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S O M A T I C SYSTEMS

of domestic animals

Textbook for students
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GENERAL ANATOMY

Anatomy (anatome - dissection) is is the study of the form, arrangement, and structure of the tissues and organs that compose the body. a science of the laws structure of the animal organism caused by their development in specific environmental conditions and by influence of heritage factors. The term "anatomy", of Greek origin, means “cutting apart” (anatomeo: ana – equally, tomeo – cut).

Anatomy is an integral part of Biological Sciences.

Veterinary anatomy is the branch which deals with the form and structure of the principal domesticated animals. It is fundamental to the art and practice of veterinary medicine. It is usually pursued with regard to professional requirements, and is therefore largely descriptive in character. As a matter of convenience the horse is generally selected as the type to be studied in detail and to form a basis for comparison of the more essential differential characters in the other animals.

Etymologically the word “anatomy" signifies the cutting apart or disassociating of parts of the body. In the earlier phases of its development anatomy was necessarily a purely descriptive science, based on such observations as were possible with the unaided eye and simple dissecting instruments – the scalpel, forceps, and the like. At this time, therefore, the term adequately expressed the nature of the subject. But as the scope of the science extended and the body of anatomical knowledge grew, subdivisions became necessary and new terms were introduced to designate special fields and methods of work. With the introduction of the microscope and its accessories it became possible to study the finer details of structure and minute organisms hitherto unknown, and this field of inquiry rapidly developed into the science of **microscopic anatomy as** conventionally distinguished from **macroscopic anatomy.** Microscopic anatomy combines cytology (the science about cells) and histology (the science about tissues).

In the same way the study of the changes which organisms undergo during their development soon attained sufficient importance to be regarded on practical grounds as a separate branch known as **embryology.**

Anatomy is therefore in close correlation with physiology, which treats of the functions of the body.

Course of Anatomy forms a theoretical understanding of the development laws and structure of the animal body and study the structure of organs and body systems using the identified laws.

Value of anatomy for a Doctor of Veterinary Medicine

1. General education.
2. Anatomy is the basis for the fundamental disciplines (physiology, biochemistry, and genetics).
3. Anatomy is a base for the special disciplines (surgery, internal diseases of animals, gynecology and biotechnology of animal reproduction, parasitology, etc.).
4. The practical value of anatomy (ability to describe the structure and topography of organs, hygiene skills when working with live animals and animal corpses).

The **objects** of anatomy are the following:

1. Horse - *equus caballus*
2. Cattle - *bos taurus*
3. Sheep - *ovis aries*
4. Goat - *capra hircus*
5. Pig - *sus scrofa domestica*
6. Dog - *canis familiaris*
7. Cat - *felis silvestris domestica*
8. Rabbit - *cuniculus*
9. Bird – *avis*

Methods of anatomy study

1. Inspection is the simplest method, gives a conception about organ.
2. Autopsy – used for the study the topography of the internal organs.
3. Dissection (lat. prepare) – used to isolate the organ (muscles, nerves, vessels) from the surrounding tissues.
4. Microscopic method - involves the use of optical devices (a microscope) to examine tissues, cells.
5. Method of the enlightenment – when tissue fluid in replaced with solutions (ethanol, xylene), thereby changing the refractive index of the light rays, and the preparation becomes transparent.
7. The method of injection. The vessels are filled with colored solutions, which eventually solidified. Thus, the vessels will be contouring with anatomical preparations.
8. The method of corrosion. The body vessels filled with the substance, which capable to solidify and doesn’t react with hydrochloric acid. Then the organ (kidney, liver) is immersed in an acid solution, which disrupts tissue. It remains a mask of the organ vessels.

9. The method of maceration. It is used for the bone preparation. The soft tissues of the body are decomposed, while the bones remain untouched.

10. The freezing method. It is used to study the organs topography of the body. The method devised by the famous anatomist and surgeon N. I. Pirogov.

11. The method of comparison – is used to compare the organ structure of the different species of animals or explore the age characteristics of the one animal species.

12. X-ray examination – involve the use of X-ray machines for organ image.

13. The method of sonography (ultrasound diagnosis) - a modern method for studying the structures of internal organs and deep tissues with the use of ultrasonic waves.

14. Plastination is a replacement of tissue on fluid with silicone.

Types of anatomy depending on:

I. Objects of study:
   1. Anatomy of domestic animals
   2. Anatomy of farm animals
   3. Specific anatomy
   4. Breed anatomy

II. Methods of study:
   1. Comparative Anatomy
   2. X-ray anatomy
   3. Macro-microscopic anatomy

III. Status of studied object:
   1. Normal anatomy
   2. Pathological anatomy

IV. Practical value:
   1. Topographic anatomy
   2. Exterior anatomy

We study the *normal, systematic, macroscopic* and *comparative* anatomy of domestic animals with elements of *topographic* anatomy and *age-related* anatomy.

Systematic anatomy is the study of groups of organs that are closely related in their functions to constitute body systems – the digestive system, the cardiovascular system, and so forth. Systematic anatomy lends itself to

a comparative approach; readily combines gross, microscopic, developmental, and functional aspects; and provides the basis for the study of the other medical sciences.

The term **topographic anatomy** designates the methods by which the relative positions of the various parts of the body are accurately determined. It presupposes a fair working knowledge of systematic anatomy.

DIRECTIONAL TERMS AND PLANES OF THE ANIMAL BODY

The terms that indicate position and direction must be mastered at once. These official terms are more precise than the common alternatives because they retain their relevance regardless of the actual posture of the subject. To precise determine the location of individual organs, the animal's body is divided into three planes: segmental, frontal and sagittal.

Segmental plane is vertical plane. It draws perpendicular to the longitudinal axis of the body. It divides the animal body into two parts: front and back.

From this plane the two directions are defined:

- cranial – is nearer to the head (cranium – the skull)
- caudal – is nearer to the tail (cauda – the tail)

Cranial structures lie toward the head, caudal ones toward the tail.

Frontal plane is horizontal. It draws parallel to the longitudinal axis of the body. The animal body divides into two parts: higher and lower.

From it two directions are determined:

- dorsal – is nearer to the back (dorsum – the back)
- ventral – is nearer to the abdomen (venter – the abdomen)

Dorsal structures (or positions) lie toward the back, ventral structures lie toward the belly.

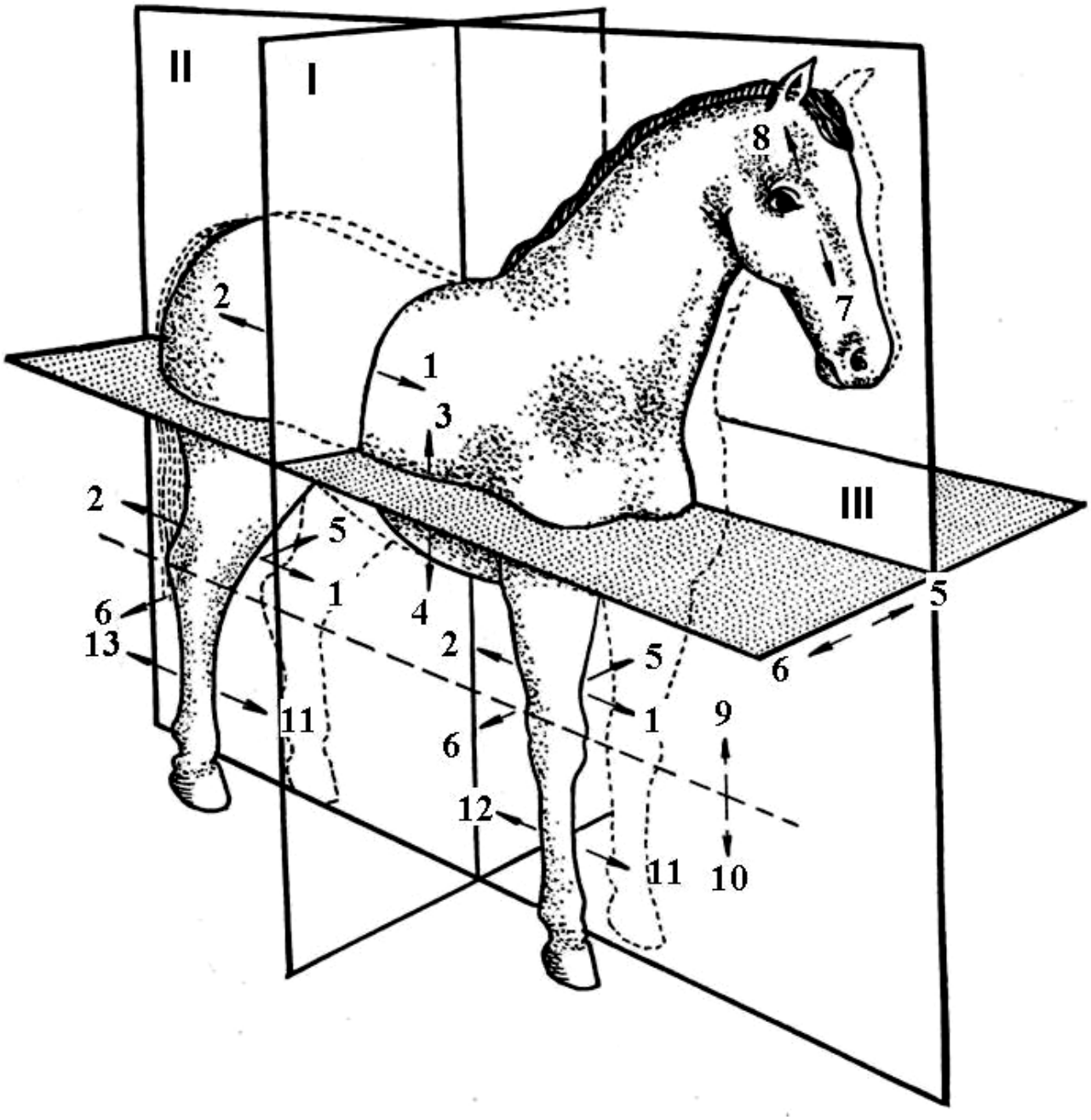
Sagittal plane is vertical. It draws parallel to the longitudinal axis of the body and the animal body divides into two parts: right and left.

From the sagittal plane two directions are defined:

- lateral – outward
- medial – is nearer to the median plane

Medial structures lie toward the median plane, lateral structures lie toward the side.

The sagittal plane, which is carried out strictly according to the longitudinal axis of the body, called the ***median plane*** (middle sagittal plane) draws by longitudinal axis. There is only one plane in the body. From the median plane two directions are defined: left and right – only lateral.



Planes in animal body and directions from them

Plane: I – segmental, II – middle sagittal (median), III – frontal

Direction: 1 – cranial, 2 – caudal, 3 – dorsal, 4 – ventral, 5 – medial, 6 – lateral, 7 – oral, 8 – aboral, 9 – proximal, 10 – distal, 11 – dorsal – cranial (anterior) surface of the manus and pes, 12 – palmar – caudal (posterior) surface of the manus, 13 – plantar – caudal (posterior) surface of the manus.

BASIC MORPHOLOGICAL CONCEPTS

Any science uses its specific notions. So, mathematical notions are a number. The main morphological concepts include:

- cell
- tissue
- organ
- system of organs
- apparatus of organs
- organism

CELL (cellula, Greek – cytus) is a smallest elementary living biological system which is capable to self-reproduction, self-regulation and subject to higher regulatory systems. In the organism somatic and germ cells can be distinguished. Between cells there is acellular substance.

TISSUE (histos, tela) is a complex of cells and their derivatives, which is similar morphologically and functionally.

There are 4 types of tissues: epithelial, connective, muscular and nervous.

EPITHELIAL tissue, or integumentary.

The epithelium consists of cells of different shapes.

The epithelium lines the skin, mucous membranes of the tubular organs (oral and nasal cavity, stomach, intestines, uterus, and bladder).

CONNECTIVE (supporting-trophic) tissue: the proper connective tissue, skeletal and trophic tissue.

Proper connective tissue includes:

- fibrous tissue:
  - soft connective tissue
  - solid connective tissue
- connective tissues with specific properties:
  - reticular tissue
  - adipose tissue
  - mucous tissue

The ***skeletal*** tissues include:

- **bone**
- **cartilage**

Trophic tissues combine:

- **blood** (fills the blood vessels and consists of formed elements (erythrocytes, leukocytes) and interstitial fluid (plasma))
- **lymph** (fills lymphatic vessels and consists of cells (lymphocytes) and limfoplazma);
- **endothelium of vascular vessels** (covers membrane of the blood and lymph vessels).

MUSCLE tissues have ability to contract. In the body two groups of muscle tissues are distinguished: striated (skeletal) and unstriated (smooth).

Striated muscle tissue is divided into:

✓ striated skeletal (myon)

✓ striated cardiac (cardiomyocytes), which forms the myocardium

The unstriated muscle tissue (myocytes) forms the wall of tubular organs (stomach, intestine, uterus, bladder, oesophagus), and vessels.

NERVOUS tissue consists of nerve cells (neurocytes) and glial cells. Neuroglia has supporting, trophic and protective functions. It is the structural basis of the organs of nervous system.

ORGAN (Greek - organum) is a part of the body, which has a distinctive structure and functions. An organ consists of tissues which naturally harmonized with each other and united in a single functional unit. **Organ** is a basic anatomical concept.

CLASSIFICATION OF ORGANS

I. According to the structure:

1. The tube-shaped organs. These have a wall and a cavity (intestine, oesophagus, and trachea).

2. Parenchymal (compact) organs. These have a stroma and a parenchyma (liver, lungs, kidneys, testes).

II. According to time of occurrence:

1. Atavistic organs, which have ancestry, but now these organs appear in the progeny with genetic changes.

2. Rudimentary organs are on the way to disappearance due to loss of function (the second and fourth metatarsal bones in the horse).

3. Provisional (temporary) organs perform their functions in a particular age period (deciduous (baby) teeth).

4. Definitive (permanent) organs are persisting through life.

SYSTEM OF ORGANS is a complex of organs, that is similar to structure and functions (muscle system, bone system).

APPARATUS OF ORGANS is a complex of organs, which is similar to functions, but different in the structure (apparatus of digestive, apparatus of respiratory).

Systems and apparatus are combined into the following **groups:**

I. Somatic group (soma - body):
   1. Bone (skeletal) system
   2. Joint system
   3. Muscular system
   4. Common integument

II. Visceral group (viscera – internal organs):
   1. Digestive apparatus
   2. Respiratory apparatus
   3. Urinary apparatus
   4. Reproductive apparatus

III. The integral group (integration - union):
   1. Cardiovascular system
   2. System of endocrine glands
   3. Nervous system
   4. Analyzers

ORGANISM is a holistic biological structure that emerged in close connection with the conditions of existence and consists of organ systems and apparatus, united morphologically and functionally.

PRINCIPLES OF BODY COMPOSITION OF ANIMALS

The body structure of animals is subordinated to four principles:

1. Principle of uniaxial structure
2. Principle of bilateral symmetry
3. Principle of segmentation
4. Principle of the two tubes

The *principle of uniaxial structure* is the following: in the animal body one axis is identified. One axis begins with head at the anterior pole and finishes with tail at the posterior pole.

The *principle of double-sided (bilateral) symmetry* is the following: the animal body divides into right and left symmetrical halves.

The *principle of segmentation* is the following: the animal body divides into a certain number of parts (segments, metamers), which relatively similar in structure.

The *principle of two tubes* is the following: in the animal body nervous and visceral tubes are distinguished. The nervous tube consists of organs of the central nervous system, the visceral tube – internal organ (viscera).

Regularities of the organism development

The ontogeny is the individual development of an organism from conception to death. Periods of ontogeny:

1. Prenatal - from conception to the birth of the organism.
2. Postnatal - from birth to death.

The phylogeny is the process of changing the forms and structures of the organism throughout the history of the development of a single species of animal.

SOMATIC SYSTEMS

SKELETAL SYSTEM

OSTEOLOGY *(os, ossis – bone, logos – teaching)* is an anatomy section which studies the structure and location of bones in the body.

Skeletal system (systema ossium) forms the skeleton in the body. The primary functions of the skeleton are to support the body, to provide the system of levers used in locomotion, and to protect soft parts. Therefore, biomechanical factors are most important in shaping the bones and in determining their microscopic design. The major skeletal tissue, bone, has a secondary role in mineral homeostasis: being a reservoir for calcium, phosphate, and other ions.

The term **skeleton** is applied to the framework of hard structures which supports and protects the soft tissues of animals. In the descriptive anatomy of the higher animals it is usually restricted to the bones and

cartilages, although the ligaments which bind these together might well be included.

Bone types of the skeleton

1. Long bone *(ossa longa).* They develop from at least three centers of ossification: one for the shaft (diaphysis, the middle, narrow part of the bone) and one for each extremity (epiphysis). These bones play a major role in the statics and dynamics of animal and perform the hematopoietic function.

2. Short bone *(ossa brevia).* It performs a spring function (the carpal bones, sesamoidal bones).

3. Flat bone *(ossa plana).* It has a large surface and a small thickness. The category includes the scapula, the bones of the pelvic girdle, and many of those of the skull. Their broad surfaces afford attachment to large muscle masses and protection to underlying soft parts. The flat bones of the skull can be pneumatical. These bones have cavities *(sinuses)* filled with air.

4. Mixed bone (ossa mixta). It combines the flat and short bone types (vertebrae, occipital bone).

Bone structure

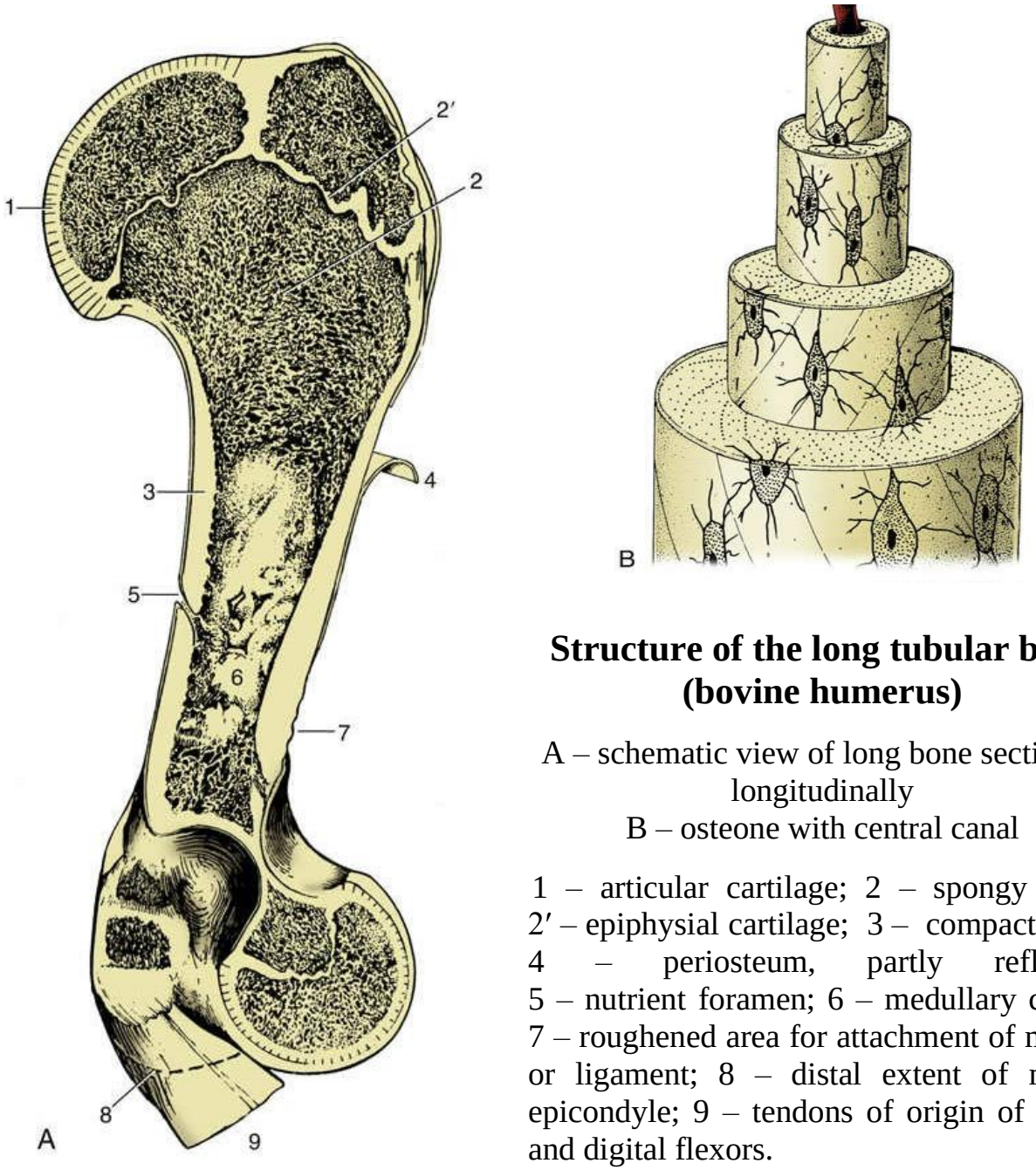
A large part of the bone surface is covered with periosteum. This is a double-layered cover that constructed of connective tissue. The outer fibrous layer strengthens the bone, contains blood vessels and nerves. The inner layer of the periosteum contains cells, which give a bone growth on thickness.

The articular surfaces of the bones are smooth and clothed in hyaline articular cartilage *(cartilago articularis).*

Cartilage is never ossified but it can thin. The compact bone is located under the periosteum *(substantia ossea compacta).* This has a high density and strength. The spongy bone *(substantia ossea spongiosa)* is located under the compact bone.

The diaphysis of a tubular bone has a cerebral cavity (cavum medullare). It is filled with red bone marrow (medulla ossea). Red bone marrow (medulla ossea rubra) is a hematopoetic organ which is involved in the bone regeneration.

Red bone marrow is a source of blood cells. All bones of the fetus and newborn are hematopoietic. The bone grows whereby metaphyseal cartilage which located between diaphysis and epiphyses. Metaphyseal cartilage includes the osteoblast cells improving the bone growth on length. The short and flat bones have no brain cavity.



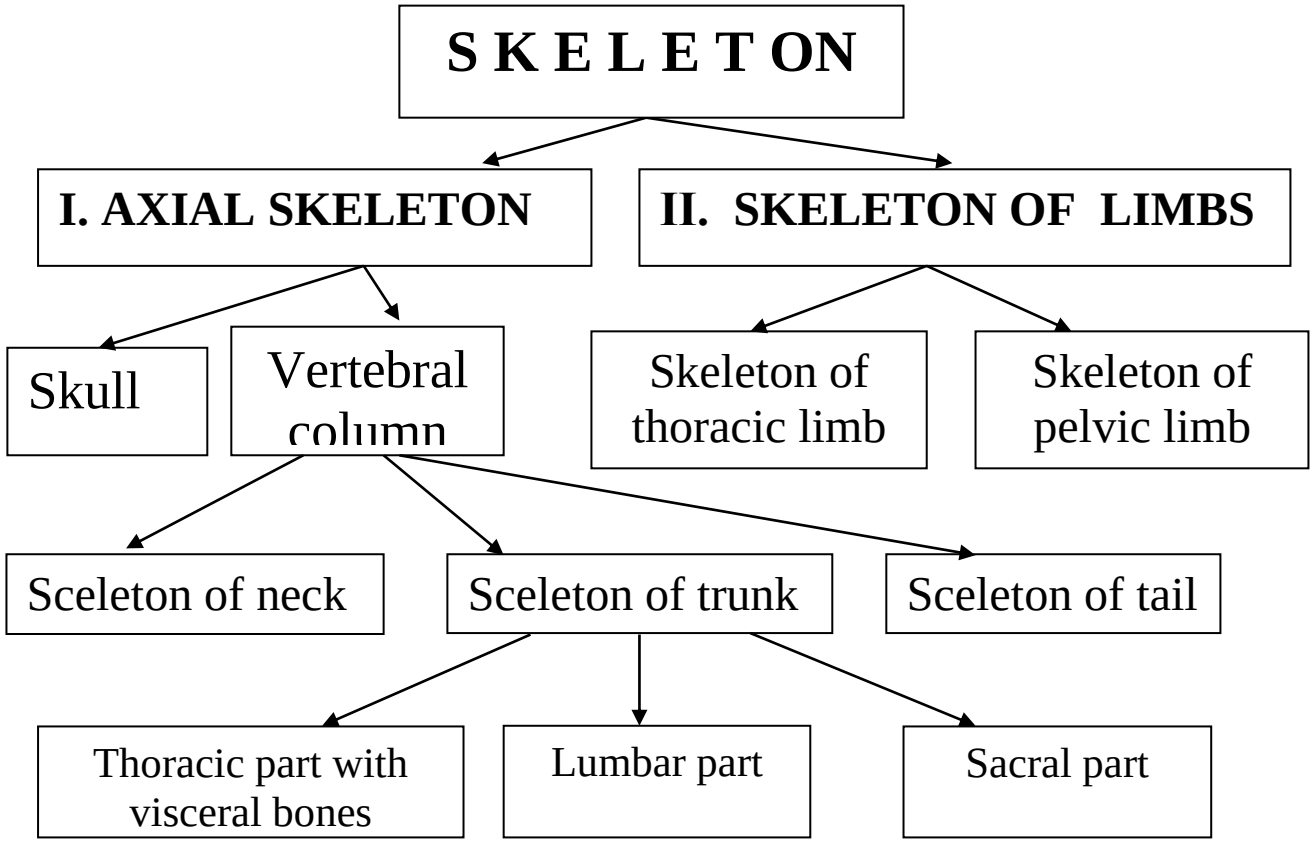
Structure of the long tubular bone (bovine humerus)

A – schematic view of long bone sectioned longitudinally
B – osteone with central canal

1 – articular cartilage; 2 – spongy bone; 2′ – epiphysial cartilage; 3 – compact bone; 4 – periosteum, partly reflected; 5 – nutrient foramen; 6 – medullary cavity; 7 – roughened area for attachment of muscle or ligament; 8 – distal extent of medial epicondyle; 9 – tendons of origin of carpal and digital flexors.

SKELETON (skeleton – dried) is a set of bones and cartilages of the individual organizm, linking by natural ligaments in a natural sequence.

DIVISION OF SKELETON INTO SECTIONS



DESCRIPTIVE TERMS

The surfaces of the bones present a great variety of eminences and depressions, as well as perforations. The prominences and cavities may be articular, or non- articular, furnishing attachment to muscles, tendons, ligaments or fascia.

A number of descriptive terms are used to designate these features, and the following are some of those in general use:

- **process** (processus) is a general term for a prominence
- **tuber** (or **tuberosity**) is a large, rounded projection
- **tubercle** (tuberculum) is a smaller one
- **trochanter** is applied to a few prominences, *e. g.*, the trochanters of the femur.
- **spinous process** (processus spinosus) is a pointed projection
- **crest** (crista) is a sharp ridge
- **line** (linea) is a very small ridge
- **head** (caput) is a rounded articular enlargement at the end of a bone; it may be joined to the shaft by a constricted part, the **neck** (collum)
- **condyle** (condylus) is an articular eminence which is somewhat

cylindrical; a non-articular projection in connection with a condyle may be termed an **epicondyle.**

- **trochlea** is a pulley-like articular mass.
- **glenoid cavity** (cavitas glenoidalis) is a shallow articular depression, and **cotyloid cavity** or **acetabulum** is a deeper one.
- **facet** is commonly applied to articular surfaces of small extent, especially when they are not strongly concave or convex
- **fossa, fovea, groove** or **sulcus,** and **impression** are applied to various forms of depressions
- **foramen** is a perforation for the transmission of vessels, nerves, etc.
- **sinus** or **antrum** is an air-cavity

Other terms, such as **canal, fissure, notch,** etc., require no explanation.

A X I A L S K E L E T O N

VERTEBRAL COLUMN

The **VERTEBRAL COLUMN** (columna vertebralis), or **SPINE**, comprises vertebrae and extends from the skull to the tip of the tail. It consists of the following vertebrae.

- Cervical *(vertebrae cervicales)*
- Thoracic *(vertebrae thoracicae)*
- Lumbar *(vertebrae lumbales)*
- Sacral *(vertebrae sacrales)*
- Caudal [coccygeal] *(vertebrae caudales, s. coccygea)*

Number of vertebrae

Animal species	Divisions of the spine					Total
	Cervical	Thoracic	Lumbar	Sacral	Caudal	
Cattle	7	13	6	5	18-20	49-51
Horse	7	18-19	5-6	5	15-21	50-58
Sheep	7	13	6(7)	4	3-24	33-55
Goat	7	13	6(7)	5	12-16	43-48
Dog	7	13	7	3	20-23	50-53

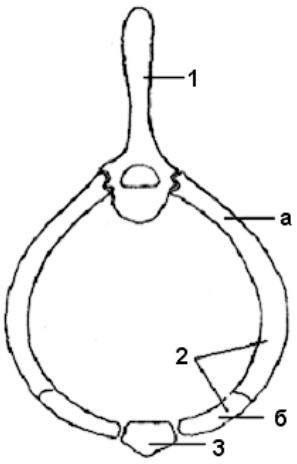
According to the principle of segmentation, the spine consists of bone segments. There are complete and incomplete bone segments.

Complete bone segment consists of:

1. Thoracic vertebra *(vertebra thoracica)*
2. A pair of ribs *(costae).* Each rib has a bone and cartilaginous parts.
3. Segment of the sternum *(sternebra).*

Complete bone segments are located in the front part of the thoracic part of the spine. Their number match with number of sternum segments (domestic animals have it's from 7 to 9). The remaining bone segments are *incomplete.*

The main part of the bone segment is a vertebra *(vertebra, s. spondylus).*



Complete bone segment

1 – thoracic vertebra
2 – rib
а – rib bone
б – rib cartilage
3 – segment of the sternum

All vertebrae except the sacral vertebrae are separate segments and articulate with contiguous vertebrae in forming movable joints. The sacral vertebrae are fused to form a single bone, the ***sacrum*** *(os sacrum).*

The vertebrae protect the spinal cord and roots of the spinal nerves, aid in the support of the head and the internal organs, and provide attachment for the muscles governing body movements.

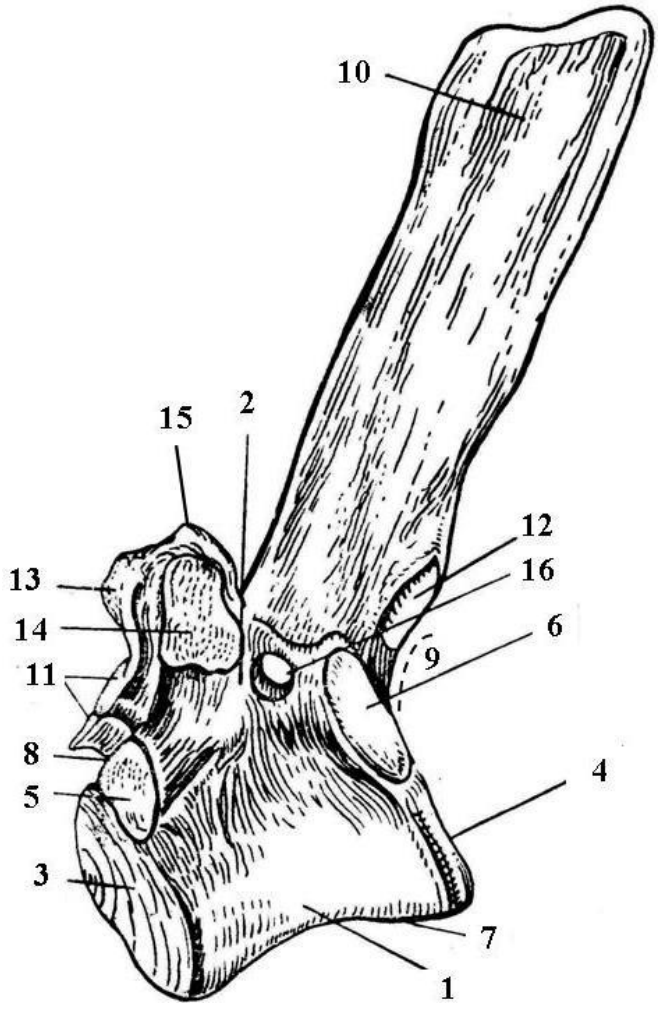
A typical vertebra consists of a ***body,*** an ***arch*** and ***processes*** for muscular or articular connections, which include ***transverse, spinous,*** and ***articular processes.***

THORACIC VERTEBRA

THORACIC VERTEBRA *(vertebra thoracica).* The dog and cattle have 13 thoracic vertebrae, horse – 18-19.

The **body** *(corpus vertebrae)* of a vertebra is constricted centrally. Cranially it has a slightly convex **head** of vertebra *(caput vertebrae),* and caudally a concave **hole** of vertebra *(fossa vertebrae).*

In life, the ***intervertebral cartilage*** or ***disc*** *(discus intervertebralis)* is located between adjacent vertebrae. Its center is composed of a ***pulpy nucleus*** (nucleus pulposus) and outer portion ***fibrous ring*** *(anulus fibrosus)*.



Thoracic vertebra of cattle

1 – body of vertebra
2 – arch of vertebra
3 – head of vertebra
4 – fossa of vertebra
5 – cranial costal facet
6 – caudal costal facet
7 – ventral crest
8 – cranial vertebral notch
9 – caudal vertebral notch
10 – spinous process
11 – cranial articular process
12 – caudal articular process
13 – transverse process
14 – transverse coastal facet
15 – mamillary process
16 – lateral foramen

The **vertebral arch** *(arcus vertebralis)* together with the body forms a short tube, the ***vertebral foramen*** *(foramen vertebrale).* All the ***vertebral foramina*** unite to form the ***vertebral canal*** (canalis vertebralis). On cranial and caudal sides of the vertebra presenting smooth-surfaced notches. The ***cranial vertebral notch*** *(incisura vertebralis cranialis)* is shallow; the ***caudal vertebral notch*** *(incisura vertebralis caudalis)* is deep.

When the vertebral column is articulated in the natural state, the notches of adjacent vertebrae form the right and left ***intervertebral foramina*** (foramina intervertebralia). Through these pass the spinal nerves, arteries, and veins.

The dorsal part of the vertebral arch has a single **spine,** or **spinous process** *(processus spinosus)*. The ***spinous process*** is the most conspicuous feature of the first nine thoracic vertebrae. The spine of the

eleventh thoracic vertebra is nearly perpendicular to the long axis. This vertebra is the ***anticlinal vertebra*** *(vertebra anticlinalis)*.

Most processes arise from the vertebral arch. Each vertebra has, in addition to the single, unpaired, dorsally located spinous process, on either side ***transverse process*** *(processus transversus)* which projects laterally. The ***mammillary processes*** (*processus mammillares*) are small knoblike eminences which project dorsally from the transverse processes.

Paired **articular processes** are present at both the cranial and the caudal surface of a vertebra, at the junction of the body and arch. The ***cranial process*** *(processus articularis cranialis)* faces craniodorsally, whereas the ***caudal process*** *(processus articularis caudalis)* faces caudoventrally.

Three pair of the costal facets for articulation with the ribs characterize the thoracic vertebrae.

The body of each thoracic vertebra possesses a **cranial and a caudal costal facet** *(fovea costalis cranialis et caudalis)* on each side as far caudally as the last. The body of the last thoracic vertebrae always have only cranial fovea on each side. The foveae on the bodies of the thoracic vertebrae are for articulation with the heads of the ribs. The tubercles of the ribs articulate with the transverse processes of the thoracic vertebrae of the same number in all instances. The transverse processes are short. All contain ***facets*** (foveae costales transversales) for articulation with the tubercles of the ribs. These foveae decrease in size.

The heads of the first pair of ribs articulate with the the last cervical vertebra. The first ribs therefore articulate usually with the cranial part of the body of the first thoracic vertebra and with caudal part of the body of the last cervical vertebra.

The horse's vertebra has a deep caudal vertebral notch**.**

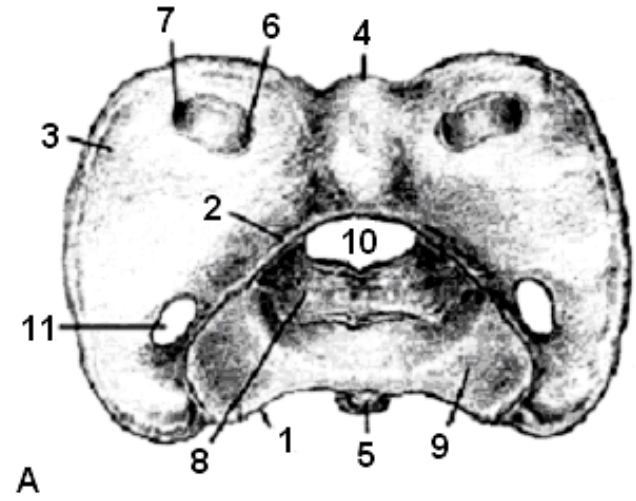
The vertebra of cattle has ***lateral thoracic foramen*** *(foramen vertebrale laterale).*

The dog's vertebra has ***accessory processes*** *(processus accessorii)* appear first in the mid-thoracic region and are located on succeeding segments as far caudally as the fifth or sixth lumbar vertebra. They leave the caudal borders of the arch.

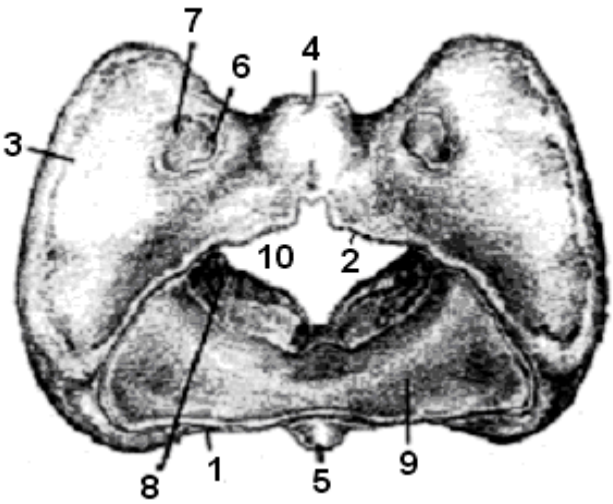
CERVICAL VERTEBRAE

The **CERVICAL VERTEBRAE** *(vertebrae cervicales)* are seven in number in most mammals. The first two, differing greatly from each other and also from all the other vertebrae. The third, fourth, and fifth differ only slightly, and are difficult to differentiate. The sixth and seventh cervical vertebrae present differences distinct to make their identification possible.

The **ATLAS**, or first cervical vertebra, is atypical in both structure and function. It articulates with the skull cranially, and with the second cervical vertebra caudally. Its chief peculiarities are the modified articular processes, lack of a spinous process, and reduction of its body. As if to compensate for these deficiencies, the lateral parts are thick and strong and are united by the ***dorsal*** and the ***ventral arch*** *(arcus dorsalis et ventralis).*



A



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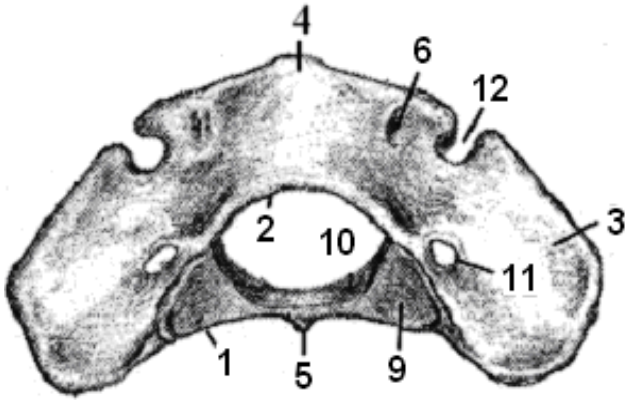


C

Atlas

A – horse, B – cattle, C – dog

1 - ventral arch
2 - dorsal arch
3 - wing of atlas
4 - dorsal tubercle
5 - ventral tubercle
6 - intervertebral foramen
7 - alar foramen
8 - cranial articular fossa
9 - caudal articular surface
10 - vertebral foramen
11 - transverse foramen
12 - alar notch

The two ***cranial articular facets*** *(fovea articularis cranialis)* articulate with the occipital condyles of the skull, forming a joint of which the main movements are flexion and extension.

The two ***caudal articular facets*** *(fovea articularis caudalis)* have shallow glenoid cavities which form a freely movable articulation with the second cervical vertebra.

The caudal part of the dorsal surface of the ventral arch contains the ***dental facet*** *(fovea dentis),* which is concave from side to side and articulates with the dens of the second cervical vertebra.

Besides the large ***vertebral foramen,*** through which the spinal cord passes, there are two pairs of foramina in the atlas. The ***alar foramina*** are short canals passing obliquely through the transverse processes, or wings, of the atlas, whereas the ***intervertebral foramina*** perforate the craniodorsal part of the dorsal arch. The ***atlantal fossae*** are deepening ventral to the wings.

The horse's atlas has transverse foramen on the wings.

The atlas of the cattle does not have lateral opening.

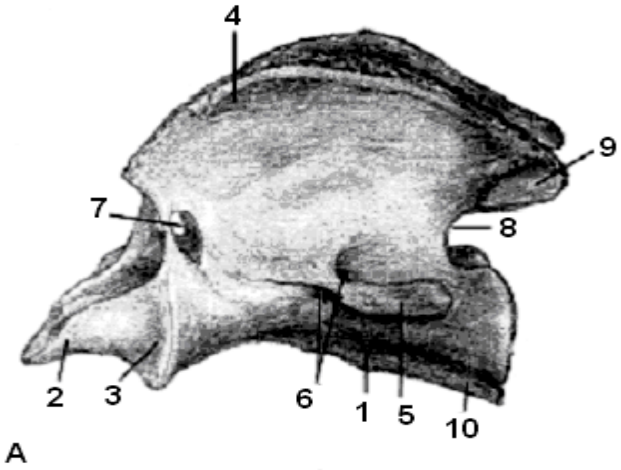
The wings of dog's atlas have an ***alar notch*** (incisura alaris).

The **AXIS,** or **SECOND CERVICAL VERTEBRA**, presents an elongated, dorsal ***spinous process,*** which is bladelike cranially and expanded caudally.

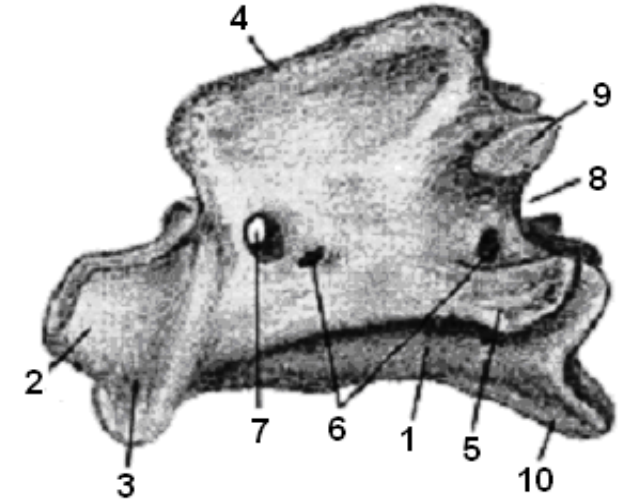
The spinous process overhangs the ventral and dorsal articular surfaces of the vertebral body.

The axis is further characterized by a cranioventral peglike eminence, the ***dens,*** or odontoid process. This process is morphologically the caudal part of the body of the atlas, although definitively it lies on the ventral floor within the vertebral foramen of the atlas, held down by the transverse ligament. The ventral articular surfaces of the axis are located laterally. The dorsal articular processes are ventrolateral extensions of the vertebral arch which face ventrally.

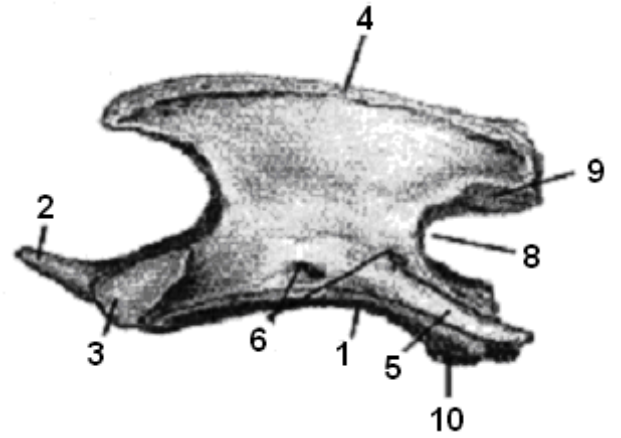
Through the base of the vertebra extend the short transverse canals. The cranial vertebral notches unite on either side with those of the atlas to form the large intervertebral foramina for the transmission of the second pair of cervical nerves and the intervertebral vessels. The caudal notches unite with those of the third cervical vertebra to form the third pair of intervertebral foramina, through which pass the third pair of cervical nerves and the intervertebral vessels.



A



B



C

Horse. The dens is pointed. The crest is furcated and merges with the caudal articular processes.

Cattle. Dens has semi-cylindrical shape. The crest has the form of a square plate.

Dog. The dens is cylindrical. Crest cranially hanging over the dens, low. Intervertebral foramen is absent.

Second cervical vertebra (axis)

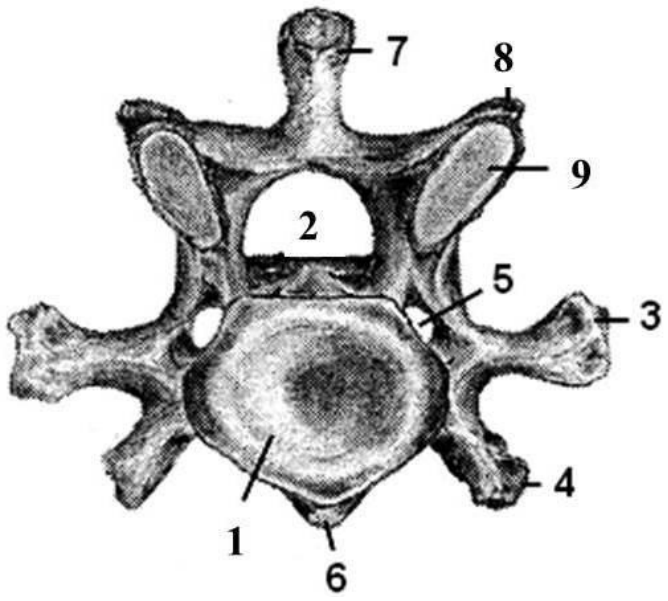
A – horse, B – cattle, C – dog

1 - body
2 - dens
3 - ventral articular process
4 - dorsal crest
5 - transverse process
6 - transverse foramen
7 - intervertebral foramen
8 - caudal vertebral notch
9 - dorsal articular process
10 - ventral crest

The THIRD, FOURTH, and FIFTH CERVICAL VERTEBRAE differ slightly from each other. These are named as typical. The spinous processes increase in length from the third to the fifth vertebra. The costotransverse processes are two-pronged and have transverse and costal *(cranial)* parts.

At the base of each transverse process, in the cervical region, is the

transverse foramen *(foramen transversarium)*. All caudal articular processes have mammillary processes.

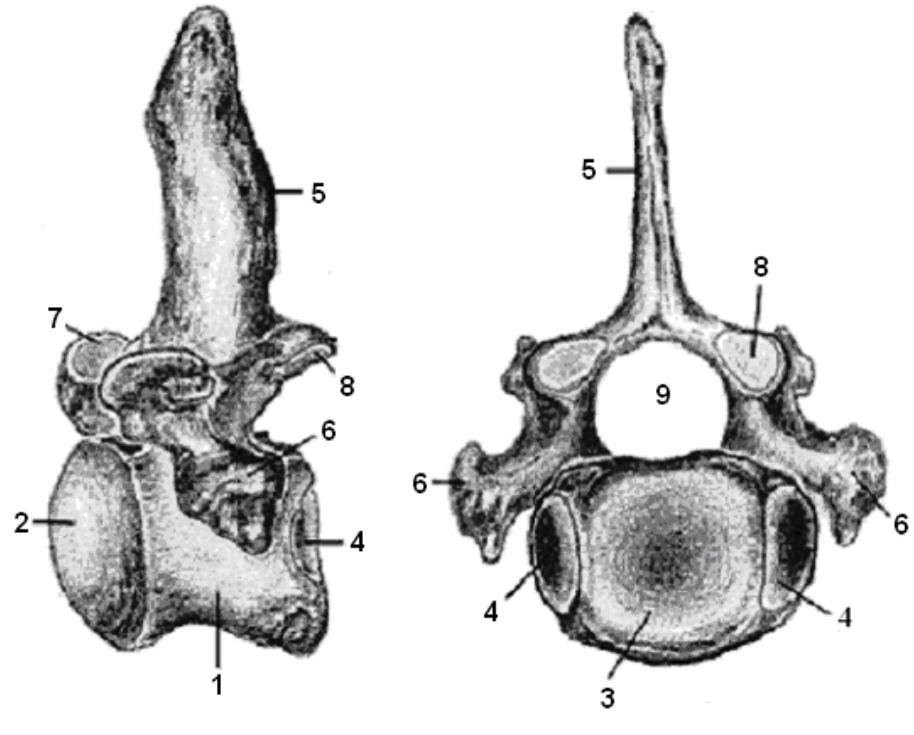


Typical cervical vertebra of cattle
(posterior view)

1 – fossa of vertebra
2 – vertebral foramen
3 – transverse part of costotransverse process
4 – costal part of costotransverse process
5 – transverse foramen
6 – ventral crest
7 – spinous process
8 – cranial articular process
9 – caudal articular process

The **SIXTH CERVICAL VERTEBRA** possesses a higher spine than the third, fourth, or fifth. In contrast to all other vertebrae, the first six cervical vertebrae are characterized by transverse foramina.

