General arthrology (Joints)

2 types of joints : 1. Synarthrosis
2. Diarthrosis

1. Synarthrosis (connective tissue, cartilage, bone)
-connection by some kind of connective tissue : fibrous tissue, cartilage or bone
A. fibrous joint (articulatio fibrosa, **syndesmosis) - (**sutures, ligaments, Gomphosis)
a) 3 types of sutures

- sutura serrata -
- sutura squamosa – squamous suture
- sutura plana – flat suture

b) membrana interossea antebrachii, various ligaments
c) gomphosis (socket) – dentoalveolar syndesmosis
B. cartilaginous joint (articulatio cartilaginea, **synchondrosis**) – bones are linked by cartilage, nearly immobile continuous connection of bones
C. synostosis (by bone tissue, origin of the bones was isolated)

2. Diarthrosis (articulatio synovialis) - Synovial joint
Movable connection of 2 or more bones by touch or contact
Art. surfaces covered by articular cartilage
General features of a joint.
Facies articulares- articular surfaces
Caput articulare – articular head
Fossa (fovea) articularis – articular fossa
Cartilago articularis – articular cartilage
Capsula articularis – articular capsule (joint capsule)
Membrana fibrosa, stratum fibrosum– fibrous membrane, layer
Membrana synovialis, stratum synoviale – synovial membrane, inner layer
Plicae synoviales
Villi synoviales
Synovia – synovial fluid
Rete articulare – articular network of arteries
Cavitas articularis – articular cavity, joint cavity
Additional joint structures, features of the joint
***Labrum articulare* -**
***Disci et menisci* – articular discs and meniscs (difference)**
***Ligamenta* - ligaments**
Ligamenta articularia – accessory ligaments (joint ligaments)
Ligamenta capsularia
Ligamenta intracapsularia (intraarticularia)
Ligamenta extracapsularia (extraarticularia)
***Musculi articulares* – articular muscles**
***Bursae synoviales* – bursae and synovial pockets**

Types of joints

Joints may be classified from various points of view:

1. According to a number of articular surfaces:

Articulatio simplex – simple joint
Articulatio composita – compound joint

2. According to the shape of articular surfaces:

1. *Amphiarthrosis* –
2. *Articulatio plana* – flat joint
3. *Articulatio spheroidea* – ball and socket joint (spheroidal joint)
   Arthrodia – free spheroid joint
   Enarthrosis – spheroid joint with limited movements
4. *Articulatio ellipsoidea* – ellipsoidal (ovoid) condyloid joint
5. *Articulatio sellaris* – saddle joint (sellar)
6. *Articulatio cylindroidea* – cylindrical joint
   Ginglymus
   Articulatio trochoidea – trochoid joint, pivot joint
7. *Articulatio trochlearis* – hinge joint

3. According to the movement

a) Joints with rotary movements

- **<u>monoaxial</u> joints –** flexion, extension. Trochoid and hinge joints.
- **<u>biaxial</u> joints –** flexion, extension, ulnar and radial deviation. Saddle and ellipsoid joint.
- **<u>multiaxial</u> joints–** flexion, extension, internal and external rotation (*pronatio* and *supinatio*), abduction and adduction (spheroidal joint).

b) Joints with sliding movement – plane joints – for example intervertebral joints *(art. intervertebrales)*.

c) Joints with minimal movements – amfiarthrosis (for example *carpometacarpal joints*)

Middle position of the joint – position in which a joint capsule is evenly relaxed.

Description of the joint !!!! Follow this scheme!!!!

