

Lecture 10

The skeletal system IV - Cranial Bones. Facial Bones

Plan of the Lecture

1. Overview of the Skeleton
 - a. Bones of the Skeletal System
 - b. Anatomical Features of Bones
2. The Skull
 - a. Cranial Bones
 - i. The Frontal Bone
 - ii. The Parietal Bones
 - iii. The Temporal Bones
 - iv. The Occipital Bone
 - v. The Sphenoid Bone
 - vi. The Ethmoid Bone
 - b. Facial Bones
 - i. The Maxillae
 - ii. The Palatine Bones
 - iii. The Zygomatic Bones
 - iv. The Lacrimal Bones
 - v. The Nasal Bones
 - vi. The Inferior Nasal Conchae
 - vii. The Vomer
 - viii. The Mandible
 - c. Bones Associated with the Skull
 - d. The Skull in Infancy and Childhood

LEARNING OUTCOMES

1. define the two subdivisions of the skeleton;
2. state the approximate number of bones in the adult body;
3. explain why this number varies with age and from one person to another;
4. define several terms that denote surface features of bones;
5. distinguish between cranial and facial bones;
6. name the bones of the skull and their anatomical features;
7. identify the cavities in the skull and in some of its individual bones;
8. name the principal sutures that join the bones of the skull;
9. describe some bones that are closely associated with the skull;
10. describe the development of the skull from infancy through childhood.

The skeleton is divided into two regions: the axial skeleton and appendicular skeleton. The axial skeleton, which forms the central supporting axis of the body, includes the skull, auditory ossicles, hyoid bone, vertebral column, and thoracic cage (ribs and sternum). The appendicular skeleton includes the bones of the upper limb and pectoral girdle and the bones of the lower limb and pelvic girdle. This is only a typical adult count, not an invariable number. At birth there are about 270, and even more bones form during childhood. With age, however, the number decreases as separate bones gradually fuse. For example, each side of a child's pelvic girdle has three bones—the ilium, ischium, and pubis—but in adults, these are fused into a single hip bone on each side. The fusion of several bones, completed by late adolescence to the mid-20s, brings about the average adult number of 206. Bones exhibit a variety of ridges, spines, bumps, depressions, canals, pores, slits, cavities, and articular surfaces. It is important to know the names of these bone markings because later descriptions of joints, muscle attachments, and the routes traveled by nerves and blood vessels are based on this terminology.

The skull is the most complex part of the skeleton. The next four figures present an overview of the skull's general anatomy. Although it may seem to consist only of the mandible (lower jaw) and “the rest,” it is composed of 22 bones and sometimes more. Most of these are connected by immovable joints called sutures, which are visible as seams on the surface. The skull contains several prominent cavities. The largest, with an adult volume of about 1,350 mL, is the cranial cavity, which encloses the brain. Other cavities include the orbits (eye sockets), nasal cavity, oral (buccal) cavity, middle- and inner-ear cavities, and paranasal sinuses. The sinuses are named for the bones in which they occur — the frontal, sphenoid, ethmoid, and maxillary sinuses. They are connected with the nasal cavity, lined by mucous membranes, and filled with air. They lighten the anterior portion of the skull and act as chambers that add resonance to the voice. The latter effect can be sensed in the way your voice changes when you have a cold and mucus obstructs the travel of sound into the sinuses and back. Bones of the skull have especially conspicuous foramina—singular, foramen—holes that allow passage for nerves and blood vessels.

Cranial bones are those that enclose the brain; collectively, they compose the cranium² (braincase). The delicate brain tissue does not come directly into contact with the bones, but is separated from them by three membranes called the meninges. The thickest and toughest of these, the dura mater, is pressed against the inside of the cranium in most places and firmly attached to it at a few points. The cranium is a rigid structure with an opening, the foramen magnum (literally “large hole”), where the spinal cord meets the brain. The cranium consists of two major parts—the calvaria and the base. The calvaria (skullcap) is not a single bone but simply the dome of the top of the skull; it is composed of parts of multiple bones that form the roof and walls. In skulls prepared for study, the calvaria is often sawed so that part of it can be lifted off for examination of the interior. This reveals the base (floor) of

