COURSE CODE: VBA 201

COURSE TITLE: TOPOGRAPHIC AND MUSCULOSKELETAL ANATOMY

NUMBER OF UNITS: 3 Units

COURSE DURATION: Three hours per week

COURSE DETAILS:

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**Other Lecturers:** Drs. AKINLOYE A.K., ADEBAYO A.O., and MUSTAPHA O.A

COURSE CONTENT:

Scope and necessity for the study of Anatomy, anatomical terminologies and nomenclature, Osteology: divisions of the skeleton, classification of bones and cartilages, surface anatomy and conformation of the bony thorax, the thoracic wall: epiaxial muscles of the thorax and the shoulder girdle. The brachial plexus and nerve supply to the thorax, the pelvis, pelvic cavity and the pelvic limb, osteology and myology of the head, the ocular orbit and adnexa, the oral cavity: osteology and myology of the neck.

COURSE REQUIREMENTS:

This is a compulsory course for all students in the University in view of this, students are expected to participate in all the course activities and have minimum of 75% attendance to be able to write the final examination.

READING LIST:

1. Septimus Sisson: The anatomy of the domestic animals, Fourth Edition revised.
2. Dyce, Sack and Wensing: Textbook of Veterinary Anatomy. Third Edition.
3. Konig, Liebel. Veterinary anatomy of domestic mammals: Textbook and colour atlas. Third edition.
4. Klaus-Dieter Budras, Patrick H. McCarthy, Wolfgang Fricke and Renate Richter: Anatomy of the dog. Fifth revised edition.
5. Raymond R. Ashdown and Stanley H. Done: Colour atlas of veterinary anatomy: The Horse. Volume 2.
6. Thomas O. McCracken; Robert A. Kainer Thomas L. Spurgeon: Spurgeon’s colour atlas of Large animal anatomy: The Essentials.

E

LECTURE NOTES

**INTRODUCTION TO VETERINARY ANATOMY**

The term anatomy refers to that science which deals with the form and structures of all organisms. It is often regarded as the firm foundation of the whole art of medicine and its essential preliminary, whereas the term Veterinary Anatomy refers to that branch of Veterinary Medicine which deals with the form and structure of the principal domesticated animals.

The study of anatomy usually involves dissection of animals in gross anatomy laboratory coupled with close observation of the shape, texture, location and relations of those structures visible to the naked eyes. The use of the microscope with properly prepared tissue section on slides is equally essential for an understanding of structures that are so small to be seen without optical assistance.

**DIVISIONS OF ANATOMY**

The science of anatomy has become so extensive that it is now divided into many specialized branches. However, the followings are of major interest to now.

1. **Gross (Macroscopic) Anatomy**: is the study of the form and relations (relative positions) of structures if the body that can be seen with the naked eye.
2. **Histology (Microscopic Anatomy**): involves study of those tissues and cells that can be seen only with the aid of a microscope.
3. **Comparative anatomy**: is a study of the structures of various species of animals, with particular emphasis on those characteristics that aid in classification.
4. **Embryology**: is the study of developmental anatomy, covering period from conception (fertilization of the egg with the female) to birth.
5. **Ultrastructural cytology**: deals with portions of cells and tissues as they are visualized with the aid of electron microscope. This is a recent development in the study of Anatomy.
6. **Applied Anatomy**: Is the application of knowledge of anatomical landmarks in solving clinical problems.

The method of study in Anatomy is chiefly by system and this is referred to as Systemic anatomy. The following are the commonly accepted systems:

**Systems**  **Name of Study** **Structures**

1. Skeletal system Osteology Bones

2. Arthricular system Arthrology Joints

3. Muscular system Myology Muscles

4. Viscera systems Splanchnology Internal organs

- Digestive system ) - Stomach & Intestine

)

- Respiratory system ) - Lungs

)

- Urinary system ) - Kidneys & Bladder

- Reproductive system ) - Ovaries & Testes

5. Endocrine system Endocrinology Ductless gland

6. Nervous system Neurology Brain, Spinal cord

7. Circulatory system Angiology Heart, Vessels

8. Integumentary systems Dermatology Skin

9. Sensory system Esthesiology Eye, Ear.

The course shall be concerned with all these system and studies as they are related to specifically to domestic animals. The domestic animals are those animals with mutual relationship with human being and the relationship should be positive. Those include:

