Skull and Cranial Nerves

Introduction to Skull Bones

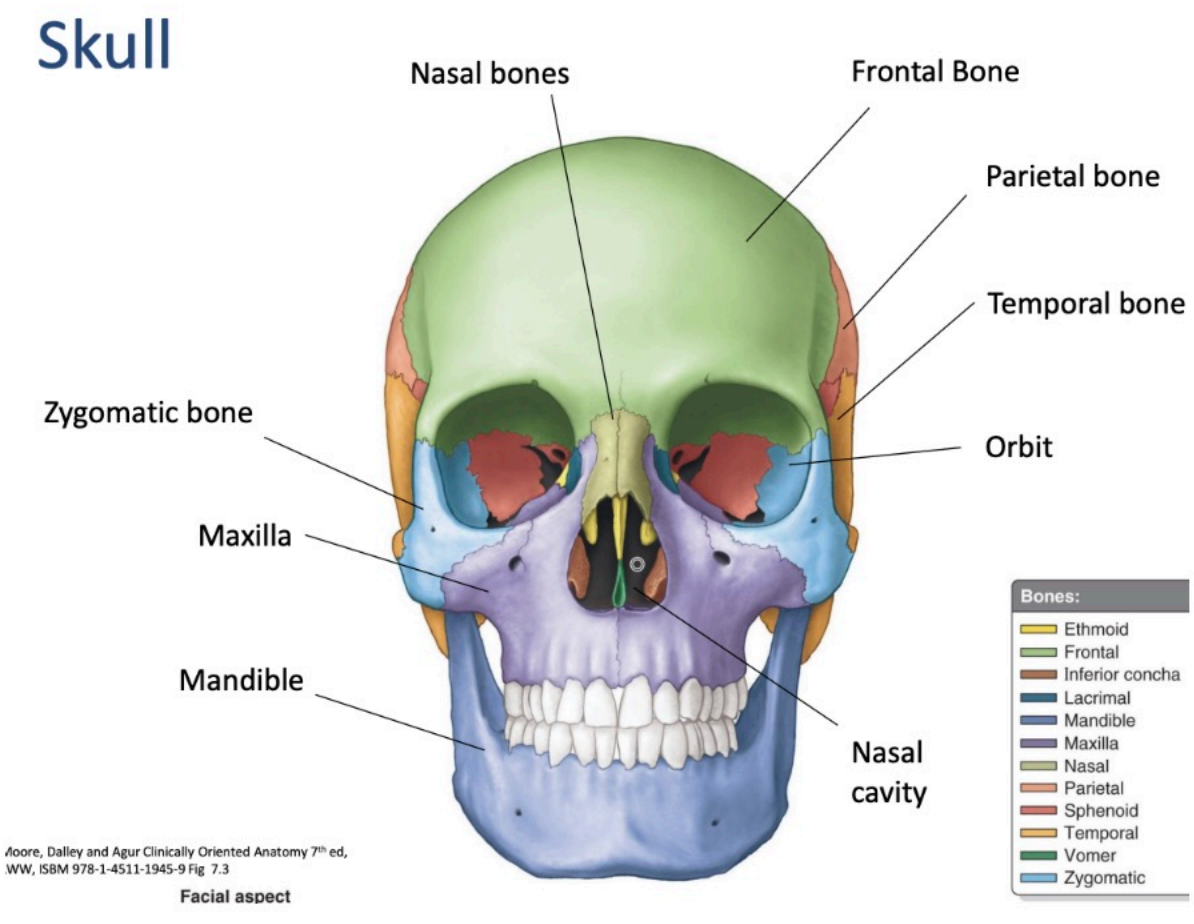
The skull comprises multiple bones that form a protective encasing around the brain and facial structures. Many of these bones are interconnected through sutures, which are fibrous joints that allow growth and slight movement during development.

