General arthrology

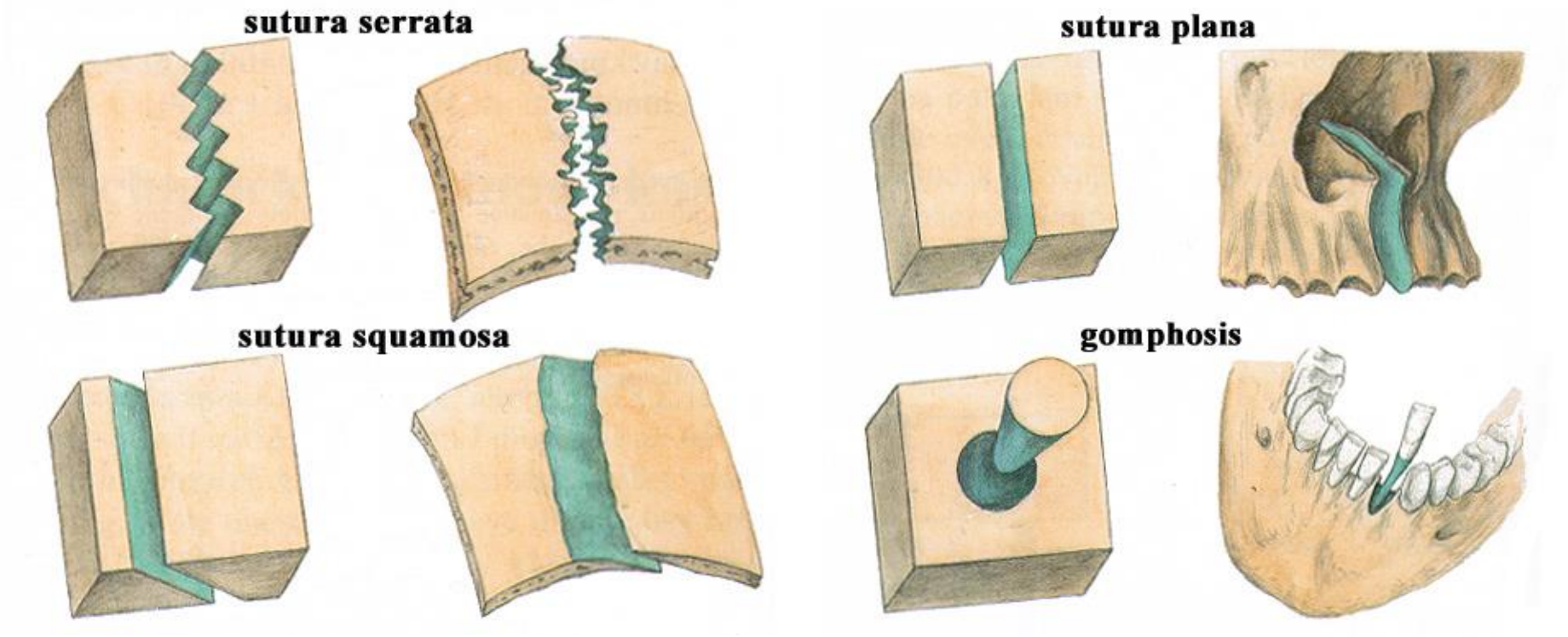
Juncturae *seu* **Systema articulare**
Joint or **Articular system**

- **synathrosis** (immovable joints)
  - connection by means of connective tissue
    - fibrous (junctura fibrosa) - *syndesmosis*
    - cartilage (junctura cartilaginea) - *synchondrosis*, *symphysis*
    - bony (junctura ossea) – *synostosis*
  - no joint cavity
- **diarthrosis** (synovial joint)
  - connecting surfaces with a cavity

Synarthrosis

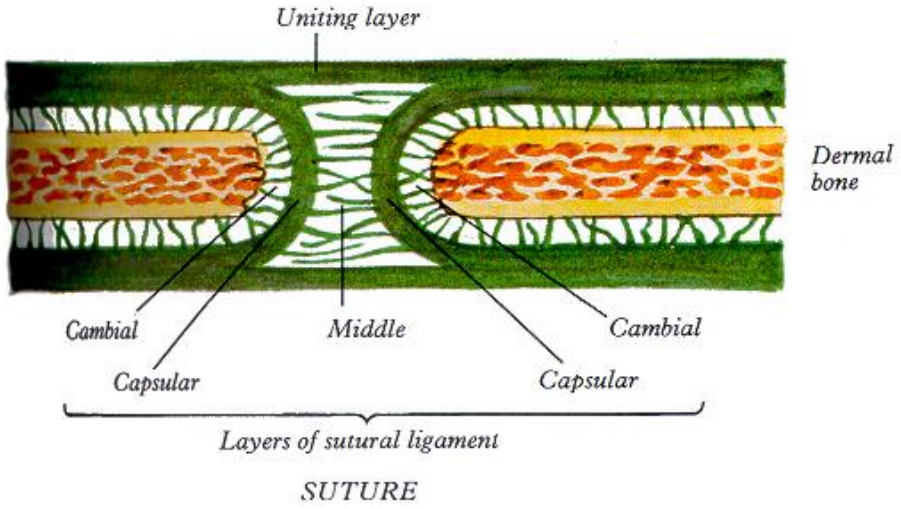
junctura fibrosa /fibrous joints/	syndesmosis	ligamenta /ligaments/	all extra-articular ligaments
		gomphosis /socket/	syndesmosis dentoalveolaris /dento-alveolar syndesmosis/
		membrana /membrane/	membrana interossea antebrachii et cruris, intercostalis externa et interna, obturatoria
	sutura /suture/	sutura plana, squamosa, limbosa, serrata et denticulata, schindylesis	33 cranial sutures
junctura cartilaginea /cartilaginous joint/	synchondrosis		cranial synchondrosis, epiphysial joint /primary cartilaginous joint, growth plate/, artt. costochondrales, interchondrales
	symphysis /secondary cartilaginous joint/		symphysis intervetebralis, pubis, sacrales, mandibulae, manubriosternalis, xiphisternalis
junctura ossea /bony union/	synostosis		os coxae /hip bone/ (os ilium + os ischii + os pubis), os sacrum /sacral

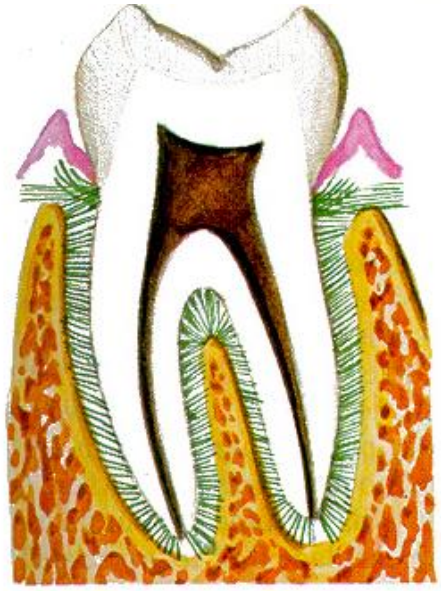
Junctura fibrosa I

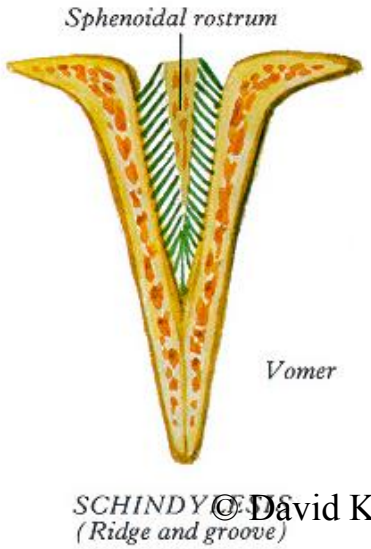


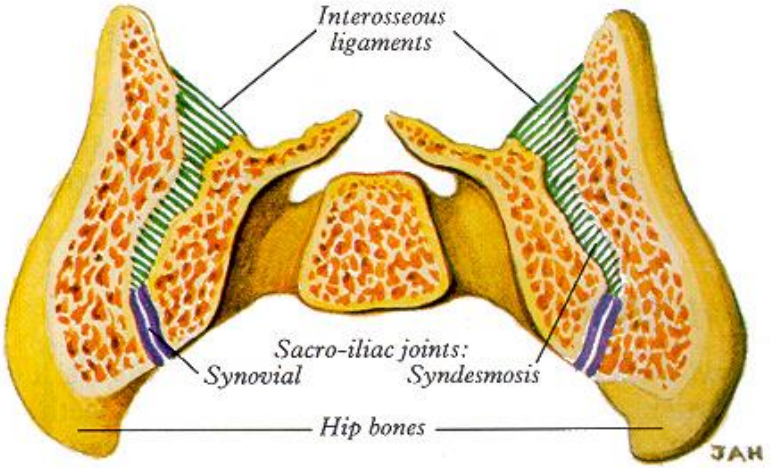
Čihák R., Anatomie 1, Grada Publishing a.s. 2001

Junctura fibrosa II





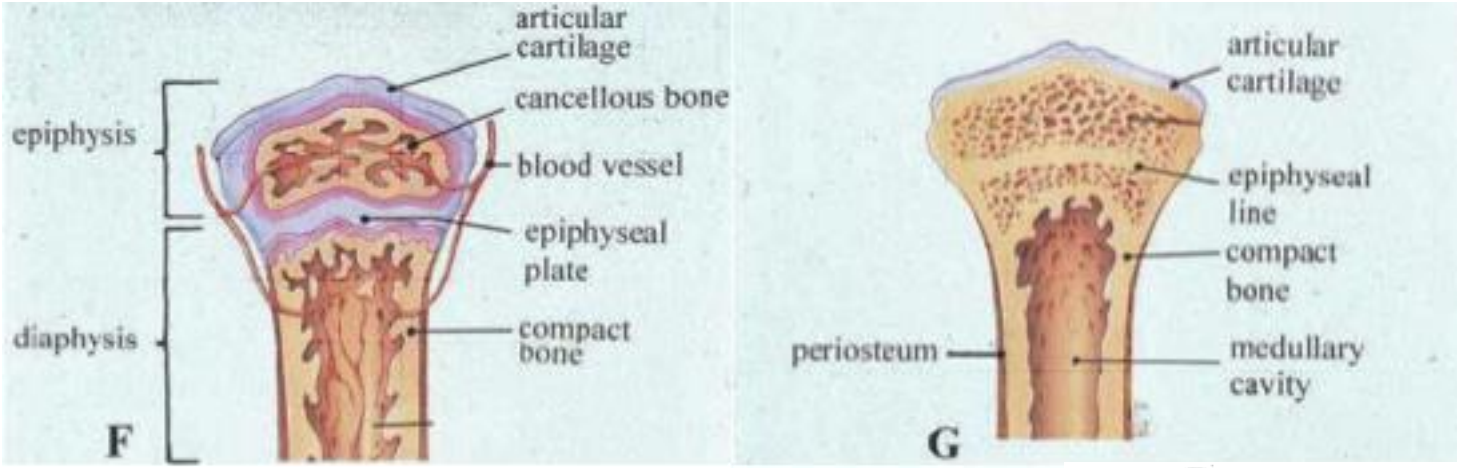




Gray´s anatomy, 37th edition, Churchill Livingstone 1989

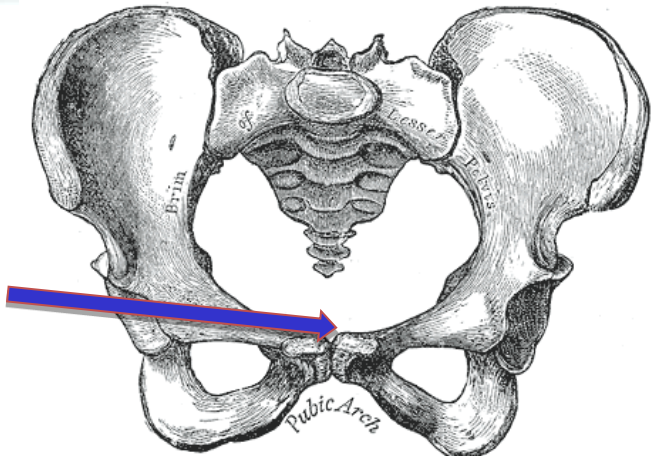
Junctura cartilaginea I

- synchondrosis (connection by hyaline cartilage)

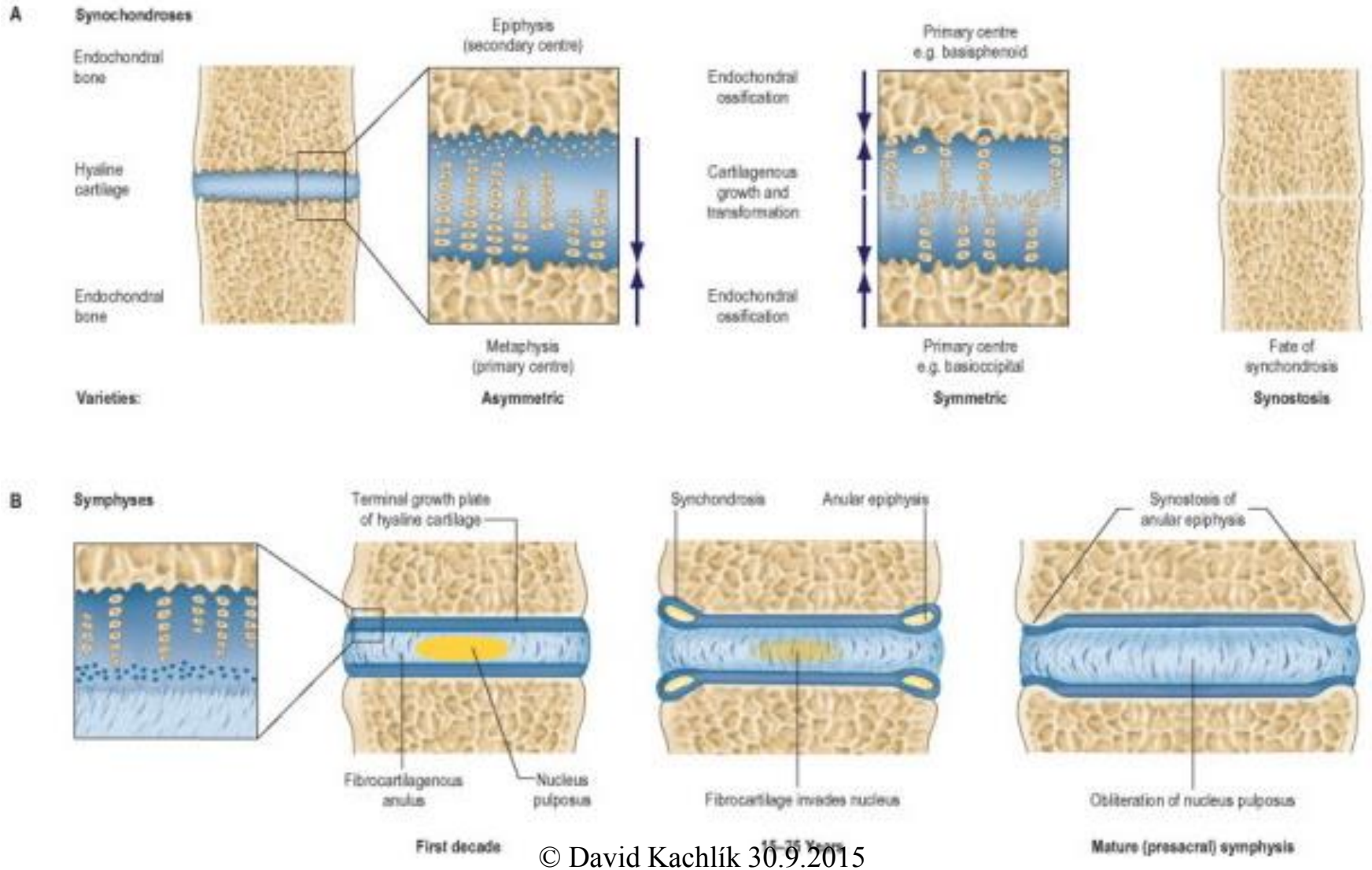


- symphysis (connection by fibrous cartilage)

symphysis pubis



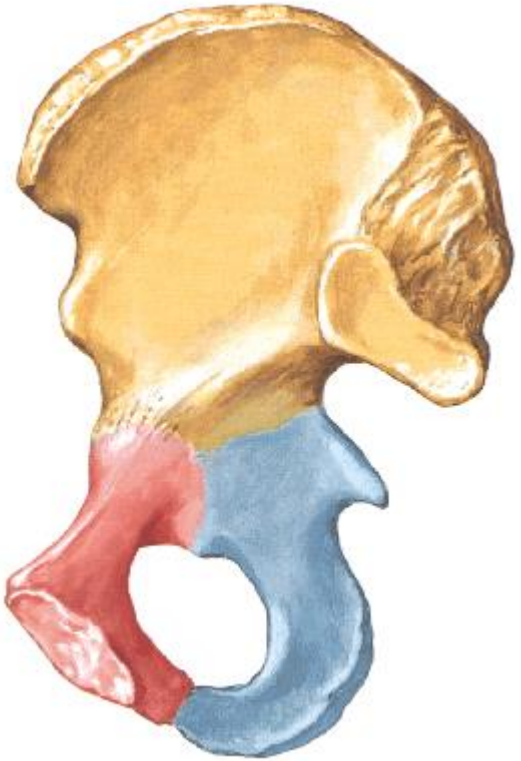
Junctura cartilaginea II



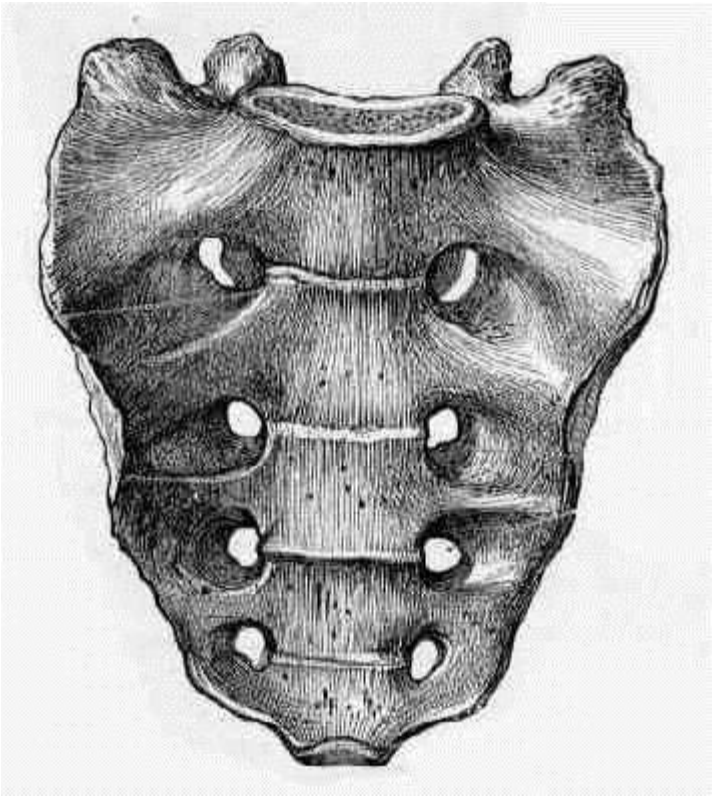
Gray´s anatomy, 40th edition, Churchill Livingstone Elsevier 2008

Junctura ossea

os coxae



os sacrum



Netter, Atlas of Clinical Anatomy

http://www.wheelessonline.com/ortho/sacrum_and_sacral_fractures

Diarthrosis = Junctura synovialis = Articulatio = Synovial joint

- facies articulares (articular surfaces)
  - fossa (*fossa articularis*) x head (*caput articulare*)
- capsula articularis (joint capsule)
  - stratum fibrosum (externally)
  - stratum synoviale (little differentiated synovialocytes → hyaluronic acid)

  plicae synoviales (synovial folds), corpus adiposum intraarticulare (intraarticular fat pad)
- cavitas articularis (articular cavity)
  - capillary slit
  - contains synovia (synovial fluid) = plasma transsudate + hyaluronic acid + a few leukocytes

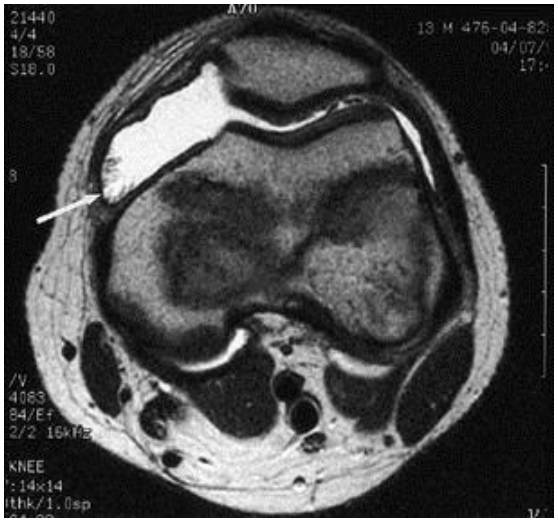
- special joint structures

Membrana synovialis (Synovial membrane)

- lines the whole articular cavity
  - apart from articular surfaces
- protrudes in plicae synoviales and villi synoviales
- well supplied by vessels and nerves
- 3 types
  - fibrous
  - areolar
  - adipose

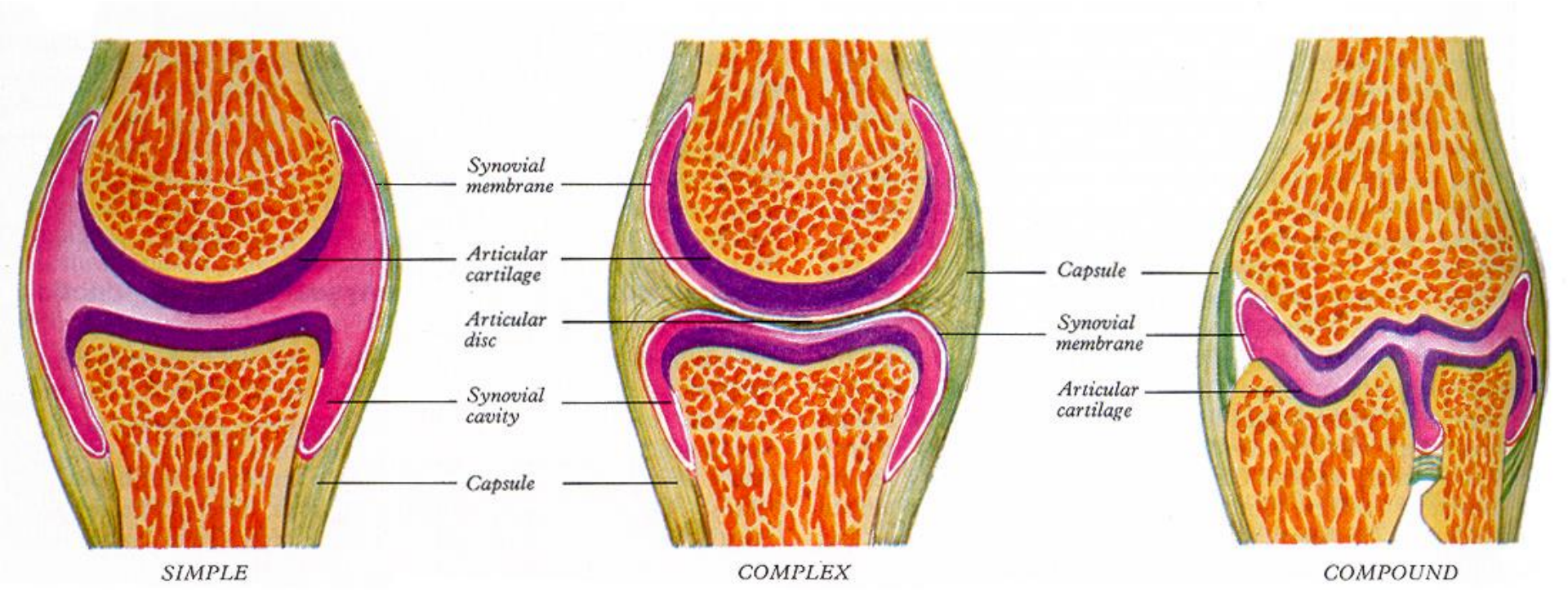
Synovitis

- inflammation of the synovial membrane
- production of effusion into the articular cavity



http://mskcases.com/index.php?module=article&view=39

http://www.health-pic.com/pigmented-villonodular-synovitis-knee/



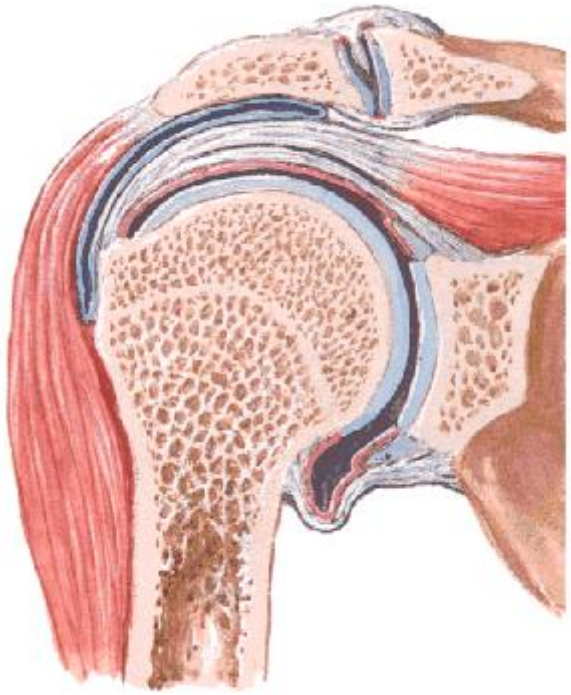
Gray´s anatomy, 37th edition, Churchill Livingstone 1989

