Contents

Locomotor apparatus

The main functions of locomotor apparatus are: movement of the human body, as well as weight-bearing and antigravity functions. It consist of passive (the skeleton and its joints) and active (muscles) parts.

Development of the locomotor apparatus

During the 3rd week of embryogenesis, the paraxial mesoderm forms into balls of mesoderm paired either side of the neural groove, called somites. Somites appear bilaterally as pairs at the same time and form earliest at the cranial (rostral, brain) end of the neural groove and are added sequentially at the caudal end. This addition occurs so regularly that embryos are staged according to the number of somites that are present. Different regions of the somite differentiate into dermomyotome (dermal and muscle component) and sclerotome (forms vertebral column). An example of a specialized musculoskeletal structure can be seen in the development of the limbs.

Cells migrate through the primitive streak to form mesodermal layer. Extraembryonic mesoderm lies adjacent to the trilaminar embryo totally enclosing the amnion, yolk sac and forming the connecting stalk. Paraxial mesoderm accumulates under the neural plate with thinner mesoderm laterally. This forms 2 thickened streaks running the length of the embryonic disc along the rostrocaudal axis. In humans, during the 3rd week of embryogenesis, this mesoderm begins to segment. The neural plate folds to form a neural groove and folds. Segmentation of the paraxial mesoderm into somites continues caudally at 1 somite/90 minutes, and a cavity (intraembryonic coelom) forms in the lateral plate mesoderm separating somatic and splanchnic mesoderm. Note that intraembryonic coelomic cavity communicates with extraembryonic coelom through portals (holes), initially on lateral margin of embryonic disc. Somites continue to form. The neural groove fuses dorsally to form a tube at the level of the 4th somite and "zips up" cranially and caudally, and the neural crest migrates into the mesoderm. Mesoderm beside the notochord (axial mesoderm, blue) thickens forming the paraxial mesoderm as a pair of strips along the rostrocaudal axis. Paraxial mesoderm towards the rostral end begins to segment forming the first somite. Somites are then sequentially added caudally. The somitocoel is a cavity forming in early somites, which disappears as the somite matures. Cells in the somite differentiate medially to form the sclerotome (forms vertebral column) and dorsolaterally to form the dermomyotome. The dermomyotome then forms the dermotome (forms dermis) and myotome (forms muscle). Neural crest cells migrate beside and through somite.

The myotome differentiates to form 2 components, dorsally the epimere and ventrally the hypomere, which in turn form epaxial and hypaxial muscles, respectively. The bulk of the trunk and limb muscle originate from the hypaxial mesoderm. Different structures will be contributed depending upon the somite level. Mesoderm within the developing limb bud differentiates to initially form cartilage, which later ossifies during endochondral ossification. Hypaxial somitic mesoderm from somites at the levels of limb bud formation migrates into the bud. These cells within the bud proliferate in regions of muscle formation, fuse to form myotubes and then differentiate to form skeletal muscle cells.

Osteology, skeletal system *(systema skeletale)*

The skeleton *(Fig. 1)* is divided into **axial** and **appendicular skeleton.**

Bones of the **axial skeleton** are subdivided into **bones of the trunk** and **skull.** Bones of the trunk comprise **vertebrae, sternum** and **ribs.**

The appendicular skeleton includes **bones of the upper** and **lower extremities.**

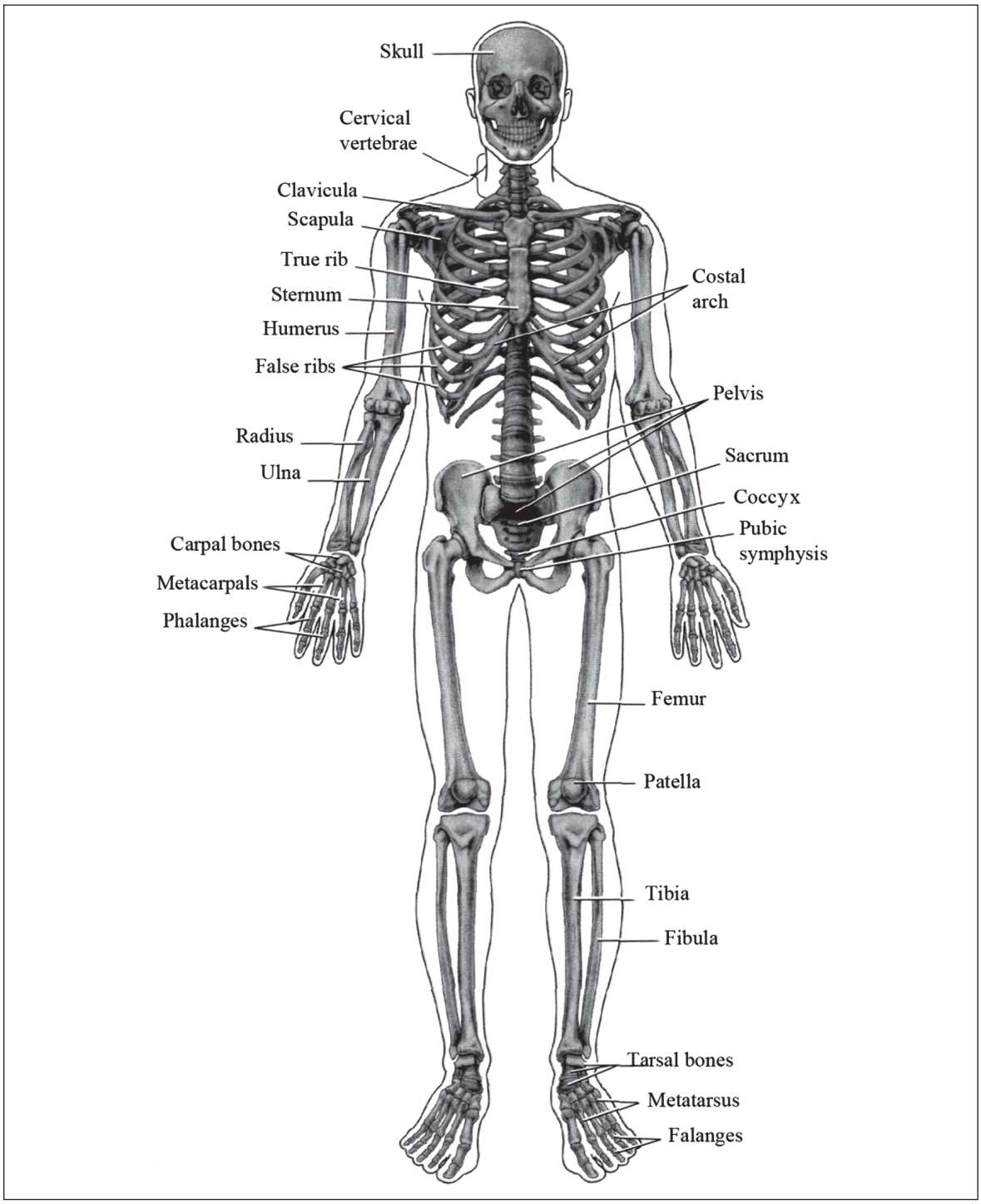

Fig. 1. Human skeleton

Classification of bones

Bones are classified according to their shape:

— *long bones* are tubular (e.g., the humerus);

— *short bones* are cuboidal and are found only in the ankle (tarsus) and wrist (carpus);

— *flat bones* usually have protective functions (e.g., those forming the cranium protect the brain);

— *irregular bones* (e.g., in the face) have various shapes other than long, short, or flat;

— *sesamoid bones* (e.g., the patella, or kneecap) develop in certain tendons and are found where tendons cross the ends of long bones in the limbs; they protect the tendons from excessive load and often change the angle of the tendons as they pass to their attachments.

Bone markings and formations

Bone markings appear wherever tendons, ligaments and fascias are attached or where arteries lie adjacent to or enter bones. Other formations occur in relation to the passage of the tendon (often to direct the tendon or improve its leverage) or to control the type of movement occurring in the joint.

Capitulum *(capitulum):* small, round, articular head (e.g., the capitulum of the humerus).

Condyle *(condylus):* rounded, knuckle-like articular area, usually paired (e.g., the lateral femoral condyle).

Crest *(crista):* ridge of bone (e.g., the iliac crest).

Epicondyle *(epicondylus):* eminence superior to the condyle (e.g., the lateral epicondyle of the humerus).

Facet *(facet):* smooth flat area, usually covered with cartilage, where the bone articulates with another bone (e.g., the superior costal facet on the vertebral body for articulation with the rib).

Foramen *(foramen):* passage through the bone (e.g., the obturator foramen).

Fossa *(fossa):* hollow or depressed area (e.g., the infraspinous fossa of the scapula).

Groove *(sulcus):* elongated depression or furrow (e.g., the radial groove of the humerus).

Head *(caput):* large, round articular end (e.g., the head of the humerus).

Line *(linea):* linear elevation (e.g., the soleal line of the tibia).

Malleolus *(malleolus):* rounded process (e.g., the lateral malleolus of the fibula).

Notch *(incisura):* indentation at the edge of bone (e.g., the greater sciatic notch).

Protuberance *(protuberantia):* projection of bone (e.g., the external occipital protuberance).

Spine *(spina):* thorn-like process (e.g., the spine of the scapula).

Spinous process*:* projecting spine-like part (e.g., the spinous process of a vertebra).

Trochanter *(trochanter):* large blunt elevation (e.g., the greater trochanter of the femur).

Trochlea *(trochlea):* spool-like articular process or process that acts as a pulley (e.g., trochlea of the humerus).

Tubercle *(tuberculum):* small raised eminence (e.g., the greater tubercle of the humerus).

Tuberosity *(tuberositas):* large rounded elevation (e.g., the ischial tuberosity).

Skeletal system diseases

1. Fracture

There are many types of fractures, but the main categories are displaced, non-displaced, open and closed. Displaced and non-displaced fractures refer to the way the bone breaks.

2. Osteoporosis

As bone mineral density decreases, bones loose their integral strength. Age, hormone status and diet all play a vital role in osteoporosis. Bones become progressively weak and are prone to fractures with minor trauma.

3. Rickets/osteomalacia

Rickets is caused by a severe deficiency of calcium, vitamin D and phosphate. Bones soften and become weak losing their normal shape. Bone pain, muscle cramps and skeletal deformities occur.

4. Clubfoot

Clubfoot is a birth defect resulting one or both feet pointing inward and downward. This makes learning to walk difficult, and specialized orthopedic therapy or surgery is often required. The medical term for this condition is talipes equinovarus.

5. Spina bifida

This birth-related condition results in incomplete closure of the vertebra around the spinal canal. Many people have a mild form and do not even know about it. More severe forms are accompanied by nerve defects, difficulty walking, bowel and bladder dysfunction.

6. Leukemia

White blood cells are produced in part by the bone marrow. A variety of blood cancers are generally termed leukemia. The onset is generally insidious, and until a critical mass of abnormal cells occurs, most people are without symptoms. Early warning signs include: bone pain, excess fatigue, easy bruising, night sweats, unexplained weight loss and bleeding gums.

7. Bone cancer

Tumors can arise in bones in a similar fashion as other solid organ cancers. Bone cancer can occur as a primary type of cancer or can be a sign of an advanced cancer located elsewhere in the body that has spread (metastasized) to the bones. Primary bone cancers include osteosarcoma and Ewing's sarcoma. Metastatic cancer examples include lung, breast and prostate cancers.