Facial Bones and Their Functions

The facial skeleton includes several key bones:

- **Frontal Bone:** Located at the top of the face, forming the forehead and part of the orbital cavity.
- **Nasal Bones:** Form the bridge of the nose, which can be palpated externally.
- **Maxilla:** Constitutes the upper jaw, forming part of the nasal cavity's lateral walls and contributing to the cheekbone (zygomatic bone).
- **Mandible:** The lower jawbone, crucial for mastication and speech.
- **Zygomatic Bone:** Known as the cheekbone, articulates with the maxilla and temporal bones.

These bones form the anterior part of the skull and are involved in facial expression, mastication, and sensory functions.



Lateral Skull Bones and Their Features

Moving to the sides of the skull, several bones are visible:

- **Temporal Bones:** Located on the sides of the skull, housing the external auditory meatus (ear canal). They have notable projections like the mastoid process, which can be palpated behind the ears, and processes for muscle attachments.
- **Parietal Bones:** Paired bones forming the superior and lateral aspects of the skull, posterior to the frontal bone.
- **Occipital Bone:** Located at the posterior base of the skull, articulates with parietal and temporal bones, and contains the foramen magnum.

The temporal bones are complex, with various parts visible in different views, and are critical for housing structures like the ear and for muscle attachments.

Development and Fusion of Skull Bones

Many skull bones are initially separate in infants and fuse over time. For example:

- The sutures between bones such as the frontal and parietal bones (coronal suture), occipital and parietal bones (lambdoid suture), and between the parietal bones themselves (sagittal suture).
- The temporal bones fuse with surrounding bones during early childhood, with complete fusion occurring around 18 months.
- The mandible's two halves fuse in the midline, completing fusion later in childhood.

In infants, the ratio of skull size to face is larger, and this ratio gradually changes until about age 16-17, when facial growth completes. This has implications for surgical interventions, as early surgeries may be affected by ongoing growth.

Sutures and Their Clinical Significance

Sutures are fibrous joints that connect skull bones. Key sutures include:

- **Coronal Suture:** Between the frontal and parietal bones.
- **Lambdoid Suture:** Between the parietal and occipital bones.
- **Sagittal Suture:** Between the two parietal bones.
- **Squamous Sutures:** Between the temporal and parietal bones.

Particularly important is the pterion region, where multiple sutures converge. This area is a site of structural weakness, making it vulnerable to fractures from side impacts. The middle meningeal artery runs beneath this region, and damage here can cause epidural hematomas, which are serious bleeding events into the meninges.

Internal Cranial Anatomy and Fossa Structures

Removing the cranial bones reveals the internal cranial cavity, which houses the brain. The cavity is divided into three fossae:

1. **Anterior Cranial Fossa:** Contains the frontal lobes; formed mainly by the frontal bone and the lesser wing of the sphenoid.
2. **Middle Cranial Fossa:** Houses the temporal lobes; formed by parts of the sphenoid (greater wings) and temporal bones.
3. **Posterior Cranial Fossa:** Contains the cerebellum and brainstem; primarily formed by the occipital bone and parts of the temporal bones.

Each fossa contains specific brain regions and features numerous foramina and openings for nerves and blood vessels.

Key Structures in the Cranial Cavity

The bones contribute to the shape and protection of the brain, with complex three-dimensional arrangements. For example:

- The **frontal bone** forms most of the anterior cranial fossa.
- The **occipital bone** forms the posterior and inferior parts of the posterior cranial fossa.
- The **temporal bones** contribute to the lateral walls and contain the petrous part, which houses the inner ear structures.
- The **sphenoid bone** has a butterfly shape, with wings contributing to multiple fossae.

Important blood vessels, such as the middle meningeal artery, run within grooves on the inner skull surface. Damage to these vessels during fractures can lead to bleeding into the meninges, causing increased intracranial pressure and potential brain damage.

Detailed View of the Anterior Cranial Fossa

The anterior cranial fossa is primarily formed by the frontal bone, with the **cribriform plate** of the ethmoid bone at its midline. This plate contains numerous small holes that transmit the olfactory nerves (cranial nerve I), responsible for the sense of smell. The olfactory bulbs sit just above these openings.

