pass through fibro osseous tunnel.
- Comprised of 5 transversely oriented ANNULAR PULLEY (Vaginal ligament).
- 3 obliquely oriented CRUCIATE PULLEY

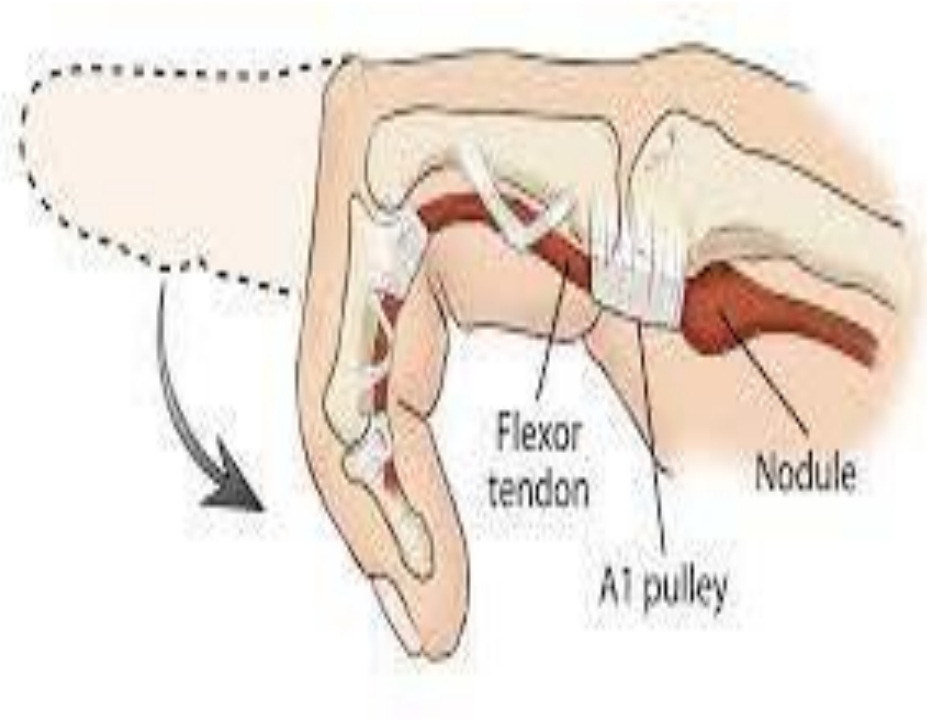
- **A1**-@ the head of metacarpal
- **A2-** along volar midshaft of proximal phalanx
- **A3**- distal most part of proximal phalanx
- **A4-** center of middle phalanx
- **A5-** base of distal phalanx.
- **C1-** Located between A1 and A2
- **C2-** between A3 and A4
- **C3**- between A4 and A5.
- Thumb has two annular pulley and 1 obique pulley

- **VINCULA TENDINUM**:
- These are folds of synovial membrane that carry blood vessels to the body of the tendon and to the insertions of FDS, FDP muscles of each finger.
- Direct vascularisation to tendon occurs through the vincula tendinum.
- Whenever this direct vascularisation is losed, it can withstand partialy with the nutrition from synovial fluid.


Flexor digitorum profundus
Vinculum longum profundus (VLP)
Vinculum brevis profundus (VBP)
Dorsal
Flexor digitorum superficialis
Vinculum longum superficialis (VLS)
Vinculum brevis superficialis (VBS)

TRIGGER FINGER

- Repetative trauma of flexor tendons results in nodules on the tendon and thickenning of annular pulley.
- During active finger flexion the nodule get caught/ stuck beneath the pulley that requires passive extension to unlock from the stucked flexed position.


