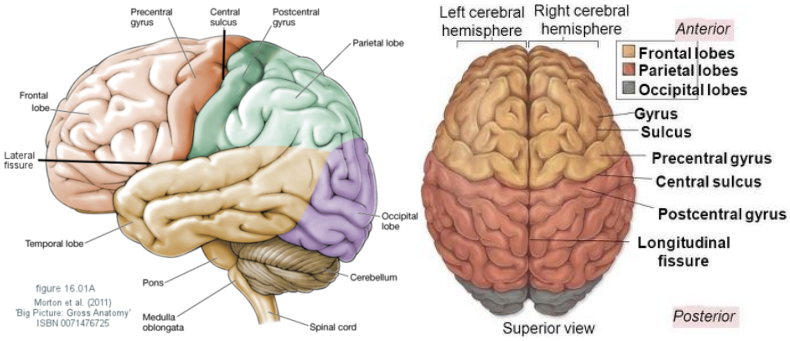
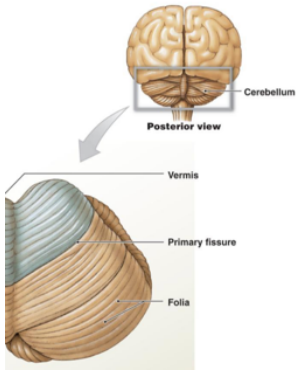
Principles of Human Structure

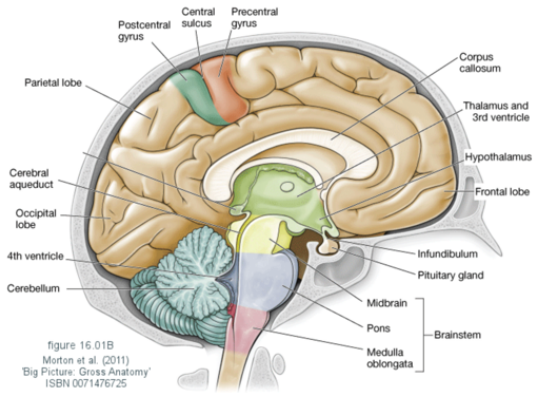
SEMESTER 1

Introduction to Brain Anatomy



- Cerebrum: The collective name for left and right hemisphere of the brain – A greater part of brain.
- Cerebral Cortex: Outer layer of each hemisphere – An extensive sheet of grey matter.
    - Its characteristic wrinkles are formed by numerous gyri (ridges) and sulci (grooves).
        - Central sulcus: A major lateral groove that separates the frontal and parietal lobe.
        - Precentral gyrus: Primary motor control site.
        - Postcentral gyrus: Primary sensory reception site.
        - Parietooccipital sulcus: Separates parietal and occipital lobe.
- Longitudinal Fissure: Separates the left and right cerebral hemisphere.
- Lateral Fissure: Separates frontal and parietal lobe from the temporal lobe.
- Brainstem: A smaller but very important part of the brain. It has 3 divisions:
    - Midbrain – Pons – Medulla (which is joined to the spinal cord).
    - Damage to brainstem is more life-threatening than in any other CNS region, due to control centres that control breathing and other vital functions.
- Cerebellum: The fist-sized structure attached to the dorsal side of the brainstem.
    - It is underneath the occipital lobes but completely separated from them.
    - Although it looks small, it is very densely packed with neurons.
    - Crucial for accurate coordination of movements and effective postural adjustments.
    - The ridges in the cerebellum are called Folia – instead of gyri.





- This is the mid-sagittal view, after bisecting the brain by cutting down in midline.
- It reveals even more cerebral cortex; and the corpus callosum, a thick band of white matter that interlinks left and right hemispheres.
- It also opens the third and fourth ventricles, which are connected by the cerebral aqueduct through the midbrain. The hindbrain (cerebellum + lower brainstem) surrounds the fourth ventricle.
- Diencephalon: A structure that contains hypothalamus (autonomic functions), thalamus (sensory relay site) – interbrain.

L13: Vertebral Column and Back

Bony Framework of the Vertebral Column

- The vertebrae are classified by region into 5 sets:
    - 7 Cervical – In the neck.
    - 12 Thoracic – In the thorax.
    - 5 Lumbar – In the lower back.
    - 5 Sacral
    - Variable number (2 – 5) of Coccygeal vertebrae.
        - The sacrum and coccyx are fused vertebrae – Each vertebra is independent in early development but fuse later to become one singular bone.
    - They are joined by joints; so, the feature of most joints is that they are mobile.
    - Encased within the vertebral column is the spinal cord → protective → support / supporting axis.