Special joint structures I

- labrum articulare (labrum)
  - enlarges the area of articular fossa
  - *art. humeri*, *art. coxae*

- disci et menisci articulares (articular discs and menisci)
  - they level articular incongruations
  - elastic liner/pad
  - disc divides articular cavity in two
    - *art. temporomandibularis*, *art. sternoclavicularis*
  - meniscus is becoming flatter in the inner direction, has free inner margin
    - *art. genus*

Labrum articulare



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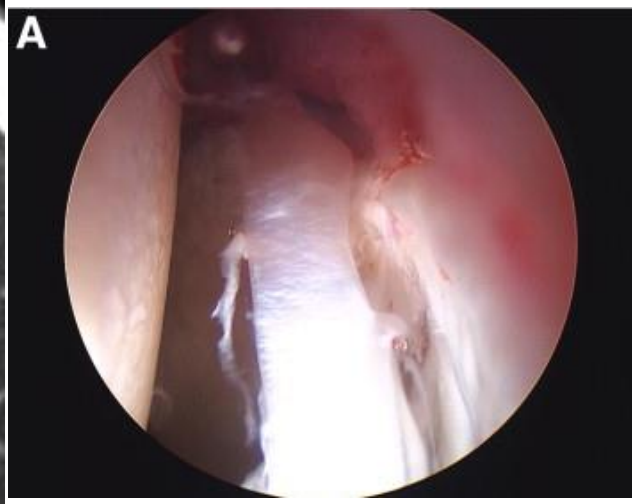
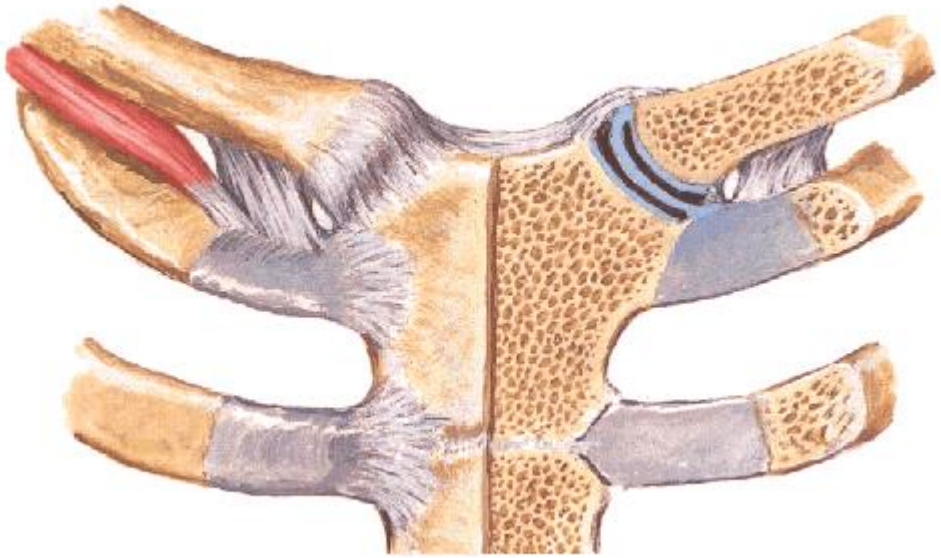
http://www.mypacs.net/cases/SHOULDER-PAIN-4066.html



http://www.sciencedirect.com/science/article/pii/S0749806310000988

Discus et meniscus articularis



Special joint structures II

- ligamenta (ligaments)
  - capsular (*ligg. capsularia*), extracapsular (*ligg. extracapsularia*) and intracapsular (*ligg. intracapsularia*)
  - strenghten the capsule
  - support the movements of the joint
  - limit the movement of the joint
- bursae synoviales (synovial bursae)
  - cavities lined by synovial membrane
  - inside there is a fluid similar to synovia
  - place of pathological changes
- musculi articulares (joint muscles)
  - prevent joint capsule strangulation

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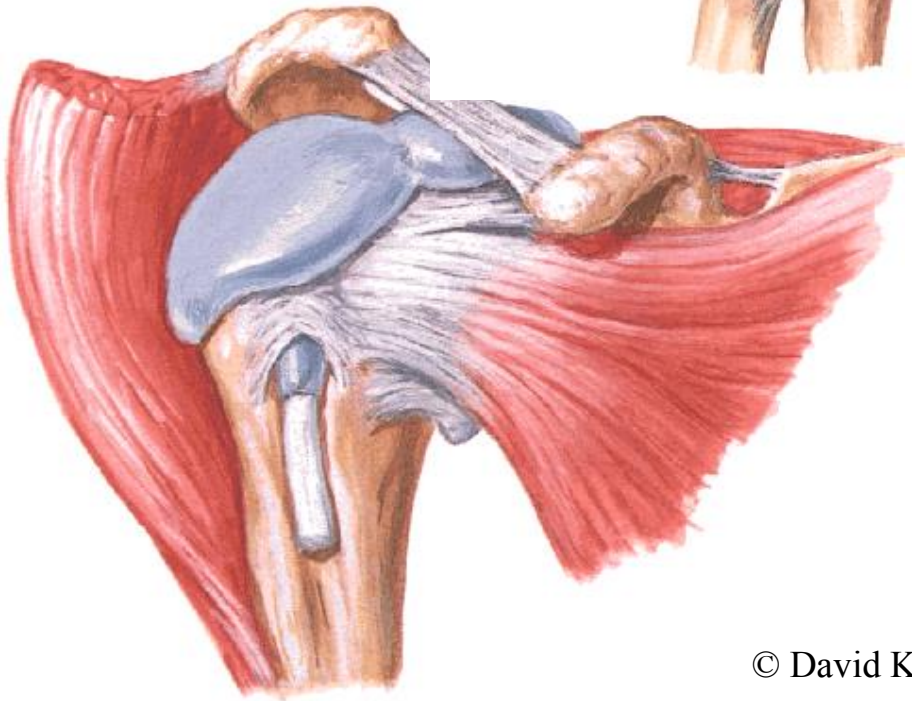
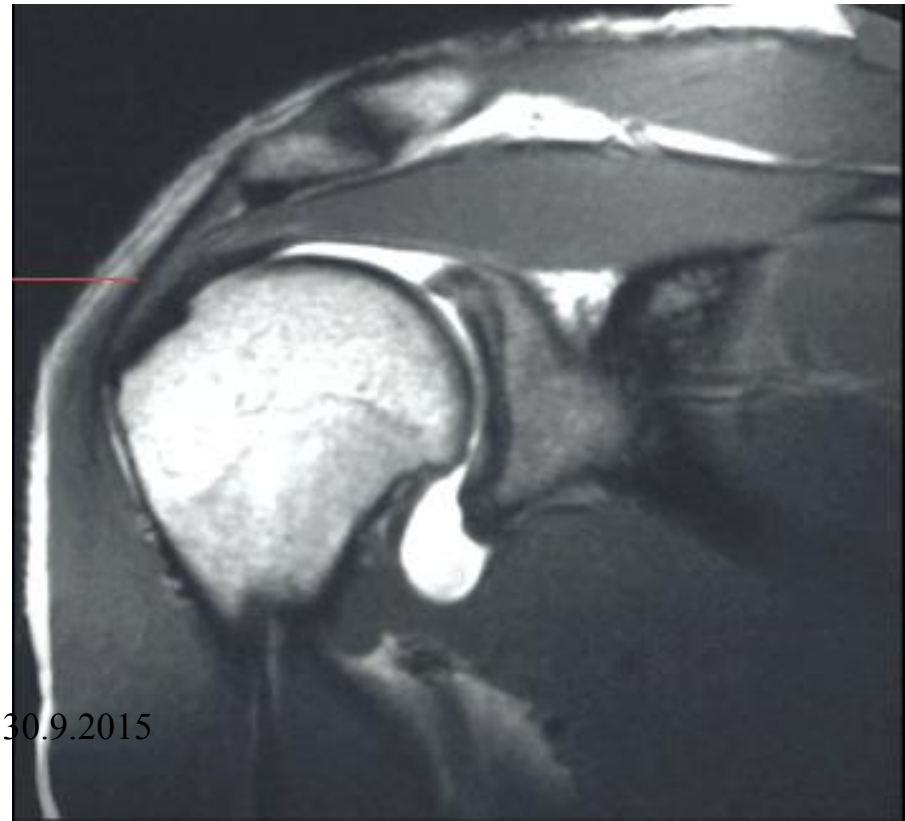




Special joint structures III

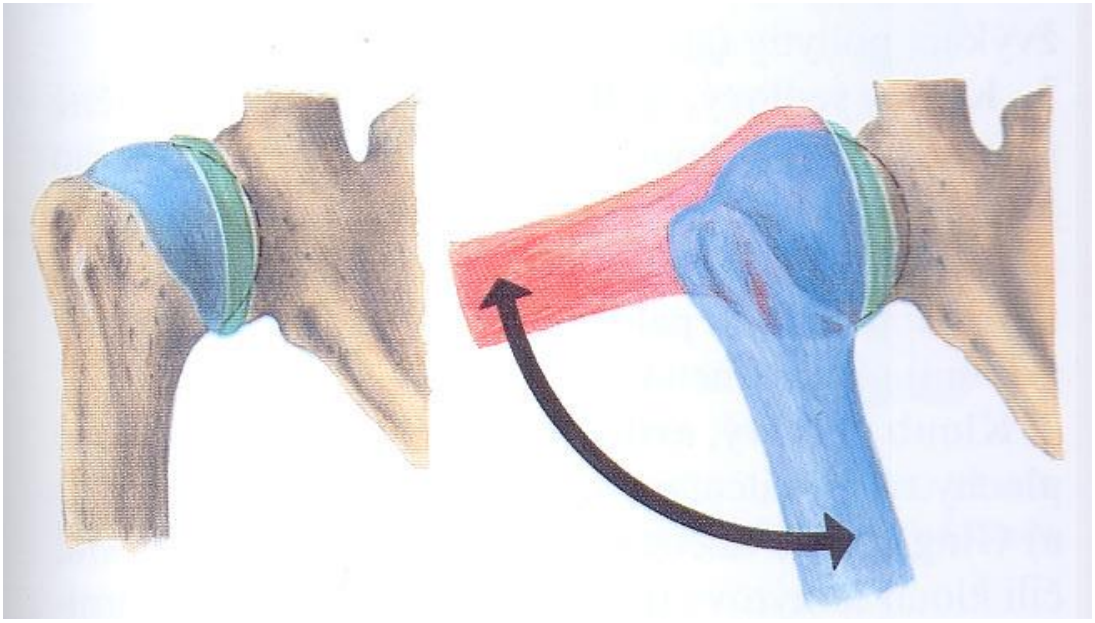
- fibrocartilago (fibrocartilage)
  - enlarge the articular fossa and strengthen the capsule
- corpus adiposum (fat pad)
- plica synovialis
  - level incongruations of the articular surfaces

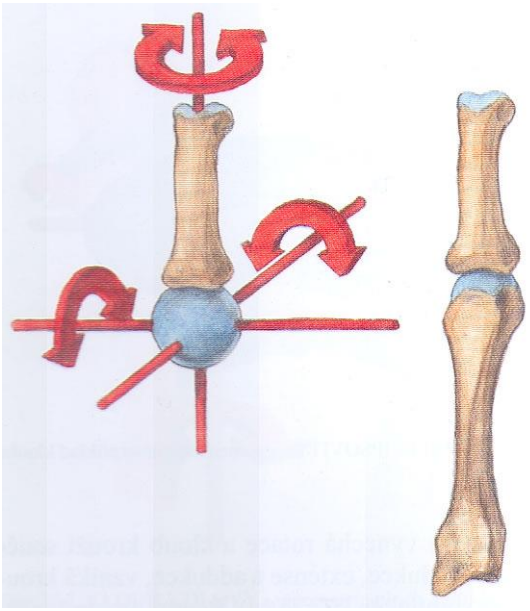
Classification of diarthrosis

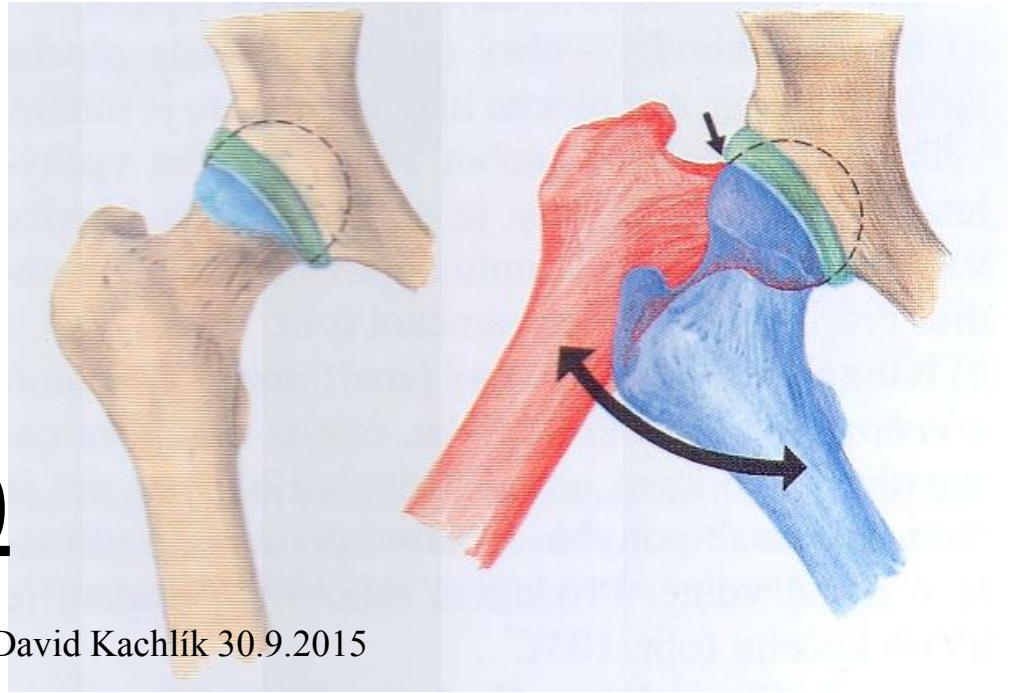
- by part number:
  - simple /art. simplices/ - 2 kosti
  - compound /art. compositae/
    - more than 2 bones
    - 2 bones + disc or meniscus
- by movement extension
  - amphiarthrosis (rigid)
  - more movable (all others)
- by shape of connecting surfaces

Diarthrosis division by shape of connecting surfaces

art. plana /plane joint/		art. acromioclavicularis, sacroiliaca, intermetatarsales, zygapophysiales
art. cylindrica /cylindrical joint/	ginglymus /hinge joint/ *including trochler joint*	art. interphalangeae proximales et distales, humeroulnaris, subtalaris
	a. trochoidea /pivot joint/	art. radioulnaris proximalis et distalis, atlantoaxialis mediana
art. bicondylaris /bicondylar joint/		art. genus /knee joint/, temporomandibularis
art. sellaris /saddle joint/		art. carpometacarpalis pollicis
art. ellipsoidea /condylar *or* elipsoid joint/		art. radiocarpalis, metacarpophalangeae, atlantooccipitalis
art. spheroidea /ball-and-socket *or* spheroidal joint/	/*free spheroidal*/	art. humeri /shoulder joint/, humeroradialis, sternoclavicularis
	art. cotylica /cotyloid joint/	art. coxae /hip joint/







Spheroidal

(ball and socket)

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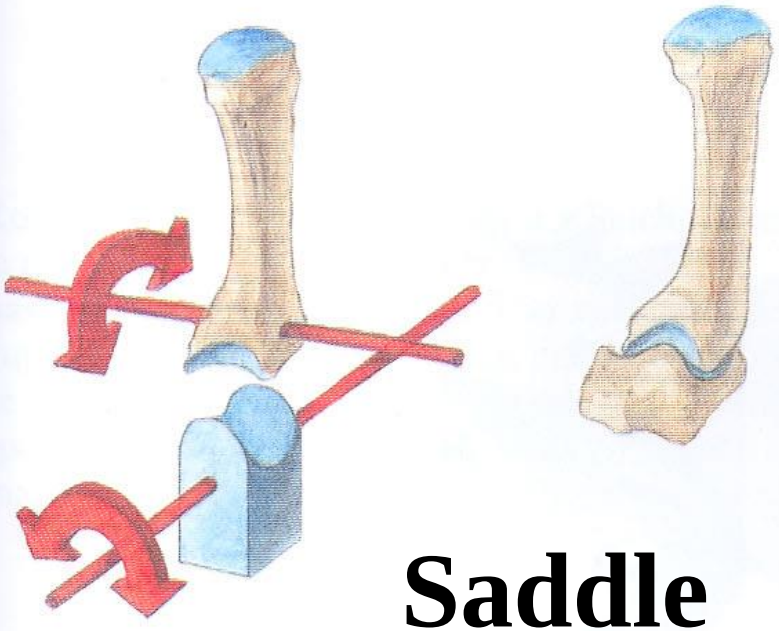
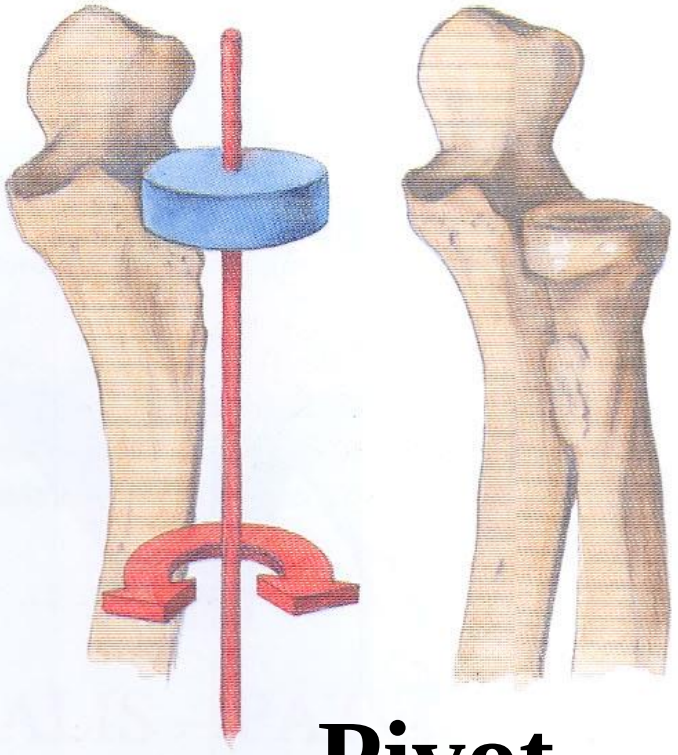
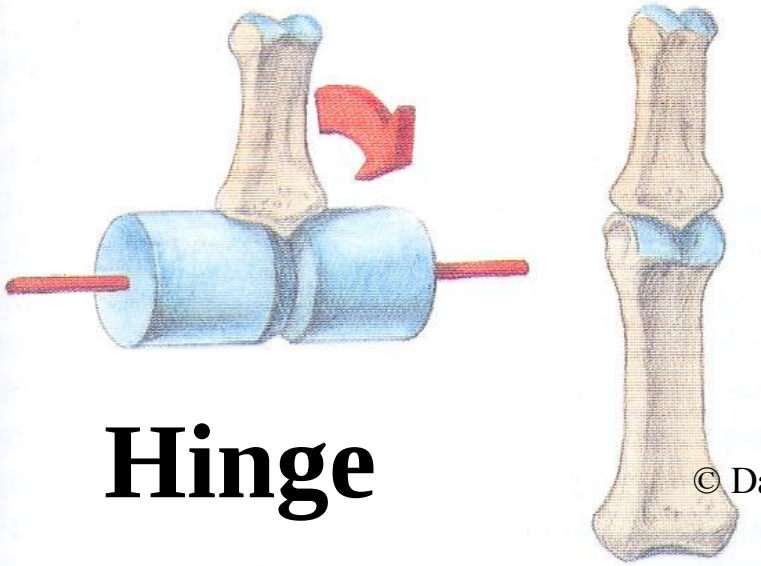