The posterior part of the anterior cranial fossa involves the **lesser wing of the sphenoid**, which contributes to the floor of this fossa. The sphenoid is a complex bone with three wings: the greater wings, lesser wings, and pterygoid processes, all playing roles in forming the skull base and supporting the brain.

Understanding these structures is essential for grasping the anatomy of the brain's protective housing and the pathways for nerves and blood vessels entering

Structure of the Pelvis: Bones, Joints, Muscles, Fascia

Learning Outcomes

1. Identify and describe the bones and key ligaments of the pelvis, including their anatomical features and functional significance.
2. Explain the muscle components of the pelvis, detailing the origins, insertions, and actions of major pelvic muscles.
3. Describe the structure and role of pelvic fascia, including its relationship with pelvic organs and muscles.
4. Locate and explain the anatomical gaps and pathways that connect the pelvis to the abdomen and lower limb, highlighting their clinical importance.
5. Describe the anatomy of the pelvic inlet, pelvic outlet, pelvic walls, and pelvic floor, and explain their relevance to pelvic function.
6. Compare and contrast sex differences in pelvic skeletal anatomy and discuss how these differences relate to function and clinical considerations.

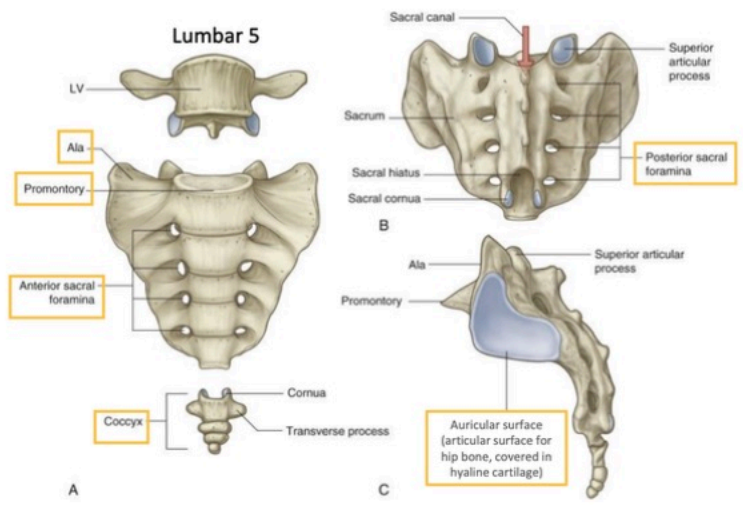
Overview of the Pelvic Girdle

The pelvic girdle, also known as the pelvis, consists of the hip bones (pelvic bones) and the sacrum. It is important to distinguish between the pelvic bones and the hip joint; the pelvic bones form the girdle, while the hip joint involves the femur and acetabulum. The pelvic bones are made up of three parts: the ileum, ischium, and pubis, which are part of the appendicular skeleton. The sacrum, a fusion of five sacral vertebrae, connects the two hip bones and is part of the axial skeleton. These components fuse during development to form a continuous structure, with the acetabulum serving as the socket for the head of the femur, where the three bones meet.

Key Features of the Pelvic Bones

The sacrum articulates with the fifth lumbar vertebra and features a prominent ridge called the promontory, an important landmark for the pelvic brim. The sacral foramina are openings at the front and back for nerve passage, and the canal within the sacrum allows passage of the cauda equina. The coccyx, located below the sacrum, joins it and provides attachment points for ligaments and muscles. The sacral hiatus at the lower end allows nerves and the filum terminale to exit, anchoring the spinal cord.

The auricular surface of the sacrum, covered in hyaline cartilage, articulates with the ileum at the sacroiliac joint, which is an atypical synovial joint involving hyaline and fibrocartilage. The joint's stability is reinforced by ligaments, despite its limited mobility.