- Vertebrae have evolved for weight bearing, and this has special implications for humans as we have an erect posture and a bipedal gait.
- The sacrum is a wedge that is tightly held in the pelvic girdle, so that it takes the weight of the upper body.
- To deal with this weight, the vertebrae progressively increase in size from superior to inferior.
- From a lateral viewpoint, the vertebral column is curved.
    - In the foetus and a new-born baby (early development), there is a single primary / foetal curve that is anteriorly convex.
    - Then, as the child achieves head control, adopts an upright posture and learns to walk, secondary or lordotic curves develops.
        - These are concaved posteriorly and are in the cervical and lumbar spine regions.
            - Cervical secondary curve develops after child achieves head control.
            - Lumbar secondary curve develops after child adopts an upright posture and learns to walk (~1 y/o).
    - The primary curves persist in the thoracic spine and become fixed by fusion in the sacrum.
        - This helps the head and shoulder girdle to generally be centred over the pelvis.
    - These curvatures allow an upright posture.

- As with most anatomy, abnormal curvatures can occur:

abnormal lordosis kyphosis scoliosis

- Abnormal Lordosis: Exaggeration of the forward convexity of the lumbar spine.
- Abnormal Kyphosis: Exaggeration of the primary curvature of the thoracic spine.

L14: Upper Limb 1 – Bones and Joints

Bony Framework – Upper Limb

- As bipeds, humans have adapted the basic quadruped scheme of two pairs of jointed limbs, attached to the vertebral column by a shoulder girdle (upper limbs) and a pelvic girdle (lower limbs).
- The upper limb develops with:
    - A proximal long bone (humerus)
    - A pair of distal long bones (radius and ulna)
    - Short carpal bones and five digits (the mammalian pattern of a pentadactyl hand).
        - In Humans, one of the greatest evolutionary advantage that we evolved with is our opposable thumb.

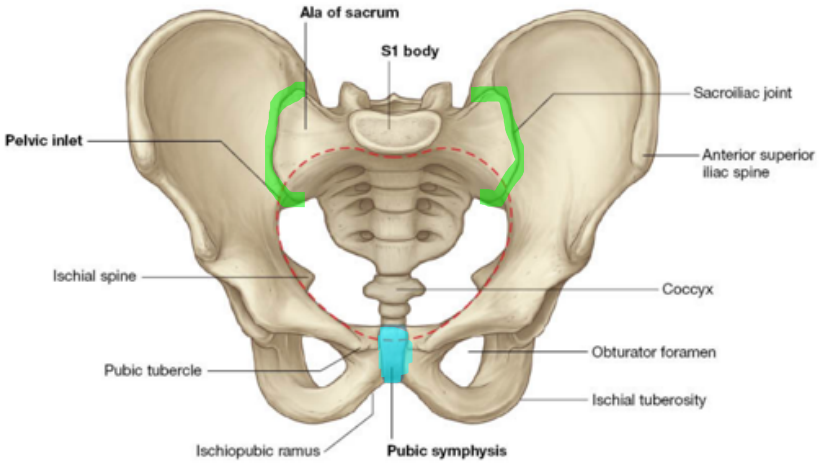
Osteology of the Shoulder Girdle – The clavicle and Scapula

- The shoulder girdle is defined by two bones:

    - Clavicle:
        - Long bone.
        - Its function is to support the upper limb → It pushes the upper limbs to the side.
        - It has two ends:
            - Acromial End: The distal end (broader and flatter) which attach to the scapula.
            - Sternal End: The proximal end which attach to the sternum.
        - It has muscle and Ligament attachments.

    - Scapula:
        - Flat bone.
        - The posterior view of scapula shows a big lateral ridge of bone across the surface and this is the spine of scapula.
            - As the spine of scapular comes around laterally, it broadens out to a process called acromion process.
                - This is where the acromial end of the clavicle attaches.
            - The spine of scapular separates the scapula into two depressions (fossae):
                - Supraspinous Fossae: Depression above the spine.
                - Infraspinous Fossae: Depression below the spine.
                    - For muscle attachments.
        - The anterior side of scapula is relatively concave, and it has another process protruding anteriorly, coracoid process.
        - The lateral view of the scapula exposes another fossa called, glenoid fossa.
            - This fossa allows the humerus to articulate with the shoulder girdle.

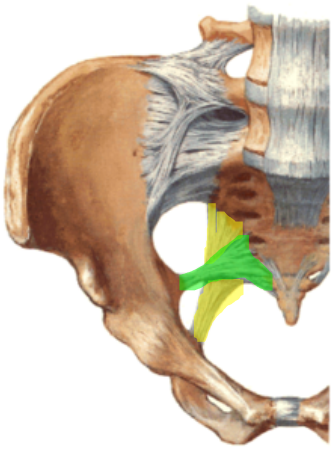
Joints of the Pelvic Girdle



- When we put every components of the pelvic girdle together, there 2 types of joints:
    - Sacroiliac Joint: There are 2 sacroiliac joints in the pelvic girdle between sacrum and Illium.
        - **Synovial Plane Joint**.
        - They are reinforced by strong interosseous ligament → Limits most movement.
            - In late stage pregnancy, the body releases hormone called relaxin, which relaxes ligaments and tendons in the body to allow pelvis some mobility during child birth.
    - Pubic symphysis: This joint is between the pubic bones of each hip bones.
        - **Midline cartilaginous joint** (There is a disc in there as well).

