Joints:

Classifications

What is a joint?

- A joint is defined as a connection between two bones in the skeletal system
- Joints can be classified by
  - the type of the tissue present →fibrous, cartilaginous or synovial
  - the degree of movement permitted → synarthrosis, amphiarthrosis or diarthrosis

These are our _____ & _____ classifications?

Classification by Structure

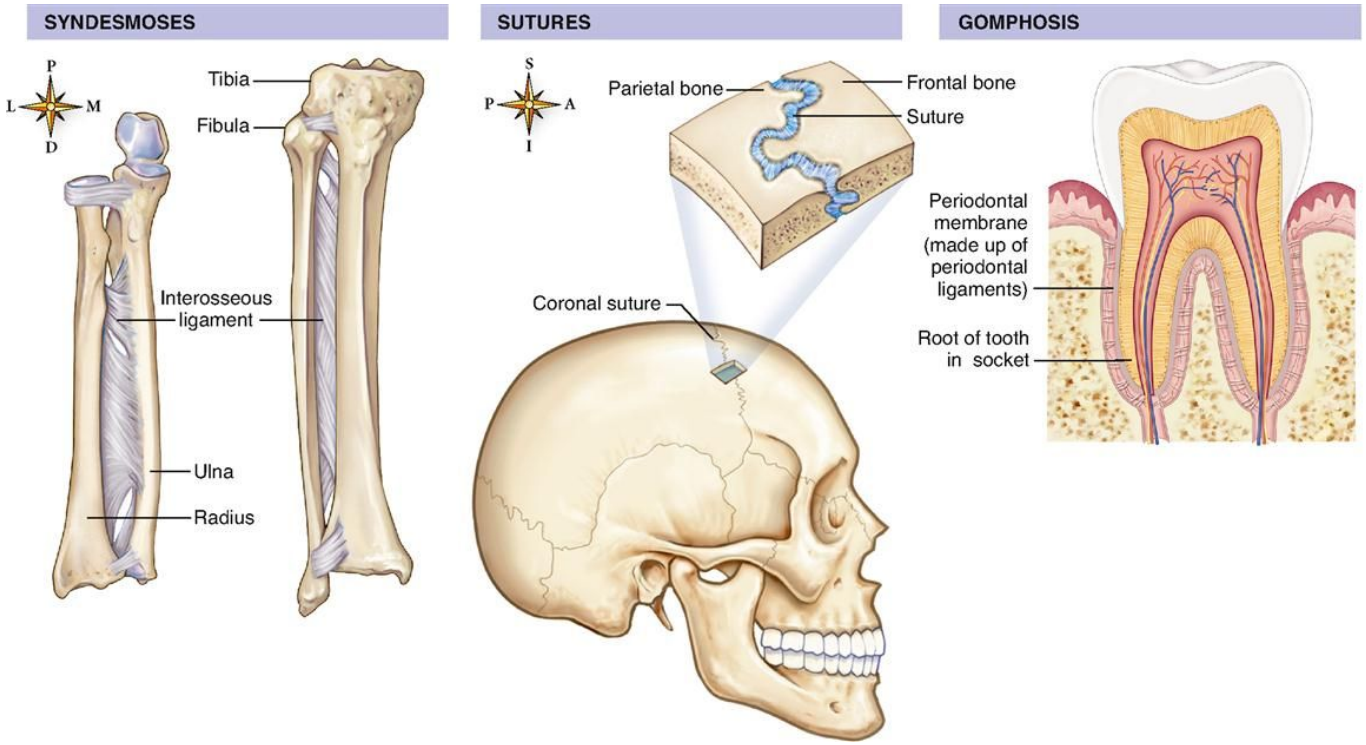
- Classification by type of tissue:
  - Fibrous → bones connected by fibrous tissue
  - Cartilaginous → bones connected by cartilage
  - Synovial → articulating surfaces enclosed within fluid-filled joint capsule

Examples?