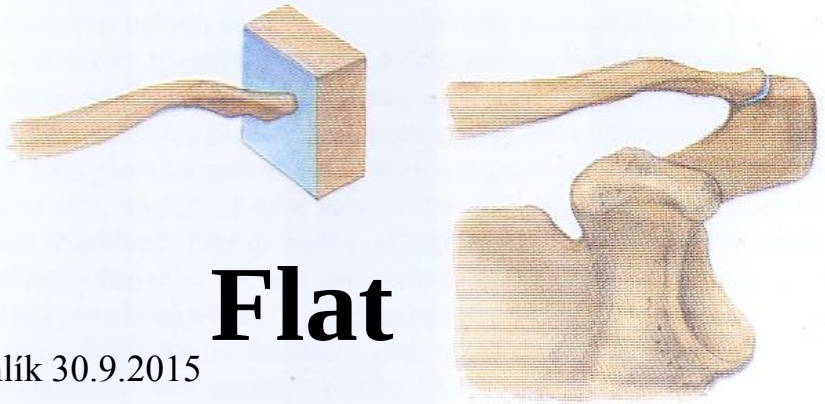
Saddle



Pivot



Hinge



Flat

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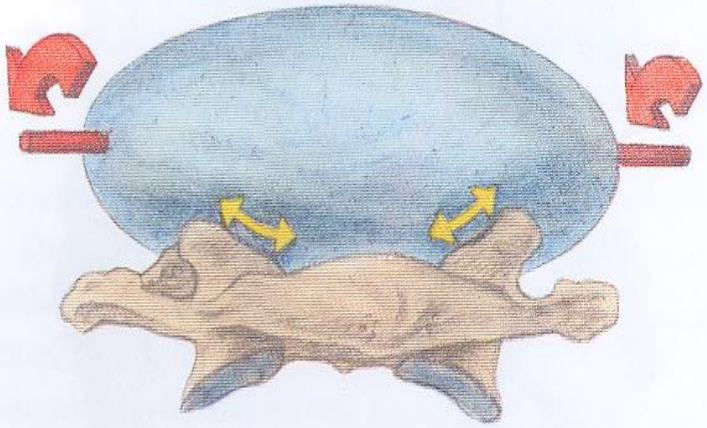
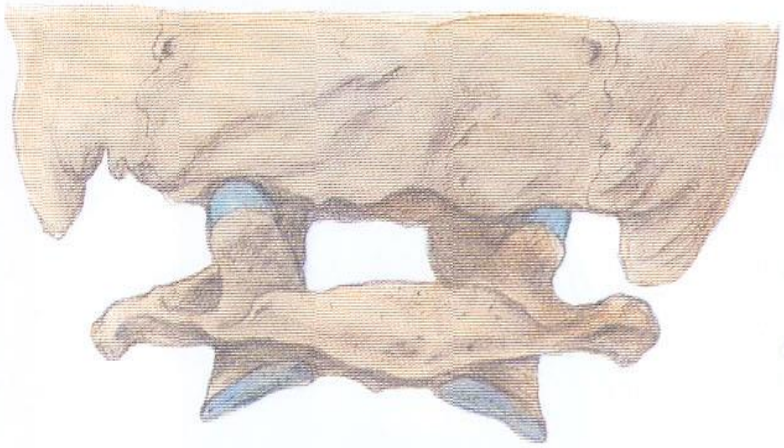
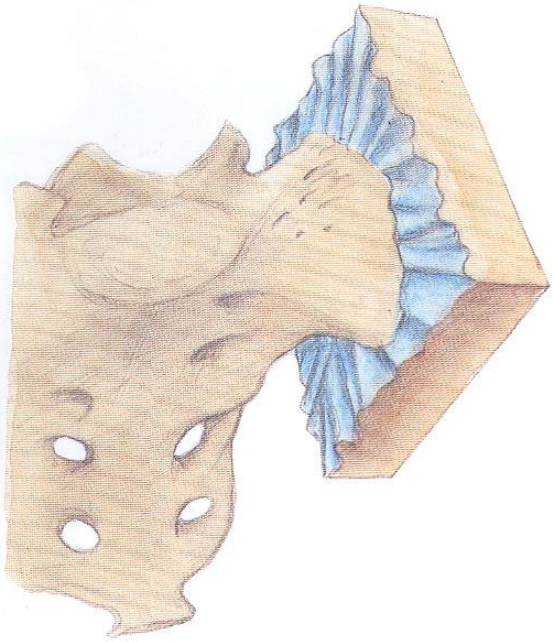
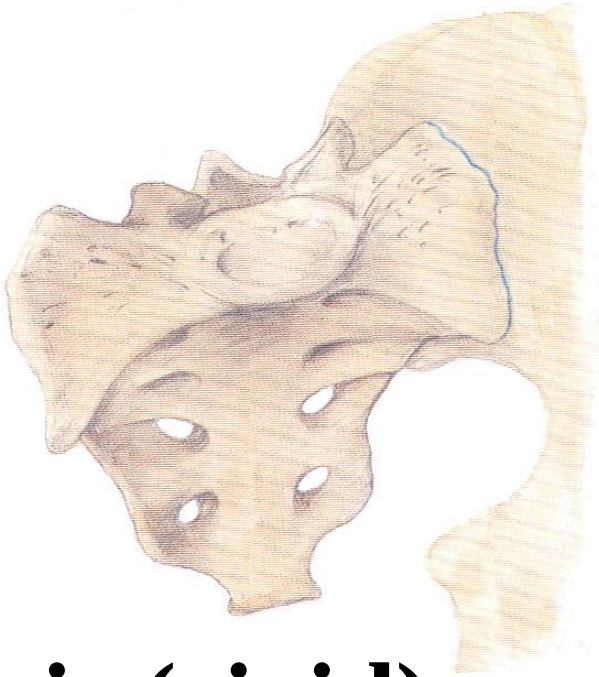




Condylar (elipsoid)





Amphiarthrosis (rigid)

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Joint movements I

- **according to axis**
  - mono-, bi- and polyaxial
- **basic position**
  - reflects the basic anatomical position (palms ventrally)
- **loose position**
  - most relaxed articular capsule (releaving position)
- **movement extension**
  - limited by
    - shape of fossa and head
    - ligaments
    - close bony projections
    - soft tissue size in the vicinity (muscles, fat)

Joint movements II

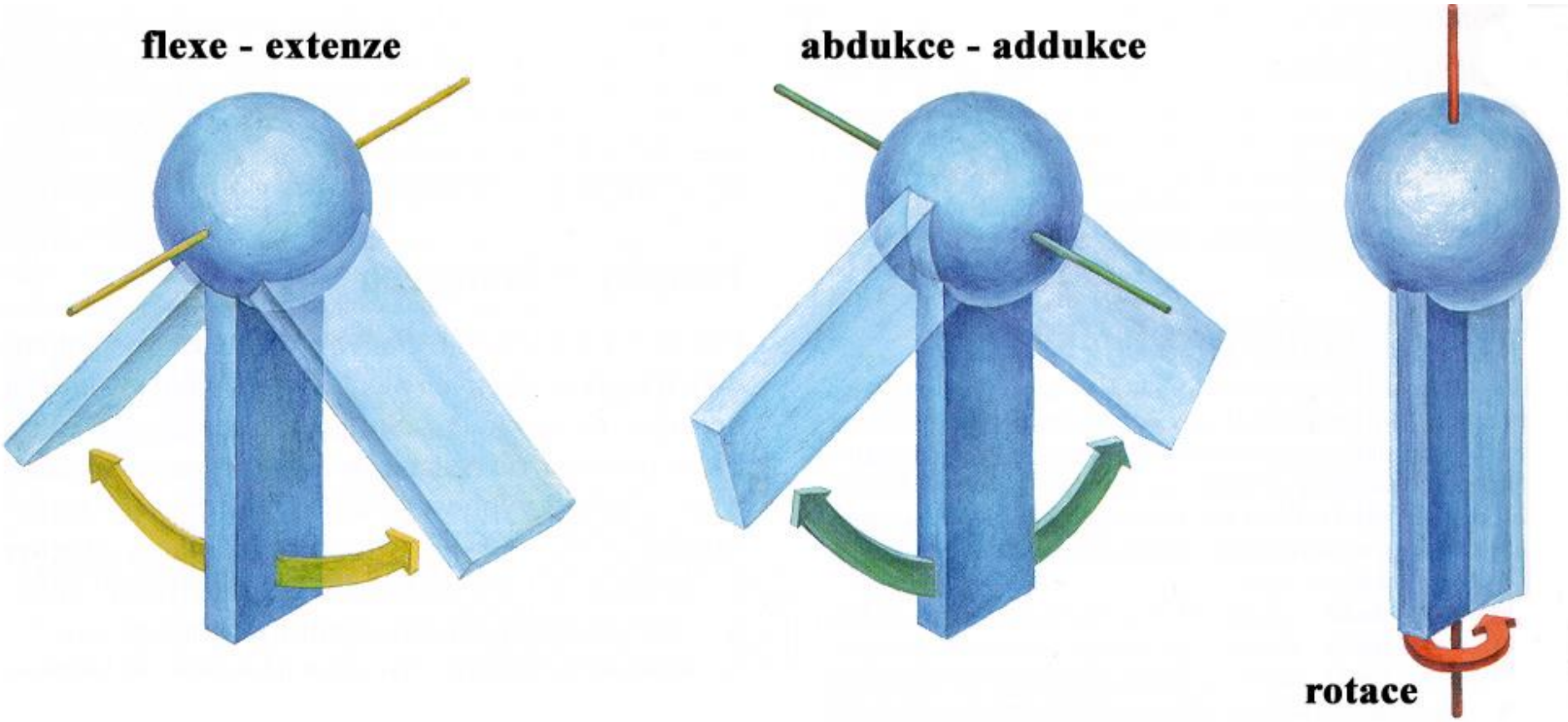
basic

- flexion x extension
- abduction x adduction
- external (lateral) rotation x internal (medial) rotation

basic with special name

ulnar duction x radial duction

= abduction x adduction in carpal joint



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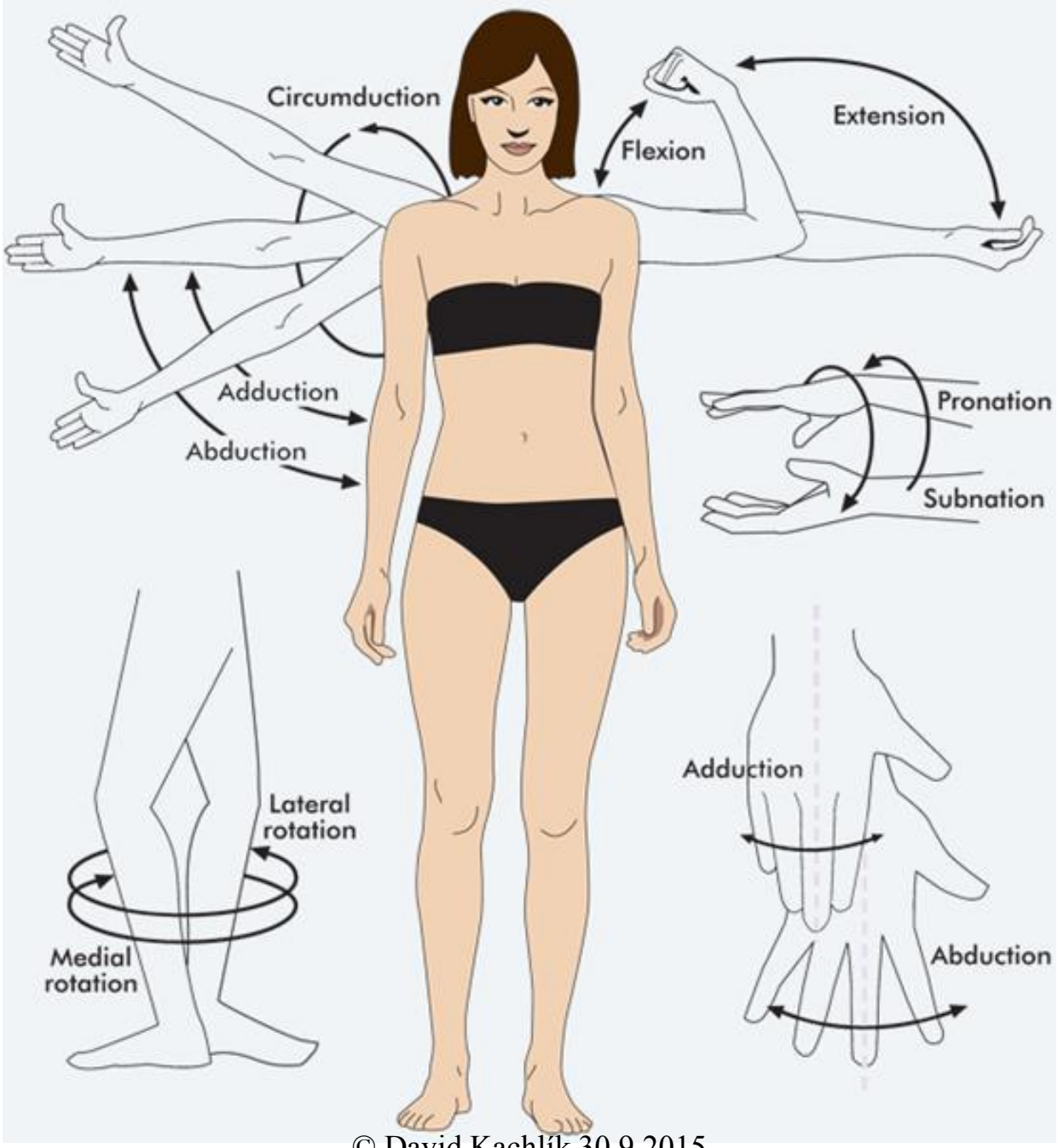
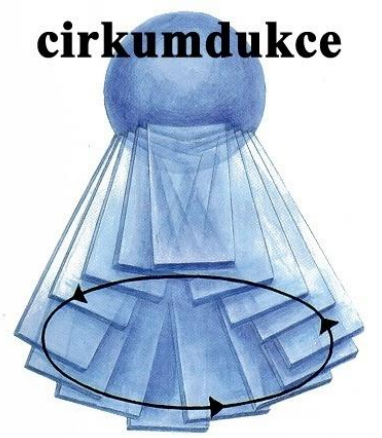
Joint movements III

- pronation x supination
  = special type of radius rotation around ulna
- opposition x reposition
  = special thumb movement to face the other fingers
- elevation x depression
  + protraction x retraction
  = special movement in temporomandibular joint and in loose connection between scapula and thorax (is not an anatomical joint, just functional connection!)



http://tle.westone.wa.gov.au/content/file/969144ed-0d3b-fa04-2e88-8b23de2a630c/1/human_bio_science_3b.zip/content/003_musculo_skeletal_support/page_11.htm



Joint movements IV – *combined*

- circumduction

  = cone surface movement, each side faces the same directon only /no turn!/

- inversion x eversion

  = combined foot motion with planta in or out

- *further*: e.g. hyperadduction (depends on the relevant joint)

Vessels and nerve supply of the joint

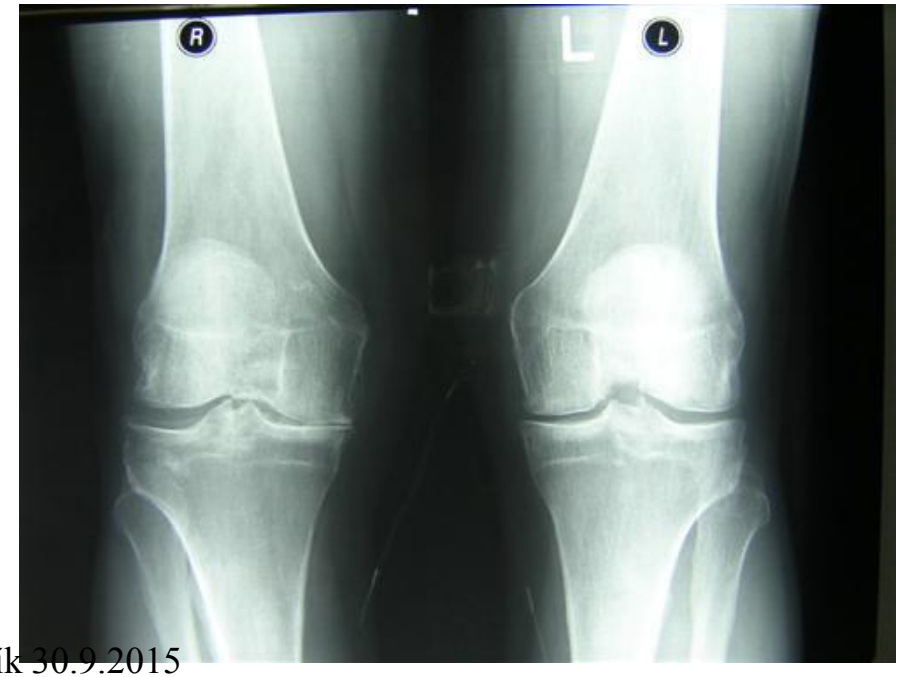
- blood vessels: rete articulare from surrounding arteries, capillaries close to the surface
- lymph vessels: blind beginnings (cul-de-sac), deeper in the capsule
- nerves:
  - centripetal sensory fibres
    - information about joint position, movement direction and grade, angular movement speed, ligaments and capsule tension grade (= **proprioception**)
    - pressure and pain informations
  - centrifugal autonomic fibres (vessels´ lumen regulation)

Development of the joint

- plates of mesenchyme between adjacent skeletal elements = *interzonal mesenchyme*
- interzonal mesenchyme becomes trilaminar
  - 2 dense strata
  - intermediate zone
- intermediate stratum merges with general mesenchyme → a cuff condenses creating a fibrous capsule of the joint
- dense strata becomes cartilaginous
- cavitation of intermediate zone establishes the cavity of the joint
- synovial mesenchyme forms synovial membrane and other structures, such as tendons, ligaments, discs and menisci

Osteoarthrosis

- noninflammatory illness of a joint
- destruction of a joint cartilage



http://www.knee-replacement-explained.com/Knee-Pain-diagnosis-xray.html

http://www.wrosc.com/Procedures/Knee_Procedures/Knee_Treatment_Options/Medial_OsteoArthrosis_Description.aspx

Arthritis

- inflammatory illness of a joint
  - autoimunne (rheumatic, psoriatic)
  - septic
  - *gout* – storage of crystals of uric acid to the vicinity of a joint

http://www.abbottdiagnostics.cz/nove-produkty/rok-2009/imunoanalyza/architect-anti-ccp.html

http://www.mojemedunka.cz/clanek.aspx/medunka-informuje/clanek/proc-jsme-nemocni--cast-xxxxi

Joint description

!!! follow general rules !!!

- name (Latin, English)
- type
  - by part number, shape of connecting surfaces, movability, axis number
- head and fossa
- joint capsule insertion
  - close to connecting surfaces – several important exceptions !!!
- special joint structures
  - labrum, disc, meniscus, fibrocartilage, ligaments, synovial bursae, fat pads
- basic and loose position
- movements (+ movements extension in degrees)
  - passive
  - active

Joints of upper limb
Juncturae membri superioris

Joints of pectoral girdle (*juncturae cinguli membri superioris*)

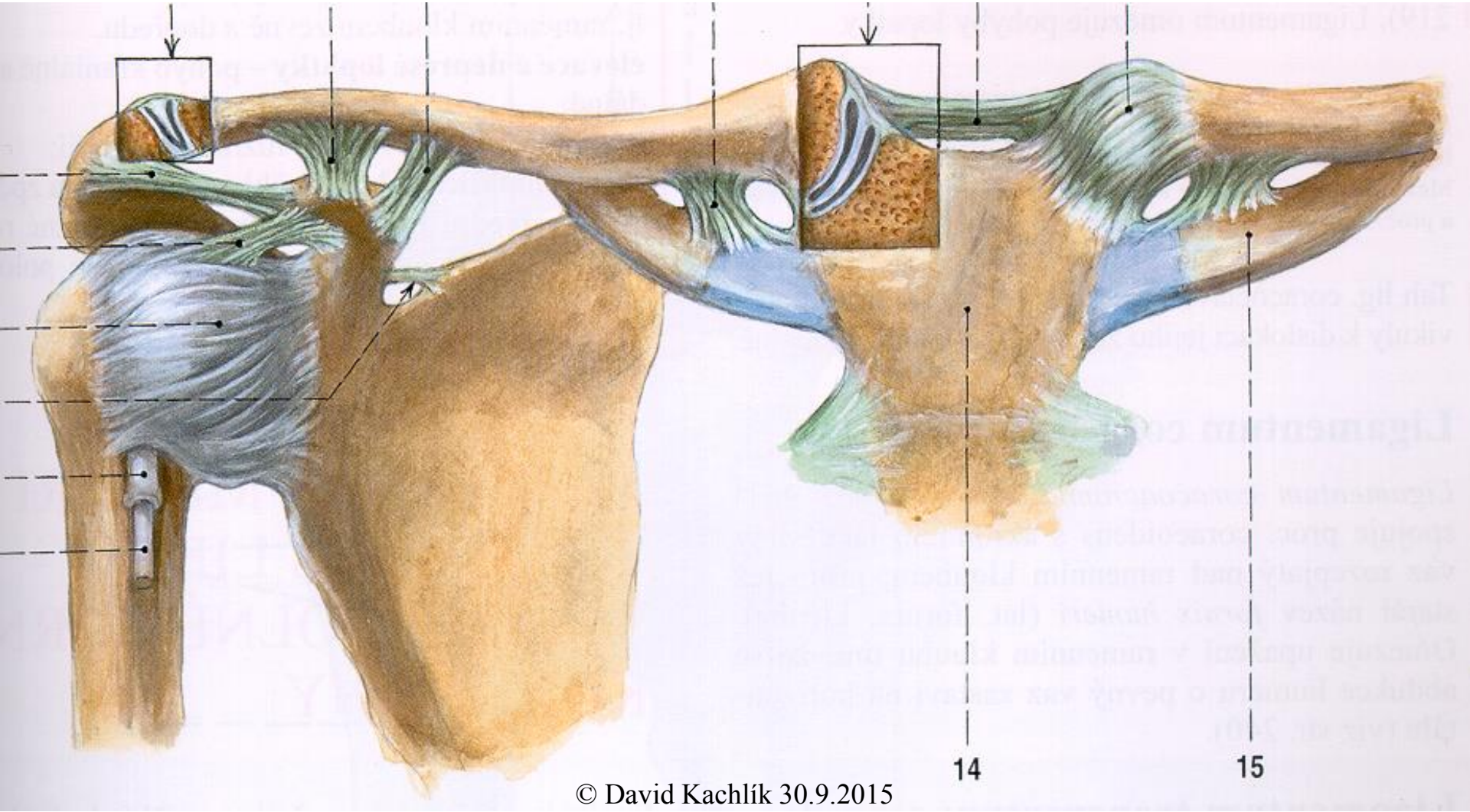
- art. sternoclavicularis (sternoclavicular joint)
- art. acromioclavicularis (acromioclavicular joint)

Joints of free upper limb (*juncturae membri superioris liberi*)

- art. humeri (glenohumeral/shoulder joint)
- art. cubiti (elbow joint)
- wrist
- joints of hand

