

LECTURE 18

LOWER LIMBS (1) BONES & JOINTS

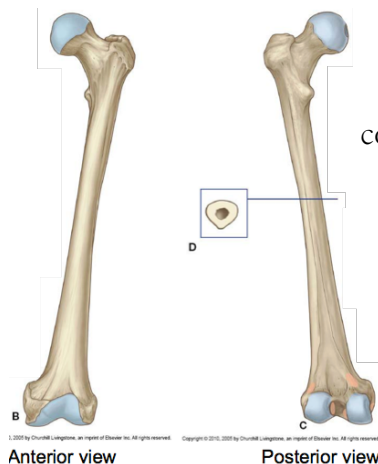
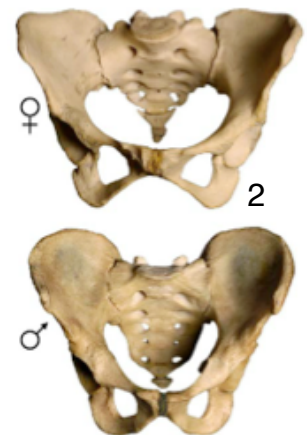
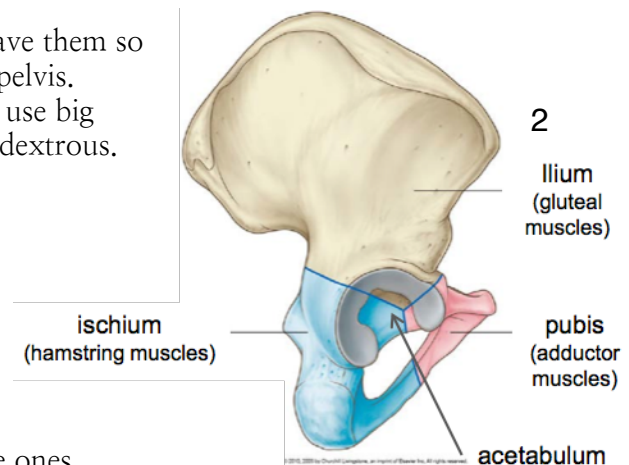
- Girdle attaching lower limb to axial skeleton.
- Lower limb: thigh, leg, foot. Generally, the organisation of the lower limb is common through evolution, just with adaptations on how we use the structures creating differences.
- Thigh: single long bone, connects to leg with 2 long bones (this is same as arm) then tarsal bones then digits.

LOWER LIMB BONES & JOINTS

- (1) Shoulder girdle made for mobility. Our pelvic girdle, however, is made for stability. It carries our whole body weight. Lower limb bones tend to be longer; increase leverage, stronger.
- These limbs rotate during development. At 4–5 weeks of age, the upper limbs begin to develop (bud out) in the embryo. As this happens, it rotates in a lateral orientation (outwards), bringing the flexor surfaces anteriorly. Few weeks later our lower limbs begin to bud out and rotate medially (inwards), bringing our lower limb flexor surfaces posteriorly.
- Cats and dogs don't have angulated femurs. We have them so that our centre of gravity remains underneath our pelvis.
- Adaptation over evolutionary times; lost ability to use big toe. However they can be, if required, remarkably dextrous.

PELVIC GIRDLE

- (2) distal component of axial skeleton is the **sacrum**. 5 sacral bones/vertebra which fuse during development, ultimately for increased stability. We have head, upper limbs, thoracic cage and abdomen weight has to be transferred via skeleton to sacrum and pelvic girdle. It is thus more stable to have 1 large sacral bone than 5 little ones.
- Sacrum articulates with hip bone. We have 2 hip bones, one on each the RHS and LHS. These arch anteriorly and meet in the midline at the front, generating a stable bony ring.
- Pelvis is the most sexually dimorphic bone in the body. Male pelvis is more narrow and higher, female is relatively wider and more shallow.
- Each hip bone has 3 distinct bones that develop independently and fuse late in development. KNOW THESE 3 COMPONENTS:
 - **Ilium**: big bony ridges (when you put your hands on your hips you are touching the ilium).



- **Ischium**: what you sit on.
- **Pubis**: (pubic bone).
- These 3 bones come together at a point called the **acetabulum**. This is also where the lower limb articulates with the pelvis. Known colloquially as a hip joint even though it isn't really.

