Axial Skeletal Markings
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I. Bones

A. Classification

1. Long – Greatest length in one dimension (Figure 1)
   Examples: Humerus, Femur
2. Short – Cube-like bones (Figure 1)
   Examples: Metatarsals, Carpals
3. Flat – Plate-like bones (Figure 1)
   Examples: Scapula, Sternum
4. Irregular – complex shapes that do not fit into any of the above categories (Figure 1)
   Examples: Vertebrae, Some Facial Bones
5. Sesamoid – small bones in tendons where pressure develops
   Example: Patella
6. Sutural – small bones between the joints of certain cranial bones (also known as Wormian bones) (Figure 2)

B. Depressions & Openings

1. Facet – a smooth flat surface
   Example: articular facet for the tubercle of rib on a vertebra (Figure 3)
2. Fossa – a depression in or on a bone
   Example: Subscapular fossa in scapula (Figure 4)
3. Groove or Sulcus – a furrow or depression accommodating a soft structure like a blood vessel, nerve, or tendon
   Example: Intertubercular groove of the humerus (Figure 5)
4. Paranasal Sinus – an air-filled cavity within a bone connected to the nasal cavity
   Example: Frontal sinus of the frontal bone (Figure 9)
5. Fissure – a narrow opening between adjacent parts of bones through which blood vessels, nerves, or ligaments pass
   Example: Superior orbital fissure of the sphenoid bone (Figure 10.5)
6. Foramen – an opening through which blood vessels, nerves, or ligaments pass
   Example: Foramen magnum of the occipital bone (Figures 9 & 10)
7. Meatus – a tube-like passageway running within a bone
   Example: External auditory meatus of the temporal bone (Figure 8, 9 & 10)

C. Processes

1. Condyle – a large, rounded articular prominence
   Examples: Medial and lateral condyles of the femur (Figure 7)
2. Epicondyle – a prominence above a condyle
   Examples: Medial and lateral epicondyles of the femur (Figure 7)
3. Crest – a prominent border or ridge
   Example: Iliac crest of the ilium (Figure 6)
4. Head – a rounded, articular projection supported on the constricted portion (neck) of a bone
   Example: Head of the femur (Figure 7)
5. Tubercle – a small, rounded process
   Examples: Greater and lesser tubercles of the humerus (Figure 5)
6. Tuberosity – a large, rounded, usually roughened process
   Examples: Tibial tuberosity, ischial tuberosity (Figure 6)
7. Trochanter – a large, blunt projection found only on the femur
   Examples: Greater and lesser trochanters (Figure 7)
The right scapula. (a) An anterior view and (b) a posterior view.

**Figure 4 - Fossa Example**

**Figure 5 – Tubercle & Groove Ex.**

**Figure 6 – Crest & Tuberosity Examples**
II. Skull – 22 bones (8 cranial & 14 facial) (Figures 8, 9 & 10)
A. Function
   1. Brain case – houses the brain, protection
   2. Facial structure – every face is different due to differences in bone size and placement, attaches muscles

B. Structure
   1. Cranial Bones
      a. Frontal (1) – forms the forehead, a portion of the nose, and the superior portions of the orbits (bony sockets of the eyes)
      b. Parietal (2) – just dorsal to the frontal bone, they form the roof of the cranium and help form its sides
      c. Temporal (2) – just inferior to the parietal bones on the sides of the cranium, also help form the base of the cranium. Each temporal bone has the following:
         • External auditory meatus, a canal leading to the middle ear
         • Mandibular fossa, articulates with the mandible
         • Mastoid process (2), provides a place of attachment for certain neck muscles
         • Styloid process, provides a place of attachment for muscles associated with the tongue and larynx
         • Zygomatic process, projects anteriorly and helps form the cheekbone
      d. Occipital (1) – forms the most dorsal part of the skull and base of the cranium. The spinal cord joins the brain by passing through a large opening here called the foramen magnum. The occipital condyles are rounded processes on either side of the foramen magnum that articulate with the first vertebra of the spinal column. The inferior portion of this is called
the occipital ridge. Another marking on the occiput is the external occipital protuberance, also known as the inion

e. Ethmoid (1) – forms part of the roof of the nasal cavity. The ethmoid bone has the following:
   • Crista galli (cock’s comb), a triangular process that serves as an attachment for membranes that enclose the brain
   • Cribriform plate with tiny holes, serve as passageways for nerve fibers from the olfactory receptors
   • Perpendicular plate, projects downward to form the nasal septum
   • Superior and middle nasal conchae, projects toward the perpendicular plate. These projections support mucous membranes that line the nasal cavity

f. Sphenoid (1) – helps form the sides and base of the cranium and the floors and sides of the orbits. Within the cranial cavity the sphenoid bone has a saddle-shaped mid-portion called the sella turcica, which houses the pituitary gland in a depression