- These joints generate a 'complete' ring of bone (shown in red dotted line) and it allows for efficient weight transfer between our lower limbs through our pelvis and into the spine.
    - It also protects the organs which reside in that region (urogenital / reproductive organs).

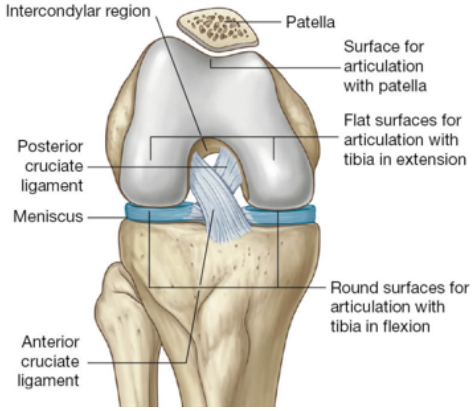
- There is also strong ligamentous support:
    - The sacroiliac joint is reinforced by ligaments anteriorly and posteriorly.
    - There is a ligament which extend from the sacrum to the tuberosity of ischium, called, Sacrotuberous ligament.
    - There is a ligament which extend from the sacrum to the ischial spine, called, sacrospinous ligament.
        - There are 2 holes, or foramen, generated by the ligaments:
            - Greater sciatic foramen (bigger)
            - Lesser sciatic foramen (smaller)
            - These foramens are important because we will have some structures that exit the pelvis posteriorly through these structures.



- There is also another foramen formed around pubis and ischium, called obturator foramen, but essentially nothing goes through that foramen.
    - It is covered by a membrane.

- In the above image, you can appreciate that acetabulum is directed laterally, which is why we need to get our femurs angulated to get them under our pelvis.

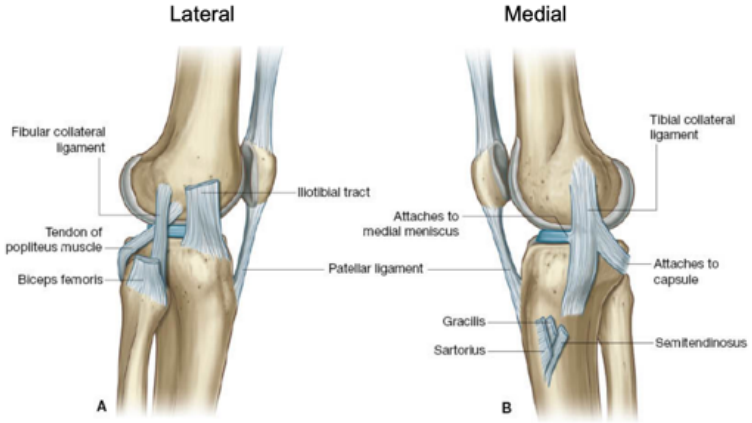
The Knee Joint: Cruciate Ligaments



- We have a pair of intra-capsular ligaments called cruciate ligaments.
    - Anterior cruciate ligament attaches to the anterior of tibial plateau and project posteriorly.
        - These limit anterior displacement of tibia.
    - Posterior cruciate ligament attaches to the posterior of tibial plateau and project anteriorly.
        - These limit posterior displacement of tibia.
    - These pair of ligaments 'cross' each other and it is where the name 'cruciate' comes from.

- Cruciate ligaments are very important in stability in the sagittal plane.
    - When you have a rounded femoral condyle sitting on top of flat tibial plateau, there is the tendency for the femoral condyles to roll across the top of tibial plateau and these cruciate ligaments inhibit the rolling and turn it into a spinning motion,
    - So, these cruciate ligaments are going to be involved throughout the range of motion (flexion and extension), limiting the relative movement of the femoral condyles on the tibial plateau, and converts that motion into spinning motion, allowing flexion and extension from occurring.

The Knee Joint: Collateral Ligaments



- The medial and lateral collateral ligaments are extracapsular ligaments that will resist movement in the coronal plane.
- The medial and lateral collateral ligaments are surprisingly quite different:
    - Lateral Collateral Ligament (LCL): A thin, rounded, taut band that extends from femur to the head of fibula
        - Resist varus stress (displacement towards midline)
    - Medial Collateral Ligament (MCL): A flat, broad band that blends into the joint capsule and also to the medial meniscus.
        - It prevents the meniscus from moving. → medial meniscus is more prone to injury.
        - Resists valgus stress (displacement away from midline).