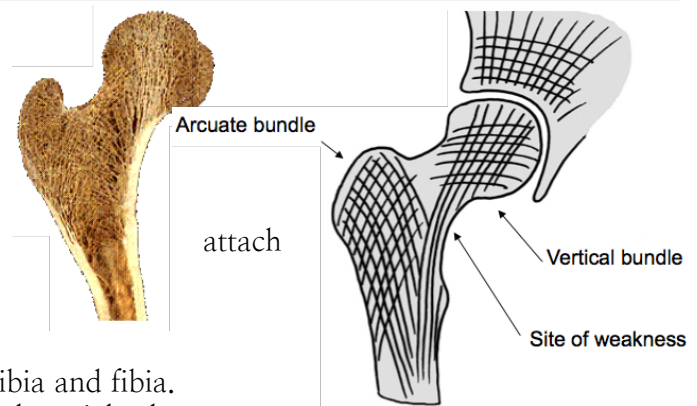
FEMUR

- (3) long bone of thigh. Recall the humerus. Single long bone with a head, a neck. We also have **trochanters** (comparable to tuberosities in humerus). There is a greater trochanter and lesser trochanter.
- There is also a **long shaft**, terminating in **medial particular condyle** and **lateral articular condyle**. The **patella** articulates with the femur. It is sesamoid bone and has leverage for knee extensors.

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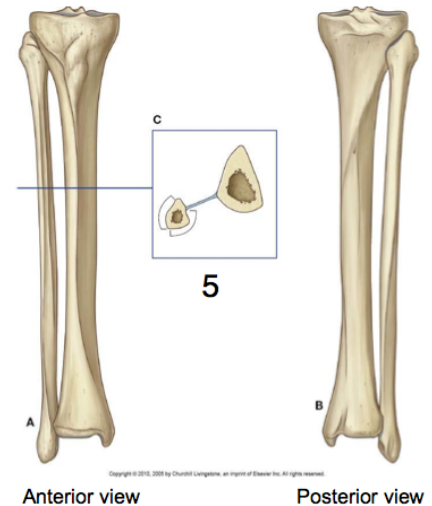
THE NECK

- (4) Very important. In a standing position with weight bearing, weight is transferred to superior aspect of acetabulum and then superior aspect of head of the femur.
- **Bony trabeculae** line up against forces of weight bearing, and also where muscles to and pull on bones.



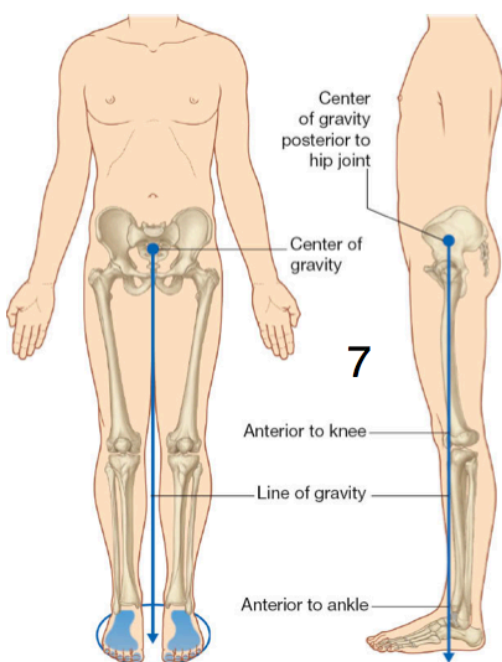
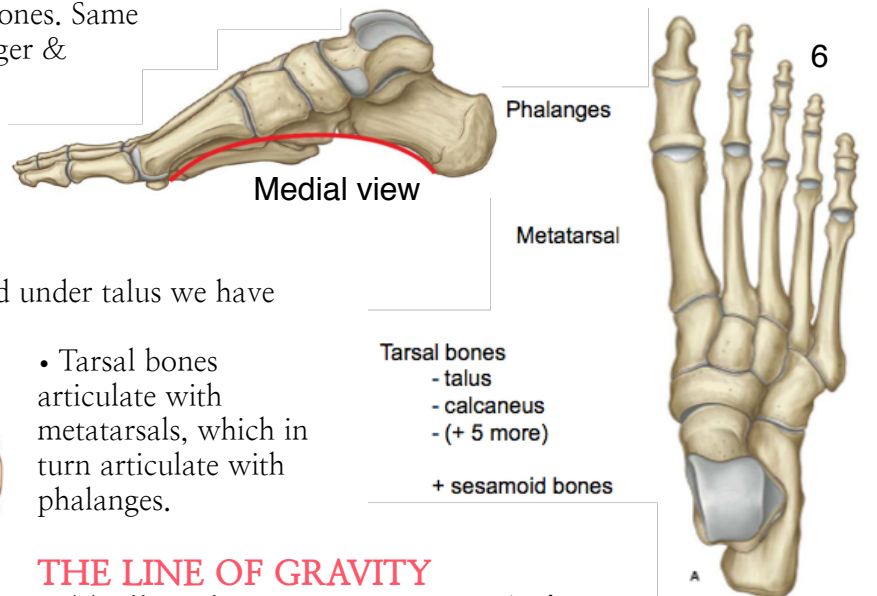
TIBIA & FIBULA

- (5) Femur articulates with 2 leg long bones, tibia and fibula.
- **Tibia**: long bone, weight bearing, bears all body weight down to angle. Is flat and has a **plateau** anteriorly. Trochlear notch for ankle joint.
 - Has a **shaft** which is in the subcutaneous part. The **tibial tuberosity** just below the kneel in front of tibia, distal to patella. Tibia terminates in the **medial malleolus**, which is the bump on the side of the angle.
- **Fibula**: long bone, not weight bearing. Joins the tibia via interosseus membrane. Shaft for muscle attachments, and **lateral malleolus**.
- Just like how in the arm the radius and ulna move relative to each other; we can pronate and supinate. Our tibia and fibula DO NOT do this, due to the interosseus membrane.