Joints of pectoral girdle

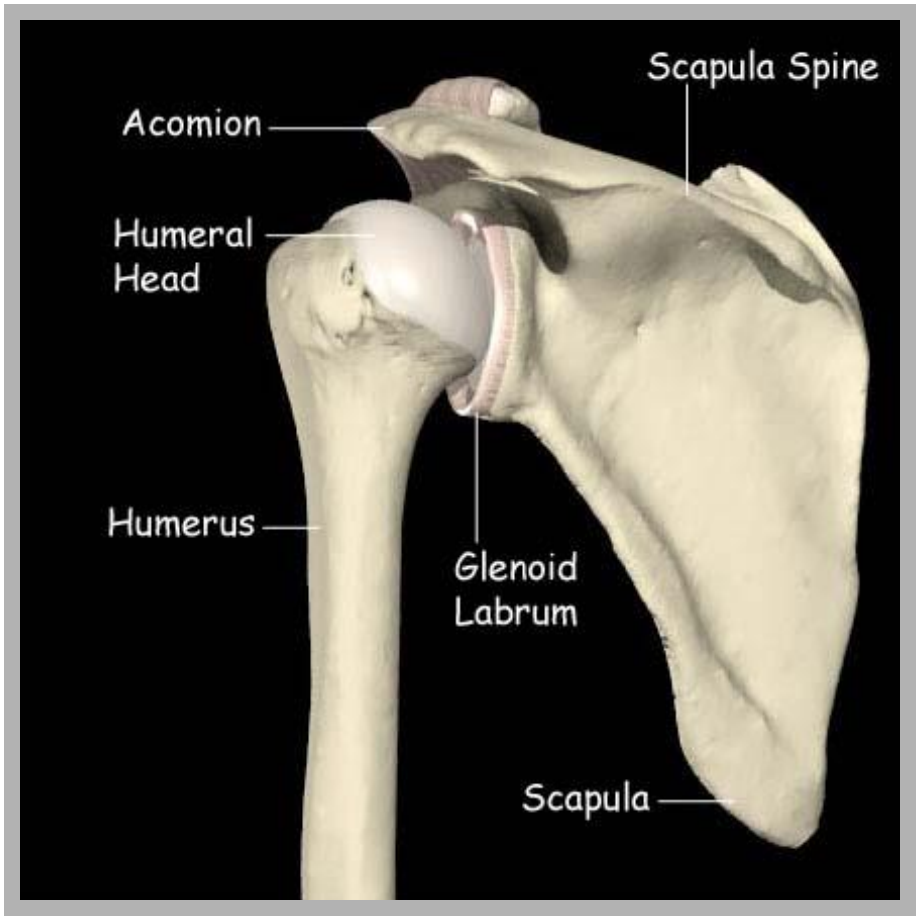
Juncturae cinguli membri superioris

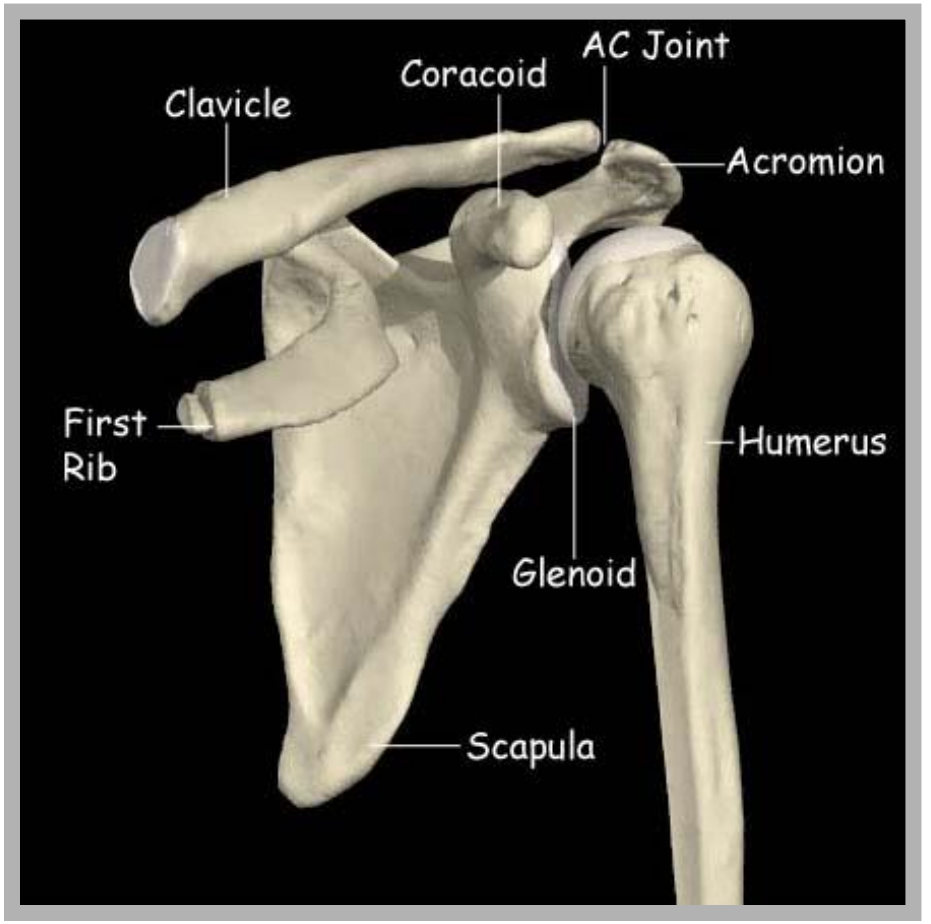


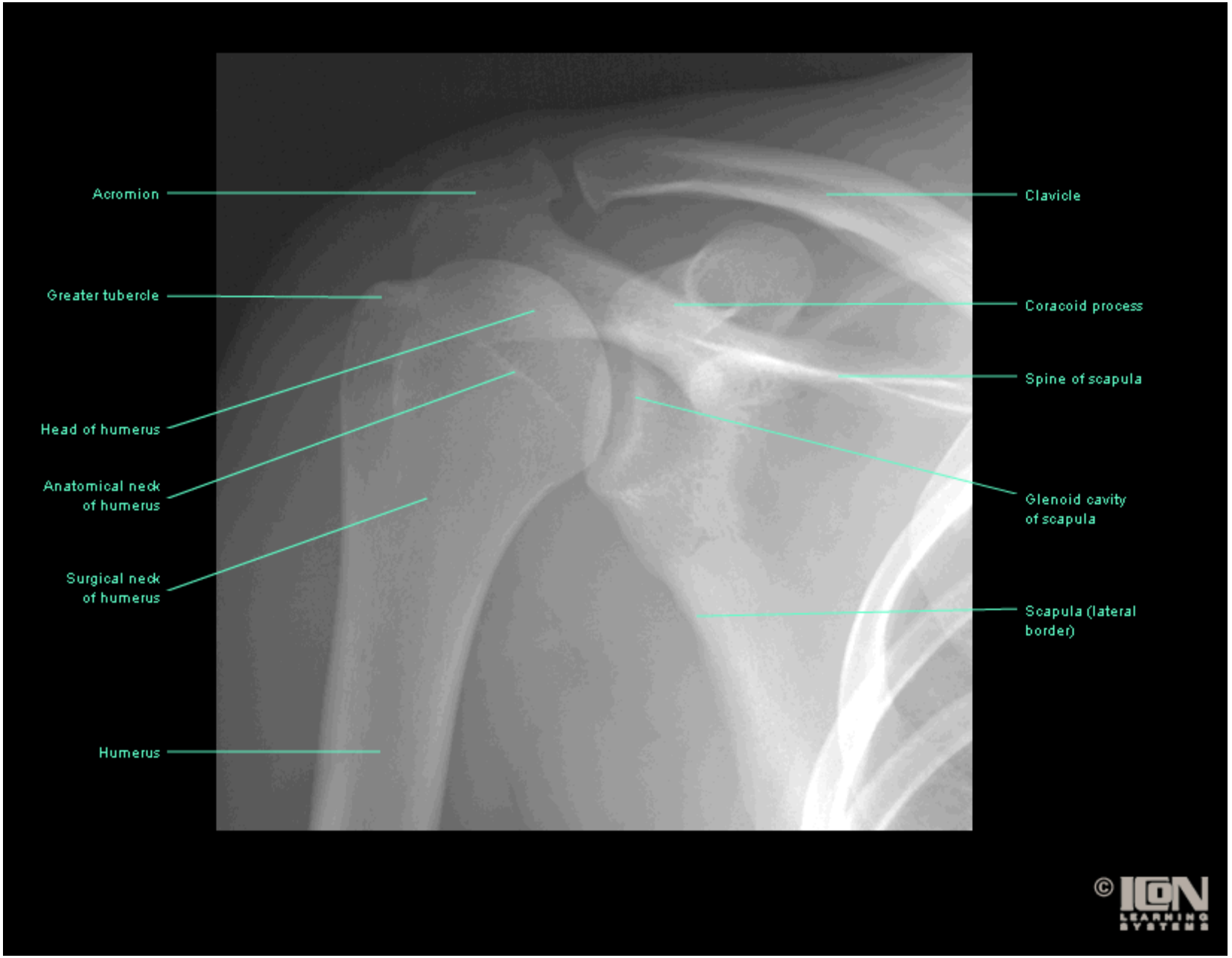
Articulatio humeri
= Glenohumeral / shoulder joint

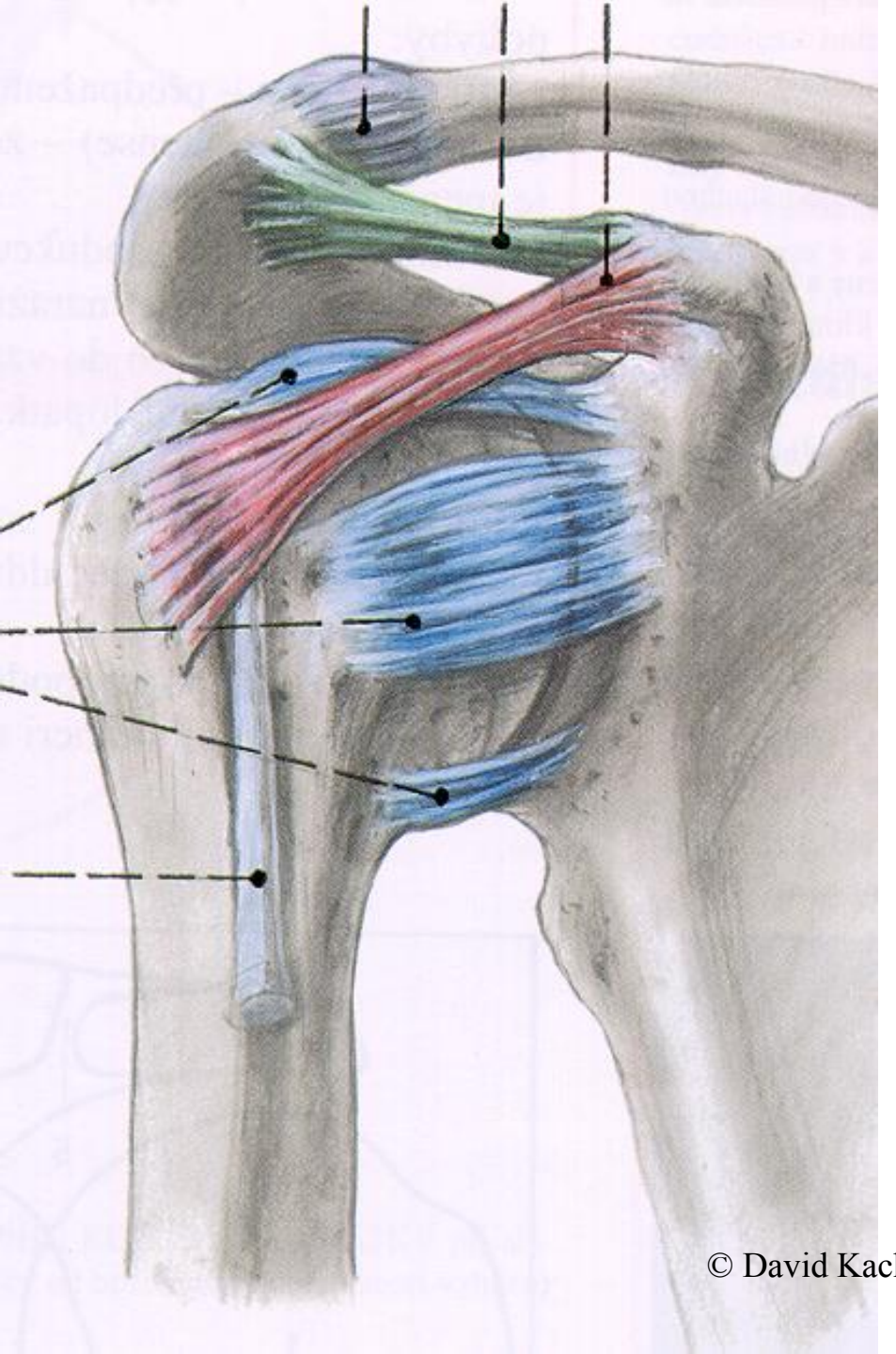
- **type:** simple, spheroidal
- **articular surfaces:**
  - **head:** caput humeri
  - **fossa:** cavitas glenoidalis scapulae
- **articular capsule:** close to connecting surfaces :
  - collum scapulae
  - collum anatomicum humeri
  - *exception* – protrudes along tendon of caput longum m. bicipitis brachii
- **special structures:**
  - labrum glenoidale
  - bursae synoviales
    - b. subtendinea m. subscapularis, b. subdeltoidea, b. subacromialis

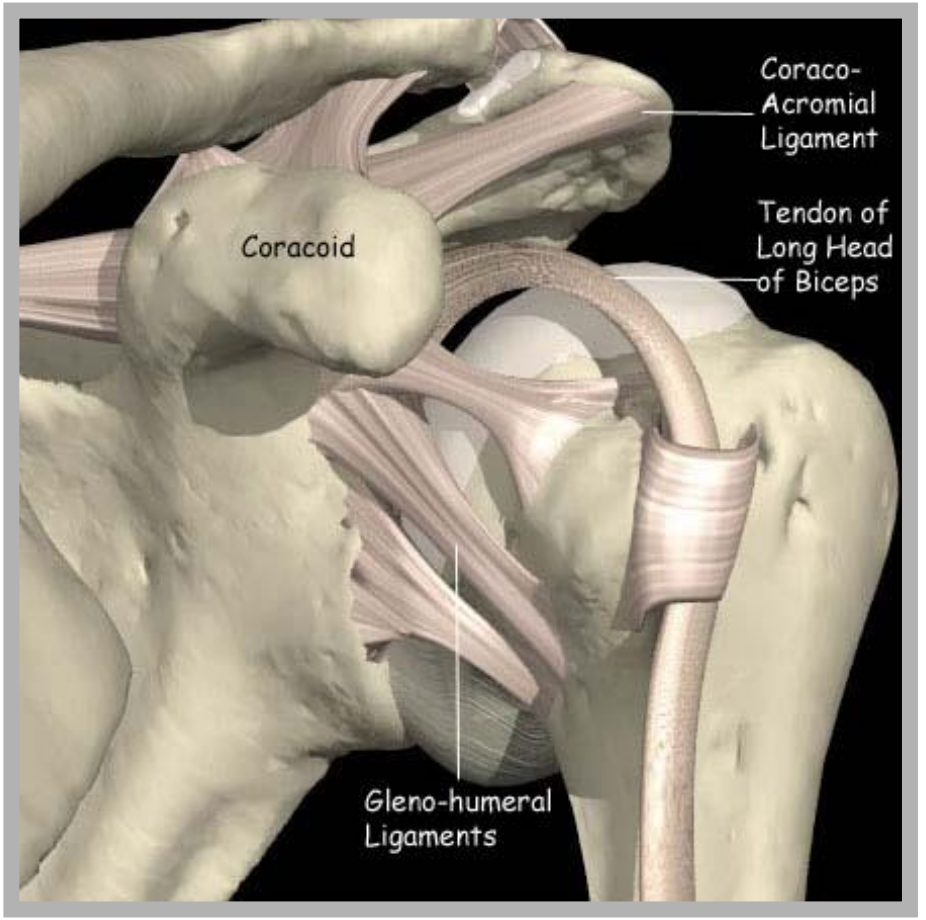
Articulatio humeri
= Glenohumeral / shoulder joint









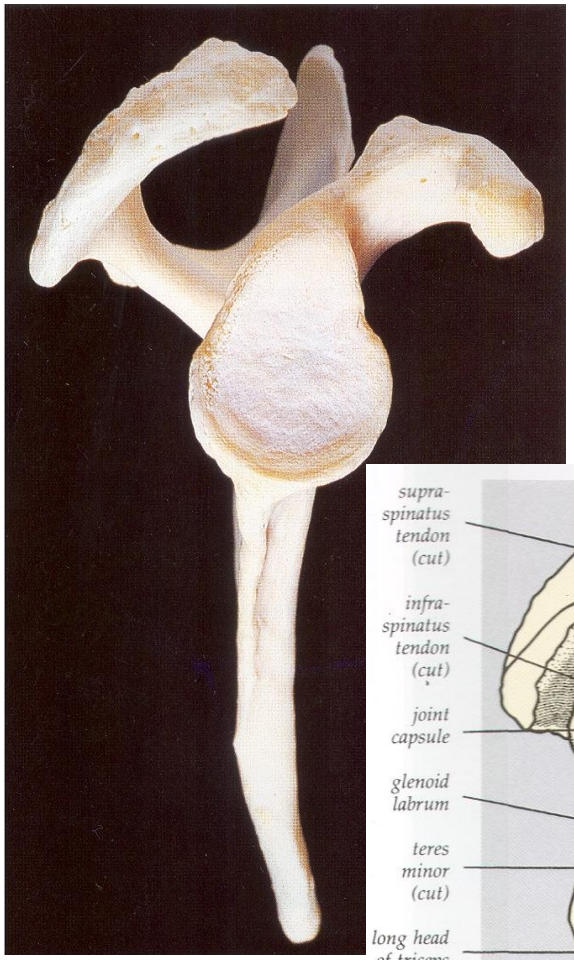


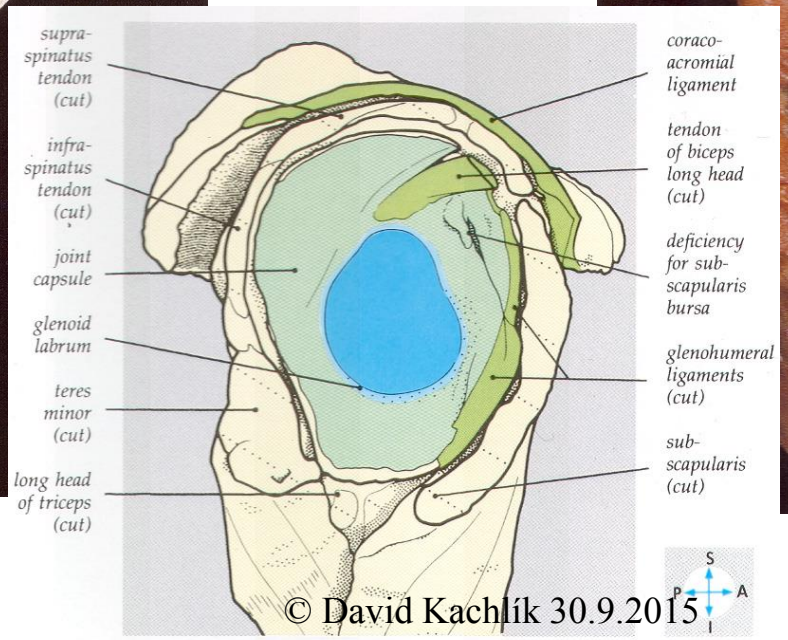
- lig. coracoacromiale
- lig. coracohumerale
- ligg. glenohumeralia (superius, medium, inferius)
- lig. transversum humeri

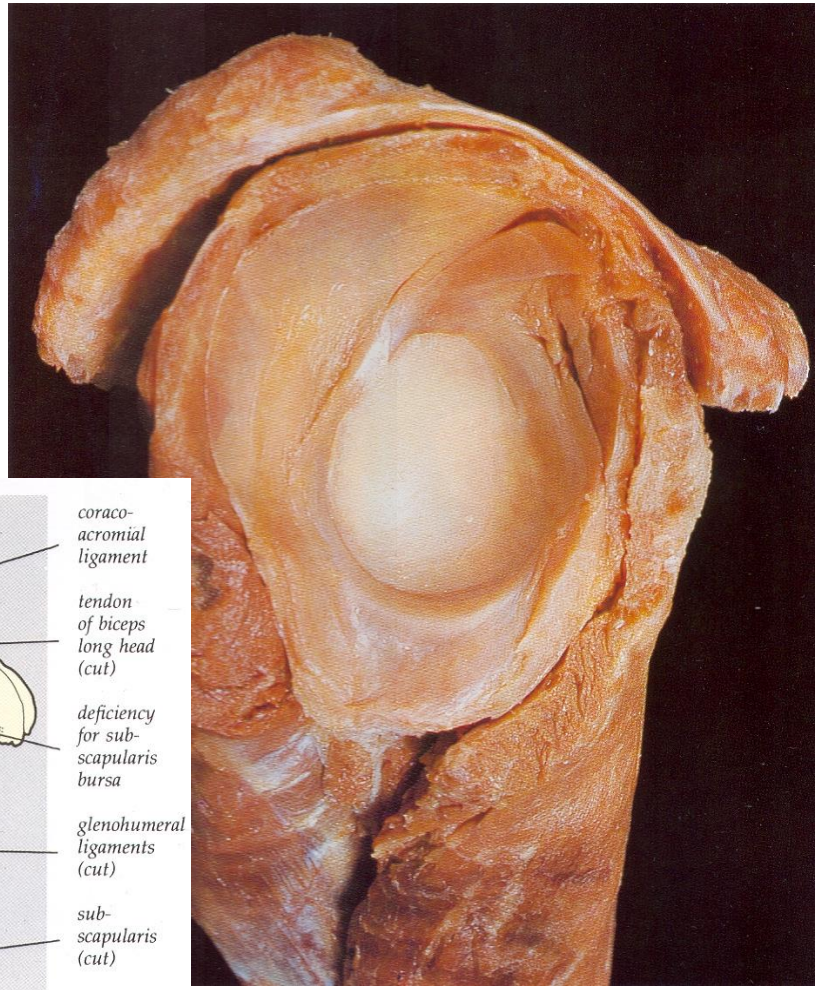
Glenohumeral / shoulder joint - movements

- **movements**:
  - abduction and adduction
  - ventral and dorsal flexion (extension)
  - internal and external rotation
  - (circumduction)
- **loose position**: mild abduction and mild ventral flexion
- **movements of scapula:**
  - protraction and retraction
  - elevation and depression
  - rotation