Fibrous Joints

- A fibrous joint is where the bones are bound by a tough, fibrous tissue
- These are typically joints that require strength.
- Fibrous joints can be further sub-classified into →
  - Sutures
  - gomphoses
  - syndesmoses

Fibrous Joints



Sutures

- Sutures→
  - immovable joints (synarthrosis),
  - are only found between the flat, plate-like bones of the skull

Features:

- There is limited movement until about 20 years of age, after which they become fixed and immobile
- They are most important in birth, as at that stage the joints are not fused, allowing deformation of the skull as it passes through the birth canal

Gomphoses

- Gomphoses →
  - immovable joints
  - found where the teeth articulate with their sockets in the maxilla (upper teeth) or the mandible (lower teeth)

Example:

- The tooth is bound into its socket by the strong periodontal ligament

Syndesmoses

- Syndesmoses →
  - slightly movable joints (amphiarthrotic)

Features & Examples

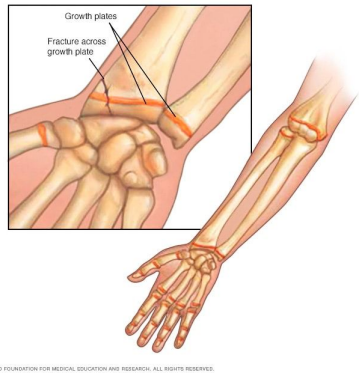
- comprised of bones held together by an interosseous membrane
- the middle radioulnar joint and middle tibiofibular joint are examples of a syndesmosis joint

Cartilaginous joints

- bones are united by fibrocartilage or hyaline cartilage

- There are two main types
  - synchondroses (primary cartilaginous)
  - symphyses (secondary cartilaginous)

Synchondrosis



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- synchondrosis joints →
  - the bones are connected by hyaline cartilage
  - these joints are immovable (synarthrosis)

Example:

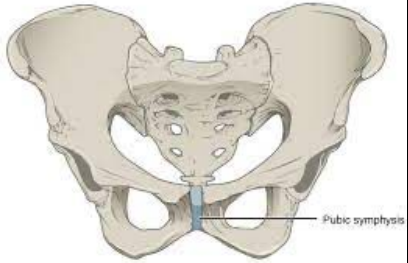
- between the diaphysis and epiphysis of a growing long bone (growth plate)

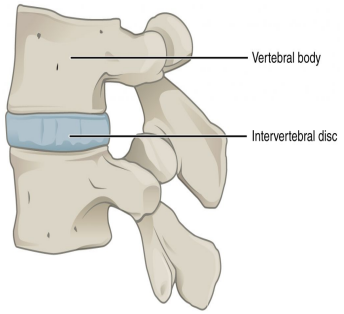
Sympheses

- where the bones are united by a layer of fibrocartilage
- slightly movable (amphiarthrosis)

Examples:

- pubic symphysis
- joints between vertebral bodies





Synovial

- defined by →
  - the presence of a fluid-filled joint cavity
  - fibrous joint capsule