THE ANKLE & FOOT

- (6) distal to leg bones are foot bones. Same general arrangement as hand larger & heavier for weight transfer.
- Same organisation as hand bones but carpals become **tarsals** here. Don't need to know the 7 names of them, just remember these 2:
 - **Talus**: forms ankle bone, and under talus we have **calcaneus**.



THE LINE OF GRAVITY

- (7) effect of gravity on joints. We don't want line of gravity going directly through hip ankle or knee joints. See the line of gravity passes slightly behind the hip joint and slightly in front of the knee joint.
 - passes behind hip joint
 - (resisted by anterior capsule)
 - slightly in front of knee
 - (resisted by posterior capsule)
 - long way in front of ankle
 - (resisted by calf muscles, especially soleus)

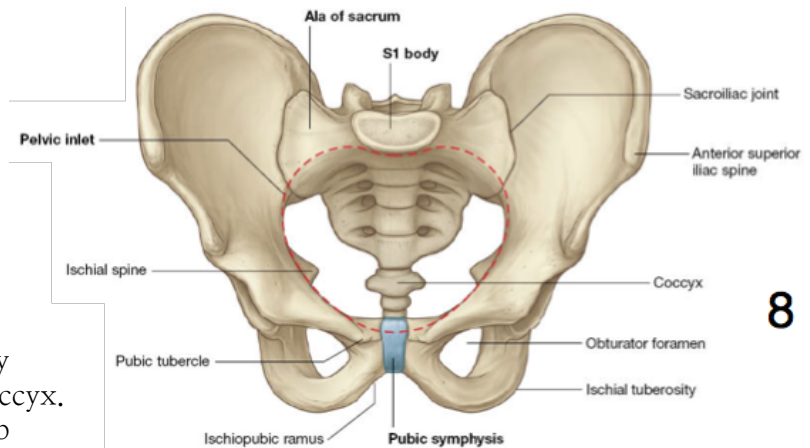
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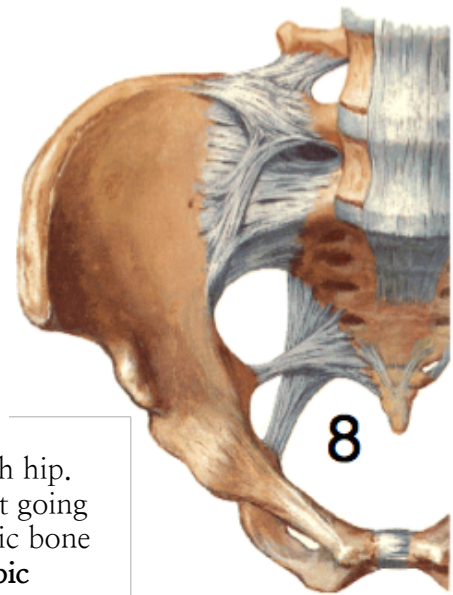
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PELVIC GIRDLE JOINTS

- (8) joint between sacrum and ilium: **sacroiliac joint**. Plane synovial joints with strong interosseus ligaments, creating a stable joint. Also an interosseus ligament joining the 2 joints together.
- **Pubic symphysis** is a very stable cartilaginous joint. Important for mobility and weight transference.
- The sacrococcygeal joint don't worry about it. Cartilaginous, sacrum & coccyx.
- interface between spine & lower limb
- strong 'complete' ring of bone
 - for weight transfer
 - protects contents
- stability v. mobility (compare to shoulder girdle)
- strong ligamentous support