1. name of the joint in latin and in english
2. bones and articular surfaces articulating in the joint, articular head and fossa
3. type of the joint
   a) simplex or composita
   b) according to the shape of the articular surfaces
   c) according to the possible movements
4. attachment of the joint capsule
5. additional joint structures (features)
6. possible movements of the joint (degrees)

SPECIAL ARTHROLOGY

Connection of the skull
All types of conection

craniovertebral connection, syndesmosis, synchondrosis, temporomandibular joint and connection of the hyoid bone *(os hyoideum)*

I. Craniovertebral articulation
Connection of the skull with atlas and axis.

1. **Atlanto-occipital articulation – *(articulatio atlantooccipitalis)***
articular surfaces: occipital condyles (*condyli occipitales*) and **superior articular surfaces of atlas (*foveae articulares superiores atlantis)***
articular capsule: is attached to the margins of the articular surfaces
additional features: anterior and **posterior atlanto-occipital membranes (*membrana atlantooccipitalis anterior*** and ***posterior*** **)** located between both arches of atlas and occipital bone), **tectorial membrane (*membrana tectoria*)** is a cranial continuation of **posterior longitudinal ligament** (***lig. longitudinale posterius*****)** reaches to the *clivus*
type of joint: ellipsoidal joint
movements: flexion and extension of the head and its lateral motion

2 . Articulatio atlantoaxialis – is divided into two parts:

a) lateral atlantoaxial articulations – *articulatio atlantoaxialis lateralis*
Articular surfaces: inferior articular facets of atlas **(*foveae articulares inferiores atlantis***) and **superior articular process** of axis **(*processus articulares superiores axis***)

b) median atlantoaxial articulation (*articulatio atlantoaxialis mediana*)
Articular surfaces : anterior articular facet of the dens axis **(*facies articularis anterior)*** on the ventral side of dens axis with ***fovea dentis*** of the posterior surface of the anterior arch of the atlas
Articular capsule: is common for both a) and b) joints and is attached to the margins of contact articular surfaces
Additional features: apical ligament of the dens (*lig. apicis dentis*), alar ligaments (*ligg. alaria*), transverse ligament of atlas (*lig. transversum atlantis*), cruciform ligament of the atlas (*lig. cruciforme atlantis*) – formed by **transverse ligament of atlas (*lig. transversum atlantis*)** and **longitudinal bands (*fasciculi longitudinales*)**
Anterior and **posterior atlantoocipital membranes (*membrana atlantooccipitalis anterior* and *posterior*)**
Type of joint:
functionally – the mechanical unit. Flexion, extension. Atlas rotates around *dens axis* in about 60^{o}

II. Syndesmosis of a skull
For example: Sutures, stylomandibular ligament *(lig. stylomandibulare)*, sphenomandibular ligament (*lig. sphenomandibulare*)

III. Synchondrosis of a skull
For example*:* sphenopetrosal synchondrosis*(synchondrosis sphenopetrosa)* and petrooccipital synchondrosis *(synchondrosis petrooccipitalis)*

IV. Temporomandibular joint (articulatio temporomandibularis)
Articular surfaces: **mandibular head *(caput mandibulae)*** with **mandibular fossa and articular tubercle *(fossa mandibularis and tuberculum articulare)*** of the temporal bone
Articular capsule: is attached to the margins of contact articular surfaces, ventrally and dorsally is lax, its medial part is tense
Additional features: **articular disc *(discus articularis)* –** with thin center and thicker margins. It divides joint cavity into the upper **discotemporal portion *(pars discotemporalis)*** and lower **discomandibular portion *(pars discomandibularis).*** Disk is attached to the capsule and to the lateral pterygoid muscle. At the lateral side of the capsule is attached **lateral ligament *(lig. laterale).*** Close to the joint are located a **sphenomandibular ligament and a stylomandibular ligament *(lig. sphenomandibulare*** and ***lig. stylomandibulare)***
Type of joint: ginglymus or possible also elipsoid joint
Movements: opening and closing mouth, rotatory and sliding movements and grinding movements

V. Connection of the hyoid bone *(os hyoideum)*
Os hyoideum is joined with skull by muscles and by stylohyoid ligament *(lig. stylohyoideum)*

Union of the spine

The spine *(columna vertebralis)* originates by join isolated presacral vertebrae, sacral bone and coccygeal bone. There are both types of connection between bones – synarthrosis and diarthrosis on the spine.