The **LAST CERVICAL VERTEBRA** lacks transverse foramina. The first rib articulate with last cervical vertebra and first thoracic vertebrae due to a presens of the **caudal costal facet** at the side of the seventh cervical vertebra body**.**



A **B**

Seventh cervical vertebrate of cattle

A – lateral view
B – posterior view

1 – body of vertebra
2 – head of vertebra
3 – fossa of vertebra
4 – caudal costal facet
5 – spinous process
6 – transverse process
7 – cranial articular process
8 – caudal articular process
9 – vertebral foramen

LUMBAR VERTEBRAE

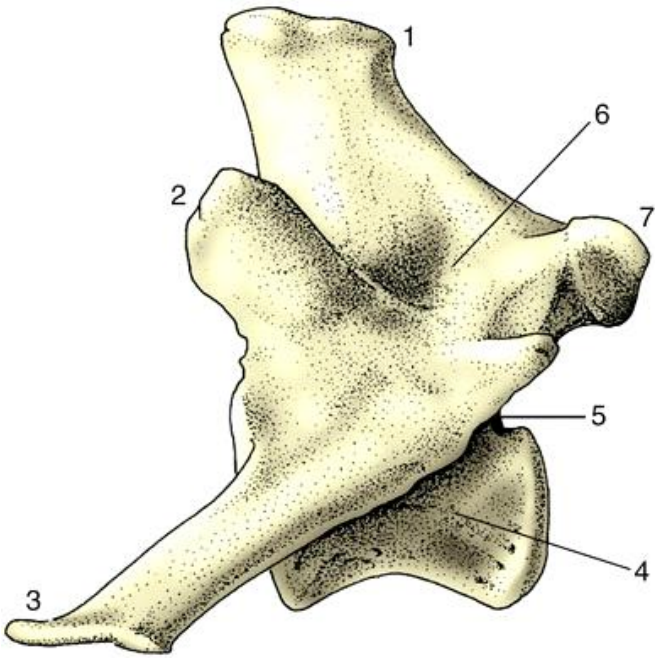
The **LUMBAR VERTEBRAE** *(vertebrae lumbales)*, 7 in number in dogs, 6 in cattle and 5-6 in horse, have longer bodies than do the thoracic vertebrae.

The ***spinous processes*** are highest. The ***transverse processes*** are broad, directed cranioventrally. In emaciated animals the extremities of the transverse processes can be palpated.

The ***articular processes*** lie mainly in sagittal planes. All cranial articular processes bear ***mammillary processes.***

The ***accessory processes*** in the dog are well developed on the first three or four lumbar vertebrae, and absent on the fifth or sixth.

The ***transverse processes*** of the adjacent vertebrae in the horse articulate each other by the ***articular surfases*** (facies articularis). The *transverse processes* of the *first lumbar* vertebrae articulate also with sacrum.



Lumbar vertebra of the dog.
Left lateral view.

1 – spinous process;
2 – cranial articular process;
3 – transverse process;
4 – body;
5 – caudal vertebral notch;
6 – arch;
7 – caudal articular process.

SACRAL VERTEBRAE

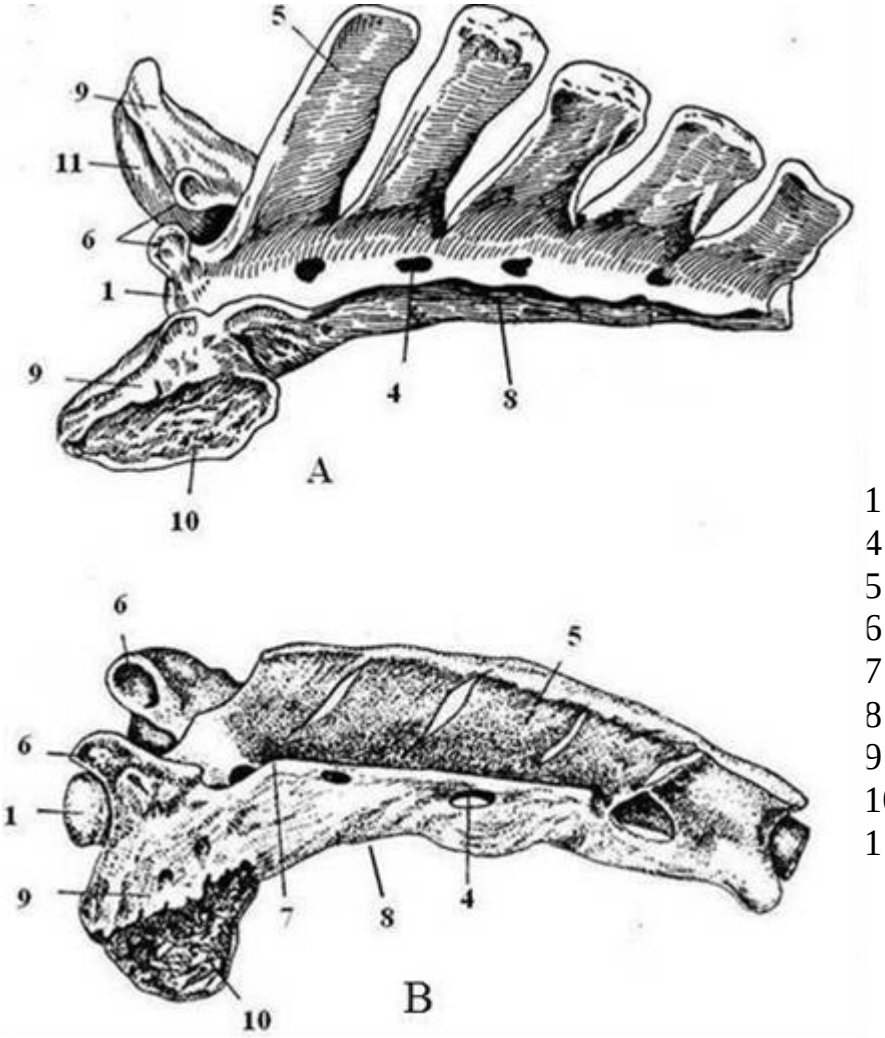
SACRAL VERTEBRAE *(vertebrae sacrales)* are 3 in dog, 5 in cattle and 5-6 in horse.

The bodies, arches and processes of the sacral vertebrae fuse in the adult to form the ***sacrum*** (os sacrum). The body of the first segment is larger than the bodies of the other segments combined. Medial to these

processes are low projections representing the fused articular processes of adjacent segments.

The articular processes form the ***intermedian sacral crest*** *(crista sacralis intermedia).* The ***caudal articular processes*** are small and articulate with the first coccygeal vertebra.

The ***dorsal surface*** *(facies dorsalis)* presents the ***median sacral crest*** *(crista sacralis mediana),* which represents the fusion of the spinous processes. The dorsal surface also bears two pairs of ***dorsal sacral foramina*** *(foramina sacralia dorsalia),* which transmit the dorsal divisions of the sacral nerves and vessels.



Sacrum
A – horse, B – cattle

1 – head
4 – dorsal sacral foramina
5 – median sacral crest
6 – cranial articular processes
7 – intermediate sacral crest
8 – lateral sacral crest
9 – wing of sacrum
10 – auricular surface
11 – articular surfaces on the wings of horse's sacrum

The ***cranial articular processes*** are large, face dorsomedially.These form joints with the last lumbar vertebra in the horse.

The ***pelvic surface*** *(facies pelvina)* of the sacrum in the adult has ***transverse lines*** *(lineae transversae).* Two pairs of ***pelvic sacral foramina*** *(foramina sacralia pelvina),* situated just lateral to the fused sacral bodies, are larger than the corresponding dorsal foramina. Lateral to the pelvic

sacral foramina are the fused transverse processes. Those of the first segment is greatly enlarged and modified for articulation with the ilium. These are called ***sacral wing*** *(ala sacralis),* which has a large semilunar facet, the ***auricular surface*** *(facies auricularis),* which articulates with the ilium.

The transverse processes of the sacral vertebrae form the narrow, thin ***lateral sacral crest*** *(crista sacralis lateralis)*. The ***base of sacrum*** *(basis ossis sacri)* faces cranially. The wide ***sacral canal*** (canalis sacralis) is formed by the united of the vertebral foramina. The cranioventral part of the base has a transverse ridge, the ***promontory*** *(promontorium)*.

CAUDAL [COCCYGEAL] VERTEBRAE

The average number of **CAUDAL [COCCYGEAL] VERTEBRAE** *(vertebrae caudalis, s. coccygeae)* is usually 20, although the number may vary from 6 to 23. The coccygeal vertebrae are subject to greater variation than are the vertebrae of any other region.

The ***body*** of the first coccygeal vertebra is as wide as it is long. The segments decrease in width from the sacrum caudally. The ***vertebral arch*** is best developed in the first coccygeal segment. The ***articular processes*** exist, although they have lost their articular function.

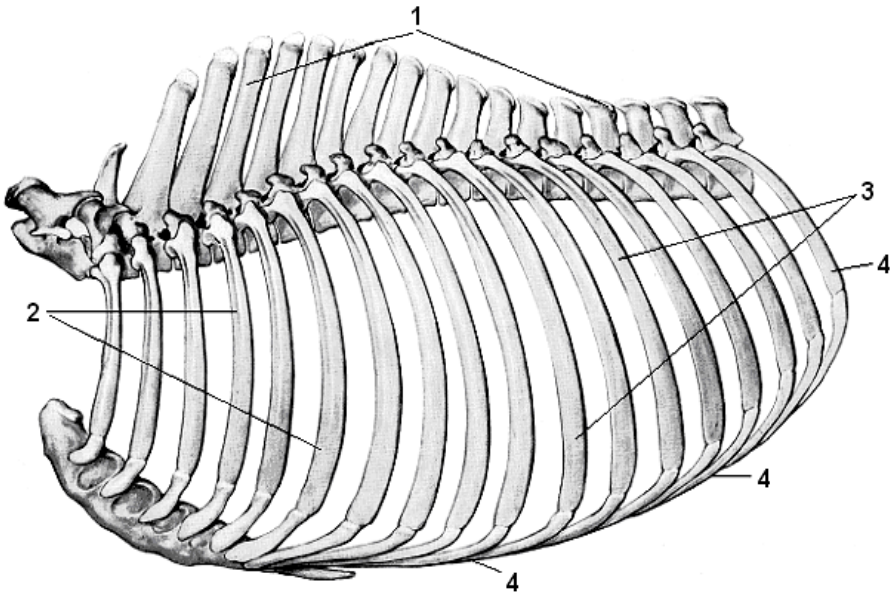
Hemal arches (arcus hemales) are present as separate bones which articulate with the ventral surfaces of the caudal ends of the bodies. In life, they protect the median coccygeal artery, which passes through them. Caudal to the hemal arches, and in corresponding positions on succeeding vertebrae, are the paired *hemal processes (processus hemales)*.

THORAX.
VISCERAL BONES

THORAX is formed by the thoracic vertebrae, ribs and sternum. These structures surround the **thoracic cavity**. The ribs and the sternum are the **visceral bones**.

The *thoracic inlet*, also known as the **cranial thoracic aperture**, is essentially a hole surrounded by a bony ring, through which several vital structures pass. The thoracic inlet is bounded by: the first thoracic vertebra dorsally; the first pair of ribs and the costal cartilage of the first rib laterally; the manubrium of sterni ventrally.

The *thoracic outlet,* also known as the **caudal thoracic aperture** is bounded by: the costal arches laterally; last thoracic vertebra dorsally; the xiphoid cartilage of sterni ventrally. It is much larger than the thoracic inlet.



Left half of horse's thorax

1 – thoracic vertebrae,
2 – true ribs,
3 – false ribs,
4 – costal margin.

The **RIBS** *(costae)* are usually 13 pairs in the dog and cattle, and 18-19 in the horse.

Each rib is divided into a dorsal bone part, the ***costal bone*** *(os costale),* and a ventral cartilaginous part, the ***costal cartilage*** *(cartilago costalis).*

The first 8-9 ribs articulate with the sternum and are called the ***true [sternal] ribs*** (costae verae); the last are called the ***false ribs [asternal]*** *(costae spuriae).*

The final rib with the costal cartilages of the false ribs form the ***costal arch*** (costal margin) on each side.

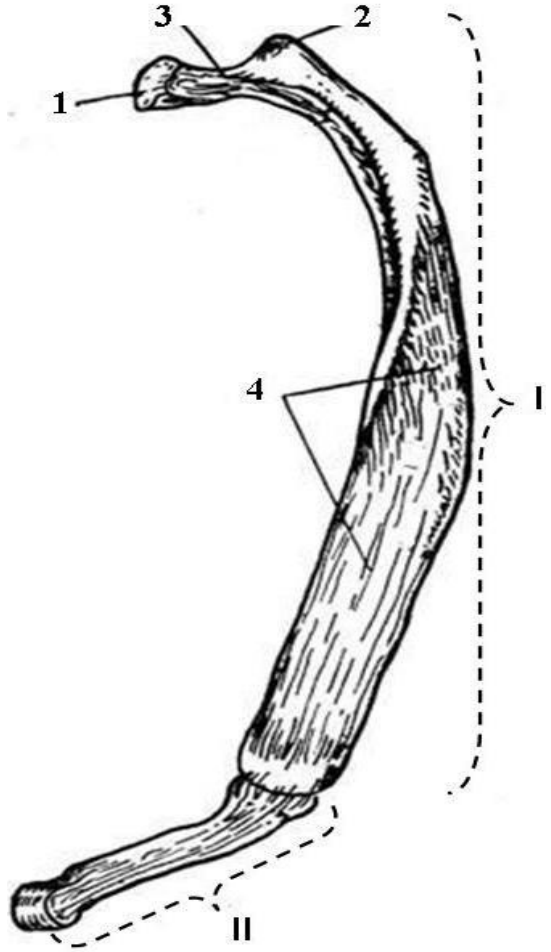
Since the cartilages of the last pair of ribs end freely in the musculature, these ribs are known as ***floating ribs*** *(costae fluctuantes).*

The space between adjacent ribs is known as the ***intercostal space*** (spatium intercostale).

A typical rib *(os costale)* has a vertebral **extremity**, a **sternal extremity**, and an intermediate part, or **body**. The vertebral extremity consists of a **head of rib** *(caput costae),* a **neck of rib** *(collum costae),* and a **costal tubercle** *(tuberculum costae).*

The head of rib has two wedge-shaped articular surfaces which articulate with adjacent costal foveae of contiguous vertebrae. This call

cranially and caudally surfaces (facies articularis capitis costae cranialis et caudalis).



Rib of cattle
I – rib bone, II – rib cartilage
1 – head, 2 – tubercle, 3 – neck,
4 – body.

The costal tubercle of the rib bears an ***articular surface*** (facies articularis tuberculi costae) for articulation with the transverse process of the vertebra of the same number. The ***costal angle*** *(angulus costae)* is an indistinct lateral eminence about 2 cm. distal to the tubercle.

The ***costal groove*** *(sulcus costae)* on the inner surface, for the intercostal vessels and nerve. The ***costal cartilage*** is the cartilaginous continuation of the bony rib.

The first rib articulates with the first sternebra, or ***manubrium of sternum***. Succeeding true rib cartilages articulate with successive intersternebral cartilages.

However, the last two costal cartilages articulate with the cartilage between the last sternebra and xiphoid process.

STERNUM is an impaired segmental series of bones *(sternebrae)* which forms the floor of the thorax. The consecutive sternebrae are joined by ***interstemebral cartilages*** *(cartilago intersternebralis).* The sternal ends of the ribs articulate with the intersternebral cartilages, with the exception of the first pair, which articulate with the first sternebra.

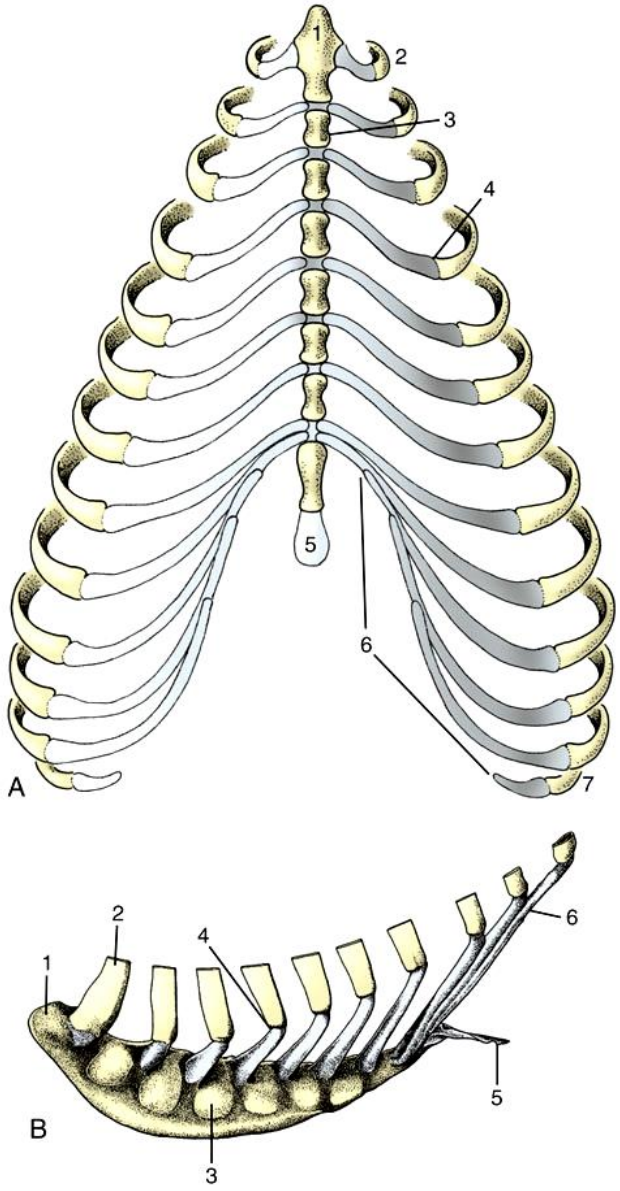
The first and last sternebrae are specialized. The first sternebra is longer than the others and is known as the **manubrium of sternum** *(manubrium sterni).*

The last sternebra, called the **xiphoid process** *(processus xiphoideus).* A thin **xiphoid cartilage** (cartilago xiphoidea) prolongs the xiphoid process caudally.

The firm cartilaginous joints between the sternebrae *(synchondroses sternales)* may ossify in old individuals.

The sternum is cylindrical in the dog, is wide and flat in ruminants, and carries a ventral keel in the horse

The number of the rib notches is the specific feature. The horse and cattle have 8 rib notches, dog has 9 rib notches.



Canine (A) and equine (B) sternum and costal cartilages. Ventral and left lateral views.

1 – manubrium
2 – first rib
3 – segments of the sternum
4 – xiphoid cartilage
5 – costal cartilages
6 – costal arch
7 – floating rib

SKULL

The ***skull*** *(cranium)* is the most important, complex, and specialized part of the skeleton. It lodges the brain, and houses the sense organs for hearing, equilibrium, sight, smell, and taste. In addition to providing the attachment for the teeth, tongue, larynx.

The braincase encloses the brain in the large *cranial cavity (cavum cranii),* and houses the organs of hearing and equilibrium in the petrous part of the temporal bone. The cranial cavity is separated from the *nasal cavity (cavum nasi)* by a curved perforated plate of bone, and is open

caudally by way of the foramen magnum for the passage of the spinal cord. The ventral part of the cranium has a number of foramina and canals for the passage of nerves and blood vessels. At the junction of the facial and cranial parts, on each side, are the orbital cavities, in which are located the globes of the eyes and accessory structures.

The many bones of the skull have a sinus *(sinuses)*. It is cavity filled with air that does light in weight the skull.

There are five surfaces on the scull:

- dorsal – facies dorsalis
- ventral – facies ventralis
- two lateral – facies laterales
- occipital, or aboral – facies occipitalis

The scull is basically divided by morphologically and functionally.

Morphologically the skull is divided into:

a) **nasocerebral part** *(cranium nasocerebrale)*
b) **mandible** *(mandibula)*
c) **hyoid bone** *(os hyoideum)*

Functionally the skull is divided into:

a) **neural part** *(cranium cerebrale*, s. n*eurocranium)*
b) **facial part** *(cranium viscerale, s. splanchnocranium)*

The **ethmoid bone** *(os ethmoidale)* is the inner (natural) boundary between the neural and facial portions of the skull. The supraorbital line is the outer (imaginary) boundary which corresponds to the location of the ethmoid bone. The **ethmoid bone** and **nasal conchae** [**turbinates]** are the inner bone of the scull. These is can not see on the outer surfase.

Direction of the skull

Nasalis is near to the nose
Oralis is near to the mouth
Aboralis is further from the mouth

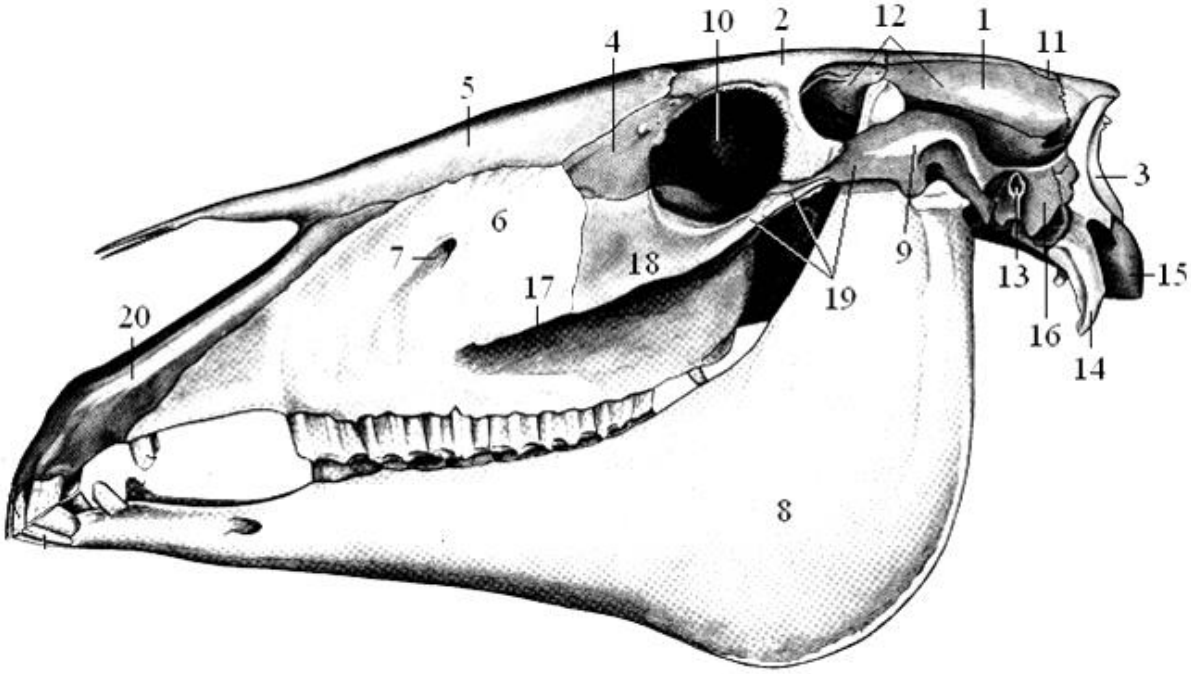
Aboral surface is formed by the squamous part of the occipital bone *(os occipitale).*

Dorsal surface is formed by the following bones:

- parietal bones *(ossa parietalia)*
- interparietal bone *(os interparietale)*
- frontal bones *(ossa frontalia)*
- nasal bones *(ossa nasalia)*

The **lateral surface** consists of:

- temporal bone *(os temporale)*
- zygomatic bone *(os zygomaticum)*
- lacrimal bone *(os lacrimale)*
- maxilla *(maxilla)*
- incisive bone *(os incisivum)*



Horse's skull. Lateral aspect

1 – parietal bone; 2 – frontal bone; 3 – occipita bone l; 4 – lacrimal bone; 5 – nasal bone; 6 – maxilla; 7 – infraorbital foramen; 8 – mandible; 9 – temporal bone; 10 – orbit; 11 – interparietal bone; 12 – temporal fossa; 13 – external acoustic meatus; 14 – jugular process; 15 – occipital condyle; 16 – petrosal bone; 17 – facial crest; 18 – zygomatic bone; 19 – zygomatic arch; 20 – incisive bone.

On the **ventral surface** of skull are located:

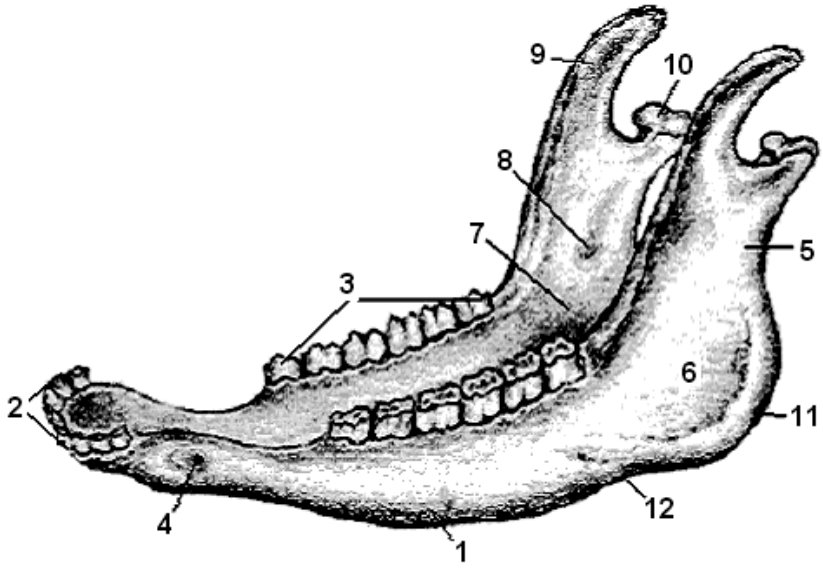
- body of the occipital bone *(os occipitale)*
- sphenoid bone *(os sphenoidale)*
- vomer *(vomer)*
- pterygoid bones *(ossa pterygoidei)*
- palatine bones *(ossa palatine)*
- maxilla *(maxilla)*
- incisive bones *(ossa incisive)*

MANDIBLE

The mandible *(mandibula)* consists of right and left halves firmly united in life at the ***mandibular symphysis*** *(symphysis mandibulae),* which is a strong, fibrous joint. Each half is divided into a horizontal part, or **body**, and a vertical part, or **ramus.**

The **body of the mandible** *(corpus mandibulae)* can be further divided into the *incisive part* that bears the incisor teeth *(pars incisiva),* and the *molar part* that contains the molar teeth *(pars molaris).* The sockets, or dental alveoli *(alveoli dentales),* which are conical cavities for the roots of the teeth, indent the ***alveolar arch*** (arcus alveolaris) of the body of the mandible.

From the symphysis, the bodies of each half of the mandible diverge from each other, forming the ***mandibular space*** *(spatium mandibulae),* in which lies the tongue.



Mandible of cattle

1 – body; 2 – incisive part; 3 – molar part; 4 – mental foramen; 5 – ramus; 6 – masseteric fossa; 7 – pterygoid fossa; 8 – mandibular foramen; 9 – coronoid process; 10 – condyloid (articular) process; 11 – angle of mandible; 12 – notch of facial vessel.

The **ramus of mandible** *(ramus mandibulae)* is the posterior non-tooth-bearing, vertical part of the bone. It contains two processes. The ***condyloid or articular process*** *(processus condylaris s. articularis)* is a transversely elongated, sagittally convex articular process which forms the temporomandibular joint by articulating with the temporal bone. The **coronoid process** *(processus coronoideus)* lies in front of the articular process.

The lateral surface of the ramus contains the ***masseteric fossa (fossa*** masseterica), for the insertion of the strong masseter muscle. The medial surface of the ramus contains the ***pterygoid fossa*** (*fossa pterygoidea*), for the insertion of the pterygoidal muscle.

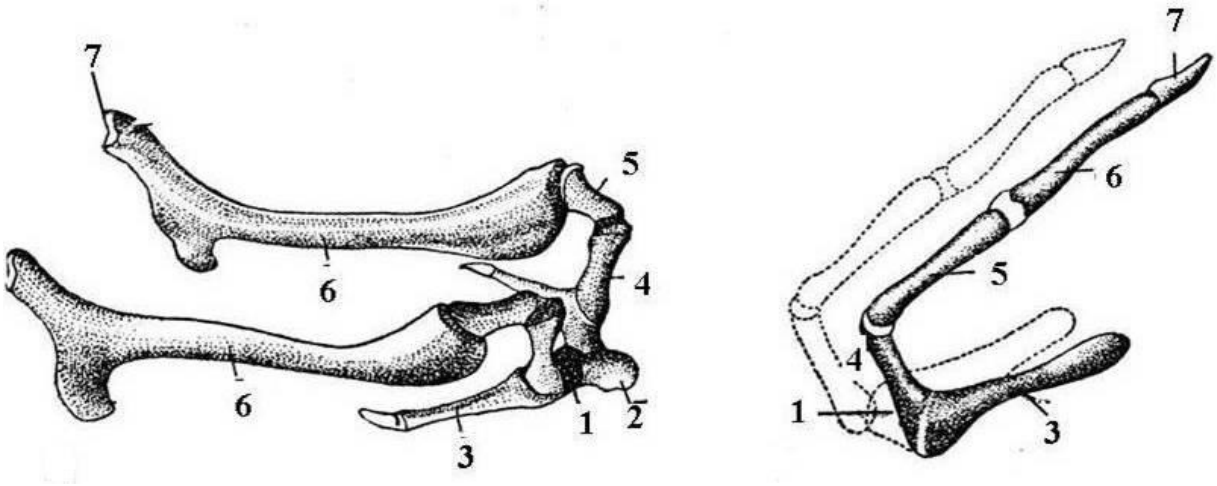
The ***angle of mandible*** *(angulus mandibulae)* is the posteroventral part of the bone. It contains a salient hooked process in the dog, the ***angular process*** *(processus angularis).*

On the pterygoid fossa is ***mandibular foramen*** *(foramen mandibulae).* This foramen is opening of the ***mandibular canal*** *(canalis mandibulae).* The mandibular canal contains the mandibular artery and vein, and the mandibular alveolar nerve, which supply the lower teeth and jaw. The mandible articulates with the temporal bones.

BONES OF HYOID APPARATUS [HYOID BONE]

The **hyoid apparatus** *(apparatus hyoideus)* acts as a suspensory mechanism for the tongue and larynx. The component parts, united by synchondroses, consist of the single basihyoid and the paired thyrohyoid, ceratohyoid, epihyoid, and stylohyoid bones, and the tympanohyoid

Basihyoid or body (basihyoideum) is a transverse unpaired element lying in the musculature of the base of the tongue as a ventrally bowed, dorsoventrally compressed rod. Its extremities articulate with both the thyrohyoid and the ceratohyoid bones.



A B

Hyoid bone

A – horse, B – dog

1 – basihyoid, 2 – lingual process, 3 – thyrohyoid, 4 – ceratohyoid, 5 – epihyoid, 6 – stylohyoid, 7 – tympanohyoid.

Thyrohyoid [greater horn]

The thyrohyoid (thyrohyoideum) is a laterally bowed, sagittally compressed, slender element which extends dorsocaudally from the

basihyoid to articulate with the cranial cornu of the thyroid cartilage of the larynx.

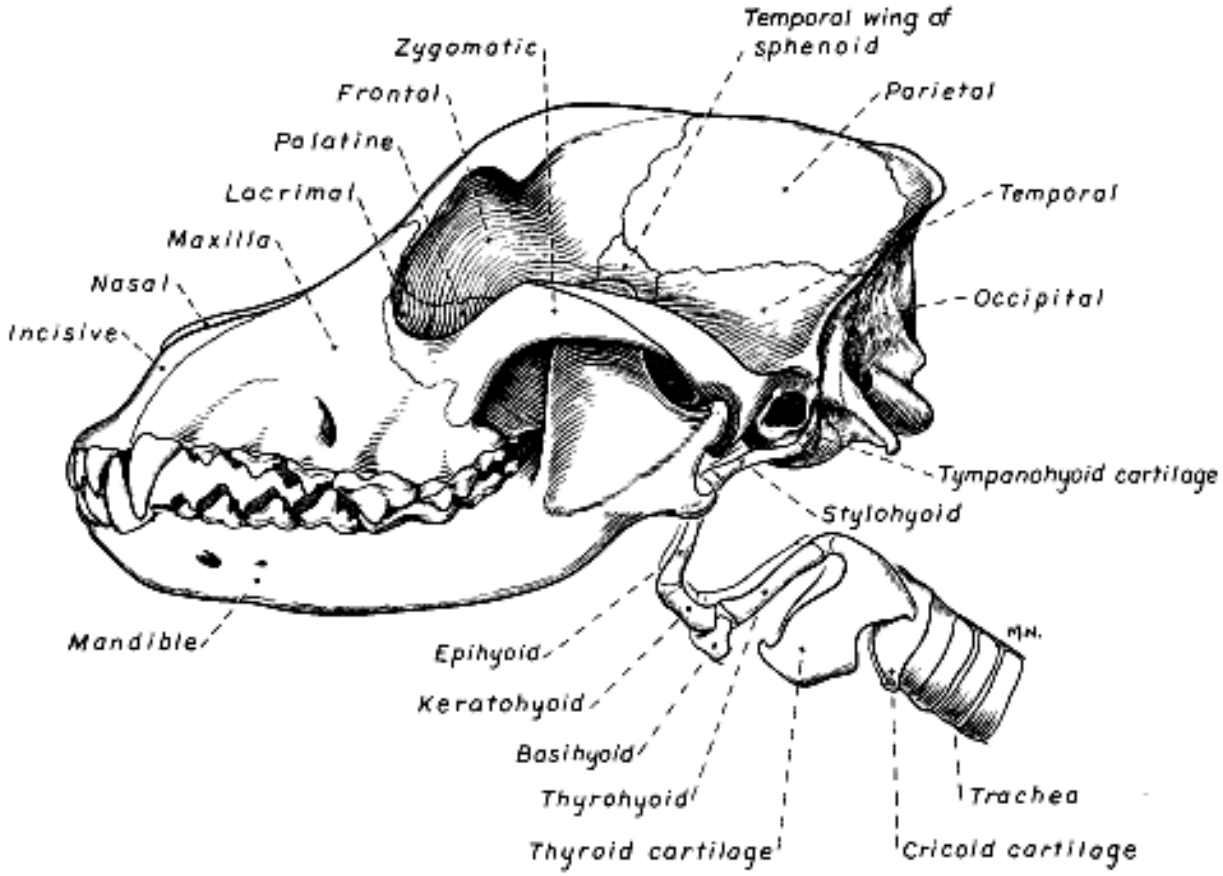
Ceratohyoid [lesser horn]

The ceratohyoid *(ceratohyoideum)* is a small, short, tapered rod having a distal extremity which is about twice as large as its proximal extremity. It articulates with the basihyoid and the thyrohyoid. The proximal extremity, which points nearly cranially in life, articulates with the epihyoid bone at a right angle.

Epihyoid [distal part] *(epihyoideum)* is approximately parallel to the thyrohyoid bone. It articulates with the ceratohyoid at nearly a right angle distally and with the stylohyoid proximally.

Stylohyoid [middle part] *(stylohyoideum)* is slightly longer than the epihyoid, with which it articulates. It is flattened slightly craniocaudally and is distinctly bowed toward the median plane.

Tympanohyoid [proximal part] *(tympanohyoideum)* is a small cartilaginous bar which continues the proximal end of the stylohyoid bone to the inconspicuous mastoid process of the skull.



Bones of the scull, hyoid apparatus and laryngeal cartlilages of dog
(lateral aspect)

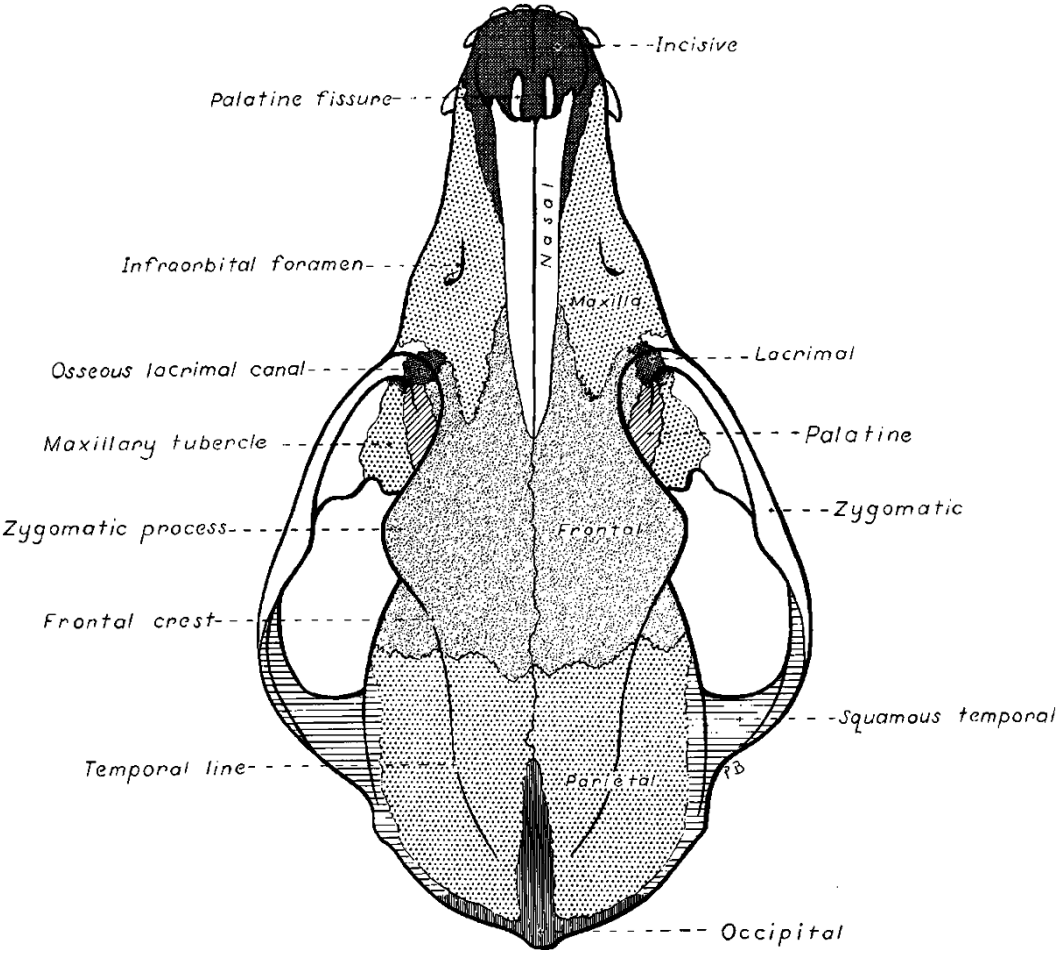
ABORAL SURFACE OF SKULL

The *squamous part* of the *occipital bone* is the largest division. The ***external occipital crest*** *(crista occipitalis externa)* is a dorsal ridge.

The occipital surface are formed by the squama of the occipital bone. The *lateral parts* bear the **occipital condyles** *(condyli occipitales)*, which are convex and, with the atlas, form the atlanto-occipital joints. The **jugular process** *(processus jugularis)* is located, one on either side, lateral to the condyle. The adjacent occipital condyles on each side contribute to formation of the **foramen magnum** that is opening in the ventral portion of the skull. The spinal cord pass through this.

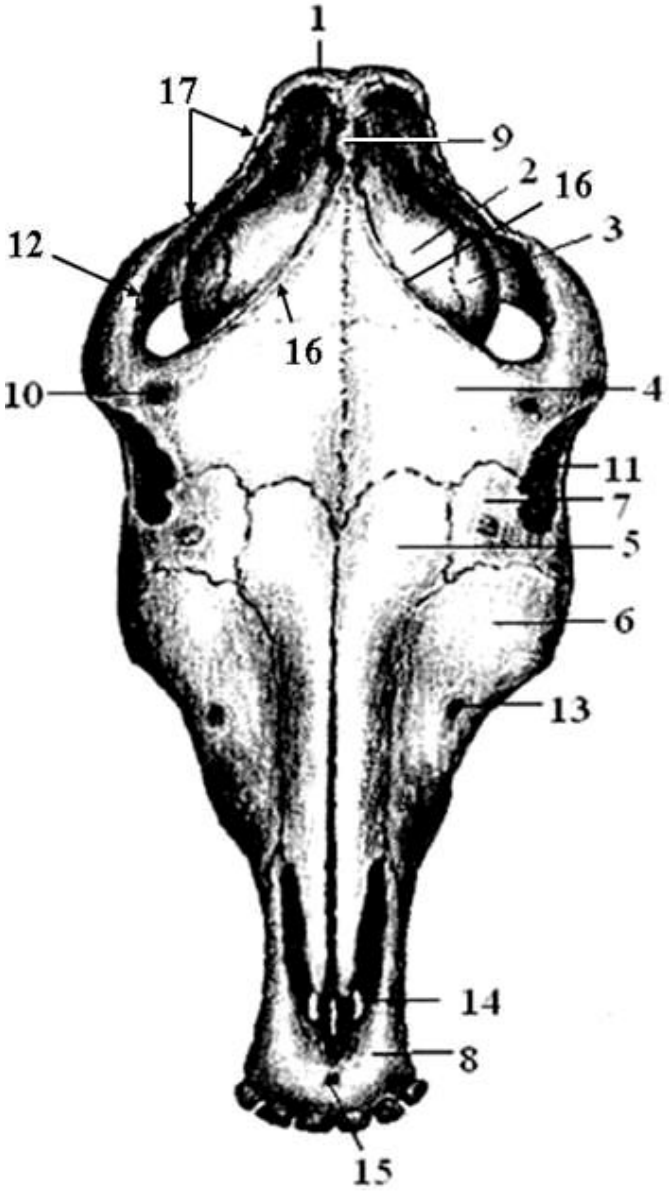
DORSAL SURFACE OF SKULL

The dorsal surface is separated from the occipital surface by the occipital crest, from which begin the ***external sagittal crest*** *(crista sagittalis externa)* that is continuing nasally into the frontal crests (cristae frontales). ***External sagittal crest*** is a median longitudinal projection and most prominent feature of the dorsal surface of the skull.



Skull of dog. Dorsal aspect.

The laterally border of the ***frontal bone*** forms the medial wall of the orbit. The ***frontal sinus*** *(sinus frontalis)* is an air cavity located between the inner and outer tables of the frontal bone. Each ***incisive bone*** carries upper incisor teeth. The incisive bone articulates posteriorly with the maxilla. The posterodorsal parts of the right and left palatine processes articulate with the vomer. The ***nasal bone*** is long, slender, and narrow posteriorly. The nasal bones articulate on the median plane. Posteriorly it articulates with frontal bone; laterally – with maxilla and incisive bone.



Skull of horse
(dorsal aspect)

1 – occipital bone
2 – parietal bone
3 – temporal bone
4 – frontal bone
5 – nasal bones
6 – maxilla
7 – lacrimal bone
8 – incisive bone
9 – external sagittal crest
10 – supraorbital foramen
11 – orbit
12 – zygomatic arch
13 – infraorbital foramen
14 – palatal notch
15 – foramen of interincisive canal
16 – frontal crest
17 – temporal crest

Supraorbital foramen *(for. supraorbitale),* opening into the orbit, is located on the zygomatic process of the frontal bone. The line connecting supraorbital foramina, called supraorbital line. It is arbitrary outer boundary between the brain and nasal cavities.

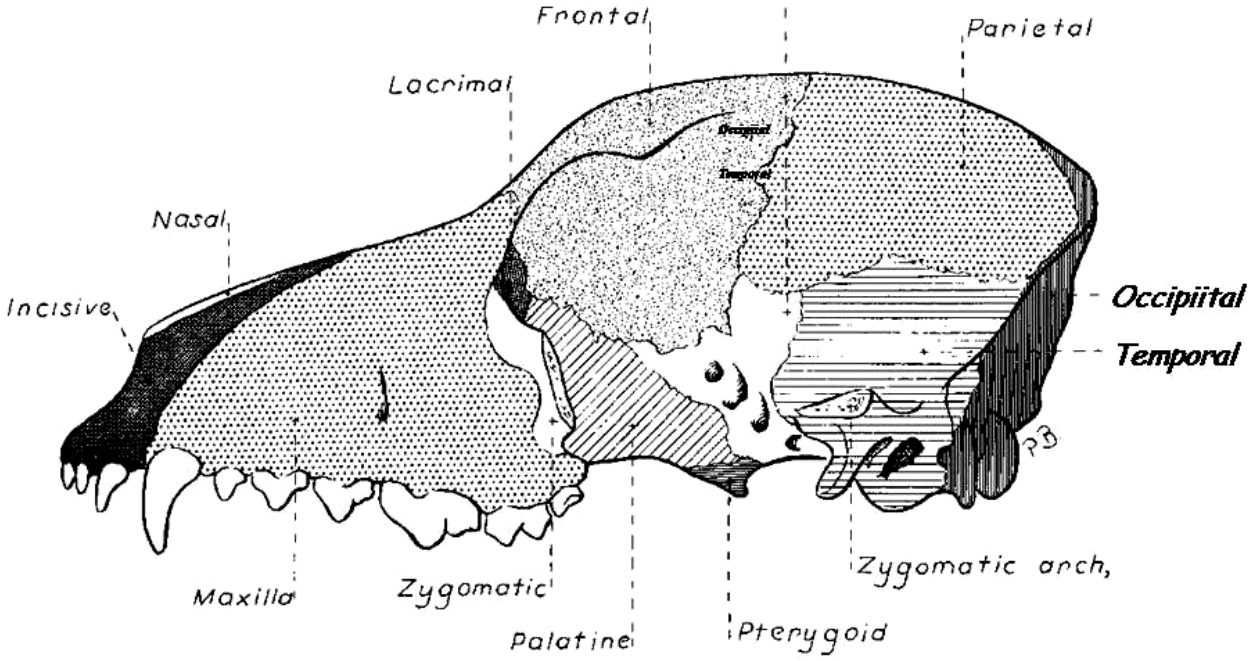
The temporal crest (crista temporalis) is directed from lateral end of the occipital crest to the zygomatic arch. The convex surface on each side

of the dorsum of the skull is the ***temporal fossa*** *(fossa temporalis).* Occipital crest, external sagittal crest, frontal crest, zygomatic arch and temporal crest surround of the ***temporal fossa***.

LATERAL SURFACE OF SKULL

Zygomatic arch *(arcus zygomaticus)* is formed by fusion of zygomatic process of the temporal bone and the temporal process of the zygomatic bone. It is a lower border of the orbit and temporal fossa. It serves three important functions: to protect the eye, to give origin to the masseter and temporal muscle, and to provide an articulation for the mandible.

The ***temporal bone*** *(os temporale)* forms a large part of the lateral wall of the cranium. The temporal bone can be separated into petrosal, tympanic, and squamous parts. The petrosal part can further be divided into the pyramid and mastoid part. The pyramid houses the cochlea and the semicircular canals. It is located completely within the skull. The pars mastoidea is the only part of the temporal bone to form a part of the posterior surface of the skull. It is located in front of the jugular process.



Dog's skull. Lateral aspect.

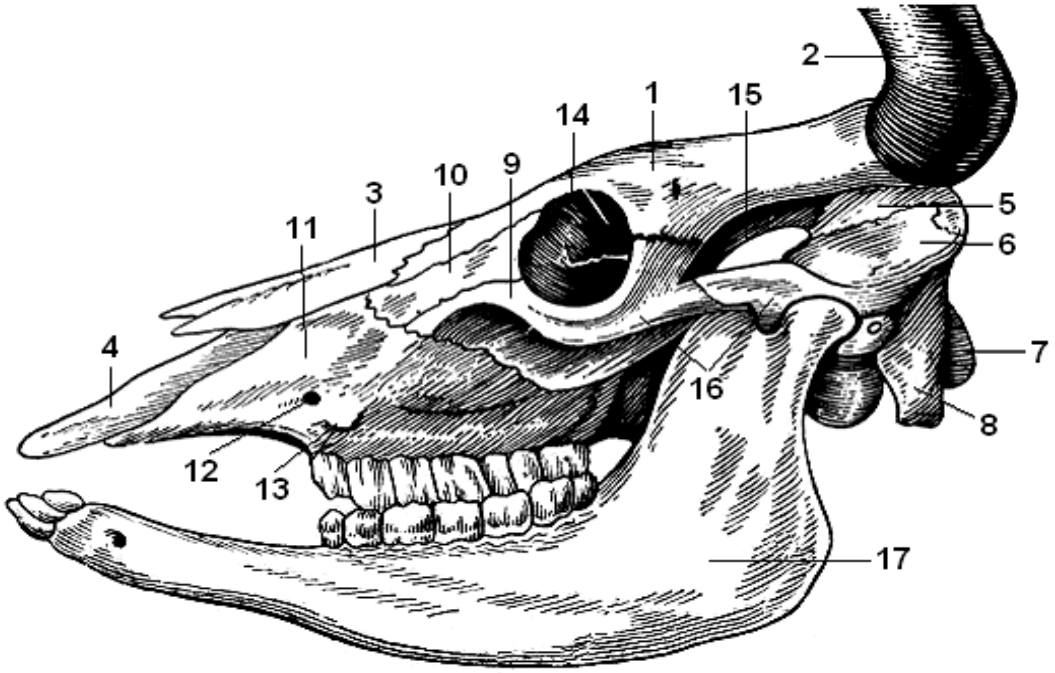
The ***petrous*** **part**, or ***petrosal bone*** *(os petrosum)*, is fused around its periphery laterally to the medial surfaces of the tympanic and squamous parts; posteriorly, it may on rare occasions be united with the mastoid part. It is roughly pyramidal in shape, and is called the pyramid for this reason.

The part immediately surrounding the membranous labyrinth ossifies first and is composed of very dense bone.

On its lateral surface is located the osseous tube. It is the ***external acoustic meatus*** *(meatus acusticus externus).* The ***external acoustic meatus*** is the opening of the ***external acoustic process*** to which the external ear is attached. Ventral and medial to the external acoustic process is the ***tympanic bulla,*** which can be seen best from the ventral aspect. The ***jugular process*** is a sturdy ventral projection posterior to the bulla tympanica, and lateral to the occipital condyle.