1. Bovine species e.g. Cattle
2. Caprine species e.g. Goat
3. Ovine species e.g. Sheep Large Animals
4. Equine species e.g. Horse
5. Porcine species e.g. Pig (swine)
6. Canine species e.g. Dog
7. Feline species e.g. Cat Small Animals
8. Avian species e.g. Chicken

Note that anatomy requires a lot of imagination, and it is a visual science in which verbal descriptions are always inadequate, therefore, learning it requires careful observation, preferably repeatedly and from different perspectives. In gross anatomy, then, the major study must take place in the dissecting room, where repeated handling and review is possible. Except for the purposes of communication, useful anatomy is visual anatomy: the picture of structures and relationships that can be seen in the “mind’s eye” or “X-ray eye”, not the words used to describe the structure.

**Descriptive Terms Useful In The Study Of Anatomy**

In order to indicate precisely the position and direction of part of the animals body certain descriptive terms are used. These include –

(A) **Directional Terms:**

1. The Longitudinal axis - This splits the body into equal left and right half (bilaterally symmetrical cut). This is also called longitudinal axis.
2. Sagittal plane or sagittal axis – This is a split that is parallel to the median plane. If it is near the middle, it is the mid sagittal plane but if it is far from the middle it is called lateral sagittal plane.
3. Transverse plane - Any point perpendicular to the median plane and at right angle to the longitudinal axis. It divides the body into a cranial and a caudal segment.
4. The frontal plane - Is at right angles to both the median plane and transverse plane. It divides the body into dorsal (upper) and ventral (Lower) segments.

**Adjectives of Relative Position:**

1. Medial - point closer to the median plane
2. Lateral - a point further away from the median plane
3. Dorsal - is toward the back or closer to the dorsum
4. Ventral - is closer to the lower position
5. Cranial - towards the head (cranium – the brain cavity) or it can be anterior.
6. Rostral - closer to the mouth region or rostrum
7. Deep - internal
8. Superficial – close to the surface. (external)
9. Caudal – tail wards
10. Proximal – toward the front or closer to the body
11. Distal – further away from the body (related to the limbs)
12. Palmar (volar) – the under side of the foot (fore limb)
13. Plantar – the dorsal of the limbs
14. Pronation – the dorsal of the limbs
15. Supination – the ventral of the limb
16. Axial – closer to the longitudinal axis
17. Abaxial – away from the longitudinal axis
18. Inspiration – breathing – in
19. Expiration – breathing – out
20. Adduction – bringing together of limbs
21. Abduction – Keeping apart of limbs

**THE SKELETAL SYSTEM**

The study of bones that collectively make up the skeleton or framework of the body is called osteology. The skeleton of a living animal is made up of bones that are themselves living structures. They have blood vessels lymphatic vessels, and nerves. They are subject to disease, and adjust to changes in stretch.

The function of bones include providing protection, giving rigidity and form to the body, acting as levers, storing minerals, and providing a site for bloods formation.

**CLASSIFICATION OF BONES**

Any bone may be classified in one of the following groups: long, short, flat, sessamoid, pneumatic or irregular.

1. Long bones – are greater in some dimension than any other. Each consists of a relatively cylindrical shaft (diaphysis) and two extremities called epiphysis with a metaphysic between epiphysis and the diaphysis. Basically the long bones functions as levers and this is to aid locomotion and support and in some cases even prehension e.g. humerus, femur etc.
2. Short Bone - are basically short and they appear cuboidal in shape. They do not have a marrow cavity. They function in absorbing concussion (shocks) and they are often found in complex joint. e.g. carpal and tarsal bones.
3. Flat Bones - are relatively thin and expand in two dimensions. They consist of two plates of compact substance, Lamina external and lamina internal, separated by spongy material called diploe. They protect many of the vital organs e.g. cranium protect brain, the ribs protects heart, lungs.
4. Sessamoid bones - (Seed –like) usually found along the course of tendons. They may also change the angle of pull of muscles and thus give a greater mechanical advantage. E.g. the patellar (knee cap) is the longest sessamoid bone in the body.
5. Pneumatic bones - Contain air sinuses that communicate with the exterior, e.g. the frontal bones or sinuses.
6. Irregular bones – irregular in shape e.g. vertebral bone

**The Skeleton**

The skeleton of the animal can be divided basically into the axial and appendicular skeleton and splanchnic skeleton.