Union between vertebrae
1. union between vertebral bodies – intervertebral disks *(disci intervertebrales)*
Intervertebral disc *(discus intervertebralis)*
Cartilage between terminal facets of the bodies of movable vertebrae. 23 discs (form about 1/3 – ¼ of the spine height).
External layer – fibrous cartilage *(anulus fibrosus). Inner layer* – gelatinous *(nucleus pulposus)* – serves as a spherical bearing
Height at the evening is about 3 cm lower than in the morning.

2. union between vertebral arches *(arcus vertebrales)* – ligamenta flava
3. union between articular processes *(processus articulares)* – intervertebral joints (*articulationes intervertebrales*)
intertransversal ligaments (*ligg. intertransversaria*)
interspinal ligaments –*(ligg. interspinalia).* There is a supraspinal ligament (*lig. supraspinale*) in the cervical area, which reaches as a nuchal ligament (*lig. nuchae*) to the occipital bone.

4. Common union of the spine
a) anterior longitudinal ligament (*lig. longitudinale anterius)* – prevents hyperextension of vertebral column
b) posterior longitudinal ligament (*lig. longitudinale posterius*) – prevents hyperflexion of vertebral column
c) continuation of both longitudinal ligg. - small sacrococcygeal ligaments – dorsal superficial, profound, ventral (*lig. sacrococcygeum dorsale superficiale* and *profundum, lig. sacrococcygeum ventrale).*

Shape and curve of spine

Spine has ***cervical*** and ***lumbar lordoses*** and ***thoracic*** and ***sacral kyfoses***.
In frontal plane – ***skoliosis***.

Movements of the spine
Anteflexion and retroflexion = forward nad backward bending, lateral flexion, rotation, spring action .
cervical spine – anteflexion, retroflexion, lateral flexion, rotation
thoracic spine – rotation
lumbar spine – anteflexion, retroflexion, lateral flexion

Union of the thorax

I) Union of the thorax

A. Costovertebral joints (articulationes costovertebrales)
1. Joints of the head of the ribs *(articulationes capitis costae*)
Articular surfaces: articular surface of the head of the rib (*facies articularis capitis costae*) and costal foveae (*foveae costales)* of the bodies of thoracic vertebrae
Articular capsule: is attached to the margins of contact articular surfaces.
Additional features: superficial radiate costal ligament (*lig. capitis costae radiatum*), 2. – 10. ribs – from the crest of the head of a rib *(crista capitis costae)* to the intervertebral disk (*discus intervertebralis*) runs the intraarticular costal ligament *(lig. capitis costae intraarticulare)*.
Movements: – around axis which is paralel to the costal neck *(collum costae)*.

2. Costotransverse joints *(articulationes costotransversariae*)
Articular surfaces : articular surface of the transverse process of the thoracic vertebrae (*foveae costales transversales*) and the articular facet of the costal tubercle *(facies articularis tuberculi costae).*
Articular capsule: is attached to the margins of contact articular surfaces.
Additional features : costotransverse ligaments *(ligg. costotransversaria*), lateral and superior costotransverse ligaments (*ligg. costotransversaria lateralia* and *superiora*),
Movements: – around axis which is paralel to the neck of rib (*collum costae*).

B. Sternocostal connection *(juncturae sternocostales)*
Connection between sternum and costal cartilages

1. Sternocostal synchondroses *(synchondrosis sternocostalis)* cartilaginous union of costal notch of sternum *(incisura costalis sterni)* and ventral end of the1. and often the 6th and 7th ribs**.**
2. Sternocostal joints (a*rticulationes sternocostales*) between 2.–5. ribs and sternum**.**
Articular surfaces: head is formed by sternal end of costal cartilage and an articular fossa is formed by costal notch of a sternum *(incisura costalis sterni)*
Articular capsule: is attached to the margins of contact articular surfaces.
Additional features: radiate sternocostal ligaments (*ligg. sternocostalia radiata)* form external and internal *membrana sterni (externa* and *interna)*.