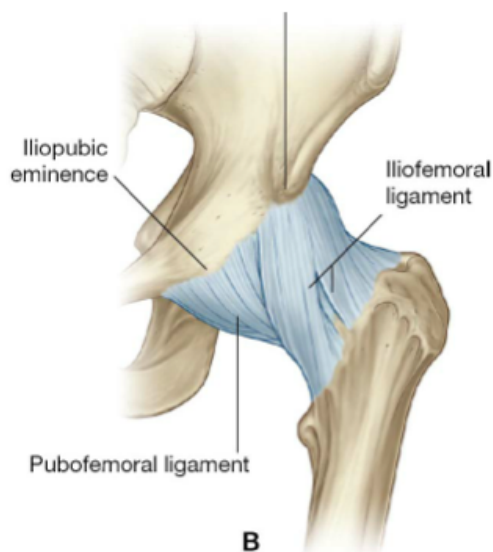
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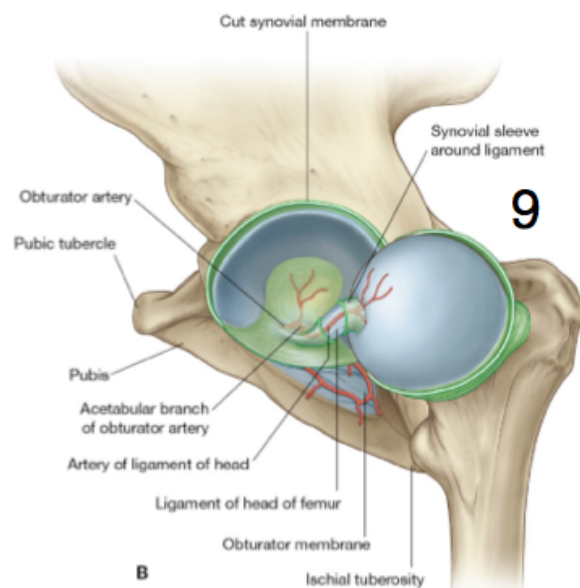
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HIP JOINT

- (9) Ball & socket joint. Very stable, deepened by labrum, has movement in 3 planes. Differences between shoulder and hip joint is congruity. Shoulder joint: shallow glenoid & large humerus head. Hip joint: acetabulum is very deep, allowing for good stability and congruency.
- Hip joint capsule is reinforced by strong ligaments. In front there is the iliofemoral ligament, which spirals and tightens with hip.
- Each of the 3 long bones mentioned above will have a ligament going to the femur. The ilium has the **iliofemoral ligament**. Each pelvic bone has own ligament. Also have **pubofemoral ligament** and **iliopubic ligament**.



B



B

9

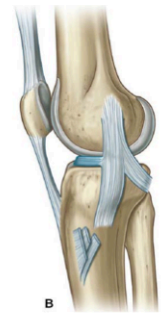
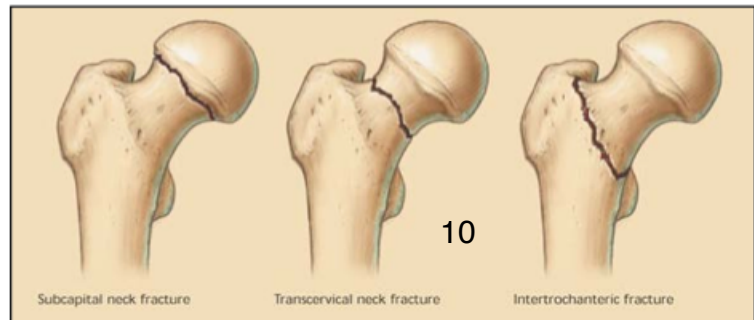
APPLIED ANATOMY OF THE HIP JOINT

- (10) Femur neck susceptible to fracture due to trabecular organisation. Can have several different types of fractures. The blood supply to the femur is unusual; it comes past the head and the neck,

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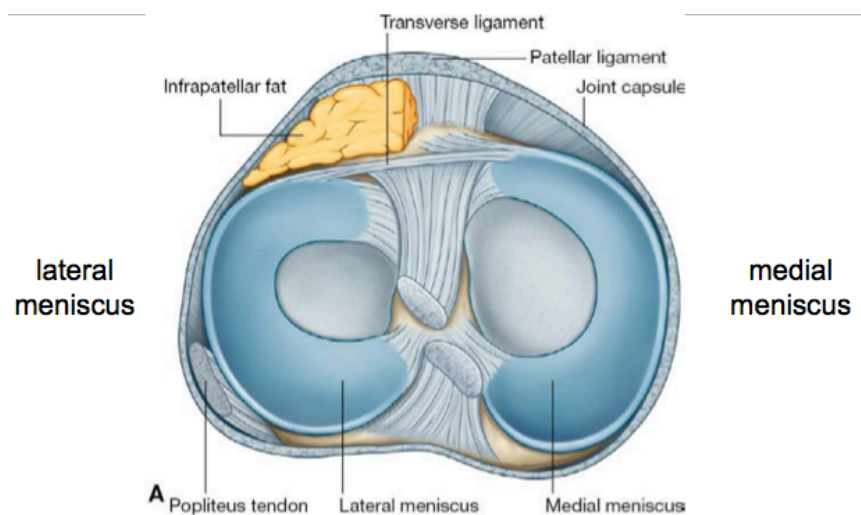
come under the capsule and go through the neck to supply the head. Consequence of this sort of fracture leads to loss of blood supply to head of femur, which can lead to necrosis.