8. Other causes

Osteogenesis imperfecta is a spectrum of bone disorders ranging from mild to severe and life-threatening. People with this condition are prone to fractures with minor trauma. The most severe form usually results in death in utero. Persons with this disorder may have blue appearing sclera (the white part of the eye has a bluish tint).

Osteopetrosis is a rare bone disorder when the bones literally become petrified, dissolve and break.

In Paget's disease, bone breakdown is faster than they rebuild. Normally, this process is kept in balance, but the accelerated breakdown occurring in Paget's disease results in fragile bones with an increased risk of fracture.

Bones of the trunk

Vertebra *(vertebra)*

The vertebral column *(Fig. 1)* consists of 33–34 vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4–5 coccygeal. The sacral vertebrae fuse to form the sacrum and the coccygeal vertebrae fuse to form the coccyx. Thus, the sacral and coccygeal vertebrae are false vertebrae while the others are true.

Functions of the vertebrae: 1) supporting and amortization; 2) defense; 3) motor; 4) metabolic; 5) hoemeopoetic.

General data about the structure of vertebra

Vertebra *(Fig. 2)* consists of 2 parts: a body and vertebral arch. The vertebral foramen *(foramen vertebrale)* is surrounded by these parts.

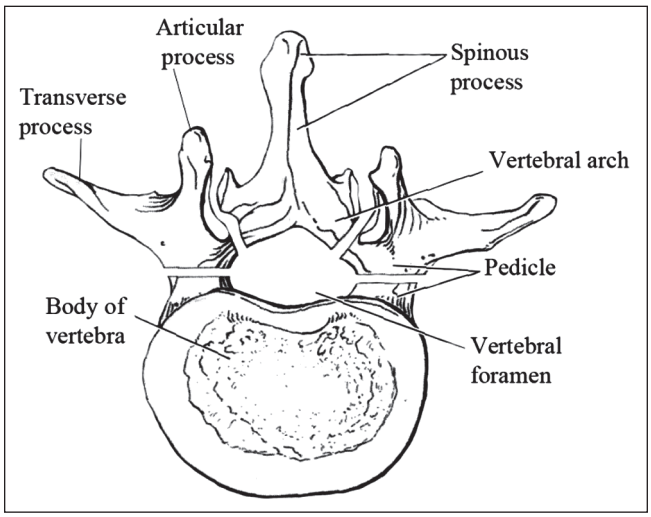

Fig. 2. General structure of a vertebra (superior view)

Body *(corpus vertebrae)* is the largest and heaviest part.

Vertebral arch *(arcus vertebrae)* has 2 pedicles. Pedicle *(pediculus arcus vertebrae)* joins arch to posterolateral surface of the vertebral body and lamina and has 7 processes: 1 spinous *(processus spinosus)*, 4 articular *(processus articulares superiores et inferiores)* and 2 transverse *(processus transversus)*. Concavities on the upper and lower margins are called vertebral notches *(incisura vertebralis superior et inferior)*.

Lamina *(lamina arcus vertebrae)*: plates extending posteriorly and medially from pedicle.

Spinous processes are directed posteriorly and caudally from union of lamina.

Articular processes extend upward and downward from point where pedicles and lamina joint.

Transverse processes project laterally between the superior and inferior articular processes.

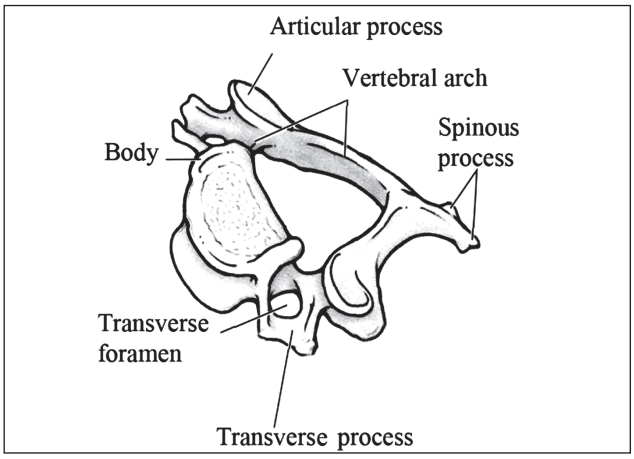

Fig. 3. Cervical vertebra (typical, superolateral view)

Cervical vertebrae *(vertebrae cervicales) (Fig. 3)*:

I. Typical cervical vertebrae: smallest among others vertebrae.

A. Body is small.

B. Vertebral foramen is large and triangular.

C. Spinous process is short and bifid.

D. Transverse process contains a foramen — transverse foramen *(foramen transversarium)*. There are anterior and posterior tubercles *(tuberculum anterius et posterius)* on processes transverses.

Thus, at last each vertebra has:

A. Body.

B. Arch.

C. Pedicles with 2 superior and 2 inferior notches.

D. Vertebral foramen, large and triangular.

E. Seven processes: 2 pairs — articular, 1 pair — transverse, 1 unpair — spinous.

II. Untypical cervical vertebrae *(Fig. 4)* (only points of difference will be given).

A. The first cervical vertebrae — **atlas** *(atlas)*:

1. Atlas has anterior and posterior arch *(arcus anterior et posterior atlantis)* and lateral masses *(massae laterales atlantis)* with superior and inferior articular surfaces *(facies articulares superiores et inferiores)*.

2. Superior articular facets are very large concave ovals facing upward.

3. Inferior articular facets are circular.

4. Transverse processes are large, anterior and posterior tubercles are fused.

5. On superior margin of posterior arch, there is the groove for vertebral artery *(sulcus arteriae vertebralis)*.

6. On posterior surfaces of anterior arch, there is a facet for dens *(fovea dentis)*.

B. The second cervical vertebrae — **axis** *(axis)*:

1. Body has a long, pointed projection directed cranially — the dens *(dens axis)*. Process has an oval articular facet on anterior surface.

2. Pedicles are strong, fused with sides of the body and dens, and their upper surface forms the superior articular facet.

3. Transverse processes are small, end in a single tubercle. Foramen transversarium sets obliquely.

C. The seventh cervical vertebrae — **vertebra prominens** *(vertebra prominens)*:

1. Spinous process: thick, long, directed almost straight posteriorly; is not bifid, but ends in tubercle to which is attached the lower end of the ligamentum nuchae. When a patient stands erect, only spinous process of C7 is visible; hence, its name is *vertebra prominens.*

2. Transverse processes are large, tubercles are not clear.

3. The costal process can be slender and fragile, and the vertebral artery does not usually pass through the foramen transverse.

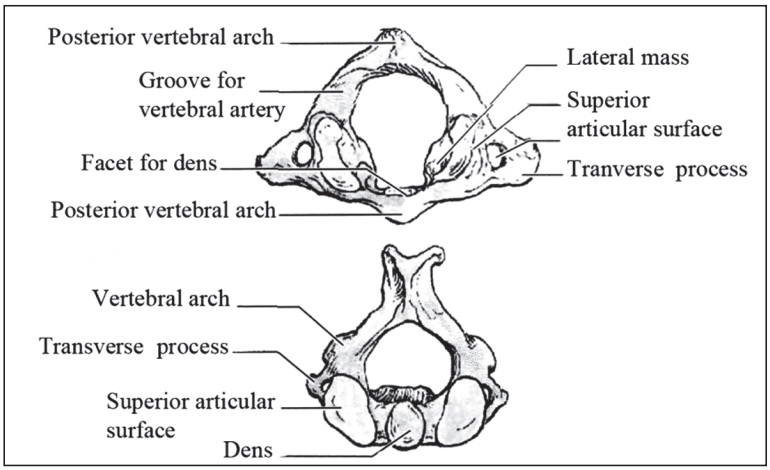

Fig. 4. Cervical vertebra (untypical, superior view)

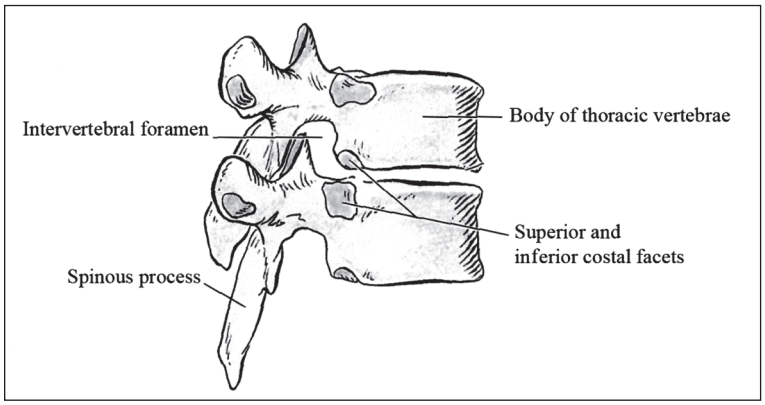

Fig. 5. Thoracic vertebra (lateral view)

Thoracic vertebrae *(vertebrae thoracicae) (Fig. 5)*

A. General characteristics: body increases in size from above downward, has articular facets *(facies articularis capitis costae)* or hemifacets for rib articulation; laminae are broad and thick; spinous processes are long and directed obliquely caudally; the superior articular processes are thin, with facets directed posteriorly; the inferior articular processes are short, and their facets are directed anteriorly; the transverse processes are thick, strong and have articular facets for rib tubercles *(facies articularis tuberculum costae)*.

B. Special features (untypical vertebrae):

1. T1 has one entire facet on each side of the body for the first rib and one half-facet for the second rib.
2. T10 has a single half articular facet on each side.
3. T11 has large a body, large articular entire facet; spinous process is short and almost horizontal; transverse process is short, without articular facet for rib tubercles.
4. T12 resembles both T11 and L1; inferior articular facet is directed laterally; transverse process has not articular facet for rib tubercles.

Lumbar vertebrae *(vertebrae lumbales)*

A. General characteristics: body is large, wide and thick; pedicles are strong and directed posteriorly; laminae are broad and strong; spinous processes are thick, broad and directed posteriorly; superior articular processes are directed medially and posteriorly; inferior articular processes are directed anteriorly and laterally; transverse processes are long, slender and have upper tubercle at junction with superior articular process called mammillary process *(processus mammillaris)* and inferior tubercle at the base of process called accessory process *(processus accessorius)*.

B. Special feature: L5 has a heavy body, small spinous process and thick transverse process.

C. The transverse process of L5 is short and massive, with strong iliolumbar ligament arising from its top.

Sacrum *(os sacrum) (Fig. 6, 7)*: a fusion of 5 vertebrae, triangular in shape

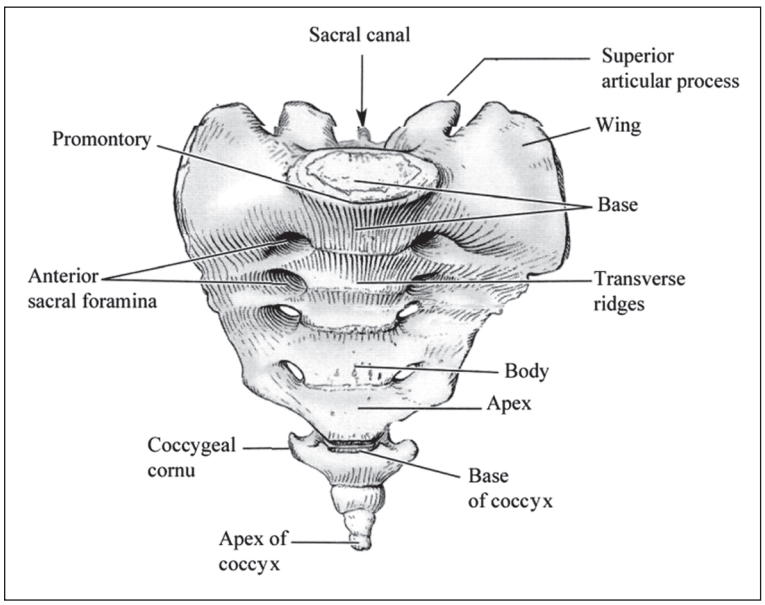

Fig. 6. Sacrum and coccyx (anterior view)

A. Base *(basis ossis sacri)*: directed upward with a large, oval articular surface in the middle of body just behind which the sacral canal *(canalis sacralis)* is (borders with vertebral ach, which fuse together). Superior surface exhibits a projecting anterior border — the sacral promontory *(promontorium)*; superior articular processes are supported by short, heavy pedicles and laminae, which enclose sacral canal.