The ***mastoid part*** of the petrosum is the only part to have an external surface. This surface articulates with the occipital medially and the squamosum laterally. The ventral part is slightly enlarged, forming the *mastoid process* (processus mastoideus), which serves for muscle attachment and articulates with the tympanohyoid cartilage.

The ***squamous part*** *(pars squamosa)* of the temporal bone possesses a long, curved, ***zygomatic process*** *(processus zygomaticus),* which extends anterolaterally and overlies the posterior half of the zygomatic bone in forming the ***zygomatic arch*** *(arcus zygomaticus).*



Skull of cattle. Lateral aspect.

1 – frontal, 2 – corneal process of the frontal bone, 3 – nasal, 4 – incisive, 5 – parietal, 6 – temporal, 7 – occipital, 8 – jugular processes, 9 – zygomatic, 10 – lacrimal, 11 – maxilla, 12 – infraorbital hole, 13 – buccal tubercle, 14 – orbit, 15 – temporal fossa, 16 – zygomatic arch, 17 – mandible.

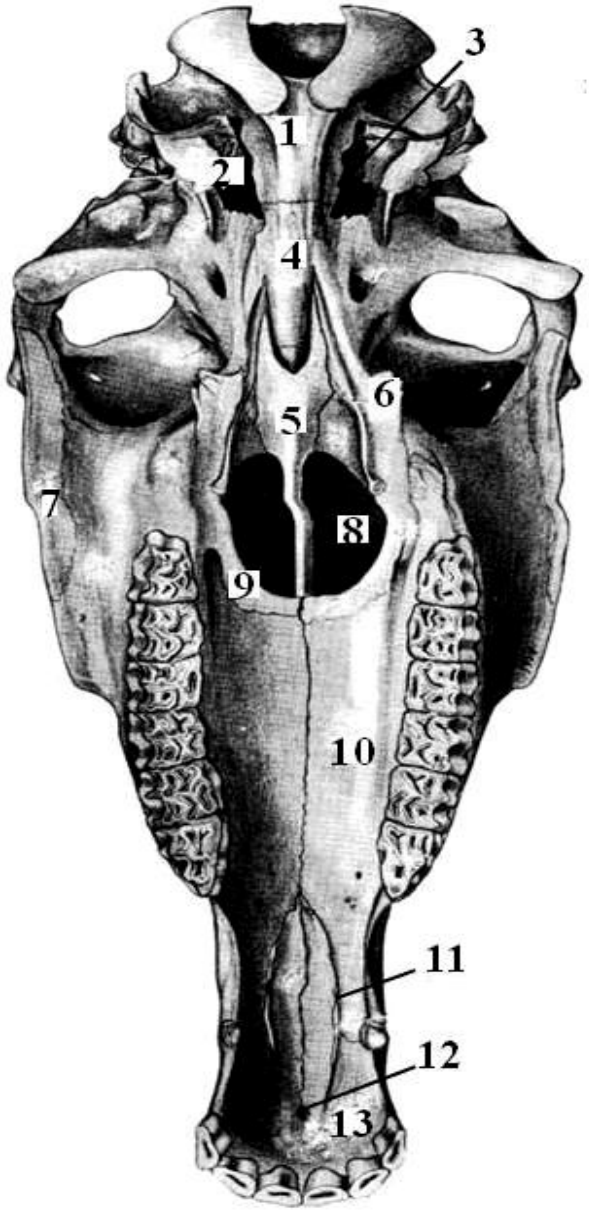
Zygomatic bone forms the anterior half of the ***zygomatic arch*** *(arcus*

zygomaticus). Zygomatic arch continues orally as ***facial crest*** *(crista facialis).*

Lacrimal bone located in the anterior margin of the orbit. The osseous orbit is a deep hollow, in which is placed the eye. The ***orbital region*** is formed by the ***orbit*** and the ventrally lying ***pterygopalatine fossa.***

Maxilla and the incisive bone of each side form the upper jaw. It is the largest bone of the face, and bears all of the upper teeth. The ventrolateral surface of the bone which bears the teeth is the ***alveolar process***. The ***palatine process*** is a transverse shelf of bone which forms most of the ***bony palate*** and separates the respiratory from the digestive passageway.

VENTRAL SURFACE OF SKULL



Lacerated foramen is located between the bodies of the occipital bone, sphenoid bones and petrosal bone. The outlet of the nasal cavity is presented by ***choanae***.

Palatine bone *(os palatinum)* is located posteromedial to the maxilla, where it forms the posterior part of the hard palate.

Skull of horse. Ventral aspect

1 – occipital bone
2 – petrosal bone
3 – foramen lacerum
4 – sphenoid bone
5 – vomer
6 – pterygoid bone
7 – zygomatic bone
8 – choanae
9 – palatine bones
10 – maxilla
11 – palatal notch
12 – foramen of interincisive canal
13 – incisive bone

Pterygoid bone *(os pterygoideum)* is a small, thin, slightly curved, nearly four-sided plate of bone which articulates with the bodies of sphenoid bone. ***Vomer*** is an unpaired bone which forms the posteroventral part of the nasal septum and therefore forms the medial boundaries of the ***choanae***. The vomer articulates with the sphenoid bone and with the ethmoid bone.

Sphenoid bone *(os sphenoidale)* consists of two parts, each possessing a pair of wings and a median body. At the base of each wing, near its junction with the body, are a series of foramina. The *oval foramen* (foramen ovale) is a large opening which leads directly through the cranial wall. It is located about 0.5 cm. medial to the temporomandibular joint.

INTERNAL STRUCTURE OF HORSE'S SKULL

There are **three** cavities inside the skull:

- cerebral cavity (cavum cranii)
- nasal cavity (cavum nasi)
- oral cavity (cavum oris)

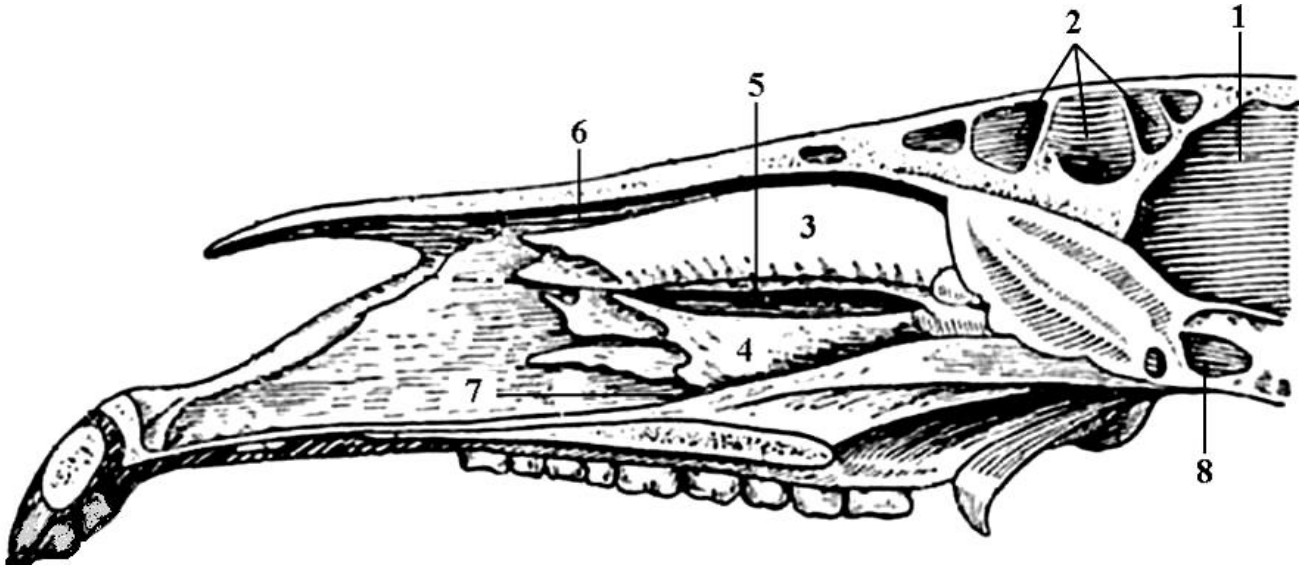
Cerebral cavity has six walls. The right and left walls are formed by the temporal bones and wings of the sphenoid bone. Dorsal wall is formed the part of the frontal bone and parietal bones. Front wall is presented ethmoid bone, and the back wall is formed by the scales of the occipital bone. Ventral wall is formed by the bodies of the occipital and sphenoid bones. The inner surface of the walls of brain cavity bears the digital impressions.

Nasal cavity is formed by five walls. Dorsal wall is formed by the anterior divisions of the frontal bones and nasal bones. Lateral walls are formed by the lacrimal, zygomatic, maxillary and premaxillary bone; ventral wall is presented by hard palatine. The back wall is formed of the ethmoid bone that separates the nasal and brain cavities.

Ethmoid bone *(os ethmoidale)* is located between the cerebral and facial parts of the skull, both of which it helps to form. It consists of three parts: a bone lamina, a cribriform plate and ethmoidal labyrinth.

The ***lamina*** is a median vertical sheet of bone which, by articulating with the vomer forms the *osseous nasal septum*. This septum is prolonged anteriorly by the cartilaginous nasal septum. Posteriorly, it fuses with the cribriform plate. The ***cribriform plate*** *(lamina cribrosa)* is a deeply

concave partition, protruding anteriorly. Approximately 300 foramina, some as large as 1.5 mm. in diameter, perforate the plate and serve for the transmission of olfactory nerve bundles. The ***ethmoid labyrinth*** *(labyrinthus ethmoidalis)* attaches to the lamina and to the cribriform plate.



Sagittal section of facial skull of horse

1 – cerebral cavity, 2 – conchofrontal sinus, 3 – dorsal concha, 4 – ventral concha, 5 – middle nasal meatus, 6 – dorsal nasal meatus, 7 – ventral nasal meatus, 8 – sphenopalatal sinus.

Paired ***dorsal and ventral nasal conchae [turbinates]*** *(conchae nasales dorsales et ventrales)* locate inside the nasal cavity.

The conchae restrict the ***nasal pathway***:

1) dorsal nasal pathway *(meatus nasi dorsalis)* is restricted to the dorsal wall of the nasal cavity and dorsal concha;

2) middle nasal pathway (meatus nasi medius) is located between the dorsal and ventral nasal conchae;

3) the ventral nasal pathway *(meatus nasi ventralis)* is located between the ventral concha and bottom of the nasal cavity.

These three pathways are combined fourth, or common, pathway *(meatus nasi communis)*, which is restricted to the medial septum and nasal conchae.

The **paranasal sinuses** communicate with nasal cavity. These are a pneumatic cavity in the flat bones of the skull. The paranasal sinuses enlarge with age, and only the largest definitive diverticula is presented at birth.

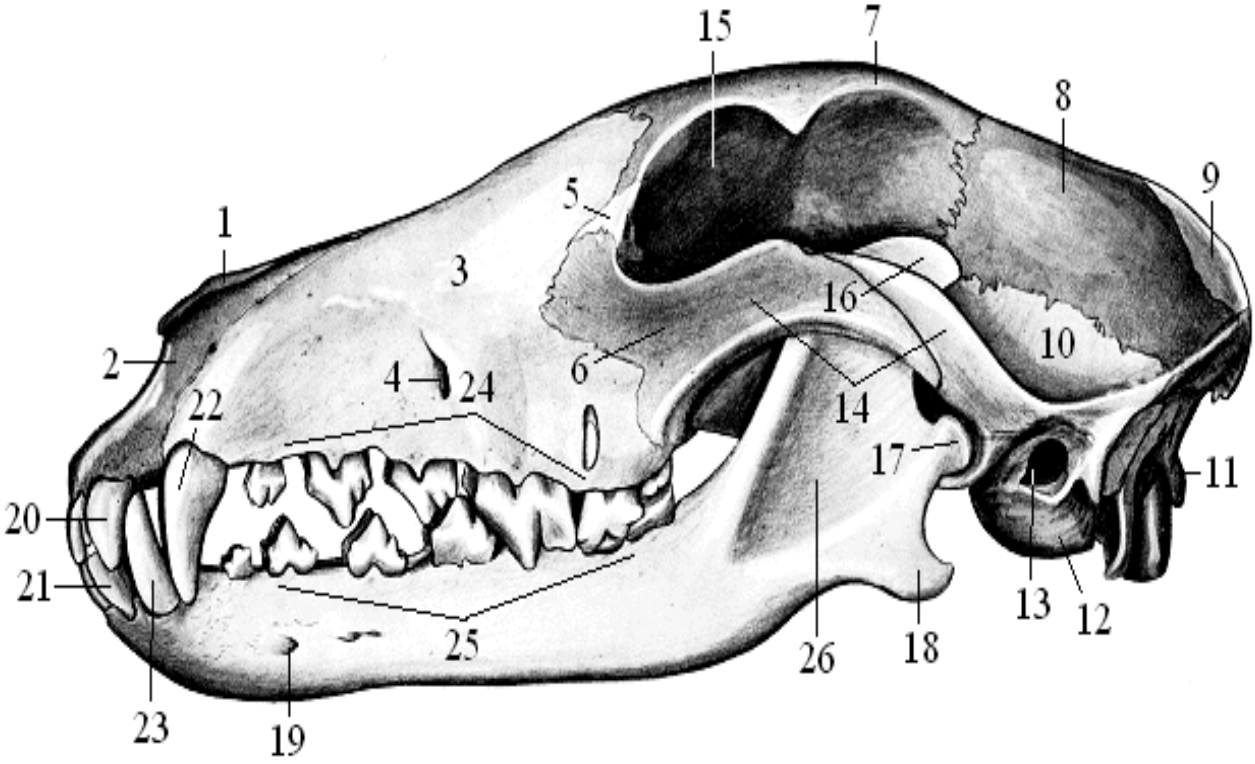
Paranasal sinuses of the horse:

1) ***rostral maxillary sinus*** *(sinus maxillaris rostralis),* is a large, lateral diverticulum of the lacrimal, zygomatic, maxillary bones and the dorsal turbinate. From a large maxillary sinus protrude rest sinuses.

2) ***caudal maxillary sinus*** *(sinus maxillaris caudalis)* is front protrusion of the maxillary bone.

3) ***conchofrontal sinus*** *(sinus conchofrontalis)* is a protrusion in the frontal and nasal bones and dorsal turbinate.

4) ***sphenopalatinal sinus*** *(sinus sphenopalatinus)* is a protrusion in the palatine and sphenoid bones.



Scull of dog

1 – nasal bone;2 – incisive bone; 3 – maxilla; 4 – infraorbital foramen; 5 – lacrimal bone; 6 – zygomatic bone; 7 – frontal bone; 8 – parietal bone; 9 – interparietal bone; 10 – temporal bone; 11 – occipital bone; 12 – petrosal bone; 13 – external *acoustic* meatus; 14 – zygomatic arch; 15 – orbit; 16 – coronoid process of mandible; 17 – condylar process of mandible; 18 – angular process of mandible; 19 – mental foramen; 20 – incisor teeth of maxilla; 21 – incisor teeth of mandible; 22 – canine of maxilla; 23 – canine of mandible; 24 – upper molar teeth; 25 – lover molar teeth; 26 – fossa of masseter.

APPENDICULAR SKELETON

L I M B S

Limb (*membrum*) is the part of the animal body. Animals have two pairs of limbs:

- **thoracic limb (*membrum thoracicum*)**
- **pelvic limb (*membrum pelvinum***

The pelvic limbs are the primary at movement of the body. The thoracic limbs are support the body during movement, standing, lifting.

Limb provides:

- movement of the body forward
- lifting the body and keeping it in standing position
- different types of grasping movements

Directions on the limbs:

Proximalis is nearer to the body axis
Distalis is further from the body axis
Dorsalis – front
Caudalis – back (except manus and pes)
Palmaris – back (palmar) on the manus
Plantaris – back (plantar) of the pes
Axialis is nearer to the longitudinal axis of the limb
Abaxialis is further from the longitudinal axis of the limb

Division of limbs into parts and links

The limbs are divided into the parts and the links, connected at a certain angle. The limb divides into two parts:

- girdle of limb (*cingulum membri*)
- free limb (*extremitas liberi*), which, in turn, consists of three links:- proximal, middle, and distal.

Division of thoracic limb

I. Sholder [pectoral] girdle (*cingulum membri thoracici*)
II. Free thoracic limb (*extremitas liberi membri thoracici)*:
1. Arm (*brachium)* is the proximal link
2. Forearm (*antebrachium*) is the middle link
3. Forepaw, or manus (*manus*) is the distal link:

a) wrist (*carpus*) is the proximal link of the manus
b) metacarpus (*metacarpus*) is the middle link of the manus
c) digit (*digitus*) is the distal link of the manus
The digit has three phalanges:
- proximal (phalanx prima)
- middle (phalanx secunda)
- distal (phalanx tertia)

Division of pelvic limb

I. Pelvic girdle (*cingulum membri pelvini*)
II. Free pelvic limb (*extremitas liberi membri pelvini*):
1. Femur (*femur*) is the proximal link
2. Leg (*crus*) is the middle link
3. Hindpaw, or foot (*pes*) is the distal link:
a) tarsal (*tarsus*) is the proximal link of the hindpaw
b) metatarsals (*metatarsus*) is the middle link of the hindpaw
c) digit (*digitus*) is the distal link of the hindpaw
The digit has three phalanges:
- proximal (phalanx prima)
- middle (phalanx secunda)
- distal (phalanx tertia)

Definition of limbs divisions and links (examples)

Pectoral girdle (cingulum membri thoracici) is a proximal part of the thoracic limb, located between the body and the arm.

The arm (*brachium*) is a proximal link of the free thoracic limb located between the pectoral girdle and forearm.

The leg (*crus*) is a middle link of the free pelvic limb, located between arm and pes.

The hindpaw (*pes*) is a distal link of the free pelvic limb, located lower of the leg.

The wrist (*carpus*) is a proximal link of the manus, located between forearm and metacarpus.

The metatarsals (*metatarsus*) is a middle link of the pes, located between ankle and digits.

Using these examples, we could give the definition of other links of limbs.

BONES OF THORACIC LIMB

Each **pectoral or thoracic limb** *(membrum thoracicum)* consists of its half of the pectoral girdle *(cingulum membri thoracici)*, composed of the ***scapula;*** the ***arm*** or ***brachium***, represented by the ***humerus;*** the ***forearm*** or ***antebrachium***, consisting of the ***radius*** and ***ulna;*** and the ***forepaw***, or ***manus***. The manus includes the ***wrist*** or ***carpus,*** with its digits, consisting of ***metacarpals, phalanges,*** and palmar ***sesamoid*** bones.

SCAPULA. The scapula is the large, flat bone of the shoulder. Since the pectoral limb has no articulation with the axial skeleton and supports the trunk by muscles only. In general it forms an imperfect triangle having two surfaces, three borders, and three angles.

The **lateral surface** (facies lateralis) is divided into two nearly equal fossae by a shelf of bone, the ***spine of scapulae*** (spina scapulae). The spine is located on the lateral surface of the bone. It devides surfaces on cranial and caudal portions. The distal end of the spine of the scapula is called the ***acromion.*** Its broadened superficial portion is subcutaneous and easily palpated in the living animal.

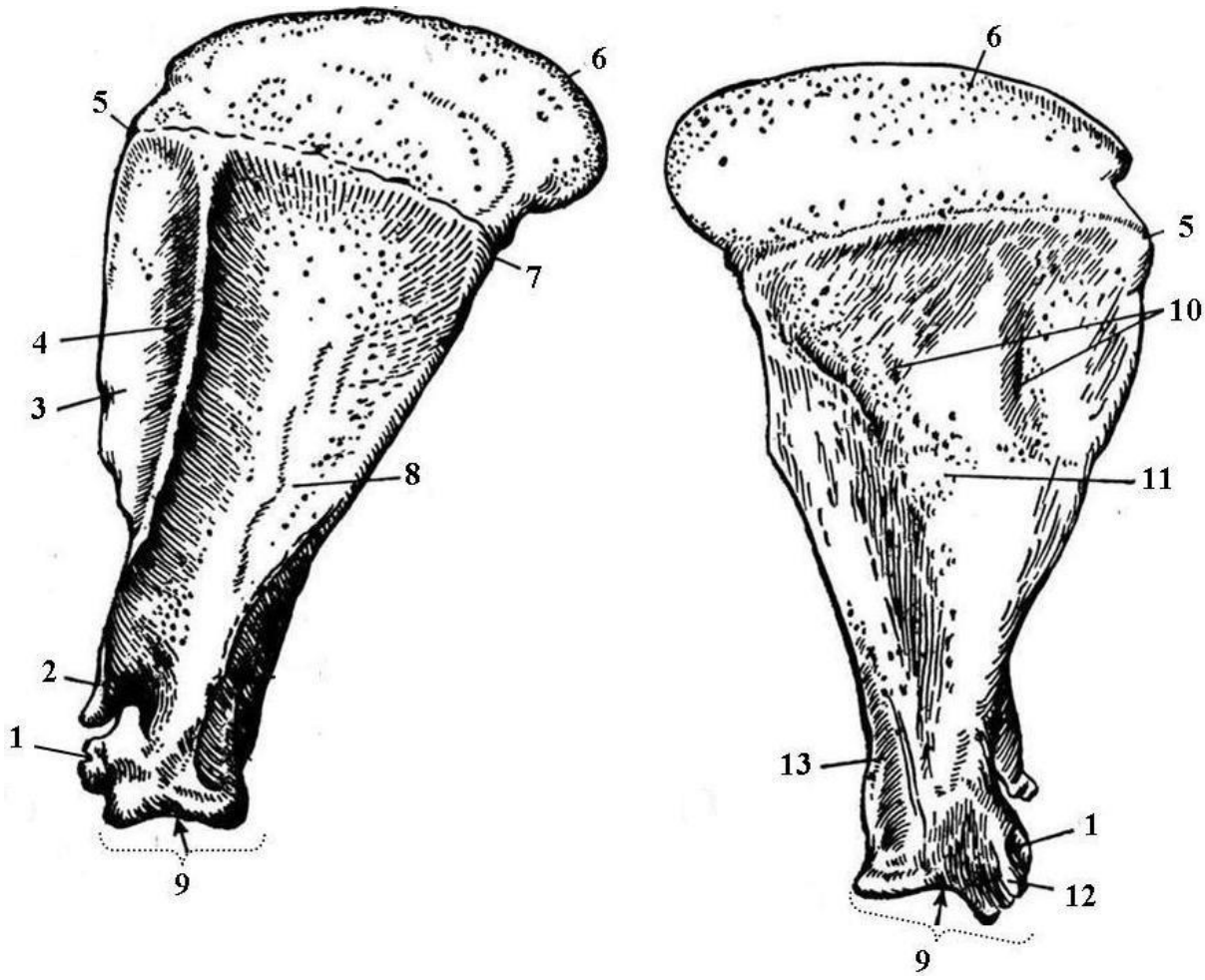
The ***supraspinous fossa*** (fossa supraspinata) is bounded by the cranial surface of the scapular spine and the adjacent lateral surface of the scapula. The ***infraspinous fossa*** (fossa infraspinata) is in general triangular.

The medial **surface** (facies costalis) has two areas: a small dorsocranial rectangular area, ***facies serrata***, and the large remaining part of the costal surface, or the ***subscapular fossa*** (fossa subscapularis).

The scapula has three **margins: cranial** (margo cranialis), **caudal** (margo caudalis) and **dorsal,** or the **base** (margo dorsalis).

Also scapula has three angles: **caudal, cranial** and **articular angle** (angularis cranialis, caudalis et articularis). The articular angle forms the expanded distal end of the scapula. Clinically, the articular angle is the most important part of the bone, since it contains the ***glenoid cavity*** (cavitas glenoidalis), which receives the head of the humerus in forming the shoulder joint.

The articular angle has the ***supraglenoid tubercle*** (tuberculum supraglenoidale s. tuber scapulae) that is the largest tuberosity of the scapula. The small beaklike process which leaves the medial side of the scapular tuberosity is the ***coracoid process*** (processus coracoideus), which is a remnant of the coracoid bone.



A **B**

Scapula of cattle

A – lateral aspect, B – medial aspect

1 – supraglenoid tubercle
2 – acromion
3 – supraspinous fossa
4 – spine of scapulae
5 – cranial angle
6 – cartilage of scapulae
7 – caudal angle
8 – infraspinous fossa
9 – articular angle with glenoid cavity
10 – facies serrata
11 – subscapular fossa
12 – coracoid process
13 – neck of scapulae.

Horse: the acromion is absent; the spina of scapula has **tuber spinae scapulae** in the middle part of it's; the glenoid cavity has a **notch** *(incisura glenoidalis).*

Cattle: the spina of scapula is finished by acromion; cartilage of scapulae is large in size; the glenoid cavity is round.

Dog: the spina of scapula is finished by acromion; the acromion achive the glenoid cavity; cranial angle is rounded; the glenoid cavity is oval.

HUMERUS. The humerus is the bone of the true arm, or brachium, and is the largest bone of the thoracic limb. Proximally it articulates with the scapula in forming the shoulder joint; distally it articulates with the radius and ulna in forming the elbow joint. Developmentally it is divided into a shaft and two extremities.

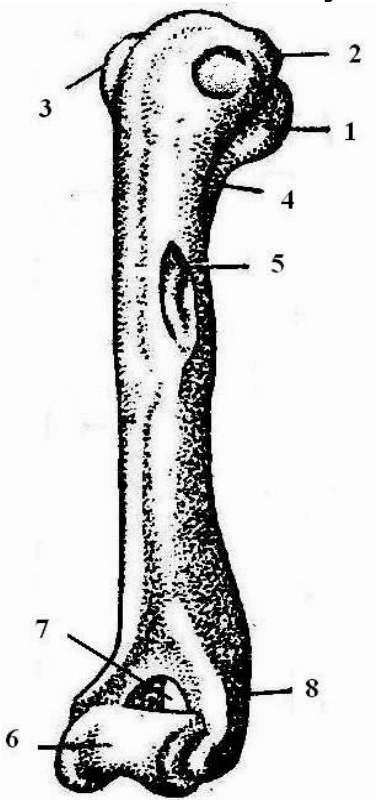
The ***head of humerus*** *(caput humeri)* is oval, being elongated in a sagittal plane. The articular area it presents is about twice the size of that of the glenoid cavity of the scapula with which it articulates.

The ***greater tubercle*** *(tuberculum majus)*, or large craniolateral projection of the proximal extremity of the humerus extends higher than the head. The ***lesser tubercle*** (tuberculum minus) is a medially flattened enlargement of the proximal medial part of the humerus.

The ***neck*** of humerus *(collum humeri)* is distinct only caudally and laterally. The ***body*** of humerus *(corpus humeri)*, or ***shaft***, is the long part of the humerus which unites the two extremities.

The ***lateral surface*** *(facies lateralis)* has ***deltoid tuberosity*** *(tuberositas deltoides).* The deltoid tuberosity is the most prominent feature of the lateral surface of the humerus and serves for the insertion of the m. deltoideus.

The ***medial surface*** *(facies medialis)* has distally the ***teres tuberosity*** *(tuberositas teres)*, which lies in the same transverse plane as the laterally located deltoid tuberosity.



Humerus of dog
(dorsal surface)

1 - head of humerus
2 - greater tubercle
3 - lesser tubercle
4 - crest of greater tubercle
5 - deltoid tuberosity
6 - trochlea of humerus
7 – supratrochlear foramen
8 - lateral condyle

The ***cranial surface*** *(facies cranialis)* of the humerus begins proximally at the crest of the greater tubercle. This crest swings laterally just medial to the deltoid tuberosity.

The ***caudal surface*** *(facies caudalis)* begins at the neck of the humerus. The caudal border is perforated below its middle by the distally directed ***nutrient foramen.***

The distal end of the humerus has the ***trochlea of humerus***. The trochlea articuates with the trochlear notch of the ulna in forming one of the most stable hinge joints in the body. The distal end of the humerus, including its articular areas and the adjacent fossae, may be regarded as the ***condyle of humerus*** *(condylus humeri).* The ***lateral and medial epicondyles*** *(epicondylus lateralis et medialis)* is the enlarged distolateral and distomedial end of the humerus.

RADIUS. The radius is the main weight-supporting bone of the forearm; it is shorter than the ulna, which parallels it and serves primarily for muscle attachment. The radius articulates with the humerus proximally in forming the elbow joint and with the carpal bones distally in forming the joint of the carpus. The radius, like the humerus, is divided into proximal and distal extremities, with an intervening shaft or body.

The **head of radius** *(caput radii)* is concave oval in outline as it extends transversely across the proximal end of the bone.

The **body of radius** *(corpus radii),* or ***shaft,*** is compressed so that it presents two surfaces and two borders. The ***tuberosity of radius*** *(tuberositas radii)* is a small projection which lies on the medial border and adjacent caudal surface of the bone. A large eminence lies on the lateral border of the radius.

The **distal extremity** of the radius is the most massive part of the bone. It is irregularly quadrilateral in shape. Its carpal articular surface *(facies articularis carpea)* articulates with the radial carpal bone.

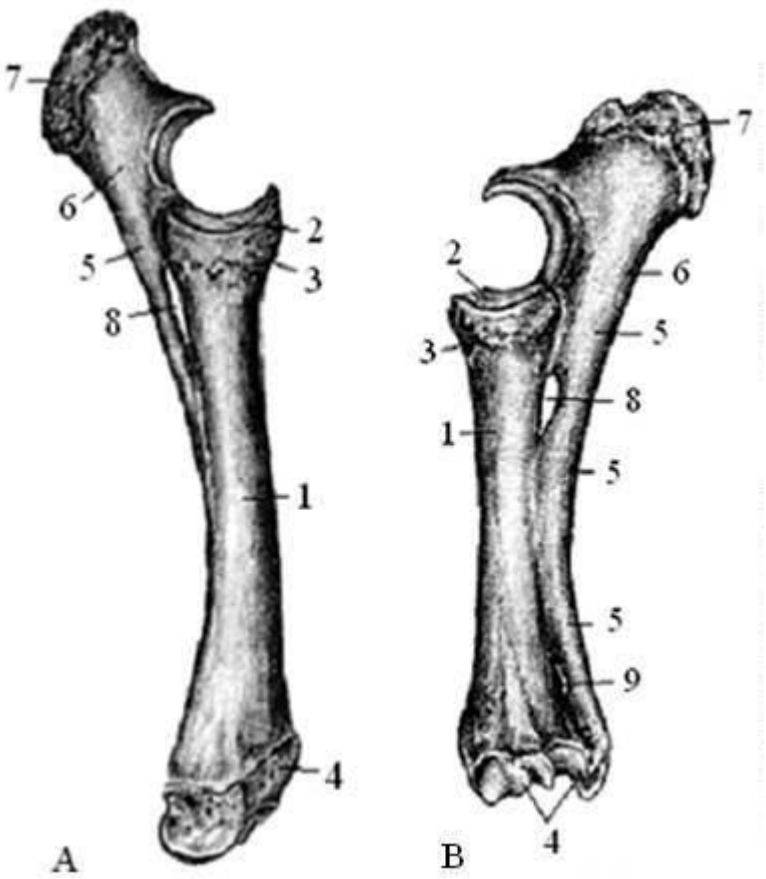
ULNA. The ulna, for descriptive purposes, is divided into a body, or shaft, and two extremities. It exceeds the radius in length. Proximally it articulates with the humerus and with the radius. Distally it articulates with the radius, and with the ulnar carpal and accessory carpal bones.

The **proximal extremity** of the ulna is the ***olecranon,*** which serves as a lever arm. The ***trochlear notch,*** is known, in some texts, as the semilunar notch. It is a smooth, vertical, half-moon-shaped concavity which faces cranially.

Skeleton of forearm

A – horse
B – cattle

1 – radius
2 – head of radius
3 – tuberosity of radius
4 – carpal articular surface
5 – ulna
6 – olecranon
7 – tuber of olecranon
8 – proximal interosseous space
9 – distal interosseous space



BONES OF MANUS [FOREPAW]

The skeleton of the ***forepaw*** *(manus)* includes:

- carpal bones **– *ossa carpi***
- metacarpals bones – ***ossa metacarpi***
- digital skeleton of hand – ***ossa digitorum manus***

Location of horse's bones

CARPUS. The carpal bones ***(ossa carpi)*** are arranged in a proximal and a distal row.

The ***proximal*** row includes 4 bones (beginning with the medial side):

The **radial carpal bone** *(os carpi radiale)* is located on the medial side of the proximal row, is the largest of the carpal elements.

The **intermedial carpal bone** *(os carpi intermedium).*

The **ulnar carpal bone** *(os carpi ulnare)* is the lateral bone of the proximal row.

The **accessory carpal bone** *(os carpi accessorium)* is located on the caudal or palmar side of the ulnar carpal.

The ***distal*** row includes the carpal bones:

The **first carpal bone** *(os carpale primum)*

The **second carpal bone** *(os carpale secundum)*

The **third carpal bone** *(os carpale tertium)*

The **fourth** fuses with the **fifth carpal bone** *(os carpale quartum et quintum)*

METACARPUS. The term *metacarpus* refers to the region of the manus, or forepaw, located between the carpus and the digits. Like the distal row of carpal bones, the metacarpals bones *(ossa metacarpi)* are numbered from the medial to the lateral side.

The metacarpals bones *(ossa metacarpi*) are long and tubular.

II – the second metacarpal bone *(os metacarpale secundum)*

III – the third metacarpal bone *(os metacarpale tertium)*

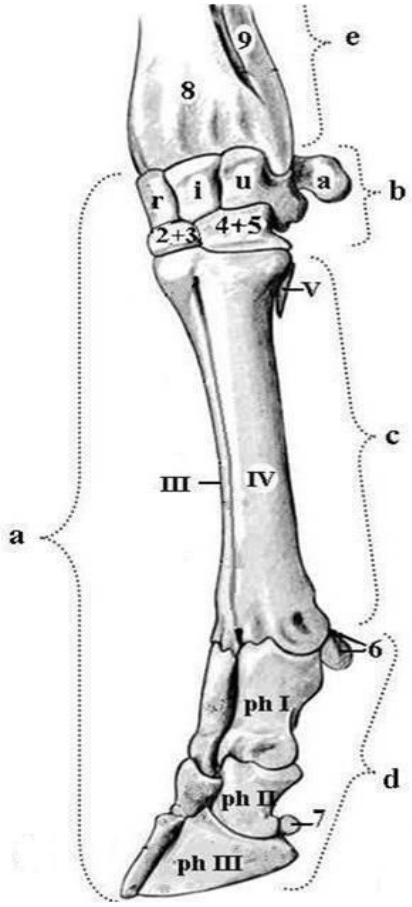
IV – the fourth metacarpal bone *(os metacarpale quartum)*

Metacarpal bone III is the main metacarpal bone.

II and IV metacarpals bones are largely reduced.

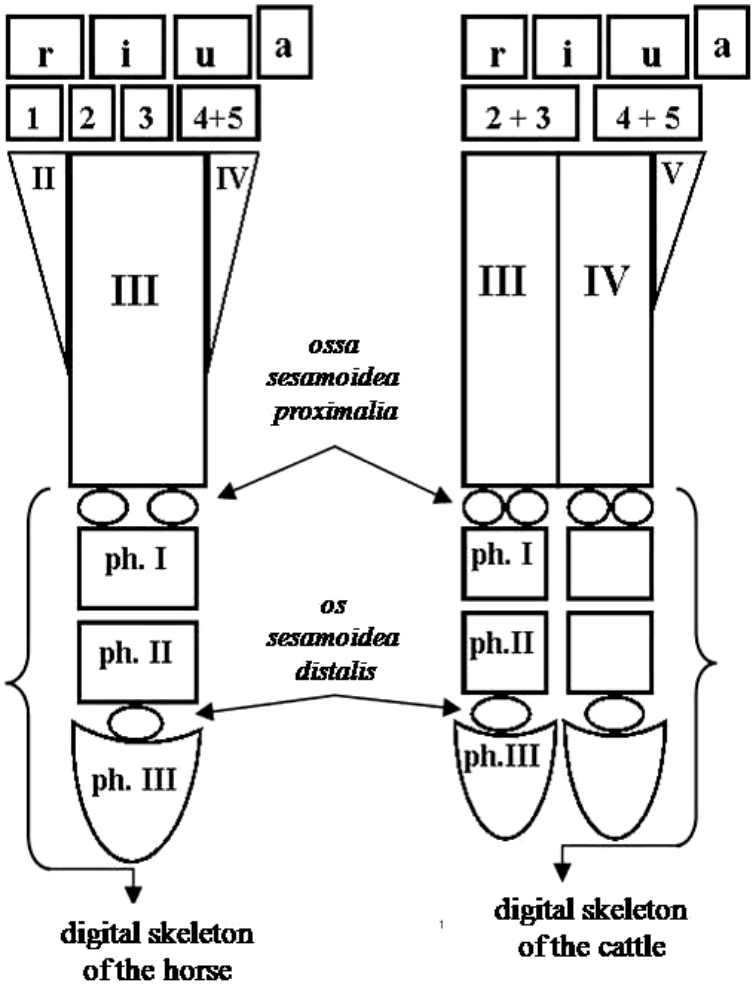
PHALANGES. The digital skeleton (ossa digitorum manus) is presented the bones of the third finger.

The digital skeleton (ossa digitorum manus) consists of three phalanges (proximal, middle and distal) and three sesamoid bones (ossa sesamoidea).



Bones of manus [forepaw] of cattle

a – bones of manus
b – carpal bones
c – metacarpals bones
d – digitial skeleton of manus
e – antebrahial skeleton of manus
6 – proximal sesamoid bones
7 – distal sesamoid bone
8 – radius
9 – ulna



Sceleton of forepaw (scheme)

A – horse
B – cattle

r – radial carpal bone
i – intermedial carpal bone
u – ulnar carpal bone
a – accessory carpal bone

1 – first carpal bone
2 – second carpal bone
3 – third carpal bone
4 – fourth carpal bone
5 – fifth carpal bone
I–V – first, second, third, fourth and fifth metacarpals bones

The proximal (first) phalanx *(phalanx proximalis).*

The middle (second) phalanx *(phalanx media)* [coronary bone – os coronale].

The distal (third) phalanx *(phalanx distalis)* [ungular bone – os ungulare].

Two proximal sesamoid bones *(ossa sesamoidea proximalia)* are associated with the plantar surface of the proximal phalanx.

One distal sesamoid bone *(os sesamoidea distalis)* is associated with the plantar surface of the distal phalanx.

Location of dog's bones

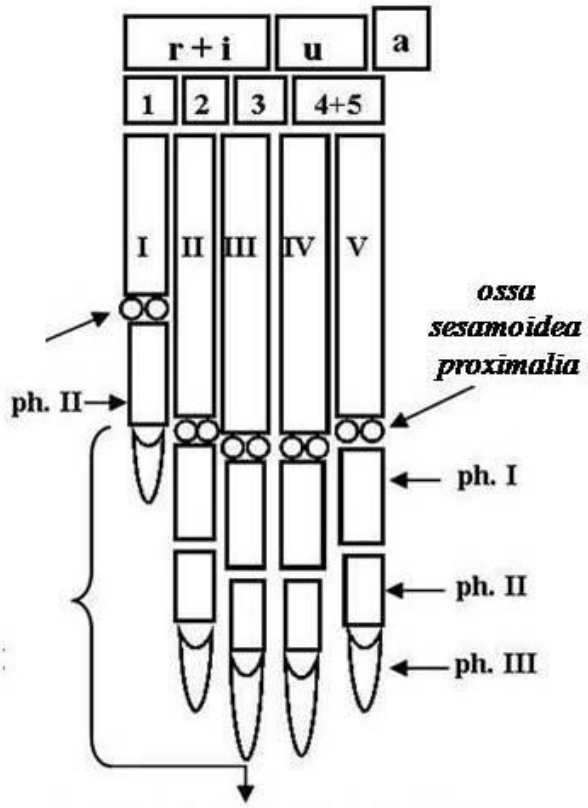
The bones of the proximal row are the radial, intermediate, ulnar, and accessory carpal bones. Those of the distal row are the first, second, third, and fourth carpal bones.

The intermedial carpal bone fuses with the radial carpal.

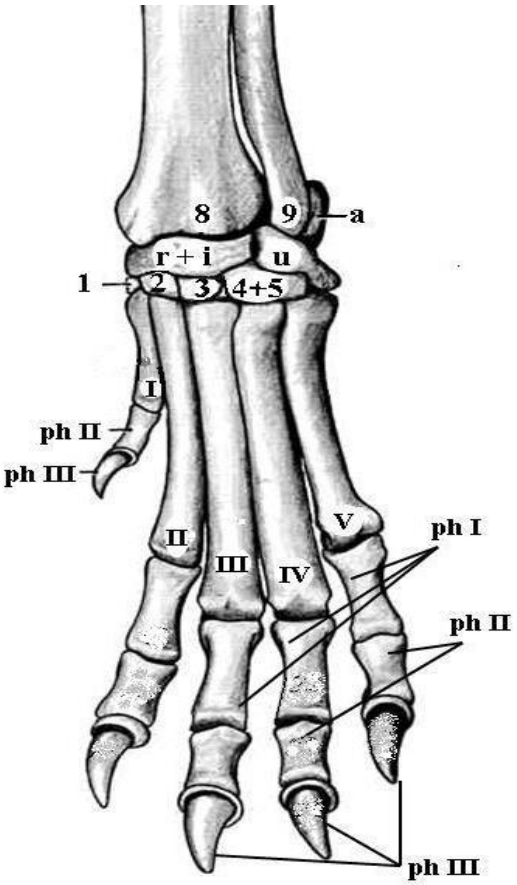
There are five metacarpal bones.

The ***first metacarpal bone*** of the forepaw is usually present, although it is by far the shortest of the metacarpals bones. Metacarpals bones **II** ***to*** V are the main metacarpal bones. The small, first metacarpals bone bears only two, which form the skeleton of the rudimentary first digit.

The **digital skeleton of manus** *(ossa digitorum manus)* of the forepaw consists of five units, of which four are fully developed and one is rudimentary.



digital skeleton of the dog

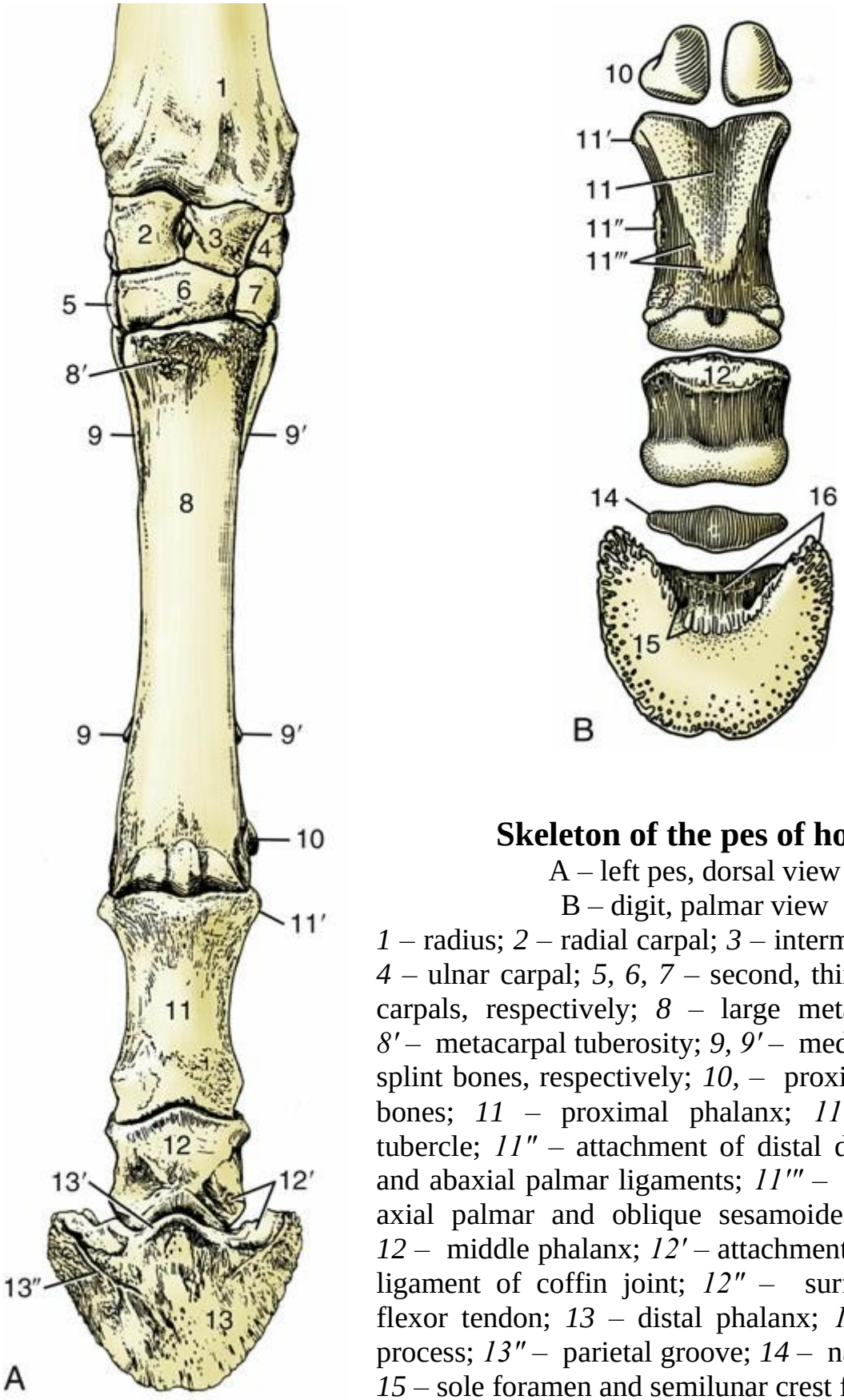


Sceleton of left forepaw of dog's

Each main digit consists of a proximal phalanx, middle phalanx, and distal phalanx, and two large palmar sesamoid bones at the metacarpophalangeal joint.

The middle or second phalanx (phalanx media s. secunda) is present only in each of the main digits, there being none in digit I.

The sesamoid bones *(ossa sesamoidea)* articulate with the each metacarpal bone and with the each proximal phalanx. Distal sesamoid bones are absent.



Skeleton of the pes of horse

A – left pes, dorsal view
B – digit, palmar view

1 – radius; *2* – radial carpal; *3* – intermediate carpal; *4* – ulnar carpal; *5*, *6*, *7* – second, third, and fourth carpals, respectively; *8* – large metacarpal bone; *8′* – metacarpal tuberosity; *9*, *9′* – medial and lateral splint bones, respectively; *10*, – proximal sesamoid bones; *11* – proximal phalanx; *11′* – proximal tubercle; *11″* – attachment of distal digital annular and abaxial palmar ligaments; *11‴* – attachment of axial palmar and oblique sesamoidean ligaments; *12* – middle phalanx; *12′* – attachments of collateral ligament of coffin joint; *12″* – surface for deep flexor tendon; *13* – distal phalanx; *13′* – extensor process; *13″* – parietal groove; *14* – navicular bone; *15* – sole foramen and semilunar crest for attachment of deep flexor tendon; *16* – palmar process and attachment of distal navicular ligament.

BONES OF THE PELVIC LIMB

Each pelvic limb (membrum pelvinum) consists of its half of the **pelvic girdle** (cingulum membri pelvini), composed of the ***ilium, ischium, pubis*** bones fused as the hip bone (os coxae); the thigh, represented by the ***femur;*** the stifle or knee joint, with its menisci, fabellae, and patella; the **crus** or leg, consisting of the ***tibia*** and ***fibula;*** and the hindpaw, or pes.

The pes includes the ankle or ***tarsus,*** with its digits, consisting of ***metatarsals, phalanges,*** and the ***sesamoid bones*** associated with the phalanges.

The bone ***pelvis*** is formed by the ossa coxarum, the sacrum, and the first coccygeal vertebra.

HIP [COXAL] BONE - *os coxae*. The **hip** bone is composed of three distinct bones: **ilium, ischium and pubis**. These are joined and form a cavity (socket) at the junction of these. This socket is a deep, called the ***acetabulum***. The ***symphysis pelvis*** is the median synostosis formed by the right and left hip bones. It is, therefore, composed of the *symphysis pubis* cranially and the ***symphysis ischii*** caudally.