C. Union of 5th – 9th ribs
by interchondral joints *(artt. interchondrales)* and intercostal membranes.
1. Interchondral joints *(articulationes interchondrales)*
Articular union between costal cartilages of the 5th – 9th ribs (***cartilagines costales* 5.–9.)** with short articular capsule**.**

2. **Intercostal membranes (m*embranae intercostales)*** – external intercostal membranes (m*embranae intercostales externae)* are located between costal cartilages close to the sternum. Internal intercostal membranes *(membranae intercostales internae)* are located close to spine.

II. Shape of the rib cage (thorax)

a) Ventral wall – sternum, costal cartilages and ribs
b) Lateral wall – anguli costae.
c) Dorsal wall – thoracic vertebrae *(vertebrae thoracicae)* and bone parts of the ribs.
d) Cranial basis *(apertura thoracis superior)* - superior thoracic aperture, is limited by the 1. thoracic vertebra, the 1. rib and cranial margin of sternum.
e) Caudal basis *(apertura thoracis inferior)* – inferior thoracic aperture, is limited by 12. thoracic vertebra, 12. and 11. ribs and *arcus costarum.*

III. Movements of the thorax

In the union of rib and thoracic vertebra is possible to make rotation along longitudinal axis (runs through *collum costae)* - increasing volume of the chest is inspiration (inspire), decreasing volume of the chest is expiration (expire).

Connection of the upper limb

Connection of the shoulder girdle

(juncturae ossium cinguli extremitatis superioris)

1. Sternoclavicular joint *(articulatio sternoclavicularis)* (compoud joint)
Articular surfaces: clavicular notch of the sternum *(incisura clavicularis sterni)* and sternal articular surface of the clavicula *(facies articularis sternalis claviculae)*.
Articular capsule: stiff and attached to the margines of the articular surfaces
Additional features: articular disk *(discus articularis)*, anterior and posterior sternoclavicular ligaments *(lig. sternoclaviculare anterius* and *posterius)*, interclavicular ligament *(lig. interclaviculare)*, costoclavicular ligament *(lig. costoclaviculare)*
Type of joint: ball–and–socket joint with movements to all directions but movements are limited by a component of movements of scapula and shoulder joint.
2. Acromioclavicular joint *(articulatio acromioclavicularis)* (usually a compound joint)
Articular surfaces : articular facet of the acromion *(facies articularis clavicularis acromii)* and articular facet of the clavicula *(facies articularis acromialis claviculae)*.
Articular capsule : is attached to margines of articular surfaces
Additional features : often is here present articular disk *(discus articularis)*, acromioclavicular ligament *(lig. acromioclaviculare)*, coracoclavicular ligament *(lig. coracoclaviculare)*
Type of joint: ball–and–socket joint with movements to all directions but movements are limited by a component of movements of scapula and shoulder joint.

3. Ligaments of the scapula (syndesmoses of scapula)
Transverse ligament of scapula *(lig. transversum scapulae)*
Coracoacromial ligament *(lig. coracoacromiale)* – between coracoid process (*processus coracoideus)* and acromion of the scapula. Together with both bone processes forms the *fornix humeri*. Abduction of shoulder joint is always associated with movements of the scapula!
Movements of the scapula: sliding and rotational movements

Connections of the free part of the upper limb
(juncturae ossium extremitatis superioris)