The ***axial skeleton*** includes practically all the bones in the body axis. These are the bones that are situated along the median axis to the skeleton. They include: the skull, vertebral column; the ribs and the hips bones. The ***appendicular skeleton*** includes all the bones of the limbs, includes fore and hind bones. The ***splanchnic skeleton*** refers to soft bones found in some organs e.g. os sclera in birds, os penis in dog, Lyssa in tongues of dog, os nostri in pig, os cordis in battle.

**The Skull**

That point of the skeleton which forms the basis of the head is called the skull. It functions in protection of the brain, supports many of the sense organs, and forms passages for the beginning of the digestive and respiratory system. The Skull consists of:

1. The *cranial part,* which surrounds the brain
2. The *facial part* - It is this facial part that is used in differentiation between the animal species.

**Vertebral Column**

Composed of medium, unpaired, irregular bones called vertebrae. These bones vary in number from one animal to the other and as a result there are Vertebral formulas. The following patterns are used to designate the respective regions.

C = Cervical vertebra - neck region

T = Thoracic or dorsal chest region

L = Lumbar – loin region

S = Sacral – in region of pelvis – Fused vertebrae

LS = Fused lumbar and sacral (fowl)

CD = Caudal (Coccygeal)

The vertebral formula for a given species of animal consists of the symbol for each region together with the number of bones or the number of vertebrae in that region. The vertebral formulas of common animals are as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species** | **C** | **T** | **L** | **S** | **CY** |
| Camel | 7 | 12 | 7 | 4 | 18-0 |
| Sheep/Goat | 7 | 13 | 6-7 | 4 | 12-18 |
| Cattle | 7 | 13 | 6 | 5 | 18-20 |
| Dog | 7 | 13 | 7 | 3 | 20-23 |
| Pig | 7 | 14-15 | 6-7 | 4 | 20-23 |
| Horse | 7 | 18 | 6 | 5 | 15-21 |
| Man | 7 | 12 | 5 | 5 | 4 |
| Bird | 16-17 | 5-6 | 15 - 16 | | Pygostyle |

\*Synsacrum: fused L and S

**DIFFERENTIATIVE CHARACTERISTICS OF THE VERTEBRAE**

1. The cervical do not have long spine; they have large foramina on either side.
2. The thoracic has long neural spine. The lengths of the body to that of the neural spine has ratio 1:2. Another characteristic is the fact that it has 2 facets for articulation with the ribs. Transverse process is absolutely absent.
3. The basic characteristic in lumbar is the long transverse process. They have fairy reduced neural spine 1: 1
4. The sacral vertebrae are fused into a composite bone called sacrum. On each side of the sacrum bears a large flattened process for articulation with the ilium of the pelvic girdle.
5. Coccygeal (caudal) region consists of caudal coccygeal vertebrae which are progressively reduced. They serve as site for the insertion for the muscle which makes the tail.

A typical vertebra consists surrounded by an arch that completes the closure of the vertebral foramen; it is a summation of these vertebral foramina that form the vertebral canal through which the spinal cord passes.

The body is broadly cylindrical, somewhat flattened on its dorsal surface, which faces into the vertebral canal, may carry a median crest ventrally. The extremities are usually curved, the cranial one being convex, the caudal- concave.

The arch consists of 2 pedicles from which a lamina projects each, to meet medially to meet its fellow and thus complete the ring about the spinal cord. The bases of each pedicle is notched, and when successive bones articulate, these notches combine to outline the intervertebral foramina, openings through which passes the spinal nerves and vessels that supply the structures within the intervertebral foramen.

Each vertebra carries a number of processes. The dorsal or spinous process arises from the union of the laminae. It is generally prominent, although its form, length and inclination vary with the region and species.