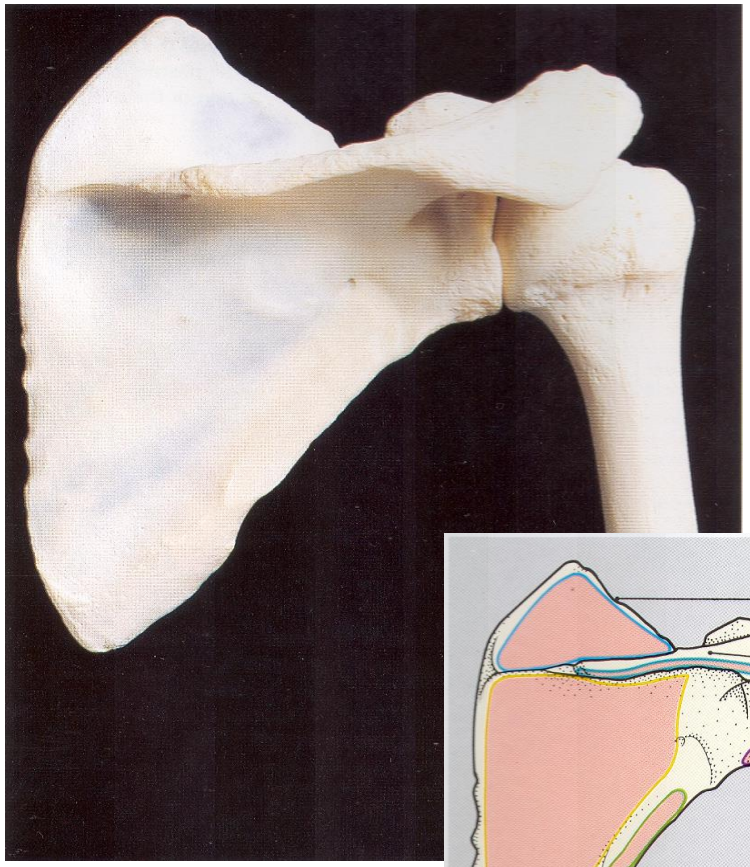
Shoulder – lateral view

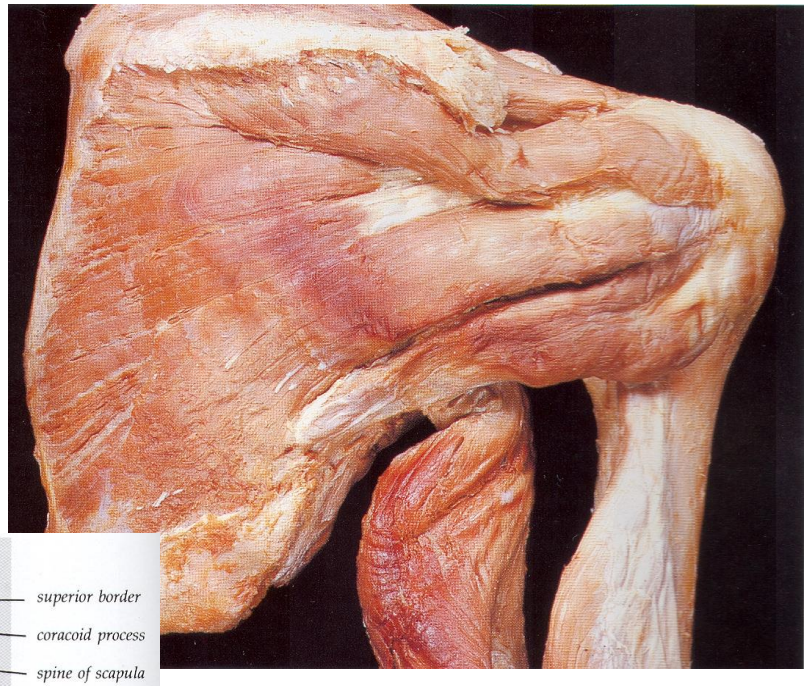


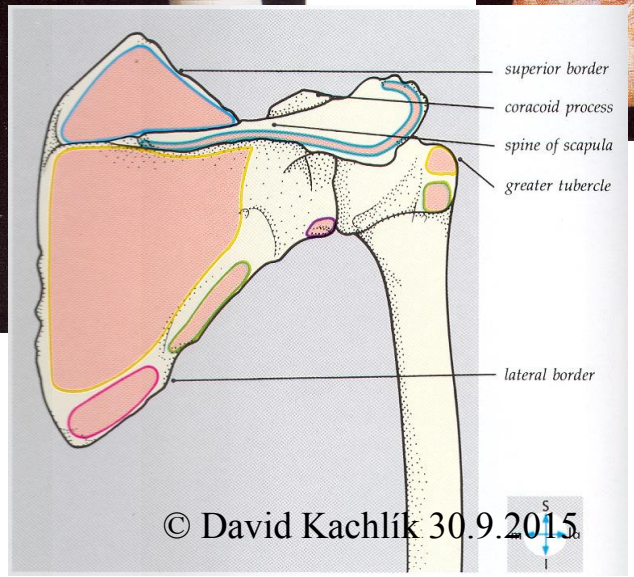




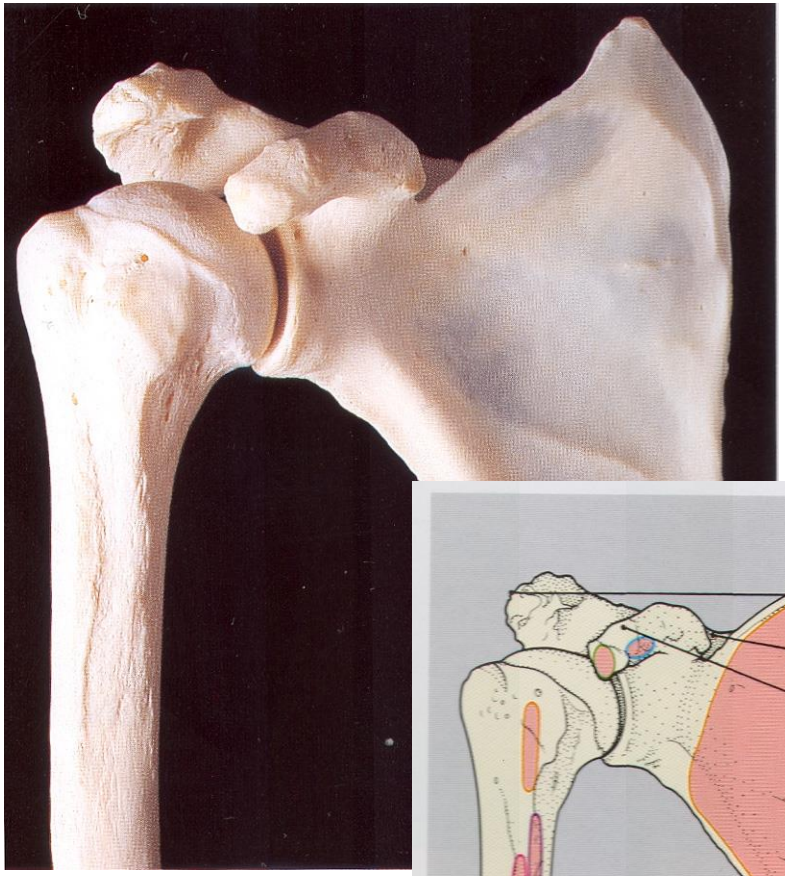
Periarticular muscles – posterior view

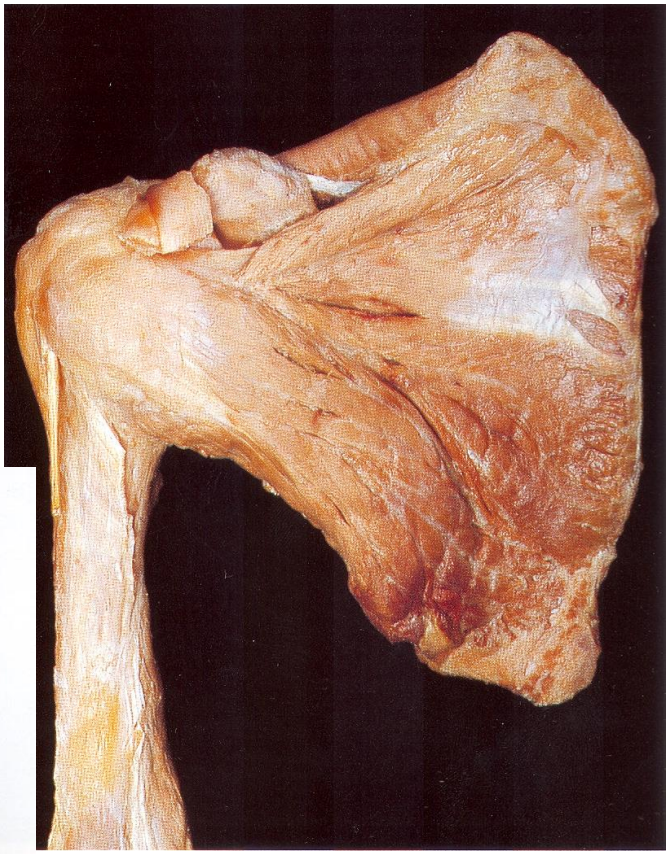


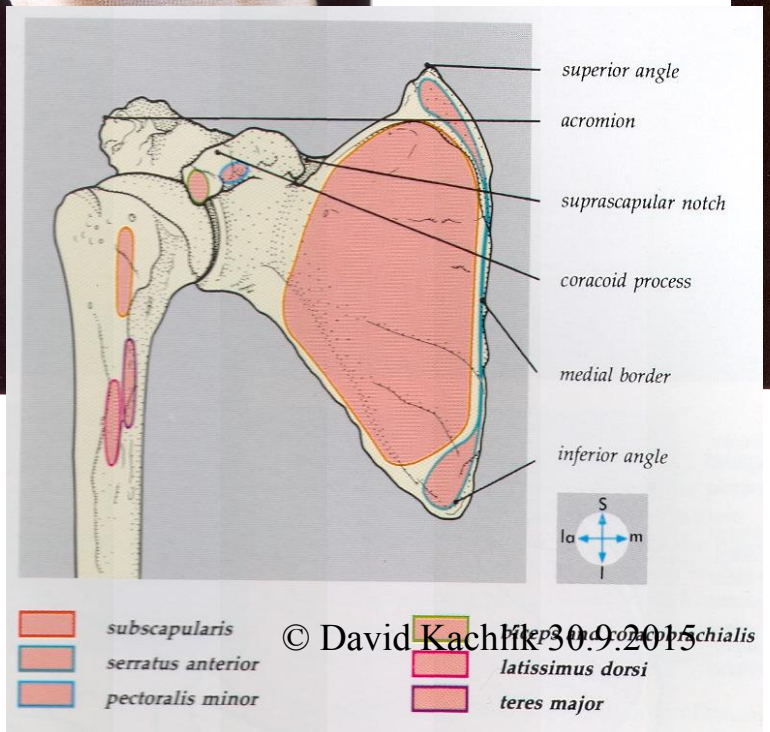




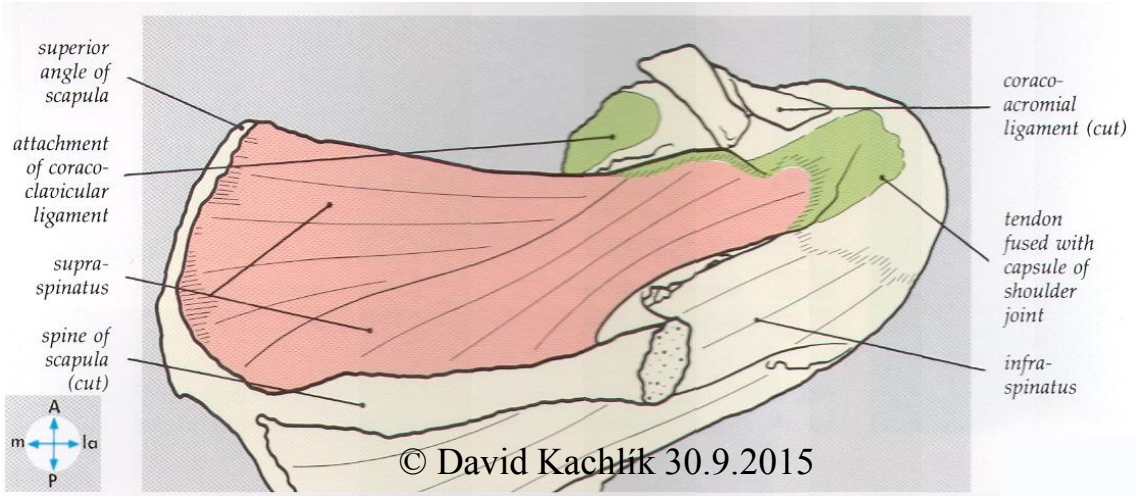
Periarticular muscles – anterior view



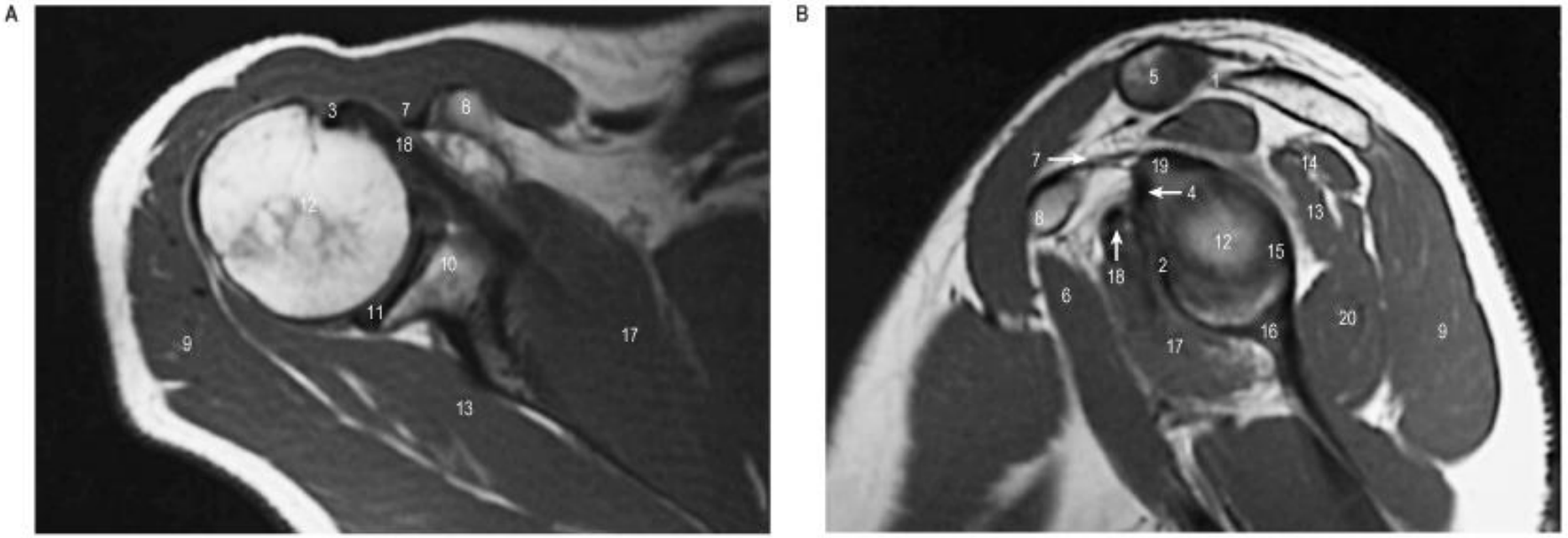




Periarticular muscles – superior view



Shoulder - MRI



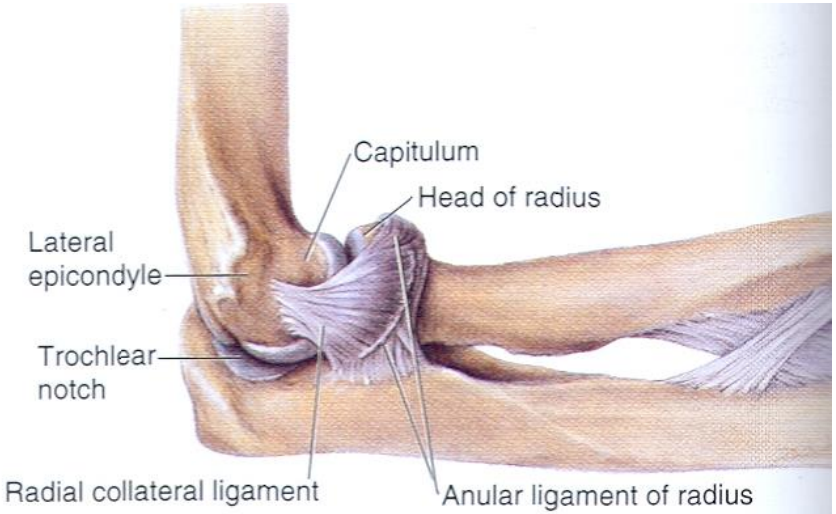
1. Acromioclavicular joint. **2.** Anterior labrum. **3.** Biceps brachii tendon. **4.** Biceps brachii tendon – long head. **5.** Clavicle. **6.** Coracobrachialis muscle. **7.** Coracohumeral ligament. **8.** Coracoid process. **9.** Deltoid muscle. **10.** Glenoid. **11.** Glenoid labrum. **12.** Head of humerus. **13.** Infraspinatus muscle. **14.** Infraspinatus tendon. **15.** Posterior labrum. **16.** Scapula. **17.** Subscapularis muscle. **18.** Subscapularis tendon. **19.** Superior labrum. **20.** Teres minor muscle.

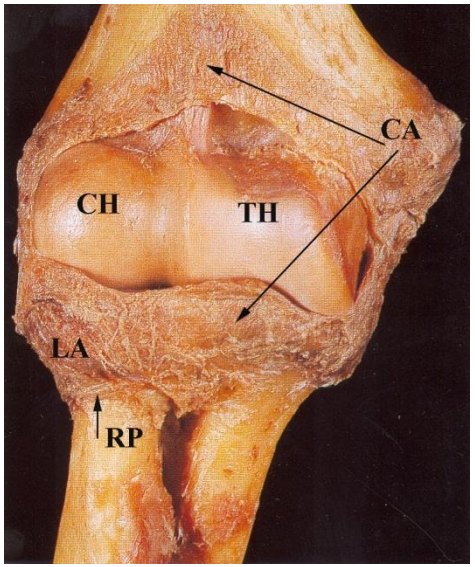
Figure 49.19 MRI of shoulder. **A**, Axial image. **B**, Sagittal oblique section. (By permission from Weir J, Abrahams PH 2003 Imaging Atlas of Human Anatomy, 3rd edn, London: Mosby, and contributions from Anna-Maria Belli, Margaret Hourihan, Naill Moore and Philip Owen.)

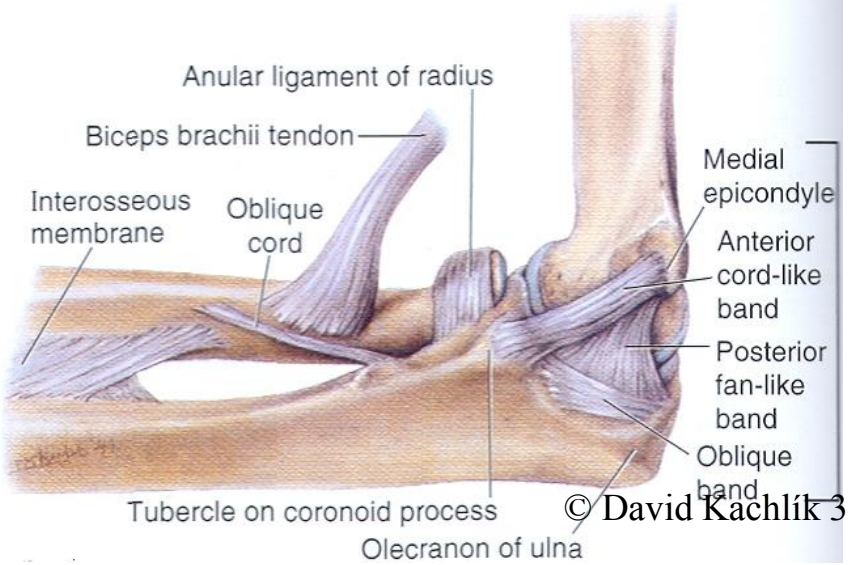
Elbow joint = Articulatio cubiti

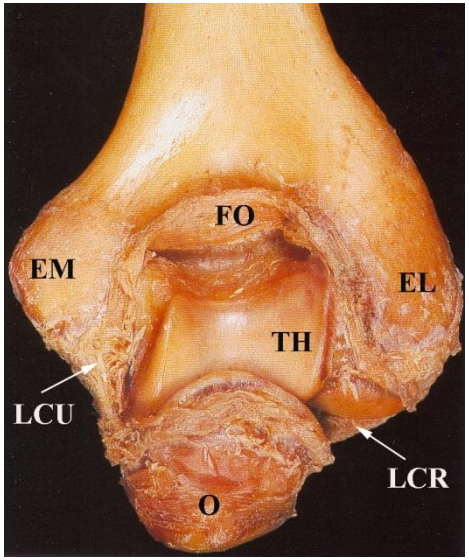
- compound, functionally trochlear
- **articular capsule -** *! exception !* recessus sacciformis reaches collum radii
- fat pad, m. articularis
- **movements**:
  - flexion and extension
  - in cooperation with articulatio radioulnaris distalis → supination and pronation
- **ligaments:** lig. collaterale radiale et ulnare, lig. anulare

