Articular system II

Senior lecturer: Pevnev G.O.
# Cartilages

## Hyaline
- Has an intercellular matrix rich in hyaluronic acid and mucopolysaccharides, which are natural lubricants
- Forms the articular cartilage in most joints
- Provides the anlage for long bone development

## Fibrous
- Has an intercellular matrix rich in mucopolysaccharides and bundles of collagenous fibers
- Mucopolysaccharides provide high water content
- Especially resilient and durable form of cartilage
- Forms most symphyses and joint discs

## Elastic
- Has an intercellular matrix rich in mucopolysaccharides and bundles of elastic fibers, which provide a strong, yet flexible, support
- Forms the skeletal structure of external ear and the tip of the nose
Classification of the joints

1. Synarthrosis (immovable joint):
   1) Syndesmosis
   2) Synchondrosis
   3) Synostosis

2. Diarthrosis (synovial joint, joint)
Complexity of the joints

Simple joint
- two articular surfaces

Complex joint
- more than two articular surfaces
Synovial joints

Combined joint

- Two anatomically isolated joints move together at the same time
Joints of the vertebral column

Zygapophysial joint
(simple plane combined synovial joint)

Symphysis / synchondrosis

Syndesmosis (Ligaments)
Intervertebral disc

- Each disc composed of an outer fibrocartilaginous portion (*annulus fibrosus*) and an inner gelatinous central portion (*nucleus pulposus*)
- Nucleus pulposus – remnant of notochord

**Functions of intervertebral disc:**
- Permit limited movement between adjacent vertebrae
- Nucleus pulposus – compressible but deformable pad, that distribute forces over the entire surface of the vertebra
* Syndesmoses of vertebral column (ligaments):

* The anterior longitudinal ligament (lig. longitudinale anterius)
* The posterior longitudinal ligament (lig. longitudinale posterius)
* The yellow ligaments (ligg. flava) - elastic fibers!
* The interspinous ligaments (ligg. interspinalia)
* The supraspinous ligament (lig. supraspinale)
* The intertransverse ligaments (ligg. intertransversaria)
* Movements of Spinal Column

* Flexion and extension along frontal axis
* Movements of Spinal Column

- Lateral flexion along sagittal axis
- Rotation along vertical axis
There are four natural curves in the vertebral column:

- **Cervical curvature**
- **Thoracic curvature**
- **Lumbar curvature**
- **Sacral curvature**

**Additional Terms:**

- **Lordosis**
- **Kyphosis**
- **Scoliosis**
- **Abnormal curve of spine**

**Images:**

- Human skeleton diagram highlighting lordosis and kyphosis.
- Dog skeleton diagram with thoracic and lumbar vertebrae labeled.
*Shoulder Girdle*
**Shoulder Girdle**

Adduction and abduction along sagittal axis
*Shoulder Girdle

*Elevation and depression along transverse axis
*Shoulder joint* (*articulatio humeri*)

**Articular surfaces:**

* The head of the humerus - the glenoid cavity of the scapula.

* *The glenoid labrum* (labrum glenoidale) is on the circumference of the glenoid cavity. It increases its depth.
Shoulder joint (articulatio humeri)
Shoulder joint (*articulatio humeri*)
*Shoulder joint (articulatio humeri)*

*Simple spheroidal joint.*
*Shoulder Joint*

*Flexion and extension along frontal axis*
Sagittal plane

*Shoulder Joint*

*Adduction and abduction along sagittal axis*
*Shoulder Joint

Outward Medial Rotation  Inward Medial Rotation  Circumduction

*Rotation and circumduction along vertical axis
The elbow joint (*articulatio cubiti*)

Three articulating bones form three joints invested in a common capsule:

1) **humero-ulnar joint** (hinge joint)
2) **humeroradial joint** (spheroidal joint)
3) **proximal radio-ulnar joint** (cylindrical=pivot joint)

_Articular capsule_ embraces the olecranon, radial and coronoid fossae but leaves the epicondyles free.
*Elbow Joint

*Flexion and extension along frontal axis
*Elbow Joint*

* Pronation and supination along vertical axis
* Combined movement in proximal and distal radio-ulnar joint
*The wrist joint (articulatio radiocarpalis)*