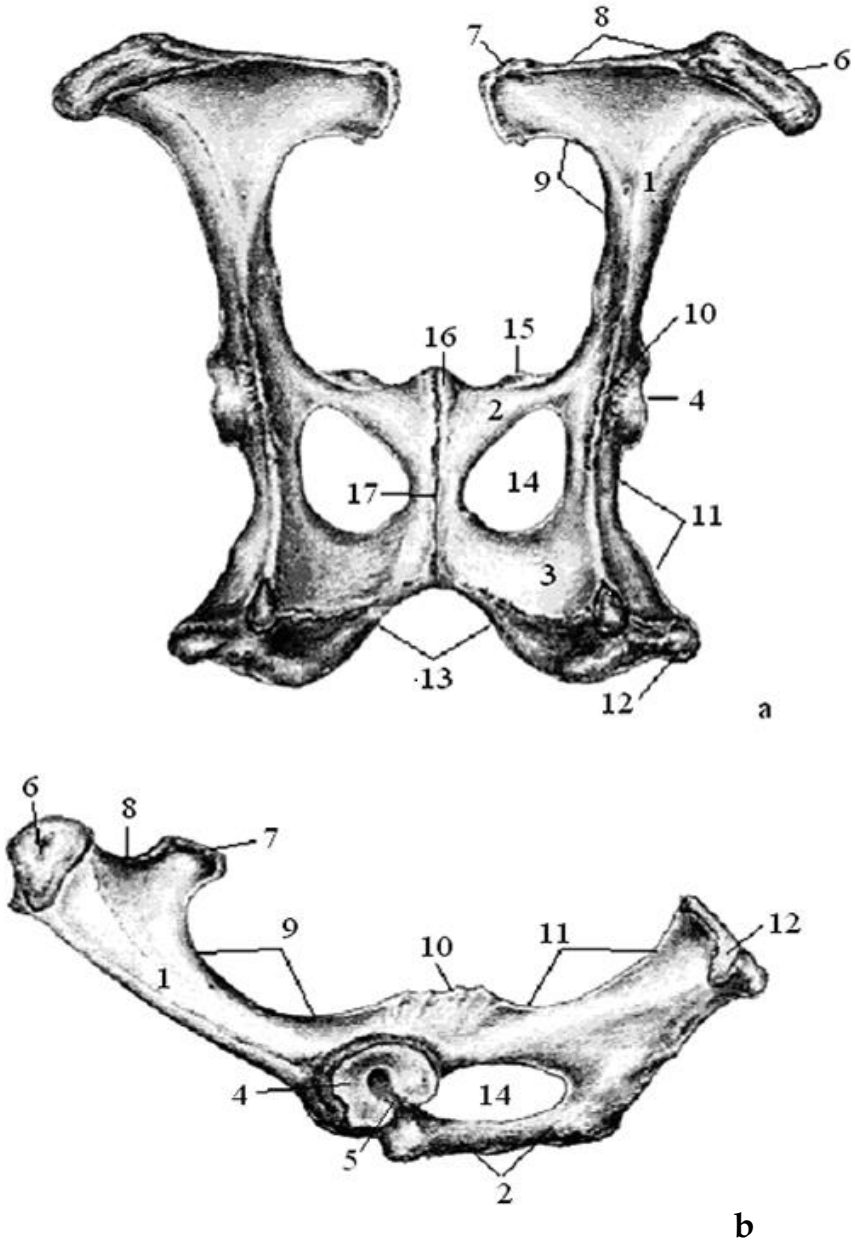
The **ilium** (os ilium) is the largest and most cranial of the bones which compose the os coxae. It is basically divided into a cranial, nearly sagittal, laterally concave part, the *wing* (ala ossis ilii) and a narrow, more irregular caudal part, the *body (corpus ossis ilii).* The ilium is divided into two surfaces, three borders, and three angles. The *cranial border* is more commonly known as the *iliac crest* (crista iliaca). The caudal half of the dorsal border forms the *greater ischiatic notch (incisura ischiadica major).* The dorsal border of the ilium is continuous with the dorsal border of the ischium as a slight convexity dorsal to the acetabulum. This is the *ischiatic spine* (spina ischiadica). The *lesser ischiatic notch (incisura ischiadica minor)* is located caudal from *ischiatic spine*.

Medial end of the ilium has tubercle called *sacral tuber*. Lateral end of the ilium has tubercle called *coxal tuber*. The *gluteal surface* (facies glutea) of the ilium faces laterally.

The **ischium** (os ischii) consists of a body, ramus, and tuberosity. It forms the caudal third of the os coxae and enters into the formation of the acetabulum, obturator foramen, and symphysis pelvis. The *ischiatic tuberosity (tuber ischiadicum)* is the caudolateral part of the bone.

The *body of ischium* (corpus ossis ischii) is that part of the bone which lies caudal to the acetabulum. The *ramus of ischium* (ramus ossis ischii) joins the body at a right angle. The cranial border of the ramus forms the caudal boundary of the obturator foramen. The caudomedial

parts of the adjacent ischium bones form the deep *ischial arch* (arcus ischiadicus).



Hip [coxal] bone of the cattle

a – dorsally;
b – laterally
1 – ilium;
2 – pubis;
3 – ischium;
4 – acetabulum;
5 – notch of acetabulum;
6 – coxal tuber;
7 – sacral tuber;
8 – iliac crest;
9 – greater ischiatic notch;
10 – ischiatic spine;
11 – lesser ischiatic notch;
12 – ischiatic tuberosity;
13 – ischial arch;
14 – obturator foramen;
15 – crest of pubic;
16 – pubic tubercle;
17 – symphysis pelvis.

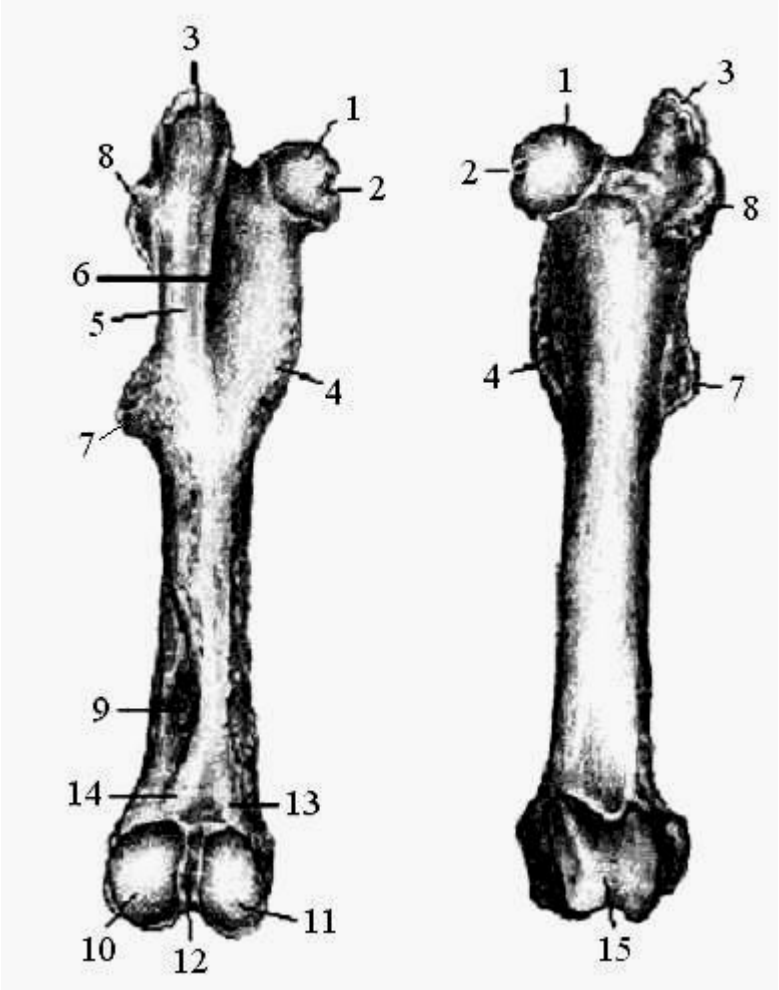
The **pubis** (os pubis) is a dorsoventrally compressed, curved bar of bone which extends from the ilium and ischium laterally to the symphysis pubis medially. Its caudal border bounds the cranial part of the obturator foramen.

The *iliopectineal eminence* (eminentia iliopectinea), its largest process, is located on the cranial border of the bone as it joins the ilium. Medially it fuses with other pubis bone, forming the pubic part of the symphysis pelvis. Caudally it fuses with the ischium. The *pubic tubercle* (tuberculum pubicum) is located on the ventral surface of the pubic symphysis. The cranial border of the pubis, stretching from the

iliopectineal eminence to the symphysis pubis, is also called the *pecten ossis pubis,* or the medial part of the terminal line. It serves for the attachment of the prepubic tendon, whereby all of the abdominal muscles, except for the m. transversus abdominis, attach wholly or in part. The m. pectineus also arises here.

FEMUR. The femur is the heaviest bone in the skeleton. It articulates with the os coxae proximally and with the tibia distally.

The **proximal end** of the femur presents a smooth, hemispherical ***head of femur***, supported by a neck on its proximolateral side and three processes, or trochanters. The *fovea of head of femur* is a small circular pit on the medial part of the head. The fovea serves for the attachment of the round ligament of the hip joint. The ***neck of femur*** unites the head with the rest of the proximal extremity.



a **b**

Femur of horse

a – caudal aspect
b – dorsal aspect

1 – head of femur;
2 – fovea of head of femur;
3 – greater trochanter;
4 – lesser trochanter;
5 – intertrochanteric crest;
6 – trochanteric fossa;
7 – third trochanter;
8 – middle trochanter;
9 – supracondylar fossa;
10 –lateral condyles;
11 – medial condyles;
12 – intercondylar fossa;
13 – medial epicondyles;
14 – lateral epicondyles;
15 – femoral trochlea.

The *greater trochanter* (trochanter major), the largest tuber of the proximal extremity of the bone, is located directly lateral to the head. Its

free, pyramid-shaped apex. Between the femoral head and the greater trochanter, caudal to the ridge of bone connecting the two, is the deep *trochanteric fossa* (fossa trochanterica). The *lesser trochanter* (trochanter minor) is a distinct, pyramid-shaped eminence which projects from the caudomedial surface of the proximal extremity near its junction with the shaft. It is connected with the greater trochanter by an *intertrochanteric crest*. The most craniolateral eminence of the greater trochanter is called the cervical tubercle. On the line which arches distocaudally from this tubercle is the *third trochanter* (trochanter tertius).

The **distal end** of the femur contains three main articular areas. Two of these are on the medial and lateral condyles, and the third is an articular groove on the cranial surface. Each condyle articulates directly with the tibia, but most extensively with the menisci of the tibia.

The *femoral trochlea* (trochlea femoris) on the cranial surface of the distal extremity is continuous with the articular surfaces of the condyles. The medial ridge is thicker than the lateral one. The patella, or knee cap, articulates with the patellar surface of the femur.

Proximal and cranial to the medial and lateral condyles are the *medial and lateral epicondyles* (epicondylus medialis et lateralis). These serve for the proximal attachments of the medial and lateral collateral ligaments of the stifle joint.

On the caudal proximal surfaces of the medial and lateral condyles are facets for the articulation of the medial and lateral fabellae, the sesamoid bones.

Sesamoid Bones. The **patella**, or knee cap, is the largest sesamoid bone in the body. It is ovate in shape and curved so as to articulate with the patellar surface of the femur. The **fabelle** are two sesamoid bones, each less than 1 cm. long. These are located on the caudal surfaces of the medial and lateral condyles of the distal end of the femur. These are present only in dog.

TIBIA. The tibia is a long, strong bone which lies in the medial part of the crus. It articulates proximally with the femur, distally with the tarsus, and on its lateral side both proximally and distally with companion bone of the crus, the fibula. Its proximal half is triangular in cross section and more massive than its distal half, which is nearly cylindrical.

The **proximal end** of the tibia is relatively flat and triangular, with its apex cranial. Extending from the margin of the base on each side of a central elevation are articular areas which form the *proximal articular*

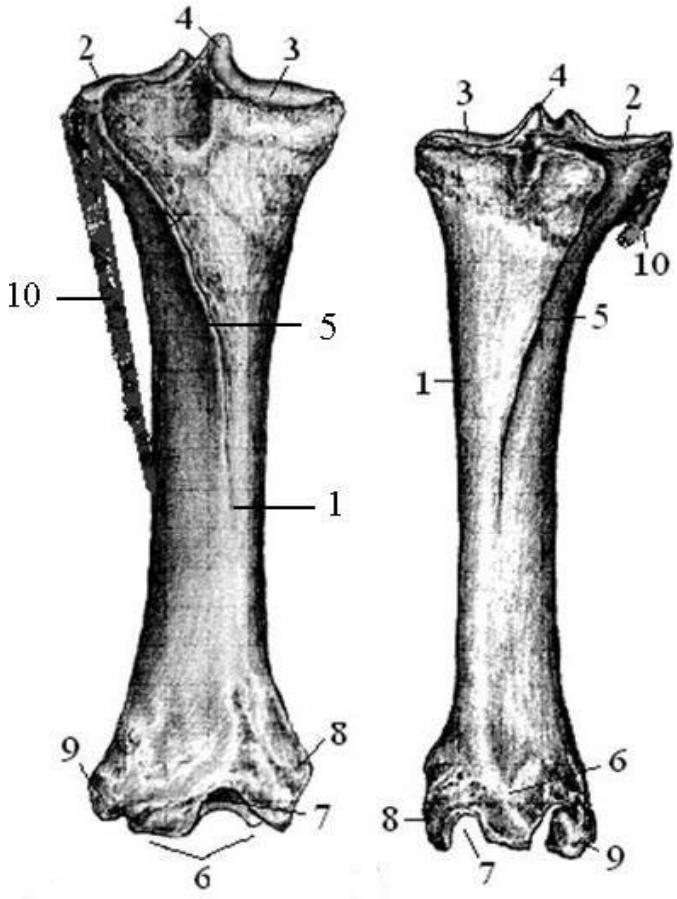
surface (facies articularis proximalis). The divided proximal articular surface lies on the *lateral and medial condyles* (condylus lateralis et medialis). The articular areas of the condyles are separated by a sagittal eminence. In the fresh state they are covered by articular cartilage and have only a small area of contact with the articular cartilage of the femoral condyles. Functionally the medial and lateral tibial condyles are separated from the medial and lateral femoral condyles by the ***medial and lateral menisci*** (meniscus medialis et lateralis). These fibrocartilages are biconcave discs. The ***intercondylar eminence*** (eminentia intercondylaris) is a low eminence between the medial and lateral tibial condyles.

The ***tibial tuberosity*** (tuberositas tibiae) is the large, quadrangular, proximocranial process. Extending distally from the tibial tuberosity is the ***cranial margin [border]***, which has a slight medial inclination.

The **distal end** of the tibia has the ***distal articular surface*** which is in the form of two nearly grooves. The grooves are separated by an intermediate ridge.

Bones of leg [crus]
dorsal aspect
A – horse, B – cattle

1 – tibia
2 – lateral condyle
3 – medial condyle
4 – intercondylar eminence
5 – cranial margin
6 – distal articular surface
7 – articular grooves
8 – medial ancle
9 – lateral ancle
10 – fibula



FIBULA is along, thin, laterally compressed bone located in the lateral part of the crus. It articulates with the caudolateral part of the tibia proximally and with the tibia and tibial tarsal bone distally.

BONES OF PES [HINDPAW]

The bones of hindpaw (pes) is composed of the tarsal bones, metatarsals, phalanges, and the sesamoid bones associated with the phalanges. The tarsus is composed of bones basically arranged in three transverse rows. Articulating with the distal surfaces of the most distally located tarsal bones are the metatarsal bones.

Each of the metatarsal bones bears three phalanges which, with their associated sesamoid bones, form the skeleton of each of the digits. The first digit is absent in the dog.

The skeleton of the ***hindpaw*** *(pes)* includes:

- tarsal bones **– *ossa tarsi***
- metatarsals bones – ***ossa metatarsalia***
- digital skeleton of foot – ***ossa digitorum pedis***

Location of horse's bones

Tarsal bones. The tarsus, or **hock**, consists of seven **tarsal bones** (ossa tarsi). The term also applies collectively to the several joints between the tarsal bones, as well as the region between the crus and the metatarsus.

All bones are located into three raws:

P r o x i m a l r a w :

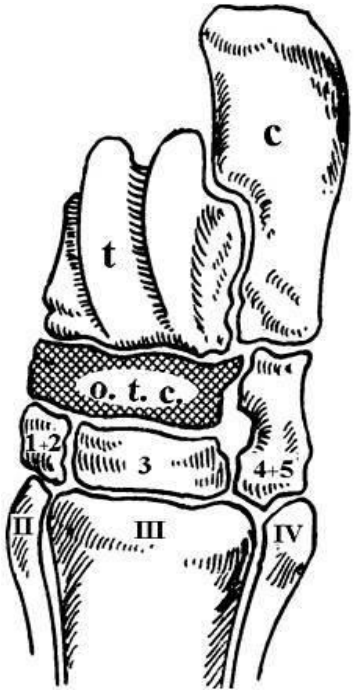
- **talus** is the second largest of the tarsal bones
- **calcaneus** is the largest and longest bone of the tarsus

M i d d l e r a w :

- **central tarsal *bone*** *(os tarsi centrale)* lies in the medial part of the tarsus between the proximal and distal rows

D i s t a l r a w :

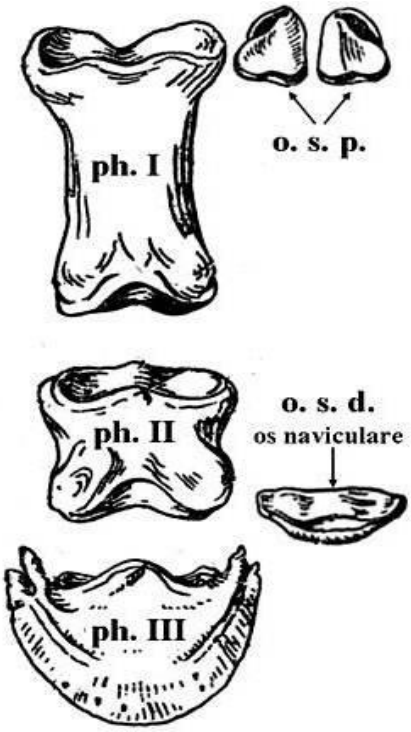
- **first tarsal bone** (os tarsale primum) + **second tarsal bone** (os tarsale secundum)
- **third tarsal bone** (os tarsale tertium)
- **fourth tarsal bone** (os tarsale quartum) + **fifth tarsal bone** (os tarsale quintum)



Tarsal and metatarsals bones of horse

(Latin terminology)

t– talus, c – calcaneus
o. t. c. – os tarsale centrale
1+2 – os tarsale primum et secundum
3 – os tarsale tertium
4+5 – os tarsale quartum et quintum



Digital skeleton of horse

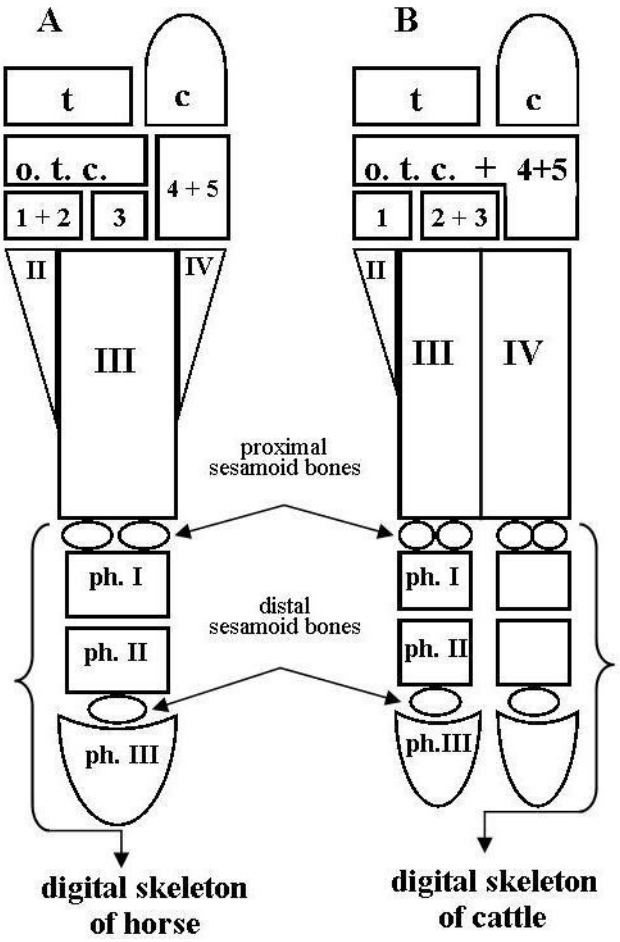
(Latin terminology)

o. s. p. – ossa sesamoidea proximalia
o. s. d. – os sesamoidea distalis
ph. I, ph. II, ph. III – phalanx prima, secunda, tertia

Metatarsals. The term metatarsus refers to the region of the pes, or hindpaw, located between the tarsus and the phalanges. The **metatarsals** (ossa metatarsalia I-V) resemble the corresponding metacarpal bones in general form. They are, however, longer.

II – second metatarsal bones *(os metatarsale secundum)*
III – third metatarsal bones *(os metatarsale tertium)*
IV – fourth metatarsal bones *(os metatarsale quartum)*
Metatarsal bone III *is the main metatarsal bone.*
II and IV metatarsals bones are largely reduced.

Phalanges. The digital skeleton of hindpaw *(ossa digitorum pedis)* is **similar** to digital skeleton of the forepaw.



Sceleton
of hindpaw
(scheme)

A – horse
B – cattle
C – dog

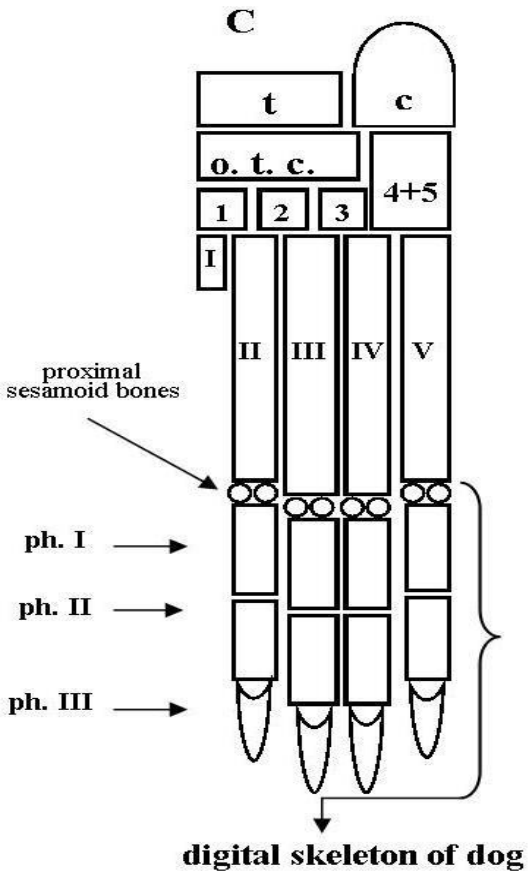
t – tibial tarsal bone or ***talus***
c – fibular tarsal bone ***(calcaneus)***
o.t.c. – central tarsal bone

1 – first tarsal bone
2 – second tarsal bone
3 – third tarsal bone
4 – fourth tarsal bone
5 – fifth tarsal bone
II –V – second, third, fourth and fifth metatarsal bones

Location of dog's bones

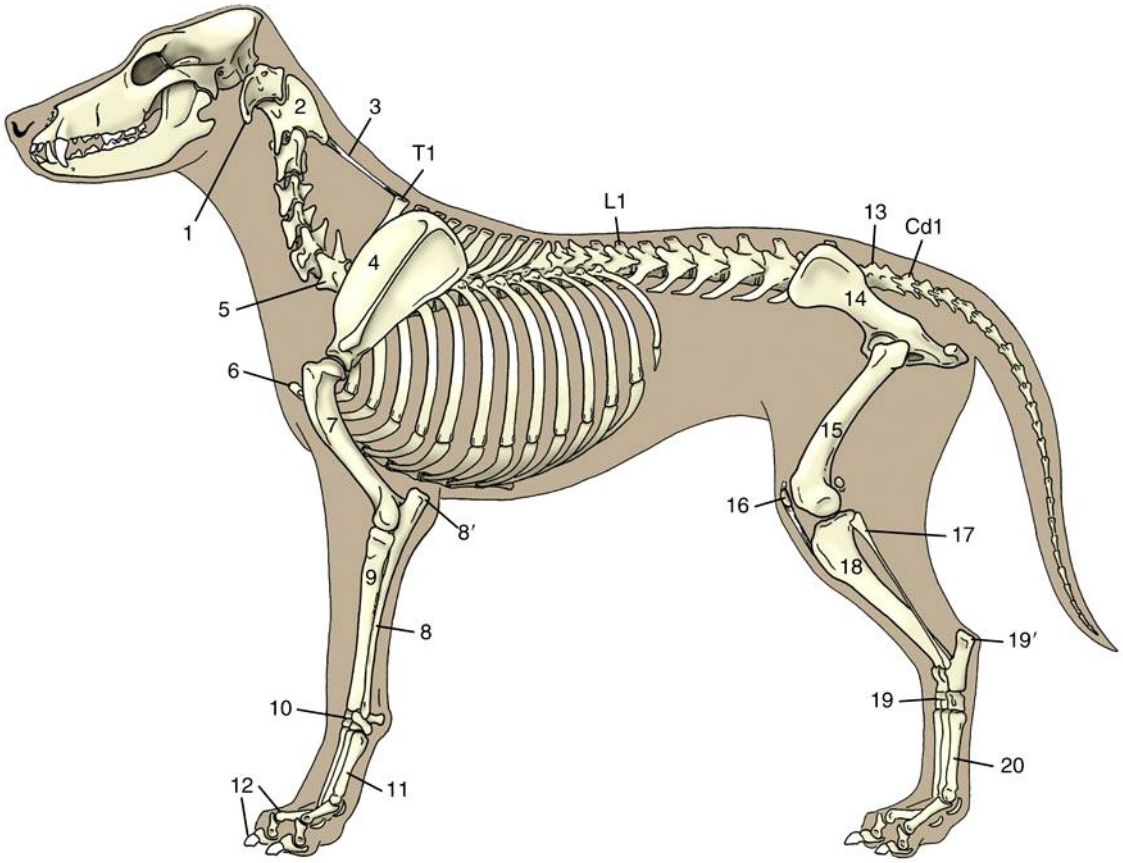
The phalanges and sesamoid bones of the hindpaw are so similar to those of the forepaw that no separate description is necessary, except for the bones of digit 1.

The whole skeleton of the hindpaw is longer and narrower than that of the forepaw.



MEANING OF BONE LANDMARKS

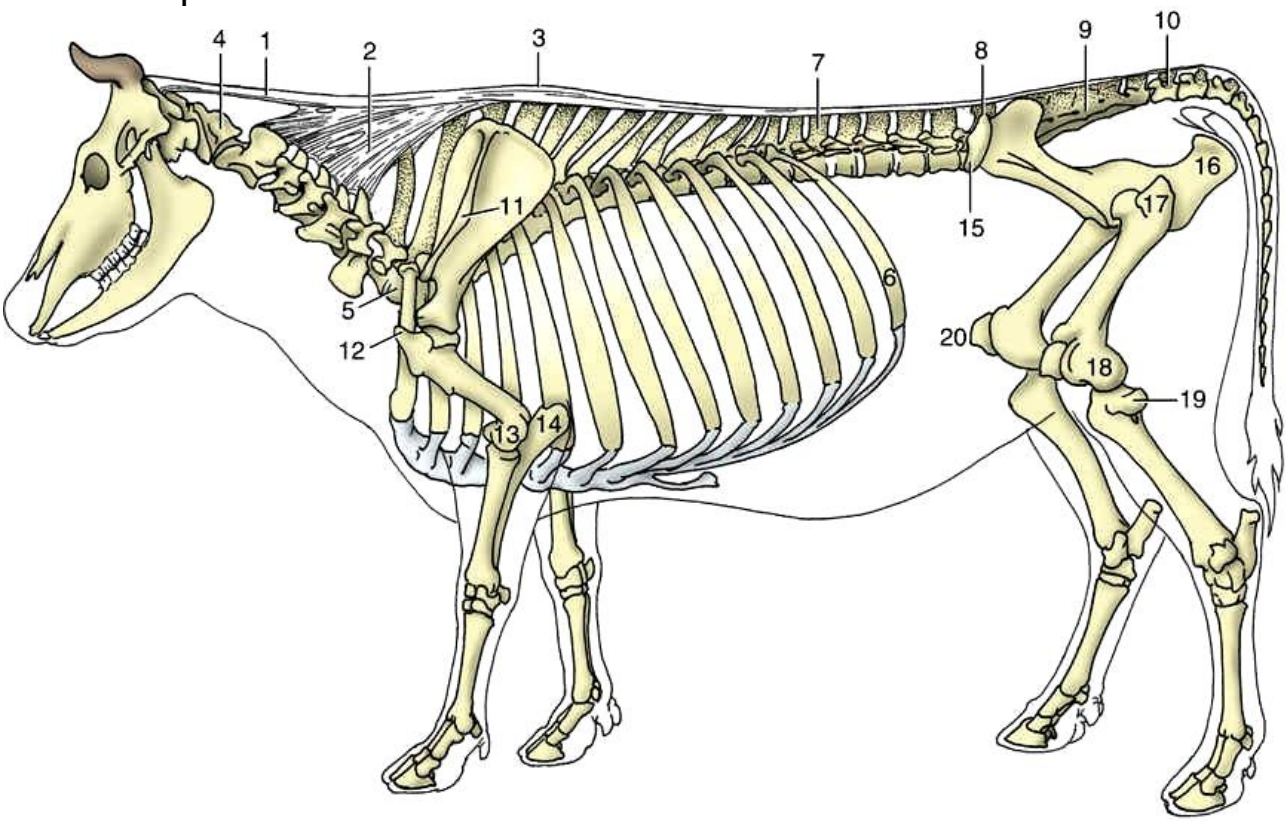
The knowleges of skeletal system is a base for **topographic anatomy**, which the directly concerned with the form and relationships of all the organs present in particular parts or regions of the body. It pays less attention to function than systematic anatomy but has immediate application to clinical work. Because matters of detail that may lack theoretical interest are often relevant to the clinician, it is necessary to give separate consideration to the regional anatomy of the different species. Topographic anatomy is one of the foundations of clinical practice, and different aspects pursued with particular aims are sometimes known as *surface*, *applied*, and *surgical* anatomy – terms whose connotations overlap buthardly require definition.



The skeleton of the dog

1 – atlas (C1); 2 – axis (C2); 3 – ligamentum nuchae; 4 – scapula; 5 – last cervical vertebra (C7); 6 –manubrium of sternum; 7 – humerus; 8 – ulna; 8′ – olecranon (point of elbow); 9 – radius; 10 – carpal bones; 11 – metacarpal bones; 12 – proximal, middle, and distal phalanges; 13 – sacrum; 14 – hip bone (os coxae); 15 – femur; 16 – patella; 17 – fibula; 18 – tibia; 19 – tarsal bones; 19′ – calcanean tuber (point of hock); 20 – metatarsal bones; T1, L1, and Cd1, first thoracic, first lumbar, and first caudal (tail) vertebrae.

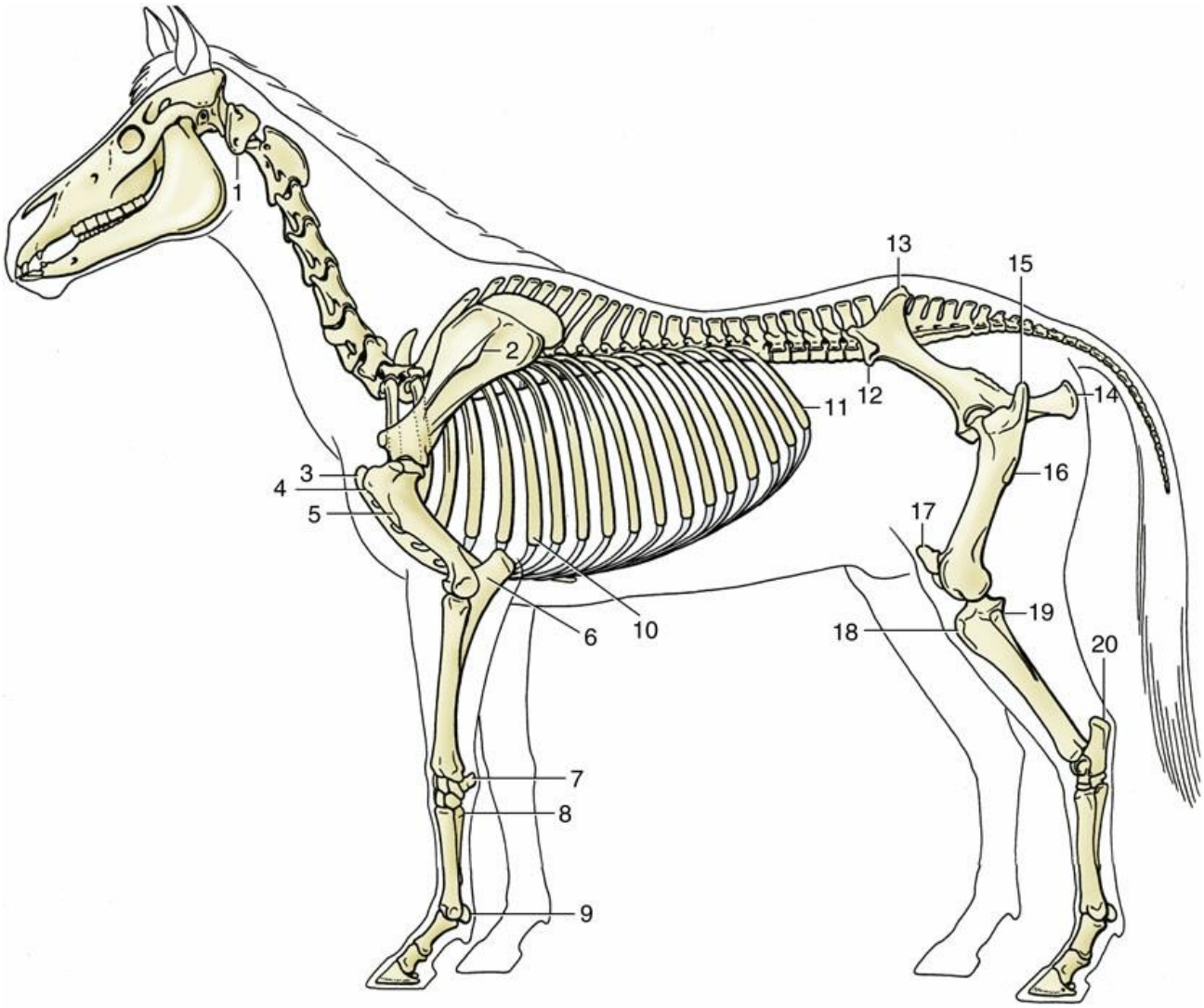
The simplest method is observation of the contours, the proportions, and the posture of the body. Bony projections provide the clearest landmarks, but superficial muscles and blood vessels are also useful, if less striking; reference to these landmarks allows the positions of other structures to be deduced from their known relationships. Little experience is required to reveal the importance of breed, age, sex, and individual variation or to show that although some landmarks are fixed and reliable, others are prone to move.



Bovine skeleton with nuchal and supraspinous ligaments

1, 2 – nuchal ligament: 1 – funiculus nuchae, and 2 – lamina nuchae; 3 – supraspinous ligament; 4 – atlas; 5 – last cervical vertebra (C7); 6 – 13th rib; 7 – first lumbar vertebra (L1); 8 – last lumbar vertebra (L6); 9 – sacrum; 10 – first caudal vertebra; 11 – spine of scapula; 12 – greater tubercle; 13, 14 – palpable features at elbow joint: 13 – lateral epicondyle, and 14 – olecranon; 15 – coxal tuber; 16 – ischial tuber; 17 – greater trochanter; 18, 19, 20 – palpable features of stifle joint: 18 – lateral condyle of femur, 19 – lateral condyle of tibia and remnant of fibula, and 20 – patella.

Some (e.g., the costal arch) move with each respiration, whereas other features change more gradually, for example, becoming more or less prominent or shifting in position with the deposition or depletion of fat or with the advance of pregnancy.



The equine skeleton.

The features labeled are among those normally palpable.

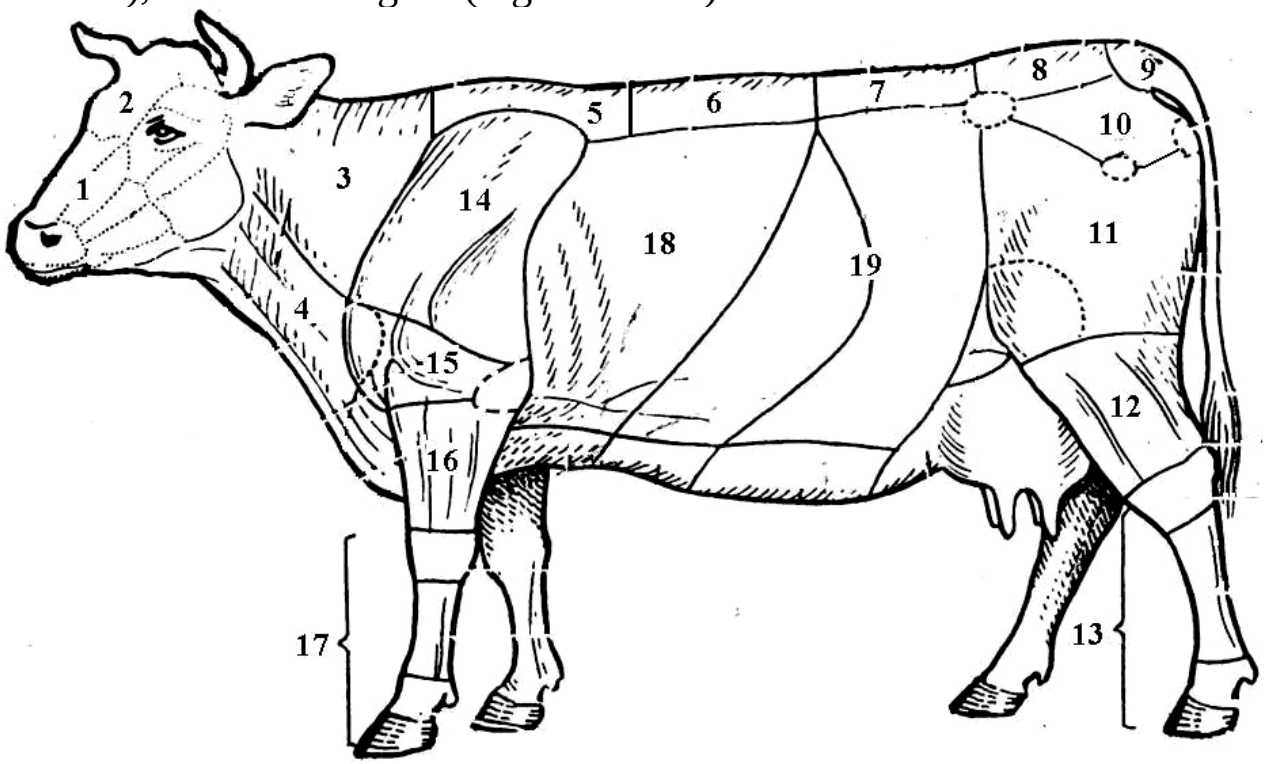
1 –wing of atlas; 2 – tuber of scapula; 3 – manubrium; 4 – greater tubercle; 5 – deltoid tuberosity; 6 – olecranon; 7 – accessory carpal bone; 8 – proximal end (base) of lateral splint bone; 9 – proximal sesamoid bone; 10 – sixth rib; 11 – last (18th) rib; 12 – coxal tuber; 13 – sacral tuber; 14 – ischial tuber; 15 – greater trochanter; 16 – third trochanter; 17 – patella; 18 – tibial tuberosity; 19 – head of fibula; 20 – calcanean tuber

Structures that are not directly visible may be identified by palpation – that is, by gentle or firmer touch as circumstances require. Bones may be identified by their rigidity, muscles by their contraction, arteries by pulsation, and veins by swelling when the blood flow is interrupted by pressure, and lymph nodes and internal organs by their size, configuration, and consistency.

REGIONS OF ANIMAL BODY

The body of animals is divided into parts and regions. Parts of the body *(partes corporis)* include head, neck, corpus, tail and limbs.

The head (caput), conditionally divided into cerebral and facial areas, the skull (cranium) is the skeleton of head. Neck (collum, s. cervix) devides in a dorsal (regio nuchae), and ventral (regio colli ventralis) areas. The cervical vertebrae are the skeleton of the neck. The trunk (truncus) consists off interscapular region (regio interscapularis), back (dorsum), loin (lumbus), and sacral region (regio sacralis).



1 – facial part of head, 2 – cerebral part of head, 3 – dorsal neck region (nuchal region), 4 – ventral neck region, 5 – interscapular region, 6 – back , 7 – lumbar region, 8 – sacral region, 9 – region of the root of tail, 10 – pelvic girdle, 11 – femur, 12 - crus, 13 - pes, 14 – shoulder girdle, 15 – brachium, 16 – antebrachium, 17 – manus , 18 – thoracic wall, 19 – abdominal wall.

The first thoracic vertebrae with higher spinous processes (for horse - 7, for cattle - 9) form the skeleton of interscapular region. The remaining thoracic vertebrae form the skeleton of the back. The lumbar vertebrae are the skeleton of the loin. The sacral vertebrae are the skeleton of the sacral region. The first caudal vertebrae are the skeleton of the tail root area (regio radix caudae). Down from the interscapular region and back is the costal area (regio costalis). Below the loin is the abdominal area (regio abdominalis), these have no bone base. At the extremities there is a gurdle and a free section, which has three links.

JOINT SYSTEM
ARTHROLOGY

ARTHROLOGY is a science concerned with the study of joints**.**

JOINTS (juncturae ossium), are formed when two or more bones are united by fibrous, elastic, or cartilaginous tissue.

Three main groups of the joints are recognized:

- ***fibrous joints*** (junctura fibrosa) is one of this nature; such joints include syndesmosis, sutures, and gomphosis.
- ***cartilaginous joints*** (junctura cartilaginea) permits only limited movement, such as compression or stretching.
- ***synovial joints*** (articulationes synoviales), or **true joint**, formerly known as a diarthrosis, facilitates mobility.

FIBROUS JOINT

A syndesmosis is a **fibrous joint** with a considerable amount of intervening connective tissue.

A suture (sutura) is a fibrous joint. This term is applied to those joints in the skull in which the adjacent bones are closely united by fibrous tissue – the sutural ligament.

Depending on the shape of apposed edges, sutures are divided into:

- ***serrata suture*** (sutura serrata)
- ***squamous suture*** (sutura squamosa)
- ***plane suture*** (sutura plana)
- ***foliate suture*** (sutura foliata

The implantation of a tooth in its socket is by means of a fibrous union known as a **gomphosis [dentoalveolar syndesmosis].** This specialized type of fibrous joint is formed by the periodontal ligament, which attaches the cementum of the tooth to the alveolar bone of the socket and permits slight movement while at the same time it provides firm attachment.

CARTILAGINOUS JOINT

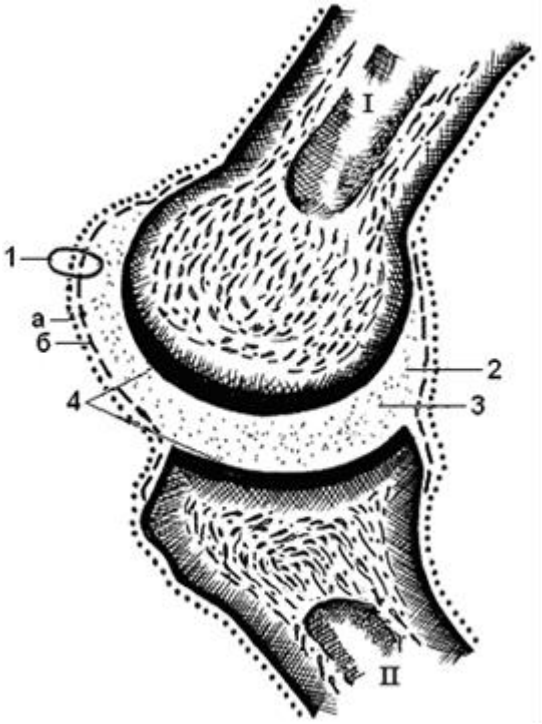
Many bones are united by cartilaginous joints, which are sometimes referred to as **synchondrosis**. Unions of this type may be formed by hyaline cartilage, by fibrocartilage, or by a combination of the two, and they are subject to change with increasing age.

Term "**symphysis"** is usually limited to a few median joints which connect symmetrical parts of the skeleton (symphysis pelvis, symphysis mandibulae). The uniting media are cartilage and fibrous tissue. In some cases a cleft-like rudimentary joint cavity occurs.

With age, **fibrous** and **cartilaginous** joints may be replaced by synostosis. **SYNOSTOSIS** is the union or fusion of adjacent bones by the growth of bony substance, as a normal process during growth (individual bones of the skull, sacral vertebrae).

SYNOVIAL JOINT

It is a **true joint** (articulatio) of the extremities permit the greatest degree of movement and are most commonly involved in dislocations. All synovial joints are characterized by a ***articular cavity*** (cavum articulare), ***articular capsule*** (capsula articularis), ***synovial fluid*** (synovia), and ***articular cartilage*** (cartilago articularis).



Simple joint
(scheme of structure)

I, II – bone links
1 – articular capsule
a – fibrous layer of articular capsule
b – synovial layer of articular capsule
2 – articular cavity
3 – synovial fluid

The **articular capsule** is composed of an inner synovial layer and an outer fibrous layer.

The ***synovial layer*** (stratum synovialis) is a connective tissue which lines the inner surface of the capsule and is responsible for the production of synovial fluid. The synovial layer does not cover the articular cartilage but blends with the periosteum as it reflects onto the bone. Synovial layer covers all structures within a synovial joint except the articular cartilage

and the contact surfaces of fibrocartilaginous plates.

The ***fibrous layer*** (stratum fibrosa) of an articular capsule is also known as the capsular ligament. The fibrous layer attaches at the margin of the articular cartilage where it blends with the periosteum.

The **synovial fluid** *(synovia)* serves to lubricate the contact surfaces of synovial joints. In all cases these surfaces are hyaline cartilage or fibrocartilage. Fibrocartilage contains few blood vessels and nerves, and hyaline cartilage has neither. Therefore, the synovial fluid serves the additional function of transporting nutrient material to the hyaline cartilage and removing the waste metabolites from it.

The **articular cartilage** *(cartilago articularis)* is usually hyaline cartilage. It covers the articular surfaces of bones.

A **meniscus** *(meniscus articularis),* or **disc** *(discus articularis),* is a complete or partial fibrocartilaginous plate which divides a joint cavity into two parts.

The temporomandibular joint contains a thin, but complete, meniscus, and, because the capsular ligament attaches to the entire periphery of the meniscus, the articular cavity is completely divided into two parts. Two menisci are found in the stifle joint, and neither is complete, thus allowing all parts of the joint cavity to intercommunicate. The stifle and temporomandibular joints are the only synovial joints in the dog which possess discs, or menisci.

A **ligament** (ligamentum) is a band or a cord of nearly pure collagenous tissue which unites two or more bones. Ligaments may be intracapsular (stifle and hip joints) or extracapsular where they are developed within or in relation to the capsular ligament.

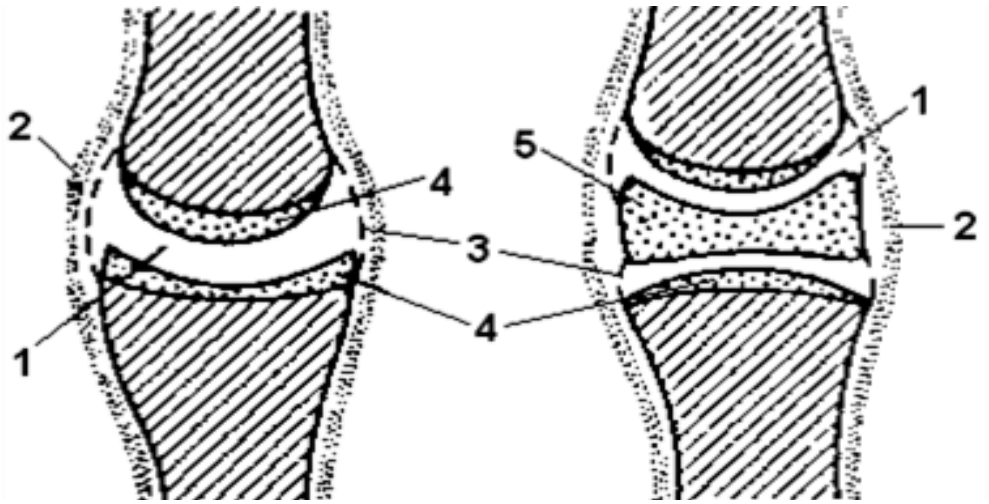
CLASSIFICATION OF SYNOVIAL JOINTS

Synovial joints may be classified according to:

- the number of articulating surfaces, which connecting
- the shape or form of the articular surfaces
- the function of joint

According to the number of articulating surfaces a joint is either ***simple joint*** (articulatio simplex) or ***complex*** (articulatio composita).

A simple joint is formed by two articular surfaces within an articular capsule. When more than two articular surfaces are enclosed within the same capsule, the joint is complex.



a **b**

Scheme of joint structure

a – simple joint, b – complex joint

1 – articular cavity; 2 – fibrous layer of capsule; 3 – synovial layer of capsule; 4 – articular hyaline cartilage, 5 – articular meniscus.

There are seven basic types of synovial joints which based on the **shape or form of the articular surfaces**:

- a **plane joint** (articulatio plana) is one in which the articular surfaces are essentially flat (costotransverse joint).
- a **ball-and-socket joint,** or **spheroidal joint** (art. spheroidea), is formed by a convex hemispherical head which fits into a shallow glenoid cavity (shoulder joint) or into a deep cotyloid cavity (hip joint).
- an **ellipsoidal joint** (art. ellipsoidea) is similar to a spheroidal joint. It is characterized by an elongation of one surface at a right angle to the other, forming an ellipse (radiocarpal articulation).
- a **hinge joint** (ginglymus) permits flexion and extension with a limited degree of rotation. An example would be the elbow joint.
- a **condylar joint** (art. condylaris) resembles a hinge joint in its movement but differs in structure. The surfaces of such a joint include rounded prominences (condyles) which fit into reciprocal depressions or condyles on the adjacent bone, resulting in two articular surfaces usually included in one articular capsule (temporomandibular and knee joints).
- a **pivot joint** [**trochoid]** (art. trochoidea) is one in which the chief movement is around a longitudinal axis through the bones forming the joint (the median atlantoaxial joint and the proximal radio-ulnar joint).
- a **saddle joint** (art. sellaris) is characterized by opposed surfaces each of which is convex in one direction. The interphalangeal joints are examples of this type of articulation.

Synovial joints are capable of diverse **movements**.

Flexion, or folding, denotes moving two or more bones so that the angle between them becomes less than 180 degrees.

Extension, or straightening, denotes movement by which the angle is increased to 180 degrees.

Adduction is the term applied to moving an extremity toward the median plane or a digit toward the axis of the limb.

Abduction, or taking away, is the opposite movement.

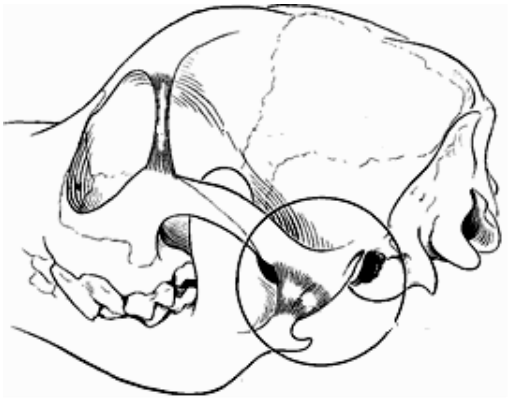
Circumduction occurs when an extremity follows in the curved plane of the surface of a cone.