Flexor
tendon
Nodule
A1 pulley


Trigger Finger
Nodule trapped behind tendon sheath

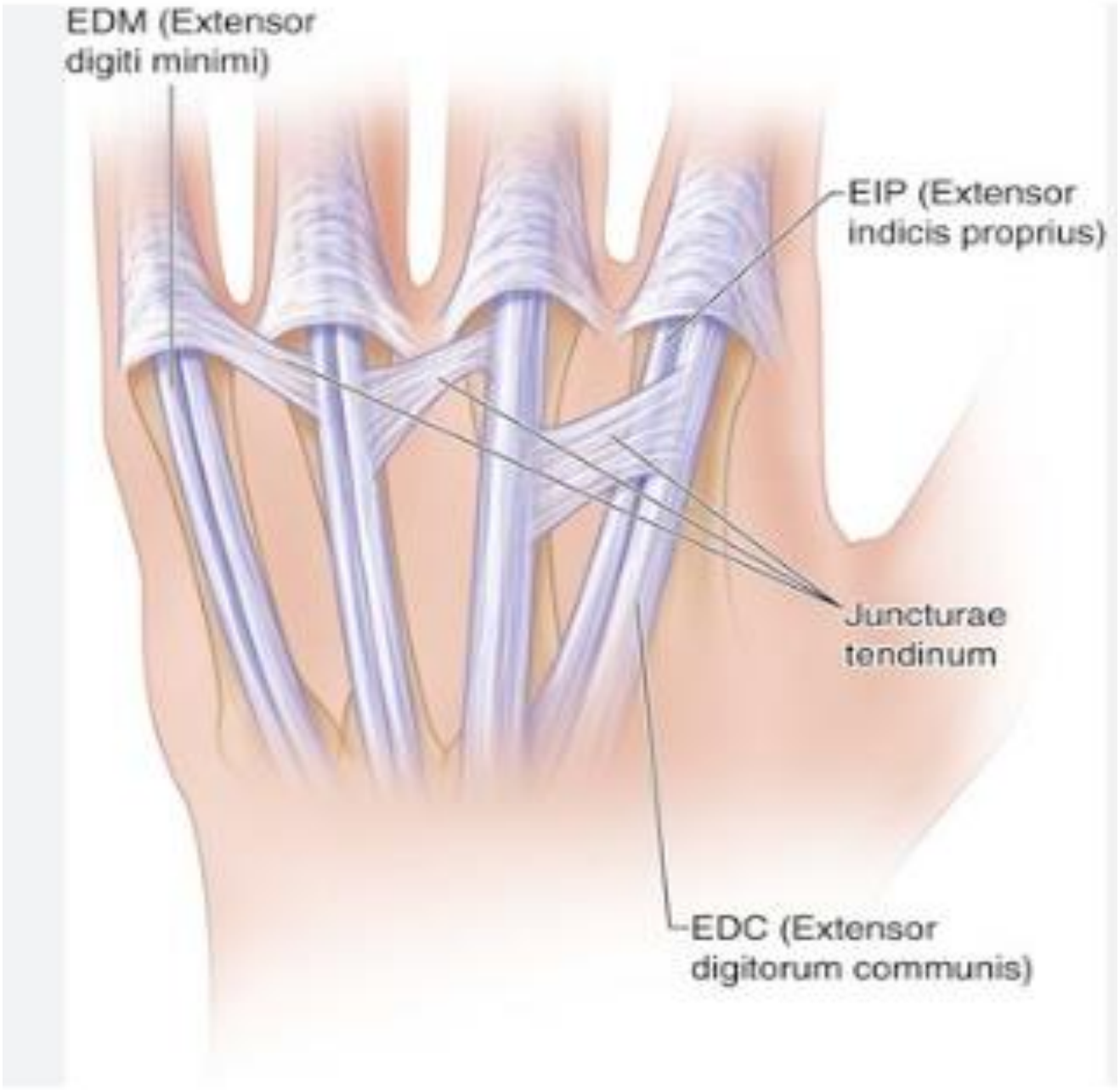
Extrinsic-finger extensors

- Extensor digitorum communis
- Extensor indicis propius
- Extensor digiti minimi
- These muscle passes the forearm beneath the extensor retinaculum.

- At the level of MCP joint , extensor communis tendon of each finger merges with a broad aponeurosis known as- **EXTENSOR EXPANSION/ EXTENSOR HOOD.**
- Distal to extensor hood, the EDC tendon splits into 3 band as: central tendon, 2 lateral bands.
- Central tendon insert to base of middle phalanx.

- The extensor digitorum communis tendon of one finger is connected to the tendon of other adjacent fingers by a connective tissue called **JUCTURA TENDINAE.**
- This fibrous interconnections cause active extension of one finger to be accompanied by passive extension of other finger.

- The EDC, EIP, EDM, Junctura tendinae connections results- independent extension of index finger with reduced independence of ring, middle, little finger.


EDM (Extensor digiti minimi)
EIP (Extensor indicis proprius)
Juncturae tendinum
EDC (Extensor digitorum communis)

Extensor mechanism

- **Formed by EDC, EIP, EDM, extensor hood, central tendon, & the lateral bands that merge into terminal tendon**
- Passive components are –
- Triangular ligaments (helps stabilize the bands on the dorsum of fingers) .
- Sagittal bands (connects volar surface of hood to volar plates) .
- Deep transverse MC ligament – prevents bowstringing of extensor tendons.
- Active components are:
- Dorsal interossei (DI), Volar interossei (VI) ,Lumbrical.
- Lumbrical and interossei are called intrinsic muscles (

Extensor mechanism influence on MCP joint function

- EDC tendon passes dorsal to MCP joint axis.
- Active contraction of muscle creates tension on sagittal band of extensor mechanism.
- This tension pulls the band proximally over the MCP joint and extends proximal phalanx.
- Isolated contraction of EDC tendon cause:
- MCP joint hyperextension, IP joint flexion.

- IP joint flexion is caused tension of FDS and FDP.
- The position of finger with MCP joint hyperextension with passive IP flexion is known as **clawing.**
- In order to extend PIP, DIP, EDC tendon requires active assistance.
- Active forces of extensor expansion are DI, VI, Lumbricals.

- DI,VI- passes volar to MCP joint axis.
- When EDC, DI,VI, Lumbricals contract simultaneously MCP and IP joint will Extends.
- When intrinsic muscles are weak, EDC is unopposed, results in clawing of fingers with MCP joint hyperextension.
- Clawed position is also called **INTRINSIC MINUS POSITION.**

Extensor mechanism influence on IP joint function

- When PIP Joint is extended, Dip joint is also extend.
- Active contraction of intrinsic muscle alone extends PIP, DIP joint.
- When intrinsic muscle contraction without simultaneous contraction of EDC cause flexion of MCP joint.
- Tension in both intrinsic and EDC tendon is necessary to produce full extension.

INTRINSIC FINGER MUSCULATURE

- Attachments distal to radiocarpal joint.
- Dorsal & volar interossei muscles :-
- Arise between the Metacarpals
- 4 DI & 3-4 VI muscles
- Function:
- MCP joint abduction &adduction.

- The interossei muscle fibers join extensor expansion in 2 locations.
- some fibers attach proximally to the proximal phalanx & to extensor hood.
- some attach more distally to lateral bands & central tendons.