- **Articular surfaces** The carpal articular surface of the radius and the articular disc (the distal radio-ulnar joint) - scaphoid, lunate and triquetral bones.
- Complex ellipsoidal joint.
*The wrist joint*
Wrist Joint

Flexion and extension along frontal axis
Wrist Joint

Adduction and abduction along sagittal axis
*Wrist Joint

Circumduction
The hip joint (articulatio coxae)
The hip joint (articulatio coxae)
Ligaments:
1) Lig. iliofemorale
2) Lig. ischiofemorale
3) Lig. pubofemorale
4) Zona orbicularis
5) Lig. capitis femoris
* The hip joint

* Flexion and extension along frontal axis
* Hip Joint

* Adduction and abduction along sagittal axis
Hip Joint

Rotation along vertical axis
The knee joint (articulatio genus)

Frontal View of Right Knee (with patella reflected)

- Femur (thighbone)
- Patella (underside)
- Trochlea (patellofemoral groove)
- Anterior Cruciate Ligament
- Posterior Cruciate Ligament
- Medial Collateral Ligament
- Medial Meniscus
- Lateral Femoral Condyle
- Lateral Meniscus
- Lateral Collateral Ligament
- Tibial Plateau
- Tibia (shinbone)
- Tibial Tuberosity

Complex bicondylar joint

Hinge joint
The knee joint (*articulatio genus*)

Intra-articular ligaments
The knee joint (*articulatio genus*)

Extra-articular ligaments
Hypothesized function -
control internal tibial rotation, stabilize internal rotation
Origin – on the prominence of the lateral femoral epicondyle
Insertion - the body of the ALL ran an oblique course to the anterolateral side of the proximal tibia.

Fig. 4 Anatomic drawing considering the ALL and its relationship with well-known anatomical landmarks on the lateral aspect of the human knee. (A) Knee in full extension. (B) Knee in 90° of flexion.

ALL, anterolateral ligament; LCL, lateral collateral ligament; GT, Gerdy’s tubercle; LFE, lateral femoral epicondyle; PT, popliteus tendon; PFL, popliteo-fibular ligament.
1879, years before the discovery of X-rays, Dr. Paul Segond described a remarkably constant avulsion fracture pattern at the anterolateral proximal tibia as a result of forced internal rotation at the knee (Segond fracture)
Lateral and medial menisci of the knee joint
(viscoelastic soft tissue)

**Functions of the menisci:**
- Adapt articular surfaces of femur and tibia, increase their congruence, hence the stresses on tibial cartilage are reduced
- To distribute loads and therefore reduce the stresses on the tibia,
- Joint stabilisation;
- Shock absorption;
- Joint lubrication;
- Cartilage protection and prevention of osteoarthritis
Fig. 1. Human meniscus. (a) Right human knee joint viewed from above (the femur has been removed); the tibial tuberosity is on top. The medial and lateral menisci are connected by a transverse ligament (TL).

1 - anterior insertional ligament of the medial meniscus; 2 - posterior insertional ligament of the medial meniscus; 3 - anterior insertional ligament of the lateral meniscus; 4 - posterior insertional ligament of the lateral meniscus; ACL - cross section of the anterior cruciate ligament; PCL – cross section of the posterior cruciate ligament.

Fig. 2. Diagram demonstrating the importance of intact meniscal entheses for the load distribution function of the meniscus.  
(a) With intact entheses the load (thick arrows) is transmitted via the menisci and articular cartilage through a large contact area (left hand side of figure; small arrows). Part of the load is transformed to hoop stresses (right hand side of figure; long arrows).
(b) When the insertional ligaments are transected (right hand side of figure; arrowheads), the meniscus will extrude from the knee joint during loading, and the load (left hand side of figure; thick arrows) is mainly transmitted via articular cartilage through a reduced contact area (small arrows).