Elbow joint = Articulatio cubiti

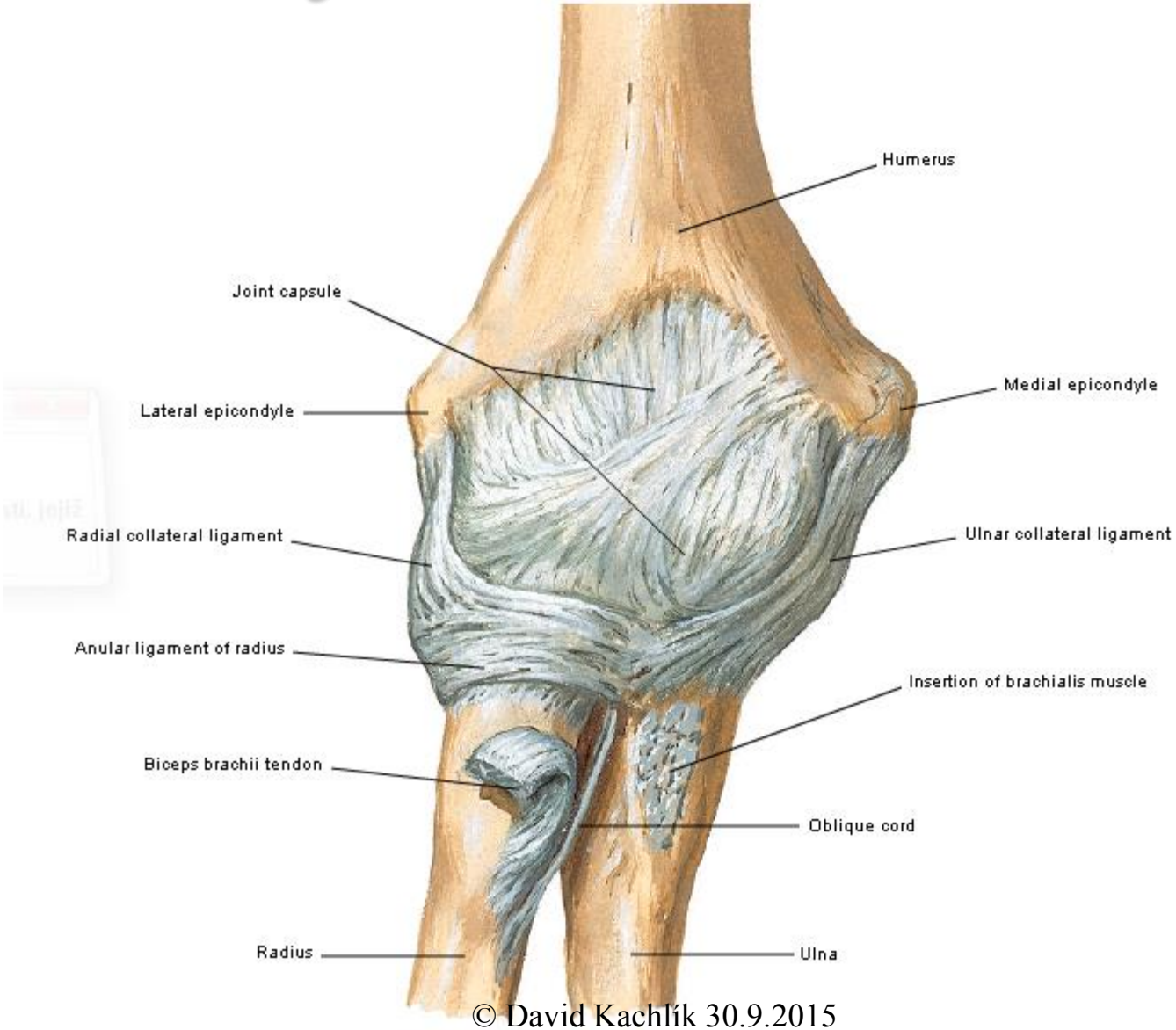






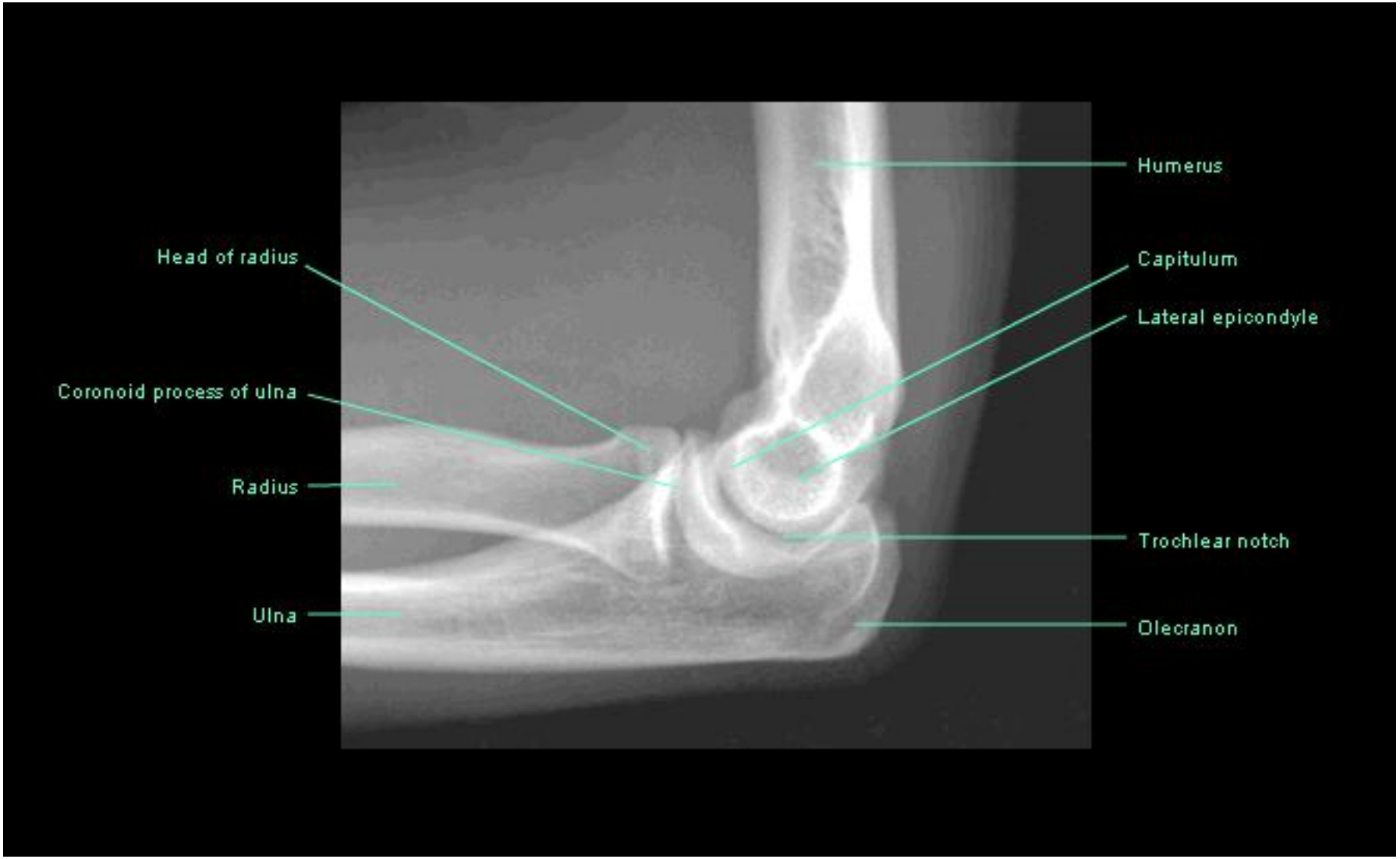


Elbow joint = Articulatio cubiti



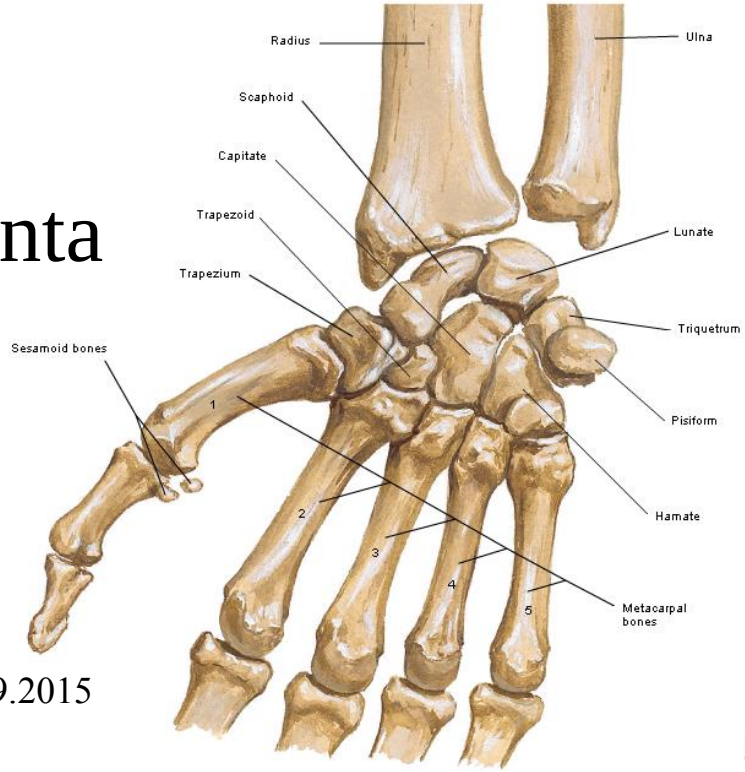
Elbow joint = Articulatio cubiti

Elbow joint = Articulatio cubiti

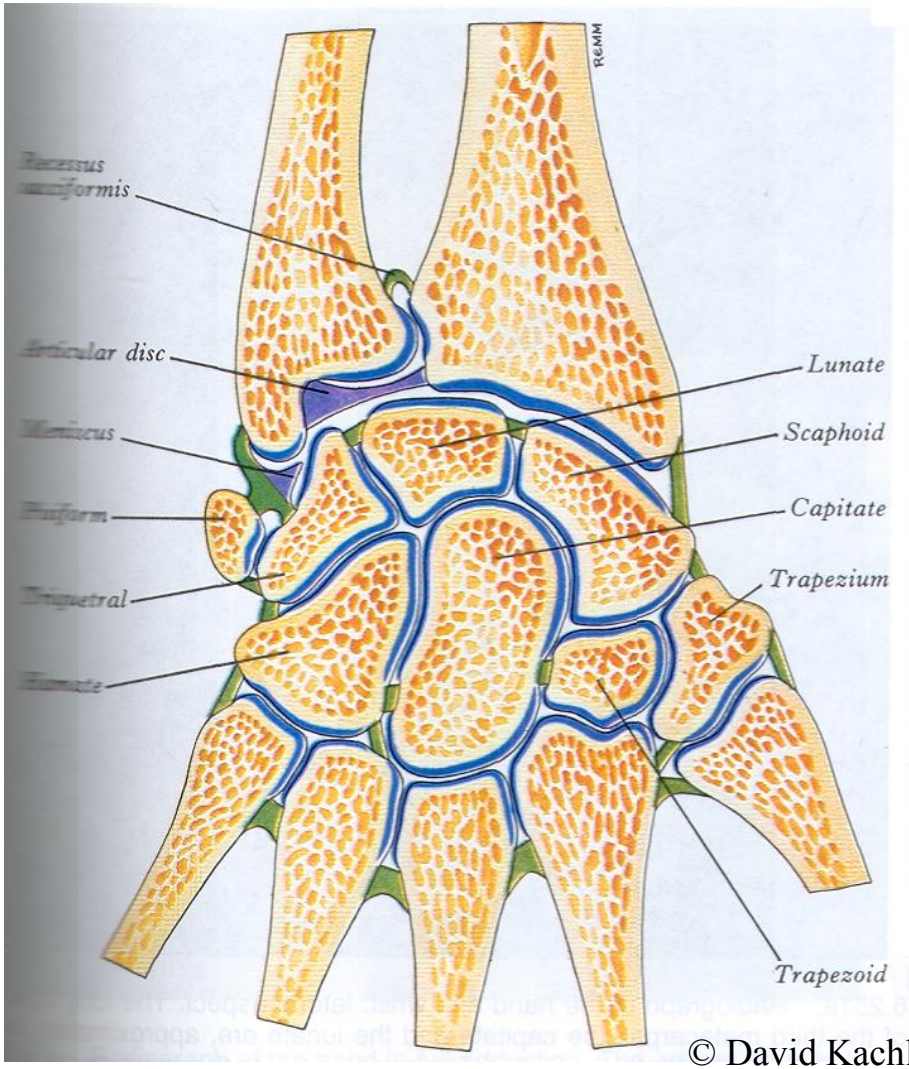


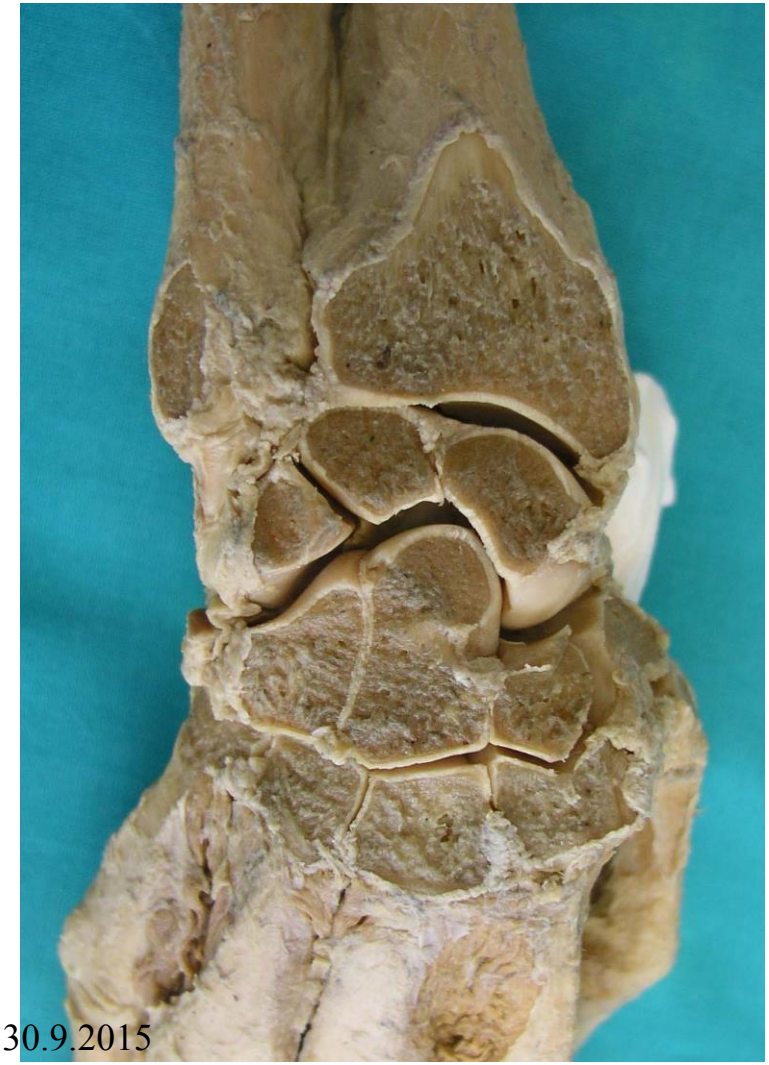
Wrist = functional unit

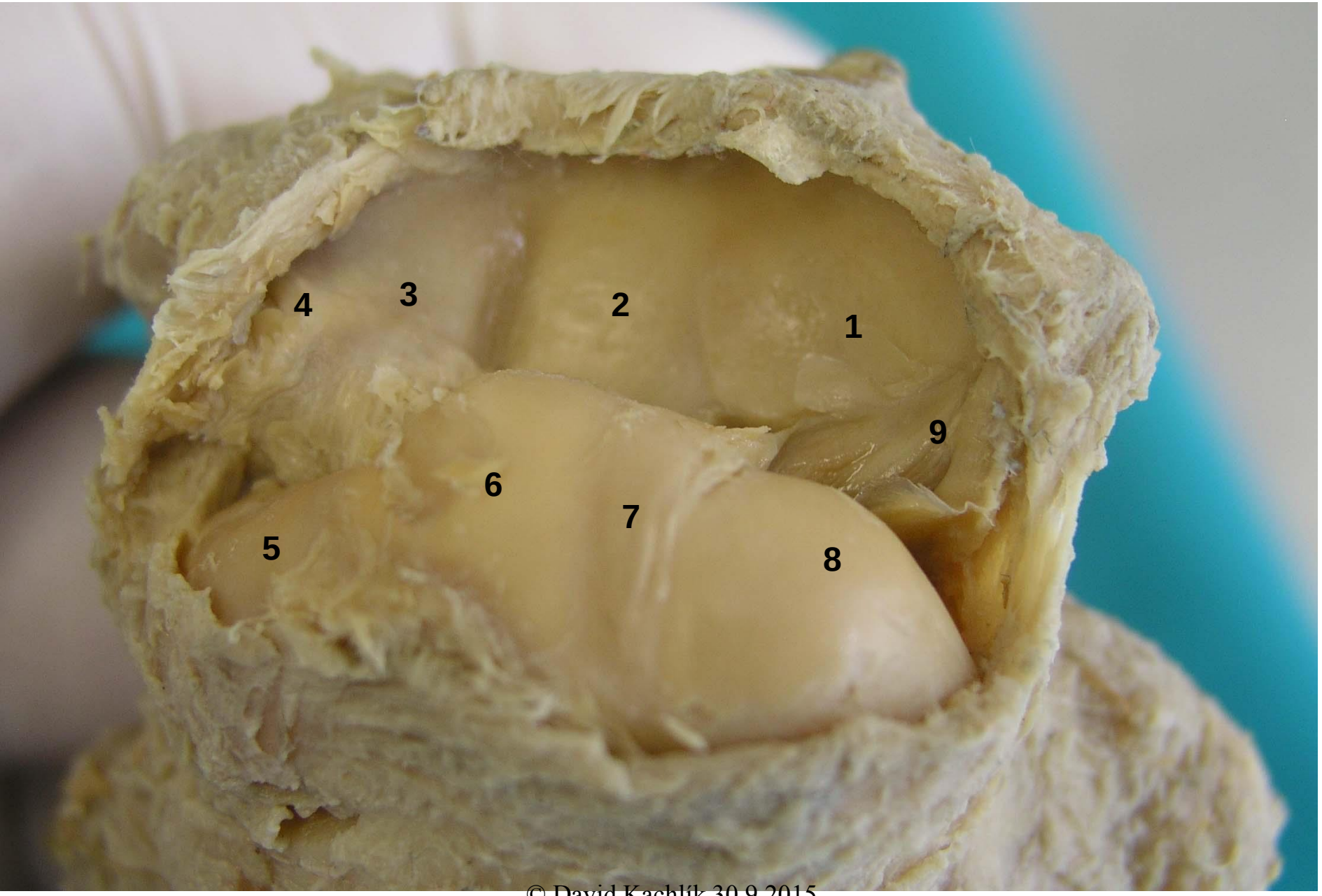
- compound, functionally elipsoid
  - art. radiocarpalis
  - art. mediocarpalis (two heads and fosssae)
  - artt. intercarpales
  - (art. carpometacarpales)
- discus articularis + ligamenta
- **movements**:
  - palmar and dorsal flexion
  - radial and ulnar duction
  - (circumduction)



Wrist = functional unit
Articular cavities

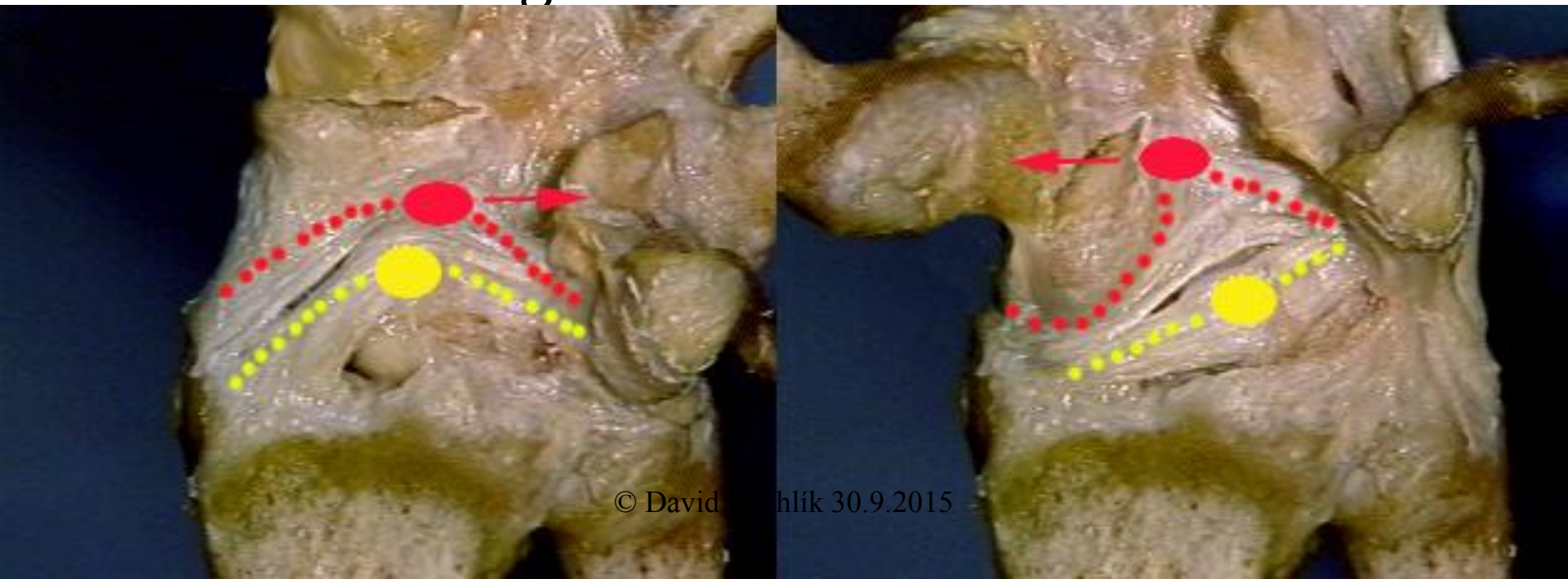




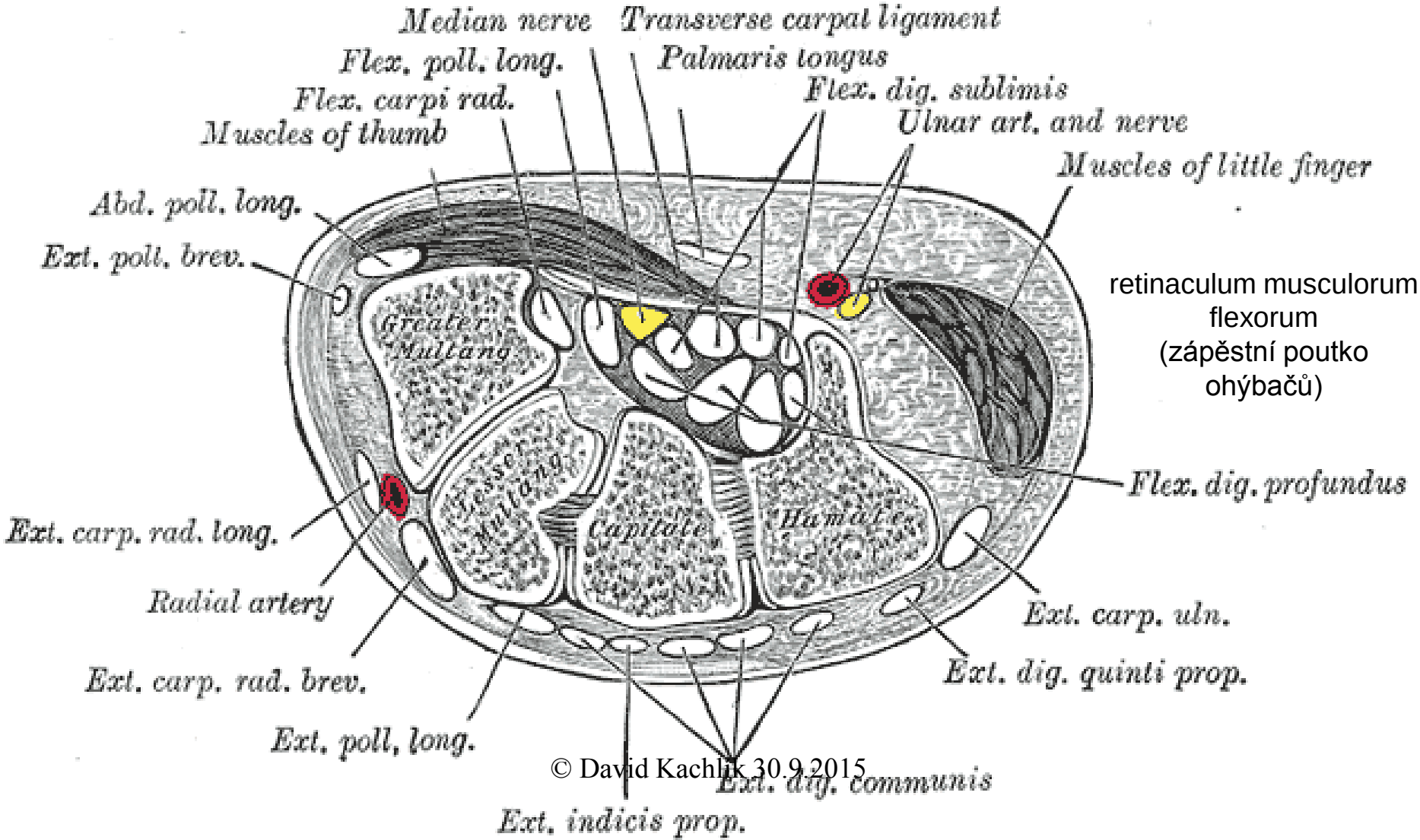


Wrist joint - ligaments

- TFCC („triangular fibrocartilagineous complex“)
- discus articularis – triangular shape
- ligaments of articular capsule
  - palmar (“V“), dorsal (“V“), collaterall (weak)
- interosseous ligaments



Canalis carpi = Carpal tunnel



retinaculum musculorum flexorum
(zápěstní poutko ohýbačů)

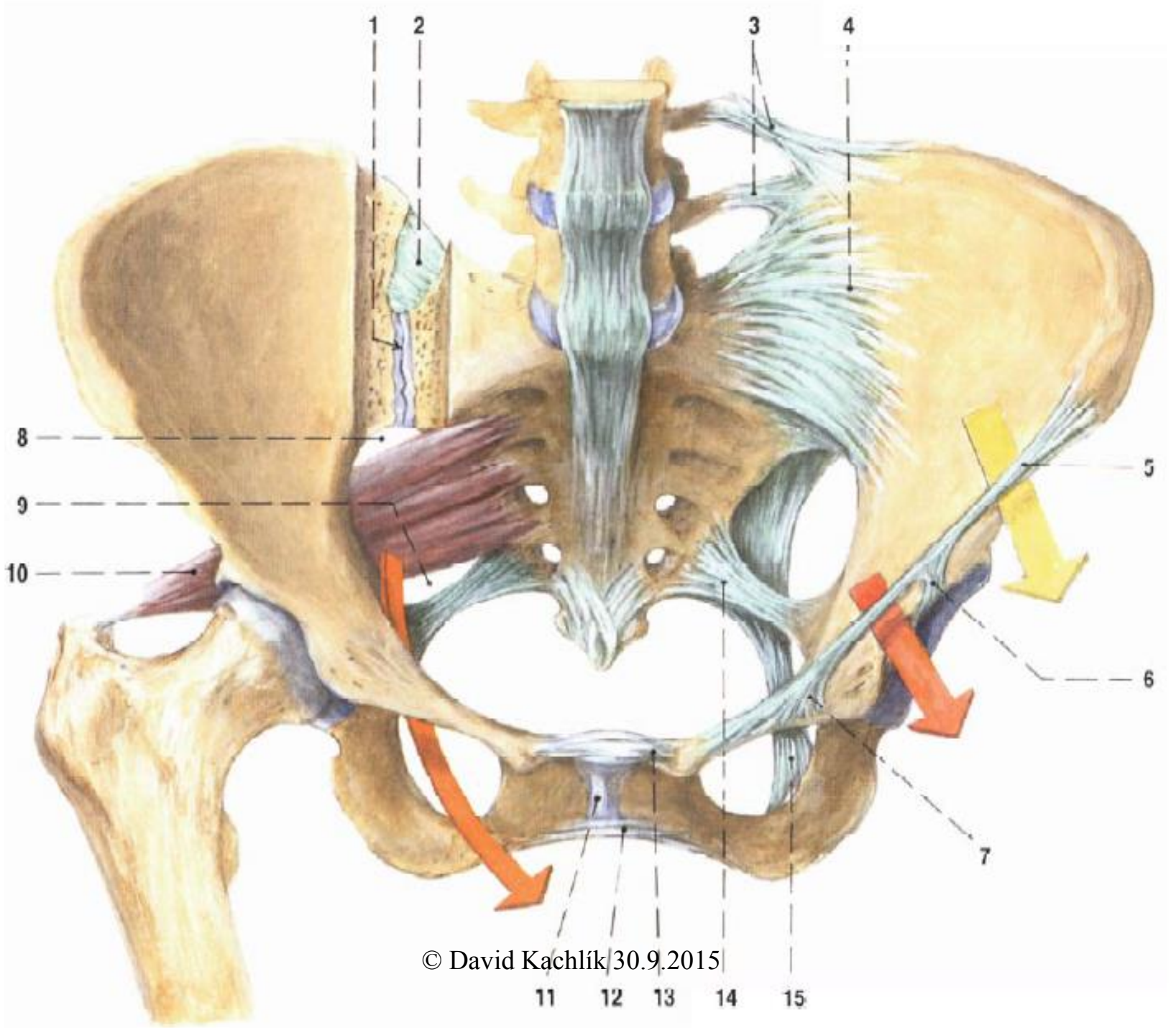
Joints of lower limb
Juncturae membri inferioris

Joints of pelvic girdle (*juncturae cinguli membri inferioris*)

- art. sacroiliaca (sacroiliac joint)
- symphysis pubica (pubic symphysis)

Joints of free lower limb (*juncturae membri inferioris liberi*)

- art. coxae (hip joint)
- art. genus (knee joint)
- art. talocruralis (ankle joint)
- joints of foot