B. Apex *(apex ossis sacri)*: directed caudally.

C. Ala *(ala ossis sacri)*: on either side of body of sacrum, formed of costal and transverse processes. Lateral surface: upper half, auricular surface with sacral tuberosity *(tuberositas ossis sacri)*

just behind this; inferolateral angle is at lower end of this surface.

Pelvic surface *(facies pelvica)*: concave crossed by 4 transverse ridges *(linea transversae)* — a sign of fusion of the edges of the vertebral bodies; anterior sacral foramina *(foramina sacralia anteriora)* are seen at ends of the ridges.

Posterior surface *(facies dorsalis)*: convex, median sacral crest at midline *(crista sacralis mediana)* — a sign of fusion of the spinous processes, sacral articular (medial) crest *(crista sacralis medialis)* — a sign of fusion of the articular processes, which terminate as the sacral cornu *(cornu sacrale)*, row of posterior sacral foramina *(foramina sacralia posteriora)* laterally to articular crest; lateral crests *(crista sacralis lateralis)* — a sign of fusion of the transverse processes, lie lateral to foramina.

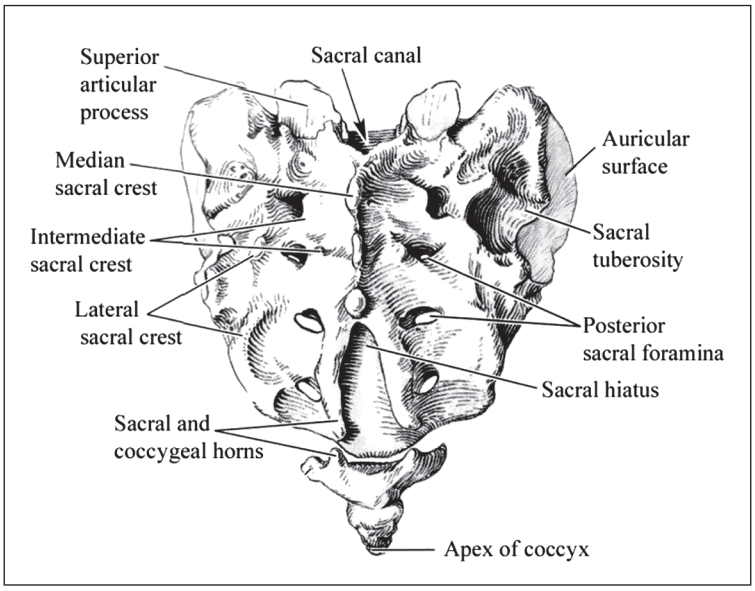

Fig. 7. Sacrum and coccyx (posterior view)

Coccyx *(os coccygis)* is formed by fusion of 3 to 5 vertebrae.

A. Anterior surface: slight convex with transverse ridges.

B. Posterior surface: convex with transverse ridges; has articular crest (as sacrum), the cephalic end of which projects upward as coccygeal cornu.

C. Base: oval articular facet.

D. Apex: caudally directed, rounded, but may be bifid.

Sternum *(sternum)*

The sternum *(Fig. 1)* is a flat bone that may be divided into three parts: the manubrium, the body and the xiphoid process.

A. Manubrium *(manubrium sterni)*. The manubrium is the upper part of the sternum. On each side it has clavicular notch *(incisura clavicularis)*, costal notches *(incisurae costalis)* to joint with the first rib and half of costal notch to articulate with the second rib.

B. Body *(corpus sterni)* of the sternum also has costal notches to joint with ribs on each side. The sternal angle (angle of Louis) *(angulus sterni)* is formed by the articulation of the manubrium with the body of the sternum. This ridge is an important surface landmark and lies at the level of the second costal cartilage.

C. The xiphoid process *(processus xiphoideus)* is a thin plate of hyaline cartilage that becomes ossified at its proximal end in adulthood.

Ribs *(costae) (Fig. 1)*

There are 12 pairs of ribs all of which are attached posteriorly to the thoracic vertebrae:

1. True ribs (*costae verae*): the upper seven pairs are attached to the sternum by their costal cartilages.

2. False ribs (*costae spuriae*): the eighth, ninth and tenth ribs are attached anteriorly to each other and to the seventh rib by means of their costal cartilages and small synovial joints.

3. Floating ribs (*costae fluctuantes*): the eleventh and twelfth pairs have no anterior attachment.

I. Typical rib. Each rib consists of bone part and costal cartilage *(cartilago costalis)*. The typical rib is a long, twisted flat bone with a rounded superior border and a grooved inferior border, the costal groove *(sulcus costae)*, which accommodates the intercostal vessels and nerve.

A rib has a head *(caput costae)*, neck *(collum costae)*, tubercle *(tuberculum costae)*, shaft *(corpus costae)* and angle *(angulus costae)*. The head has two facets *(facies articularis capitis costae)* for articulation with the numerically corresponding vertebral body and with the vertebra immediately above and crest for ligament *(crista capitis costae)*. The tubercle has a facet *(facies articularis tuberculi costae)* for

articulation with the transverse process of the numerically corresponding vertebrae. The angle is where the shaft bends sharply forward.

II. Untypical rib. The head of the 1st, 11th, 12th ribs has not crest. The 11th, 12th ribs have not tubercle and articular facet for articulation with the transverse process of vertebra.

The **first rib** is small and flattened from above downward. It has superior and inferior surface and anterior and posterior margin. Scalene tubercle *(tuberculum musculi scaleni anterioris)* is located on the superior surface of the first rib (area of anterior scalene muscle attachment). Anteriorly to the scalene tubercle, there is the groove for subclavian vein *(sulcus venae subclaviae)*, posteriorly to the scalene tubercle — the groove for subclavian artery *(sulcus arteriae subclaviae)*.

Check list:

1. Name main axis, surface and planes of human body.
2. The skeleton (general data). Main functions.
3. Classification of bones. Main periods of bone development.
4. Vertebral column as a whole. Parts of the vertebral column. Name and demonstrate on preparations.
5. Describe and demonstrate the general quantity of vertebra.
6. Describe features of the cervical, thoracic and lumbar vertebrae. Name and demonstrate on preparations.
7. Describe the features of the 1st, 2nd, 3rd and 7th cervical vertebrae.
8. Describe the structure of the sacrum and coccyx. Demonstrate on preparations.
9. Describe structure of the sternum. Demonstrate on preparations.
10. Classification of ribs. The structure of the 1st — 7th ribs. Describe and demonstrate on preparations.
11. Thorax as a whole. Describe its structure.

Necessary terms *(vocabulary)*

Latin	English
Columna vertebralis	**Vertebral column**
Vertebra	**Vertebra**
Corpus vertebrae	Vertebral body
Facies intervertebralis	Intervertebral surface
Arcus vertebrae	Vertebral arch
Pediculus arcus vertebrae	Pedicle of vertebral arch
Lamina arcus vertebrae	Lamina of vertebral arch
Foramen intervertebrale	Intervertebral foramen
Incisura vertebralis superior	Superior vertebral notch
Incisura vertebralis inferior	Inferior vertebral notch
Foramen vertebrale	Vertebral foramen
Processus spinosus	Spinous process
Processus transversus	Transverse process
Processus articularis superior	Superior articular process
Facies articularis superior	Superior articular facet
Processus articularis inferior	Inferior articular process
Facies articularis inferior	Inferior articular facet
Vertebrae cervicales (C1-C7)	Cervical vertebrae (C1-C7)
Foramen transversarium	Transverse foramen
Tuberculum anterius	Anterior tubercle
Tuberculum caroticum	Carotid tubercle
Tuberculum posterius	Posterior tubercle
Sulcus nervi spinalis	Groove for spinal nerve
Atlas (C1)	Atlas (C1)
Massa lateralis atlantis	Lateral mass of atlas

Latin	English
Facies articularis superior	Superior articular surface
Facies articularis inferior	Inferior articular surface
Arcus anterior atlantis	Anterior arch of atlas
Fovea dentis	Facet for dens
Tuberculum anterius	Anterior tubercle
Arcus posterior atlantis	Posterior arch of atlas
Sulcus arteriae vertebralis	Groove for vertebral artery
Tuberculum posterius	Posterior tubercle
Axis (C2)	Axis (C2)
Dens axis	Dens axis
Apex dentis	Apex of dens
Facies articularis anterior	Anterior articular facet
Facies articularis posterior	Posterior articular facet
Vertebra prominens (C7)	Prominent vertebra (C7)
Vertebrae thoracicae (T1-T12)	Thoracic vertebrae (T1-T12)
Fovea costalis superior	Superior costal facet
Fovea costalis inferior	Inferior costal facet
Fovea costalis processus transversi	Transverse costal facet
Vertebrae lumbales (L1-L5)	Lumbar vertebrae (L1-L5)
Processus accessorius	Accessory process
Processus costiformis; processus costalis	Costal process
Processus mamillaris	Mamillary process
Os sacrum (vertebrae sacrales 1–5)	Sacrum (sacral vertebrae 1–5)
Basis ossis sacri	Base of sacrum

Latin	English
Promontorium	Promontory
Ala ossis sacri	Sacral ala (wing)
Processus articularis superior	Superior articular process
Pars lateralis	Lateral part
Facies auricularis	Auricular surface
Tuberositas ossis sacri	Sacral tuberosity
Facies pelvica	Pelvic surface
Lineae transversae	Transverse ridges
Foramina intervertebralia	Intervertebral foramina
Foramina sacralia anteriora	Anterior sacral foramina
Facies dorsalis	Dorsal surface
Crista sacralis mediana	Median sacral crest
Foramina sacralia posteriora	Posterior sacral foramina
Crista sacralis medialis	Intermediate sacral crest
Crista sacralis lateralis	Lateral sacral crest
Cornu sacrale	Sacral horn
Canalis sacralis	Sacral canal
Hiatus sacralis	Sacral hiatus
Apex ossis sacri	Apex of sacrum
Os coccygis (vertebrae coccygeae 1–4)	Coccyx (coccygeal vertebrae 1–4)
Cornu coccygeum	Coccygeal horn
Skeleton thoracis	**Thoracic skeleton**
Costae (1–12)	Ribs (1–12)
Costae verae (1–7)	True ribs (1–7)
Costae spuriae (8–12)	False ribs (8–12)
Costae fluctuantes (11–12)	Floating ribs (11–12)
Cartilago costalis	Costal cartilage
Costa	Rib
Caput costae	Head of rib
Facies articularis capitis costae	Articular facet of costal head
Crista capitis costae	Crest of costal head
Collum costae	Neck of rib

Latin	English
Crista colli costae	Crest of costal neck
Corpus costae	Body of rib; shaft of rib
Tuberculum costae	Tubercle of rib
Facies articularis tuberculi costae	Articular facet of costal tubercle
Angulus costae	Angle of rib
Sulcus costae	Costal groove
Crista costae	Crest of rib
Costa prima	First rib
Tuberculum musculi scaleni anterioris	Scalene tubercle
Sulcus arteriae subclaviae	Groove for subclavian artery
Sulcus venae subclaviae	Groove for subclavian vein
Costa secunda	Second rib
Tuberositas musculi serrati anterioris	Tuberosity for serratus anterior
Sternum	Sternum
Manubrium sterni	Manubrium of sternum
Incisura clavicularis	Clavicular notch
Incisura jugularis	Jugular notch; suprasternal notch
Angulus sterni	Sternal angle
Corpus sterni	Body of sternum
Processus xiphoideus	Xiphoid process
Incisurae costales	Costal notches
Vertebrae thoracicae (T1-T12)	Thoracic vertebrae (T1-T12)
Cavea thoracis	Thoracic cage
Cavitas thoracis	Thoracic cavity
Apertura thoracis superior	Superior thoracic aperture; thoracic inlet
Apertura thoracis inferior	Inferior thoracic aperture; thoracic outlet
Sulcus pulmonalis	Pulmonary groove
Arcus costalis	Costal margin; costal arch
Spatium intercostale	Intercostal space
Angulus infrasternalis	Infrasternal angle; subcostal angle

Skull

The **skull** ***(cranium)*** *(Fig. 8)* contains 22 bones, which form the cranial cavity, enclose and protect brain, special sense organs of vision, hearing, taste and smell, and provide support for the entrance to digestive and respiratory tract systems. Bones of skull are divided into neurocranium *(neurocranium)* and viscerocranium *(viscerocranium)*.