Rotation is the movement of a part around its long axis.

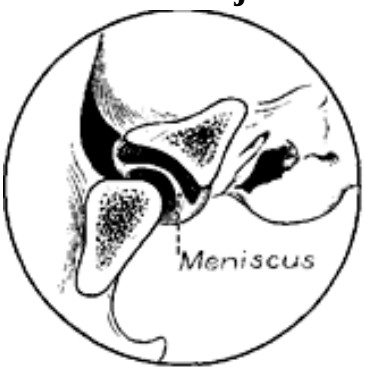
BONES CONNECTION OF AXIAL SKELETON

CONNECTION OF SKULL BONES

The individual bones of the skull are connected by **sutures** of all types that are ossified with age. An example of **synchondrosis** is the connection of the proximal segments of the hyoid bone with petrosal bone.



Temporomandibular joint of dog



Temporomandibular joint *(articulatio temporomandibularis)* is a biaxial condylar joint which allows considerable sliding movement.

The transversely elongated condyle of the mandible does not correspond entirely to the articular surface of the mandibular fossa of the temporal bone.

A thin ***articular disk*** (discus articularis) lies between the cartilage-covered articular surface of the condyloid process of the mandible and the similarly covered mandibular fossa of the temporal bone.

Laterally the fibrous part of the joint capsule is strengthened by fibrous strands to form the ***mandibular ligament*** (lig. mandibulae).

The **intermandibular synchondrosis** (synchondrosis intermandibularis) is the median synchondrosis uniting right and left mandibular bodies. The fibrocartilage of it's persists through out life.

Individual segments of the hyoid bone are connected by **joints**.

CONNECTION OF VERTEBRAE

Joints of spine:

The **atlanto-occipital joint** *(articulatio. atlantooccipitalis)* is formed by the dorsolaterally extending occipital condyles and the corresponding concavities of the atlas. The atlanto-occipital joint cavity communicates with the atlanto-axial joint cavity. It has two capsules, two membrane (dorsal and ventral) and two lateral ligament *(lig. laterale).*

The **atlanto-axial joint** *(art. atlanto-axialis)* is a pivot joint which permits the head and atlas to rotate around a longitudinal axis. It has two capsules and dorsal membrane The ***apical ligament of dens*** *(lig. apicis dentis)* leaves the apex of the dens by three pillars.

Articular processes of the vertebrae are connected by a joint capsule, forming joints *(juncturae zygapophyseales).*

Cervical (4th to 7th), **thoracic** and **lumbar** vertebrae are connected by the *same type*:

Connection of the vertebrae body is follow:

1. The **intervertebral discs** *(disci intervertebrales)* are interposed in every intervertebral space, uniting the bodies of the adjacent vertebrae. Each intervertebral disc consists of an outer laminated **fibrous ring**, and a central, amorphous, gelatinous center, the **pulpy nucleus**.

*The **fibrous ring** (anulus fibrosus)* consists of bands of parallel fibers which run obliquely from one vertebra] body to the next. They provide a means for the transmission of stresses and strains which are required by all lateral and upward movements. The ***pulpy nucleus*** *(nucleus pulposus)* is a gelatinous remnant of the notochord. Its position and shape are indicated on each end of the vertebral body as a depressed area surrounded by a line. Since its consistency is semifluid, it bulges when the retaining fibrous ring ruptures or degenerates. Resultant pressure upon the spinal cord may cause paralysis.

2**. Dorsal and ventral longitudinal ligaments** *(ligg. longitudinale dorsale et ventrale).*

The **ventral longitudinal ligament** lies on the ventral surfaces of the bodies of the vertebrae. It can be traced from the axis to the sacrum. The **dorsal longitudinal ligament** lies on the dorsal surfaces of the bodies of the vertebrae. It extends from the dens of the axis to the end of the vertebral canal in the coccygeal region.

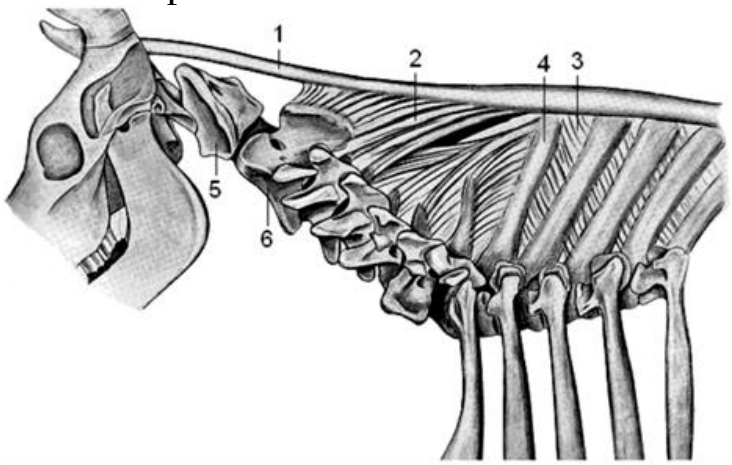
Connection of the vertebrae arches provides the **yellow ligaments** *(ligg. flava)* or interarcuate ligaments, are loose, thin elastic sheets between the **arches** of adjacent vertebrae.

Spinous processes are connected:

1. The **interspinous ligaments** *(ligg. interspinalia)* connect adjacent vertebral spines.

2. The **supraspinous ligament** *(lig. supraspinale)* extends from the spinous process of the first thoracic vertebra to the third coccygeal vertebra. The dog's spinous processes connected by **interspinal muscles** *(mm. interspinale).*

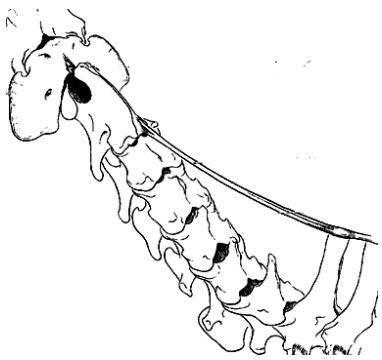
3. The **nuchal ligament** *(lig. nuchae*) is composed of funicular part and lamellar part ***in the horse and cattle***. The funicular part originates from the occipital bone and ends on the spinous processes of the first thoracic vertebrae. The lamellar part of nuchal ligament originates from the spinous processes of typical cervical vertebrae and woven into funicular part.



Nuchal ligament of cattle

1 – funicular part of nuchal ligament, 2 – lamellar part of nuchal ligament, 3 – interspinal ligament, 4 – spinous process of first thoracic vertebra, 5 – atlant, 6 – axis.

In the dog nuchal ligament has only funicular part. It attaches cranially to the caudal part of the spinous process (crest) of the axis. It extends caudally to the tip of the spinous process of the first thoracic vertebra.



Nuchal ligament of dog

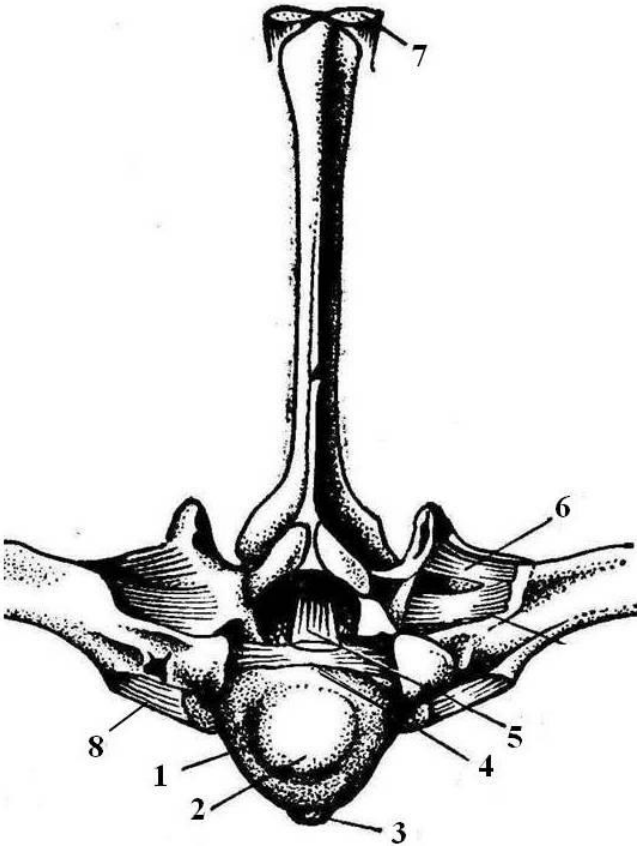
The ***transverse processes*** are connected with ***intertransverse ligaments*** *(ligamenta intertransversaria).*

The ***horse's*** transverse processes of the 5-th and 6-th lumbar vertebra and the transverse processes of the 6-th lumbar vertebra and sacral wings form joints *(art. intertransversariae lumbales et lumbosacralis).*

The ***sacral vertebrae*** are connected by synostosis.

CONNECTING OF RIBS AND STERNUM

Each typical rib articulates with the vertebral column by two synovial joints and with the sternum by one. There is usually a synchondrosis between the rib and its costal cartilage.

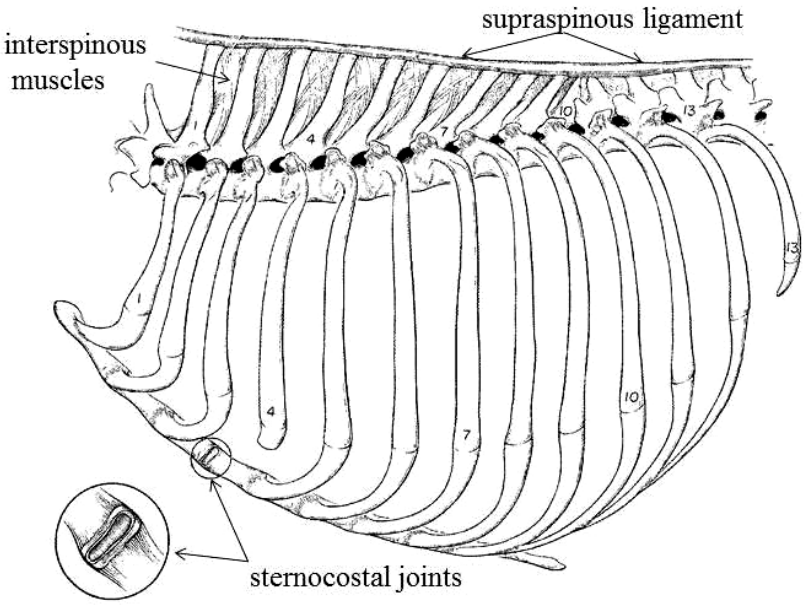


Connection of the vertebrae and ribs

1 - fibrous ring of intervertebral disc
2 - pulpous nucleus
3 - ventral longitudinal ligament
4 – ligament between the heads
5 - dorsal longitudinal ligament
6 - costotransverse ligament
7 - supraspinal ligament
8 - radiate ligament of head

The **costovertebral joints** *(articulationes costovertebrales)* are formed by the articulation of the capitulum of each rib *(art. capitis costae)* with the costal facets of appropriate vertebrae, and the articulation of each tuberculum (*art. costotransversaria)* with the transverse process of the corresponding vertebra. Joints are surrounded by capsules and have ligaments:

- ***radiate ligament of head*** *(lig. capituli costae radiatum)*
- ***intercapital ligament*** *(lig. intercapitale)*
- ***costotransverse ligament*** *(lig. costotransversarium)*



Connecting of ribs and vertebrae of dog

The first 8-9 costal cartilages articulating with the sternum and form the synovial **sternocostal joints** *(art. sternocostales).* These are the ***dorsal and ventral sternocostal radiate ligaments*** *(ligg. sternocostalia radiata dorsalia et ventralia).*

Costal cartilage of false ribs are connected by syndesmosis.

The **ribs** are connected by intercostal muscles. The ***segments of the sternum*** are connected by synchondrosis and internal sternal ligament *(lig. sterni internum).* The **rib cartilage** with the **rib bone** are connected by synchondrosis. The **costochondral joints** (art. costochondrales) are the joints between the ribs and the costal cartilages in the cattle.

BONES CONNECTION OF PERIPHERAL SKELETON

BONES CONNECTION OF THORACIC LIMB

I. The bone of the shoulder girdle (scapula) is connected with bones of the body by only **muscles**.

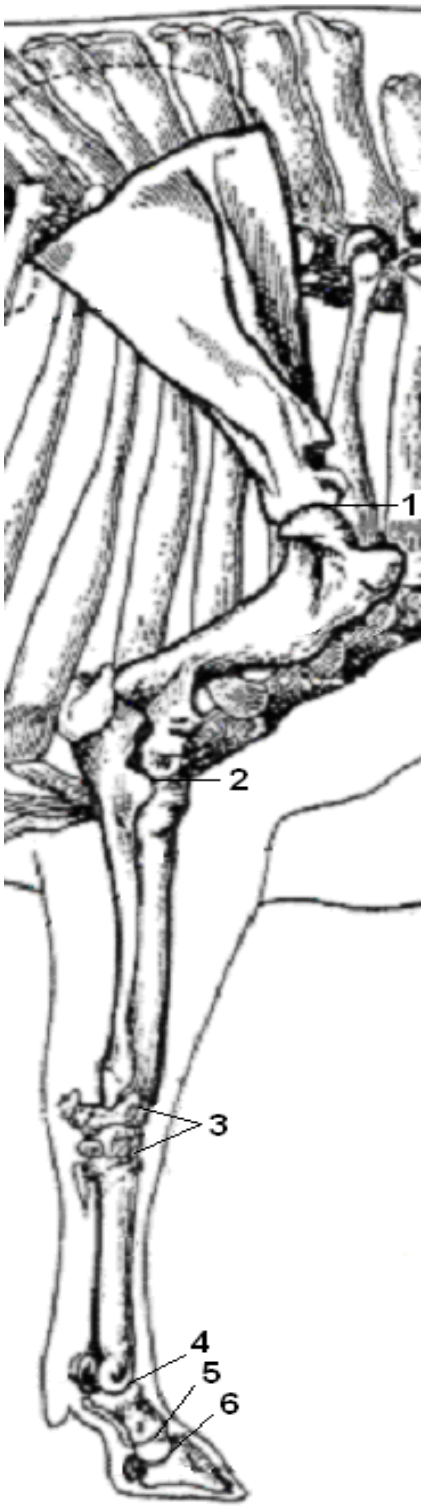
II. The bones of the free thoracic limb form the following joints:

1. **Shoulder** [humeral] **joint** – (art. humeri) is simple, multi-axis, spherical. The scapula and humerus are connected only by the articular capsule, which has a thickened fibrous layer.

2. **Elbow joint** (art. cubiti) is simple, hinge and uniaxial for herbivores. In addition to the capsule has a ***lateral and medial cubital collateral ligaments*** (ligg. collaterale cubiti laterale et mediale).

The radius and ulna **in dog** are united by the *proximal and distal*

radioulnar synovial joints and by the surprisingly heavy interosseous ligament and the narrow weak interosseous membrane which extends both proximally and distally from the interosseous ligament.



The **proximal radioulnar joint** in the dog is included to the **elbow joint** *(articulatio cubiti*), which is a composite joint formed by the humeral condyle with the head of the radius, the ***humeroradial joint***, and with the semilunar notch of the ulna, the ***humeroulnar joint***. The articular capsule is common to all three articulations.

The ***ulnar collateral ligament*** *(lig. collaterale ulnare)* attaches proximally to the lateral epicondyle of the humerus.

The ***radial collateral ligament*** attaches proximally to the medial epicondyle of the humerus. The ***annular ligament of the radius*** (lig. annulare radii) attaches to the lateral and medial extremities of the radial incisure of the ulna.

The **distal radioulnar joint** (articulatio radioulnaris distalis), which extends between the radius and ulna distally, is included to the carpal joint.

Joints of thoracic limb of cattle

1 – art. humeri, 2 – art. cubiti,3 – art. carpi, 4 – art. metacarpophalangea, 5 – art. interphalangea proximalis, 6 – art. interphalangea distalis.

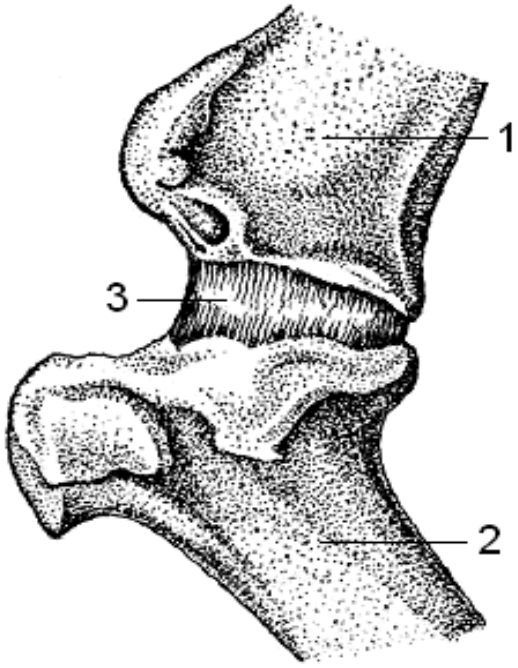
3. **Carpal joint** (art. carpi) is complex in structure. It is formed of four rows of bone: the bones of forearm**,** two rows of carpal bones and the metacarpal bones. It is a trochlear joint and uniaxial by types of movements.

The joint combine the following joints:

- antebrachiocarpal joint – articulatio antebrachiocarpea
- intercarpal joint – marticulatio intercarpea
- carpometacarpal joint – articulatio carpometacarpea

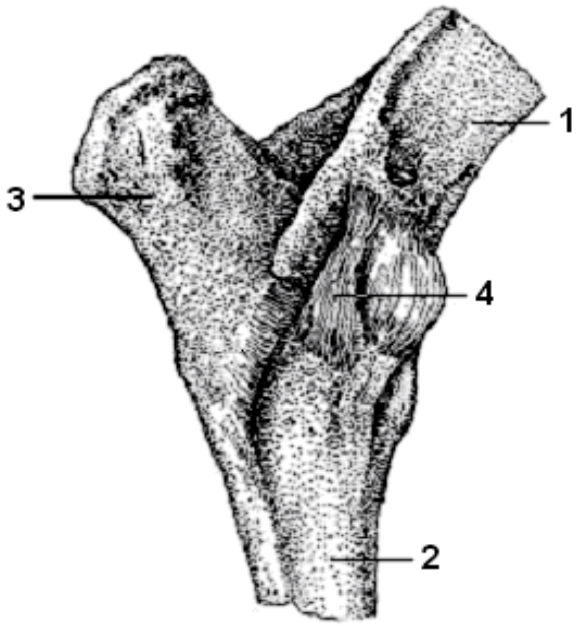
The joint has the capsule and the following ligaments:

- *radiocarpal ligament*
- *intercarpal ligamenta*
- *carpometacarpal ligament*



Shoulder joint of horse

1 – scapula, 2 – humerus
3 – articular capsule



Elbow joint of horse

1 – humerus (distal epiphysis), 2 – radius, 3 – olecranon, 4 – collateral ligament.

4. **Metacarpophalangeal joint** (art. metacarpophalangea) (or **fetlock joint** (art. compedale) for cattle and horse) is a simple, hinge, uniaxial. It joint are formed by the distal ends of the metacarpal bones and the proximal ends of the proximal phalanges. Joint has a ***joint capsule*** and two ***collateral ligaments*** (ligg. collateralia) which unite the osseous parts. To this are connected two palmar sesamoid bones. Each of palmar sesamoid bones is joined by the:

- interdigital phalangosesamoid ligaments
- collateral sesamoid ligaments

5. **Proximal interphalangeal joint** (articulationes interphalangea proximalis manus) (or **pastern joint** (art. coronale) for cattle and horse) is

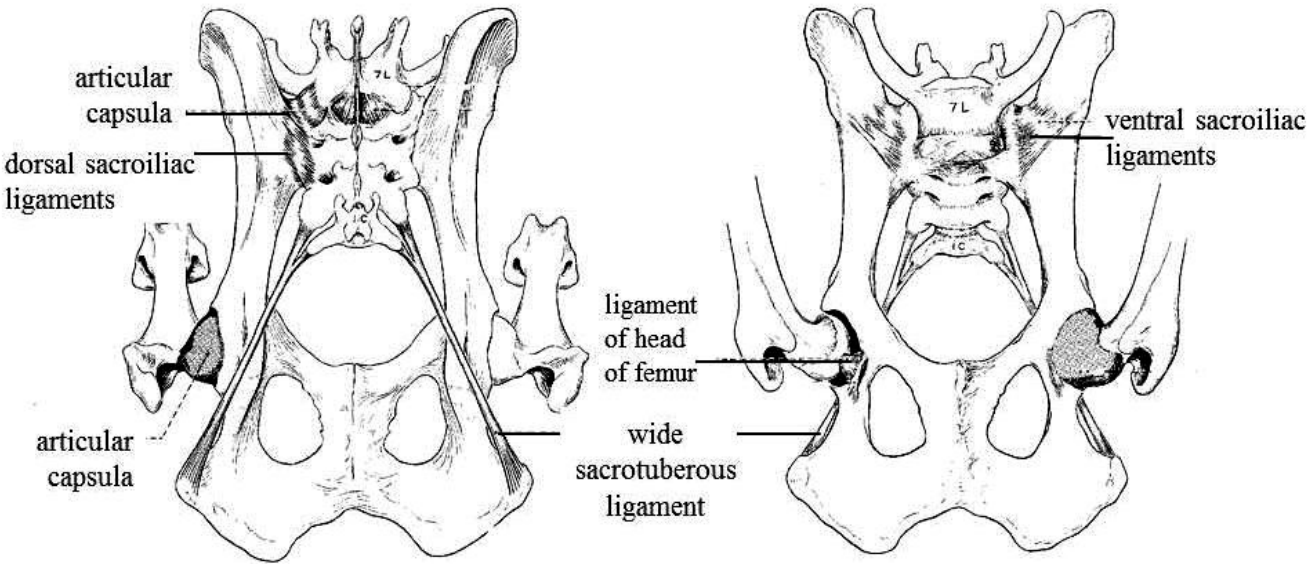
a simple, saddle-type, uniaxial. It formed by the heads of the proximal phalanges articulating with the fossae of the middle phalanges in each of the main digits. Two, small, spheroidal, sesamoid cartilages are located on the palmar side of the joint capsule. In addition to the capsule of the joint has a side **collateral ligament** – ligg. collateralia.

6. **Distal interphalangeal joint** (art. interphalangea distalis manus) (or **coffin joint** (art. ungulare) for cattle and horse) is simple, uniaxial, saddle-type. It is formed by the heads of the middle phalanges articulating with the saddle- shaped fossae on the proximal ends of the distal phalanges. A single, small, spheroidal, sesamoid cartilage is located on the palmar side of the joint capsule.

BONES CONNECTION OF PELVIC LIMB

I. The bones of **pelwic girdle** (right and the left os coxae) are united midventrally by cartilage to form the ***pelvic symphysis*** (symphysis pelvina). The cranial half is formed by the ***pubic symphysis*** (symphysis pubica) and the caudal half by the ***ischial symphysis***(symphysis ischiadica). In the adult, the joint ossifies.

Sacroiliac joint (articulatio sacroiliaca) is a combined synovial and cartilaginous joint. The apposed auricular surfaces on the wings of the sacrum and ilium (pelwic girdle) are covered by cartilage, and their margins are united by a thin articular capsule.



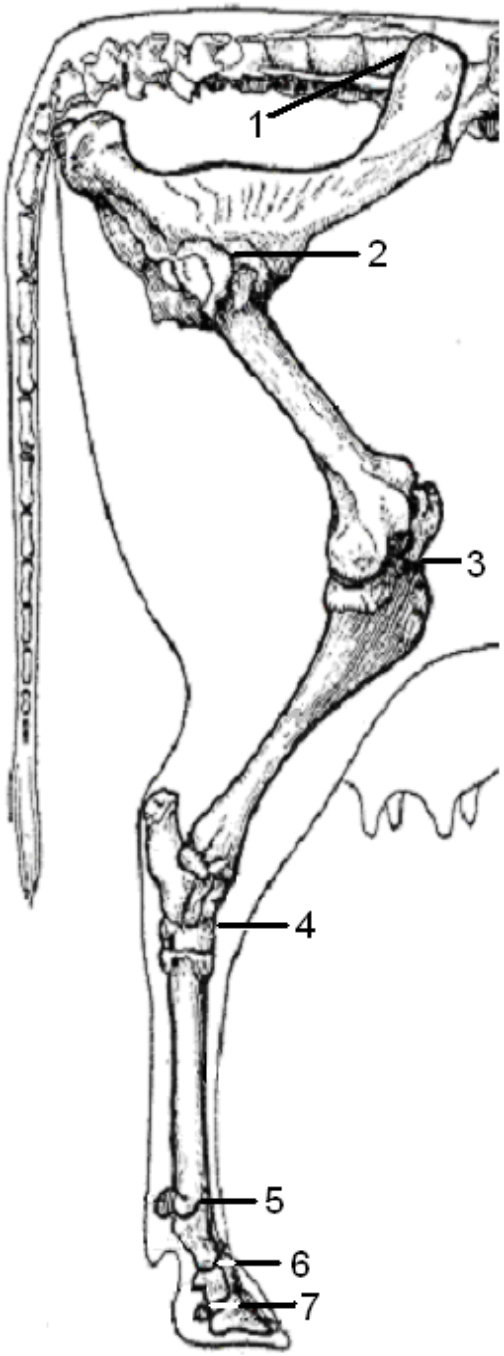
dorsal aspect ventral aspect

Ligaments of pelvis of dog

The joint has the capsule and the following ligaments:

- ***ventral sacroiliac ligaments*** (ligg. sacroiliaca ventralia)
- ***dorsal sacroiliac ligaments*** (ligg. sacroiliaca dorsalia)
- ***wide sacrotuberous ligament*** (lig. sacrotuberale latum) which extends from the caudolateral part of the apex of the sacrum and the transverse process of the first coccygeal vertebra to the lateral angle of the ischiatic tuberosity

II. The bones of the **free pelwic limb** are formed the following joints:



Joints of pelvic limb of cattle

1 – art. sacroiliaca, 2 – art. coxae,
3 – art. genus, 4 – art. tarsi,
5 – art. metatarsophalangea,
6 – art. interphalangea proximalis,
7 – art. interphalangea distalis.

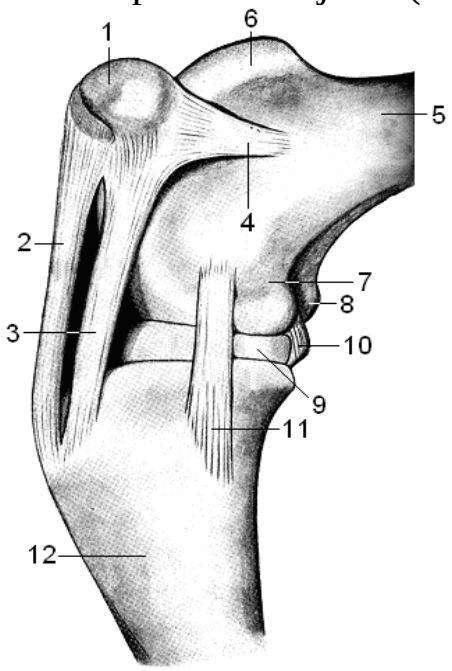
1. **Hip joint** (articulatio coxae) is formed by the head of the femur articulating with the acetabulum, the cotyloid cavity of the os coxae. Axes through the femur and os coxae meet at the hip joint in a cranially open angle of about 95 degrees. Although flexion and extension are the chief movements of the joint, its ball-and-socket construction allows a great range of movement. The articular capsule is very capacious.

The joint has the following ligaments:

- ligament of head of the femur *(lig. capitis ossis femoris)*
- transverse acetabular ligament *(lig. transversum acetabuli)*

2. **Stiffle joint**, or **knee** (art. genus), is a complex condylar synovial joint.

The main spheroidal part is formed by the thick roller-like condyles of the femur articulating with the flattened condyles of the tibia to form the **femorotibial** part of the joint (art. femorotibialis).



Knee joint of cattle
(medial aspect)

1 – patella (knee cap),
2, 3, 4 – ligaments of knee cap (lateral, intermediate and medial),
5 – femoral bone,
6 – pivot of femur,
7 – medial condyle,
8 – lateral condyle,
9 – medial meniscus,
10 – ligamenta cruciata genus,
11 – ligamentum collaterale,
12 – tibia.

Freely connected with this is the **femoropatellar joint** (art. femoropatellaris), located between the patella and the trochlea of the femur. The *incongruence* which exists between the tibia and femur is occupied, in life, by two fibrocartilages, or ***menisci,*** one located between the adjacent medial condyles and the other between the adjacent lateral condyles of the femur and tibia.

The ***lateral and medial menisci*** (meniscus lateralis et medialis) are semilunar fibrocartilaginous discs with sharp, deeply concave axial, and thick convex abaxial borders. The articular capsule of stiffle joint is the largest in the body.

Femorotibial joint has the capsule and the following ligaments:

- ***cruciate ligaments of knee*** – *ligamenta cruciata genus*
- ***collateral ligaments*** – *ligamenta collateralia*
- ***meniscal ligaments***

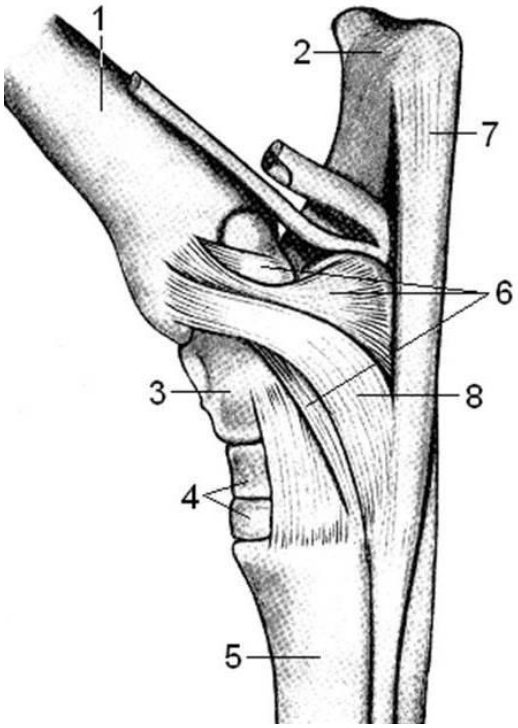
Femoropatellar joint has the capsule and the following ligaments:

- ***medial and lateral femoropatellar ligaments*** – *ligg. femoropatellare laterale et mediale*
- ***ligaments of patella*** – *ligamenta patellae*

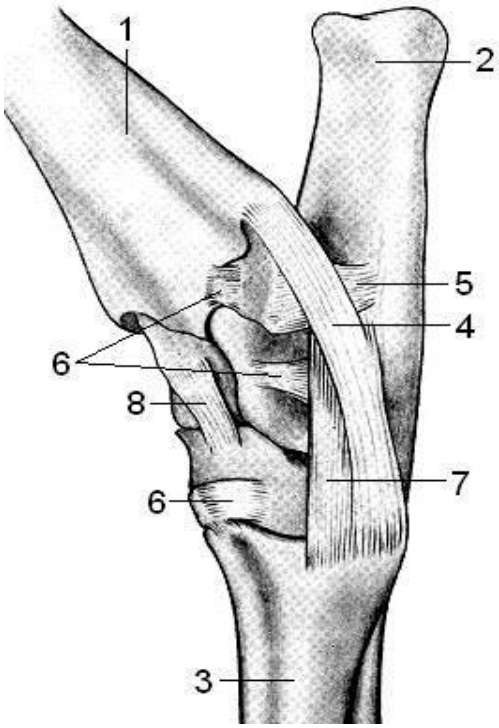
The patella is a large sesamoid bone intercalated in the tendon of insertion of the m. quadriceps femoris.

The **proximal tibiofibular joint** is also a component of the stifle joint **in the dog.**

The **distal tibiofibular joint** (art. tibiofibularis distalis) is hardly more than a synovial pocket between the distal surfaces of the fibula and tibia. Only dogs have this.



medial surface



lateral surface

Tarsal joint of cattle

1 – tibia, 2 – talus, 3 – calcaneus, 4 – bones of middle and distal rows of metatarsus, 5 – tarsal bones, 6 – collateral medial short ligaments, 7 – plantar straight tarsal ligament, 8 – collateral medial long ligament.

1 – tibia, 2 – talus, 3 – tarsal bones, 4 – collateral lateral long ligament, 5 – collateral lateral short ligaments, 6 – interosseous ligaments, 7 – collateral calcaneotarsal lateral ligament, 8 – supracalcaneo-central ligament.

3. **Tarsal joint** (articulatio tarsi), like the carpal joints, are composite: it formed by the bones of the leg, tarsal and metatarsal bones.

The fibrous layer of the capsule of the joint forms the ligaments:

- ***collateral lateral and medial long and short*** – *ligg. collaterale tarsi laterale et mediale longum et breve*
- ***plantar ligaments of tarsi*** – *ligamenta tarsi plantaria*

- ***dorsal ligaments of tarsi*** *– ligamentum tarsi dorsalia*
- ***interosseous ligaments***
- ***ligaments between rows of tarsi***

The synovial layer of the capsule of the joint is fixed on adjacent bones and surrounds the following microjoints:

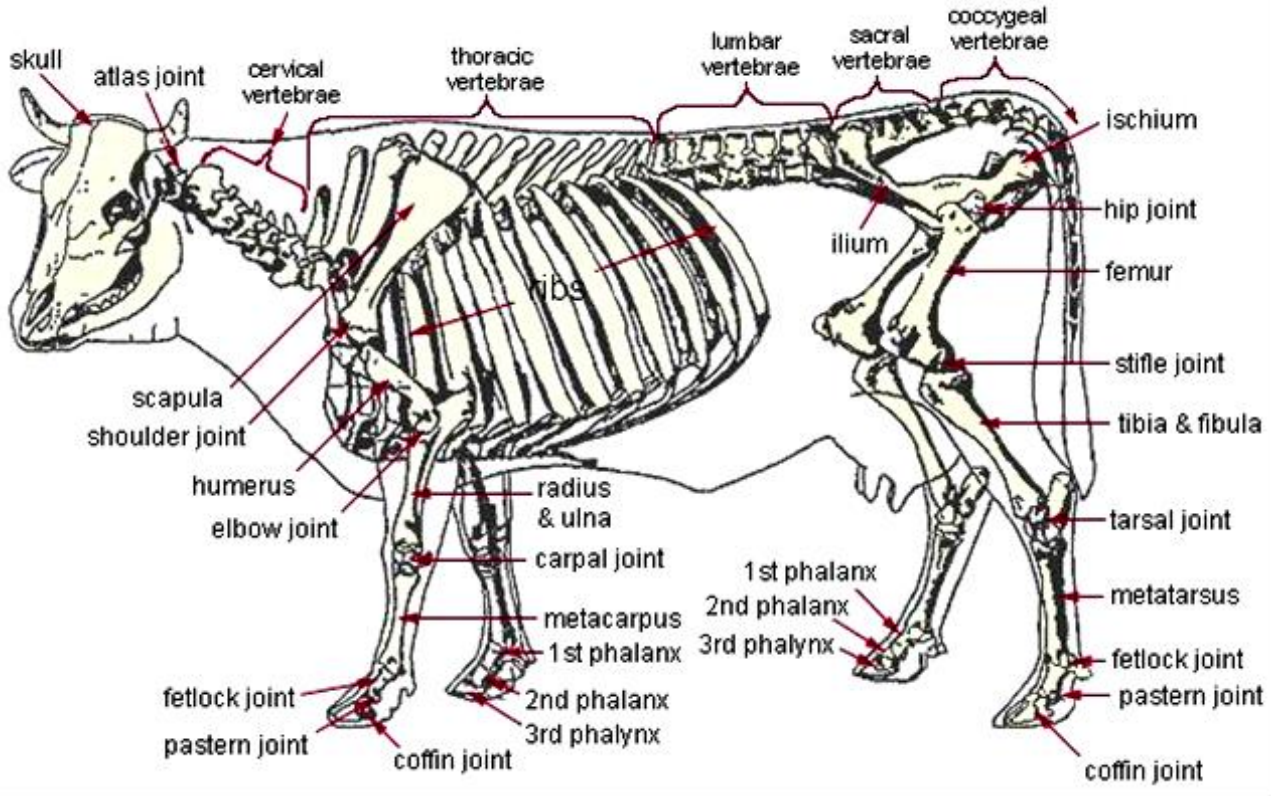
- **tarsocrural joint** – art. tarsocruralis
- **intertarsal joints** – articulationes intertarseae (proximal and distal)
- **tarsometatarsal joints** – articulationes tarsometatarseae

4. **Metatarsophalangeal joint** (articulatio metatarsophalangeae, s. articulatio compedale).

5. **Proximal interphalangeal joint** (articulatio interphalangeae proximalis pedis, s. articulatio coronale).

6. **Distal interphalangeal joint** (articulatio interphalangeae distalis pedis, s. articulatio ungulare).

The joints and ligaments of these joints of pes **are similar** to the comparable joints and ligaments of the manus.



MUSCULAR SYSTEM

MYOLOGY is a branch of anatomy that studies the muscular system (MS).

MUSCULAR SYSTEM *(systema musculorum)* is a part of movement apparatus and somatic systems group.

The muscular system, composed of contractile units. The functional cell unit is known as a *muscle fiber,* and it is customary to classify muscle fibers as striated, unstriated, or cardiac.

Striated muscle fibers are long, cylindrical, multinucleated cells organized into distinct bundles within connective tissue envelopes. Other names applied to striated muscle include skeletal, voluntary, or somatic muscle.

Unstriated muscle fibers possess myofibrils, but they are not striated. They are found in the walls of hollow organs, and in blood vessels, as well as in association with glands, and with the spleen, the eyeball, and hair follicles of the skin. Other names that have been used for unstriated muscle are: smooth, plain, involuntary, or visceral muscle.

Cardiac muscle fibers form the bulk of the heart. The fibers are arranged in a network of individual cellular units with intercalated discs between the cell extremities. Cardiac muscle is capable of rhythmic contractions and is under autonomic control.

SKELETAL MUSCLES

Skeletal muscle (musculus) is a parenchymal organ of the voluntary movements.

The muscles are an active part of the movement apparatus. They are a source of strength. The muscles move the body or parts of it (dynamic function). The muscles keep the body or parts of it in fixed position (static function). Muscles are water depot. Muscles take part in the metabolism. MS is a source of animal protein, which is most important part of the meat.

Biological role of the muscles:

a) each muscle links morphologically and functionally with nervous system (muscles tonus is an indicator of the nervous activity)
b) MS is a determiner of the body position in space that is called "muscular sense"

c) “All the visible life of the body, all it’s ratio with the outside world (interaction with surrounding environment) is carried out by MS” (Ivan Pavlov, Russian physiologist, academician).

Anatomical composition of muscular system

1. Muscles *(musculi – m.)*
2. Accessory structures:
    - fascia *(fascia – f.)*
    - synovial bursa *(bursa synovialis)*
    - synovial tendon sheath *(vagina tendinis synovialis)*
    - fibrous tendon sheath *(vagina tendinis fibrosa)*
    - sesamoid bones *(ossa sesamoidea)*
    - static elements *(blocks, tendon fibres)*

Structure of muscle

I. External structure

Most skeletal muscles are attached by connective tissue to a bone or cartilage. Some are attached to an organ (eye, tongue), to another muscle, or to the skin; others lie free beneath the skin and act as sphincters.

The connective tissue (tendon of the muscle) attachment may be in the form of a cordlike ***tendon*** or a flat sheetlike ***aponeurosis.*** The tendon of the muscle does not stretch and get tired and has great resistance.

The more fixed point of muscle attachment is spoken of as the ***origin***; the more movable point of attachment is called the ***insertion.*** In the limb the insertion of a muscle is always considered to be distal to its origin, although functionally it may be the most fixed point at some phase of the stride

The muscle has three parts:

- head (caput musculi) is the beginning tendon (origin)
- muscle belly (venter musculi)
- tail (cauda musculi) is the ending tendon (insertion)

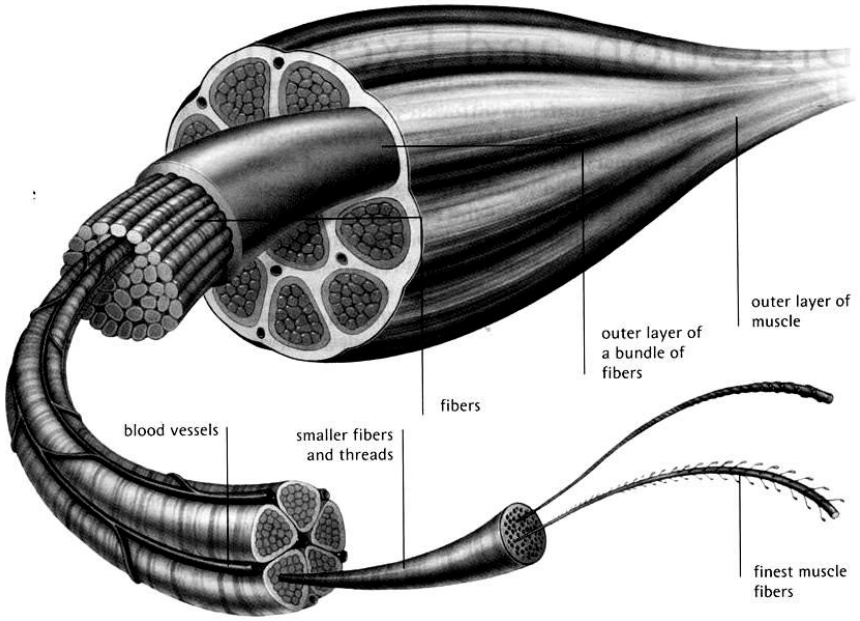
A muscle may have more than one belly (digastric) or more than one head (triceps), and frequently has several insertions.

II. Internal structure of muscle

The striated muscle fiber *(myonum)* is a morphofunctional unit of the skeletal muscle. The parenchyma is represented by striated muscle tissue,

that consists of muscle fibers. The muscle fibers contract under the influence of the nervous impulses. The muscles stroma has blood vessels and nerves.

Each muscle fiber is surrounded by a thin ***sarcolemma*** and a delicate connective tissue sheath known as the ***endomysium.*** When several fibers are grouped into a fasciculus they are enclosed by internal ***perimysium.*** The definitive muscle is composed of several fasciculi wrapped by an external ***perimysium,*** which delimits one muscle from another or occasionally fuses with the intervening fascia.



Structure of muscle

ACCESSORY STRUCTURES OF MUSCULAR SYSTEM

FASCIA

Fascia *(fascia)* is thin, wide plate-shaped connective formation. Fascia surraunds the individual muscle, muscle groups and all muscles of the body in general.

Fascia:

- separates muscles
- forms a fibrous skeleton for the individual muscles, muscle groups and the entire muscular system
- is a place of attachment for muscles
- prevents the offset of muscles in their work, particularly in the joints area
- tension of fascia stimulates the blood and lymph circulations.

There are **two fascias** in the body:

- superficial fascia *(fascia superficialis)*
- deep fascia *(fascia profunda)*

The **superficial fascia** beneath the skin is closely associated with the dermis, and often includes cutaneous muscle fibers.

Superficial fascia lies under the skin and has two layers:

- external layer *(lamina externa fasciae superficialis)*
- internal layer *(lamina interna fasciae superficialis)*

The cutaneous trunci *(musculus cutaneus trunci)* and adipose tissue lie between of the superficial fascia layers. The cutaneous trunci provides the skin movements.

Superficial fascia has topographical names: superficial fascia of the head, neck, trunk, limbs.

The **deep fascia** which covers and passes between the muscles is particularly tough and distinct in the limbs. It functions as a sleeve within which the muscles can operate, and often serves as an aponeurosis of origin or insertion.

Deep fascia is attached to the bones gives beginning to some muscle, and separates muscles from each other.

It has two layers:

- external layer (lamina externa fasciae superficialis)
- internal layer (lamina interna fasciae superficialis)

All skeletal muscles and even individual bones (e.g. ribs) lie between the layers of deep fascia.

The internal layer of deep fascia attaches to the periosteum also covers the walls of body cavities and has the names:

- endothoracic fascia *(fascia endothoracica)* which covers the thoracic cavity;
- transverse fascia *(fascia transversalis)* which covers the abdominal cavity;
- endopelvic fascia *(fascia endopelvina)* which covers the pelvic cavity.

SYNOVIAL BURSAE

Synovial bursa *(bursa synovialis)* is a double-layered closed saccule, filled with synovia and located between the bone protrusion and muscle. Bursae are serving to reduce friction. They are usually located between a tendon, ligament, or muscle, and a bony prominence. Occasionally they are located between tendons or between a bony prominence and the skin.

It prevents rubbing of a muscle or tendon on a bone.

Depending on location there are bursas:

– subtendinous synovial bursa
– submuscular synovial bursa
– subligamentous synovial bursa
– subcutaneous synovial bursa

TENDINOUS SYNOVIAL SHEATH

The structure of **tendinous synovial sheath** *(vagina synovialis tendinis)* is like to synovial bursa. It is double-layered, elongated sacs containing synovia which wrap tendons as they pass through osseous or fibrous grooves. Synovial sheath covers the tendon from all sides. The tendon sheath with its contained synovia serves for reducing friction during movement.

TENDINOUS FIBROUS SHEATH

The fibrous tendon vagina *(vagina fibrosa tendinis)* is formed by thickening of deep fascia in the joint region. Synovial vagina is plased between the fibrous vagina and the tendon.

SESAMOID BONES

Sesamoid bones *(ossa sesamoidea)* are the ossified tendons.

Sesamoid bones are located in certain tendons or joint capsules as small rounded nodules. Occasionally they develop in response to friction, but usually they form prenatally. They are formed in those places where the tendon glides over the bone block. Sesamoid bones increase the strength of tendons and reduce rubbing. The patella, or knee cap, is an example of a large sesamoid bone in the tendon of insertion of the quadriceps femoris muscle.

Sesamoid bones serve three important functions:

- protect tendons which pass over bony prominences;

- increase the surface area for attachment of tendons over certain joints;
- serve to redirect the pull of tendons so that greater effective force can be applied to the part being moved.

FUNCTIONS OF MUSCLE

The overall function of the muscles is ***ability to contract***, i.e. to reduce its length.

The private function of the muscles is an effect that achieved by result of the contraction. Private function can be major and additional.

The major function is an action on the joint at the place of the "registration". The additional function is an associated effect on other joints.

If muscles act on one joint in the same way, they are called the *synergists*. When muscles act on the joint in opposite ways, they are called *antagonists* (e.g., the flexors and the extensors of the fingers).

The ***muscle tonus*** is a state of permanent muscle tension, its ability to contract. It is the sign of a healthy animal.

CLASSIFICATION OF MUSCLES

There are several types of the muscle classification:

I. Classification by function:

1) flexor – m. flexor
2) extensor – m. extensor
3) abductor – m. abductor
4) adductor – m. adductor
5) rotator – m. rotator:
    a) inside – m. pronator
    b) outside – m. supinator
6) levator – m. levator
7) depressor – m. depressor
8) constrictor – m. constrictor
9) dilatator – m. dilatator
10) sphincter – m. sphincter

Muscles which open a joint, are ***extensors;*** those which angulate the bones, or bend the joint, are ***flexors.*** Flexion and extension are the

primary movements necessary for locomotion. Accompanying movements include ***adduction,*** or the movement of an extremity toward the median plane; ***abduction,*** or movement away from the median plane (in the case of the digits the reference point is the axis of the limb); ***circumduction,*** or moving an extremity in a plane describing the surface of a cone; and ***rotation,*** or moving a part around its long axis.

II. Classification by external structure:

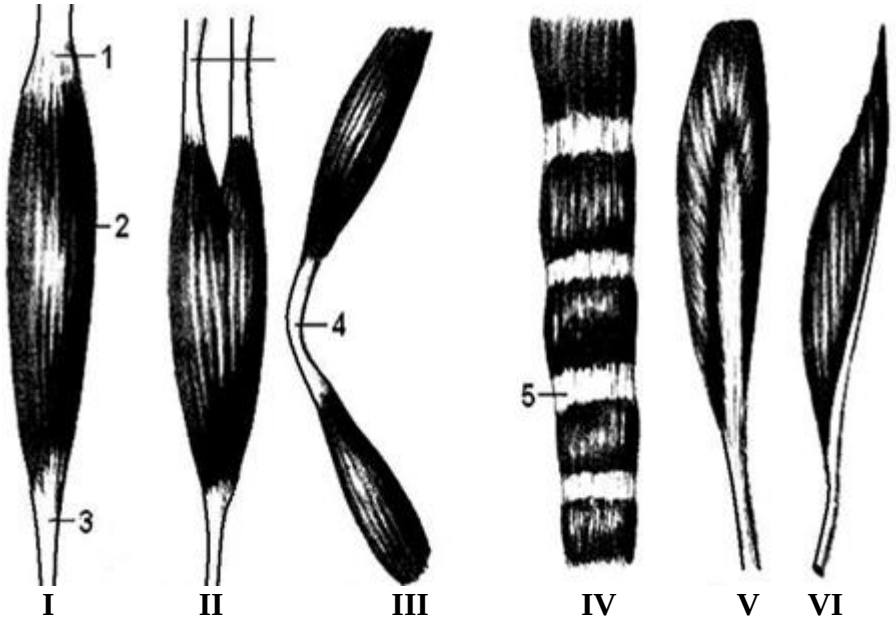
1) single-headed muscles *(m. uniceps)*. It has one beginning tendon.

2) two-headed muscles *(m. biceps)*. It has two beginning tendons.

3) three- or four-headed muscles *(m. triceps, m. quadriceps).* They have three or four beginning tendons respectively.

4) common muscle *(m. communis).* It has a few ending tendons.

5) digastric *(m. digastricus)*. The muscle venter (belly) is separated by an intermediate tendon into two parts.