The transverse processes project to each side at the junction of the body and the arch; these processes arise at the level of the intervertebral foramina and divide the muscles of the trunk into dorsal and ventral divisions.

**CERVICAL VERTEBRAE**

In mammals generally, there are usually seven cervical vertebrae. The first two i.e. the atlas and the head and require individual description. The remaining five are more typical (alike/similar).

**ATLAS**

Appears to posses no body but consists of 2 lateral masses joined by ventral arches (see fig). A plate of bone, the wing of the atlas (transverse process, ala atlantis), projects laterally from each mass, constituting a landmark that is often visible or palpable in the living animal.

The cranial aspect of the ventral arch and the adjacent areas on the wings carry two deep excavations that receive the occipital condyles of the skull. These facets approach ventrally and in some species they merge.

The caudal aspect of the ventral arch is hollowed transversely to provide an articular surface that engages with the cranial extremity of the axis. An extension (fovea dentis) of this facet onto the dorsal surface of the ventral arch accommodates the dens. The dorsal arch is perforated by openings that correspond with the transverse and intervertebral foramina of more typical cervical vertebrae; in some species a third (alar) foramen perforates the wing.

**AXIS**

It is the longest vertebra. Its cranial extremity bears the dens, which is rod-like in carnivores and spout like in other species. The cranial extremity of the body and the ventral surface of the dens concur in forming a single wide articulation for the atlas. Dorsally the dens is roughened for ligamentous attachment. The arch carries a long spinous process that bears articular surfaces at its caudal extremity which meet with corresponding facets on the 3rd cervical vertebra. Transverse process are large, each is perforated toward its root by a transverse foramen that transmits the vertebral artery, vein and nerve.

**Skeleton of the Thorax**

This is made up of the thoracic vertebrate dorsally the ribs and the curtail cartilage laterally and the sternum (vertebral) ventrally. The thoracic cavity is conically shaped. The structure of the lateral wall of the thorax varies from one animal to another. But in general the ribs form the basis bony elements.

A typical rib has a shaft and two extremities which are often termed vertebral and sternal extremity. The shaft is curved thus, giving the thorax a BARREL like appearance. The vertebral extremity of the rib has the head, neck and tubercle. The sternal extremity of the ribs jams with the coastal cartilage. There are intercoastal spaces between the ribs which is occupies by the intercoastal muscle as well as intercoastal vessels and nerves. The limb consists of the shoulder girdle, the arm, forearms and the manus.

**Bones of the thoracic Limb**

The thoracic limb is attached to the body by the pectoral girdle which is made up of 3 bones (scapular, clavicle and the coracoid). The clavicle and the coracoid bones have been reduced to an eminence on the scapular. The clavicle is completely absent in Bovine and other domestic animal. The thoracic limb is made up of shoulder, the arm, the fore arm and the manus. The principal bones of this region are: the scapula (the shoulder girdle), humerus (the arm), radius and ulna (the fore arm), and in the manus we have the carpals and metacarpals and the phalanges

**THE SCAPULA**

This is a flat bone. It is triangular in shape. It has 2 surface, three borders (the dorsal border, the caudal border and the cranial border) and three angles. The cranial and the caudal borders converge at the distal extremities on which the glenoid cavity for articulation with the humerus is found

The scapula spine divides the lateral surface of the scapula into two: the *supraspinous fossa*, which is cranial and the *infraspinous fossa* is the smaller of the two and it occupies the supraspinous muscle. The infraspinous fossa lodges the infraspinatus muscle. The ventral end of the scapula carries the **glenoid cavity** in which the head of the humerus articulate.

In the cattle, it is found the smaller prominent and the supraspinous fossa doesn’t extend to lower part of the bone. In the sheep, sub-scapular fossa is more extensive. In the pig the scapular is very wide, it is found to be triangular and the scapula spine is found in the middle. The spine also curves backward in the middle over the infraspinous fossa.