Bones of the neurocranium

Frontal bone ***(os frontale)*** (*Fig. 8)* consists of four portions — the squama corresponding with the region of the forehead; two orbital portions, which form the roofs of the orbital and nasal cavities, and nasal portion. The frontal bone contains frontal air sinuses *(sinus frontalis)*.

A. Squama *(squama frontalis)* has external and internal surfaces, parietal and sphenoid borders.

The external surface of this portion is convex and usually exhibits, in the lower part of the middle line, the remains of the frontal, or metopic, suture. On either side of this suture, there is the frontal eminence *(tuber frontale)*. Below the frontal eminences — two arched elevations, the *superciliary arches (arcus superciliares)*; smooth elevation named the glabella *(glabella)*. Below each superciliary arch, there is a curved and prominent margin, the supraorbital margin *(margo supraorbitalis)*, which forms the upper boundary of the orbit and separates the squama from the orbital portion of the bone.

The supraorbital margin ends laterally in the zygomatic process *(processus zygomaticus)*. Running upward and backward from this process, there is the temporal line *(linea temporalis)*, which divides into the upper and lower temporal lines.

The internal surface of the squama is concave and presents in the upper part of the middle line a vertical groove, the sagittal sulcus *(sulcus sinus sagittalis superioris)*, the edges of which unite below to form the frontal crest *(crista frontalis)* that ends below in foramen caecum *(foramen caecum)*.

B. Orbital part *(pars orbitalis)* consists of two thin triangular orbital plates. The inferior surface of each orbital plate is smooth and concave, and presents, laterally, the lacrimal fossa *(fossa glandulae lacrimalis)* for the lacrimal gland. Near the nasal part, there is a depression, the trochlear fovea *(fovea trochlearis)*, or occasionally trochlear spine *(trochlear spine)*. The superior surface is convex, and marked by depressions for the convolutions of the frontal lobes of the brain.

C. Nasal part *(pars nasalis)* includes ethmoidal notch *(incisura ethmoidalis)* closed by the cribriform plate of the ethmoid bone in the articulated skull, nasal spine *(spina nasalis)* as part of the nasal sept.

Occipital bone *(os occipitale)* (*Fig. 9, 10)* consists of occipital squama, 2 lateral and basilar parts:

A. Squama *(squama occipitalis)* is situated above and behind the foramen magnum and has external occipital protuberance *(protuberantia occipitalis externa)* and external occipital crest *(crista occipitalis externa)* on outer surface of it. Also there are the highest, superior and inferior nuchal lines *(linea nuchalis suprema, linea nuchalis superior et linea nuchalis inferior)*. Squama has parietal and mastoid borders.

The internal surface is deeply concave and carries a cruciform eminence *(eminentia cruciformis)*, which contents groove for transverse sinus *(sulcus sinus transversi)*, groove for superior sagittal sinus *(sulcus sinus sagittalis superior),* internal occipital crest *(crista occipitalis interna)*, in the middle of it — the internal occipital protuberance *(protuberantia occipitalis interna)*.

B. Lateral part *(pars lateralis)*, paired, is situated at the sides of the foramen magnum and includes jugular process *(processus jugularis)* excavated in front by the jugular notch *(incissura jugularis)*,

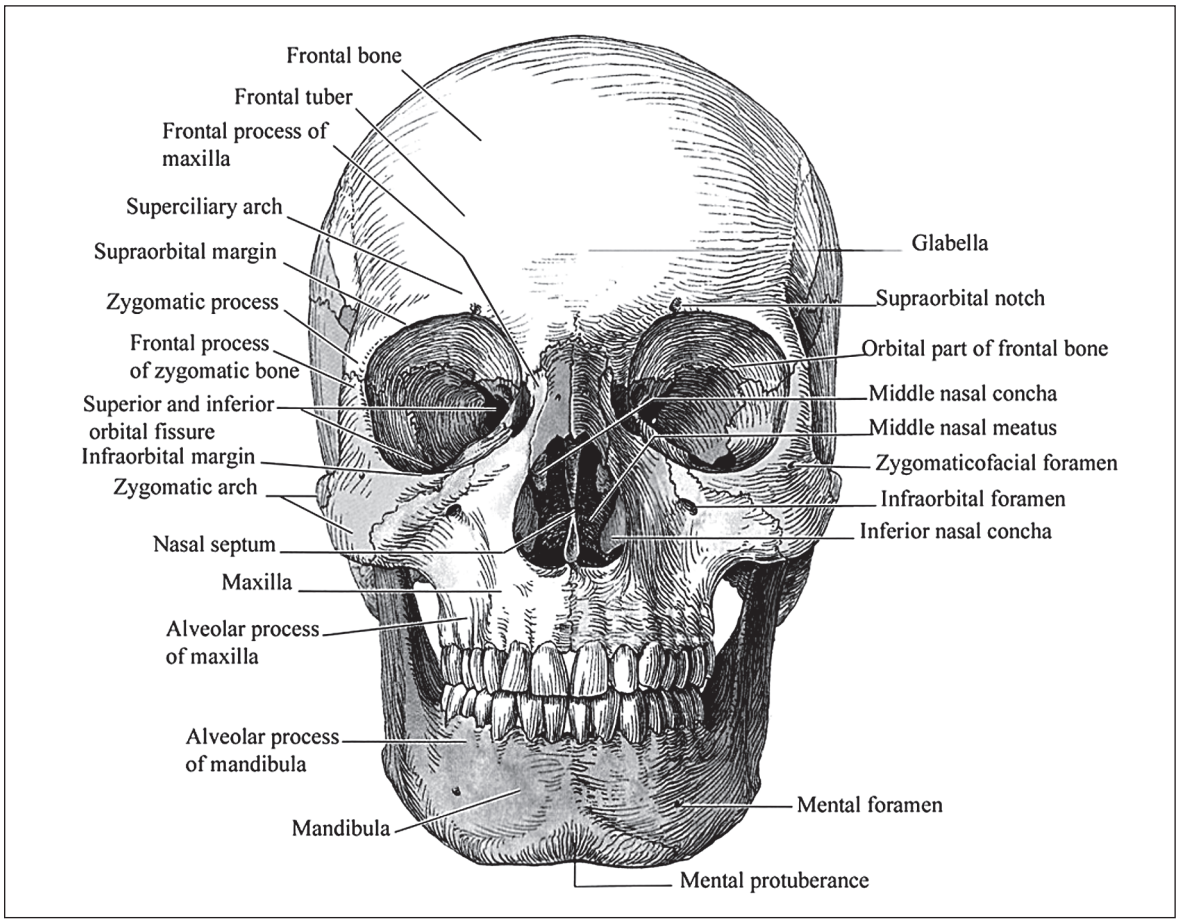

Fig. 8. Skull (anterior view)

occipital condyle *(condylus occipitalis)* with the hypoglossal canal *(canalis hypoglossalis)*. Behind condyle, there is the condyloid fossa of foramen *(fossa/canalis condylaris)*.

C. Basilar part *(pars basilaris)* extends forward and upward from the foramen magnum and forms the back part of the clivus *(clivus)*. On its lower surface, there is the pharyngeal tubercle *(tuberculum pharyngeum)*, which gives attachment to the fibrous raphe of the pharynx.

Parietal bone *(os parietale)* (*Fig. 9)* is irregularly quadrilateral in shape and has convex external surface with parietal tuber *(tuber parietale)*, superior and inferior temporal lines *(lineae temporalis superior et inferior)*. Bone has four corners*:* frontal, sphenoid, mastoid and occipital *(angulus occipitalis, angulus sphenoidalis, angulus mastoideus, angulus frontalis)*; and four margins*:* sagittal, frontal, squamous, occipital *(margo sagittalis, margo frontalis, margo squamosus, margo occipitalis)*. Near the sagittal margin on the concave internal surfaces, there are several depressions for the arachnoid granulation, grooves for meningeal artery and its branches. Along sagittal margin, there is the groove for superior sagittal sinus.

Sphenoid bone *(os sphenoidale)* is divided into a median portion or body, two great and two small wings extending outward from the sides of the body, and two pterygoid processes, which project from it below.

A. Body *(corpus ossis sphenoidale)* is cubical in shape, is hollowed out in its interior to form two large cavities, the sphenoid air sinuses *(sinus sphenoidalis)*, which are separated from each other by a septum. Surfaces of the body: superior, posterior, 2 lateral, anterior, inferior.

The superior surface is bounded behind by the prechiasmatic groove *(sulcus praechiasmaticus)*. The groove ends on either side in the optic canal *(canalis opticus)*. Behind the chiasmatic groove, there is an elevation, the tuberculum sellae *(tuberculum sellae)*, and still more posteriorly, there is deep depression of sella turcica *(sella turcica)*, the deepest part of it is hypophysial fossa *(fossa hypophysialis),* which is limited posteriorly by the dorsum sellae *(dorsum sellae)*.

The posterior surface fuses with basilar portion of the occipital bone to form clivus.

The lateral surfaces have carotid groove *(sulcus caroticus)*.