- **Role of interossei at MCP joint in Extension :-**
- Effective stabilizer.
- prevent clawing due to flexion torque.
- Balances passive tension in the extrinsic extensors at MCP joint.
- Interossei muscles are effective abductors & adductors at MCP joint when MCP joint is in extension.

Role of interossei at MCP joint in flexion :-

- From extension to flexion – tendons & action lines of interossei muscles migrate volarly away from coronal axis of MCP joint
- – increases moment arm for MCP flexion –
- Increases the flexion torque at MCP joint as it approaches to full flexion.
- In full MCP flexion, abduction/adduction is restricted due to –tight collateral ligaments, shape of condyles on MC heads & active insufficiency of fully shortened interossei muscles.

Role of interossei at IP joint in IP extension:-

- IP joint extension produced by distal interossei is stronger than MCP abduction/adduction during MCP extension.
- Index & little finger has weaker IP extension than middle &ring fingers.
- proximal components are effective in MCP flexion & distal component in IP extension.
- So most consistent activity of interossei is when MCP joints are flexed & IP joints are extended.

Lumbrical muscles:-

- Only Muscles in the body that attaches to tendons of other muscles.
- Each muscle originates from tendon of FDP muscle in the palm
- –volar to deep transverse MC ligament .
- Inserted to lateral band of extensor mechanism on radial side.

- Lumbrical contraction increases tension In lateral band leading to PIP, DIP joint extension.

INTRINSIC PLUS POSITION OF HAND.

- **When lumbricals and interossei contract together without any extrinsic muscle activity – these muscles produce :**
- ***MCP flexion and interphalangeal extension – called as INTRINSIC PLUS POSITION OF HAND.***

Intrinsic plus position

- **This position is also known as ANTI DEFORMITY POSITION.-** MCP- flexion and IP- Extension.
- After trauma to hand, splint is provided in this position.
- If MCP joint is in extended position, it result in shortening of collateral ligaments, that will limit MCP joint flexion that will leads to impairment in grasp and functional use.

- **So immobilasation splint should be in MCP Flexion**
- So collateral ligaments are stretched,reduces the risk of contracture.

- When extrinsic finger flexors and extensors are active without any activity of intrinsic muscles causes MCP extension and IP flexion.-

INTRINSIC MINUS POSITION

How Is Bunnell Test Performed?

- This test is done in two stages, metacarpophalangeal joint MCP extension and flexion:
- The metacarpophalangeal joint is stabilized in **extension** and the proximal interphalangeal joint is tried to flex and the degree of flexion is noted.
- Then the metacarpophalangeal joint is **flexed** and again the degree of flexion of proximal interphalangeal joint is noted.

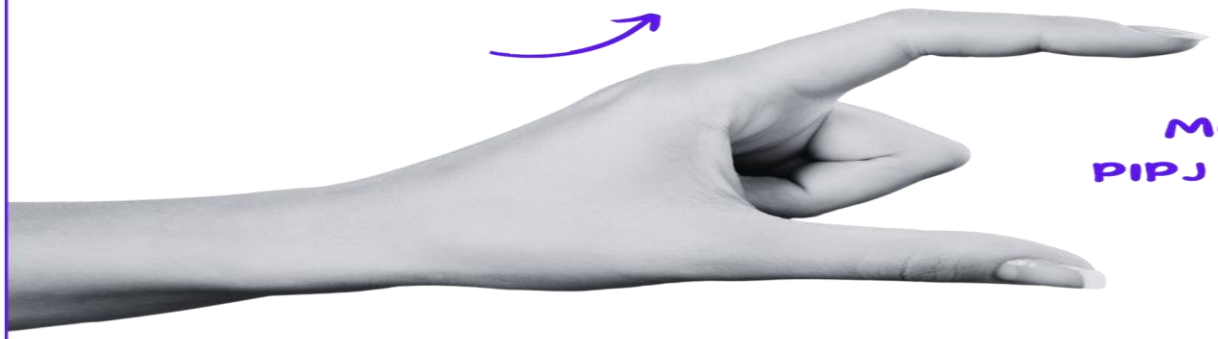
- The test most commonly used to test for intrinsic contracture is the intrinsic tightness (Bunnell) test.

What Does A Positive Bunnell Test Mean?

- **We differentiate 3 cases:**
- If the **PIP flexion is increased,** the pathology is intrinsic muscle contracture (**Intrinsic tightness**) as the intrinsic get released on MCP flexion.
- If the **PIP flexion is decreased**, the pathology is Extensor tendon contracture (**extrinsic tightness**) which is stretched further on MCP flexion.
- If the **PIP flexion is the same in both situations**, the pathology is articular changes such as joint stiffness, tendon adhesions, and tenosynovitis