**HUMERUS**

The humerus is a long bone consisting of a shaft and two extremities. The shaft is twisted in its half like a tongue to form a musculospiral groove in which runs the brachial muscle. The musculospiral groove is located on the lateral side of the shaft. The medial surface of the shaft is fairly smooth and bears the ***teres tuberosity*** at its middle. The proximal extremity of the humerus has tuberosities on both the lateral and medial surface for both attachments. It is also has a head for articulation with the glenoid cavity of the scapular. The distal extremities of the humerus bears rounded surface known as **condyles** which articulate with the radius and ulna. The condyles consist of a medial condyle and a lateral condyle and between the two condyles is the **olecranon** fossa into which the olecranon process of the ulna lodges

**RADIUS AND ULNAR**

The radius and ulnar forms the bone of the fore arm. The radius is bigger than the ulna. The radius is located in the cranio–medial aspect of the ulna. In most livestock or domestic animals, the radius is fused with the ulnar. The ulna is located caudolateral at the proximal extremity. At the proximal extremities of the radius are rough prominences on the lateral and medial aspects for the attachment of ligament. The distal extremities of the radius are broadened out laterally and medially to form an articular surface for the carpal bones.

The ulnar is fused to the radius except at “the proximal and distal interosseous spaces”. The ulna has a prominent olecranon process which projects dorsally above the Elbow joint. The development of ulna is variable in different species of animal except in the fowl where the ulnar is more developed than the radius. In cattle, sheep and pigs, the shaft of the ulnar extend as far distant end of the radius.

**THE CARPAL BONES**

They are short bones. They are seven in number and are arranged in two rows. The first row is the proximal row and the second row is the distal row.

The proximal row which articulates with the distal extremity of the ulnar and radius bone consists of three carpal bones. They are named from the medial to lateral as ***radial carpal, intermediate carpal*** and ***Ulna carpal bone***.

The distal row of the carpal bone articulates with the metacarpal bone. It consists of four carpal bones: the 1st medial carpal bone, 2nd M. C. B, 3rd M. C. B. and 4th M.C.B. from medial to lateral side and the accessory carpal bone is situated behind the carpals.

**THE METACARPAL BONES**

These bones are distal to the carpal and primarily consist of five bones. The human has 5 metacarpal bones (M.C.B) and pig has 4 and Bovine has 2 fixed i.e. the 3rd and 4th M.C.B with the 1st, 2nd and 5th metacarpals missing. The horse has only one large M.C.B which is the 3rd so the 1st, 2nd, 4th and 5th are absent or have been reduced to a thin vestigial bone known as *splint.*

**THE PHALANGES (DIGITS)**

The number of functional digits corresponds to the number of functional metacarpal bones. Three phalanges are contained in each functional mammalian digit. This consists of the *proximal phalanx* which articulates with the metacarpal bone; the *middle phalange* and the *distal phalanx*. The distal phalanx is enclosed in the hoof.

**BONES OF THE PELVIC GIRDLE**

In the adult, three bones unite to form the pelvic girdle. These include the ilium, pubis and ischium. The three bones (pubis, ilium and ischium) of the pelvic girdle of one side are correctly fused in an adult to form single os coxae. The three bones of each side unite at the acetabulum.

The pubic bone is the smallest of the pelvic bones and it unites medially with its corresponding opposite side to form the cranial floor of the bony pelvis.

The ilium is the largest and the most dorsal of the bone of Os Coxae. It is made up of the wing and shaft.

The ischium forms the caudal part of the ventral wall in floor of the bony pelvis. It has a large, rough, caudal, prominence known as ***tuber ischi***.

The ***femur*** – is the major bone of the thigh which extends from the hip joint to the stifle (knee) joint. It is a long bone and has a shaft and two extremities. The proximal extremity of the femur has s smooth rounded edge adapted to fit into the acetabulum of the os coxae. The proximal extremity also has a large rough tuberosity on its lateral side known as the greater trochanter. The head of the femur has a small depression in its middle known as fovea capitis for the attachment of round ligament that attaches the head of the femur to the acetabulum. The distal extremity of the femur is larger than the proximal extremity. The distal extremity possesses a trochlear cranially and condyles caudally. The trochlear is separated by a groove in which slides a large sessamoid bone known as the patella or the knee cap.

**Tibia and Fibula**

A tibia is long bone that has a body and 2 extremities. The bone is larger proximally but dually decreases in size distally. It articulates with condyles of the femur proximally and with the dorsal row of the tarsal bones distally. Of the common livestock, only the pig has a complete fibular while in the ruminants the proximal head of the fibular is higher and fused with the tibia.