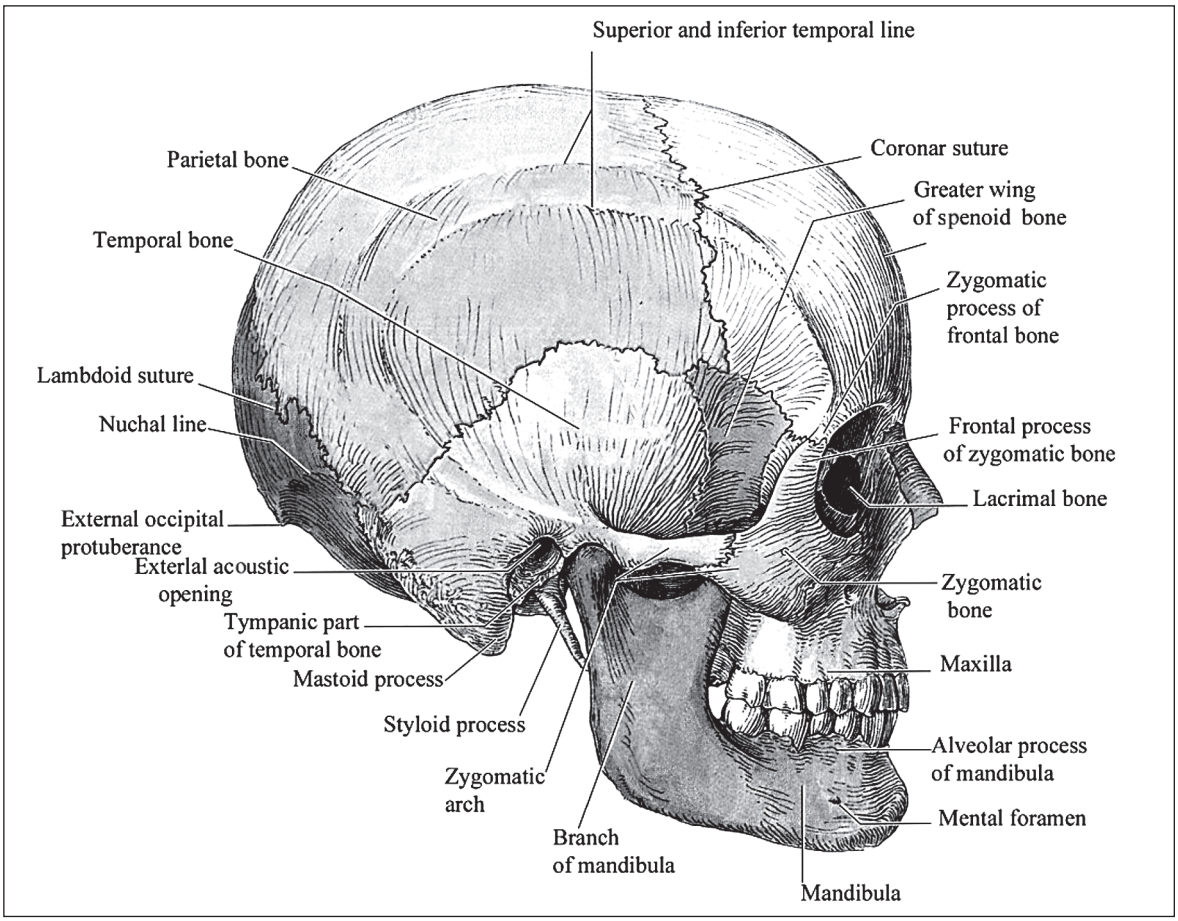

Fig. 9. Skull (lateral view)

The anterior surface of sphenoid body has sphenoidal crest *(crista sphenoidalis)* in the middle line. On either side of the crest, there is opening leading into the corresponding sphenoidal air sinus.

The inferior surface has the sphenoidal rostrum *(rostrum sphenoidalis)*, which is continuous with the sphenoidal crest on the anterior surface.

B. The greater wing *(ala major)* has orbital, maxillar, temporal, infratemporal and cerebral surfaces, which are directed to the same named structures.

The cerebral surface of each great wing has foramen rotundum *(foramen rotundum)*, behind and lateral to this, there is the foramen ovale *(foramen ovale)* and foramen spinosum *(foramen spinosum)*.

The infratemporal crest *(crista infratemporalis)* is situated between temporal and infratemporal surfaces. The orbital surface of the great wing is directed forward and forms the lateral wall of the orbit.

C. The small wing *(alae minor)* is a thin triangular plate, which arises upward and anteriorly from body. Between great and small wings, there is superior orbital fissure *(fissura orbitalis superior)*.

D. Pterygoid process *(processus pterygoideus)* descends perpendicularly from the body. Each process consists of medial and lateral plates *(laminae lateralis et medialis)*. The plates are separated below by the pterygoid notch *(incisura pterygoidea)*. Pterygoid canal *(canalis pterygoideus)* passes through base of process. The medial pterygoid plate has pterygoid hamulus *(hamulus pterygoideus)*.

Ethmoid bone *(os ethmoidale)* is situated at the anterior part of the base of the cranium, between the two orbits, at the roof of the nose. It consists of cribriform plate, perpendicular plate *(lamina perpendicularis)*, constituting part of the nasal septum and two lateral labyrinths.

A. Cribiform plate *(lamina cribrosa)* is perforated by foramina, carries the crista galli *(crista galli)*, which borders the foramen caecum *(foramen caecum)*.

B. Labyrinth *(labyrinthus ethmoidalis)* contains anterior, middle and posterior groups of air cellular cavities, the ethmoidal cells *(cellulae ethmoidalis)*. Lateral surface of labyrinth is called the orbital plate *(lamina orbitalis)* because it forms medial wall of orbita. Medially (into nasal cavity) superior nasal concha *(concha nasalis superior)* and middle nasal concha *(concha nasalis media)* attach to labyrinth.

Temporal bone *(os temporale)* *(Fig. 9, 10)*, paired, forms the base and lateral wall of neurocranium. Structurally the temporal bone has three parts: squamous, tympanic and petrous. Between these parts, there are petrosquamous, tympanomastoid and petrotympanic fissures.

A. Squamous part *(pars squamosa)* is the flattened plate of bone at the sides of the skull. It has a groove for the middle temporal artery *(sulcus arteriae temporalis mediae)* on internal surface and the

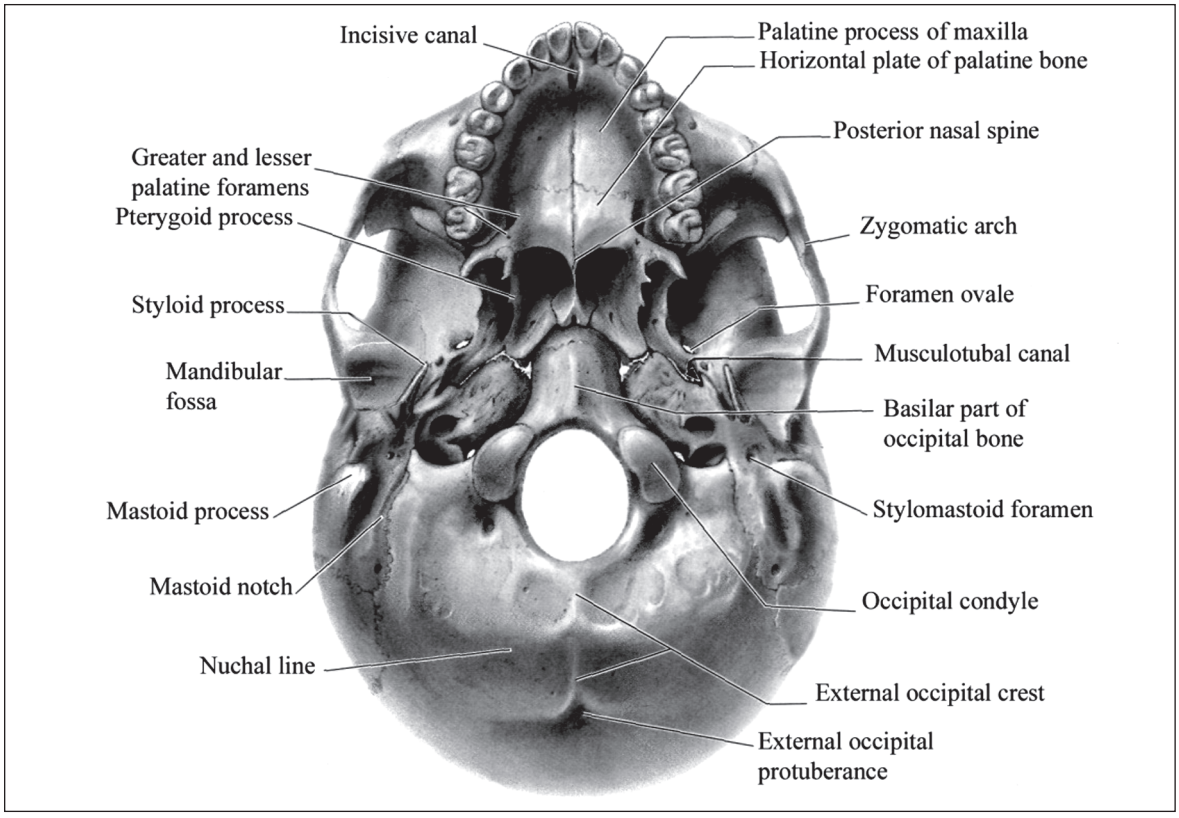

Fig. 10. Skull (inferior view)

temporal line, zygomatic process that forms the posterior portion of the zygomatic arch *(arcus zygomaticus)* and mandibular fossa *(fossa mandibularis)* on the external surface. The mandibular fossa is bounded, in front, by the articular tubercle *(tuberculum articularis)*.

B. Tympanic part *(pars tympanica)* is located immediately posteriorly to the mandibular fossa and forms lateral wall of the external acoustic meatus.

C. Petrous portion *(pars petrosa)* is pyramidal in shape. Its base directs laterally, backward and continues with mastoid process. Apex of petrous part directs medially and forward. Petrous portion has three surfaces (anterior, posterior, inferior) and three margins (anterior, posterior, superior).

The anterior surface forms the posterior part of the middle cranial fossa of the base of the skull. It has following structures:

1) arcuate eminence *(eminentia arcuata)* is located near the center, indicates the position of the superior semicircular canal;

2) tegmen tympani *(tegmen tympani)* indicating the roof of the tympanic cavity;

3) groove for the lesser and greater petrosal nerves *(sulcus nervi petrosi minoris et sulcus nervi petrosi majoris)*;

4) hiatus for lesser and greater petrosal nerves *(hiatus canalis nervi petrosi minoris et hiatus canalis nervi petrosi majoris)*;

5) trigeminal impression *(impressio trigeminalis)* is located near apex of petrous part.

The posterior surface forms the posterior cranial fossa of the base of the skull. It has next structures:

1) internal acoustic opening *(porus acusticus internus)* leads into internal acoustic meatus *(meatus acusticus internus)*;

2) opening of vestibular canaliculus *(apertura canaliculus vestibuli)*;

3) subarcuate fossa *(fossa subarcuate)* is an irregular depression, which lodges a process of the dura mater.

The inferior surface forms the external base of the skull. It has the following structures:

1) external opening of carotid canal *(apertura externa canalis carotici)*;

2) jugular fossa *(fossa jugularis)*. It connects with jugular notch of the occipital bone and together they form jugular foramen *(foramen jugularis)*;

3) fossula petrosa *(fossula petrosa)* is between the external opening of carotid canal and jugular fossa;

4) styloid process *(processus styloideus)* is sharp spine, about 2.5 cm in length;

5) stylomastoid foramen *(foramen stylomastoideus)* is between the styloid and mastoid processes.

The anterior margin is situated between inferior and anterior surfaces. It has orifice of the musculotubal canal. The superior margin is the longest and has groove for superior petrosal sinus *(sulcus sinus petrosi superioris)*. The posterior margin is intermediate in length between the inferior and the posterior surfaces of petrous portion. Its medial half is marked by a jugular fossa *(fossa jugularis)*.

Mastoid process *(processus mastoideus)* situates posteriorly the external acoustic pore. It has rough external surface. Behind the mastoid process, there are the mastoid notch *(incisura mastoidea)* and groove for occipital artery *(sulcus arteriae occipitalis)*. On the internal surface, there is the groove for the sigmoid sinus *(sulcus sinus sigmoidei)*. There are cells inside the mastoid process.