2. Facial Bones
   a. Maxilla (2) – form the upper jaw, each has an alveolar process in which the teeth are located, a palatine processes form the anterior portion of the hard palate, the roof of the mouth. The maxilla also contribute to the floors of the orbits, and the sides and floor of the nasal cavity
   b. Palatine (2) – form the posterior portion of the hard palate and the floor of the nasal cavity. A cleft palate results when the palatine bones have failed to fuse
   c. Zygomatic (2) – form the sides of the orbits and the cheek bones, each has a temporal process that joins the zygomatic process of a temporal bone. Each also has a Zygomatic arch, also known as cheek bones.
   d. Mandible (1) – this is the lower jaw – the only movable portion of the skull. Its horseshoe-shaped body forms the chin. There are also two upright projections called rami. Each ramus has a mandibular condyle that articulates with a temporal bone and a coronoid process, which serves as a place of attachment for the muscles that are used for chewing. The lower teeth are located on the alveolar arch of the mandible
   e. Nasal Bones (2) – these are small, rectangular bones that form the bridge of the nose. The ventral portion of the nose is cartilage
   f. Inferior Nasal Conchae (2) – these are thin, curved bones that project into the nasal cavity and are attached to their lateral walls. Like other conchae, they support the mucous membranes that line the nasal cavity
   g. Lacrimal Bones (2) – these small, thin bones are located on the medial walls of the orbits. A small groove lies between the orbit and the nasal cavity, which serves as a pathway for a tube that carries tears from the eyes to the nose
   h. Vomer (1) – this joins with the perpendicular plate of the ethmoid bone to form the nasal septum
Figure 8
Figure 9
Figure 10
III. Hyoid Bone (1) (Figure 11) – a single bone uniquely placed, does not articulate with any other bone. Rather, it is suspended from the styloid process of the temporal bone by ligaments and muscles. It is located in the neck between the mandible and larynx. It consists of a horizontal body and paired projections called the lesser cornu (horn) and attach to these paired projections. The hyoid is frequently fractured during strangulation. The trachea is directly inferior to the hyoid bone.

A. Function

1. Support tongue – the muscles that make up the tongue and surrounding area are attached to the hyoid for support
2. Attachment site for muscles that move the tongue and help in swallowing
IV. Vertebral Column (26) – this along with the sternum and ribs makes up the skeleton of the trunk of the body. The vertebral column is composed of a series of bones called vertebrae. In the average adult, the column measures about 28 inches in length. In effect, the column is a strong, flexible rod that moves anteriorly, posteriorly, and laterally. (Figure 12)

A. Function
   1. Supports the head and trunk
   2. Encloses and protects the spinal cord
   3. Serves as a point of attachment for the ribs and the muscles of the back

B. Structure
   1. Vertebrae (24) (Figure 13, 14)
      a. Body – the portion that is anterior in our bodies, drum-shaped, is the load-bearing portion of the vertebrae
      b. Spinous process – projects posteriorly, serves as attachment sites for muscles. There is also a structure called the Nuchal ligament attaching to the spinous processes in the cervical area and to the occiput. This gives even more attachment sites for muscles.
      c. Transverse process – there are two projecting laterally from each vertebra serving as attachment sites for muscles.
      d. Vertebral foramen – the opening through which the spinal cord passes. The vertebral foramina for all vertebrae together form the vertebral (spinal) canal.
      e. Intervertebral disk – these disks made of fibrocartilage with an inner, soft, pulpy, highly elastic material and are located between the vertebrae and act as a cushion. They prevent the vertebrae from grinding against one another and absorb shock caused by movements such as running, jumping, and even walking. Unfortunately these become weakened with age, and can move or even rupture. Under compression they flatten, broaden, and bulge from their intervertebral spaces. This causes pain when the damaged disk presses against the spinal cord and/or spinal nerves. The body may heal itself or the disk can be surgically removed. If surgery is required, the vertebrae are fused together, limiting the flexibility of the body. The presence of the disks allows motion between the vertebrae so that a person can bend forward, backward, and from side to side.
      f. Intervertebral foramina – The nerves that connect the spinal cord to various parts of the body pass through these openings