Bunnell Test

Intrinsic Tightness



MCPJ EXTENSION
PIPJ REDUCED FLEXION

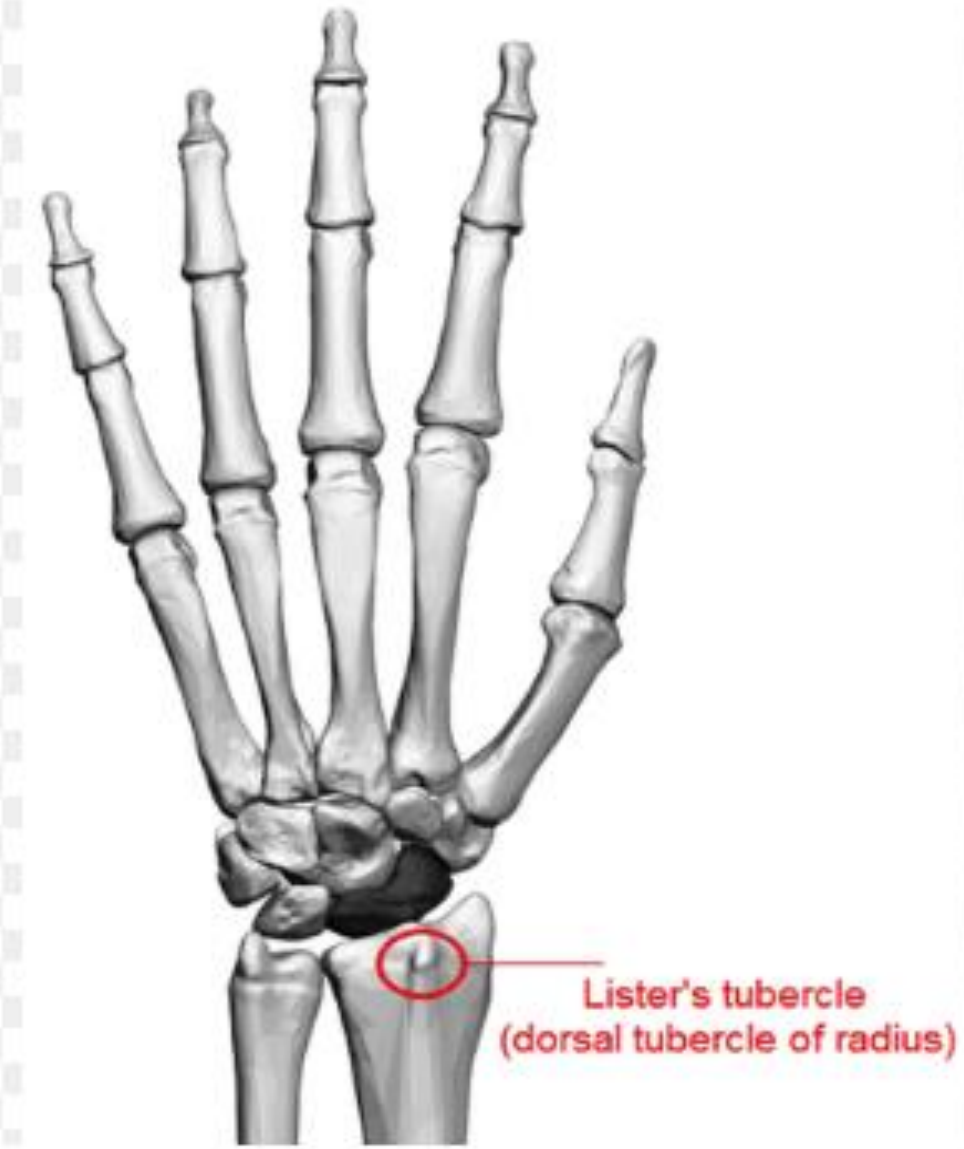
MCPJ FLEXION
PIPJ INCREASED FLEXION

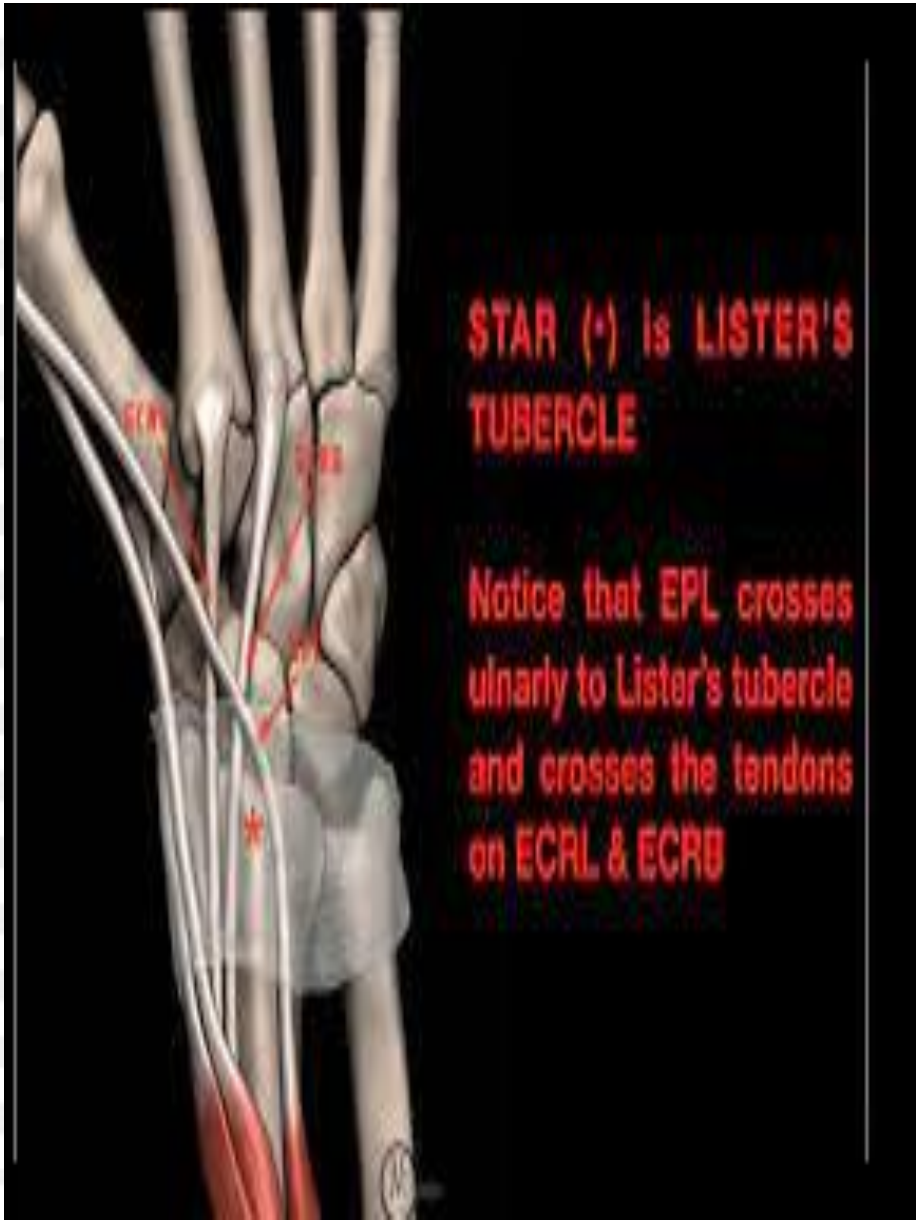
Bunnel's 1946 intrinsic tightness test consists of two steps: extend then flex the MCPJ, measuring PIPJ flexion each time, with an increase in PIPJ flexion indicating isolated intrinsic tightness.