Components of the Hip Bone (Pelvic Bone)

The hip bone, or os coxa, comprises three fused bones: the ileum, ischium, and pubis. During development, these bones start as cartilage and fuse over time, with the fusion points visible in the acetabulum. The ileum is the upper part, the ischium forms the posterior and inferior part (the bone you sit on), and the pubis is at the front.

Important landmarks include:

- **Anterosuperior Iliac Spine (ASIS):** attachment point for the inguinal ligament.
- **Pubic Tubercle:** also involved in ligament attachment.
- **Iliac Crest:** the superior border of the ileum.
- **Obturator Foramen:** a large opening covered by membrane, allowing passage of vessels and nerves.
- **Ischial Spine and Tuberosity:** sit bones, with the tuberosity supporting weight when sitting.

Sacroiliac Joint and Related Structures

The sacroiliac joint is formed between the auricular surfaces of the ileum and sacrum. The sacral surface is covered in hyaline cartilage and reinforced by ligaments posteriorly, making it a strong, limited-mobility joint. The joint's articular surface is ear-shaped, called the auricular surface, and the iliac surface is covered in fibrocartilage.

The joint's stability is crucial for weight transfer from the upper body to the lower limbs.

Other notable features include:

- **Greater Sciatic Notch:** becomes a foramen via ligaments, allowing passage of nerves and vessels.
- **Lesser Sciatic Notch:** another passageway for structures like the pudendal nerve.
- **Ischial Spine and Tuberosity:** important for muscle attachment and sitting support.

Pelvic Landmarks and Their Significance

The pelvis forms a basin-like structure, with the false pelvis above the pelvic brim and the true pelvis below. The false pelvis contains abdominal organs like intestines, while the true pelvis houses reproductive organs, the bladder, rectum, and anal canal. The pelvic inlet, marked by the pelvic brim, separates these regions and is formed by specific bony landmarks.

The pelvic brim is a circular boundary made up of several key landmarks:

1. **Sacral Promontory:** anterior edge of the sacrum.
2. **Sacral Ala:**
3. **Arcuate Line:** on the ileum, part of the pelvic inlet boundary.
4. **Pectineal Line:** on the pubis, provides attachment for muscles.
5. **Pubic Crest and Symphysis:** anterior joint where pubic bones meet.

The linear terminalis is a continuous line that forms the boundary of the pelvic inlet, extending from the arcuate line to the pubi crest.

The entire circle of landmarks defines the pelvic brim, which is crucial for understanding pelvic dimensions and obstetric considerations.

Function of Pelvic Bones

The term "pelvis" derives from Latin meaning "basin," reflecting its basin-like shape. The pelvis's structure supports weight bearing and transfer, provides attachment points for muscles and ligaments, forms pelvic floor (attachment of related muscles and fascia), attachment of erectile bodies (external genitalia), and protects pelvic viscera. Despite being a synovial joint, the sacroiliac joint has limited mobility, emphasizing stability over movement.

Inlet, Brim, and Pelvic Regions

The pelvis is divided into different regions, notably the inlet, brim, and the true pelvis. The inlet marks the transition from the false pelvis to the true pelvis, extending from the false to the true pelvis. The brim, or pelvic inlet, is composed of several bony landmarks that are essential to identify for clinical and anatomical understanding. When standing, the pelvis is tilted forward, with the tubercles and symphysis aligning with the anterior superior iliac spine (ASIS) in a vertical plane. The pelvic cavity projects posteriorly, while the inlet tilts forward at approximately 50-60 degrees in the horizontal plane. This tilt is crucial for understanding how the pelvis sits in a standing position and how structures are oriented relative to each other.

The Pelvic Inlet and Its Orientation

The orientation of the pelvic inlet is significant in clinical assessments, especially in obstetrics. The tilt ensures that the inlet is not facing directly upward but inclined forward, facilitating childbirth. The tilt angle, roughly 50-60 degrees, influences how the pelvis accommodates the