Chapter 7: Head & Neck
Osteology

I. Overview
A. Skull
   - The cranium is composed of irregularly shaped bones that are fused together at unique joints called sutures
     - The skull provides durable protection from outside forces and helps protect the brain from trauma
     - The skull is composed of bones called flat bones
     - The face is composed of bones called irregular bones
     - The interior of the skull has three defined regions: anterior, middle and posterior cranial fossa in which the brain resides

B. Overview
   - The bones of the head and face have defining contours and foramen unique to the neurovascular structures that course within. The bones also define the soft tissues and aesthetics of the face.
   - Calvarium
     - The bones of the calvarium (skull cap) constitute the superior, lateral and posterior portion of the skull
     - The skull bones develop via intramembranous ossification
       ○ Frontal – two bones fused anteriorly, forms the anterior cranial fossa
       ○ Occipital – posterior bone, forms posterior cranial fossa
       ○ Parietal – superolateral bones
   - Base of the Cranium
     - The base of the cranium is important for axial loading and serves as a fulcrum for movement during vertebral column articulation
     - Base of cranium is defined by the anterior, middle and posterior fossa
     - Ethmoid
       ○ Separates the nasal cavity and the brain, forms orbital wall, contains the cribriform plate (contains olfactory nerve fiber projections) and perpendicular plate (a portion of the nasal septum)
     - Sphenoid
       ○ Large, butterfly shaped bone fixed between the temporal bone and lower occipital bone

Figure 7.1: Cranial Bones of Anterior Face and Head
Figure 7.2: Sphenoid Bone
Head & Neck

○ Forms site of attachment for muscles of mastication, borders for the cranial fossa, and contains trigeminal neurovascular foramina
  i. Sphenoid body – contains the sella turcica (houses the pituitary gland)
  ii. Greater wing – forms walls for the pterygoid canal, superior orbital fissure, orbit, foramen rotundum, foramen ovale and foramen spinosum
  iii. Lesser wing – forms wall for the superior orbital fissure
  iv. Pterygoid plates
    1. Medial – contains the pterygoid hamulus, which the tensor veli palatini wraps around
    2. Lateral plates – attachment site for medial and lateral pterygoid muscles

– Temporal
  ○ Bilateral bones located on the inferi orlateral portion of the skull
  ○ Composed of the petrous, squamous, mastoid and tympanic regions. Contains the zygomatic, mastoid, styloid process and forms the internal and external auditory canal.

– Frontal
– Occipital

• Viscerocranium
  – These bones of the skull are not involved in protecting the brain (e.g. facial bones)
  – The bones of the face are more irregular and are composed of many individual bones fused together
    ○ Maxilla
      i. Upper portion of the jaw (see more information in “Maxilla & Mandible”)
    ○ Mandible
      i. Lower portion of the jaw, (see more information in “Maxilla & Mandible”)
    ○ Palatine
      i. Forms the hard palate, nasal septum, inferior orbital fissure and pterygopalatine fossa
    ○ Zygomatic
      i. Fused with the maxilla, frontal and parietal bones to form the zygomatic arch or cheek bones
    ○ Nasal
      i. Bilaterally fused bones that form the bridge of the nose
    ○ Vomer
      i. Thin vertical bone that forms the nasal septum
      ii. Contains the nasopalatine grooves in which the nasopalatine vessels course across inferiorly
    ○ Lacrimal
      i. Small bone that forms the medial border of the orbit and lateral border of the nasal cavity
III. Sutures
   A. Overview
      • The sutures of the skull are immobile, fibrous joints. At birth, the bones of the skull are not completely fused as the fetal brain has a tendency to grow faster than the rate of the skull.
   