Thumb musculature

- Flexor pollicis longus
- Extensor pollicis brevis
- Extensor pollicis longus
- Abductor pollicis longus.

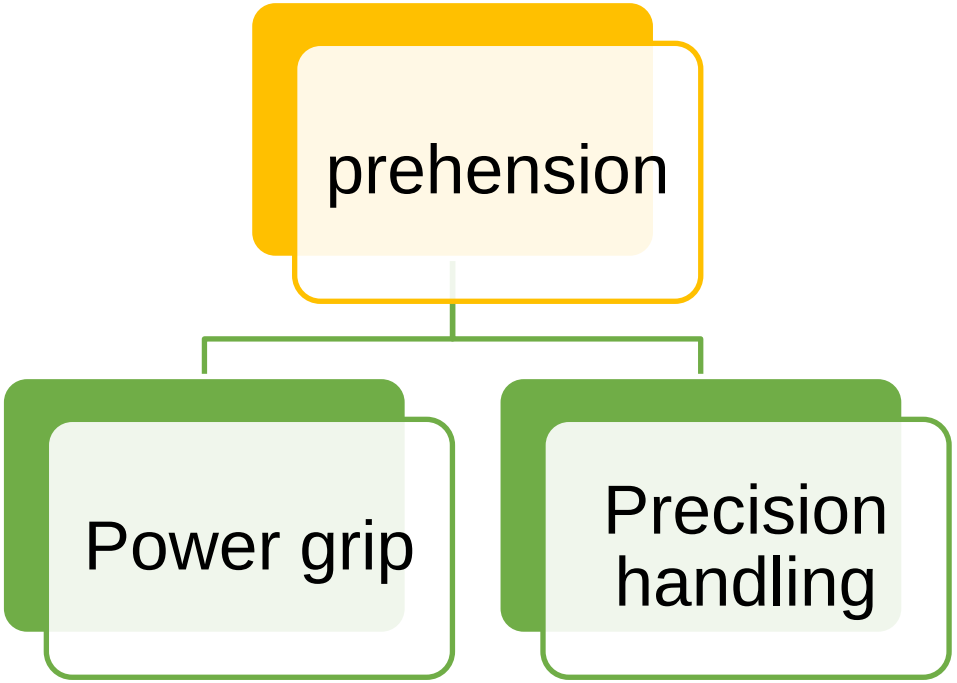
- There is a prominent bony tubercle over the dorsal aspect of distal radius known as **LISTERS TUBERCLE.**
- **It function as anatomic pulley for the extensor pollicis longus tendon** before the tendon pivot and turns to insert into distal phalanx of thumb.


Lister's tubercle
(dorsal tubercle of radius)


STAR (*) is LISTER'S TUBERCLE
Notice that EPL crosses ulnarly to Lister's tubercle and crosses the tendons on ECRL & ECRB

PREHENSION

- Prehension activities involves grasping or taking hold of an object between any 2 surfaces of hand.
- Thumb participate in most but not all the prehension activities.



Power Grips

Cylindrical Grip

Spherical Grip

Hook Grip

Lateral Prehension

Precision Grips

Pinch Grip

POWER GRIP

- Forceful act resultig in flexion of all finger joint.
- Thumb act as stabiliser to the object held in fingers/ palm.
- <u>Phases:</u>
- Opening of hand
- Positioning of the fingers
- Bringing the fingers to the object
- Maintaining static phase
- Object is grasped to move through space by some proximal joints
- Thumb is generally adducted

- Different power grips –
- Cylindrical grip
- Spherical grip
- Hook grip
- Lateral prehension