**TARSAL BONE**

In domestics animals, it consist of between 5 -7 short tarsal bones. They are arranged in three rows: a proximal row, middle row and the distal row. The largest two of these bones is in the proximal row: the Talus or Tibial tarsal and the calcaneus bone or fibular tarsal while a central tarsal bone occupies the middle row. The bones of distal row are also numbered from the medial to the lateral side I, II, III &IV. These bones are band together by strong short ligament.

**THE METATARSAL BONES**

They are long bones with two extremities and a shaft. The metatarsal bones of mammals are longer than the corresponding metacarpal bones but they show similar reduction in numbers.

***The phalanges/Digits*** - The bones of the hind digits also resemble those of the thoracic limb.

**MYOLOGY**

This involves the study of muscles and their accessory structures. They are active organs of motion. There are 3 types of muscles in the organs of animal.

(i) Skeleton muscle or striated muscle

(ii) Non-striated or smooth muscle

(iii) Cardiac muscle

A non-striated muscles are often describes as visceral muscles.

Striated muscles cover the greater part of the skeleton. They are red in colour and connect directly or indirectly with the skeleton upon which they act. Some of these muscles are intimately associated and attached to the skin and are called cutaneous muscles. Its contraction twitches the skin and thus get of rid of insects and other irritants.

The description of skeletal muscles may be based on the name, position, attachment of the muscles, action, and relation of the muscles as well as their blood and nerve supply. The name of the muscles may be determined by various considerations such as action, attachment, shape, position and direction. In most cases two or more of these factors are combined to produce a name.

The attachments of skeletal muscles are in most cases to bones. Many muscles are attached to cartilage, ligaments, fascia or skin

**MUSCLES OF THE THORACIC LIMB**

Muscles acting on the shoulder girdle include:

1) Trapezius

2) Rhomboideus

**PELVIC GIRDLE**

In the adult animal, three bones unite to form the pelvic girdle. There are 2 symmetrical hip bones (Ossa coxae) which meets ventrally at the pelvic symphysis. They articulate firmly with the sacrum dorsally and together with the sacrum and first caudal vertebrae form the bony pelvis. It encompasses and protects the pelvic viscera including the reproductive organ which in turn exerts physiological influence during pregnancy and parturition. It also plays a role in posture and locomotion in that ensures an effective transmission of forces from the hind-limb to the trunk   
**HIP BONE (ossa coxae)**

Each of the hip bone is composed of 3 bones with separate ossification centres within a single cartilage plate. Though in young animals, strips of cartilage demarcate the borders to allow for growth, they disappear once growth is complete 3 components as ilium (OS), Pubis (Os Pubis), Ischium (Os Ischium).

The pubis and Ischium of each hip unite together ventrally in the cartilaginous pelvic symphysis (a firm but non-rigid joint) allowing the 2 involved to move apart under hormonal influence to enlarge the birth canal in preparation for parturition. The pelvic symphysis is made of 2 parts. The cranial pubic part (Symphyses pubica) **pubic symphysis** and the caudal Ischial part called Ischial Ischiadica.

**ILIUM**

This is the largest of the 3 flat bones. It is located in the craniodorsal part of the hip bone and extends obliquely from the acetabulum to the sacrum it is irregularly triangular and presents two surfaces, 3 borders and 3 angles. It is divided into 2 parts: the cranial expanded wing (ala ossis ilia) and the caudal columnar body or the shaft of the ilium (corpus body ossis ilium). The ilium has 2 surfaces: gluteal surface which faces dorso-laterally and backward in standing animal. It is wide and concave in front and narrow and convex caudally. The wide part is crossed by curved gluteal line which extend from the medial border towards the tuber coxae. This surface gives attachment to the gluteus medius and gluteus profundus. The pelvic surface faces the opposite direction, convex outline and made up of 2 distinct parts and they are