Karola Messner and Jizong Gao.  
The menisci of the knee joint.  
(1998) 193, pp. 161±178
*The knee joint (articulatio genus)*
*The knee joint*

*Flexion and extension along frontal axis*
Rotation becomes possible when the knee is flexed!
Articulatio talocruralis

Complex saddle joint

Fibula
Tibia
Talus
Calcaneus
Ankle joint ligaments

LATERAL (OUTER) LIGAMENTS OF THE ANKLE JOINT

Medial ligaments
Ankle Joint

*Plantar flexion and dorsi flexion along frontal axis
*Ankle Joint (subtalar joint)*

*Inversion and eversion along vertical axis*
Articulatio tarsi transversa (Chopart`s joint) combines two joints:
- Calcaneocuboid joint
- Talonavicular joint

Ligamentum bifurcatum:
- lig. calcaneonaviculare
- lig. calcaneocuboideum

- “key” of Chopart`s joint

Articulatio tarsimetatarsales (Lisfrank`s joint)

Ligg. cuneometatarsalia interossea:
The “key” of Lisfrank`s joint – cuneometatarsal interosseus ligament between medial cuneiform bone and second metatarsal bone
- Weight distribution, amortization
- Adequate blood supply of foot
* The temporomandibular joint (articulatio temporomandibularis, TMJ)

* Complex bicondylar combined joint
The surfaces are complemented by a fibrous articular disc (discus articularis) located between them. The edges of the disc are joined to the articular capsule as a result of which the articular cavity is separated into two isolated compartments.

Disc is made out of fibrocartilage with markedly anteroposterior alignment.

**Functions:**
1) to diminish the effects of incongruence between the articular surfaces.
2) the disc acts as a shock absorber when the joint is subjected to impact loading.
*Articular capsule* is attached along the borders of articular surfaces. The mandibular neck is within the articular cavity.
* Movements of the temporomandibular joint

- **Protrusion**
  - lateral pterygoid assisted by medial pterygoid

- **Retraction**
  - posterior fibers of temporalis, deep part of masseter, and geniohyoid and digastric

- **Elevation**
  - temporalis, masseter, medial pterygoid

- **Depression**
  - gravity
  - digastric, geniohyoid, and mylohyoid muscles
Function of the Temporomandibular Joint

**Normal Closed Position**
The structures that make it possible to open and close your mouth include the bones, joints, and muscles. When functioning correctly, your jawbone is separated from your skull by a soft disc that acts as a cushion when you chew, speak or swallow.

**Normal Open Position**
When the joint is functioning properly, the disc stays in place when the jaw is in use, preventing the bony structures from coming in contact.

**Abnormal**
Disc and Muscle Displacement
When the joint is not functioning properly, the disc is commonly pulled forward when the jaw is in use, causing the bones of the skull and jaw to grind together.
When the mandible moves laterally, one condyle (B) moves forward and inward, while the other condyle (A) will shift slightly in a lateroposterior (or rotate in vertical axis) direction.
Consequence of the answer:

1. Name of the joint (English and Latin)
2. Classification of the joint (simple, combined, complex)
3. Description of the essential elements of the joint (articular surface, type of cartilage, cavity and capsule)
4. Description of the ligaments.
5. Special features (bursa)
6. Movements
Which of the joint has intraarticular ligaments:

1) Shoulder joint
2) Hip joint
3) Elbow joint
4) Knee joint
5) TMJ
6) Wrist joint
Hyaline cartilage covers the surfaces of the joints:

1) Shoulder joint
2) Hip joint
3) Sternoclavicular joint
4) Knee joint
5) TMJ
6) Wrist joint
# Comparison of Male and Female Pelves

## Table 7.4 Comparison of the Male and Female Pelves

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>FEMALE</th>
<th>MALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>General structure and</td>
<td>Tilted forward; adapted for childbearing; true pelvis defines the</td>
<td>Tilted less far forward; adapted for support of a male's heavier</td>
</tr>
<tr>
<td>functional modifications</td>
<td>birth canal; cavity of the true pelvis is broad, shallow, and has a</td>
<td>build and stronger muscles; cavity of the true pelvis is narrow and</td>
</tr>
<tr>
<td></td>
<td>greater capacity</td>
<td>deep</td>
</tr>
<tr>
<td>Bone thickness</td>
<td>Less; bones lighter, thinner, and smoother</td>
<td>Greater; bones heavier and thicker, and markings are more prominent</td>
</tr>
<tr>
<td>Acetabula</td>
<td>Smaller; farther apart</td>
<td>Larger; closer</td>
</tr>
<tr>
<td>Pubic arch/angle</td>
<td>Broader (80–90°); more rounded</td>
<td>More acute (50–60°)</td>
</tr>
</tbody>
</table>

![Anterior view of male and female pelvises with labeled structures](image)

*Table 7.4.1*