1. Shoulder joint *(articulatio humeri)*
Articular surfaces : head of humerus *(caput humeri)* and glenoid cavity *(cavitas glenoidalis)* of scapula
Articular capsule : is attached to the margines of glenoid cavity *(cavitas glenoidalis)*, reaches the anatomical neck (*collum anatomicum)* of humerus, on the medial side of humerus runs distally (folds of the articular capsule for abduction). Ventrally the synovial layer of articular capsule covers tendon of long head of the biceps muscle (*m. biceps brachii)* and forms – synovial intertubercular sheath *(vagina synovialis intertubercularis)*.
additional features : glenoidal lip *(labrum glenoidale),* glenohumeral ligaments (*ligg. glenohumeralia)*, coracohumeral ligament (*lig. coracohumerale)*. Articular capsule is reinforced by tendons of muscles – subscapular muscle *(m. subscapularis),* supraspinatus muscle *(m. supraspinatus),* infraspinatus muscle *(m. infraspinatus),* teres minor muscle (*m. teres minor)*.
Type of joint : ball-and-socket, movements are possible to all directions (three degrees of freedom of movements).

2. Elbow joint *(articulario cubiti)* – compound joint

Humeroradial joint *(articulatio humeroradialis)*
Articular surfaces : capitulum of humer *(capitulum humeri)* and articular fovea *(fovea capitis)* of the radius

Humeroulnar joint *(articulatio humeroulnaris)*
Articular surfaces : trochlea of humerus *(trochlea humeri)* and trochlear notch *(incisura trochlearis)* of the ulna

Proximal radioulnar joint *(articulatio radioulnaris proximalis)*
Articular surfaces : articular circumference of the radius *(circumferentia articularis capitis radii)* and radial notch of the ulna *(incisura radialis ulnae)*

Articular capsule : both epicondyli of humerus are free (they serve for attachment of muscles), all fossae of distal end of humerus are located intracapsularly, on the radius runs to the *collum radii* – recessus sacciformis.
Additional features : annular ligament of the radius *(lig. anulare radii)*, collateral radial and ulnar ligaments *(lig. collaterale radiale* and *lig. collaterale ulnare).*
Type of joint : Humeroradial joint *(articulatio humeroradialis)* is a ball-and-socket joint, humeroulnar joint *(articulatio humeroulnaris)* is a hinge joint and proximal radioulnar joint *(articulatio radioulnaris proximalis)* is a trochoid joint. Movements are limited by position of olecranon ulnae in olecranon fossa *(fossa olecrani)*. In elbow joint is possible only flexion and extension, rotation (internal–pronation) and external rotation (supination).

Connections of the antebrachium *(juncturae radioulnares)*
Proximal radioulnar joint *(articulatio radioulnaris proximalis)*, distal radioulnar joint *(articulatio radioulnaris distalis)* and interosseous membrane of the forearm *(membrana interossea antebrachii)*.

A. Distal radioulnar joint *(articulatio radioulnaris distalis)*
Articular surfaces : head of ulna *(caput ulnae)* and ulnar notch of radius *(incisura ulnaris radii)*
Articular capsule : is thin and lax
Additional features : together with radiocarpal joint *(articulatio radiocarpea)*

Type of joint : trochoid joint – rotation (internal and external).

B. **Interosseous membrane of the forearm** *(membrana interossea antebrachii)* – a stiff membrane attached to the margo interosseus of the radius and the ulna. It serves for the attachment of some muscles of forearm, it limits external rotation.

Joints of the hand *(articulationes manus)*

A. Radiocarpal joint *(articulatio radiocarpea)*
Articular surfaces : carpal articular surface of the radius *(facies articularis carpea radii)* and scaphoid, lunate and triquetrum bones *(os scaphoideum, os lunatum and os triquetrum)*.
Articular capsule : shares it together with midcarpal joint *(articulatio mediocarpea)*
Additional features: articular disk *(discus articularis)*, the ulna is separated from carpal bones by this disk. Ligaments shares with the midcarpal joint *(articulatio mediocarpea).*
Type of joint : ellipsoidal, movements together with midcarpal joint *(articulatio mediocarpea).*