CYLINDRICAL GRIP

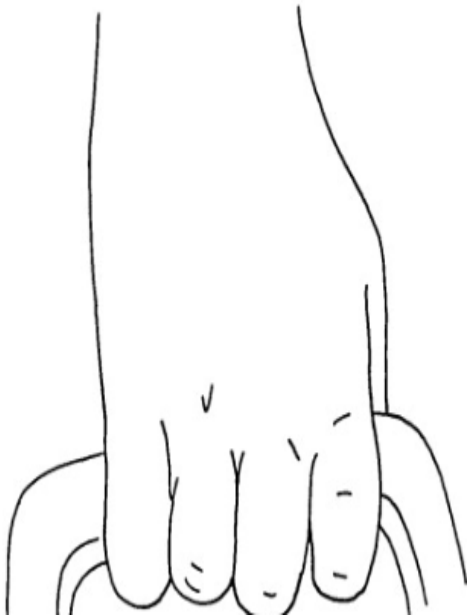
- Involves use of all finger flexors
- FDP works predominantly
- Interossei muscles – primary MCP flexors, abductors/adductors
- Wrist is in neutral/ extension and slight ulnar deviation.
- E.g. turning a door knob.

SPHERICAL GRIP

- Most respect to cylindrical grip but greater spread of fingers to encompass the object.
- More activity of interosseus
- for e.g. holding a ball.

HOOK GRIP

- Major activity of FDP&FDS.
- Load – more carried distally FDP,
- proximally (FDS)
- Thumb- moderate to full extension.
- E.g. - carrying a briefcase



LATERAL PREHENSION

- Contact between two fingers.
- MCP & IP joint- in extension
- Extensor musculature pre dominates.
- E.g. holding a paper

PRECISION HANDLING

- Require much finer motor control & more dependent on intact sensation.
- Skillful placement of an object between fingers or between fingers and thumb .
- No involvement of palm

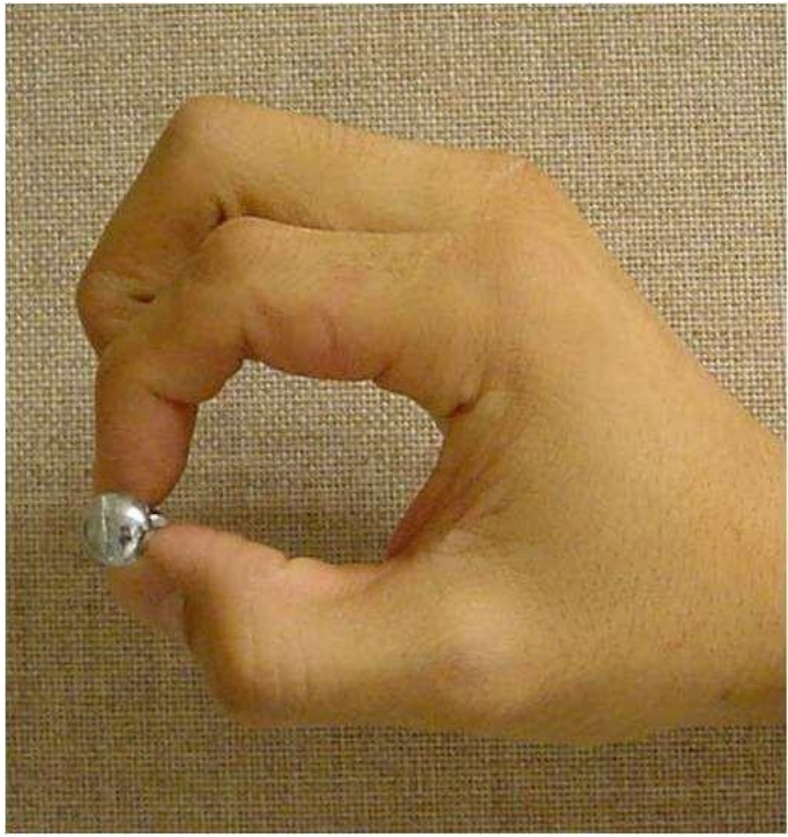
PAD TO PAD PREHENSION

- 3 varieties of precision are –
- **Pad to pad prehension**
- **Tip to tip prehension**
- **Pad to side prehension.**

- Involves opposition of pad or pulp of thumb to pad or pulp of finger.
- MCP & proximal IP joint of the finger – partially flexed
- Distal IP joint- extended or slightly flexed
- Thumb-CMC flexion, abduction
- E.g. holding a foreceps

TIP TO TIP PREHENSION

- Muscle activity almost same to pad to pad prehension with some key differences like IP joint of the fingers& the thumb have range & force to create full flexion.



- MCP joint of opposing finger deviates ulnarly.
- E.g. holding a pen.

SIDE TO SIDE PREHENSION

- Key grip or lateral pinch.
- Between thumb & side of index Finger
- Thumb more adducted and least rotated.

Power Grip

Figure 7-39 Types of power grips.