- Vessels anastomose across the femoral neck; fracture can lead to avascular necrosis of femoral head.
- Traumatic dislocation of hip
 - Joint capsule unwinds in flexion
 - Position of greatest laxity
 - Sciatic nerve susceptible to injury in posterior dislocation
- Fractured neck of femur



KNEE JOINT

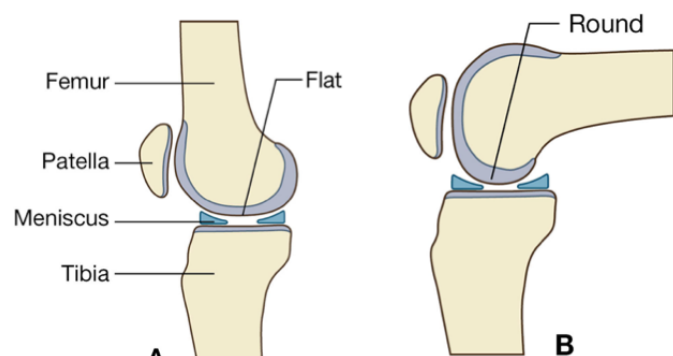
- (11) we actually have 2 joints around the knee. 2 synovial joints within one capsule: **femur with patella** (patellofemoral) and **femur with tibia** (tibiofemoral).
- The patella articulates with the femur. The patella is a sesamoid bone (lives within a tendon), it's main function is to push quadriceps tendon away from knee joint.
- Incongruous joints tend to not be very stable, however the knee has good ligamentous support and is this very stable.
- The knee joint is stable in extension. Joints around knee are taught, providing stability.
- Support primarily comes from 3 pairs of structures: the collateral ligaments (medial and lateral) (light blue ligaments on either side of top left picture), a meniscus (blue line in middle of bottom left picture) within the knee joint, and also crucial ligaments inside the knee.
- Hinge joint but some rotation still occurs. Large range of movement. Stable in extension.

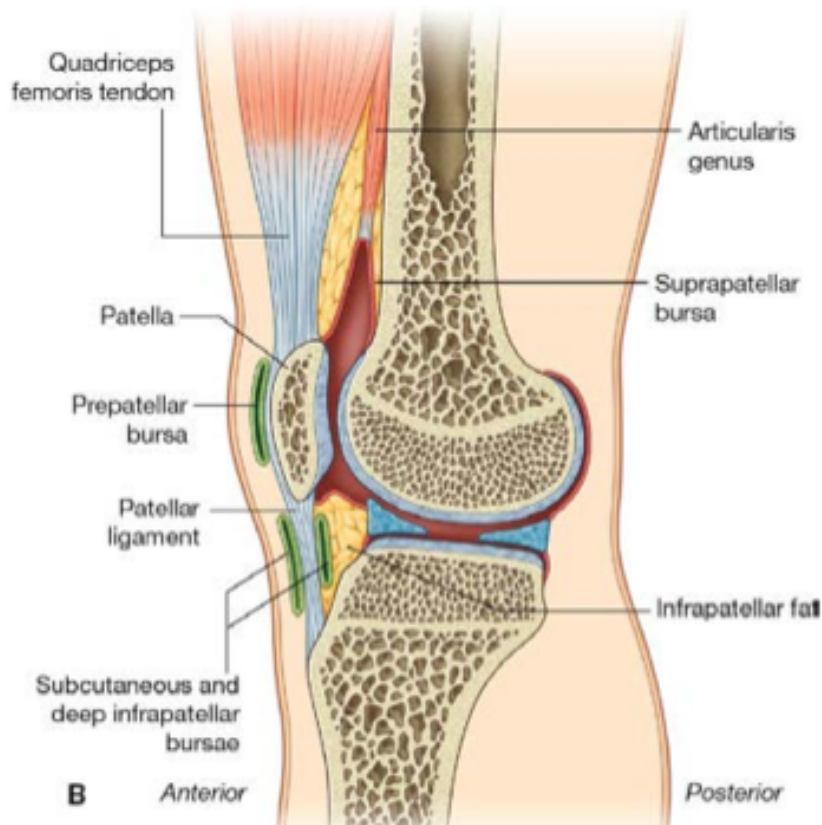


MENISCI

12) Intra-articular discs sitting on the tibial plateau. Plateau = flat, condyles = rounded. So being wedge shaped, they increase the contact surface area by 30%. Being made of fibrocartilage, they can also shock absorb, and help with synovial fluid spread. They are also semilunar (moon shaped). The **lateral menisci** is smaller.