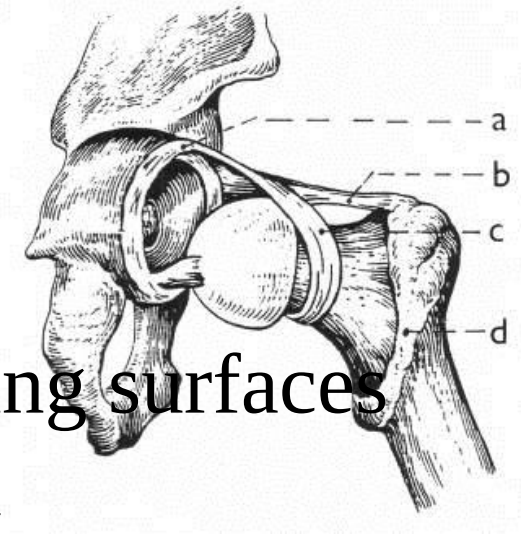


Diastáza stydké spony (zlomenina „open book“)

http://en.wikipedia.org/wiki/File:Diastasis_symphysis_pubis_1300500.JPG

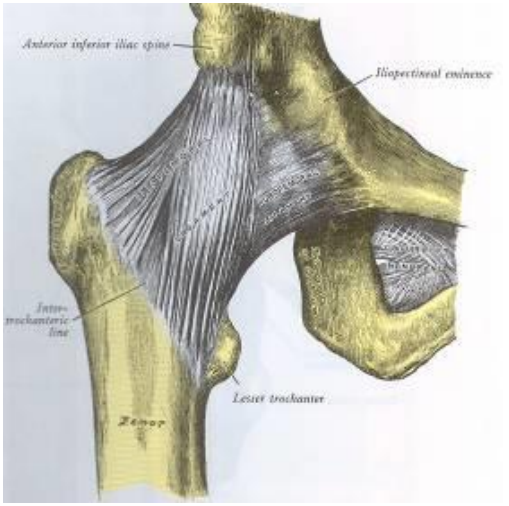
Hip joint = Articulatio coxae

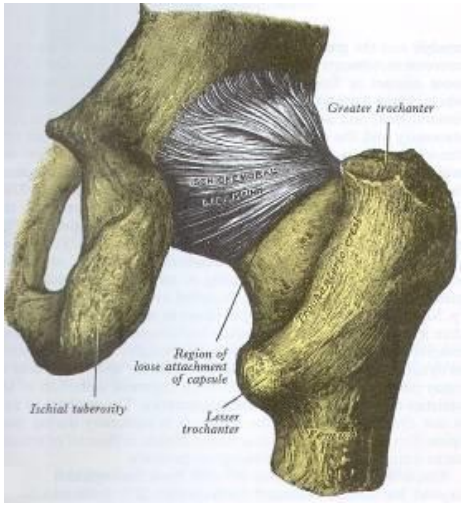
- **type**: simple, cotylic (**art. cotylica; enarthrosis)**
- **articular surfaces:**
  - **head** – caput femoris
  - **fossa** – acetabulum (facies lunata)
- **articular capsule:** close to connecting surfaces
  exception – ventrally distal to linea intertrochanterica
  - dorsally only **to 2/3 of collum femoris**
- labrum acetabuli, pulvinar acetabuli



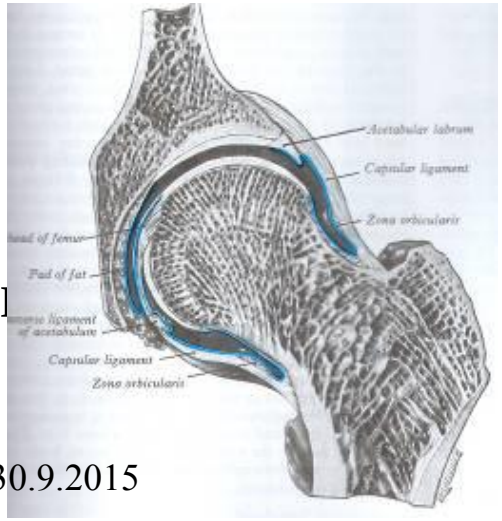
Hip joint = Articulatio coxae

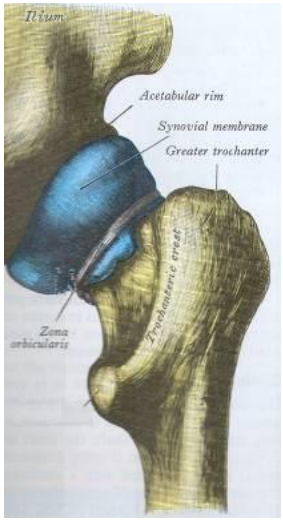
- **ligaments:**
  - lig. iliofemorale
  - lig. pubofemorale
  - lig. ischiofemorale
  - zona orbicularis
  - lig. capitis femoris

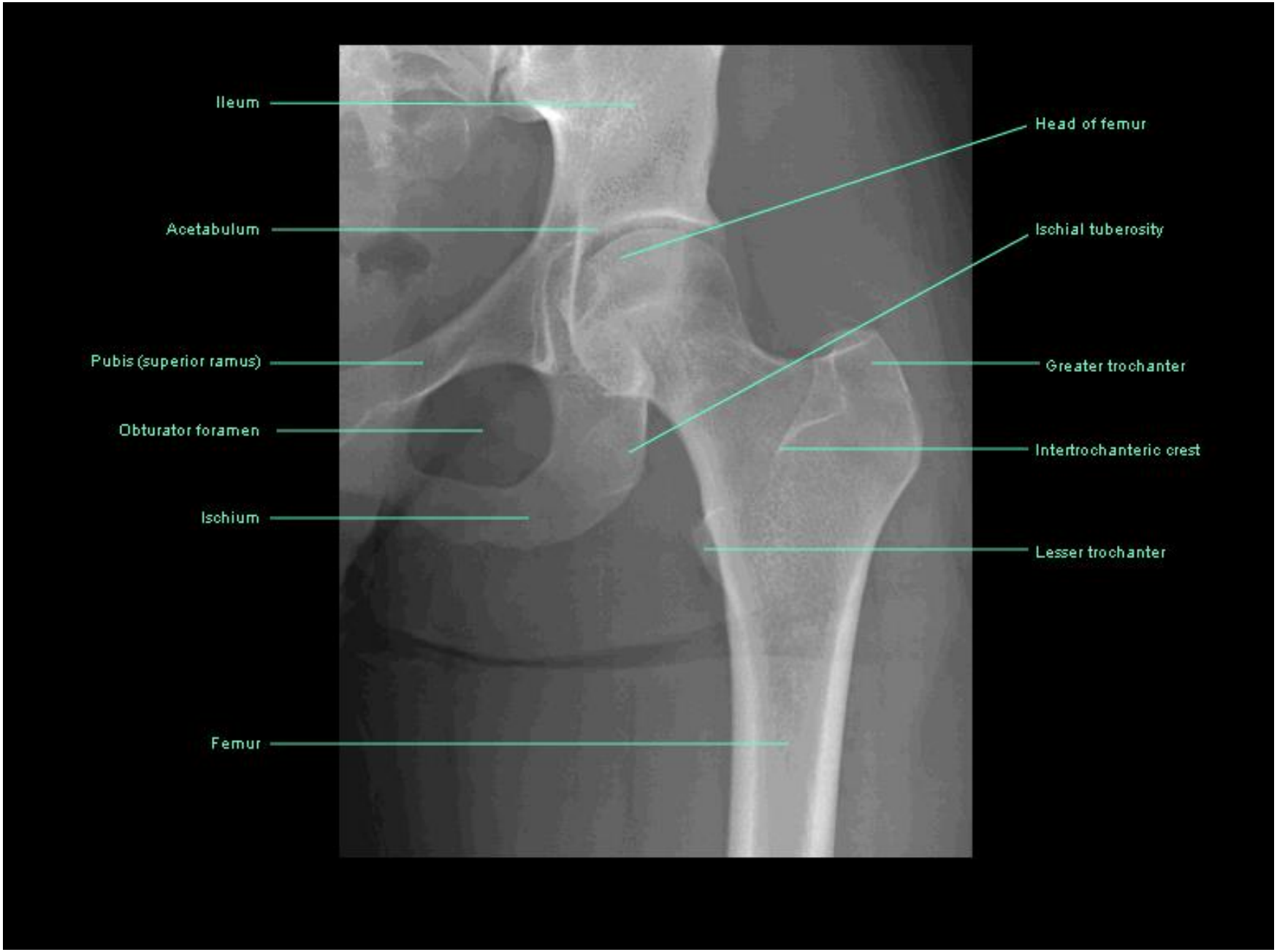




- **loose position**: mild abduction and mild flexion
- **pohyby**:
  - abduction and adduction
  - flexion and extension
  - internal and external rotatio
  - (circumduction)

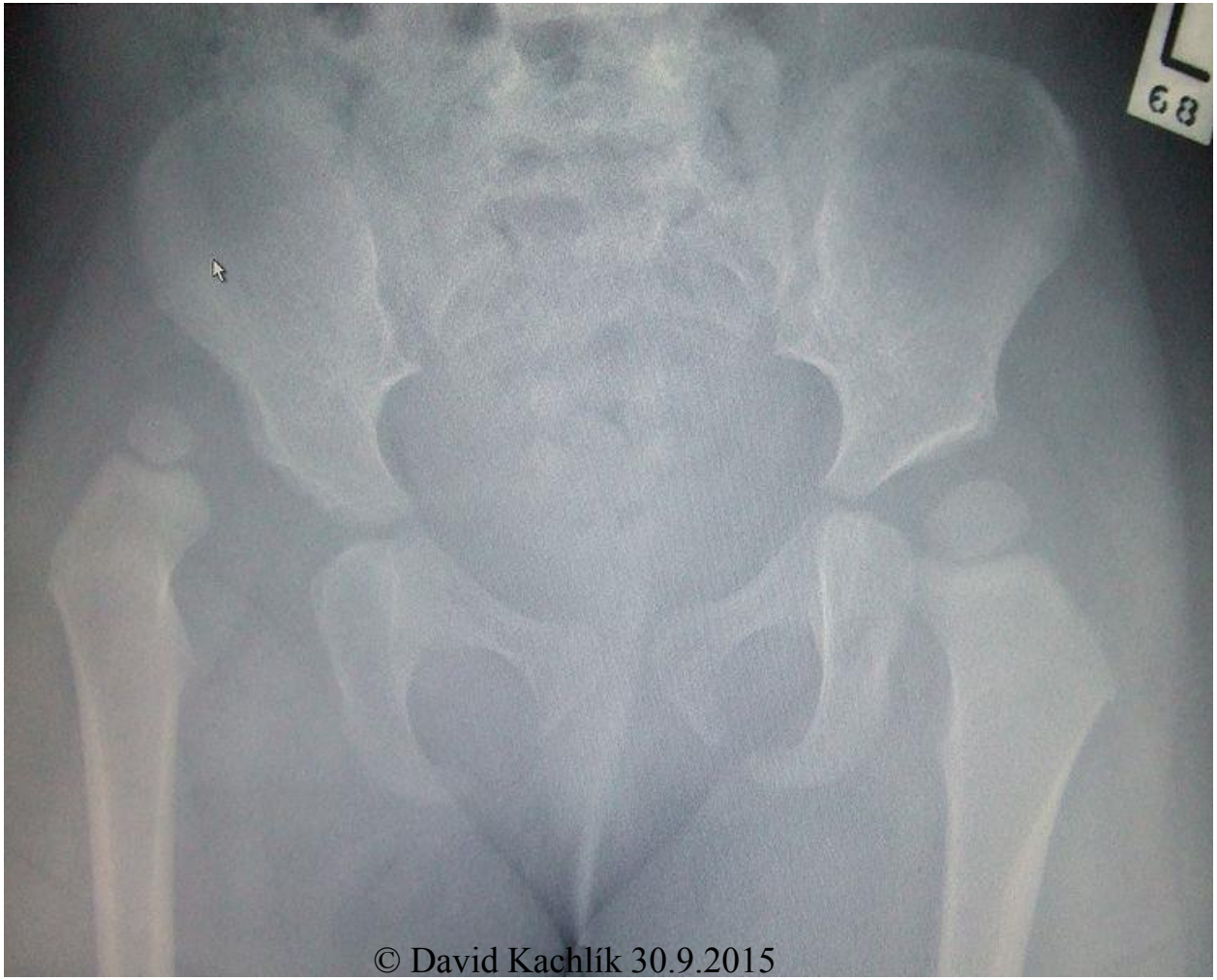




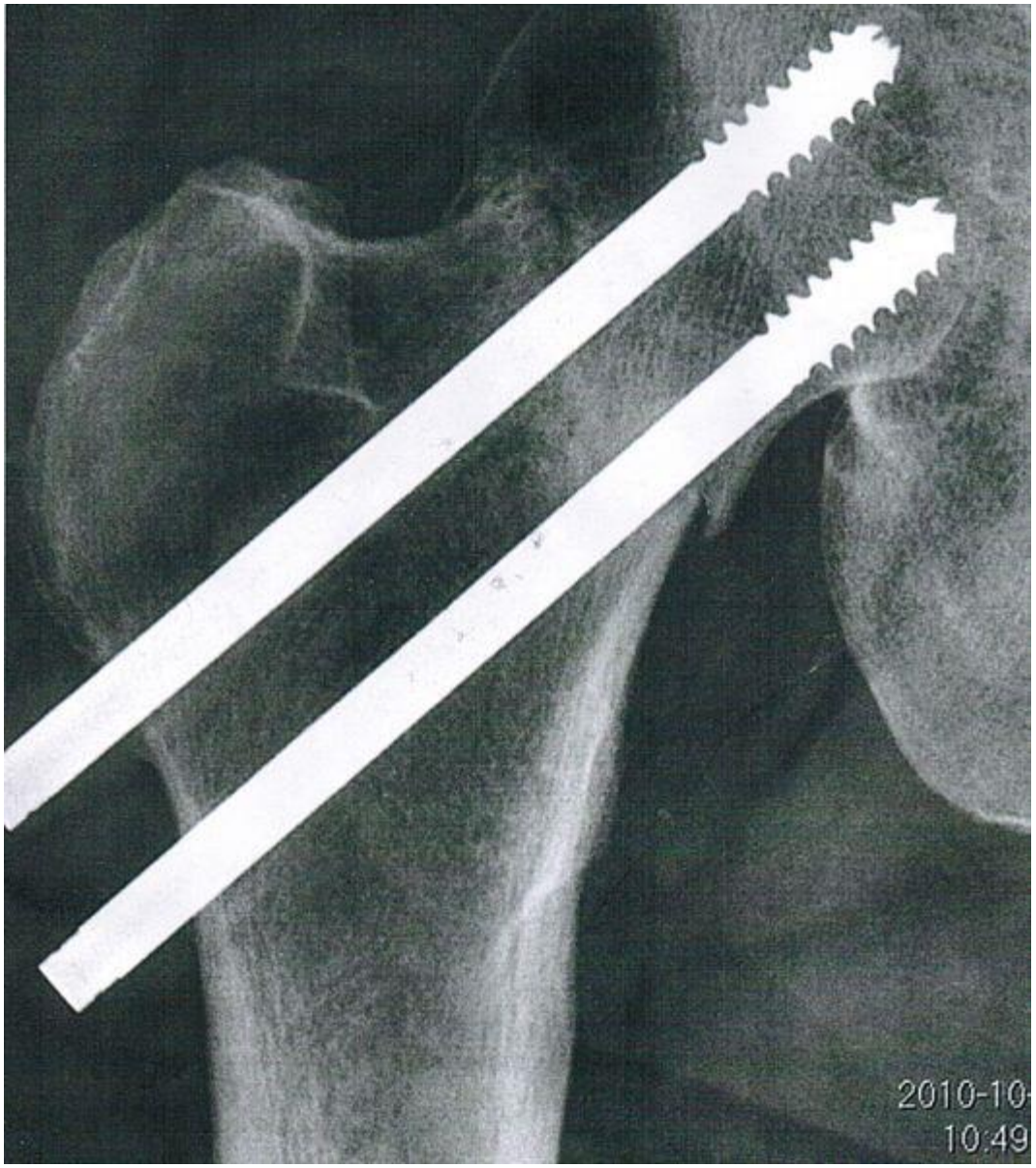

Ileum
Acetabulum
Pubis (superior ramus)
Obturator foramen
Ischium
Femur
Head of femur
Ischial tuberosity
Greater trochanter
Intertrochanteric crest
Lesser trochanter

Developmental/congenital dysplasia of hip

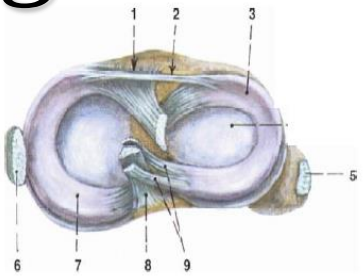
most common developmental defect of children (3%)



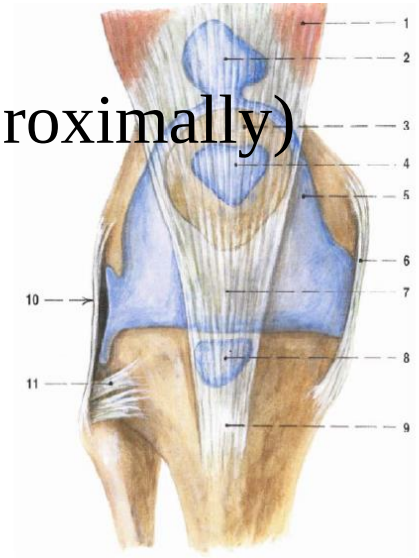
http://www.wikiskripta.eu/index.php/Soubor:Dislocated_hip.jpg

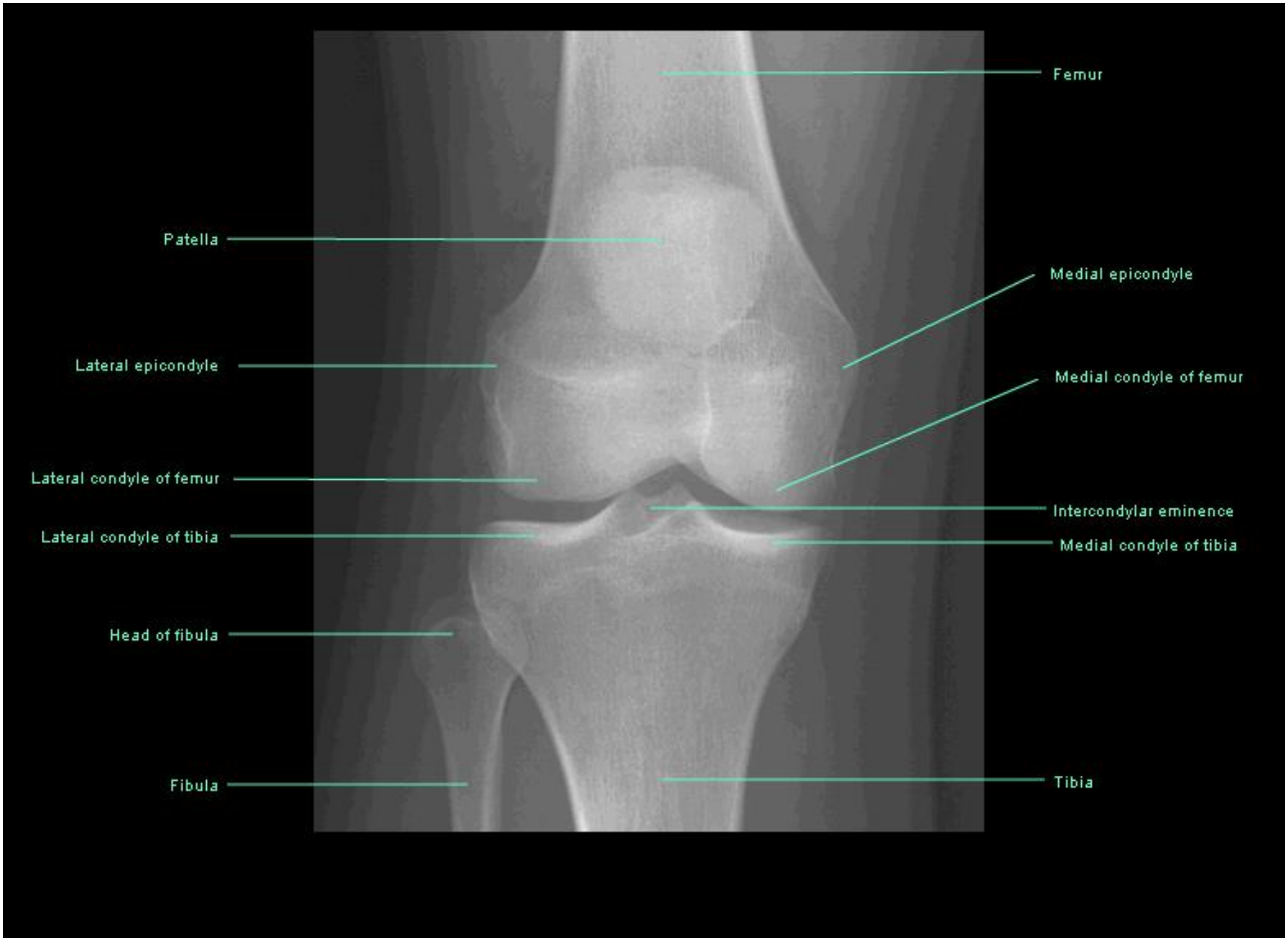


Knee joint = Articulatio genus



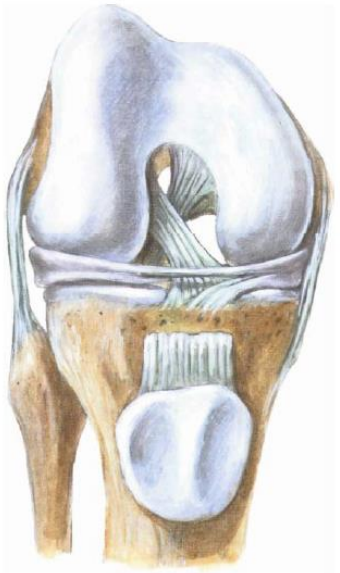
- **type:** compound, bicondylar
- **articular surfaces:**
  - **head:** facies articularis superior tibiae + menisci
  - **fossa:** condyli femoris
  - facies articularis patellae + facies patellaris femoris
- **articular capsule:**
  - close to connecting surfaces (on femur more proximally)
  - recessus suprapatellaris et subpopliteus
- **special structures:**
  - meniscus medialis et lateralis
  - musculus articularis genus
  - bursae synoviales
  - corpus adiposum infrapatellare (of Hoffa)



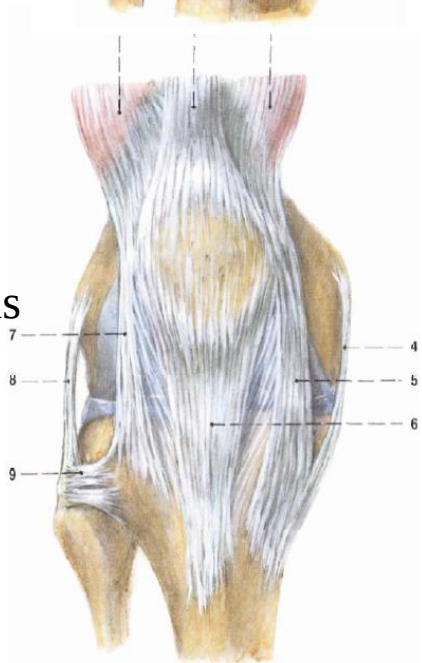

Femur
Patella
Medial epicondyle
Lateral epicondyle
Medial condyle of femur
Lateral condyle of femur
Intercondylar eminence
Lateral condyle of tibia
Medial condyle of tibia
Head of fibula
Fibula
Tibia

Knee joint = Articulatio genus

- **ligaments:**
  - ligamentum patellae (continuation of tendon of m. quadriceps femoris)
  - retinaculum patellae medialis + lateralis
  - lig. collaterale tibiale + fibulare
  - lig. popliteum obliquum + arcuatum
  - lig. cruciatum anterius + posterius
  - lig. transversum genus
  - lig. meniscofemorale anterius + posterius