Precision Grip

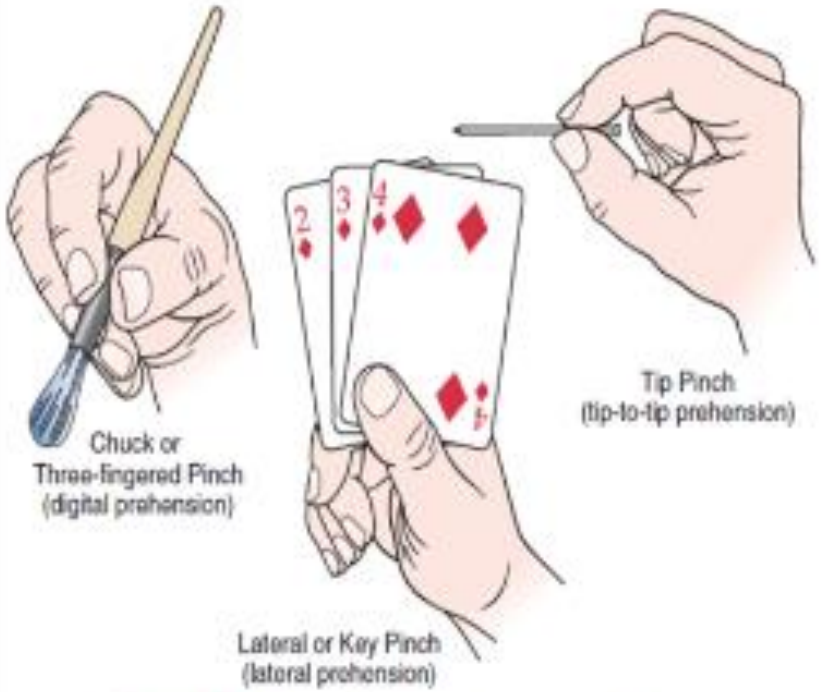


Figure 7-40 Types of precision grips or pinches.

FUNCTIONAL POSITION OF WRIST & HAND

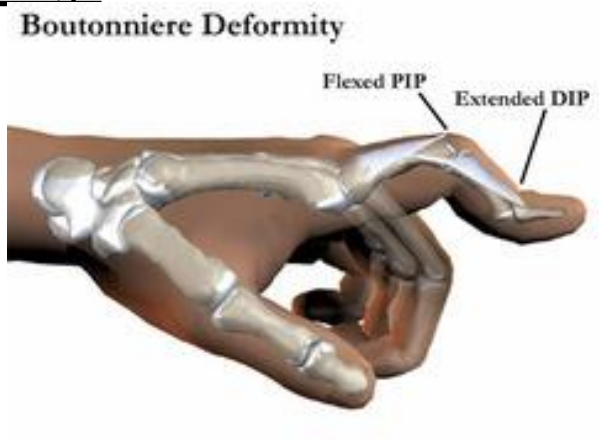
- The functional position is –
- Wrist complex in slight extension (20°) & slight ulnar deviation (10°)
- Fingers moderately flexed at MCP joint (45°) & proximal IP joint (30°) & slightly flexed at distal IP joint

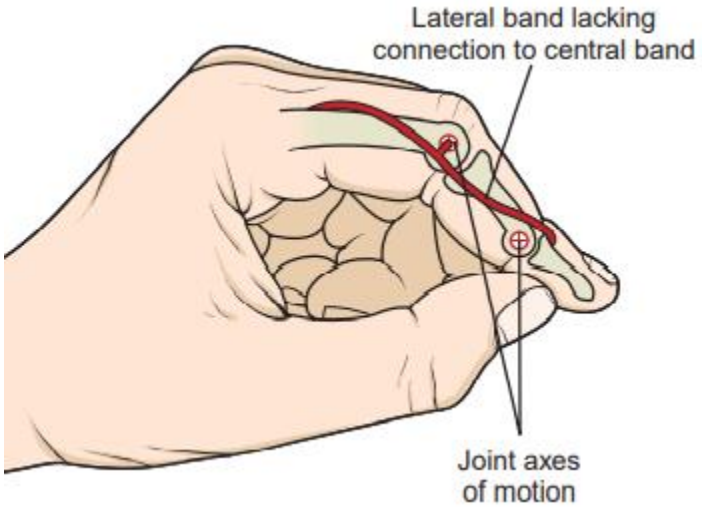
PATHOMECHANICS

- Boutonniere deformity
- Swan neck deformity
- Dupuytren’s contracture
- Mallet finger
- Claw finger

Boutonniere deformity

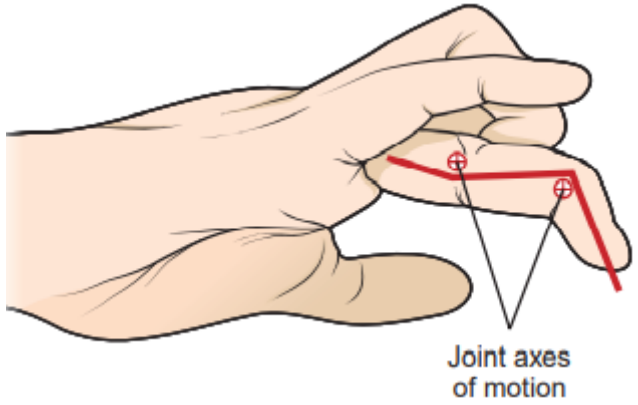
- Occurs when the central slip of the extensor digitorum is injured at its insertion on the middle phalanx.
- The lateral bands lose their connection to the central band, so they drift more anterior toward the **PIP joint**, causing that joint to **flex**.
- Because of the flexed position of the PIP, the lateral bands are now more posterior to the axis of motion of the **DIP joint**, so that joint becomes **hyperextended.**