B. Midcarpal joint *(articulatio mediocarpea)* – connection between proximal and distal row of carpal bones
Articular surfaces : laterally – trapezium *(os trapezium)* and trapezoideum *(os trapezoideum)* form the articular fossa and scaphoideum *(os scaphoideum)* forms an articular head, medially – scaphoid *(os scaphoideum),* lunate and triquetrum *(os lunatum and os triquetrum)* form an articular fossa and articular head is formed by capitate and hamate *(os capitatum* and os *hamatum).* Joint has an S-shaped joint space.
Articular capsule : shares with radiocarpal joint *(articulatio radiocarpea)*
Additional features: dorsal and palmar radiocarpal ligaments *(lig. radiocarpeum dorsale* and *palmare)*, palmar ulnocarpal ligament *(lig. ulnocarpeum palmare),* radiate carpal ligament *(lig. carpi radiatum*) runs from palmar surface of capitate *(os capitatum)* to the neighbour carpal bones. Dorsal, palmar and interosseous intercarpal ligaments *(ligg. intercarpea dorsalia, palmaria* and *interossea)* join together carpal bones.
Type of joint : ellipsoid joint, movements shares together with midcarpal joint *(articulatio mediocarpea)* – palmar and dorsal flexion, radial and ulnar deviation and rotary movement .

C. Pisotriquetral joint *(articulatio ossis pisiformis)*
Articular surfaces: connection between pisiforme *(os pisiforme)* and triquetrum *(os triquetrum)*.
Articular capsule: is attached to the margins of the articular surfaces.
Additional features: articular capsule is reinforced by pisohamate and pisometacarpale ligaments *(lig. pisohamatum* and *lig. pisometacarpeum)*.

D. Carpometacarpal joint of the thumb *(articulatio carpometacarpea pollicis)*
Articular surfaces: connection between trapezium *(os trapezium)* and basis of the I. metacarpal bone.
Articular capsule: is relatively lax and it is attached to the margins of the articular surfaces.
Type of the joint: saddle; movements – abduction and adduction of the thumb, oposition and reposition. Thumb is the most movable finger.

E. Carpometacarpal joints II. – V. *(articulationes carpometacarpeae II. – V.)*
Articular surfaces: distal row of carpal bones joins to bases of the II. – V. metacarpal bones + Connection between lateral surfaces of the bases of the metacarpal bones.
Articular capsule: is attached to the margins of the articular surfaces.
Additional features: Palmar, dorsal and interosseous carpometacarpal ligaments *(ligg. carpometacarpea palmaria, dorsalia* and *interossea)* and between bases of metacarpal bones palmar,

dorsal and interosseous intermetacarpal ligaments *(ligg. intermetacarpea palmaria, dorsalia* and *interossea).*
Type of the joint: amphiartrose (almost immobile joint).

F. Metacarpophalangeal joints *(articulationes metacarpophalangeae)*
Articular surfaces: head of metacarpals and bases of proximal phalanges
Articular capsule: is lax and it is attached to the margins of the articular surfaces.
Additional features: fibrous cartilages increase articular fossae – *laminae fibrocartilagineae palmares* and restriction of movements is caused by the strong collateral ligaments *(ligg. collateralia)*. Palmar sides of the heads of the II. – V. metacarpal bones are joined by transverse profound metacarpal ligament *(lig. metacarpeum transversum profundum).*
Type of the joint: condyloid point (ellipsoidea) or possible also ball-and-socket (extension) with cylindrical point (flexion), with possibility of flexion, extension, abduction and adduction.

G. Interphalangeal joints *(articulationes interphalangeae manus)*
Articular surfaces: *trochlea phalangis* of the proximal phalanx, basis of distal phalanx.
Articular capsule: is attached to margins of the articular surfaces.
Additional features: fibrous cartilages increase articular fossae – *laminae fibrocartilagineae palmares*. Articular capsules are reinforced by the strong collateral ligaments *(ligg. collateralia)*.
Type of joint: hinge joint, movements – flexion and extension, distal phalanx with possibility of hyperextension.

Sulcus et canalis carpi
Eminetia carpi ulnaris et radialis – ulnar and radial carpal eminence
Retinaculum flexorum