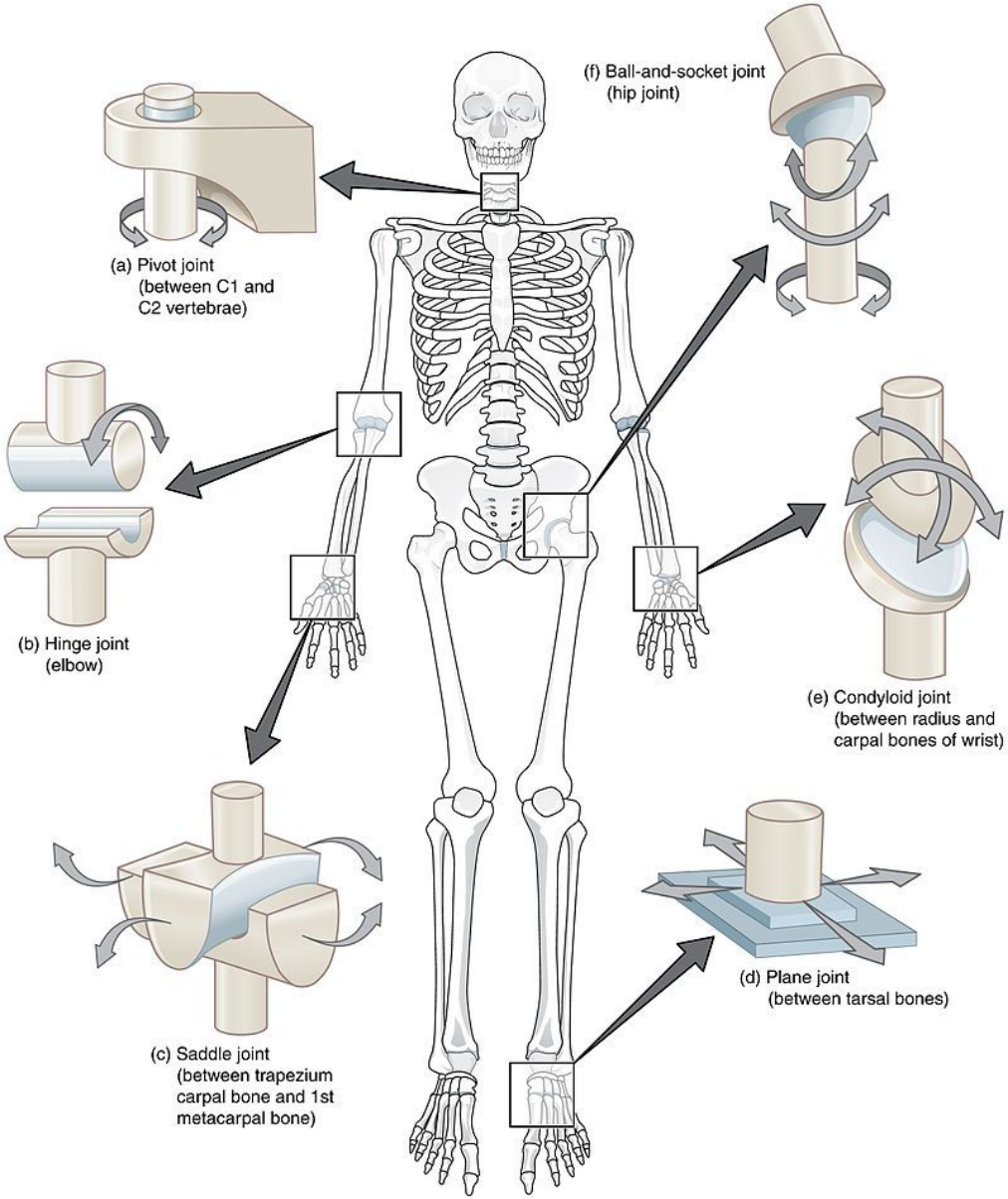
- freely movable (diarthrotic)
- are the most common type of joint found in the body

- Synovial joints can be sub-classified into several different types
  - Names depend on:
    - shape of their articular surfaces
    - movements permitted

Classifications of Synovial Joints

- Hinge →
  - permits movement in one plane
  - usually flexion and extension.
  - elbow joint, ankle joint, knee joint
- Saddle →
  - named due to its resemblance to a saddle on a horse's back
  - characterised by opposing articular surfaces with a reciprocal concave-convex shape
  - carpometacarpal joints
- Plane →
  - the articular surfaces are relatively flat, allowing the bones to glide over one another
  - sternoclavicular joint, acromioclavicular joint, subtalar joint

- Pivot →
  - allows for rotation only
  - formed by a central bony pivot, which is surrounded by a bony-ligamentous ring
  - proximal and distal radioulnar joints, atlantoaxial joint
- Condyloid/Ellipsoid →
  - contains a convex surface which articulates with a concave elliptical cavity
  - wrist joint, metacarpophalangeal joint, metatarsophalangeal joint
- Ball and Socket →
  - where the ball-shaped surface of one rounded bone fits into the cup-like depression of another bone
  - permits free movement in numerous axes
  - hip joint, shoulder joint