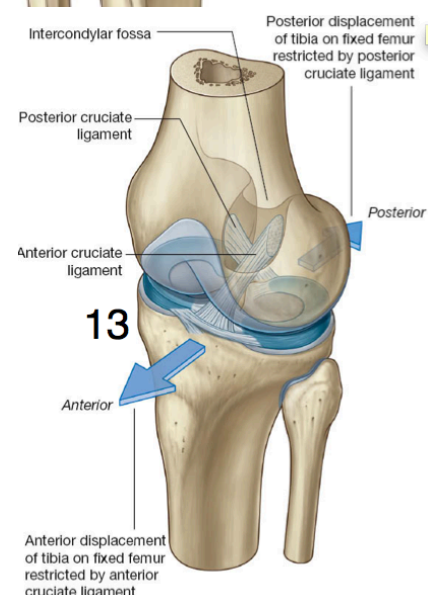
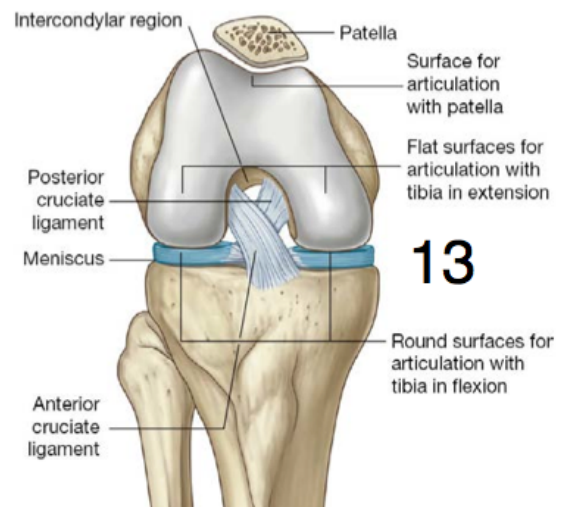
- They attach to tibial plateau by **horns**. There is an **intercondyle ridge**. The menisci themselves are mobile; they can move on the tibial plateau.
- Increase congruency.





CRUCIATE LIGAMENTS

- (13) **Anterior & Posterior Cruciate Ligaments** – ‘intracapsular’ ligaments.
- Anterior ligament takes 1 attachment on the anterior aspect of the tibia. This is how the cruciate ligaments get their names; by their attachment. The anterior ligament is attached more anteriorly and vice versa with the posterior ligament.
- The anterior ligament isn't as strong as the posterior ligament; so the anterior is more likely to snap. But still not very likely.
- Femoral condyles can slide forwards & backwards on the tibia.
- Relative to the femur:
 - The ACL keeps the tibia from slipping forward.
 - The PCL keeps the tibia from slipping backward.
 - ACL and PCL help stability in sagittal plane.
 - Femoral condyles are rounded but the tibial plateau is flat, so the femur rolls forward and backward into extension and flexion. So the cruciates stop the femur from rolling too far.
- Can see them in diagram, light blue in the middle.



COLLATERAL LIGAMENTS

- (14) **Medial & Lateral Collateral Ligaments** – ‘extracapsular’ ligaments. Provide support in coronal plane. Taut in extension and contribute to medio-lateral stability.
- Medial (tibial) ligament and collateral (fibular) ligament.
- **LCL**: thin, taut, narrow band coming from epicondyle of femur

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onto head of fibia. Quite distinct from joint capsule as seen in prac classes. There is a tendon that separates the lateral collateral ligament from the joint capsule itself.

- rounded, more narrow
- attaches to the head of fibula
- separated from joint capsule
- resist 'varus' stress