   B. Suture Types
      • Metopic – site of fusion between the frontal bones
      • Coronal – site of fusion between the frontal and parietal bones
      • Sagittal – site of fusion between the parietal bones
      • Lambdoid – site of fusion between the parietal and occipital bones
   
   C. Fontanelle
      • Anterior (bregma)
         – Large fontanelle, at the junction of frontal and parietal bones, intersection of the metopic, coronal and sagittal sutures
         – Remains open, then closes around two years old
      • Posterior (lambda)
         – Small fontanelle, at the junction of the parietal and occipital bones, intersection of the lambdoid and sagittal sutures
         – Smaller than anterior fontanelle and closes months after the infant is born

IV. Skull Growth
   A. Bones
      • Bones of the face and skull engage in intramembranous and endochondral ossification
         – Intramembranous ossification
            ○ No intermediate chondrocyte production prior to bone remodeling
            ○ Flat bones (e.g. frontal and parietal)
         – Endochondral ossification
            ○ Intermediate chondrocyte production
            ○ Irregular bones (e.g. occipital, ethmoid, sphenoid bones)
      • The infant skull grows perpendicular to the expansion of the contents underneath
      • The infant skull requires the sutures to incompletely fuse to allow for brain growth and compression during labor

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Figure 7.5: Paranasal Sinuses
Figure 7.6: Fetal Skull
V. Sinuses
   A. Overview
      • The paranasal sinuses are mucosal cavities that communicate with the nasal cavities
      • There are four sinuses located inside of their namesake bones:
         - Maxillary Sinus
           ○ Located deep to the maxillary bone
           ○ At risk for infections following dental procedures; orbital blowout fractures may damage the infraorbital vessels that travel proximal to the roof of the sinus
           ○ Sensory innervation via infraorbital, Anterior Superior Alveolar (ASA), Middle Superior Alveolar (MSA) and Posterior Superior Alveolar (PSA) nerves
           ○ Parasympathetic innervation via facial nerve (greater petrosal)
         - Ethmoid Sinus
           ○ Located between the orbit and the nasal cavity
           ○ Contains an anterior, middle and posterior portion
           ○ Sensory innervation via anterior and posterior ethmoidal nerves
           ○ Parasympathetic innervation via facial nerve branches of the PT ganglion
         - Sphenoid Sinus
           ○ Located next to the pituitary gland between the eyes
           ○ Common neurosurgical site of entry for resection of pituitary tumors
           ○ Sphenoidal sinusitis can lead to potential cavernous sinus thrombosis
           ○ Sensory innervation via posterior ethmoidal nerve
           ○ Parasympathetic innervation via facial nerve branches of the PT ganglion
         - Frontal Sinus
           ○ Located in frontal bones above the eyebrows; only sinus that naturally drains via gravity
           ○ Sensory and parasympathetic innervation via the supraorbital nerve

VI. Clinical Pearls
   A. Craniosynostosis
      • If the sutures prematurely close, then the increased intracranial pressure will force unexpected expansion of peripheral areas of the skull causing significant skull deformation called craniosynostosis
         - High risk for increased intracranial pressure
         - Suspected craniosynostosis should always receive a fundoscopic exam to check for papilledema
         - Multiple types of craniosynostosis exist based on which suture is prematurely fused
         - Children with craniosynostosis have skulls that will grow parallel at the location of the fused sutures
B. **Pterion vs. Asterion**
   - Pterion is a weak point of fusion on the lateral sides of the skull where the frontal, parietal and sphenoid bones meet
     - Middle meningeal artery lies directly underneath the pterion, site of potential epidural hematoma
   - Asterion is a site of fusion at the parietomastoid suture
     - Common site of access for neurosurgeons for safe intracranial entry

C. **Fontanelle Assessment**
   - Infant skulls are continuously growing and the human skull accommodates for brain tissue growth by not completely fusing sutures during infancy
   - Fontanelles can provide diagnostic significance for medical conditions
     - Bulging anterior fontanelle – indicates increased intracranial pressure from a traumatic fall, child abuse, extracranial or intracranial tumors
     - Sunken anterior fontanelle – indicates dehydration

D. **Subdural and Epidural Hematoma**
   - **Subdural Hematoma**
     - Blood accumulating between the dura mater and arachnoid mater
     - From damaged bridging, venous structures from the superior sagittal sinus
     - Commonly occurs in atrophied brains (e.g. alcoholics, elderly)
     - Presentation
       - Trauma followed by gradual headache and confusion
       - Crescent-shaped hyperdensity on CT
   - **Epidural Hematoma**
     - Blood accumulating between the dura mater and skull bones
     - From damaged arteries (e.g. middle meningeal artery)
     - Commonly occurs in temporal bone fractures lacerating the underlying artery
     - Presentation
       - Trauma followed by a lucid interval followed by a rapid decline
       - Lens-shaped hyperdensity on CT