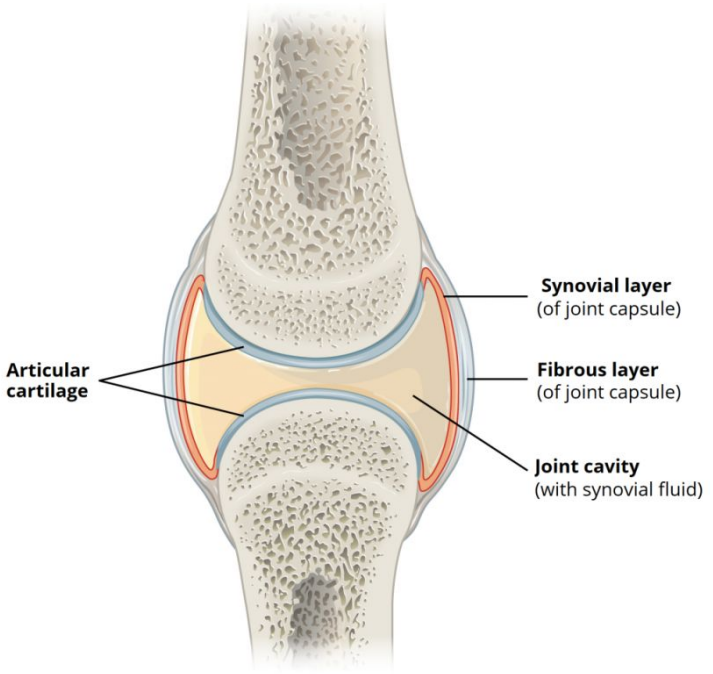

(f) Ball-and-socket joint
(hip joint)
(a) Pivot joint
(between C1 and
C2 vertebrae)
(b) Hinge joint
(elbow)
(e) Condyloid joint
(between radius and
carpal bones of wrist)
(c) Saddle joint
(between trapezium
carpal bone and 1st
metacarpal bone)
(d) Plane joint
(between tarsal bones)

Axial

- Nonaxial →
  - permit motion in a plane but is a linear movement
- Uniaxial →
  - 1 plane of motion
- Biaxial →
  - 2 planes of motion
- Multiaxial →
  - 3 planes of motion

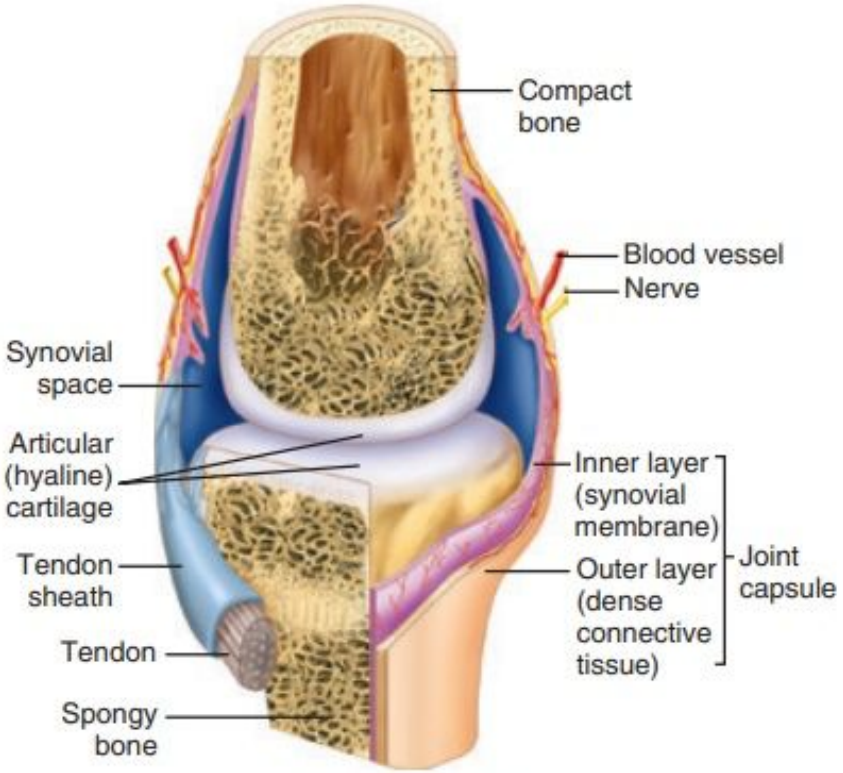
Structure of a Synovial Joint

- The three main features of a synovial joint are:
- (i) articular capsule
- (ii) articular cartilage
- (iii) synovial fluid



i) Articular Capsule

- surrounds the joint and is continuous with the periosteum of articulating bones
- Two layers:
  - **Fibrous layer (outer) →**
    - consists of white fibrous tissue, known the capsular ligament
    - Holds the articulating bones together and supports the underlying synovium
  - **Synovial layer (inner) →**
  - aka: synovium
    - a highly vascularised layer of serous connective tissue
    - absorbs and secretes synovial fluid
    - responsible for the mediation of nutrient exchange between blood and joint