   2. Cervical vertebrae (7) – also known as C 1-7, these are smaller than those of the thoracic and lumbar area. Each cervical transverse process contains a transverse foramen through which the vertebral artery and its accompanying vein and nerve fibers pass. The first two cervical vertebrae are considerably different from the others. (Figure 13)
      a. Atlas – this is the first cervical vertebra, called C-1, and is named for its support of the head. This is actually a ring of bone with anterior and posterior arches and large lateral masses – it has no spinous process. On its superior aspect there are two superior articular facets on which rests the head while allowing for movement. This allows us to “say” yes with our head.
      b. Axis – this is the second cervical vertebra, called C-2. It has a body along with a peg-like process called the dens or ondontoid process. The dens projects up through the ring of the atlas and makes a pivot on which the atlas and head rotate. This allows us to “say” no with our head.

   3. Thoracic Vertebrae (12) (Figures 12, 14) – Also known as T 1-12, these are quite a bit larger and stronger than the cervical vertebrae. These have much longer spinous processes along with longer and heavier transverse processes than the cervical vertebrae.
4. Lumbar Vertebrae (5) (Figure 15) - Also known as L 1-5, they are the largest and strongest in the column. Their various projections are short and thick.

5. Sacrum (1 made up of 5 fused bones) (Figure 16) – This is a triangular bone formed by the union of five sacral vertebrae. The sacrum serves as a strong foundation for the pelvic girdle. It is positioned at the posterior portion of the pelvic cavity between the two hipbones. Where it attaches to the hipbones is called the sacroiliac joint.

6. Coccyx (1 made up of 4 fused bones) (Figure 16) – This is also triangular in shape and is formed by the fusion of the coccygeal vertebrae. It is also known as the tail bone.
V. Thoracic cage – the term thorax refers to the chest.
   A. Function
      1. Supports shoulder girdle and arms
      2. protects organs in the thoracic cavity
      3. plays a role in breathing
   
   B. Structure
      1. Ribs (12 pairs – Figure 15) (Figures 17, 18) – these articulate posteriorly with the 12 thoracic vertebrae. The ribs increase in length from the first through seventh, then they decrease in length to the twelfth rib. The head of a typical rib is a projection at the posterior end of the rib. It is wedge-shaped and consists of one of two facets that articulate with facets on the bodies of the adjacent thoracic vertebrae. The neck is a constricted portion just lateral to the head. There is a knoblike structure on the posterior surface where the neck joins the body and is called a tubercle which articulates with the transverse process of a vertebrae. The body, or shaft, is the main part of the rib. There is a definite curvature of the shaft which is called the costal angle. There is also a costal groove on the inner surface of the rib to protect blood vessels and small nerves.
         a. True Ribs (vertebrosternal) – The first through seventh ribs have a direct anterior attachment to the sternum by way of hyaline cartilage, called costal cartilage. These are called the true ribs.
         b. False Ribs (vertebrochondral and vertebral) – The remaining five pairs of ribs are referred to as false ribs because their costal cartilages do not attach directly to the sternum. The cartilages of the eighth, ninth, and tenth ribs attach to each other and then to the cartilage of the seventh rib – vertebrochondral ribs. The eleventh and twelfth false ribs are designated as floating (vertebral) ribs anterior ends do not attach even indirectly to the sternum. They attach only posteriorly to the thoracic vertebrae.
      
      2. Sternum (Figure 18) – also known as the breastbone, is a flat, narrow bone measuring about 6 inches in length. It consists of three portions:
         a. Manubrium – the odd-shaped, superior portion
         b. Body – the middle, largest portion
         c. Xiphoid process – the small triangular inferior part, the smallest portion