Canals of the temporal bone

Name of canal	Beginning	End
Carotid canal *(canalis caroticus)*	External opening on lower surface of the petrous part	Internal opening on apex of petrous part
Caroticotympanic canaliculi *(canaliculi caroticotympanici)*	Carotid canal	Tympanic cavity
Musculotubal canal *(canalis musculotubarius):* *— semicanalis m. tensoris tympani;* *— semicanalis tubae auditivae*	Anterior margin of the petrous part	Tympanic cavity
Facial canal *(canalis nervi facialis)*	Internal acoustic meatus	Stylomastoid foramen
Canaliculus for chorda tympani *(canaliculus chordae tympani)*	Facial canal	Passes through the tympanic cavity and terminates in petrotympanic fissure
Tympanic canaliculus *(canaliculus tympanicus)*	Petrosal fossula	Hiatus canalis nervi petrosi minoris
Mastoid canaliculus *(canaliculus mastoideus)*	Jugular fossa	Tympanomastoid fissure

Bones of viscerocranium

Maxilla (upper jaw) ***(maxilla)*** (*Fig. 8)* assists in forming the roof of the mouth, the floor and lateral wall of the nasal cavity and the floor of the orbit. It consists of a body and four processes — zygomatic, frontal, alveolar, and palatine.

A. The body *(corpus maxillae)* contains air cavity, the maxillary sinus *(sinus maxillaris)*. It has four surfaces — anterior, posterior, or infratemporal, superior, or orbital, and medial, or nasal.

The orbital surface is smooth and triangular and forms the floor of the orbit. The posterior part of the orbital surface forms inferior border of inferior orbital fissure *(fissura orbitalis inferior)*. The infraorbital groove *(sulcus infraorbitalis)* continues into infraorbital canal *(canalis infraorbitalis)*, which with opened is infraorbital foramen *(foramen infraorbitalis)* on the anterior surface, the canine fossa *(fossa canina)*, below infraorbital margin *(margo infraorbitalis)* that separates anterior surface from orbital surface.

The infratemporal surface is convex, has eminence, the maxillary tuber *(tuber maxillae)* with alveolar foramens *(foramina alveolaria)*. On the border between infratemporal surface and nasal surface, there is the greater palatine groove *(sulcus palatinus major)*.

The nasal surface forms the lateral wall of nasal cavity. It has maxillary hiatus *(hiatus maxillaris)* leading into the maxillary sinus. Near this opening, there is the lacrimal groove *(sulcus lacrimalis)* converted into the nasolacrimal canal *(canalis nasolacrimalis)*, which ends in orbita. More anteriorly, there is an oblique ridge, the conchal crest *(crista conchalis)*, for articulation with the inferior nasal concha.

B. The zygomatic process *(processus zygomaticus)* is a rough triangular eminence, passes laterally and is serrated for articulation with the zygomatic bone.

C. The frontal process *(processus frontalis)* is a strong plate, which projects upward, medialward, and backward, by the side of the nose, forming part of its lateral boundary. Its lateral surface is smooth, contents the lacrimal groove *(sulcus lacrimalis)*, which is bordered anteriorly by anterior lacrimal crest *(crista lacrimalis anterior)*. On the medial surface, there is the ethmoidal crest *(crista ethmoidalis)*, the posterior end of which articulates with the middle nasal concha.

D. Alveolar process *(processus alveolaris)* forms the alveolar arch *(arcus alveolaris)*. It has deep cavities for the reception of the teeth, dental alveoli *(alveoli dentales)*.

E. The palatine process *(processus palatinus)* projects medialward. When the two maxillae are articulated, a funnel-shaped opening, the incisive foramen *(incisive foramen)*, is seen in the middle line, immediately behind the incisor teeth. The medial border forms the nasal crest *(crista nasalis)* for the reception to vomer.

Mandible ***(mandibula)*** (*Fig. 8)*, or lower jaw, is the largest and strongest bone of the face. The mandible consists of a horseshoe-shaped body and a pair of branches.

A. The body *(corpus mandibulae)*. The upper part of the body is called the alveolar part *(pars alveolaris)*, which form alveolar arch with dental alveoli. On anterior surface of body, there is eminence, the mental protuberance *(protuberantia mentalis)*, which ends by the mental tubercle *(tuberclum mentalis)*. Below and laterally mental tubercle, there is the mental foramen *(foramen mentalis)*. The oblique line *(linea obliqua)* runs from it. On the internal surface of the body of the mandible, there are next structures (in order from midline): the superior mental spine *(spina mentalis superior)*, digastric fossa *(fossa digastrica)*, the sublingual fovea *(fovea sublingualis)* and the submandibular fossa *(fossa submandibularis)*. Above the last, the mylohyoid line *(linea mylohyoidea)* runs.

B. The mandibular branch *(ramus mandibulae)* has an anterior coronoid process *(processus coronoideus)* and posterior condyloid process *(processus condylaris)* with head of mandible *(caput mandibulae)* and neck of mandible *(collum mandibulae)*. Between two processes, there is the mandibular notch *(incisura mandibulae)*.

The body of the mandible meets the ramus on each side at the angle of mandible *(angulus mandibulae)*. On its external surface, the masseteric tuberosity *(tuberositas masseterica)* is located. On internal surface of mandibular angle, the pterygoid tuberosity *(tuberositas pterygoidea)* is located. The mandibular foramen *(foramen mandibularis)* lies on the medial surface of the ramus, which leads into the mandibular canal *(canalis mandibularis)*.

Zygomatic bone ***(os zygomaticum)*** (*Fig. 8)* forms prominences of cheek, paired, has frontal and temporal processes, lateral, temporal and orbital surfaces. It has zygomaticofacial foramens on its lateral surfaces.

Nasal bone ***(os nasale)***, paired, forms bony part of nasal dorsum.

Palatine bone ***(os palatinum)***, paired, has perpendicular and horizontal laminae. It forms wall of nasal cavity, mouth, orbit and pterygopalatine fossa.

Lacrimal bone ***(os lacrimale)***, paired, forms anterior part of the medial orbital wall.

Vomer ***(vomer)***, unpaired, is located in nasal cavity and forms bony part of nasal septum.

Inferior nasal concha ***(concha nasalis inferior)***, paired, is a thin plate that separates middle from inferior nasal meatus.

Hyoid ***(os hyoideum)***, unpaired, bone is positioned in neck between mandible and larynx. It has body, large and small horns.

Skull as a whole (*Fig. 8–10)*

Neurocranial bones form the cranial base (base of the skull) and the calvaria (roof of the skull).

Calvaria ***(calvaria)*** is called skullcap and is formed anteriorly by the frontal bone and posteriorly by parietal and occipital bones, all articulating with each other via sutures. Calvaria is separated from base due to line, which arises along glabella, supraorbital margin, zygomatic process of frontal bone, frontal process of zygomatic bone, zygomatic arch, above external auditory meatus, base of mastoid process, superior nuchal line and external occipital protuberance.

Cranial base has internal and external surfaces.

Internal surface consists of anterior, middle and posterior cranial fossae.

I. Anterior cranial fossa *(fossa cranii anterior):*

A. Boundaries: anterior and lateral — squama of frontal bone; posterior — the posterior margin of lesser wing of sphenoid and prechiasmatic groove.

B. Floor: orbital plate of frontal bone, cribriform plate of ethmoid bone, and superior surface of lesser wing of sphenoid bone.

C. Special features: frontal crest, foramen cecum, crista galli, and grooves for anterior meningeal vessels.

II. Middle cranial fossa *(fossa cranii media):*

A. Boundaries: anterior — lesser wings of sphenoid bone and prechiasmatic groove; posterior — superior margin of petrous portion of the temporal bone and dorsum sellae; lateral — squamous portion of the temporal bone, great wing of sphenoid and parietal bones.

B. Floor: petrous portion of the temporal bone, great wing of sphenoid and sella turcica.

C. Special features: sella turcica, clinoid processes, carotid groove, superior orbital fissure, optic canal, foramen rotundum, foramen ovale, foramen spinosum, foramen lacerum, arcuate eminence, tegmen tympani, hiatus for greater and lesser petrosal nerves, grooves for greater and lesser petrosal nerves, and grooves for branches of middle meningeal arteries.

III. Posterior cranial fossa *(fossa cranii posterior):*

A. Boundaries: anterior — dorsum sellae and superior margin of petrous portion of the temporal bone; lateral — parietal bone; posterior — squama of occipital bones.

B. Floor: occipital and temporal bones.

C. Special features: clivus, grooves for superior petrosal sinus, foramen magnum, hypoglossal canal, condylar canal, jugular foramen, internal acoustic (auditory) opening and meatus, vestibular aqueduct, internal occipital crest, grooves for transverse and sigmoid sinuses, mastoid foramen.

Cranial fossae and theirs communications

Cranial fossa	Name of structure	Communication (with)
Anterior	Foramina of cribriform plate	Nasal cavity
Medial	Optic canal	Orbita
	Superior orbital fissure	Orbita
	Foramen rotundum	Pterygopalatine fossa
	Foramen ovale	Infratemporal fossa
	Foramen spinosum	Infratemporal fossa
	Foramen lacerum	Cranial base, external surface
	Carotid canal	Cranial base, external surface
Posterior	Magnum foramen	Cranial base, external surface; vertebral canal
	Jugular foramen	Cranial base, external surface
	Hypoglossal canal	Cranial base, external surface
	Internal auditory meatus	Leads into facial canal, through stylomastoid foramen to cranial base, external surface

Special features of the lateral aspect of the skull

I. Temporal fossa *(fossa temporalis)* (*Fig. 9)*:

A. Bounded: above and behind by temporal lines; in front by frontal and zygomatic bones, laterally by the zygomatic arch, and below by the infratemporal crest.

B. Communicated: with the orbital cavity through the inferior orbital or sphenomaxillary fissure.

II. Infratemporal fossa *(fossa infratemporalis)*:

A. Bounded: in front by the tuber of maxilla; behind by the articular tubercle of the temporal bone; above by great wing of sphenoid and the infratemporal crest; laterally by the branch of maxilla, and medially by the lateral pterygoid plate.

B. Communicated: with orbita via the inferior orbital fissure; with pterygopalatine fossa via the pterygomaxillary fissure *(fissura pterygomaxillaris)*.

III. Pterygopalatine fossa *(fossa pterygopalatine)*:

A. Bounded: above by body of sphenoid and great wing of sphenoid; in front by the tuber of maxilla; behind by pterygoid process; medially by palatine bone.

B. Communicated: with the orbit via the inferior orbital fissure; with the infratemporal fossa and via the pterygomaxillary fissure; with nasal cavity via the sphenopalatine foramen; with anterior cranial fossa via the foramen rotundum; with area of foramen lacerum via the pterygoid canal; with oral cavity via the greater and lesser palatine canals.

Special features of the anterior aspect of the skull

I. Orbita *(orbita)* (*Fig. 8)*. Bony orbit is a pyramidal cavity, with base, apex, roof, floor, medial and lateral walls:

A. Apex is directed dorsomedially, contains optic foramen for optic nerve.

B. Floor: orbital part of maxilla, orbital surface of zygomatic bone, orbital process of palatine bone.

C. Roof: orbital plate of frontal bone and small wing of sphenoid.

D. Medial: frontal process of maxilla, lacrimal bone, orbital lamina of ethmoid, body of sphenoid bone.

E. Lateral: orbital surface of great wing of sphenoid bone, frontal process of zygomatic bone, zygomatic process of frontal bone.