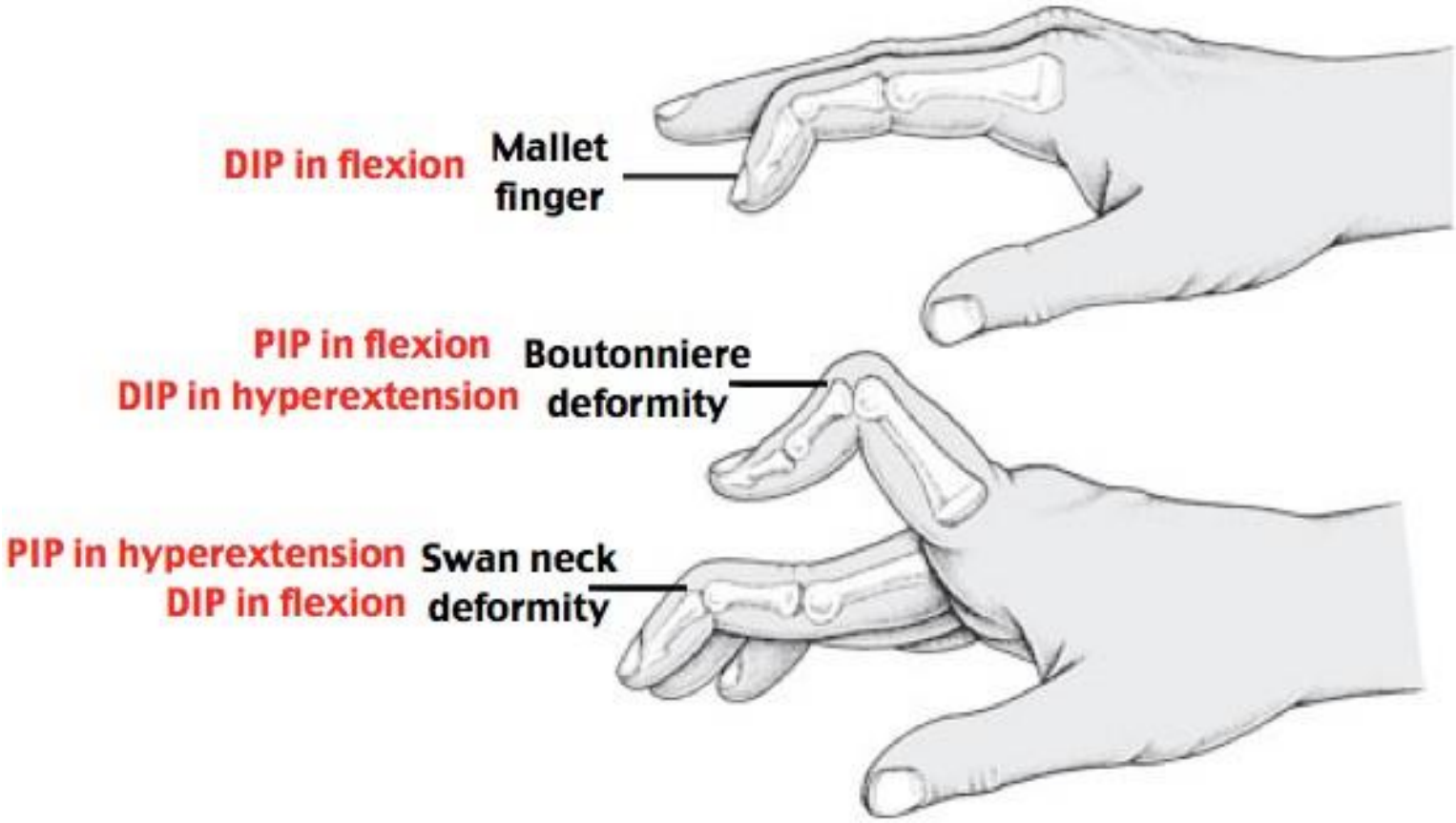
Swan neck deformity

- Occurs primarily with arthritis
- With subsequent weakness of the intrinsic muscles, the **PIP joints** deform into **hyperextension.**
- This causes increased tension on the flexor digitorum profundus so the **DIP joint** maintains a **flexed position.**



Mallet finger

- Result of the rupture of the avulsion of the extensor tendon where it inserts in the distal phalanx of the finger
- **Distal phalanx** rests in a **flexed position**


DIP in flexion
Mallet finger
PIP in flexion
DIP in hyperextension
Boutonniere deformity
PIP in hyperextension
DIP in flexion
Swan neck deformity

Dupuytren's contracture

- Palpable thickening of the palmar fascia and a progressive flexion contracture of the ulnar two fingers.

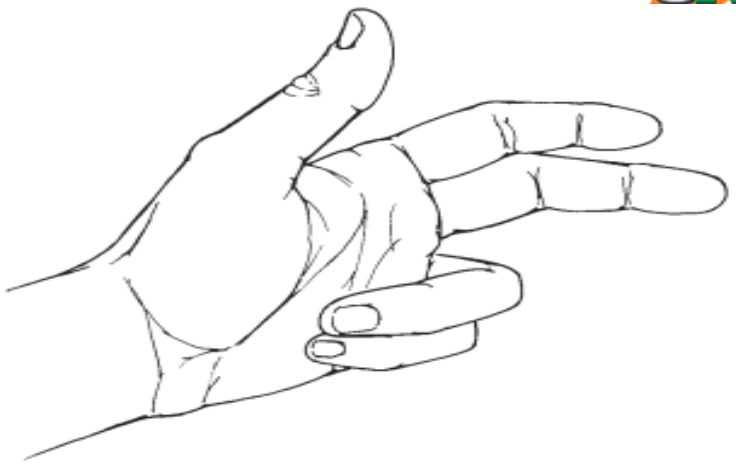


Figure 17.4: Dupuytren's contracture produces flexion of the ulnar fingers.

Claw finger

- Intrinsic minus hand
- MCP joints are hyperextended and PIP & DIP joints are flexed

THANK YOU