the cranial cavity, which exhibits three paired depressions called cranial fossae. These correspond to the contour of the inferior surface of the brain. The relatively shallow anterior cranial fossa is crescent-shaped and accommodates the frontal lobes of the brain. The middle cranial fossa, which drops abruptly deeper, is shaped like a pair of outstretched bird's wings and accommodates the temporal lobes. The posterior cranial fossa is deepest and houses a large posterior division of the brain called the cerebellum. Facial bones do not enclose the brain but lie anterior to the cranial cavity. They support the orbital, nasal, and oral cavities, shape the face, and provide attachment for the muscles of facial expression and mastication. There are 14 facial bones: 2 maxillae 2 nasal bones 2 palatine bones 2 inferior nasal conchae 2 zygomatic bones 1 vomer 2 lacrimal bones 1 mandible. Seven bones are closely associated with the skull but not considered part of it. These are the three auditory ossicles in each middle ear cavity and the hyoid bone beneath the chin. The auditory ossicles—named the malleus (hammer), incus (anvil), and stapes (stirrup). The hyoid bone is a slender U-shaped bone between the chin and larynx. It is one of the few bones that does not articulate with any other. It is suspended from the styloid processes of the skull, somewhat like a hammock, by the small stylohyoid muscles and stylohyoid ligaments. The median body of the hyoid is flanked on either side by hornlike projections called the greater and lesser horns (cornua). The larynx (voice box) is suspended from the hyoid bone by a broad ligament, and the hyoid serves for attachment of several muscles that control the mandible, tongue, and larynx. Forensic pathologists look for a fractured hyoid as evidence of strangulation. The head of an infant could not fit through the mother's pelvic outlet at birth were it not for the fact that the bones of its skull are not yet fused. The shifting of the skull bones during birth may cause the infant's head to appear deformed, but it soon assumes a more normal shape. Spaces between the unfused cranial bones are called fontanelles, after the fact that pulsation of the infant's blood can be felt there. The bones are joined at these points only by fibrous membranes, in which intramembranous ossification is completed later. Four of these sites are especially prominent and regular in location: the anterior, posterior, sphenoid (anterolateral), and mastoid (posterolateral) fontanelles. Most fontanelles ossify by the time the infant is a year old, but the largest one—the anterior fontanelle—can still be palpated 18 to 24 months after birth. The frontal bone and mandible are separate right and left bones at birth, but fuse medially in early childhood. The frontal bones usually fuse by age 5 or 6, but in some children a metopic suture persists between them. Traces of this suture are evident in some adult skulls. The face of a newborn is flat and the cranium relatively large. To accommodate the growing brain, the skull grows more rapidly than the rest of the skeleton during childhood. It reaches about half its adult size by 9 months of age, three-quarters by age 2, and nearly final size by 8 or 9 years. The heads of babies and children are therefore much larger in proportion to the trunk than the heads of adults—an attribute thoroughly exploited by cartoonists and advertisers who draw big-headed characters to give them a more endearing or immature

appearance. In humans and other animals, the large rounded heads of the young are thought to promote survival by stimulating parental caregiving instincts.

Check yourself! The questions for self-control

1. Name the major components of the axial skeleton. Name those of the appendicular skeleton.
2. Explain why an adult does not have as many bones as a child does. Explain why one adult may have more bones than another.
3. Briefly describe each of the following bone features: a condyle, crest, tubercle, fossa, sulcus, and foramen.
4. Name the paranasal sinuses and state their locations. Name any four other cavities in the skull.
5. Explain the difference between a cranial bone and a facial bone. Give four examples of each.
6. Draw an oval representing a superior view of the calvaria.
7. Draw lines representing the coronal, lambdoid, and sagittal sutures. Label the four bones separated by these sutures.
8. State which bone has each of these features: a squamous part, hypoglossal canal, greater horn, greater wing, condylar process, and cribriform plate.
9. Determine which of the following structures cannot normally be palpated on a living person: the mastoid process, crista galli, superior orbital fissure, palatine processes, zygomatic bone, mental protuberance, and stapes. You may find it useful to palpate some of these on your own skull as you try to answer.

Recommended readings:

1. Kenneth S Saladin - Anatomy & Physiology. The Unity of Form and Function (2016, McGraw-Hill Education)
2. Barbara Gylys - Medical Terminology Systems (2012, F.A. Davis Company)
3. Richard L. Drake A. Wayne Vogl, Adam W. M. Mitchell - Gray's Atlas of Anatomy, Second Edition (2015, Churchill Livingstone Elsevier)