F. Base is directed anterolaterally and is formed by structures of the orbital opening *(aditus orbitalis)*: above — supraorbital margin of frontal bone with its supraorbital notch (foramen); laterally — zygomatic and zygomatic process of frontal bone; below — supraorbital margin of maxillary bones; medially, frontal bone and frontal process of maxillary bone.

G. Special features: medially — trochlea for superior oblique muscle, lacrimal groove, opening of nasolacrimal duct, anterior and posterior ethmoidal foramina; laterally — lacrimal fossa, zygomaticoorbital foramina; inferiorly — infraorbital groove. Superior orbital fissure is between roof and lateral wall of orbita, inferior orbital fissure is between lateral wall of orbita and floor.

II. Bony nasal cavity *(cavitas nasalis ossea)*:

A. Opening: piriform aperture *(apertura piriformis)*, pear-shaped, bounded by nasal bone and nasal incisure of both maxilla.

B. Nasal septum: perpendicular plate of ethmoid, vomer.

C. Roof: nasal bone, nasal part of frontal bone, cribriform plate of ethmoid bone, body of sphenoid bone.

D. Floor: palatine process of maxilla, horizontal plate of palatine bone.

E. Lateral wall: frontal process and nasal surface of maxilla, nasal bone, lacrimal bone, perpendicular plate of the palatine, medial plate, pterygoid process, labyrinth of ethmoid bone with superior and middle conchae and inferior concha (turbinate).

The inferior nasal conchae and floor border inferior nasal meatus *(meatus nasi inferior)*, into which the nasolacrimal duct opens. Inferior and middle conchae project medially and inferiorly creating air passage ways beneath them called the middle nasal meatus *(meatus nasi medius)*, into which the maxillaris and frontal sinuses open. The short superior concha conceals the superior nasal meatus *(meatus nasi superior)* into which the sphenoid sinus via the sphenoethmoidal recess *(recessus sphenoethmoidalis)* opens. The space along the nasal septum and free margin of all concha is common nasal meatus *(meatus nasi communis)* into which the sphenoid sinus opens.

F. All nasal meatuses continue with nasopharyngeal meatus *(meatus nasopharyngeus)*, which ends by posterior aperture *(choana)*.

Bony palate *(palatum osseum)* *(Fig. 10)* is formed by palatine process of maxilla and horizontal plate of palatine bone.

Check list:

1. Parts of cranium. Name and demonstrate on preparations.
2. Neurocranium. Name bones, which form it. Demonstrate on preparations.
3. Neurocranium. Demonstrate on preparations the border between calvaria and base of cranium.
4. Parietal bone: surfaces, corners, margins. Name and demonstrate on preparations.
5. Frontal bone: parts, formations. Name and demonstrate on preparations.
6. Occipital bone: parts, formations. Name and demonstrate on preparations.
7. Ethmoid bone: parts, formations. Name and demonstrate on preparations.
8. Sphenoid bone: parts, formations. Name and demonstrate on preparations.
9. Temporal bone: parts, formations. Name and demonstrate on preparations.
10. Canals of the temporal bone. Demonstrate external and internal openings of the carotid canal, of the facial canal, opening of the musculotubal canal, external and internal openings of the canaliculus for chorda tympani, of the tympanic canaliculus and mastoid canaliculus. Demonstrate external and internal openings of the caroticotympanic canaliculi.
11. Cranium viscerale. Name bones, which form it. Demonstrate on preparations.
12. Maxilla: parts, processes, formation of these structures. Describe and demonstrate on preparations.
13. Mandibule: parts, formations. Describe and demonstrate on preparations.
14. Inferior nasal concha, vomer, hyoid bone. Describe the structure of these bones. Demonstrate on preparations.
15. Lacrimal bone, nasal bone, zygomatic bone, palatine bone. Describe the structure of these bones. Demonstrate on preparations.
16. Temporal fossa: describe borders and walls. Demonstrate on preparations.
17. Infratemporal fossa: describe borders and its connections. Demonstrate on preparations.
18. Pterygopalatine fossa: describe borders and its connections. Demonstrate on preparations.
19. Orbita. Describe borders and its connections. Demonstrate on preparations.
20. The nasal cavities. Describe external and internal openings and walls. Demonstrate on preparations.
21. Nasal passages. Describe the structure, connections of these passages. Demonstrate on preparations.
22. Skull as a whole. Describe the structure of internal surface. Demonstrate on preparations.
23. Skull as a whole. Describe the structure of external surface. Demonstrate on preparations.
24. Internal surface of cranial base. Name structures, which form anterior cranial fossa. Describe the structure and connection of anterior cranial fossa.
25. Internal surface of cranial base. Name structures, which form middle cranial fossa. Describe the structure and connection of middle cranial fossa. Demonstrate on preparations.
26. Internal surface of cranial base. Name structures, which form posterior cranial fossa. Describe the structure and connection of posterior cranial fossa. Demonstrate on preparations.
27. Age characteristics of the skull.
28. Sexual characteristics and individual variations of the skull.

Necessary terms *(vocabulary)*

Latin	English
Cranium	**Cranium**
Neurocranium	Neurocranium; brain box
Viscerocranium	Viscerocranium; facial skeleton
Cavitas cranii	Cranial cavity
Calvaria	Calvaria
Ossa cranii	**Bones of cranium**
Os frontale	**Frontal bone**
Squama frontalis	Squamous part
Facies externa	External surface
Tuber frontale; eminentia frontalis	Frontal tuber; frontal eminence

Latin	English
Arcus superciliaris	Superciliary arch
Glabella	Glabella
Margo supraorbitalis	Supraorbital margin
Incisura supraorbitalis	Supraorbital notch
Foramen supraorbitale	Supraorbital foramen
Incisura frontalis	Frontal notch
Foramen frontale	Frontal foramen
Facies temporalis	Temporal surface
Margo parietalis	Parietal margin
Linea temporalis	Temporal line

Latin	English
Processus zygomaticus	Zygomatic process
Facies interna	Internal surface
Crista frontalis	Frontal crest
Sulcus sinus sagittalis superior	Groove for superior sagittal sinus
Foramen caecum	Foramen caecum
Pars nasalis	Nasal part
Spina nasalis	Nasal spine
Margo nasalis	Nasal margin
Pars orbitalis	Orbital part
Facies orbitalis	Orbital surface
Spina trochlearis	Trochlear spine
Fovea trochlearis	Trochlear fovea
Fossa glandulae lacrimalis	Fossa for lacrimal gland; lacrimal fossa
Margo sphenoidalis	Sphenoidal margin
Incisura ethmoidalis	Ethmoidal notch
Sinus frontalis	Frontal sinus
Apertura sinus frontalis	Opening of frontal sinus
Os occipitale	**Occipital bone**
Foramen magnum	Foramen magnum
Pars basilaris	Basilar part
Clivus	Clivus
Tuberculum pharyngeum	Pharyngeal tubercle
Sulcus sinus petrosi inferioris	Groove for inferior petrosal sinus
Pars lateralis	Lateral part
Squama occipitalis	Squamous part of occipital bone
Margo mastoideus	Mastoid border
Margo lambdoideus	Lambdoid border
Condylus occipitalis	Occipital condyle
Canalis condylaris	Condylar canal
Canalis nervi hypoglossi	Hypoglossal canal
Fossa condylaris	Condylar fossa
Tuberculum jugulare	Jugular tubercle
Incisura jugularis	Jugular notch
Processus jugularis	Jugular process
Processus intrajugulans	Intrajugular process
Protuberantia occipitalis externa	External occipital protuberance
Crista occipitalis externa	External occipital crest
Linea nuchalis suprema	Highest nuchal line
Linea nuchalis superior	Superior nuchal line
Linea nuchalis inferior	Inferior nuchal line
Planum occipitale	Occipital plane
Eminentia cruciformis	Cruciform eminence
Protuberantia occipitalis interna	Internal occipital protuberance
Crista occipitalis interna	Internal occipital crest
Sulcus sinus transversi	Groove for transverse sinus

Latin	English
Sulcus sinus sigmoidei	Groove for sigmoid sinus
Sulcus sinus occipitalis	Groove for occipital sinus
Sulcus sinus marginalis	Groove for marginal sinus
Processus paramastoideus	Paramastoid process
Os parietale	**Parietal bone**
Facies interna	Internal surface
Sulcus sinus sigmoidei	Groove for sigmoid sinus
Sulcus sinus sagittalis superioris	Groove for superior sagittal sinus
Sulcus arteriae meningeae mediae	Groove for middle meningeal artery
Sulci arteriosi	Grooves for arteries
Facies externa	External surface
Linea temporalis superior	Superior temporal line
Linea temporalis inferior	Inferior temporal line
Tuber parietale; eminentia parietalis	Parietal tuber; parietal eminence
Margo occipitalis	Occipital border
Margo squamosus	Squamosal border
Margo sagittalis	Sagittal border
Margo frontalis	Frontal border
Angulus frontalis	Frontal angle
Angulus occipitalis	Occipital angle
Angulus sphenoidalis	Sphenoidal angle
Angulus mastoideus	Mastoid angle
Foramen parietale	Parietal foramen
Os sphenoidale	**Sphenoid bone**
Corpus	Body
Sulcus prechiasmaticus	Prechiasmatic groove
Sella turcica	Sella turcica
Tuberculum sellae	Tuberculum sellae
Fossa hypophysialis	Hypophysial fossa
Dorsum sellae	Dorsum sellae
Processus clinoideus posterior	Posterior clinoid process
Sulcus caroticus	Carotid groove
Lingula sphenoidalis	Sphenoidal lingula
Crista sphenoidalis	Sphenoidal crest
Rostrum sphenoidale	Sphenoidal rostrum
Sinus sphenoidalis	Sphenoidal sinus
Apertura sinus sphenoidalis	Opening of sphenoidal sinus
Concha sphenoidalis	Sphenoidal concha
Ala minor	Lesser wing
Canalis opticus	Optic canal
Processus clinoideus anterior	Anterior clinoid process
Fissura orbitalis superior	Superior orbital fissure
Ala major	Greater wing
Facies cerebralis	Cerebral surface
Facies temporalis	Temporal surface

Latin	English
Facies infratemporalis	Infratemporal surface
Crista infratemporalis	Infratemporal crest
Facies maxillaris	Maxillary surface
Facies orbitalis	Orbital surface
Margo zygomaticus	Zygomatic margin
Margo frontalis	Frontal margin
Margo parietalis	Parietal margin
Margo squamosus	Squamosal margin
Foramen rotundum	Foramen rotundum
Foramen ovale	Foramen ovale
Foramen spinosum	Foramen spinosum
Spina ossis sphenoidalis	Spine of sphenoid bone
Processus pterygoideus	Pterygoid process
Lamina lateralis	Lateral plate
Lamina medialis	Medial plate
Incisura pterygoidea	Pterygoid notch
Fossa pterygoidea	Pterygoid fossa
Fossa scaphoidea	Scaphoid fossa
Hamulus pterygoideus	Pterygoid hamulus
Canalis pterygoideus	Pterygoid canal
Processus pterygospinosus	Pterygospinous process
Os ethmoidale	**Ethmoid bone**
Lamina cribrosa	Cribriform plate
Foramina cribrosa	Cribriform foramina
Crista galli	Crista galli
Lamina perpendicularis	Perpendicular plate
Labyrinthus ethmoidalis	Ethmoidal labyrinth
Cellulae ethmoidales anteriores	Anterior ethmoidal cells
Cellulae ethmoidales mediae	Middle ethmoidal cells
Cellulae ethmoidales posteriores	Posterior ethmoidal cells
Lamina orbitalis	Orbital plate
Concha nasalis suprema	Supreme nasal concha
Concha nasalis superior	Superior nasal concha
Concha nasalis media	Middle nasal concha
Bulla ethmoidalis	Ethmoidal bulla
Infundibulum ethmoidale	Ethmoidal infundibulum
Hiatus semilunaris	Semilunar piatus
Os temporale	**Temporal bone**
Pars petrosa	Petrous part
Margo occipitalis	Occipital margin
Processus mastoideus	Mastoid process
Incisura mastoidea	Mastoid notch
Sulcus sinus sigmoidei	Groove for sigmoid sinus
Sulcus arteriae occipitalis	Occipital groove
Foramen mastoideum	Mastoid foramen