Synovial joint

ii) Articular Cartilage

- hyaline cartilage covering the articulating surfaces of a synovial joint

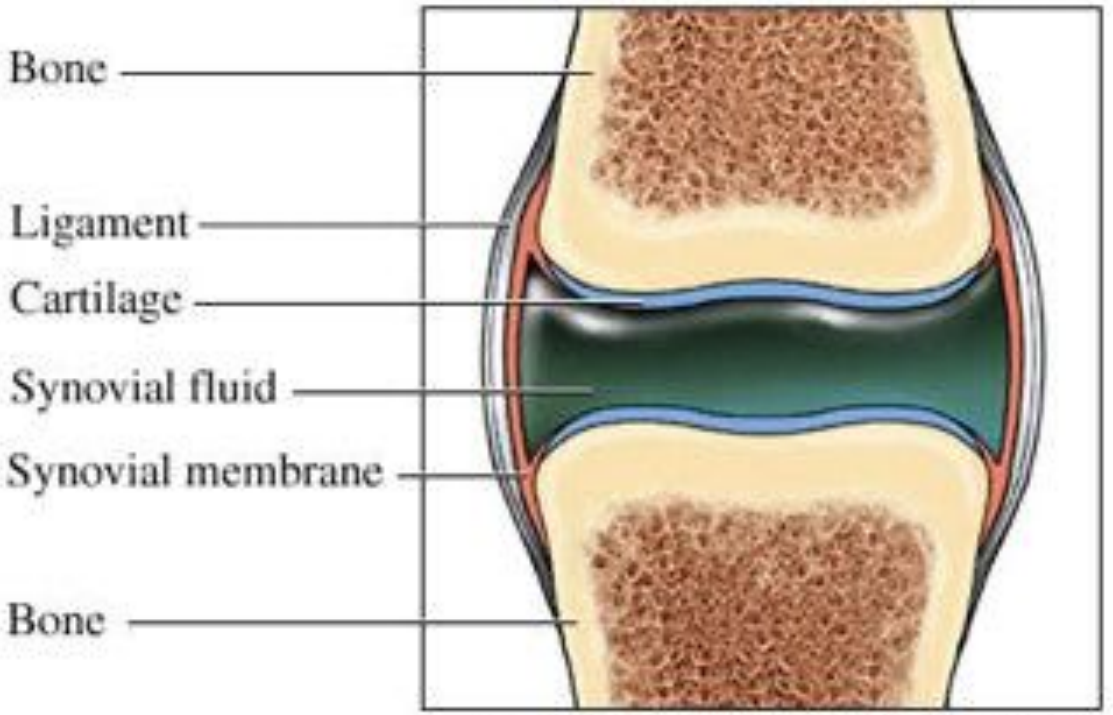
- The articular cartilage has two main roles:
  - minimizes friction upon joint movement
  - absorbs shock


Normal femoral cartilage
Damaged cartilage
Femur
Tibia

iii) Synovial Fluid

- located within the joint cavity of a synovial joint
- three primary functions:
  - lubrication
  - nutrient distribution
  - shock absorption

- articular cartilage is relatively avascular, and is reliant upon the passive diffusion of nutrients from the synovial fluid



Cross section of a healthy joint

Accessory Structures of Synovial Joints

Ligaments

- accessory ligaments
  - are separate ligaments but also part of the joint capsule

Structure:

- consist of bundles of dense regular connective tissue

Function:

- the connective tissue is highly adapted for resisting strain
- they resists any extreme movements that may damage the joint


TIBIA
ANTERIOR COLLICULUS
FLEXOR DIGITORUM TENDON
TIBIALIS POSTERIOR TENDON
DEEP POSTERIOR TIBIOTALAR (dPTTL)
TALUS
CALCANEUS
TIBIOCALCANEAL (TCL)
TIBIOSPRING (TSL)
TIBIONAVICULAR (TNL)
ANTERIOR TIBIOTALAR (ATTL)
SPRING LIGAMENT
SUSTENTACULUM TALI
NAVICULAR
MEDIAL CUNEIFORM

Accessory Structures of Synovial Joints

Bursae

Structure:

- a bursa is a small sac lined by synovial membrane and filled with synovial fluid