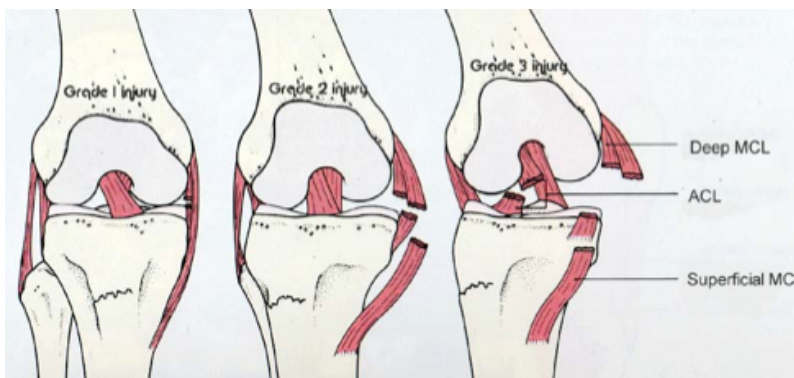
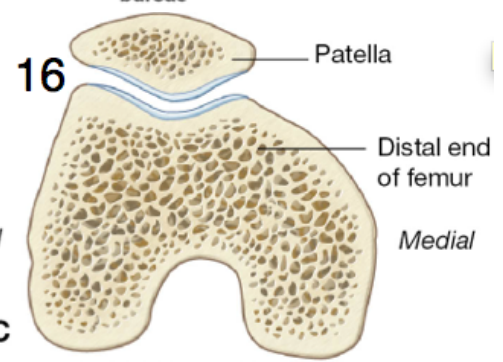
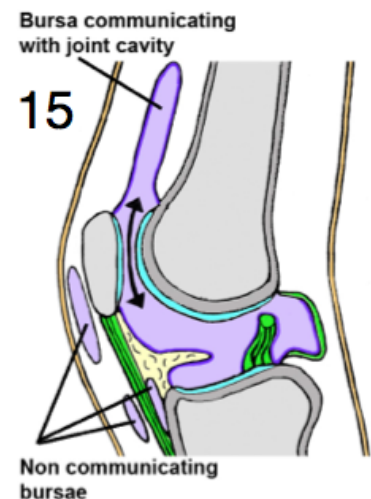
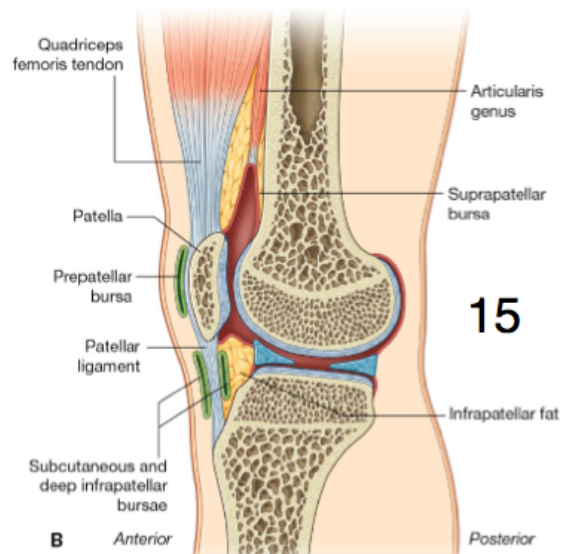
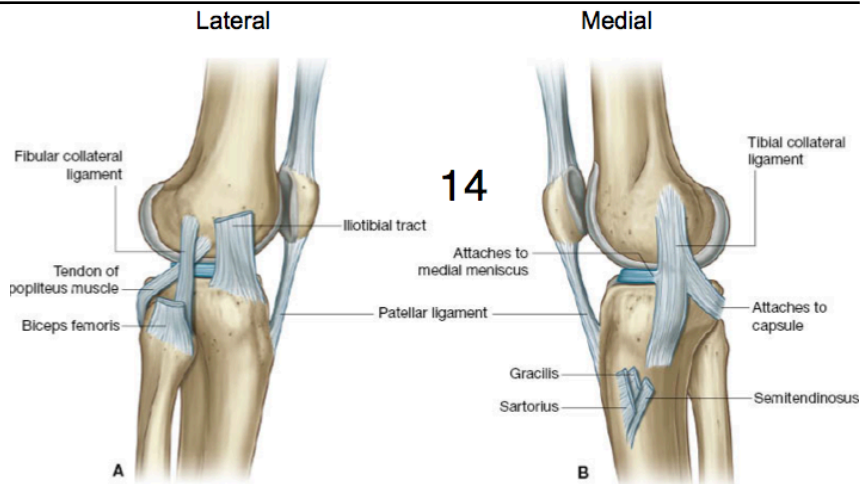
- **MCL:** intimately associated with joint capsule. More like a thickening of the joint capsule. The innermost fibres of the MCL take an attachment to the medial meniscus (as seen in diagram on right). Thus the meniscus is less mobile on the tibial plateau.
 - flat broad band
 - adherent to joint capsule
 - adherent to medial meniscus
 - resist 'valgus' stress
- Extended position of knee is most stable as all 4 ligaments are stable and tight.

BURSAE

- (15) Usually distinct from joint capsules.
- Have a bursa in front of patella, one below and one above the patella. The one above the patella is called the **supra-patella bursae**. It is continuous with the joint space itself.