Latin	English
Canalis nervi facialis	Facial canal
Geniculum canalis facialis	Geniculum of facial canal
Canaliculus chordae tympani	Canaliculus for chorda tympani
Apex partis petrosae	Apex of petrous part
Canalis caroticus	Carotid canal
Apertura externa canalis carotici	External opening of carotid canal
Apertura interna canalis carotici	Internal opening of carotid canal
Canaliculi caroticotympanici	Caroticotympanic canaliculi
Canalis musculotubarius	Musculotubal canal
Semicanalis musculi tensoris tympani	Canal for tensor tympani
Semicanalis tubae auditivae	Canal for auditory tube
Septum canalis musculotubarii	Septum of musculotubal canal
Facies anterior partis petrosae	Anterior surface of petrous part
Tegmen tympani	Tegmen tympani
Eminentia arcuata	Arcuate eminence
Hiatus canalis nervi petrosi majoris	Hiatus for greater petrosal nerve
Sulcus nervi petrosi majoris	Groove for greater petrosal nerve
Hiatus canalis nervi petrosi minoris	Hiatus for lesser petrosal nerve
Sulcus nervi petrosi minoris	Groove for lesser petrosal nerve
Impressio trigeminalis	Trigeminal impression
Margo superior partis petrosae	Superior border of petrous part
Sulcus sinus petrosi superioris	Groove for superior petrosal sinus
Facies posterior partis petrosae	Posterior surface of petrous part
Porus acusticus internus	Internal acoustic opening
Meatus acusticus internus	Internal acoustic meatus
Fossa subarcuata	Subarcuate fossa
Canaliculus vestibuli	Vestibular canaliculus
Apertura canaliculi vestibuli	Opening of vestibular canaliculus
Margo posterior partis petrosae	Posterior margin of petrous part
Sulcus sinus petrosi inferioris	Groove for inferior petrosal sinus
Incisura jugularis	Jugular notch
Facies inferior partis petrosae	Inferior surface of petrous part
Fossa jugularis	Jugular fossa
Canaliculus cochleae	Cochlear canaliculus
Apertura canaliculi cochleae	Opening of cochlear canaliculus
Canaliculus mastoideus	Mastoid canaliculus
Incisura jugularis	Jugular notch
Processus intrajugularis	Intrajugular process
Processus styloideus	Styloid process
Foramen stylomastoideum	Stylomastoid foramen
Canaliculus tympanicus	Tympanic canaliculus
Fossula petrosa	Petrosal fossula
Cavitas tympani	Tympanic cavity
Pars tympanica	Tympanic part
Anulus tympanicus	Tympanic ring

Latin	English
Porus acusticus externus	External acoustic opening
Meatus acusticus externus	External acoustic meatus
Pars squamosa	Squamous part
Margo parietalis	Parietal margin
Incisura parietalis	Parietal notch
Margo sphenoidalis	Sphenoidal margin
Facies temporalis	Temporal surface
Sulcus arteriae temporalis mediae	Groove for middle temporal artery
Processus zygomaticus	Zygomatic process
Fossa mandibuiaris	Mandibular fossa
Facies articularis	Articular surface
Tuberculum articulare	Articular tubercle
Fissura petrotympanica	Petrotympanic fissure
Fissura petrosquamosa	Petrosquamous fissure
Fissura tympanosquamosa	Tympanosquamous fissure
Fissura tympanomastoidea	Tympanomastoid fissure
Maxilla	**Maxilla**
Corpus maxillae	Body of maxilla
Facies orbitalis	Orbital surface
Canalis infraorbitalis	Infraorbital canal
Sulcus infraorbitalis	Infraorbital groove
Margo infraorbitalis	Infraorbital margin
Facies anterior	Anterior surface
Foramen infraorbitale	Infraorbital foramen
Fossa canina	Canine fossa
Incisura nasalis	Nasal notch
Spina nasalis anterior	Anterior nasal spine
Facies infratemporalis	Infratemporal surface
Foramina alveolaria	Alveolar foramina
Tuber maxillae	Maxillary tuberosity
Facies nasalis	Nasal surface
Sulcus lacrimalis	Lacrimal groove
Crista conchalis	Conchal crest
Margo lacrimalis	Lacrimal margin
Hiatus maxillaris	Maxillary hiatus
Sulcus palatinus major	Greater palatine groove
Sinus maxillaris	Maxillary sinus
Processus frontalis	Frontal process
Crista lacrimalis anterior	Anterior lacrimal crest
Incisura lacrimalis	Lacrimal notch
Crista ethmoidalis	Ethmoidal crest
Processus zygomaticus	Zygomatic process
Processus palatinus	Palatine process
Crista nasalis	Nasal crest
Canales incisivi	Incisive canals

Latin	English
Processus alveolaris	Alveolar process
Arcus alveolaris	Alveolar arch
Alveoli dentales	Dental alveoli
Septa interalveolaria	Interalveolar septa
Septa interradicularia	Interradicular septa
Juga alveolaria	Alveolar yokes
Mandibula	**Mandible**
Corpus mandibulae	Body of mandible
Basis mandibulae	Base of mandible
Protuberantia mentalis	Mental protuberance
Tuberculum mentale	Mental tubercle
Foramen mentale	Mental foramen
Linea obliqua	Oblique line
Fossa digastrica	Digastric fossa
Linea mylohyoidea	Mylohyoid line
Fovea sublingualis	Sublingual fossa
Fovea submandibularis	Submandibular fossa
Arcus alveolaris	Alveolar arch
Alveoli dentales	Dental alveoli
Septa interalveolaria	Interalveolar septa
Septa interradicularia	Interradicular septa
Juga alveolaria	Alveolar yokes
Trigonum retromolare	Retromolar triangle
Ramus mandibulae	Ramus of mandible
Angulus mandibulae	Angle of mandible
Tuberositas masseterica	Masseteric tuberosity
Tuberositas pterygoidea	Pterygoid tuberosity
Foramen mandibulae	Mandibular foramen
Canalis mandibulae	Mandibular canal
Sulcus mylohyoideus	Mylohyoid groove
Processus coronoideus	Coronoid process
Crista temporalis	Temporal crest
Incisura mandibulae	Mandibular notch
Processus condylaris	Condylar process
Condylus mandibulae	Condyle of mandible
Caput mandibulae	Head of mandible
Collum mandlbulae	Neck of mandible
Fovea pterygoidea	Pterygoid fovea
Os zygomaticum	**Zygomatic bone**
Facies lateralis	Lateral surface
Facies temporalis	Temporal surface
Facies orbitalis	Orbital surface
Processus temporalis	Temporal process
Processus frontalis	Frontal process
Tuberculum orbitale	Orbital tubercle

Latin	English
Foramen zygomaticoorbitale	Zygomaticoorbital foramen
Foramen zygomaticofaciale	Zygomaticofacial foramen
Foramen zygomaticotemporale	Zygomaticotemporal foramen
Os nasale	**Nasal bone**
Sulcus ethmoidalis	Ethmoidal groove
Foramina nasalia	Nasal foramina
Os palatinum	**Palatine bone**
Lamina perpendicularis	Perpendicular plate
Facies nasalis	Nasal surface
Facies maxillaris	Maxillary surface
Incisura sphenopalatina	Sphenopalatine notch
Sulcus palatinus major	Greater palatine groove
Processus pyramidalis	Pyramidal process
Canales palatini minores	Lesser palatine canals
Crista conchalis	Conchal crest
Crista ethmoidalis	Ethmoidal crest
Processus orbitalis	Orbital process
Processus sphenoidalis	Sphenoidal process
Lamina horizontalis	Horizontal plate
Facies nasalis	Nasal surface
Facies palatina	Palatine surface
Foramina palatina minora	Lesser palatine foramina
Spina nasalis posterior	Posterior nasal spine
Crista nasalis	Nasal crest
Crista palatina	Palatine crest
Os lacrimale	**Lacrimal bone**
Crista lacrimalis posterior	Posterior lacrimal crest
Sulcus lacrimalis	Lacrimal groove
Vomer	**Vomer**
Ala vomeris	Ala of vomer
Sulcus vomeris	Vomerine groove
Pars cuneiformis vomeris	Cuneiform part of vomer
Concha nasalis inferior	Inferior nasal concha
Processus lacrimalis	Lacrimal process
Processus maxillaris	Maxillary process
Processus ethmoidalis	Ethmoidal process
Os hyoideum	**Hyoid bone**
Corpus ossis hyoidei	Body of hyoid bone
Cornu minus	Lesser horn
Cornu majus	Greater horn
Basis cranii	**Cranial base**
Basis cranii interna	Cranial base, internal surface
Fossa cranii anterior	Anterior cranial fossa
Fossa cranii media	Middle cranial fossa
Fossa cranii posterior	Posterior cranial fossa

Latin	English
Clivus	Clivus
Sulcus sinus petrosi inferioris	Groove for inferior petrosal sinus
Basis cranii externa	Cranial base, external surface
Foramen jugulare	Jugular foramen
Foramen lacerum	Foramen lacerum
Fossa temporalis	Temporal fossa
Arcus zygomaticus	Zygomatic arch
Fossa infratemporalis	Infratemporal fossa
Fossa pterygopalatina	Pterygopalatine fossa
Fissura pterygomaxillaris	Pterygomaxillary fissure
Orbita	**Orbit**
Cavitas orbitalis	Orbital cavity
Aditus orbitalis	Orbital opening
Margo orbitalis	Orbital margin
Margo supraorbitalis	Supraorbital margin
Margo infraorbitalis	Infraorbital margin
Margo lateralis	Lateral margin
Margo medialis	Medial margin
Paries superior	Roof of orbit
Paries inferior	Floor of orbit
Paries lateralis	Lateral wall
Paries medialis	Medial wall
Foramen ethmoidale anterius	Anterior ethmoidal foramen
Foramen ethmoidale posterius	Posterior ethmoidal foramen
Sulcus lacrimalis	Lacrimal groove
Fissura orbitalis superior	Superior orbital fissure
Fissura orbitalis inferior	Inferior orbital fissure
Canalis nasolacrimalis	Nasolacrimal canal
Cavitas nasalis ossea	**Bony nasal cavity**
Septum nasi osseum	Bony nasal septum
Apertura piriformis	Piriform aperture
Meatus nasi superior	Superior nasal meatus
Meatus nasi medius	Middle nasal meatus
Meatus nasi inferior	Inferior nasal meatus
Ostium canalis nasolacrimalis	Opening of nasolacrimal canal
Meatus nasi communis	Common nasal meatus
Recessus sphenoethmoidalis	Sphenoethmoidal recess
Meatus nasopharyngeus	Nasopharyngeal meatus
Choana	Choana
Palatum osseum	**Bony palate**
Canalis palatinus major	Greater palatine canal
Foramen palatinum majus	Greater palatine foramen
Foramina palatina minora	Lesser palatine foramina
Foramen sphenopalatinum	Sphenopalatine foramen