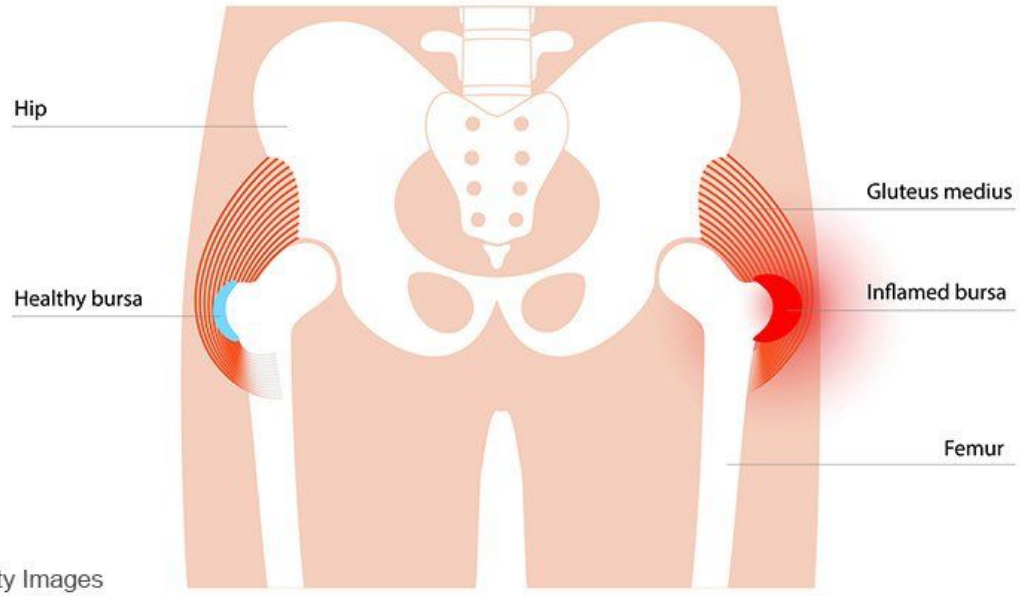
Location:

- located at key points of friction in a joint

Function:

- allow joints greater freedom of movement
- protect the articular surfaces from friction-induced degeneration

Hip (Trochanteric) Bursitis



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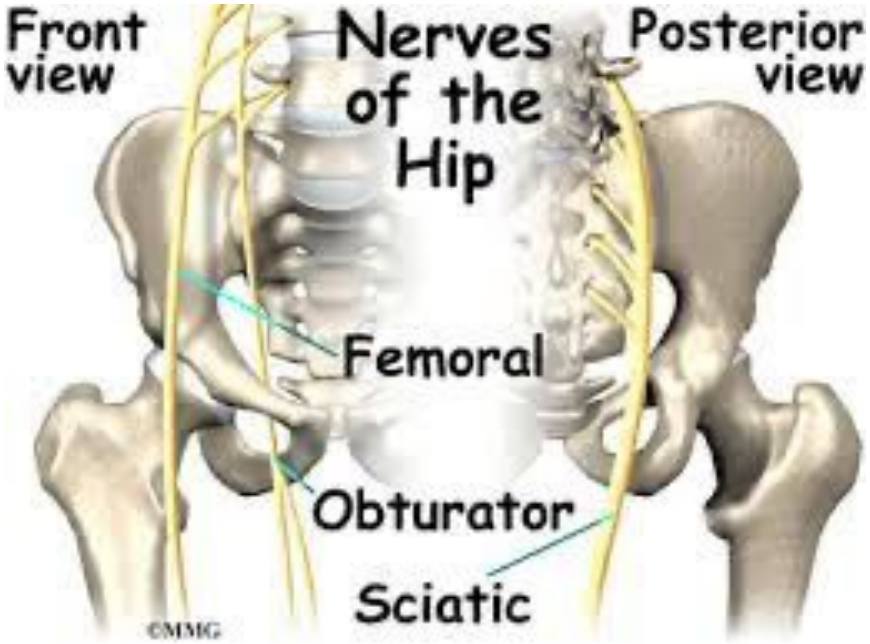
Accessory Structures of Synovial Joints

Innervation

- synovial joints have a rich supply from articular nerves
- The innervation of a joint can be determined using Hilton's Law →
  - 'the nerves supplying a joint also supply the muscles moving the joint and the skin covering their distal attachments'
- articular nerves transmit afferent impulses, including proprioceptive (joint position) and nociceptive (pain) sensation