Types of muscles

I – spindle-shaped,
II – two-headed,
III – digastric,
IV – band-shaped,
V – bipennate,
VI – unipennate,
1 – head,
2 – abdomen,
3 – tail,
4 – tendon,
5 – aponevrosis.

III. Classification by form.

The muscles can be long, short, wide, round, plane, square, rhomboid.

IV. Classification by internal structure:

1) by the ratio of parenchyma and stroma:

- dynamic muscles. They have more parenchyma.
- static muscles. They have more stroma.
- statodynamic muscles. They have the stroma and the parenchyma in equal.

2) by the direction of muscle fibers:
   - simple *(m. simplex)*. The muscle fibers direct parallel to the longitudinal axis of the muscle
   - pennate muscles *(m. pennatus).* The muscle fibers direct obliquely toward the longitudinal axis of the muscle

Muscles possessing tendons throughout all or part of their length are known as **pennate** muscles. A muscle with a tendon running along one side is called ***unipennate;*** if there is a tendon on each side of the muscle, it is ***bipennate****;* when a muscle is invaded by tendons in several places it is ***multipennate.*** Pennate muscles are stronger (exert more force) than straplike or sheetlike types because they are composed of many short oblique fibers which have an additive effect upon the insertion.

V. In relation to the system:

1. Subcutaneous
2. Skeletal
3. Muscles of internal organs

Topographic and functional muscle groups of the body

I. Muscles of trunk:
   1. Muscles of shoulder girdle
   2. Muscles of thorax
   3. Muscles of abdomen
   4. Muscles of vertebral column
   5. Ventral muscles of neck

II. Muscles of head

III. Muscles of thoracic limb

IV. Muscles of pelvic limb

MUSCLES OF TRUNK

M U S C L E S O F P E C T O R A L G I R D L E

This group consists of those muscles which connect the thoracic limb with the head, neck, and trunk.

M. TRAPEZIUS is a flat, triangular muscle, the base of the triangle corresponding with the spine.

It is divided by an aponeurotic portion into two parts: *cervical part* and *thoracic part.*

Origin.—1. The funicular portion of the ligamentum nuchae: from the second cervical to the third thoracic vertebra. 2. The supraspinous ligament, from the third to the tenth thoracic vertebra.

Insertion.—The spine of scapula and the tubercle of the spine of scapula.

Action: To elevate the shoulder; the cervical portion draws the scapula forward and upward and the thoracic portion draws it backward and upward.

.

M. OMOTRANSVERSARIUS is absent in the horse.

Origin.—The wings of atlas.

Insertion.— The acromion of the scapula.

Action: To pull the ventral angle of the scapula forward, to turn neck and to move down the neck when limbs are fixed.

M. RHOMBOIDEUS consists of two portions: ***m. rhomboideus cervicis*** *and* ***thoracis***

Origin.—1. The funicular portion of the ligamentum nuchae, from the second cervical to the second thoracic vertebra. 2. The spinous processes of the second to the seventh thoracic vertebra.

Insertion.—The internal surface of the cartilage of the scapula.

Action: To draw the scapula upward and forward. When the limb is fixed the cervical portion will elevate the neck.

M. SERRATUS VENTRALIS is a large, fan-shaped muscle, situated on the lateral surface of the neck and thorax. It derives its name from the serrated ventral edge of its thoracic portion. It consists of a cervical and a thoracic portion.

Origin.—1. The transverse processes of the last four or five cervical vertebra. 2. The external surfaces of the first eight or nine ribs.

Insertion.—The serrate surface of the scapula.

Action: Support of the trunk, to carry the trunk forward and backward; inspiration; to carry shoulder forward and backward with respect to the limb.

M. BRACHIOCEPHALICUS extends along the side of the neck from the head to the arm. It has a vestige of the clavicle in the form of

clavicular tendon *(intersectio clavicularis)* in the area of the shoulder joint. On this basis the portion of the muscle from the vestige to the arm is named ***m. cleidobrachialis***. The portion of the muscle from the vestige to the head is named ***m. cleidocephalicus.***

1. m. cleidobrachialis

Origin.—The clavicular tendon.

Insertion.—The crest of the humerus.

2. m. cleidocephalicus also has two parts: *mastoid part* and *occipital part.* There is *cervical part* in the dog only.

Origin. — The mastoid process of the petrous temporal bone and the occipital crest; the wing of the atlas and the transverse processes of the second, third, and fourth cervical vertebra.

Insertion. — The clavicular tendon.

Action: When the head and neck are fixed, to draw the limb forward, extending the shoulder joint. When the limb is fixed, to extend the head and neck, if the muscles act together; acting separately, to incline the head and neck to the same side.

M. LATISSIMUS DORSI is a wide muscle which has the form of a right-angled triangle. It lies for the most part under the skin and panniculus, on the lateral wall of the thorax, from the spine to the arm.

Origin.—The lumbodorsal fascia and by this means from the lumbar and thoracic spines as far forward as the highest point of the withers.

Insertion.—The internal tubercle of the humerus, in common with the teres major.

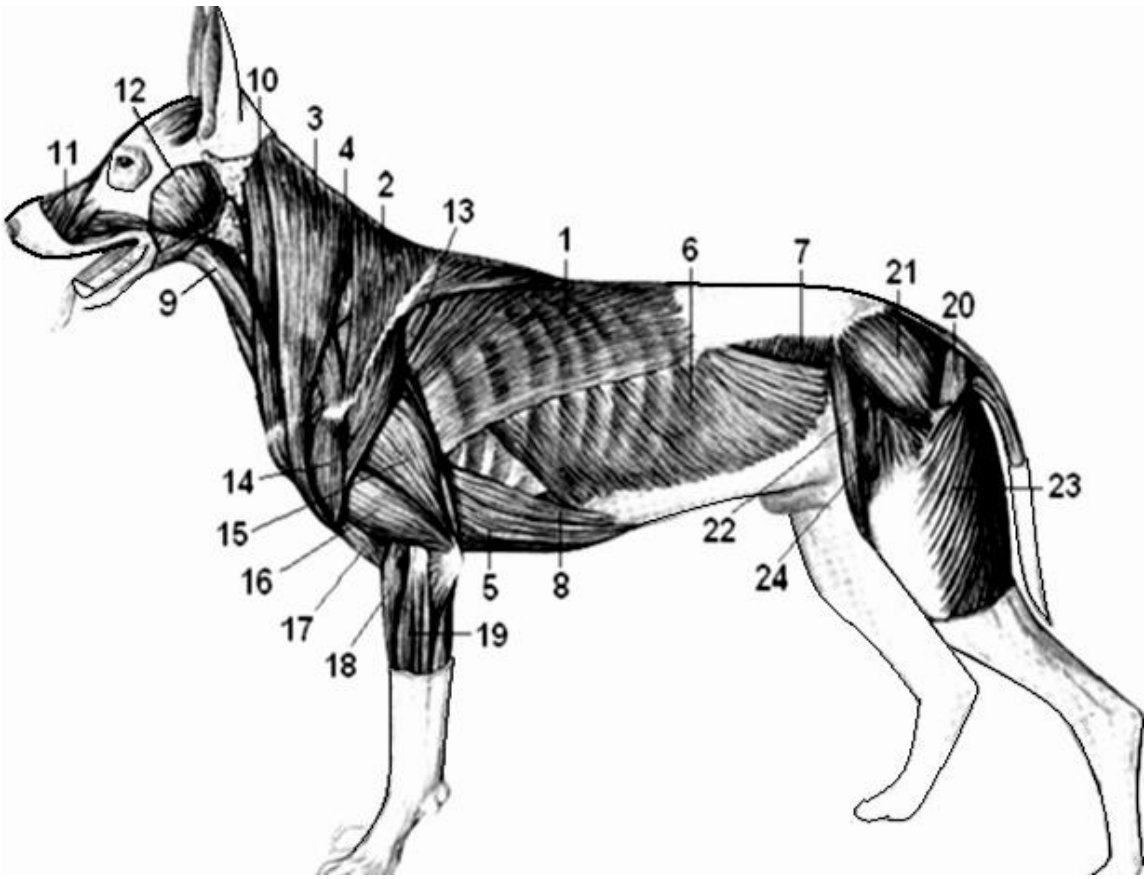
Action.—To draw the humerus upward and backward and flex the shoulder joint. If the limb is advanced and fixed, it draws the trunk forward.

M. PECTORALIS SUPERFICIALIS is a short, thick, somewhat rounded muscle, which extends between the anterior part of the sternum and the front of the arm. It forms a distinct prominence on the front of the breast, which is easily recognized in the living animal.

Origin.—The cariniform cartilage of the sternum.

Insertion.—The curved line of the humerus with the mastoido-humeralis; the fascia of the arm.

Action.—To adduct and advance the limb. To support the limb, draw the limb inward, draw the limb forward or backward according to its position, and draw the trunk sideward.



Muscles of dog

Muscles of shoulder girdle: 1 - latissimus dorsi, 2 - trapezius, 3 - brachiocephalicus, 4 - serratus ventralis, 5 - pectoralis profundus;

Muscles of trunk: 6 - obliquus externus abdominis, 7 - obliquus internus abdominis, 8 - rectus abdominis;

Ventral muscles of neck: 9 - sternohyoideus, 10 - sternocephalicus (pars mastoideus);

Muscles of head: 11 – mm. faciales, 12 – mm. masticatorii;

Muscles of thoracic limb: 13 - supraspinatus, 14 – deltoideus; 15 - triceps brachii (long head), 16 - triceps brachii (lateral head), 17 - brachialis, 18 - extensor carpi radialis, 19 - extensor digitorum communis;

Muscles of pelvic limb: 20 - glutaeus superficialis, 21 - glutaeus medius, 22 - sartorius, 23 - biceps femoris, 24 - tensor fascie latae.

M. PECTORALIS PROFUNDUS is a wide muscular sheet which extends from the ventral edge of the sternum to the fascia on the inner surface of the forearm.

Origin.—The ventral edge of the sternum and cartilages of true ribs.

Insertion.—The tubercles of the humerus with the preceding muscle.

Action.—To adduct the limb and to tense the fascia of the forearm. To pull the trunk up on the advanced limb; to draw the limb backward.

M U S C L E S O F T H O R A X

These consist of muscles or sets of muscles, which are attached to the thoracic vertebrae, to the ribs and their cartilages, and to the sternum. Functionally, they are muscles of respiration. They are distinguished:

- **musculi inspiratorii**
- **musculi expiratorii**

Inspiratory *muscles act to increase the diameter of the thorax.*
Action: Inspiration.

M. SCALENUS is deeply situated on the side of the cranial half of the rib cage.

Origin.—1. The middle third of the true ribs.

Insertion.—The transverse processes of the fourth, fifth, and sixth cervical vertebra.

Action.—The neck is flexed or inclined laterally, according as the muscles act together or singly. If the neck be the fixed point, the muscle may have a respiratory action by pulling forward or fixing the first rib.

MM. INTERCOSTALES EXTERNI occupy an intercostal space, from the levatores to the sternal extremity of the rib. They do not occupy the intercartilaginous spaces.

Origin.—The caudal borders of the ribs.

Insertion.—The cranialborders and external surfaces of the succeeding ribs.

M. SERRATUS DORSALIS CRANIALIS is a thin quadrilateral muscle, named from its toothed ventral border. It lies beneath the rhomboideus, serratus magnus, and latissimus dorsi.

Origin.— The transverse processes of the first 9-10 thoracic vertebrae.

Insertion.—The external surfaces of the second (fifth) to the eleventh or twelfth ribs inclusive.

Action: To lift the ribs for inspiration.

M. RECTUS THORACIS is a thin muscle which lies under cover of the deep pectoral muscles. It is directed obliquely backward and downward, and crosses the lower part of the first three intercostal spaces.

*Origin.***—**The outer surface of the first rib, below the scalenus.

Insertion.—The cartilage of the third or fourth rib. The aponeurosis usually joins the rectus abdominis. It may reach the sternum.

Action.—It may assist in inspiration or concur with the rectus abdominis.

M. PHRENICUS, s. DIAPHRAGMA is a broad, unpaired muscle which forms a partition between the thoracic and abdominal cavities. On a median section it is seen to have a general direction downwartl and forward from the lumbar vertebra to the xiphoid cartilage. The thoracic surface is strongly convex, and is covered by the pleura. The abdominal surface is deeply concave, and is covered for the most part by the peritoneum. The muscle consists of a peripheral fleshy portion, two muscular crura, and a tendinous center.

Action.—It is the principal muscle of inspiration and increases the longitudinal diameter of the chest.

Attachments.

The diaphragm has two parts:

- **muscular** (peripheral) - *pars muscularis*
- **tendon center** - *centrum tendineum*

The **muscular part** of diaphragm has the following parts depending on the attachments.

Costal part: the cartilages of the ninth to the fifteenth ribs, and the last three ribs at an increasing distance from their sternal ends. It consists of a series of digitations which meet, or are separated by a very narrow interval from.

Sternal part: the upper surface of the xiphoid cartilage.

Lumbar part: forms the **right** and **left crura.** The right crus is attached to the first four or five lumbar vertebra. The left crus is attached in a similar fashion to the first and second lumbar vertebra.

The **right crus** (crus dextrum) is about twice as thick as the left one and is also longer. It arises by a strong tendon from the lumbar vertebra.

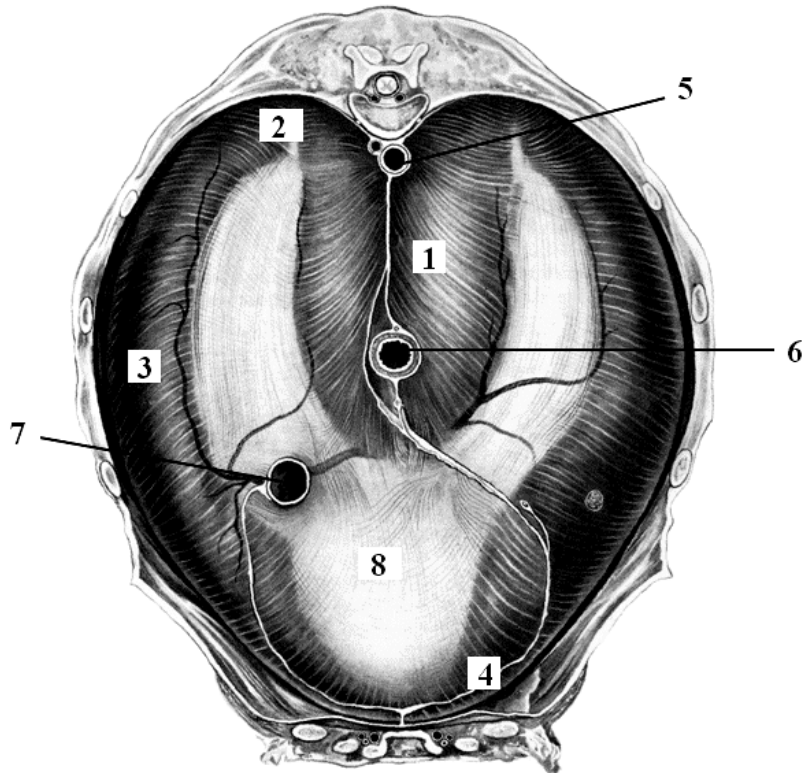
The **left crus** (crus sinistrum) arises by a thin tendon from the first and second lumbar vertebra. This is succeeded by a triangular belly which joins the central tendon.

The **tendon center** (centrum tendineum) resembles the periphery in outline, but is more elongated. It is partially divided into right and left halves by the descent of the crura into it. It is composed largely of

radiating fibers, but many interlace in various directions; this is especially evident around the foramen venae cavae, which is encircled by fibers.

The diaphragm is pierced by three foramina.

- **aortic hiatus** *(hiatus aorticus)* is an interval between the two crura and below the last thoracic vertebra. It contains the aorta
- **esophageal hiatus** *(hiatus oesophageus)* is situated a little to the left of the median plane. It transmits the oesophagus.
- **caval opening** *(foramen venae cavae)* pierces the tendon center to the right of the median plane. The vena cava is firmly attached to the margin of the opening.



Diaphragm

1 - muscle part
2 - lumbar part
3 - costal part
4 - thoracic part
5 - aortic hiatus
6 - esophageal hiatus
7 - caval opening
8 - tendon center

Exspiratory *muscles act to decrease the diameter of the thorax*.

Action: Expiration.

MM. INTERCOSTALES INTERNI occupy the entire length of the intercostal spaces, including their interchondral portion.

Origin.—The cranial borders of the ribs and their cartilages.

*Insertion.***—**The caudal borders of the preceding ribs and cartilages.

M. TRANSVERSUS THORACIS is a flat muscle situated on the thoracic surface of the sternum and the cartilages of the sternal ribs.

Origin.—The inner surface of the sternum.

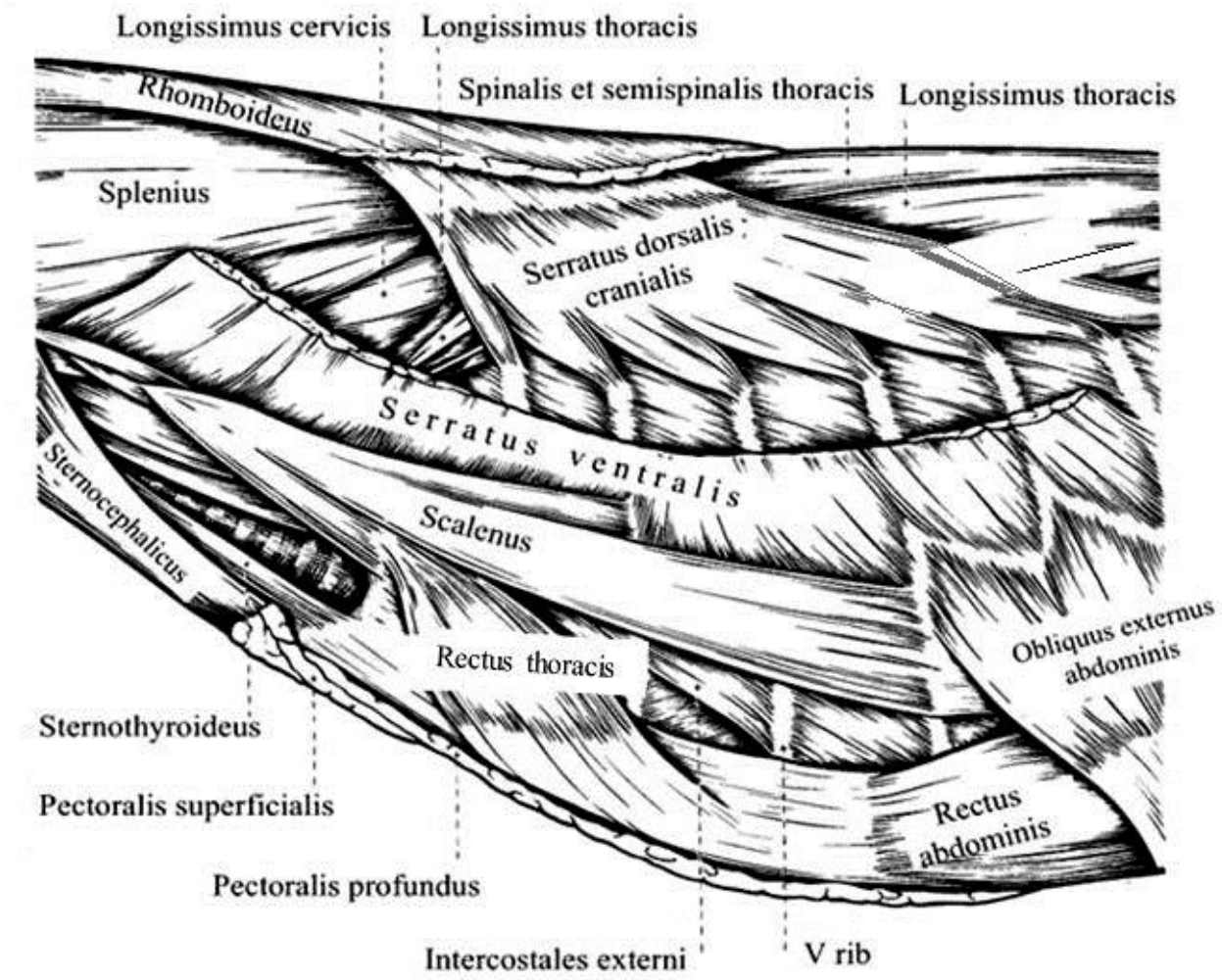
Insertion.—The cartilages of the true ribs.

M. SERRATUS DORSALIS CAUDALIS is a thin muscle, named from its toothed ventral border.

Origin.—The spinous processes of the last thoracic and first lumbar vertebrae.

Insertion.—The dorsal ends of the last three ribs.

Action.—To draw the ribs backward, thus assisting in expiration.



Muscles of ribcage of the dog

MUSCLES OF ABDOMEN

The abdominal wall is formed by four wide **muscles of abdomen** *(mm. abdominis)*. These have different directions of muscle fibers.

The muscles provide an abdominal respiration (acting as expiratory) and compression of the abdominal viscera, so-called **abdominal press** *(prelum abdominale).* This action aids in such vital functions as expiration, urination, defecation, and parturition.

M. OBLIQUUS EXTERNUS ABDOMINIS is the most extensive of the abdominal muscles. It is a broad sheet, irregularly triangular in shape, widest behind. Its fibers are directed caudoventrally and terminate on the aponeurosis. The muscle is composed of a fleshy portion and an aponeurosis. The muscular portion lies on the lateral wall of the thorax and abdomen. It arises by a series of digitations.

Origin.—1. The outer surfaces of the middle part of ribs (from fifth to last). 2 The external angle and shaft of the ilium. 3. The transverse processes of the lumbar vertebrae.

Insertion.—It ends by three flat aponeurosis: abdominal, pelvic and femoral:

- **abdominal aponeurosis** (lamina abdominalis) extends to the *linea alba*, where it unites with that of the opposite side
- **pelvic aponeurosis** (lamina iliaca) curves upward and backward and is inserted into the external angle of the ilium. Between these points the aponeurosis is much strengthened and is called the *inguinal ligament* (ligamentum inguinale)
- **femoral aponeurosis** (lamina femoralis) passes on to the inner surface of the thigh, where it blends with the femoral fascia.

M. OBLIQUUS INTERNUS ABDOMINIS is situated under the preceding one. Its fibers are directed ventrocranially. It is composed of a fleshy portion and an aponeurosis. The aponeurosis is to a great extent blended with that of the external oblique, being, indeed, considerably interwoven with it ventrally. The aponeurosis of muscle is bifurcated into two laminas in the cranial part of the abdominal wall (up to umbilical ring): lateral and medial. A rectus abdominis is located between the laminas. Where it covers the rectus abdominis it is attached to the tendinous inscriptions of that muscle.

Origin.—The external angle of the ilium and the inguinal ligament.

Insertion.—(1) The cartilages of the last four or five ribs. (2) The linea alba.

M. RECTUS ABDOMINIS is confined to the ventral part of the abdominal wall; it extends from the lower part of the chest-wall to the pubis. The fibers of the muscle are directed longitudinally.

Origin.—The cartilages of the fifth to the ninth ribs inclusive, and the adjacent surface of the sternum.

Insertion.—The pubis, by means of the prepubic tendon.

M. TRANSVERSUS ABDOMINIS is named from the general direction of its fibers. Its lateral part is muscular, its ventral aponeurotic.

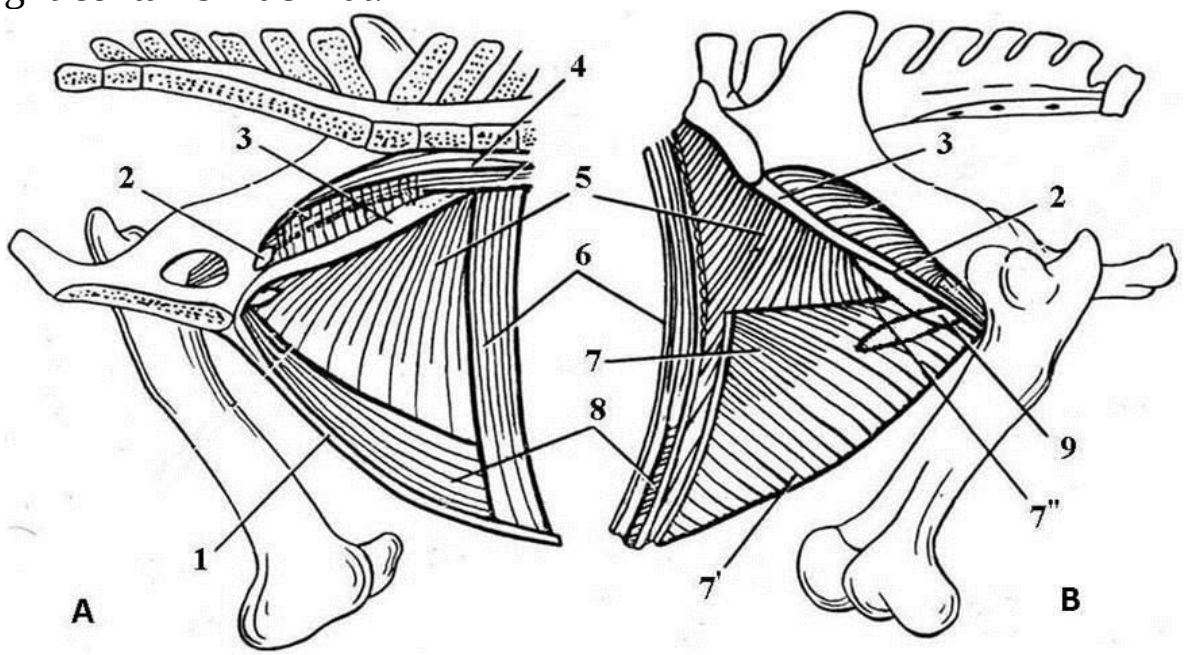
Origin.—The transverse processes of the lumbar vertebrae and the rib arch.

Insertion. —The linea alba.

The broad aponeurosis of the external oblique abdominal muscle, the internal oblique abdominal muscle, transverse muscle of the abdomen, and the external lamina of deep fascia form a **yellow abdominal tunic** (tunica flava abdominis) in the ventral part of the abdominal wall.

IMPORTANT ANATOMICAL STRUCTURES OF ABDOMINAL WALL

INGUINAL CANAL (canalis inguinalis). This term is applied to an oblique passage through the caudal part of the abdominal wall. In the male the inguinal canal serves as the passageway for the processus vaginalis with the m. cremaster externus and the spermatic cord; in the female of dog it contains much fat.



Inguinal canal

A – view from the abdominal cavity

B – view from the lateral surface of the abdominal wall

1 – linea alba, 2 – deep inguinal ring, 3 - inguinal ligament, 4 - ventral muscle of the lumbar region, 5 – internal oblique abdominal muscle, 6 – transverse abdominal muscle, 7 - external oblique abdominal muscle, 7' – abdominal aponeurosis of external oblique abdominal muscle, 7' – pelvic aponeurosis of of external oblique abdominal muscle, 8 – rectal abdominal muscle, 9 – superficial inguinal ring.

The average length of the canal, measured along the spermatic cord, is about 10 cm.

It begins at the **deep inguinal** (or abdominal) **ring**, and extends obliquely downward, inward, and somewhat forward, to end at the **external inguinal** (or subcutaneous) **ring**.

The **deep inguinal ring** (annulus inguinalis profundus) bounded in front by the thin margin of the internal oblique muscle, and behind by the inguinal ligament. It is an inlet to the inguinal canal from the abdominal cavity.

The **superficial inguinal ring** (annulus inguinalis superficialis) is the external orifice (outlet) of the inguinal canal. It is located between the abdominal and pelvic aponeurosis of the external oblique abdominal muscle

LINEA ALBA ABDOMINIS is a median fibrous raphe which extends from the xiphoid cartilage to the symphysis pelvis. It serves for the main insertion of the abdominal muscles.

It is formed by junction of aponeuroses of the following left and right muscles:

- external oblique abdominal
- internal oblique abdominal
- transversus abdominis
- internal and external layers of deep fascia

A little behind its middle is a cicatrix which indicates the position of the umbilical opening of the foetus.

RECTUS SHEATH (vagina musculi recti abdominis) is a tendon-fascial case which covers both surfaces of the rectus abdominis muscle. It is formed primarily by the aponeuroses of the other abdominal muscles. It has two layers: external and internal.

External layer of the rectus sheath consists of:

- external layer of deep fascia
- abdominal layer of aponeurosis of m. obliquus externus abdominis
- lateral layer of aponeurosis of m. obliquus internus abdominis

Internal layer of the rectus sheath consists of:

- medial layer of aponeurosis of m. obliquus internus abdominis

- aponeurosis of m. transversus abdominis
- transverse fascia (intenal layer of deep fascia of the abdomen)

LAYERED STRUCTURE OF ABDOMINAL WALL

A. lateral abdominal wall:

- skin *(cutis)*
- external layer of superficial fascia *(lamina externa fasciae superficialis)*
- cutaneous trunci
- internal layer of superficial fascia *(lamina interna fasciae superficialis)*
- external layer of deep fascia *(lamina externa fasciae profunda)*
- *m. obliquus externus abdominis*
- *m. obliquus internus abdominis*
- *m. transversus abdominis*
- transvers fascia *(fascia transversalis) or* internal layer of deep fascia *(lamina interna fasciae profundae)*
- parietal peritoneum *(peritoneum parietale)*

B. ventral abdominal wall:

- skin *(cutis)*
- external layer of superficial fascia *(lamina externa fasciae superficialis)*
- cutaneous trunci
- internal layer of superficial fascia *(lamina interna fasciae superficialis)*
- external layer of deep fascia *(lamina externa fasciae profunda)*
- abdominal aponeurosis *m. obliquus externus abdominis*
- lateral lamina of aponeurosis *m. obliquus internus abdominis*
- *m. rectus abdominis.*
- medial lamina of aponeurosis *m. obliquus internus abdominis*
- aponeurosis *m. transversus abdominis*
- transvers fascia *(fascia transversalis)* or internal layer of deep fascia *(lamina interna fasciae profundae)*
- parietal peritoneum *(peritoneum parietale)*

M U S C L E S O F V E R T E B R A L C O L U M N

There are distinguished the dorsal and ventral muscles of the vertebral column – ***mm. columnae vertebral dorsalis et ventralis.***

DORSAL MUSCLES OF THE VERTEBRAL COLUMN are located along the vertebral column and lie between the spinal and transverse processes of the vertebrae, as well as the dorsal edges of the ribs. These muscles fix the spine, with a bilateral action extens or flex the spine, elevate the neck and tail.

M. SPINALIS

Origin.— The thoracic spines of the lumbar and last thoracic vertebrae; the articular processes of the cervical vertebrae.

Insertion.— The thoracic spines and the transverse processes of the first thoracic vertebrae; the articular processes of the cervical vertebrae.

M. SEMISPINALIS is a long segmental muscle which covers the sides of the spinous processes of the vertebrae to the head.

Origin.—The thoracic spines and the transverse processes of the first six or seven thoracic vertebrae; the articular processes of the cervical vertebrae.

Insertion.—The occipital crest of skull.

Action.—It is the extensor of the head and neck. Acting singly, the muscle inclines the head to the same side.

M. LONGISSIMUS is the largest and longest muscle in the body. It extends from the sacrum and ilium to the atlas, filling up the space between the spinous processes medially and the lumbar transverse processes and the upper ends of the ribs below.

It has tree portions:

- ***m. longissimus lumborum et thoracis***
- ***m. longissimus cervicis***
- ***m. longissimus atlantis et capitis***

Origin.—The internal angle, crest, and adjacent part of the ventral surface of the ilium; the first three sacral spines; the lumbar and thoracic spines and the supraspinous ligament.

Insertion.—The lumbar transverse and articular processes; the thoracic transverse processes; the spinous and transverse processes of the last four cervical vertebrae; the outer surfaces of the ribs, except the first.

Action.—It is the most powerful extensor of the back and loins; by its

cervical attachment it assists in extending the neck. By its costal attachment it may also assist in expiration. Acting singly, it flexes the spine laterally.

M. ILIOCOSTALIS is long, segmental muscle extends, as its name indicates, across the series of ribs, in contact with the outer edge of the longissimus dorsi.

Origin.—The iliac crest and the transverse processes of the second and third lumbar vertebrae.

Insertion.— External surface of the last fifteen ribs and the transverse processes of the last two or three cervical vertebrae.

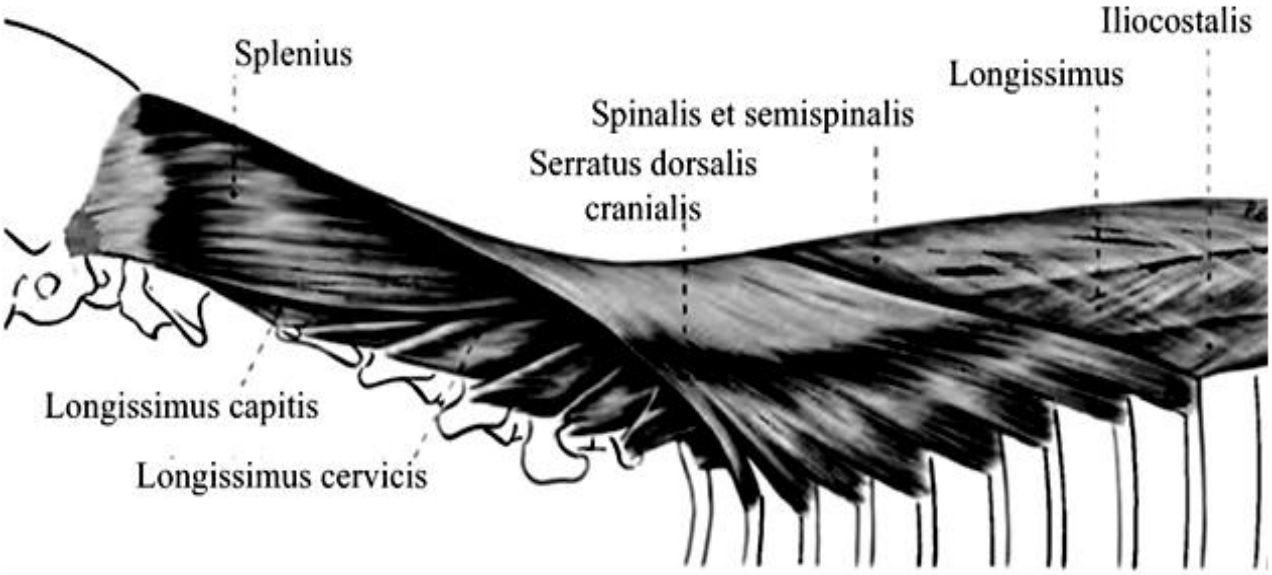
Action.—Acting together, they may assist in extending this spine, acting singly in inclining it laterally.

M. SPLENIUS CERVICIS is an extensive, flat, triangular muscle.

Origin.—The second, third, and fourth thoracic spines and the funicular portion of the ligamentum nuchae.

Insertion.—The occipital crest, the mastoid process, the wing of the atlas, and the transverse processes of the third, fourth, and fifth cervical vertebra.

Action.—To elevate the head and neck; to incline the head and neck to the side of the muscle acting.



Dorsal muscles of the vertebral column of dog

VENTRAL MUSCLES OF THE VERTEBRAL COLUMN are located on the ventral surface of the vertebral bodies in the most movible parts of the vertebral column - in the region of the neck and back.

M. LONGUS CAPITIS lies along the ventro-lateral surface of the cervical vertebrae and the base of the cranium.

Origin.—The transverse processes of the 2-6 cervical vertebrae.

Insertion.—The tubercles of the occipital bone.

Action.—Acting together, to flex the head; acting singly, to incline it to the same side also.

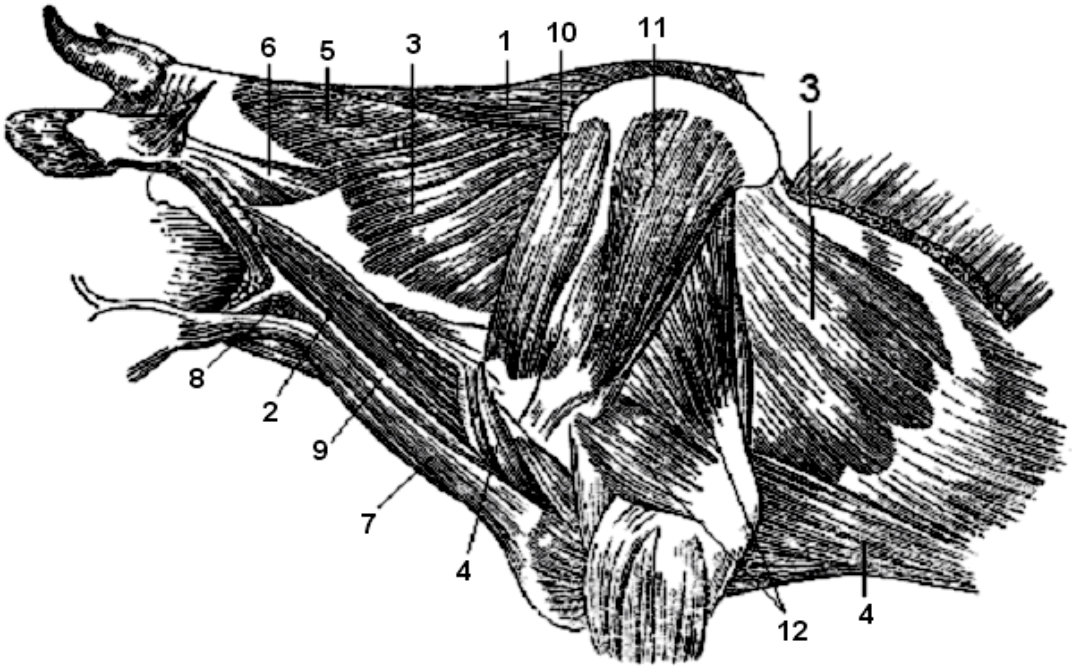
M. LONGUS COLLI covers the ventral surface of the vertebrae, from the sixth thoracic to the atlas; lies medially to m. longus capitis.

It consists of two portions, thoracic and cervical.

Origin.—Thoracic portion, the bodies of the first six thoracic vertebrae; *cervical portion*, the transverse processes of the cervical vertebrae.

Insertion.—Thoracic portion, the bodies and transverse processes of the last two cervical vertebrae; *cervical portion*, the bodies of the cervical vertebrae and the tubercle on the ventral surface of the atlas.

Action.—To flex the neck.



Muscles of the neck, shoulder girdle and thoracic region of the body of cattle

Muscles of shoulder girdle: 1 - rhomboideus, 2 - brachiocephalicus, 3 - serratus ventralis, 4 - pectoralis profundus;

Muscles of spine and the ventral muscles of neck: 5 - splenius cervicis, 6 - longissimus capitis, 7 - m. sternocephalicus (pars mandibularis), 8 - jugular groove, 9 - jugular vein;

Muscles of thoracic limb: 10 - supraspinatus, 11 - infraspinatus, 12 - triceps brachii.

M. PSOAS MINOR

Origin.—The bodies of the last three thoracic and the first four lumbar vertebrae.

Insertion.— The tubercle of the m. psoas minor of iliac bone.

Action.—To steepen the pelvis, or to flex the lumbar part of the vertebral column.

M. PSOAS MAJOR

Origin.—The bodies and transvers processes of the last four lumbar vertebrae.

Insertion.— The lesser trochanter of the femoral bone.

Action.— To flex the hip joint and to rotate the thigh outward.

1. **M. QUADRATUS LUMBORUM** lies on the outer part of the ventral surfaces of the lumbar transverse processes.

Origin.—The ventral surface of the upper part of the last two ribs and the lumbar transverse processes.

Insertion.—The ventral surface of the wing of the sacrum and the ventral sacro-iliac ligament.

Action.—Acting together, to fix the last two ribs and the lumbar vertebra; acting singly, to produce lateral flexion of the loins.

V E N T R A L M U S C L E S O F N E C K

The muscles of this topographic group form the ventral contour of the neck and restrict the cervical visceral space.

M. STERNOCEPHALICUS has two parts:

- ***mastoid part***
- ***mandibular part***

It is naimed **m. sternomastoideus** in the **dog.**

Origin.—The manubrium of the sternum.

Insertion.—1. The processus mastoideus of the petrosal bone (it is absence in horse). 2. The lower jaw.

Action.—Acting together, to flex the head and neck; acting singly, to incline the head and neck to the side of the muscle contracting.

M. STERNOTHYREOIDEUS

Origin.—The manubrium of the sternum.

Insertion.—The external surface of the thyroid cartilage of larynx.

Action.—To retract the larynx.

M. STERNOHYOIDEUS is applied to the ventral surface of the trachea and its fellow of the opposite side.

Origin.—The manubrium of the sternum.

Insertion.—The body of the hyoid bone.

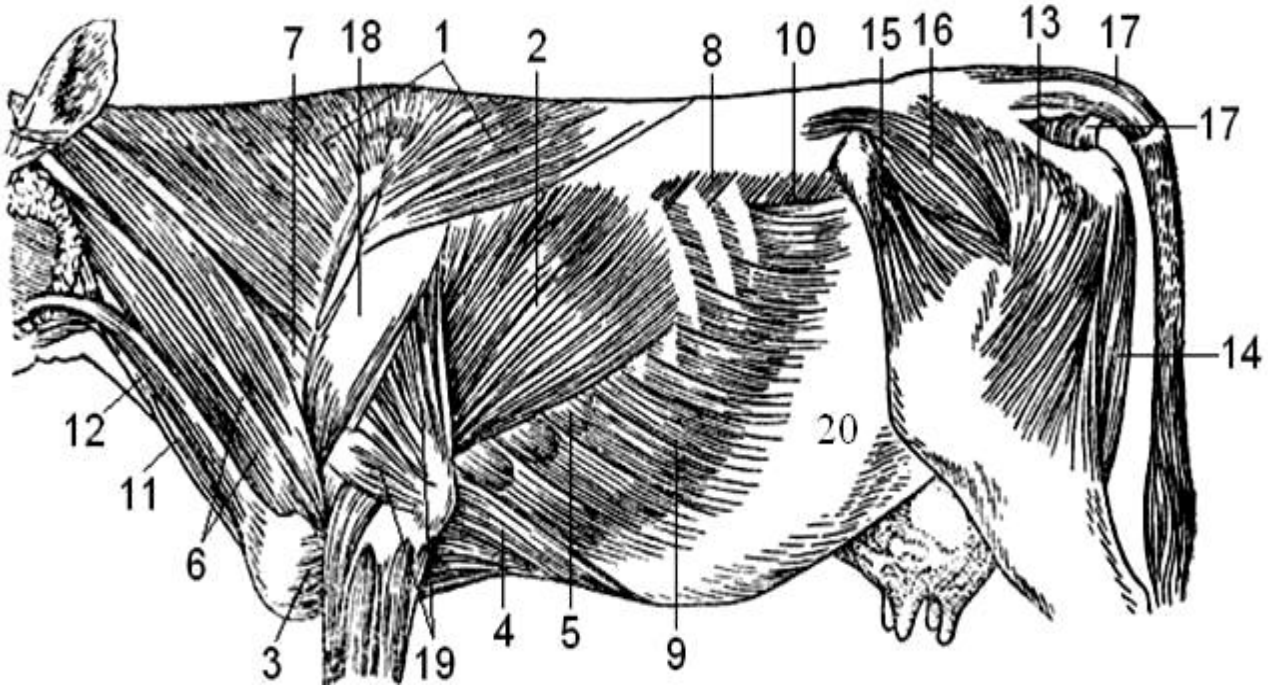
Action.—To depress and retract the hyoid bone, the base of the tongue, and the larynx, as in deglutition. It may also fix the hyoid bone when the depressors of the tongue are acting, as in suction.

M. OMOHYOIDEUS (SUBSCAPULO-HYOIDEUS) is a thin, ribbon-like muscle, is absent **in dog**.

Origin.—The subscapular fascia close to the shoulder joint.

Insertion.—The body of the hyoid bone.

Action.—To depress the hyoid bone.



Superficial muscles of cattle

1 – m. trapezius, 2 – m. latissimus dorsi, 3 – mm. pectorales superficiales, 4 – m. pectoralis profundus, 5 – m. serratus ventralis, 6 – m. brachiocephalicus, 7 – m. omotransversarius, 8 – m. serratus dorsalis caudalis; 9, 10 – m. obliquus externus abdominis, 11 – m. sternocephalicus (pars mastoideus), 12 – m. sternocephalicus (pars mandibularis), 20 – tunica flava abdominis, 13 – m. biceps femoris, 14 – m. semitendinosus, 15 – m. tensor fascie latae, 16 – m. glutaeus medius, 17 – tail muscles, 18 – m. deltoideus, 19 – m. triceps brachii.

M U S C L E S O F H E A D

The muscles of the head are composed of two groups:
1. The facial musculature – ***mm. faciales***
2. The masticatory musculature – ***mm. masticatorii***

FACIAL MUSCULATURE

M. ORBICULARIS ORIS lies between the skin and mucosa; is the sphincter muscle of the mouth.

Action: The muscle closes the mouth opening and is a pressor of the labial glands.

M. ORBICULARIS OCULI is a flat, elliptical, sphincter muscle, situated in and around the eyelids, the portion in the upper lid being much broader than that in the lower. The chief attachment is to the skin of the lids, but some bundles are attached to the palpebral ligament at the inner canthus and to the lacrimal bone. Its action is to close the lids.

M. ZYGOMATICUS is very thin muscle lies immediately under the skin of the cheek.

Origin.—The facial crest.

Insertion.—The commissure of the lips, blending with the buccinator.

Action.—To retract and raise the angle of the mouth.

M. CANINUS lies on the lateral nasal region, and passes between the two branches of the levator nasolabialis.

Origin.—The maxilla, close to the facial crest.

Insertion.—The outer wing of the nostril.

Action.—To dilate the mouth and nostril.

M. LEVATOR LABII SUPERIORIS

Origin.—The frontal and nasal bones.

Insertion.—(1) The upper lip and the outer wing of the nostril; (2) the commissure of the lips.

Action.—To elevate the upper lip; to dilate the nostril.

M. DEPRESSOR LABII SUPERIORIS lies under the mucous membrane of the upper lip.

Origin.—The alveolar border of the premaxilla from the second incisor to the first cheek tooth.

Insertion.—The upper lip.

Action.—To depress the upper lip.

M. DEPRESSOR LABII INFERIORIS lies on the outer surface of the ramus of the mandible, along the ventral border of the buccinator.

Origin.—The alveolar border of the mandible near the coronoid process and the maxillary tuberosity, in common with the buccinator.

Insertion.—The lower lip.

Action.—To depress and retract the lower lip.

M. BUCCINATOR lies in the lateral wall of the mouth. Two parts may be recognized. The *buccal part* extends from the angle of the mouth to the masseter. The *molar part* has a small tendinous and is united below with the depressor labii inferioris.

Origin.—The external surface of the maxilla and the molar teeth; the alveolar border of the mandible; the pterygo-mandibular ligament.

Insertion.—The angle of the mouth, with the orbicularis oris.

Action.—To flatten the cheeks, thus pressing the food between the teeth; also to retract the angle of the mouth.

M. LEVATOR NASOLABIALIS

Origin.—The frontal and nasal bones.

Insertion.—(1) The upper lip and the outer wing of the nostril; (2) the commissure of the lips.

Action.—(1) To elevate the upper lip and the commissure; (2) to dilate the nostril

M. LATERALIS NASI

Origin.—The incisive bone.

Insertion.—The lateral wing of the nostril.

Action.—To increase the diameter of the naris.

MASTICATORY MUSCULATURE

The muscles of this group arise chiefly from the upper jaw and the base of the cranium, and are all inserted into the mandible.

M. MASSETER extends from the zygomatic arch and facial crest over the lateral surface of the mandibular ramus.

Origin.—The zygomatic arch and the facial crest.

Insertion.—The outer surface of the ramus of the mandible.

Action.—Its action is to bring the jaws together. Acting singly, it also carries the lower jaw toward the side of the contracting muscle.

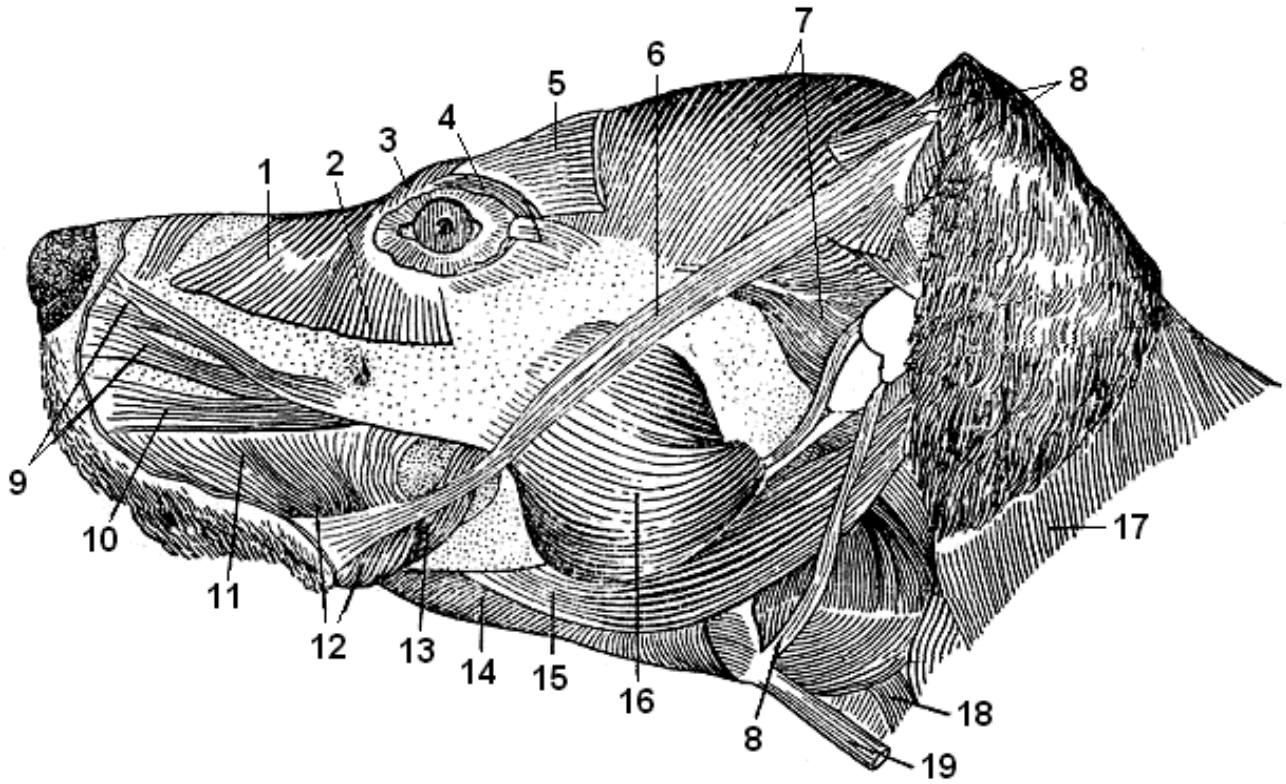
M. TEMPORALIS occupies the temporal fossa.