* The medial triangular part and the lateral quadrilateral part: The medial triangular part is roughened for ligamentous attachment and bears an irregular auricular surface. The lateral quadrilateral part is smooth in its course. It is crossed by ilio-pectineal lines that starts from the ventral part of the auricular surface and continues down to the shaft to join the pubis at its cranial border. The ilio-pectinal line is interrupted by furrows for the iliaco-femoral vessels and just below this bears the psoas tubercle which gives attachment from the psoas minor muscle CRANIAL BORDER (crest) is concave, relatively thick and rough THE MEDIAL BORDER is deeply concave and forms the greater Ischiatic notch and continues caudally with the ischiatic spine. The lateral border is also concave and is rough for its greater part. The nutrient foramen is usually located about the caudal end of this border. THE LATERAL ANGLE also called (**Tuber** **coxae**) serves as the land mark for the hip in a standing animal. It’s a quadrilateral large mass and bears a pair of tuberosities for muscular attachment. The acetabular angle meets the other 2 bones **(Ischium and pubis)** at the acetabulum.
* **MEDIAL** **ANGLE: (tuber sacrale)** curves upward and backward (dorso-caudally) opposite the first sacral spine and it forms the highest point of the pelvic-girdle. The lateral surface of the shaft of the ilium is convex and rough providing attachment from the deep gluteal muscle.

**PUBIS**

It is the smallest of the 3 pelvic bones. It forms the cranial part of the floor of the pelvic cavity. The pubis also enters in the formation of the acetabulum. The cranial part of the floor of the pelvic symphysis is formed by two symmetrical pubic bones. The pubis forms the cranial border of the obturator foramen and the cranial border of the pubic bone is rough and forms a prominence called pubic tubercle.

The pubic bone has 2 surfaces, 3 borders and 3 angles. The two surfaces are the pelvic and ventral surfaces. The former is coven in the young subject concave in the mare and stallion. The ventral surface is rough for muscular attachment and crossed by a pubic groove near its cranial border. This groove leads to the acetabular notch. The cranial border is thin in its medial part forming the pectin-ossis-pubis and laterally it bears the ilio-pectineal eminence.

The medial border joins the opposite bone at the cranial portion of pelvic symphysis.

The caudal border forms the cranial margin of the obturator foramen.

It has three angles- The medial angle, acetabular angle and caudal angle.

The Medial angle meets with its other pairs at the cranial end of the symphysis; the acetabular angle joins the ilium and Ischium at the acetabulum. While the caudal angle unites with the Ischium to form the inner boundary of the obturator foramen.

**ISCHIUM**

It forms the caudal part of the ventral wall of the bony pelvis sloping ventromedially. It presents for description 2 surface (pelvic and ventral), 4 borders (cranial, caudal, medial and lateral) and 4 angles (craniomedial, craniolateral, caudomedial, caudolateral). The pelvic surface is smooth and slightly concave while the ventral surface provides for the attachment of the adductor muscle of the thigh. The cranial border forms the caudal border of the obturator foramen.

The Caudal border is thick and rough and slopes craniomedially uniting with its other border to form the ischial arch. The Medial border unites with its opposite at pelvic symphysis. The lateral border is thick and rounded and concave in its length forming the lesser ischiatic notch.

The caudolateral (acetabular) angle is thick and 3 sided especially in the dogs and horses, triangular in the cattle and pig. The Ischium can be largely divided into 3 parts: body, caudal plate and medial branch. The medial branch forms the caudal part of the pelvic symphysis. The caudal plate extends cranially into two angles: acetabular and medial angle both of which form the caudal circumference of the obturator foramen.

The body of the Ischium forms a part of the acetabulum while its dorsal border continues with the dorsal border of the ilium to form the Ischiatic spine. The Ischiatic arch is usually broad except in the horse where it is rather shallow and irregular.

**THE ACETABULUM**

It is a deep cotyloid cavity formed by the three pelvic bones and lodges the head of the femur. An additional small bone, the small acetabular triangle in the carnivores also contributes to its formation. It faces ventrally and laterally and is formed by the body of the ilium craniolaterally and the body of the Ischium caudolaterally and the body of the pubis medially. The articulation of the acetabulum of the pelvic girdle with the femur forms the hip / coxal joint and is an example of spheroidal joint. The acetabular cavities formed by the 3 bones are made of 2 parts; the peripheral articular lunate surface and the central acetabular fossa. The lunate surface of the acetabulum is cresentric and indented medially by a deep acetabular notch. The lunate surface is divided in the bovine by a craniolateral notch into a larger craniodorsal notch and a smaller caudoventral notch. The articular (lunate) surface is enlarged by a fibro-cartilagenous articular labium. The non-articular surface.