Front view
Nerves of the Hip
Posterior view
Femoral
Obturator
Sciatic
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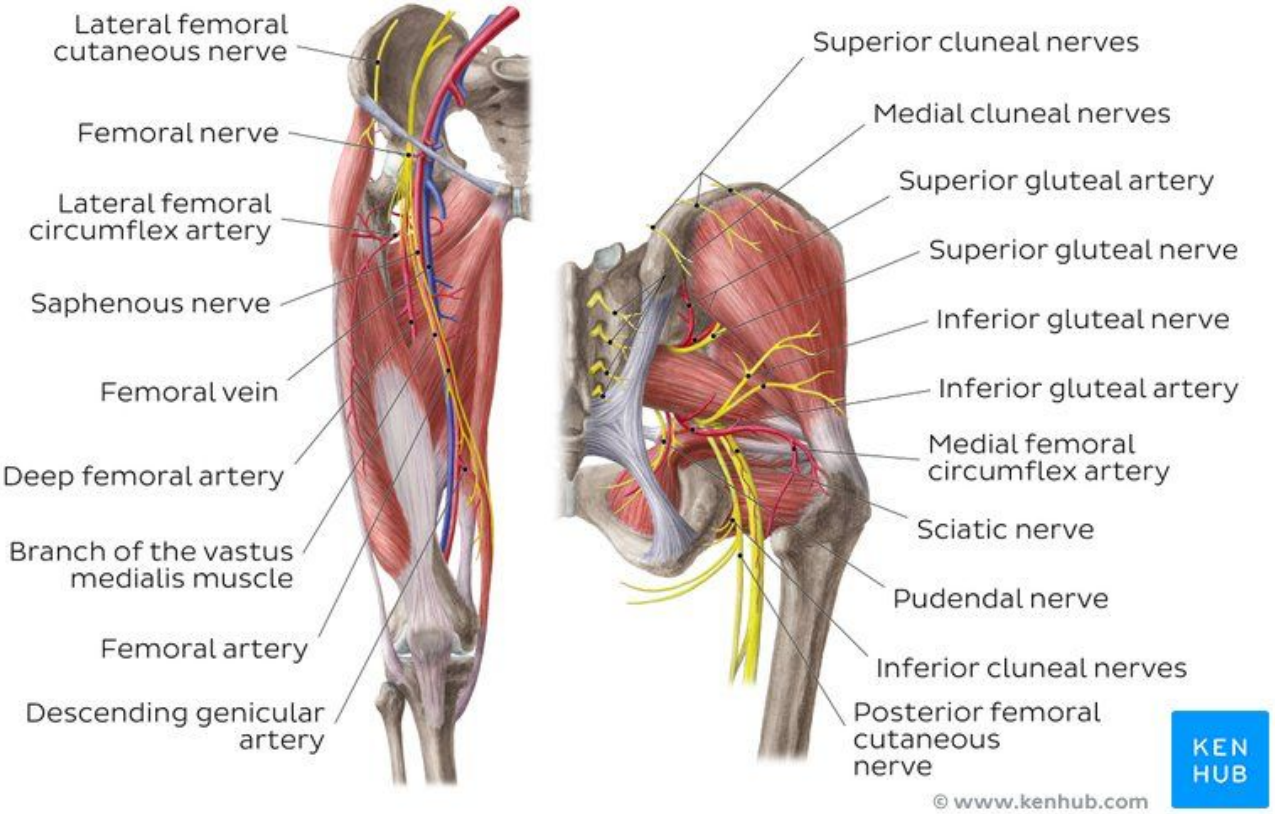
Accessory Structures of Synovial Joints

Vasculature

- articular arteries →
  - arise from the vessels around the joint
  - the articular arteries are located within the joint capsule, mostly in the synovial membrane

- articular veins →
  - accompany the articular arteries and are also found in the synovial membrane


Lateral femoral cutaneous nerve
Femoral nerve
Lateral femoral circumflex artery
Saphenous nerve
Femoral vein
Deep femoral artery
Branch of the vastus medialis muscle
Femoral artery
Descending genicular artery
Superior cluneal nerves
Medial cluneal nerves
Superior gluteal artery
Superior gluteal nerve
Inferior gluteal nerve
Inferior gluteal artery
Medial femoral circumflex artery
Sciatic nerve
Pudendal nerve
Inferior cluneal nerves
Posterior femoral cutaneous nerve
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Classification by function

- Synarthrosis – immovable
  - suture
- Amphiarthrosis – slightly moveable
  - Sympheses (pubic symphysis)
- Diarthrosis – freely moveable
  - Synovial