Musculus temporalis of dog. Lateral aspect.

Origin.—The rough part of the temporal fossa and the crests which surround it.

Insertion.—The coronoid process of the mandible, which it envelops.

Action.— Chiefly to raise the lower jaw, acting with the masseter and pterygoid muscles.



Muscles of the head of dog

1 – m. levator nasolabialis, 2 – m. depressor palpebrae superioris, 3 – m. levator palpebrae superioris, 4 – m. orbicularis oculi, 5 – m. frontalis, 6 – m. zygomaticus, 7 – m. temporalis, 8 – muscles of auricula, 9 – m. levator labii superioris, 10 – m. caninus, 11 – m. orbicularis oris, 12, 13 – m. buccinator, 14 – m. mylohyoideus, 15 – m. digastricus, 16 – m. masseter, 17 – m. brachiocephalicus, 18 – m. sternothyreoideus, 19 – m. sternohyoideus.

M. PTERYGOIDEUS occupies a position on the inner surface of the ramus of the mandible similar to that of the masseter on the outside.

Origin.—The crest formed by the pterygoid process of the sphenoid and the palate bone.

Insertion.—The concave inner surface of the broad portion of the ramus of the mandible, and the inner lip of the lower border.

Action.—Acting together, to raise the lower jaw; acting singly, to produce also lateral movement of the jaw.

M. DIGASTRICUS is composed of two fusiform, flattened bellies, united by a round tendon.

Origin.—The paramastoid or styloid process of the occipital bone, in common with the preceding muscle.

Insertion.—The inner surface of the lower border of the mandible behind the symphysis.

Action.—It assists in depressing the lower jaw and opening the mouth. If the mandible be fixed and both bellies contract, the hyoid bone and the base of the tongue are raised, as in the first phase of deglutition.

MUSCLES OF THORACIC LIMB

Muscles of the thoracic limb (musculi membri thoracici) acting on the following joints:

- shoulder
- elbow
- carpal
- metacarpophalangeal
- interphalangeal proximal
- interphalangeal distal

Muscles of shoulder joints

Extensors of shoulder joint

M. SUPRASPINATUS occupies the supraspinous fossa, which it fills, and beyond which it extends, thus coming in contact with the subscapularis.

Origin.—The supraspinous fossa, the spine, and the lower part of the cartilage of the scapula.

Insertion.—The inner and outer lips of the bicipital groove.

Action.—To extend the shoulder joint. It also assists in preventing dislocation.

Accessory extensor muscles

- m. biceps brachii
- m. brachiocephalicus

Flexors of shoulder joint

M. DELTOIDEUS lies partly on the triceps in the angle between the scapula and humerus, partly on the infraspinatus and teres minor.

Origin.—The spine of the scapula, by means of the strong aponeurosis which covers the infraspinatus.

Insertion.—The deltoid tuberosity of the humerus.

Action.—To flex the shoulder joint and abduct the arm.

M. TERES MINOR is a much smaller muscle than the foregoing. It lies chiefly on the triceps, under cover of the deltoid and infraspinatus.

Origin.—The caudal border of the scapula, about its middle.

Insertion.—The deltoid tuberosity and a small area just above it.

Action.—To flex the shoulder joint and to abduct the arm; also to assist in outward rotation.

M. TERES MAJOR is flat, widest about its middle, and lies chiefly on the deep face of the triceps.

Origin.—The proximal part of the caudal border of the scapula.

Insertion.—The tubercle on the inner surface of the shaft of the humerus, in common with the latissimus dorsi.

Action.—To flex the shoulder joint and adduct the arm.

Accessory flexor muscles

- m. latissimus dorsi
- m. triceps brachii
- m. pectoralis profundus
- m. tensor fasciae antebrachii

Abductors of shoulder joint

M. INFRASPINATUS occupies the greater part of the infraspinous fossa.

Origin.—The infraspinous fossa and the scapular cartilage.

Insertion.—The outer tuberosity of the humerus, distal to the outer insertion of the supraspinatus.

Action.—To abduct the arm and rotate it outward.

Adductors of shoulder joint

M. SUBSCAPULARIS occupies the subscapular fossa, beyond which, however, it extends both lief ore and behind.

Origin.—The subscapular fossa.

Insertion.—The internal tuberosity of the humerus.

Action.—To adduct the humerus.

M. CORACOBRACHIALIS lies on the inner surface of the shoulder joint and the arm.

Origin.—The coracoid process of the scapula.

Insertion.—The round tubercle of the humerus.

Action.—To adduct the arm and to flex the shoulder joint.

Accessory adductors muscles

- m. pectoralis superficialis
- m. pectoralis profundus

Rotators of shoulder joint

- m deltoideus
- m. teres minor
- m. teres major
- m. brachiocephalicus
- m. latissimus dorsi
- m. pectoralis superficialis

Muscles of elbow joints

Extensors of elbow joint

M. TRICEPS BRACHII constitutes the large muscular mass which fills the angle between the caudal border of the scapula and the humerus. It is clearly divisible into three heads, as described below.

Long head (caput longum tricipitis).

Origin.—The caudal border of the scapula.

Insertion.—The outer and caudal part of the summit of the olecranon.

Action.—(1) To extend the elbow joint; (2) to flex the shoulder joint.

Laterale head (caput lateralis tricipitis).

Origin.—The deltoid tuberosity and the curved rough line which extends from it to the neck of the humerus.

Insertion.—(1) A small prominent area on the outer surface of the olecranon; (2) the tendon of the long head.

Action.—To extend the elbow joint.

Medialal head (caput mediale tricipitis).

Origin.—The middle third of the inner surface of the shaft of the humerus, behind and below the internal tubercle.

Insertion.—The inner and fore part of the summit of the olecranon.

Adion.—To extend the elbow joint.

M. TENSOR FASCIAE ANTEBRACHII is a thin muscle which lies on the inner surface of the triceps.

Origin.—The tendon of insertion of the latissimus dorsi and the caudal border of the scapula.

Insertion.—(1) The fascia of the forearm; (2) a small eminence on the caudal border of the olecranon.

Action.—To tense a fascia of forearm and to extend the elbow joint.

Accessory extensor muscles

- *m. flexor carpi ulnaris*
- *m. extensor carpi ulnaris*
- *m. flexor carpi radialis*
- *m. flexor digitorum superficialis*
- *m. flexor digitorum profundus*

Flexors of elbow joint

M. BICEPS BRACHII is a strong, somewhat rounded muscle, which lies on the anterior surface of the humerus.

Origin.—The tuberosity of the scapula.

Insertion.—(1) The bicipital tuberosity of the radius; (2) the fascia of the forearm and the tendon of the extensor carpi radialis.

Action.—To flex the elbow joint, to fix the shoulder, elbow, and carpus in standing, and to tense the fascia of the forearm.

M. BRACHIALIS occupies the musculospiral groove of the humerus.

Origin.—The proximal third of the caudal surface of the humerus.

Insertion.—The inner surface of the neck of the radius.

Action.—To flex the elbow joint.

Accessory flexor muscles

- m. extensor carpi radialis
- m. extensor digitorum communis

Muscles of carpal joints

Extensors of carpal joint

M. EXTENSOR CARPI RADIALIS is the largest muscle of the extensor division, and lies on the dorsal surface of the radius.

Origin.—The external condyloid crest of the humerus.

Insertion.—The proximal extremity of the metacarpal bones.

Action.—To extend the carpal joint and to flex the elbow joint.

M. EXTENSOR CARPI ULNARIS lies on the outer surface of the forearm, behind the lateral extensor of the digit. It enveloped by a **synovial sheath,** to reach its insertion on the outer metacarpal bone.

Origin.—The external epicondyle of the humerus, behind and below the lateral ligament.

Insertion.—(1) The outer surface and upper edge of the accessory carpal bone; (2) the proximal extremity of the metacarpal bone.

Action.—To flex the carpal joint and to extend the elbow.

M. ABDUCTOR DIGITI-I LONGUS, s. **M. EXTENSOR CARPI OBLIQUUS** is a small muscle which curves obliquely over the distal half of the radius and the carpus.

Origin.—The external border of the radius.

Insertion.—The second metacarpal bone (the first metacarpal bone in dog).

Action.—To extend the carpal joint.

Accessory extensor muscles

- m. extensor digitorum communis
- m. extensor digitorum lateralis

Flexors of carpal joint

M. FLEXOR CARPI RADIALIS lies on the inner surface of the forearm, immediately behind the inner border of the radius.

Origin.—The internal epicondyle of the humerus, below and behind the lateral ligament.

Insertion.—The proximal end of the metacarpal bone.

Action.—To flex the carpal joint and to extend the elbow.

M. FLEXOR CARPI ULNARIS arises by two heads: humeral and ulnar.

Origin.—(1) The internal epicondyle of the humerus; (2) the inner surface of the olecranon.

Insertion.—The upper edge of the accessory carpal one.

Action.—To flex the carpal joint, and to extend the elbow.

Accessory flexor muscles

- m. flexor digitorum superficialis
- m. flexor digitorum profundus
- m. extensor carpi ulnaris

Muscles of digital joints of hand

Extensors of digital joints

M. EXTENSOR DIGITORUM COMMUNIS

Origin.—The front of the distal extremity of the humerus.

Insertion.—The extensor process of the third phalanx of each digits.

Action.—To extend the digital and carpal joints, and to flex the elbow joint.

M. EXTENSOR DIGITORUM LATERALIS

Origin.—The lateral ligament of the elbow joint and on the proximal ends of the antebrachial bones.

Insertion.—The extensor process of the third phalanx of each digits.

Flexors of digital joints

M. FLEXOR DIGITORUM SUPERFICIALIS is situated in the middle of the flexor group, chiefly under cover of the middle flexor of the carpus.

Origin.—The medial epicondyle of the humerus/

Insertion.—The eminences on the proximal extremity of the second phalanx of each digits.

Action.—To flex the digit and carpus, and to extend the elbow.

M. FLEXOR DIGITORUM PROFUNDUS is the largest muscle of the flexor group. This muscle consists of three principal heads.

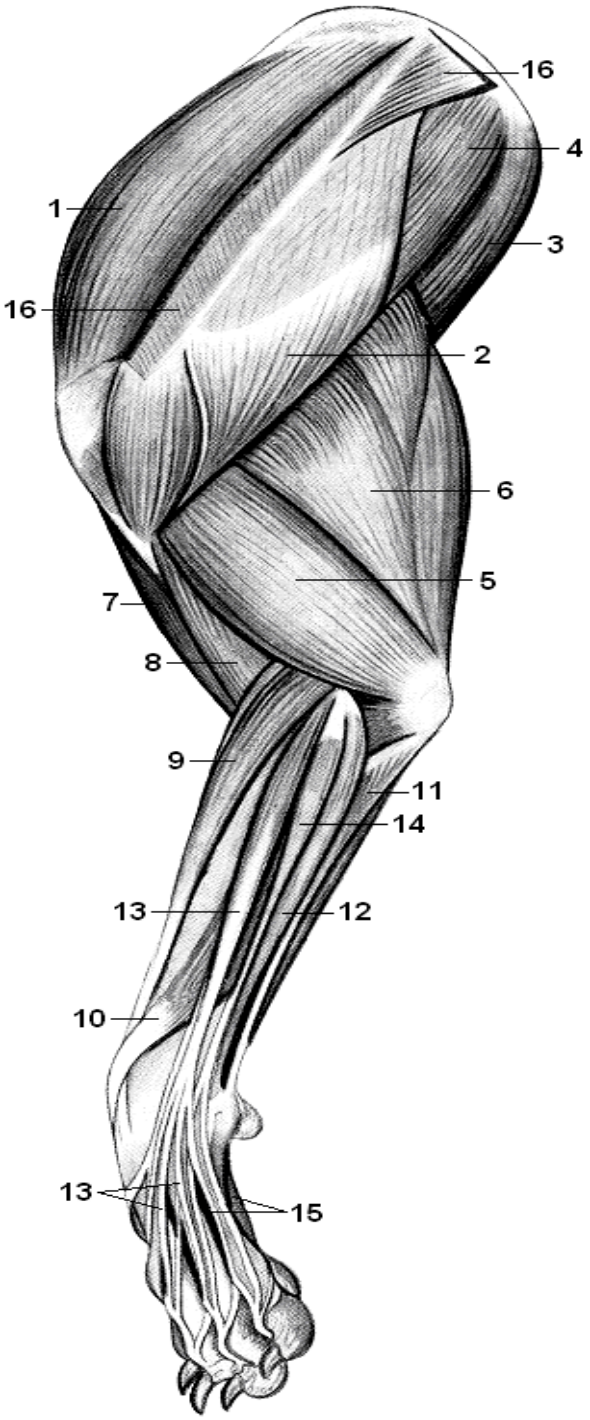
Origin.—(1) The internal epicondyle of the humerus; (2) the inner surface of the olecranon; (3) the middle of the caudal surface of the radius

and a small adjacent area of the ulna.

Insertion.—The third phalanx of each digits.

Action.—To flex the digit and carpus, and to extend the elbow.

MM. INTEROSSEI are situated chiefly in the metacarpal groove. Two, the **internus** and **externus,** are very small muscles, each of which arises from the corresponding small metacarpal bone near its proximal extremity, and is provided with a delicate tendon which is usually lost in the fascia at the fetlock. They have no appreciable action.



Muscles of thoracic limb of the dog

(lateral aspect)

1 – m. supraspinatus;
2 – m. deltoideus,
3 – m. teres major;
4 – m. infraspinatus;
5 – caput lateralis tricipitis,
6 – caput longum tricipitis;
7 – m. biceps brachii,
8 – m. brachialis;
9 – m. extensor carpi radialis;
10 – m. abductor digiti I longus;
11 – m. flexor carpi ulnaris,
12 – m. extensor carpi ulnaris;
13 – m. extensor digitorum communis,
14 – m. extensor digitorum lateralis;
15 – mm. interossei;
16 – m. trapezius.

Muscles of the pelvic limb (musculi membri pelvini) acting on the following joints:

- hip
- stiffle [knee]
- tarsal
- metatarsophalangeal
- proximal interphalangeal
- distal interphalangeal

Muscles of hip joint

Extensors of hip joint

M. GLUTAEUS SUPERFICIALIS lies behind and partly underneath the tensor fascia lata. It is triangular and consists of an anterior and a posterior head united by the gluteal fascia.

Origin.—The external angle and the adjacent part of the external border of the ilium.

Insertion.—The greater trochanter of the femur.

Action.—To abduct the limb, flex the hip joint, and tense the gluteal fascia.

M. GLUTAEUS MEDIUS is a very large muscle which covers the dorsal surface of the ilium and the greater part of the lateral wall of the pelvis, and extends forward also on the lumbar part of the longissimus.

Origin.—(1) The gluteal or dorsal surface and internal and external angles of the ilium; (2) the dorsal and lateral sacro-iliac and sacro-sciatic ligaments, and the gluteal fascia.

Insertion.—(1) The summit of the trochanter major of the femur; (2) the crest below the trochanter; (3) the outer aspect of the trochanteric ridge.

Action.—To extend the hip joint and abduct the limb. By its connection with the longissimus a muscular mass is formed which is one of the chief factors in rearing, kicking, and propulsion.

M. GLUTAEUS PROFUNDUS is much smaller muscle lies under the preceding muscle, and extends over the hip joint, from the superior ischiatic spine to the anterior part of the great trochanter.

Origin.—The ischiatic spine and the adjacent part of the shaft of ilium.

Insertion.—The trochanter major of the femur.

Action.—To abduct the thigh and to rotate it inward.

M. BICEPS FEMORIS is a large, long muscle lying in the lateral part of the buttock and thigh, behind and in part upon the superficial and middle glutei. It located on the latero-caudal surface of the thigh. It has two unequal heads: a cranial, superficial one, and a caudal, much smaller, deep one.

Origin.—(1) The sacral bone; (2) the tuber ischii.

Insertion.—(1) A cranial crest of tibia; (2) the patella; (3) the tuber calcis.

Action.—To flex the elbow joint, to fix the shoulder, elbow, and carpus in standing, and to tense the fascia of the forearm.

M. SEMITENDINOSUS is a long muscle which extends from the first two coccygeal vertebrae to the proximal third of the inner surface of the tibia. It lies at first behind the biceps, then passes downward on the back of the thigh, between that muscle and the semimembranosus.

Origin.—The ventral surface of the tuber ischii.

Insertion.—(1) The cranial crest of tibia; (2) the crural fascia and the tuber calcis.

Action.—To flex the stifle and rotate the leg inward; also to extend the hip and hock joints, acting with the biceps and semimembranosus in propulsion of the trunk.

M. SEMIMEMBRANOSUS lies on the inner surface of the preceding muscle.

Origin.—The ventral surface of the tuber ischii.

Insertion.—The medial epicondyle of the femur.

Action.—To extend the hip joint and to adduct the limb.

M. QUADRATUS FEMORIS lies under cover of the upper part of the adductor.

Origin.—The ventral surface of the ischium, just in front of the semimembranosus.

Insertion.—An oblique line on the posterior surface of the femur, near the lower part of the internal trochanter.

Action.—To extend the hip joint, and to adduct the thigh and rotate it outward.

Flexors of hip joint

M. ILIOPSOAS consists of two separate muscles: m. psoas major and m. iliacus.

M. PSOAS MAJOR

Origin.—The bodies and transvers processes of the last four lumbar vertebrae.

Insertion.— The lesser trochanter of the femoral bone.

M. ILIACUS

Origin.—The iliac bone and the wing of the sacrum.

Insertion.—The lesser trochanter of the femoral bone.

Action.— To flex the hip joint and to rotate the thigh outward.

M. TENSOR FASCIAE LATAE is triangular in form, with its apex at the external angle of the ilium.

Origin.—The external angle of the ilium.

Insertion.—The fascia lata, and thus indirectly to the patella, the external straight ligament, and the crest of the tibia.

Action.—To tense the fascia lata, flex the hip joint, and extend the stifle joint.

M. SARTORIUS extends from the sublumbar region to the lower and inner part of the stifle.

Origin.—The iliac fascia and the tendon of the psoas minor.

Insertion.—The internal straight ligament of the patella and the adjacent part of the tuberosity of the tibia.

Action.—To flex the hip joint and adduct the limb.

M. PECTINEUS is extends from the anterior border of the pubis to the middle of the inner border of the femur.

Origin.—The cranial border of the pubis.

Insertion.—The lesser trochanter of the femur.

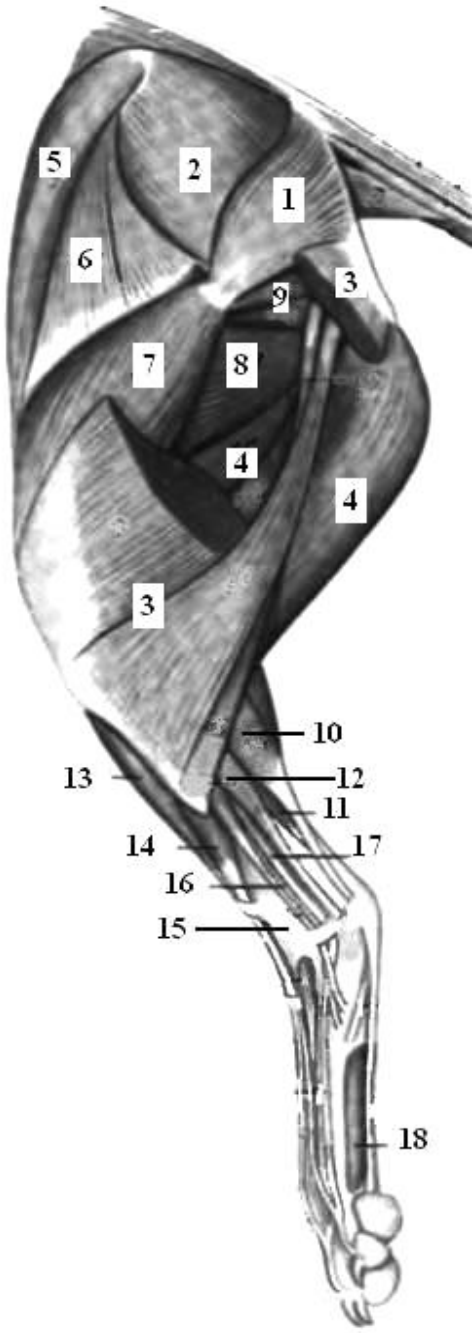
Action.—To flex the limb and adduct the hip joint.

Accessory flexor muscles

- m. rectus femoris

Abductors of hip joint

- m. glutaeus profundus.
- m. glutaeus medius.
- m. biceps femoris (for cattle – m. glutaeobiceps)



Muscles of
pelvic limb of the dog
(lateral surface)

1 – m. glutaeus superficialis
2 – m. glutaeus medius
3 – m. biceps femoris
4 – m. semitendinosus
5 – m. sartorius
6 – m. tensor fascie latae
7 – m. vastus lateralis
(m. quadriceps femoris)
8 – m. adductor
9 – m. guadratus femoris
10 – m. gastrocnemius (caput laterale)
11 – m. flexor digitorum superficialis
12 – m. flexor digitorum profundus
13 – m. tibialis cranialis
14 – m. extensor digitorum longus
15 – m. peronaeus longus
16 – m. peronaeus brevis
17 – m. extensor digitorum lateralis
18 – m. interosseous

Adductors of hip joint

M. GRACILIS is situated behind the sartorius.

Origin.—The pelvic symphysis and the ventral surface of the pubis.

Insertion.—The the internal surface of the tibia; and the patella and the fascia of the leg in horse.

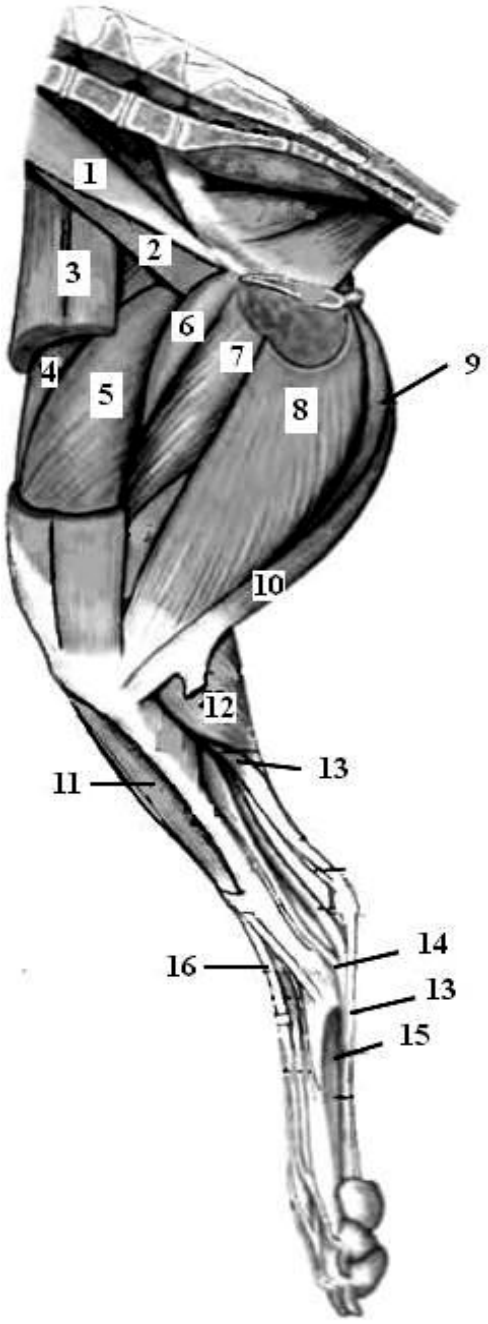
Action.—To adduct the limb. It may also rotate it inward.

M. ADDUCTOR lies behind the pectineus and vastus internus. It extends from ventral surface of the pelvis to the medial condyle of femur.

Origin.—The ventral surface of the pubis and ischium.

Insertion.—(1) The femur at level the greater trochanter; (2) the internal epicondyle of the femur.

Action.—To adduct the limb and assist in extending the hip joint. It may also rotate the femur outward.



Muscles of
pelvic limb of the dog
(medial surface)

1 – m. psoas minor
2 – m. iliopsoas
3 – m. sartorius
4 – m. rectus femoris
5 – m. vastus medialis
(m. quadriceps femoris)
6 – m. pectineus
7 – m. adductor
8 – m. gracilis
9 – m. semimembranosus
10 – m. semitendinosus
11 – m. tibialis cranialis
12 – m. gastrocnemius (caput mediale)
13 – m. flexor digitorum superficialis
14 – m. flexor digitorum profundus
15 – m. interosseous
16 – m. extensor digitorum longus

Rotators of hip joint

M. OBTURATORIUS EXTERNUS extends across the back of the hip joint from the obturator foramen to the trochanteric fossa.

Origin.—The ventral surface of the pubis and ischium, and the margin of the obturator foramen.

Insertion.—The trochanteric fossa.

Action.—To adduct the thigh and to rotate it outward.

M. OBTURATORIUS INTERNUS

Origin.—(1) The pelvic surface of the pubis and ischium around the obturator foramen; (2) the pelvic surface of the ilium and wing of sacrum.

Insertion.—The trochanteric fossa.

Action.—To rotate the fernur outward.

Accessory rotator muscles

- m. iliopsoas
- m. pectineus
- m. guadratus femoris
- m. biceps femoris
- m. glutaeus superficialis
- m. semimembranosus
- m. semitendinosus
- m. biceps femoris

Muscles of stiffle joint

Extensors of stiffle joint

M. QUADRICEPS FEMORIS is the large muscular mass which covers the front and sides of the femur. It has four heads, one of which, the rectus, arises from the ilium; the other three arise from the femur.

All are inserted into the patella.

M. RECTUS FEMORIS arises by two tendons.

Origin.—The body of the ilium above and in front of the acetabulum.

Action.—To extend the stifle joint and to flex the hip joint.

M. VASTUS LATERALIS lies on the outer surface of the thigh extending from the great trochanter to the patella.

Origin.—The external border and surface of the femur, from the great trochanter to the supracondyloid fossa.

Action.—To extend the stifle joint.

M. VASTUS MEDIALIS is smaller than the preceding muscle, and lies in a similar position on the medial side of the thigh.

Origin.—The internal surface of the femur, from the neck to the distal third.

Action.—To extend the stifle joint.

M. VASTUS INTERMEDIUS is deeply situated on the femur, and is entirely covered by the preceding heads.

Origin.—The dorsal and external surfaces of the femur, from the

proximal to the distal fourth.

Action.—To extend the stifle joint.

Accessory extensor muscles

- m. sartorius
- m. tensor fascie latae
- m. biceps femoris
- m. extensor digitorum longus
- m. peronaeus tertius

Flexors of stiffle joint

- m. semitendinosus
- m. biceps femoris
- m. semimembranosus
- m. triceps surae
- m. flexor digitorum superficialis

Muscles of tarsal joint

Extensors of tarsal joint

M. TRICEPS SURAE forms the back relief of the leg. It is formed by two muscles:

- m. gastrocnemius
- m. soleus

M. GASTROCNEMIUS arises by lateral and medial heads *(caput laterale et mediale)*.

Origin.—The plantar fossa (fossa plantaris). Two ***sesamoid bones*** (fabellae) are located under tendons of this muscle in the dogs

Insertion.—The tuber calcis.

M. SOLES is absens in the dog.

Origin.—The head of the tibia.

Insertion.—The tendon of the m. gastrocnemius.

Action.—To extend the tarsi and to flex of the stifle joint.

Accessory extensor muscles:

- m. flexor digitorum superficialis
- m. flexor digitorum profundus
- m. biceps femoris
- m. semitendinosus

Flexors of tarsal joint

M. TIBIALIS CRANIALIS is a superficial, strong, somewhat flattened muscle lying on the cranial surface of the crural skeleton. From its origin the muscle passes over the craniomedial surface of the crus, and near its distal third becomes a thin, flat tendon.

Origin.—The proximal epiphysis of tibia.

Insertion.—The tarsal and metatarsal bones.

Action.— To flex the tarsal joint, to extens of digital joints.

M. PERONAEUS LONGUS is the principal representative and the most superficial muscle of the fibular group. It lies in the proximal half on the lateral surface of the crus, close to the m. tibialis cranialis. It covers the proximal portions of the m. extensor digitorum lateralis.

Origin.—The lateral condyle of the tibia and the proximal end of the fibula.

Insertion.—The tarsal and metatarsal bones.

Action.— To flex the tarsal joint, to extens of digital joints. Rotation of the hindpaw.

M. PERONAEUS BREVIS is the deepest muscle of the fibular group. It is presented only in dog.

Origin.—The lateral surface of the distal thirds of the fibula and tibia.

Insertion.—The V-th metatarsal bone.

Accessory flexor muscles::

- m. extensor digitorum longus
- m. extensor digitorum lateralis

Muscles of digital joints of pes

Extensors of digital joints

M. EXTENSOR DIGITORUM LONGUS is situated superficially on the dorso-external aspect of the leg, and is provided with a long tendon which passes down over the front of the tarsus, metatarsus, and digit.

Origin.—The small fossa between the external condyle and the trochlea of the femur.

Insertion.—The third phalanx of each digits

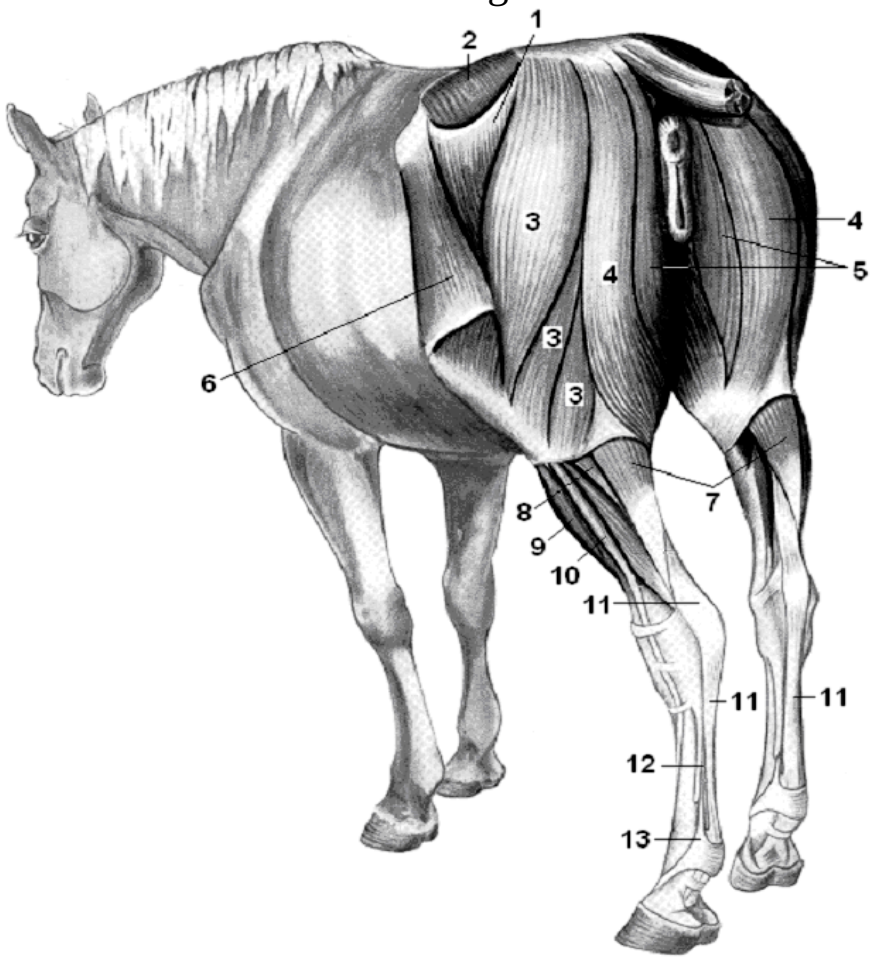
Action.—To extend the digit and flex the tarsi. It also assists in fixing the stifle joint.

M. EXTENSOR DIGITORUM LATERALIS lies on the outer surface of the leg, behind the preceding one.

Origin.—The external lateral ligament of the stifle joint, the fibula, the external border of the tibia, and the interosseus ligament.

Insertion.—The second falanx of IV-V digits.

Action.—To assist the extensor longus.



Muscles of pelvic limb of the horse

1 – m. glutaeus superficialis, 2 – m. glutaeus medius, 3 – m. biceps femoris, 4 – m. semitendinosus, 5 – m. semimembranosus;6 – m. tensor fascie latae; 7 – m. gastrocnemius, 8 – m. soleus; 9 – m. extensor digitorum longus, 10 – m. extensor digitorum lateralis; 11 – m. flexor digitorum superficialis, 12 – m. flexor digitorum profundus, 13 – m. interossei.

Flexors of digital joints

M. FLEXOR DIGITORUM SUPERFICIALIS lies between and under cover of the two heads of the gastrocnemius.

Origin.—The supracondyloid fossa (fossa plantaris) of the femur.

Insertion.—(1) The front and sides of the tuber calcis; (2) the eminences on the proximal extremity of the second phalanx of each digits.

Action.—To flex the digital joints and extend the tarsal joint.

MM. FLEXORES DIGITORUM PROFUNDI lies on the caudal surface of the tibia, and is divisible into three heads, which, however, finally unite on a common tendon of insertion.

Origin.—(1) The external condyle of the tibia; (2) the middle third of the caudal surface of the tibia, the caudal border of the fibula.

Insertion.—The third phalanx of each digits.

Action.—To flex the digital joints and to extend the tarsal joint.

M. INTEROSSEI

Origin.—The proximal extremity of metatarsal bone.

Insertion.—The sesamoid bones.

IMPORTANT ANATOMICAL STRUCTURES OF THE pelvic limb

The **FEMORAL CANAL** (canalis femoralis*)* is located medially on the thigh. It bounded by the *m. sartorius*, *m. gracilis* and *m. pectineus;* the deep wall for its form *m. iliopsoas and m. vastus medialis (quadriceps).* Canal outsides covers by the *femoral fascia*. The following structures pass through the femoral canal:

- *a. femoralis*
- *v. femoralis*
- *n. femoralis*

The **COMMON CALCANEAN TENDON** *(tendo calcaneus communis)* is formed by fusion of the following tendons:

- *m. triceps surae*
- *m. flexor digitorum superficialis*
- *m. biceps femoris*
- *m. semitendinosus*

It is attached on the tuber calci. The ***bursa tendinis calcanei*** is located between tendon and tuber calci.

The **SUBTENDINOUS BURSA OF DISTAL PHALANX OF PEDIS *(bursa podotrochlearis)*** is present only in horse. It founder between the tendon of m. flexor digitorum profundus and the third sesamoid or navicular bone. The terminal part of the tendon is bound down by the fibrous sheet.

COMMON INTEGUMENT

DERMATOLOGY – dermatologia (*derma* – skin, *logos* – science) – is a branch of anatomy studying the structure of the *skin* and its *derivatives (adnexa)*.

The **COMMON INTEGUMENT** – **integumentum commune**, comprises the skin with its adnexal structures (e.g., glands, hair, horn, hoof, claw,). It pertains to the ***somatic*** systems.

SKIN

Skin – *cutis* – is the protective covering of the body. covers the outside of the animal and is continuous with mucous membranes at oral, anal, and urogenital orifices, the vestibule of the nostril, and the palpebral fissure; these sites are characterized by a ***mucocutaneous junction***.

Thickness of skin varies both between species and on a given individual, being generally thickest where it is most exposed (e.g., on the back) and thinner in protected regions (e.g., the groin). It is also depends on the breed, sex, and age. The color also varies greatly, but this is masked in most places by the covering of hair or wool.

The skin adheres tightly to underlying structures in some locations, but in others is loosely attached to allow for considerable movement. The looseness of skin attachment is exploited by veterinarians who frequently inject medications or fluids for rehydration into the space underneath the skin (a ***subcutaneous*** injection), especially in small animals.

The skin is an important protective barrier which reduces water loss, invasion by microorganisms, and abrasive trauma. For many species, it is an important organ of thermoregulation through perspiration, control of cutaneous blood flow, and disposition of the hair coat.

Modifications of the integument are used for protection (claws and horns) and provide a tough covering to the feet where they contact the ground (hoofs and pads). It contains peripheral ramifications of the sensory nerves, and is thus an important sense organ. It is the principal factor in the regulation of the temperature of the body, and by means of its glands it plays an important part in secretion and excretion. Some of its special horny modifications or appendages are used as organs of prehension or as weapons.

Skin functions

1. *Protective function.* The skin prevents the penetration of microorganisms, ultraviolet rays of the sun, as well as exposure to chemical and mechanical irritants.

3. Skin is an extensive *receptor field* as it contains a numerous nerve terminals (receptors). It provides communication between the body and the environment. Due to the receptor function of the skin, the body receives tactile information – pain, heat, itching and others. Stimulation of biological active points (acupuncture, massage) affects positively the viscera.

4. *Synthesizing function*. Vitamin D is synthesized in the skin under the action of ultraviolet rays of the sun.

5. *Excretory function*. Sweat is excreted through the glands of the skin, which excretes excess water, salts, drugs, etc.

6. *Thermal regulation.* This is is due to the developed vascular network.

7. *Economic value* of the skin and its derivatives is as follows: milk and fat are important food products; hide and wool are raw materials for light industry; wool fat is a valuable ointment base, etc.

8. Skin is an important object in *diagnosis.*

Skin structure

The skin consists of three layers:

- epidermis
- dermis [corium]
- subcutaneous tissue

I. The outer layer of skin, the ***epidermis,*** is an avascular stratified squamous epithelium that is nearly free of nerve endings. In most areas it can be divided into several histologic layers:

- *stratum corneum*
- *stratum lucidum*
- *stratum granulosum*
- *stratum spongiosum, s. spinosum*
- *stratum basale*

The ***corneous layer*** is a multi-layer epithelium whose keratinized cells desquamate in scales.

The deep layers of the epidermis are formed by actively dividing cells. They are united by the term **germinative layer** – *stratum germinativum*, epidermis. The germinative layer lies on the basal membrane. There are no blood vessels in the epidermis.

The drying and hardening of the superficial cells, a process called both keratinization and cornification, renders the surface of the skin tough and resistant to drying.

II. The ***dermis (corium)*** – **derma** – is made up of two layers:

- *papillary layer (outert)* – **stratum papillare**
- *reticular layer (inner)* – **stratum reticulare**

The dermis includes:

- collagen and elastic fibers
- hair follicles, hair arectors – **mm. arrector pilorum**
- nerves and nerve terminals
- blood and lymph vessels
- sweat and sebaceous glands

Sensory nerve fibers, in addition to supplying the dermis, may extend a short distance into the epidermis. Color of skin is due to the pigment granules generated in the cytoplasm of the resident pigment cells, melanocytes. These cells in the basal stratum produce the pigment, melanin, which is brown, yellowish-brown, or black.

Absence of pigment in the skin (albinism), which may be partial or total, arises from a genetic inability of melanocytes to manufacture pigment. Lack of pigment can render the skin and surface mucous membranes more susceptible to actinic damage (i.e., cellular damage due to ultraviolet light); hence formation of carcinoma (cancer) of the skin or other exposed epithelia.

III. The ***subcutaneous tissue*** or ***hypodermis*** – **tela subcutanea** – connects the skin to the underlying fascia (fibrous tissue) of the bones and muscles. It is not strictly a part of the skin, although the border between the subcutaneous tissue and dermis can be difficult to distinguish. The subcutaneous tissue consists of well-vascularized, loose, areolar connective tissue and adipose tissue, which functions as a fat storage and provides insulation and cushioning for the integument. It is attached to the superficial fascia.

Variable amounts of fat, the **panniculus adiposus**, are present in the hypodermis, with species-dependent distribution and relative abundance.

The panniculus adiposus is an especially notable feature of pigs; on the dorsum of the pig, it is called backfat.

The skin forms folds. Cattle fatness is determined based on the thickness of the knee fold. ***Subcutaneous synovial bursae*** are formed between the skin and bony prominences.

DERIVATIVES OF SKIN

I. **Glandular:**

- sweat glands
- sebaceous glands
- mammary glands
- specialized glands

II. Corneous:

- horn
- hair
- digital organ
- pad

GLANDULAR DERIVATIVES OF SKIN

The ***cutaneous glands*** (glandulae cutis) are specialized organs carrying out the secretory function.

Gland has two parts:

- secretory department – *portiones terminalae*
- excretory duct – *ductus excretorii*

Classification of glands

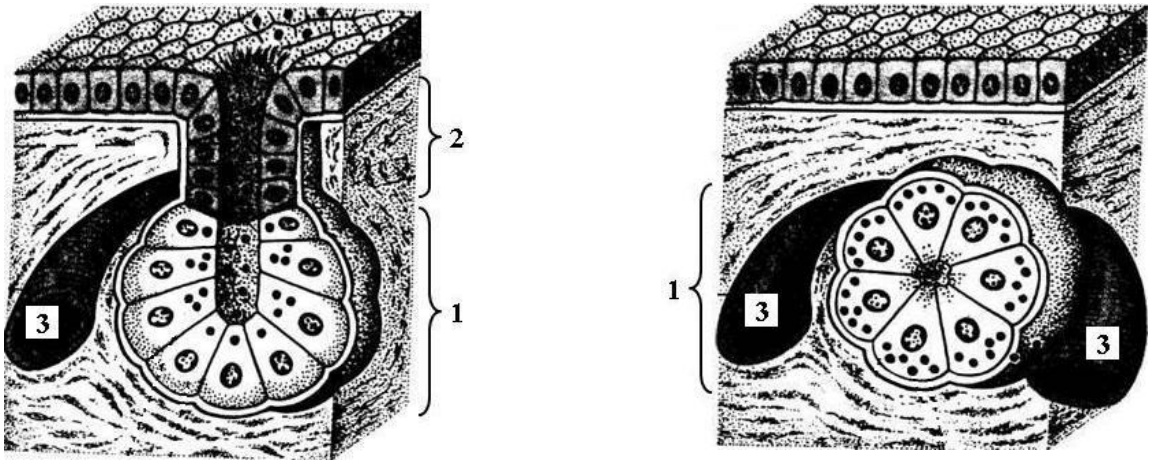
I. By the presence of an excretory duct:

An exocrine gland has an excretory duct, and the secretion is excreted to the skin surface or into an organ cavity (stomach, intestine, etc.). Skin glands are exocrine glands.

An endocrine gland does not have an excretory duct, and the hormones are excreted into the blood or lymph.

II. By the structure of secretory department:

- alveolar (saccular) glands
- tubular glands
- tubulo-alveolar glands



1 – secretory department, 2 – excretory duct вивідна протока, 3 – blood vessel

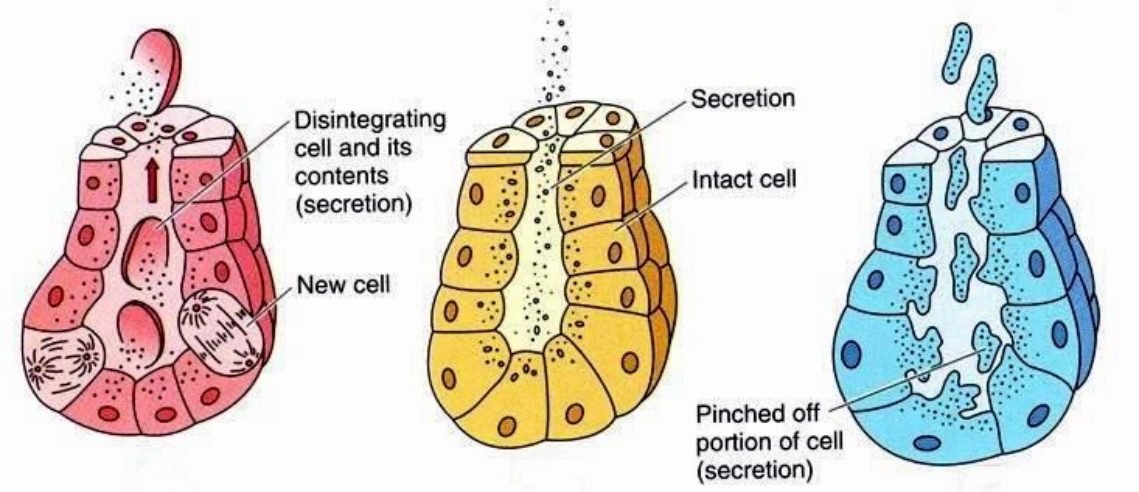
II. By the structure of excretory duct:

Ducts can be *branched* or *unbranched*.

- *simple gland* – the excretory duct does not branch, and only one secretory department is linked to it
- *branched gland* – the excretory duct does not branch, and several secretory departments open into it
- *complex gland* – the excretory duct branches and each of the branches is linked to one secretory department
- *complex branched gland* – the excretory duct branches, and each of the branches is linked to several secretory departments

III. By the method of excretion:

- *merocrine gland* (the excreting cells do not disintegrate)
- *apocrine gland* (the top of the excreting cell disintegrates during secretion)
- *holocrine gland* (the excreting cells disintegrate and results in the secretion of the product into the lumen)



A –holocrine gland *B – merocrine gland* *C – apocrine gland*

SWEAT GLAND

Sweat gland or *sudoriferous gland* – **glandula sudorifera**:

- tubular – by the structure of the secretory department
- simple – by the structure of the excretory duct
- merocrine – by the method of excretion
- excretes the *sweat* – **sudor**

Sweat glands are located in deep basal skin layers, and sometimes in the subcutaneous tissue. Their excretory ducts open to the skin surface, sometimes to the hair follicle. Perspiration is well developed in horses and sheep. Sweat glands are poorly developed in goats, rabbits, and they are localized only in pads in dogs and cats.

Sweat glands can be found over the entire body of farm animals. The glands occur on the planum nasolabiale of the cow, planum nasale of the sheep, and planum nasale of the pig (all hairless areas of the nose), where they moisten these surfaces but play little role in cooling. Excretion of sweat from the body surface cools down the body and protects it from overheating. Many modified epithelial structures, including hoofs and horns, lack sweat glands.

SEBACEOUS GLAND

Sebaceous gland – **glandula sebacea**:

- acinar – by the structure of the secretory department
- simple – by the structure of the excretory duct
- holocrine – by the method of excretion
- excretes the *skin fat* – **sebum**

Skin fat lubricates and waterproofs the epidermis and hair.

Most of these glands are derived from the external epithelial root sheath and empty their secretion into the hair follicle. Contraction of the arrector pili muscle compresses the glands and aids in emptying them. Sebaceous glands that open directly onto the skin surface include those in the ear canal, around the anus, and in the penis, prepuce, and vulva, along with the tarsal glands of the eyelid, skin of the scrotum, and udder. They are located all over the body in sheep. There are no sebaceous glands in pads.

Certain animals have specialized sebaceous glands. Sheep have several cutaneous pouches that are lined with sebaceous glands. These are the: (1) ***infraorbital pouches***, found at the medial canthus of the eye and

larger in rams than in ewes; (2) ***interdigital pouches*** on the midline above the hoofs of all four feet; and (3) ***inguinal pouches*** near the base of the udder or scrotum.

Goats have sebaceous ***horn glands*** caudal to the base of the horn.

MAMMARY GLANDS

The *mammary glands* – **glandula mammaria –** are only developed in mammals. They become fully developed in mature females.

Mammary gland:

- tubuloacinar – by the structure of the secretory department
- complex branched – by the structure of the excretory duct
- mixed secretion type (apocrine and merocrine)
- secretes the *milk* – **lac, s. galactos**

There are three types of mammary glands:

- multiple udder
- compact udder
- breast

Multiple udder (udders) – **ubera** – the mammary lobes in the form of hillocks and locates on the ventral thoracic and abdominal walls (in dogs and cats).

Compact udder – **uber** –2-4 mammary lobes are located caudally on the ventral abdominal wall. This udder is typical of ruminants and mares.

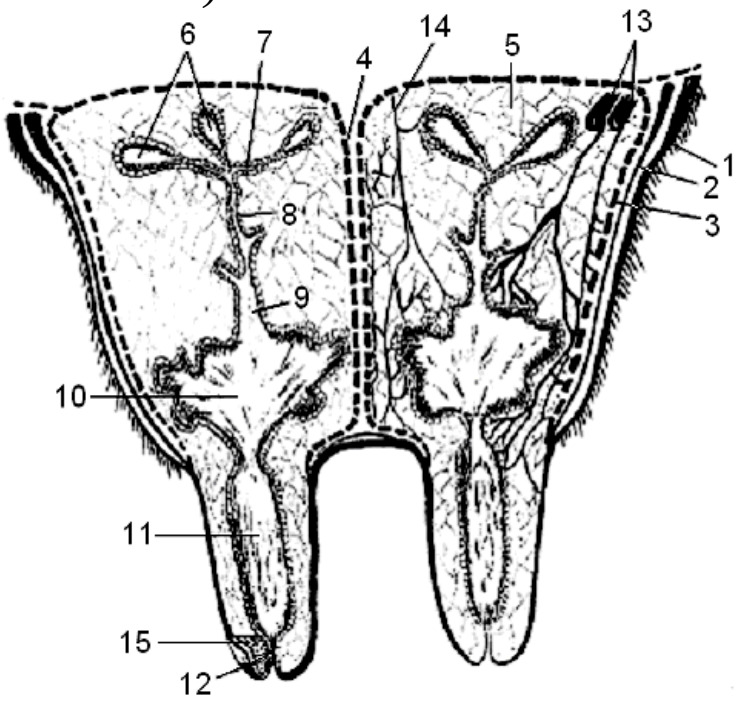
Breast – **mamma** – one pair of mammary lobes is located on the ventral thoracic wall (elephants and primates).