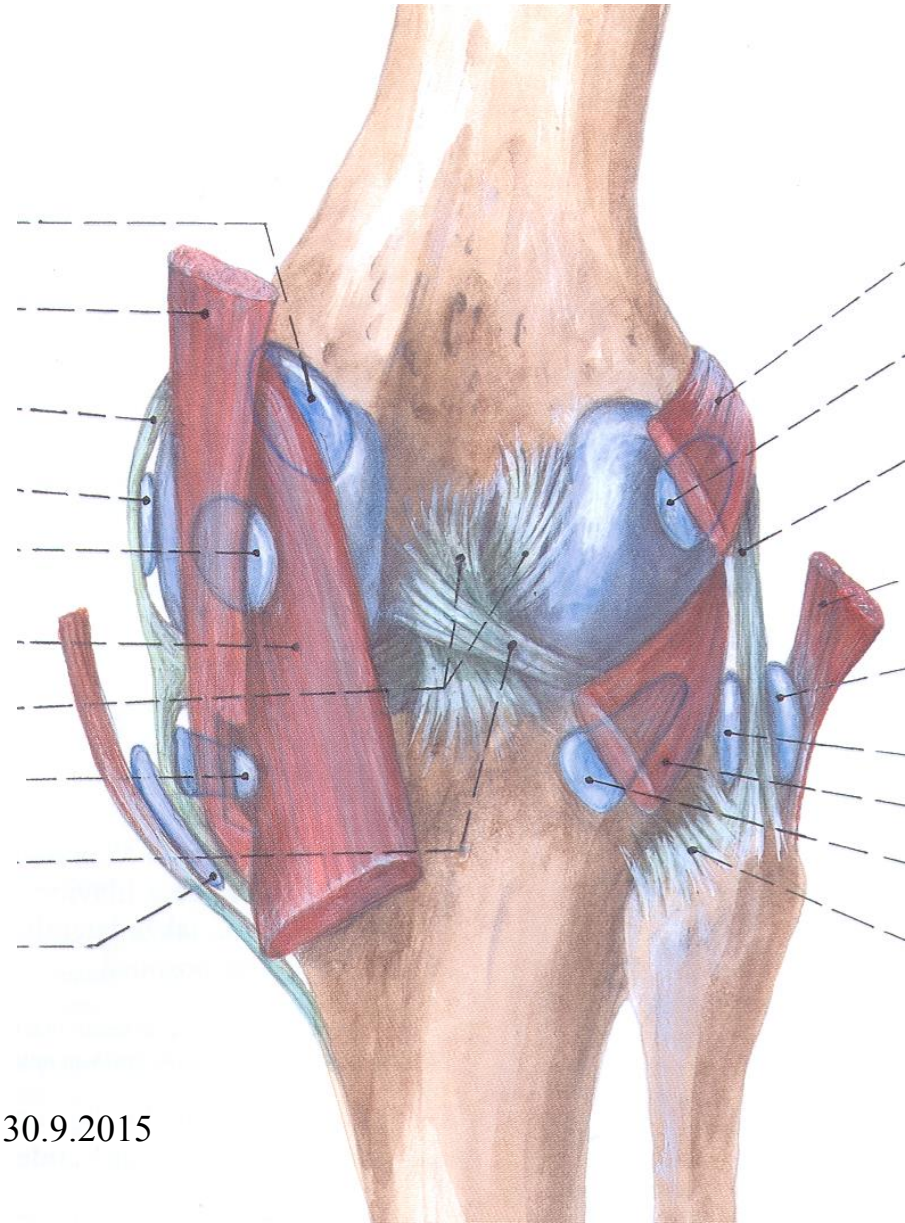


- **movements:**
  - extension = locked knee
  - flexion
    - initial rotation by loosening of lig. cruciatum anterius (tibia is rotated internally) = unlocking of knee
    - rolling
    - sliding
  - rotation – internal and external



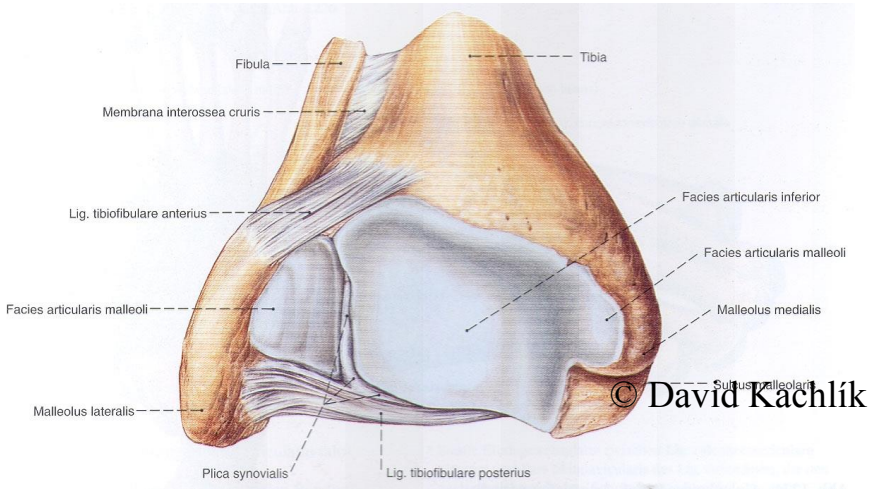
Bursae synoviales = synoviální burzy

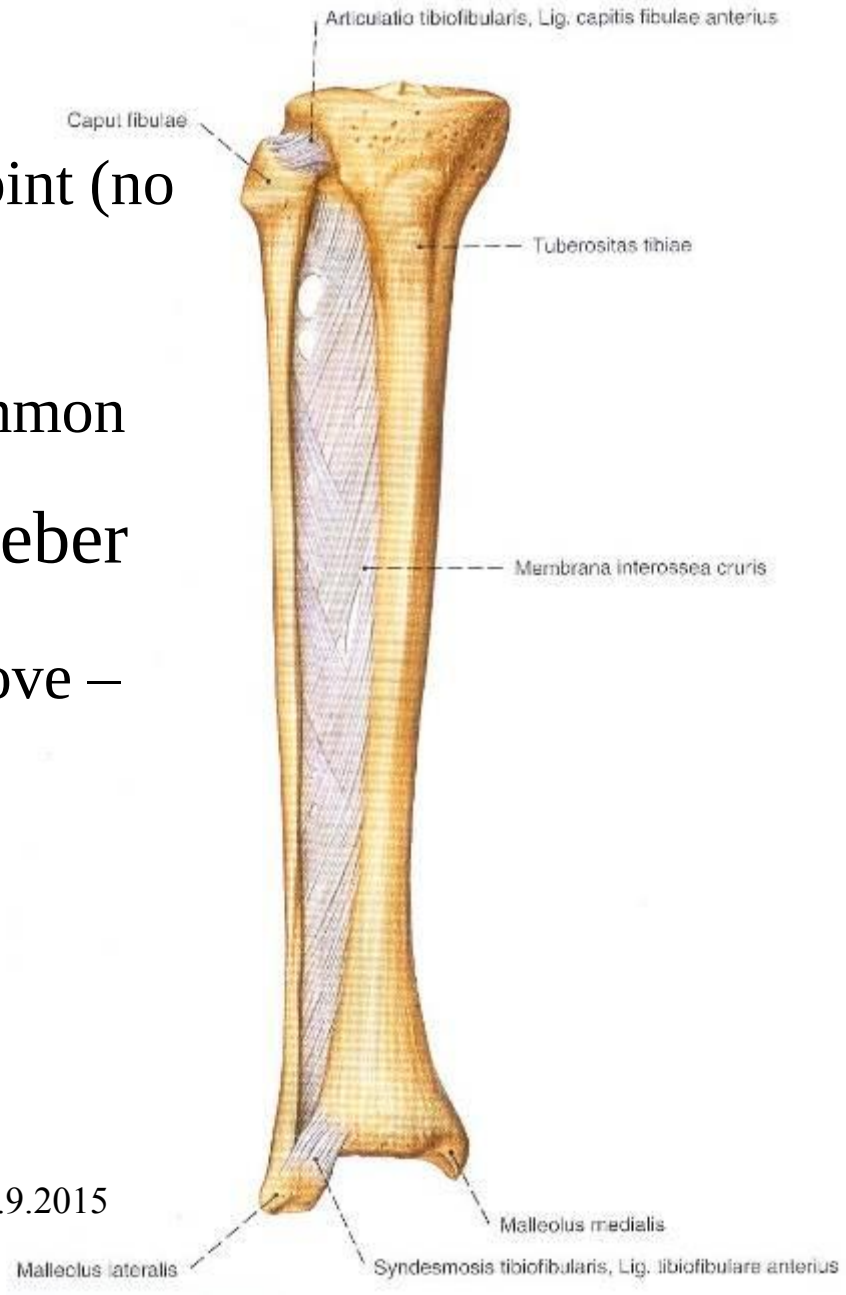
- **B. suprapatellaris**
- B. subcutanea + subfascialis + subtendinea prepatellaris
- B. subcutenae infrapatellaris + infrapatellaris profunda
- B. subcutanea tuberositatis tibiae
- Bb. subtendineae musculi sartorii
- B. subtendinea musculi bicipitis femoris inferior
- B. subtendinea musculi gastrocnemii lateralis
- B. subtendinea musculi gastrocnemii medialis
- B. musculi semimembranosi
- B. anserina
- **B. gastrocnemiosemimembranosa - pathological Baker‘s cyst**



Syndesmosis tibiofibularis

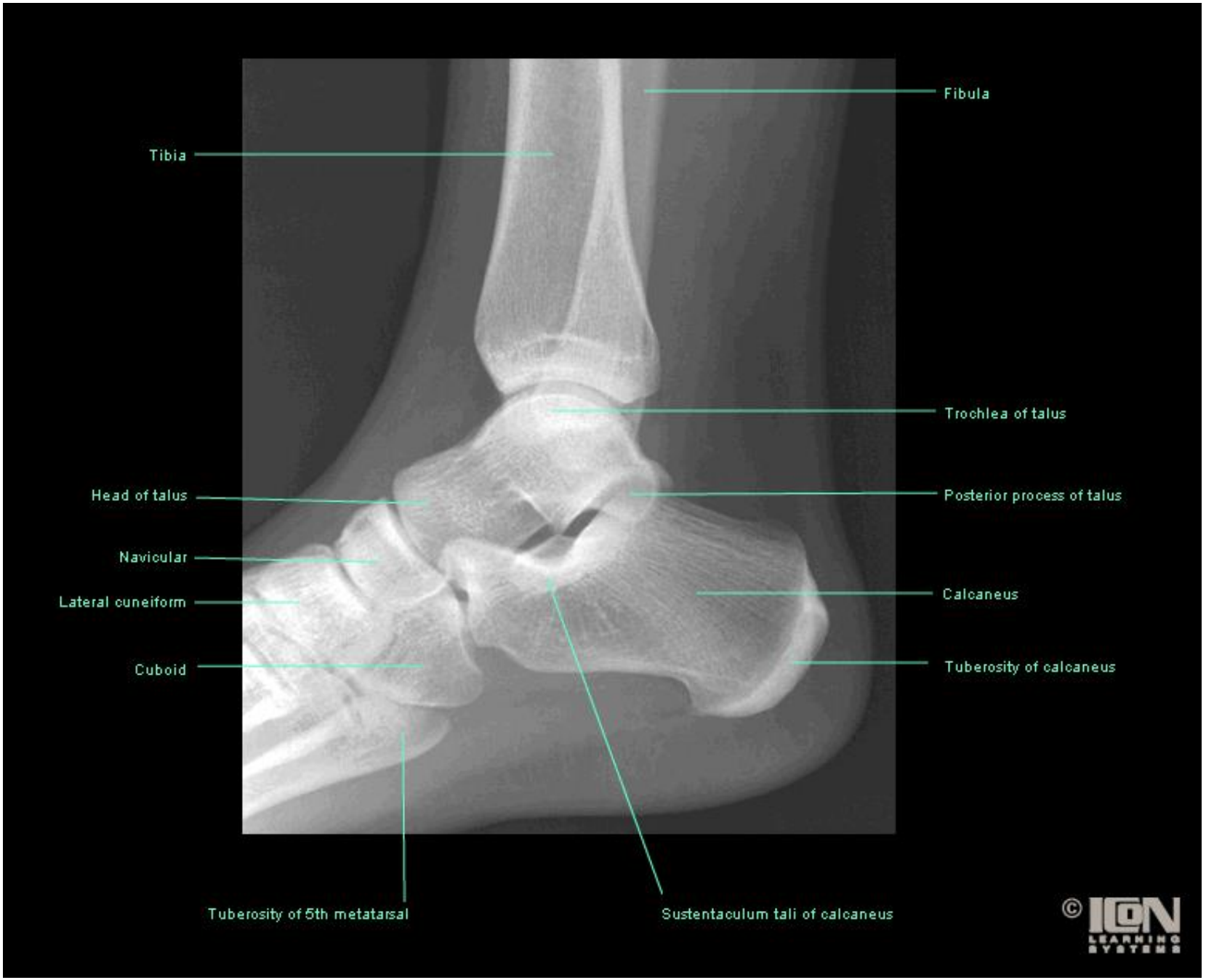
- very little mobility
  - important for function of ankle joint (no screw inside!)
- very firm joint
  - fracture of malleolus is more common then syndemosis diastasis
- fractures: classification after Weber in relation to syndesmosis
  - (below – W I, at level – W II, above – W III)





Ankle joint = Articulatio talocruralis

- **type:** compound, trochlear
- **articular surfaces:**
  - **fossa:** fork between malleolus medialis et lateralis
  - **head:** trochlea tali (wider ventrally)
- **articular capsule:**
  - close to connecting surfaces
- **ligaments**
  - lig. collaterale mediale (deltoideum)
    - pars tibionavicularis, tibiotalaris anterior, tibiocalcanearis, tibiotalaris posterior
  - lig. collaterale laterale
    - ligamentum talofibulare anterius, calcaneofibulare, talofibulare posterius


Fibula
Tibia
Trochlea of talus
Head of talus
Posterior process of talus
Navicular
Lateral cuneiform
Calcaneus
Cuboid
Tuberosity of calcaneus
Tuberosity of 5th metatarsal
Sustentaculum tali of calcaneus
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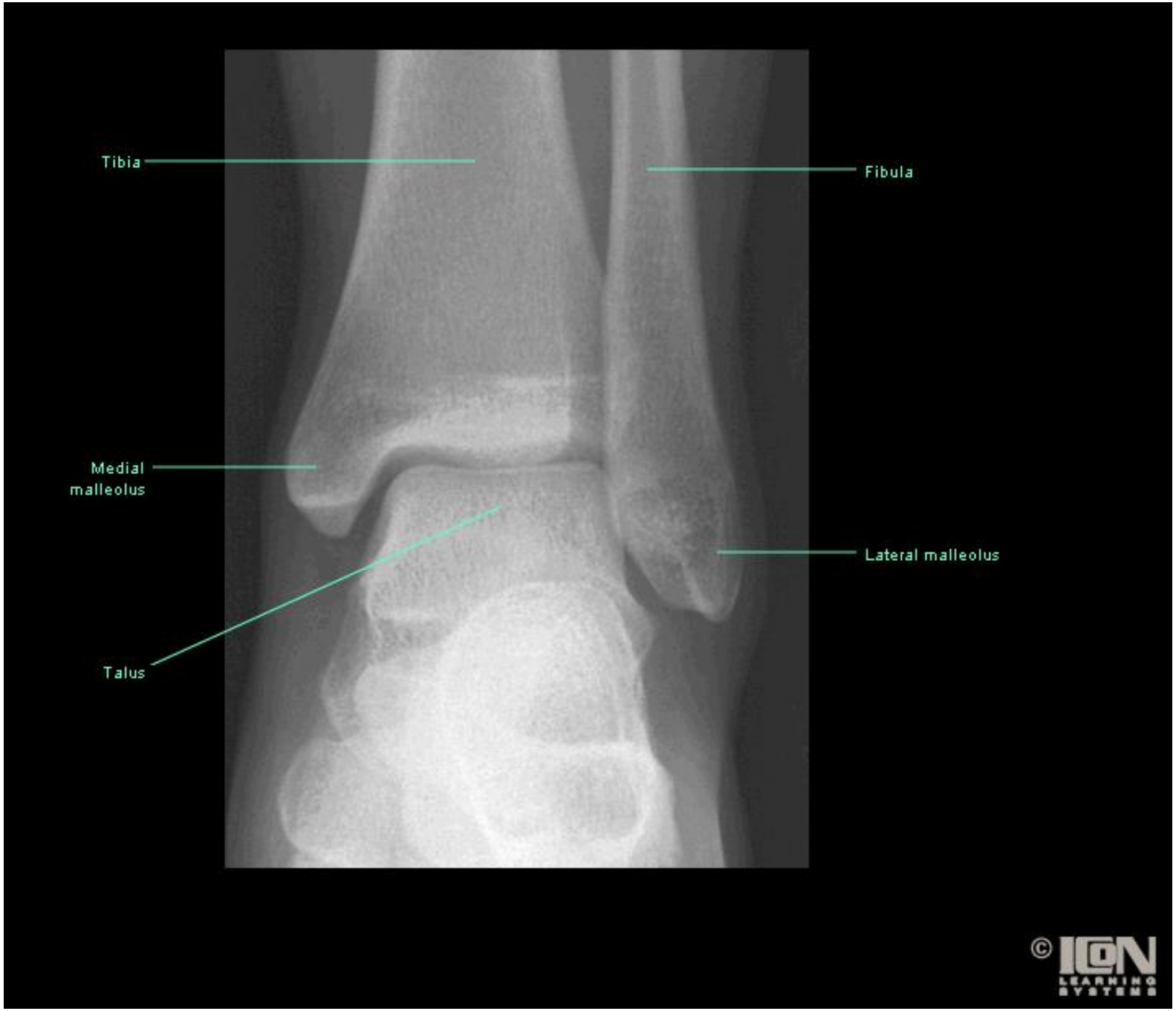
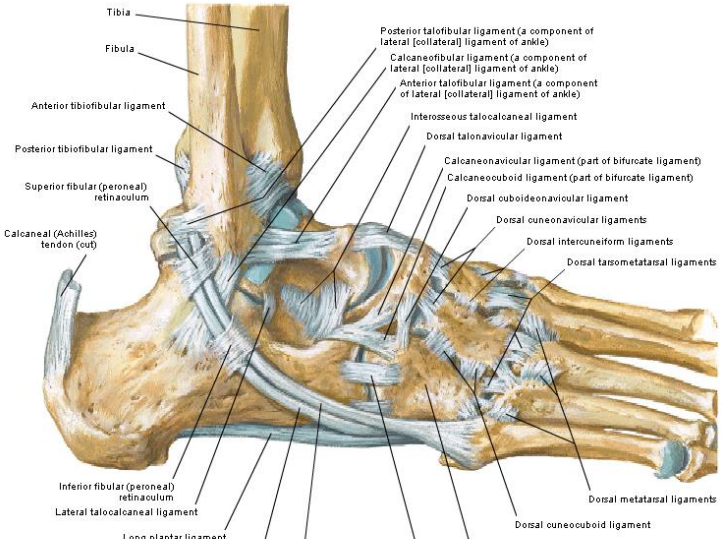
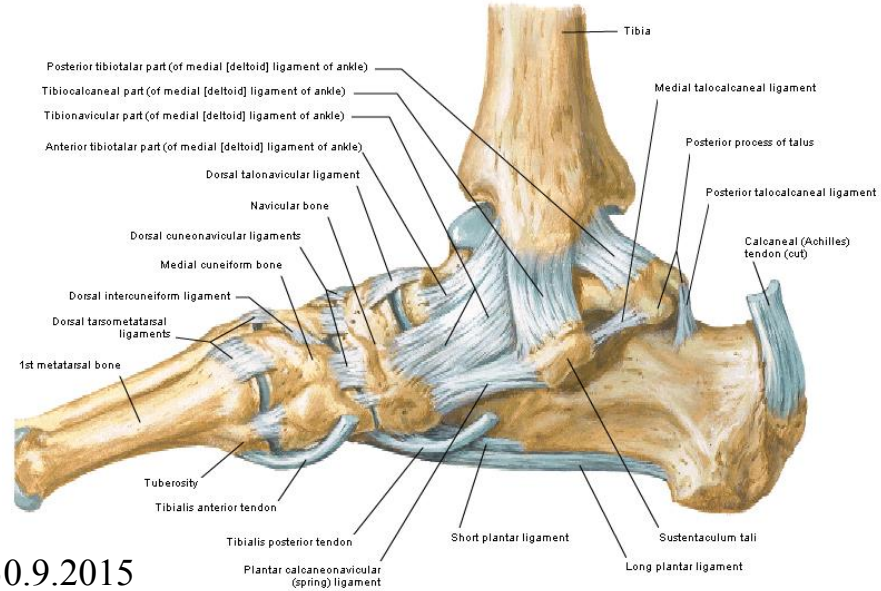


Ankle joint = Articulatio talocruralis

- **movements:**
  - plantar and dorsal flexion
  - part of foot complex movements: inversion and eversion
- **combined movements**
  - plantar and dorsal flexion, abduction - adduction, supination - pronation
  - **Inversion**: plantar flexion + adduction + supination
  - **Eversion**: dorsal flexion + abduction + pronation

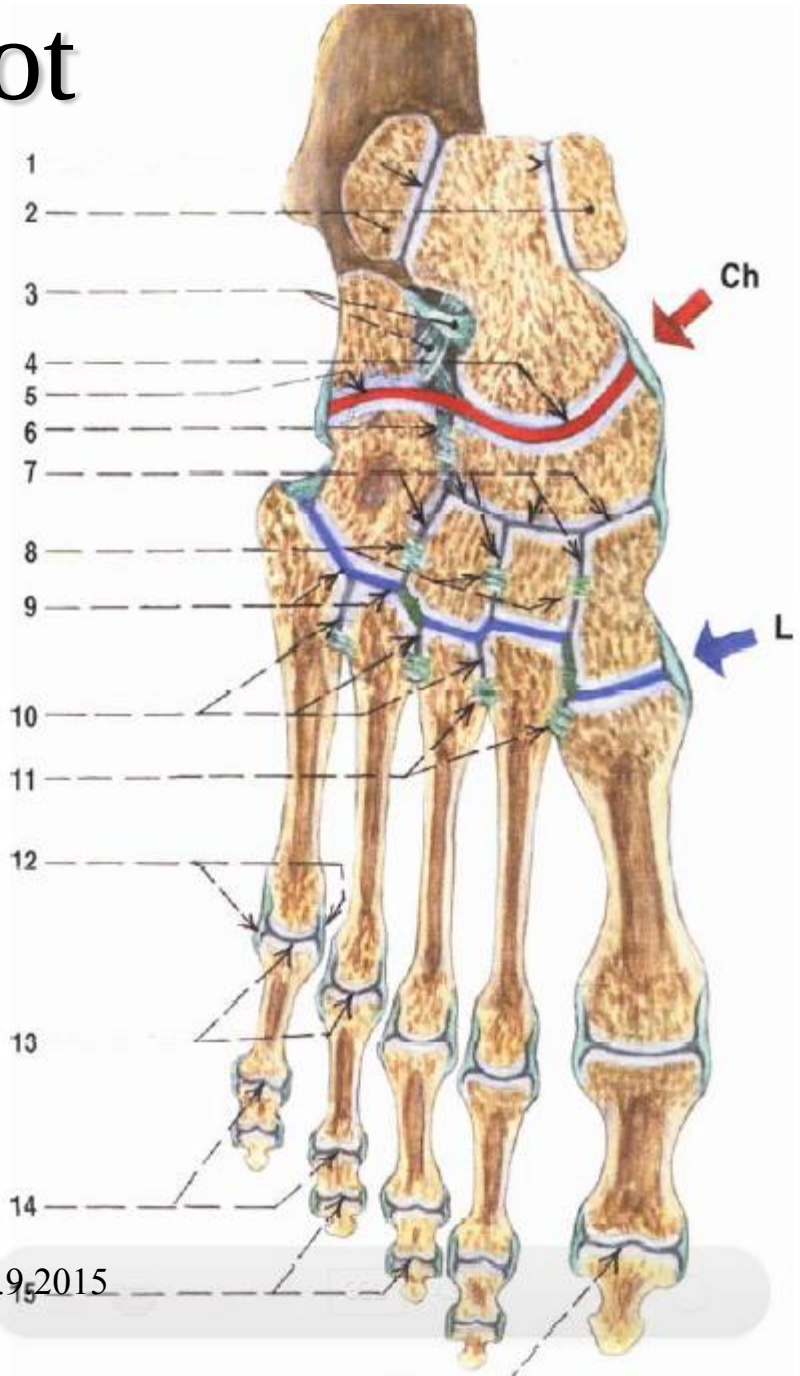




Fuctional units of foot

- **articulatio tarsi transversa *Choparti***

- **articulationes tarsometatarsales *Lisfranci***
  - 2nd metatarsal is a peg against ossa cuneiformia
  - prevents from abduction and adduction movements



Foot arch