APPLIED ANATOMY OF KNEE JOINT

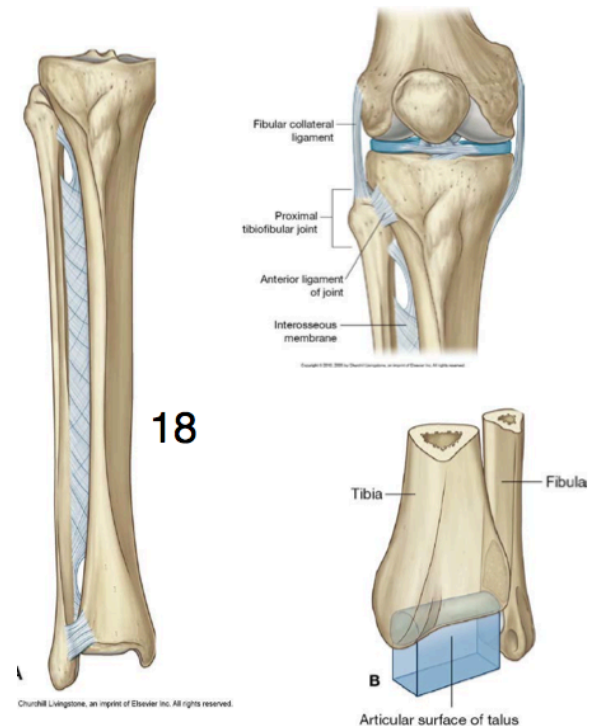
- (16) Angle of inclination. One of the consequences of this angulation is that the course taken by the patella gliding up and down the femur isn't straight up and down, it is slightly oblique along the line of inclination. So we have a slightly higher lateral lip on the top left in diagram to stop dislocation.
- (17) The "unhappy triad": Injury to ACL, MCL & medial meniscus



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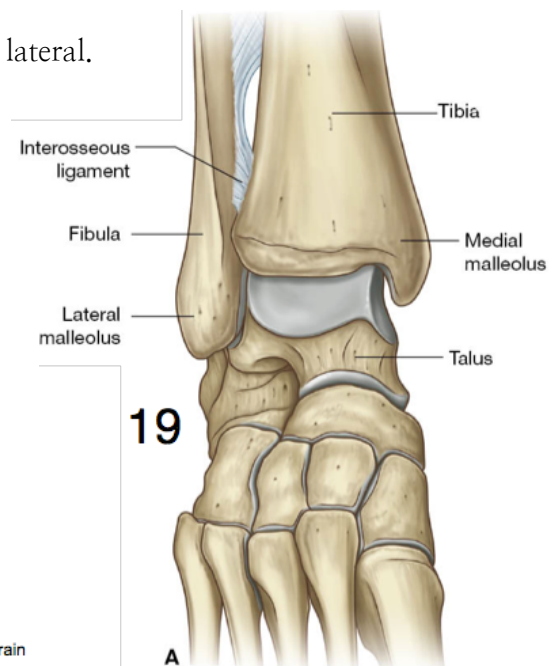
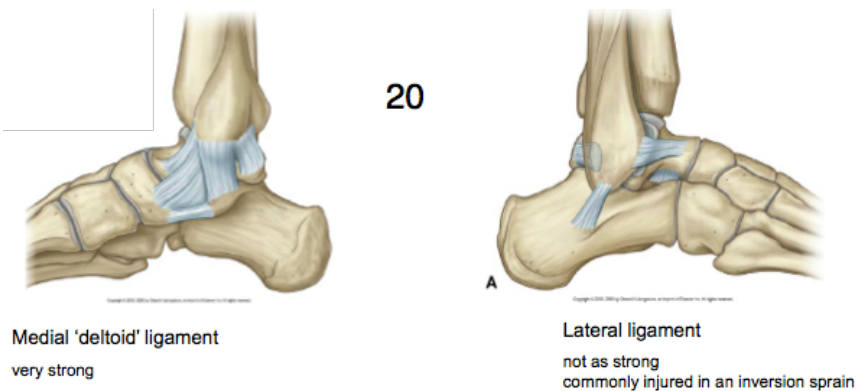
TIBIOFIBULAR JOINTS

- (18) We have 2 tibiofibular joints.
- **Superior:**
 - plane synovial joint
 - allows some gliding movement
 - has ligament support
- **Inferior:**
 - fibrous joint (syndesmosis)
 - prevents tibia & fibula from separating
 - has ligament support
- Syndesmosis joint uncommon to injure?
- As a consequence of the stable arrangement of the syndesmosis, we have a medial and **something** malleolus.
- Good stability + low loading → dislocation rare



ANKLE JOINT

- (19) Hinge joint = movement in 1 plane. Only flexion and extension.
- **Talocrural joint:** hinge type synovial joint.
- the malleolar mortise
- plantar flexion (flexion) and dorsi flexion (extension).
- (20) hinge joint, thus is supported by ligaments; medial and lateral.
- **Medial ligament = deltoid ligament.** Very comprehensive, with 5 parts to it.
- Can still turn foot inwards (inversion) and outwards (eversion). This doesn't occur at the ankle joint; it occurs as a movement of the foot.



FOOT JOINTS

- (21) Many joints:
- **Subtalar joint**
- **Midtarsal joint**
- **Intertarsal joint:** between tarsal bones.
- **Tarsometatarsal joints:** between tarsal bones and metatarsals.
- **Metatarsophalangeal joints**
- **Interphalangeal joints:** between phalanges
- Understand principles of nomenclature but that's all.