UDDER

A cow's udder (**uber)** includes: *base* – **basis uberi,** *body* – **corpus uberi,** *nipples* – **papille uberi.**

The udder base is adjacent to the abdominal wall. The caudal surface of the udder is called ***milk mirror***. The surface of the udder is covered by soft ***skin***. The ***superficial fascia of the udder*** (*fascia superficialis)* is located under the skin, and under it lays the ***deep fascia of the udder (fascia profunda)***. The deep fascia forms ***suspensory ligament of the udder*** *(lig. suspensorium uberi),* which divides the gland into the left and the right halves. Each half has cranial and caudal lobes. The parenchyma (secreting tissue) of udder lies under the deep fascia.

The *stroma* of the mammary gland is connective tissue. Connective trabecules of the organ divide it into ***lobules*** *(lobuli glandulae mammariae).*

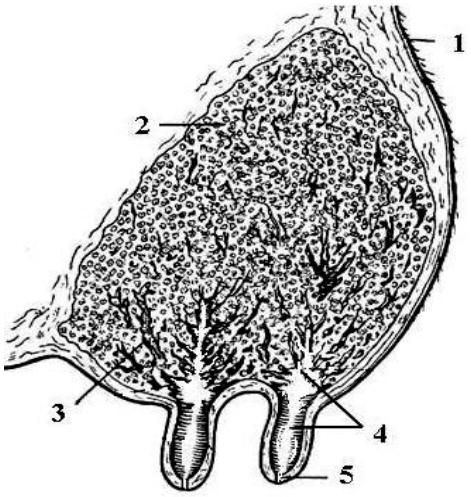


Scheme of the udder structure of cow

1 – skin of udder, 2 – superficial fascia of udder, 3 – deep fascia of udder, 4 – suspensory ligament of udder, 5 – stroma, 6 – lactiferous alveoli, 7 – lactiferous tubules, 8 – lactiferous canals, 9 – lactiferous ducts,10 – glandular part of lactiferous sinus, 11 – papillary part of lactiferous sinus, 12 – papillary duct, 13 – blood vessels, 14 – nerves, 15 – sphincter of teat.

The *excretion system* of the mammary gland begins by ***lactiferous canals*** (canales lactiferi). These merge and form the ***lactiferous ducts*** (ductuli lactiferi), which open into the ***lactiferous sinus*** (sinus lactiferi). Sinus consists of two parts: ***glandular*** (pars glandularis) and ***papillary*** (pars papillaris). Papillar part of sinus passes into the *papillary duct* (ductus papillaris), that opens at the top of the teat.

The *papillary sphincter* closes orifices of teat.



Left half of the cow's udder
(sagittal section)

1 - skin of udder
2 - lobule of udder
3 - lactiferous ducts
4 - lactiferous sinus
5 - teat opening

CORNEOUS DERIVATIVES OF SKIN

HORN

The ***horn*** (cornu) is an organ of attack and defense. Horns of cattle and sheep are formed over the cornual process that projects from the frontal bone of the skull and the corneous capsule. The cornual process contains a cavity, the frontal sinus (sinus frontalis). Both male and female cattle of horned breeds have horns, although the female animal's horns are smaller. In most horned sheep and goat breeds, both males and females have them, although in a few breeds only rams or bucks are horned. Animals that lack horns naturally are **polled.** The corium of the horn completely envelops the cornual process and blends with its periosteum. The horn itself consists of dense keratin, much like the hoof wall, and elongates from the base. A soft type of horn called the **epikeras** covers the surface of the horn at the base and extends toward the apex of the horn. The epikeras resembles the periople of the hoof.

The horn has:

- *base (root)* – **radix cornus s. basis cornus**
- *body* – **corpus cornus**
- *apex [tip]* – **apex cornus**

External structure of horn of the cattle

1 - base, 2 - body, 3 -apex, 4 - horn rings.

Variations in level of nutrition of the animal are reflected in variations in rapidity of horn growth, resulting in a series of rings on the horn. These alternations in thickness of the horn may reflect seasonal stresses, notably the stress of calving in cows. The age of a cow bearing calves annually may be estimated by counting the rings on the horn.

HAIR

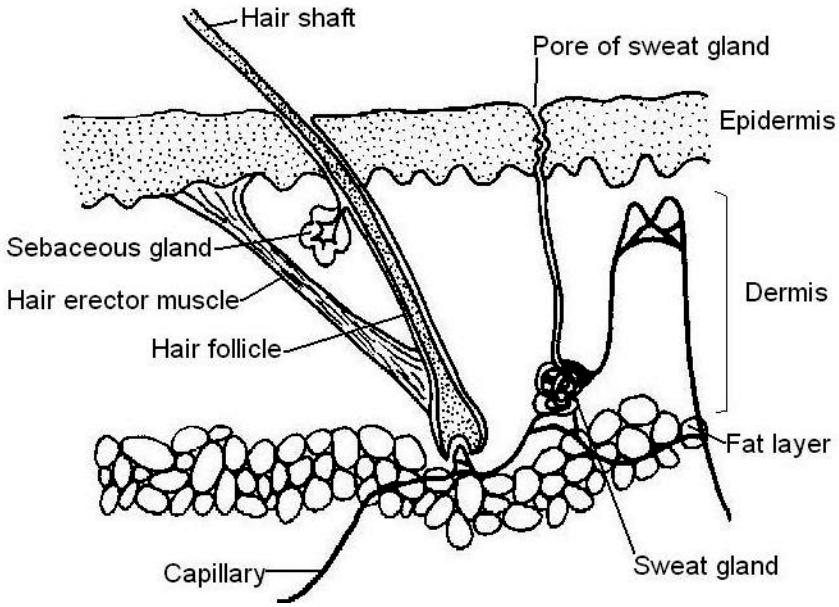
Hair (pilus) is a defining characteristic of mammals. All common domestic mammals except the pig have abundant hair.

The **hair** has:

- *shaft* (scapus pili) protruding above the skin
- *root* (radix pili) lying in the skin

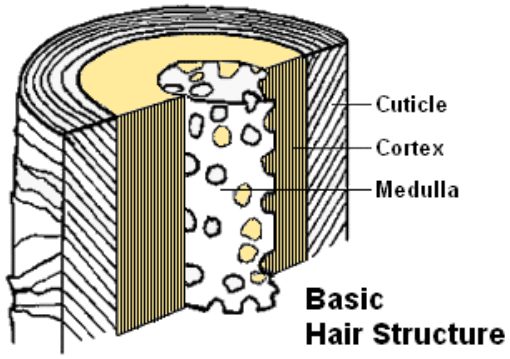
An individual hair arises from a modification of the epidermis, the hair follicle.

The follicle invaginates from the surface of the skin as a double-layered root sheath that surrounds the hair and terminates in a hair bulb of epidermal origin. The hair bulb surrounds a small knob of dermis called the dermal papilla.



Location of hair (scheme)

The *internal epithelial root sheath* intimately covers the root of the hair and is continuous with the epithelial cells covering the dermal papilla. The *external epithelial root sheath* surrounds the internal root sheath, is continuous with the epidermis, and gives rise to the sebaceous glands that are associated with hair follicles.The division of the epithelial cells covering the dermal papilla generates the hair itself. A rich network of capillaries supplies the germinative epithelium as long as the hair is growing.



Basic Hair Structure

The hair shaft has a *medulla* at its center, surrounded by a scaly *cortex*, outside of which is a thin cuticle. All parts of the hair are composed keratinized epithelial cells. The bulk of the hair comprises the cortex, which consists of several layers of cornified cells.

The amount and type of melanin in cortical cells determine whether the hair will be black, brown, or red. The cuticle is a single layer of cells covering the surface of the cortex. The medulla may contain pigment, which has little effect on hair color, but air spaces between medullary cells are believed to give a white or silver color to the hair if the cortex lacks pigment.

The *arrector pili muscle* is a tiny bundle of unstriated muscle fibers that extends from the deep portion of the hair follicle at an angle toward the epidermis. Contraction of the muscle will straighten the hair toward 90°.

Hair classification

There are three main types of hair on domestic mammals: (1) *guard* hairs, which form the smooth outer coat; (2) *wool* hairs, also called the undercoat, which are fine and often curly; and (3) *long* hair and (4) *tactile* hairs, long stiff hairs with specialized innervation – organs of touch.

Wool hairs lack a medulla.

Tactile hairs *(pilli tactile)*, or si n u o u s hair (whiskers, vibrissae) used as feelers, are also called sinus hairs because a large blood-filled sinus surrounds the deep portions of the follicle. These hairs are thicker and usually longer than guard hairs, most commonly found on the face, around lips and eyes. These hairs are particularly well supplied with sensory nerve endings that are sensitive to the movement of the hair.

L o n g hair is thick and coarse. It is found in some protective parts of the body. In horses, it forms *mane* (juba), *forelock* (cirrus capitis), *tail hair (*cirrus caudae), and *fetlock* (cirrus pedis). In goats, long hair on the muzzle forms the *beard* (barba).

A seasonal shedding of the hair coat from the light coat of summer to the heavy coat of winter and back again is characteristic of most domestic species.

Hair streams **– flumina pilorum:**

- *convergent hair vortex* – tops of hair shafts are directed in one point
- *divergent hair vortex* – tops of hair shafts are directed in different sides from a certain point
- *convergent hair line* – between two hair streams is formed a hair roll
- *divergent hair line* – hair streams are dispersed in two opposite sides

DIGITAL ORGAN

Digital organ *(organum digitale)* **is**:

- *hoof* (ungula) in horses
- *claw* (unguicula) ruminants, carnivores

Hoofed animals are ungulates. A defining characteristic of ungulates is the presence of a well-developed hoof associated with the distal phalanx. Although the hoofs of pigs, ruminants, and horses differ significantly in their gross appearance, they share certain features.

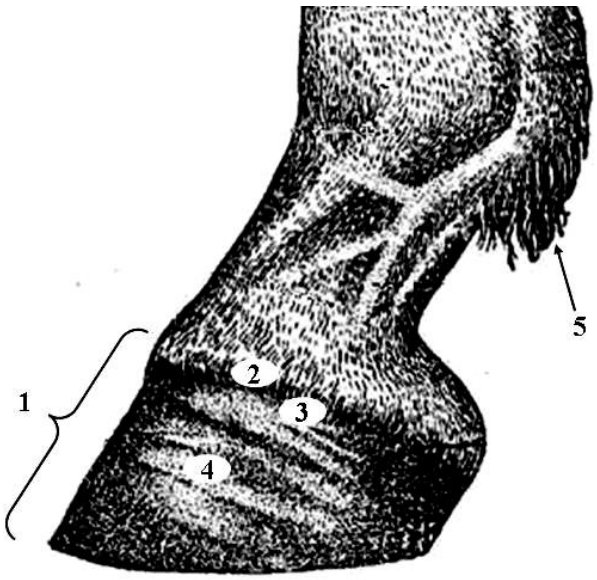
HOOF

The **HOOF** (ungula) is the distal part of the digit enclosed by a corneous covering (capsule). It has five parts: limbus, corona, paries, sole, and frog.

Limbus (limbus ungulae) is a thin band 5 to 6 mm. in width which lies at the border between the hairy skin and the top of hoof.

Digit of horse

1 – hoof
2 – limbus
3 – corona
4 – hoof paries
5 – fetlock [cirrus metacarpeus]

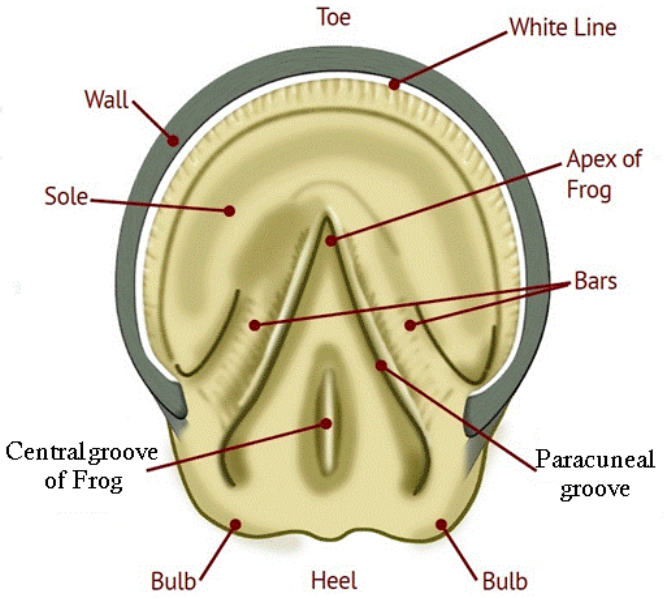


Corona (corona ungulae) is a part of the hoof 1.3-1.5 cm in width which lies underneath the limbus.

Hoof paries (paries ungulae) is defined as the part of the hoof which is visible when the foot is placed on the ground. It forms the front and sides surfaces of the hoof and is reflected posteriorly at an acute angle to form the bars.

It includes:

- front wall
- collateral walls (lateral and medial)
- bars (lateral and medial)

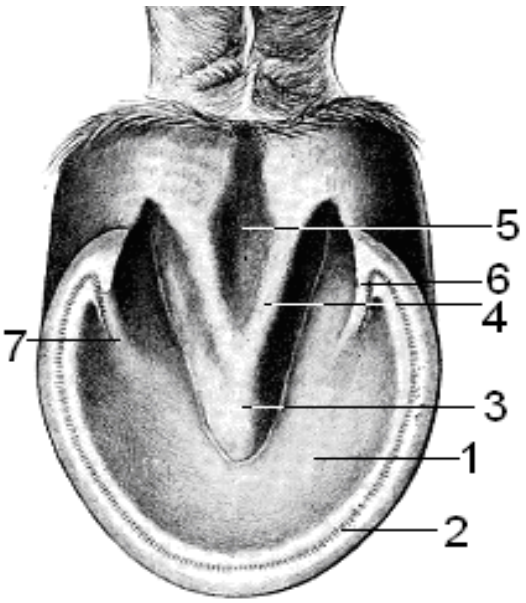


Sole (solea ungulae) forms the greater part of the ground surface of the hoof. It is somewhat crescentic in outline, and presents two surfaces and two borders. It is divided into:

- *body of sole* – corpus soleae
- *medial crus of sole* – crus soleae medialis
- *lateral crus of sole* – crus soleae lateralis

Frog [cuneus] (furca, s. cuneus ungulae) is a wedge-shaped mass which occupies the angle between the bars and sole, and extends considerably below these on the ground surface of the foot.

It includes: apex of frog, medial crus of frog and lateral crus of frog.



Hoof sole

1 – horny sole
2 – white line of hoof
3 – apex of frog
4 – crus of frog
5 – intercrural groove
6 – heel angle
7 – bar

Modified skin layers of hoof

Like the skin from which they are derived, hoofs have an outer avascular epidermal layer and an inner vascularized dermis; the dermis of hoofs and horns is more commonly called corium. Different parts of the epidermis and corium of the hoof are named for their location.

The *subcutaneous tissue* of the hoof is moderately developed in the limbus; it forms ***coronary cushion*** in the region of corona; it is absent in

the region of the wall and the sole. Deep to the bulb of the hoof is a shock-absorbing modification of the subcutis called the digital pad (flexible ***frog)***. It forms a large part of the palmar/plantar aspect of the feet.

The *reticular layer of dermis* forms a vessel network; therefore, it is called the ***vascular layer*** in all hoof parts.

The *papillary layer of the dermis* forms the dermal papillae, and this layer is called the ***laminar layer*** of the wall matrix.

The *epidermis* of the hoof forms a ***corneous capsule***. The *germinative layer* of epidermis is well-developed in all parts of the hoof. The *corneous layer* of epidermis is called the **periople** (a thin, waxy layer that cover outside of the hoof in the region of limbus; **tubular horn** in region of the corona, sole and frog; **laminar horn** in region of the wall.

The thick hoof wall grows from a belt of epidermis at the corona. The deep side of the hoof wall is intimately connected to the underlying corium, which blends with the periosteum of the distal phalanx. The connection between hoof wall and corium is characterized by interdigitating sheets of hoof wall and corium. These are the laminae, of which there are *insensitive laminae* (laminar horn) and *sensitive laminae* (part of the corium). Laminar horn are non-pigmented so when the epidermal laminae appear on the solar surface, a non-pigmented region known as the **white line** (linea alba) appears. The white line is used as important landmark in farriery as structures central to the line will be vascular and sensitive.

Anatomical composition of hoof

The hoof contains elements of all somatic system groups:

Bone (skeletal) system:

Ungular bone – os *ungulare*
(phalanx distalis, phalanx tertia – ph. III)
Distal sesamoid bone – *os naviculare* s. *os sesamoideum distale*
Distal epiphysis of the **coronary bone** [middle phalanx] – *os coronale*
(phalanx media, phalanx secunda – ph. II)

Joint system:

Distal interphalangeal joint – *articulatio ungulare*
Collateral ligaments – *lig. collaterale mediale et laterale*
Navicular bone ligaments:

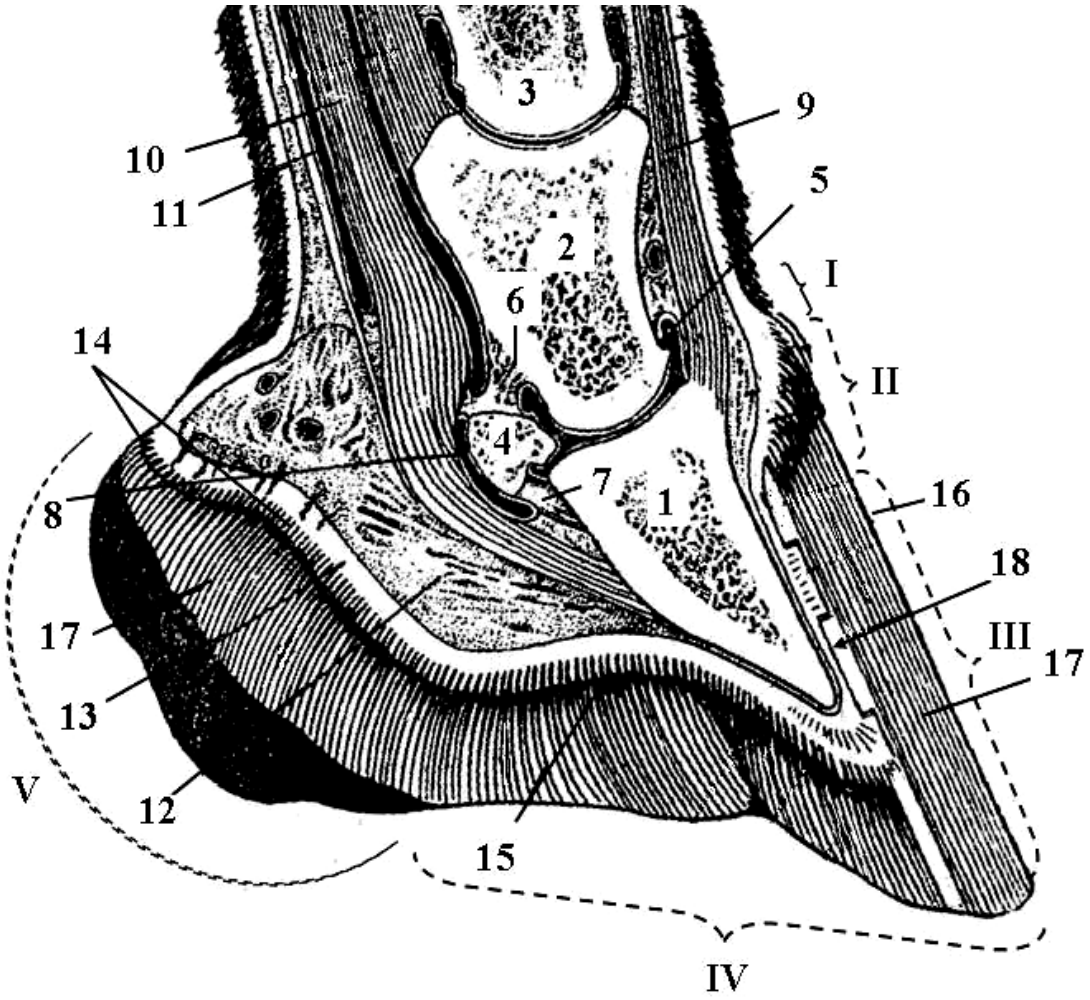
- coronal sesamoidean – *lig. sesamoideum coronale*
- ungular sesamoidean – *lig. sesamoideum ungulare*

Muscular system:

Terminal parts of **tendons** of the flexores and extensores **muscle** of coffin joint

Sinovial tendon sheath

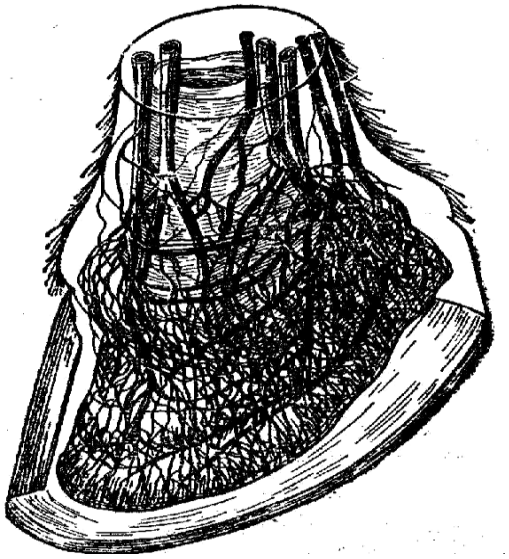
Subnavicular synovial **bursa** – *bursa podotrochlearis*



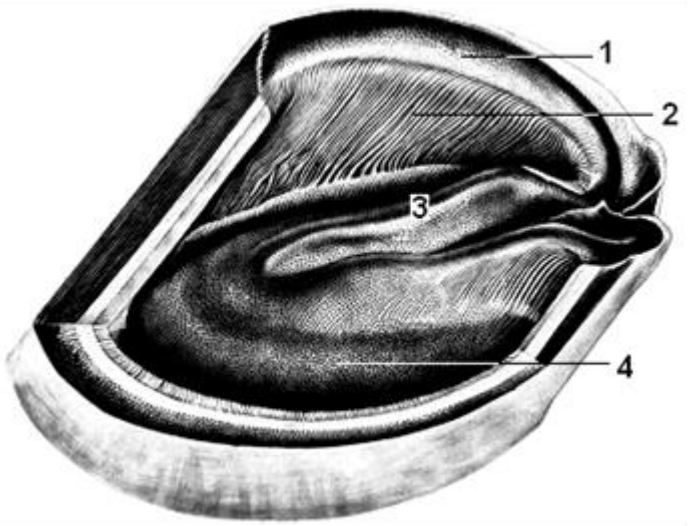
Sagittal section of hoof of the horse

I – limbus, II – corona, III – paries, IV – sole, V – frog

1 – ungular bone (distal phalanx)
2 – coronary bone (middle phalanx)
3 – proximal phalanx
4 – sesamoid bone
5 – distal interphalangeal joint
6 – chondrosesamoid ligament
7 – distal sesamoid ligament
8 – subtendinous bursa of distal phalanx
9 – extensor digitorum (tendo)
10 – flexor digitorum profundi (tendo)
11 – synovial sheath of tendon
12 – subcutaneous tissue
13 – vascular layer of dermis
14 – papillary layer of dermis
15 – germinative layer of epidermis
16 – perioplum
17 – epidermal tubules
18 – epidermal lamellae



Vascular rete of hoof

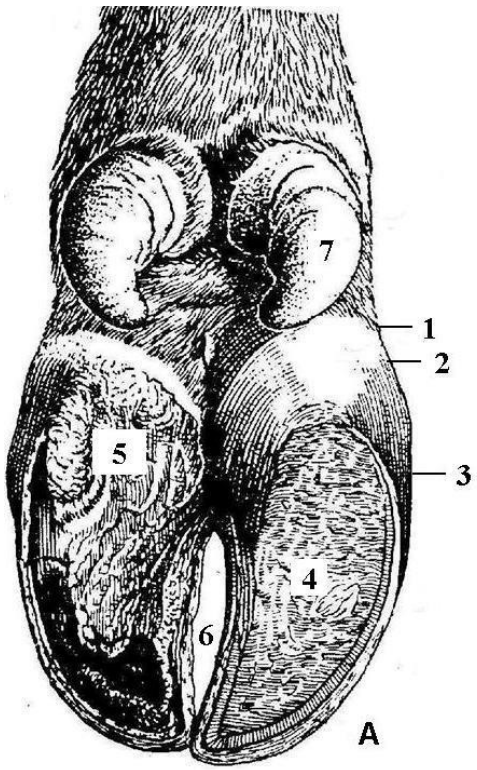


Corneous capsule of hoof (inside)

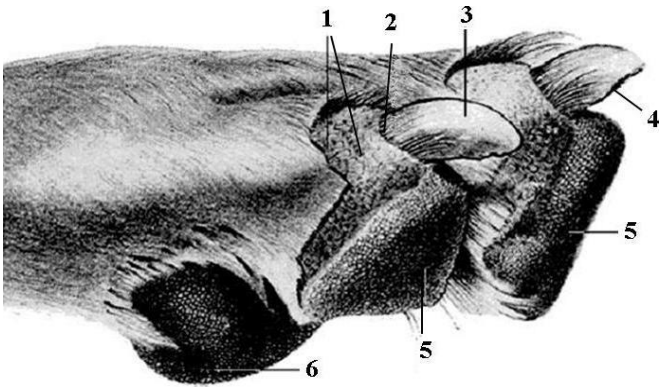
1 – coronal groove, 2 – corneous laminae of paries, 3 – corneous frog, 4 – corneous sole

CLAW

The **claws of a cattle, sheep, and goats** resemble a disc split in half, hence the term *cloven-hoof.*



1 – limbus, 2 – corona, 3 – paries, 4 – corneous sole, 5 – digital cushion, 6 – supporting digit, 7 – suspension digit.



1 – ungual limbus, 2 – ungual groove, 3 – paries, 4 – sole, 5 – digital pads, 6 – metacarpal pad.

Claws
A – cattle, B – dog

The split is named the interdigital cleft and gives rise to the flattened axial surface, the abaxial surface is the remaining rounded surface of the claw. The claws, like the hoof, includes: limbus, corona, walls, and sole.

A claw looks like a half of the horse's hoof. The difference lies in the asymmetry of the claws, absence of bars, poor development of the sole, absence of the frog, and the pronounced digital pads.

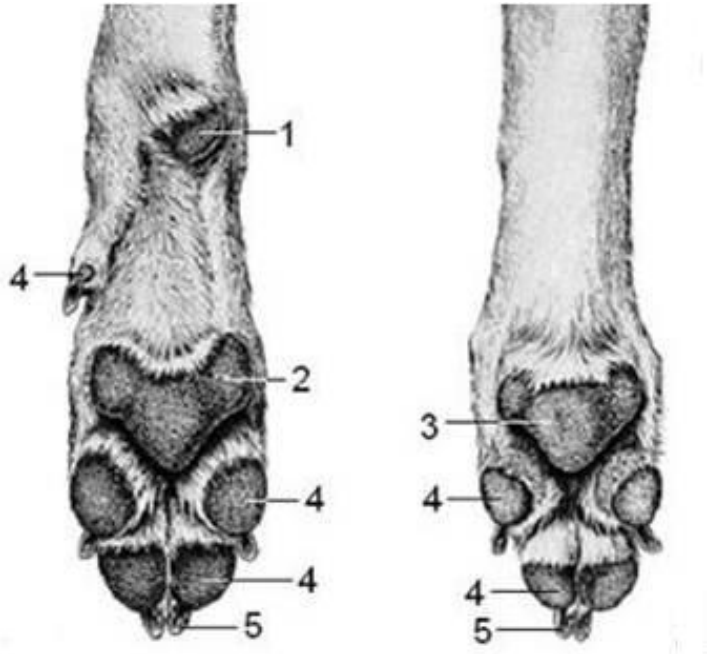
The **claws of dog** includes pad with claw groove, wall, and sole.

PADS

The **PADS** (torus, s. pulvinar), is a dense, elastic, flexible skin formation in the region of hand and foot. The digital cushion is made up of subcutaneous adipose tissue which is partitioned by reticular, collagenous, and elastic fibers. Many elastic fibers are present in the deeper layers. The cushions consist of the epidermis, dermis, and the subcutaneous tissue. Epidermis is covered with a thick, soft corneous layer. The dermis contains many flexible fibers, vessels, nerve terminals, and sweat glands.

Pads are hairless parts of the skin and perform the tactile and shock-absorbing functions. There are several types of pads:

- carpal pad – *torus carpeus*
- tarsal pad – *torus tarseus*
- metacarpal pad – *torus metacarpeus*
- metatarsal pad – *torus metatarseus*
- digital pad – *torus digitalis*



A **B**

Pads of dog

A – forepaw
B – hindpaw
1 – carpal pad
2 – metacarpal pad
3 – tarsal pad
4 – digital pad
5 – claw

Pads of domestic animals

Species of animals	Pads name				
	carpal pad	tarsal pad	metacarpal pad	metatarsal pad	digital pad
Cattle	—	—	—	—	+
Horse	+ callum	+	+ calcar	+	furca
Dog	+	—	+	+	+

Note: + - pads are present; — - pads are absent

TEST QUESTIONS

1. The somatic group includes the following systems:
1) Nerve, muscle, glands of internal secretion.
2) The nervous, cardiovascular.
3) Bone, muscle, bone connection, skin
4) Cardiovascular, reproductive, skeletal, muscular.
5) Cardiovascular, nervous system, analyzers, endocrine glands.

2. Apparatus of organs is:
1) A complex of organs, that is similar to structure and functions.
2) A complex of organs, that is similar to functions, but different in the structure.
3) A complex of organs, that is different to structure and functions.

3. Definitive organs are:
1) the organs that disappearance due to loss their function
2) the organs which had ancestry, but now these organs appear in the progeny with genetic changes
3) the organs that persisting through life
4) the organs that are functioned in a particular age period (deciduous (baby) teeth)

4. The integral group includes the organ systems:
1) Cardiovascular, reproductive, skeletal, muscular.
2) The nervous, cardiovascular.
3) Nerve, muscle, glands of internal secretion.
4) Cardiovascular, nervous system, analyzers, endocrine glands.
5) Blood, bone, lymph.

5. Directions which determine from sagittal plane are:
1) Lateral and medial.
3) Dorsal and ventral.
2) Cranial and dorsal.
4) Cranial and caudal.

6. The principle of two tubes is the following:
1) The animal body divides into right and left symmetrical halves.
2) In the animal body one axis is identified.
3) The animal body divides into a certain number of parts (segments, metamers), which relatively similar in structure.
4) In the animal body the nervous and visceral tubes are distinguished.

7. Links of the free pelvic limbs are located in the following sequence:
__ crus __ digitus __ metatarsus __ femur __ tarsus

8. The main difference of the typical cervical vertebrae from the thoracic are:
1) The presence of the transverse-costal processes, no costal foveae.
2) The presence of the transverse-costal processes.
3) The absence of the spinous processes.
4) The presence of the transverse process, no costal foveae.
5) The presence of the transverse foramens.

9. Directions which determine from segmental plane are:
1) Dorsal and ventral. 3) Cranial and caudal
2) Cranial and dorsal. 4) Lateral and medial.

10. The true rib:
1) achieve to the sternum 2) form the costal arch
3) don't achieve to the sternum

11. Link of the free thoracic limbs are located in the following sequence:
__ metacarpus __ carpus __ brachium__ digitus __ antebrachium

12. The animal body divides into a certain number of portions, which relatively similar in structure" is the principle of the:
1) Two tubes 2) Bilateral symmetry 3) Segmentation 4) Uniaxial

13. Directions which determine from frontal plane are:
1) Dorsal and ventral. 2) Cranial and caudal.
3) Cranial and dorsal. 4) Lateral and medial.

14. The principle of double-sided (bilateral) symmetry is the following:
1) The animal body divides into a certain number of parts (segments, metamers), which relatively similar in structure.
2) The animal body divides into right and left symmetrical halves.
3) In the animal body nervous and visceral tubes are distinguished.
4) In the animal body one axis is identified.

15. The bones which don’t see with the outer surfase of skull:
1) nasal turbinates 4) frontal 7) nasal
2) incisive 5) ethmoid 8) palatine
3) mandible 6) zygomatic 9) maxilla

16. The metacarpus is:
1) a middle link of the forepaw, located between carpus and digits.
2) a distal link of the free pelvic limb, located lower of the leg.
3) a proximal link of the manus, located between forearm and metacarpus.
4) a proximal link of the free thoracic limb located between the pectoral girdle and forearm.

17. Caudal direction on the manus is:
1) Palmaris 2) Dorsalis 3) Proximalis 4) Distalis 5) Caudalis 6) Axialis

18. The features of the thoracic vertebrae are:
1) Three pair of the costal fovea is presented
2) Two pair of the costal fovea is presented
3) Three costal fovea are presented.
4) The spinous process is high.

19. Rudimentary organs are:
1) the organs which had ancestry, but now these organs appear in the progeny with genetic changes
2) the organs that are functioned in a particular age period (deciduous (baby) teeth)
3) the organs that disappearance due to loss their function
4) the organs that persisting through life

20. Morphologically the skull is divided into:
1) Neural portion 3) Hyoid bone 5) Facial region
2) Nasocerebral portion 4) Mandible

21. Caudal direction on the pes is:
1) Palmaris 3) Distalis 5) Caudalis
2) Axialis 4) Dorsalis 6) Plantaris

22. Atavistic organs are:
1) the organs that are functioned in a particular age period (deciduous (baby) teeth)
2) the organs that disappearance due to loss their function
3) the organs that persisting through life
4) the organs which had ancestry, but now these organs appear in the progeny with genetic changes

23. The principle of segmentation is the following:
1) The animal body divides into right and left symmetrical halves.
2) In the animal body nervous and visceral tubes are distinguished.
3) In the animal body one axis is identified.
4) The animal body divides into a certain number of parts (segments, metamers), which relatively similar in structure.

24. Trophic tissues combine:
1) bone 2) cartilage 3) blood 4) lymph 5) nervous tissues

25. A complete bone segment is formed:
1) Cervical vertebra, a pair of ribs, segment of the sternum.
2) Thoracic vertebra, segment of the sternum.
3) Thoracic vertebra, a pair of ribs, segment of the sternum.

26. The false ribs:
1) achieve to the sternum 2) don't achieve to the sternum
3) form the costal arch

27. The spine is formed of the vertebrae which are located in the following sequence:
1) Cervical, thoracic, sacral, lumbar, coccygeal
2) Cervical, lumbar, thoracic, sacral, coccygeal.
3) Cervical, thoracic, lumbar, sacral, coccygeal

28. Dorsal surface of scull is formed by the following bones:
1) zygomatic 2) parietal 3) interparietal 4) nasal 5) frontal

29. The principle of uniaxial structure is the following:
1) The animal body divides into right and left symmetrical halves.
2) In the animal body nervous and visceral tubes are distinguished.
3) In the animal body one axis is identified.
4) The animal body divides into a certain number of parts (segments, metamers), which relatively similar in structure.

30. Directions which determine from median plane are:
1) Only medial. 2) Only lateral.
3) Dorsal and ventral. 4) Lateral and medial.

31. Scull has the following surfaces:
1) Dorsal, two lateral, occipital, oral 3) Dorsal, ventral, two lateral
2) Dorsal, ventral, occipital, oral 4) Dorsal, ventral, two lateral, occipital

32. Ventral surface of scull is formed by the following bones:
1) parietal 3) vomer 5) pterygoid 7) sphenoid 9) mandible
2) nasal 4) frontal 6) palatine 8) maxilla 10) incisive

33. The hindpaw (pes) is:
1) a middle link of the pes, located between ankle and digits.
2) a proximal link of the manus, located between forearm and metacarpus.
3) a proximal link of the free thoracic limb located between the pectoral girdle and forearm.
4) a distal link of the free pelvic limb, located lower of the leg.

34. The skeleton of the shoulder girdle consists of:
1) tibia 3) radius 5) digital skeleton 7) carpal bones
2) scapula 4) ulna 6) metacarpal bones

35. The skeleton of the forepaw (manus) consists of:
1) tibia 3) radius 5) digital skeleton 7) carpal bones
2) scapula 4) ulna 6) metacarpal bones

36. The skeleton of the hindpaw (pes) consists of:
1) tibia
2) scapula
3) radius
4) ulna
5) digital skeleton
6) metatarsal bones
7) tarsal bones

37. The skeleton of the femur of dog consists of:
1) tibia
2) scapula
3) radius
4) ulna
5) fabellae
6) patella
7) femoral bone

38. The skeleton of the femur of horse consists of:
1) tibia
2) scapula
3) radius
4) ulna
5) fabellae
6) patella
7) femoral bone

39. The skeleton of the leg consists of:
1) tibia 2) fibula 3) radius 4) ulna 5) fabellae 6) patella

40. The skeleton of the forearm consists of:
1) tibia 2) fibula 3) radius 4) ulna 5) fabellae 6) patella

41. The skeleton of third digit of horse consists of the following bones number:
1) 3 2) 6 3) 4 4) 2

42. The inner membrane of a joint capsule is:
1) synovial 2) fibrous 3) cartilaginous 4) hyaline

43. The outer membrane of a joint capsule is:
1) synovial 2) fibrous 3) cartilaginous 4) hyaline

44. The joint capsule is composed of the following number of layers:
1) one 2) two 3) three 4) four

45. All synovial joints has the following structures:
1) joint cavity
2) joint capsule
3) synovial fluid
4) articular cartilage
5) fibrocartilaginous plate
6) capsular membrane
7) intracapsular ligament

46. Temporomandibular Joint has the following structures:
1) Symphysis mandibulae
2) Lig. mandibulare
3) Lig. interspinale
4) Discus articularis

47. Joints of the free thoracic limb are located in the following sequence:
__ Art. cubiti
__ Art. carpi
__ Art. humeri

__ Art. metacarpophalangea
__ Art. interphalangea distalis
__ Art. interphalangea proximalis

48. Elbow joint of dog connect the following joints:
1) Art. humeroulnaris
2) Art. radioulnaris distalis
3) Art. humeroradialis
4) Art. radioulnaris proximalis
5) Art. humeri

49. Joints of spine:
1) Juncturae zygapophyseales
2) Sternocostal joints
3) Art. humeroulnaris
4) Art. coxae
5) Art. temporomandibularis
6) Art. atlantooccipitalis
7) Art. atlanto-axialis
8) Art. tarsi

50. Articulatio compedale connect the following bones:
1) Carpal bones and metacarpal bones
2) Carpal bones and falanx I
3) Falanx II and falanx III
4) Metacarpal bones and falanx I
5) Falanx I and falanx II

51. Bodies of vertebrae are connected by:
1) Nuchal ligament
2) Interspinous ligaments
3) Yellow ligaments
4) Dorsal longitudinal ligament
5) Ventral longitudinal ligament
6) Intervertebral discs

52. Arches of vertebrae are connected by:
1) Nuchal ligament
2) Interspinous ligaments
3) Yellow ligaments
4) Dorsal longitudinal ligament
5) Ventral longitudinal ligament
6) Intervertebral discs

53. Spinous processes are connected by:
1) Intervertebral discs
2) Interspinous ligaments
3) Supraspinous ligament
4) Dorsal longitudinal ligament
5) Ventral longitudinal ligament

54. Articular processes are connected by:
1) Interspinous ligaments
2) Yellow ligaments
3) Joints
4) Intervertebral discs

55. Transverse processes are connected by:
1) Intertransverse ligaments
2) Yellow ligaments
3) Dorsal longitudinal ligament
4) Ventral longitudinal ligament
5) Supraspinous ligament

56. Nuchal ligament of horse consists of:
1) Only rope part
2) Only lamellar part
3) Rope part and lamellar part

57. Nuchal ligament of dog consists of:
1) Only rope part 2) Only lamellar part
3) Rope part and lamellar part

58. Ribs are connected to each other by:
1) Intercostal muscles 3) Costal cartilage
2) Conjugal ligament 4) Joint capsule

59. Costal cartilages articulating with the sternum by the following joint:
1) Costovertebral 2) Sternocostal 3) Costochondral

60. Sacral vertebrae are connected by:
1) Cartilagines 2) Symphysis 3) Joints 4) Synostosis

61. Joints of dog which consist of sesamoid bones are the following:
1) Art. cubiti 3) Art. compedale 5) Art. carpi
2) Art. genus 4) Art. ungulare

62. Joints of the free thoracic limb are located in the following sequence:
__ Art. metacarpophalangea
__ Art. humeri
__ Art. unguiculare
__ Art. coronale
__ Art. carpi
__ Art. cubiti

63. Joint which consist of the meniscus or disc is the following:
1) Art. femorotibialis 4) Art. temporomandibularis
2) Art. cubiti 5) Art. coxae
3) Art. tarsi

64. Stifle joint of dog connect the following joints:
1) Interpatellar joint 4) Proximal tibiofibular joint
2) Femoropatellar joint 5) Distal tibiofibular joint
3) Femorotibial joint 6) Intertibial joint

65. Transverse processes of last lumbar vertebrae of horse are connected by:
1) Art. intertransversaria 2) Lig. longitudinale 3) Lig. laterale

66. Stifle joint of horse has the following ligaments:
1) Meniscal ligaments 4) Lig. transversum acetabuli
2) Lig. collaterale 5) Lig. capitis ossis femoris
3) Lig. cruciata genus

67. Joints of the free pelvic limb are located in the following sequence:
__ Art. genus
__ Art. tarsi

__ Art. metatarsophalangeae
__ Art. interphalangeae distalis
__ Art. interphalangeae proximalis
__ Art. sacroiliaca
__ Art. coxae

68. Tarsal joint consists of the following microjoints:
1) Metatarsophalangeal joint
2) Proximal interphalangeal joint
3) Tarsometatarsal joints
4) Intertarsal joints
5) Tarsocrural joint

69. The muscular system studies the following muscle tissue:
1) striated 2) unstriated 3) cardiac

70. Accessory structures of muscles are the following:
1) fascia
2) synovial bursa
3) sesamoid bones
4) static elements
5) blood vessels
6) ligaments

71. The muscle has the following parts:
1) head 2) belly 3) tail 4) capsule 5) ligament

72. Synovial bursa is:
1) a double-layered closed saccule, filled with synovia and located between the bone protrusion and muscle
2) a thickening of deep fascia in the joint region
3) an ossified tendons

73. Sesamoid bone is:
1) a double-layered closed saccule, filled with synovia and located between the bone protrusion and muscle
2) a thickening of deep fascia in the joint region
3) an ossified tendons

74. Extensors are the:
1) muscles which open a joint
2) muscles which angulate the bones, or bend the joint
3) muscles which provide movement of an extremity toward the median plane
4) muscles which provide movement of an extremity around its long axis

75. Flexors are the:
1) muscles which open a joint
2) muscles which angulate the bones, or bend the joint
3) muscles which provide movement of an extremity toward the median plane
4) muscles which provide movement of an extremity around its long axis

76. The features of digastric muscle:
1) the muscle venter is separated by an intermediate tendon into two parts

2) the muscle has a few ending tendons
3) the muscle has one beginning tendon
4) the muscle has more parenchyma in its internal structure

77. The features of dynamic muscles:
1) the muscle venter is separated by an intermediate tendon into two parts
2) the muscle has a few ending tendons
3) the muscle has one beginning tendon
4) the muscle has more parenchyma in its internal structure

78. Muscles of pectoral girdle are the:
1) muscles which connect the thoracic limb with the head, neck, and trunk
2) muscles which increase the diameter of the thorax
3) muscles which form the abdominal wall
4) fix the spine, extend or flex the spine, elevate the neck and tail

79. Muscles of thoracic wall are the:
1) muscles which connect the thoracic limb with the head, neck, and trunk
2) muscles which increase the diameter of the thorax
3) muscles which form the abdominal wall
4) muscles which decrease the diameter of the thorax
5) fix the spine, extend or flex the spine, elevate the neck and tail

80. Muscles of spine are the:
1) muscles which connect the thoracic limb with the head, neck, and trunk
2) elevate the neck and tail
3) fix the spine, extend or flex the spine
4) muscles which decrease the diameter of the thorax

81. Muscles of pectoral girdle are the following:
1) sternohyoideus
2) serratus ventralis
3) brachiocephalicus
4) deltoideus
5) trapezius
6) latissimus dorsi
7) obliquus externus abdominis
8) triceps brachii

82. Muscles of thoracic wall are the following:
1) m. scalenus
2) m. sternohyoideus
3) m. serratus dorsalis caudalis
4) m. serratus ventralis
5) m. transversus thoracis
6) m. deltoideus
7) m. trapezius
8) m. obliquus externus abdominis
9) m. triceps brachii

83. Muscles of spine are the following:
1) m. triceps brachii
6) m. brachiocephalicus

2) m. splenius cervicis
3) m. longissimus
4) m. obliquus externus abdominis
5) m. iliocostalis
7) m. longus colli
8) m. psoas major
9) m. rhomboideus
10) m. scalenus

84. The muscular part of diaphragm has the following parts depending on the attachments:
1) Thoracic part
2) Costal part
3) Sternal part
4) Lumbar part
5) Intercostal part

85. The diaphragm is pierced by foramina for the following organs:
1) trachea
2) aorta
3) oesophageus
4) venae portae
5) venae cavae

86. The hiatus aorticus of diaphragm is:
1) an interval between the two crura and below the last thoracic vertebra
2) is situated a little to the left of the median plane
3) pierces the tendinous center to the right of the median plane

87. M. obliquus externus abdominis ends by the following aponeurosis:
1) femoral
2) lateral
3) internal
4) external
5) pelvic
6) abdominal

88. The superficial inguinal ring of the inguinal canal is located between:
1) the internal and external laminas of the internal oblique abdominal muscle
2) the abdominal and pelvic aponeurosis of the external oblique abdominal muscle
3) the internal oblique muscle and the inguinal ligament

89. The deep inguinal ring of the inguinal canal is located between:
1) the internal and external laminas of the internal oblique abdominal muscle
2) the abdominal and pelvic aponeurosis of the external oblique abdominal muscle
3) the internal oblique muscle and the inguinal ligament

90. Linea alba abdominis is formed by junction of aponeuroses of the following muscles:
1) external oblique abdominal
2) internal oblique abdominal
3) rectal abdominal muscle
4) transverse abdominal

91. External plate of the sheath of m. rectus abdominis consists of:
1) internal plate of deep fascia of the abdomen
2) lateral plate of aponeurosis of m. obliquus internus abdominis
3) aponeurosis of m. transversus abdominis
4) abdominal plate of aponeurosis of m. obliquus externus abdominis
5) medial plate of aponeurosis of m. obliquus internus abdominis

6) external plate of deep fascia

92. Internal plate of the sheath of m. rectus abdominis consists of:
1) internal plate of deep fascia of the abdomen
2) lateral plate of aponeurosis of m. obliquus internus abdominis
3) aponeurosis of m. transversus abdominis
4) abdominal plate of aponeurosis of m. obliquus externus abdominis
5) medial plate of aponeurosis of m. obliquus internus abdominis
6) external plate of deep fascia

93. Dorsal muscles of the spine are the following:
1) m. rhomboideus
2) m. quadratus lumborum
3) m. psoas major
4) m. longus colli
5) m. brachiocephalicus
6) m. iliocostalis
7) m. longissimus
8) m. splenius cervicis

94. Ventral muscles of the spine are the following:
1) m. rhomboideus
2) m. quadratus lumborum
3) m. psoas major
4) m. longus colli
5) m. brachiocephalicus
6) m. iliocostalis
7) m. longissimus
8) m. splenius cervicis

95. Extensors of shoulder joint are the following:
1) m. biceps brachii
2) m. brachiocephalicus
3) m. supraspinatus
4) m. longissimus
5) m. rhomboideus

96. Flexors of shoulder joint are the following:
1) m. longissimus
2) m. teres major
3) m. tensor fasciae antebrachii
4) m. latissimus dorsi
5) m. triceps brachii
6) m. deltoideus
7) m. brachiocephalicus

97. Flexors of elbow joint are the following:
1) biceps brachii
2) m. deltoideus
3) m. tensor fasciae antebrachii
4) m. triceps brachii
5) m. longissimus
6) m. brachialis

98. Extensors of hip joint are the following:
1) m. quadriceps femoris
2) m. semitendinosus
3) m. tensor fascie latae
4) m. biceps femoris
5) m. glutaeus superficialis
6) m. sartorius
7) m. glutaeus medius

99. Flexsors of hip joint are the following:

1) m. pectineus
2) m. semitendinosus
3) m. tensor fascie latae
4) m. biceps femoris
5) m. glutaeus superficialis
6) m. sartorius

100. Extensors of stifle joint are the following:
1) m. sartorius
2) m. semitendinosus
3) m. quadriceps femoris
4) m. biceps femoris
5) m. extensor digitorum longus
6) m. iliopsoas

101. Flexors of stifle joint are the following:
1) m. biceps femoris
2) m. iliopsoas
3) m. quadriceps femoris
4) m. triceps surae
5) m. extensor digitorum longus
6) m. flexor digitorum superficialis

102. The common calcar tendon is formed by fusion of the following tendons:
1) m. semitendinosus
2) m. extensor digitorum longus
3) m. flexor digitorum profundus
4) m. biceps femoris
5) m. flexor digitorum superficialis
6) m. triceps surae

103. Body is formed the following group systems:
1) Bone, nerve, vascular.
2) Integral, visceral.
3) Blood lymph circulation, nervous, somatic.
4) Somatic, visceral, integral.
5) Visceral, neural, bone.

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