**THE BONY PELVIS**

It is a broad-wing around the pelvic cavity is composed of the ossa coxarum, sacrum and first 3 caudal vertebrae. Specific differences in general form are very pronounced. The dorsal wall of the roof of the bony pelvis is formed by the sacrum and the first 3 caudal vertebrae. The floor of the ventral wall is formed by pubic and Ischial bones while the lateral wall formed by the acetabular part of the Ischial bone and the ilium. The broad sacro-tuberal ligaments closes up the bony defect in the lateral wall except in the carnivores where in the ligament is string shaped in the dog and absent in the cat. The pelvic inlet (cranial pelvic aperture) is bounded by the terminal line (Brim). The terminal line is composed of the sacral promontory dorsally, the ilio-pectineal lines laterally and the pectin ossis pubis ventrally. There are two principal diameters of the pelvic inlet of the bony pelvis: the conjugate or sacro-pubic diameter which spans from the sacral promontory to the cranial end of the pelvic symphysis and the transverse diameter which is measured at its greatest width just above the psoas tubercle. The pelvic outlet is formed by the first 3-4 caudal vertebrae dorsally, ventrally by the Ischiatic arc and the tuberosity and laterally by the broad sacro-tuberal ligament (absent in the cat). The floor of the pelvis is of obstetrical importance; it is deep concave in ruminant especially in the transverse direction and inclined dorsally in the horse. The content of the pelvis are rectum, parts of the urogenital system, pelvic vessels and nerves. The pelvic cavity is lined by the peritoneum in the cranial part and by pelvic fascia in the caudal part.

**FEMUR**

It is the largest long bone and it is at an angle of 70-80 to the horizontal plane inclined obliquely and articulates with the acetabulum above: tibia and patella distally in the standing animal.

The bone presents for description: a shaft and two extremities (proximal and distal extremities); 4 surfaces (cranial, medial, lateral and caudal surface). The shaft (diaphysis) in its general length is cylindrical except at its distal portion.

The cranial, medial and lateral surfaces of the femur are continuous and strongly convex. They are enveloped by the quadriceps femoris muscle. It has 2 border; lateral and medial border. The lateral border is prominent in the upper part bearing the trochanter tertius at the junction of its proximal and middle third. This process is curved forward and has a thick end to which the tendon of the superficial gluteal muscle is attached. Distal to it is the supracondyloid fossa from where the superficial flexor muscle arises. The supracondyloid fossa is bounded laterally and medially by the lateral and medial supra-condyloid crest respectively. The lateral supra condyloid crest furnishes the attachment of the medial head of gastrocnemius muscle. The border bears on its proximal part of trochanter minor which is a rough ridge that allows for the attachment of the ilio-psoas muscle.

The proximal extremity of the femur is large and consists of 3 parts: the head, neck and trochanter major (greater trochanter). The head is on the medial surface of the femur and is directed medially, dorsally and somewhat cranially. It is almost hemispherical in shape and bears a smooth articular surface except where it is interrupted medially by a deep notch called fovea capitis into which the round and the accessory ligament are lodged.

The neck is indistinct except at the cranial and medial surface. The greater trochanter is on the lateral side possessing 3 prominent features. The cranial part is located opposite the head of the femur and rises above the level of the head thus giving attachment to the gluteus profundus. The caudal part is separated from the cranial part of the greater trochanter by notch. This furnishes the attachment of the gluteus muscle. It is continued downwards as the trochanteric ridge. Trochanteric ridge bears the lateral boundary of the trochanteric fossa into which there are numerous foramina. The distal extremity articulates with the tibia and patella. The articulation with the tibia is provided by 2 condlyes directed caudo-distally and separated by a deep inter-condyloid fossa. The abaxial surfaces of the condyles are roughed and are to give attachment to the lateral ligament of the stifle.

The lateral condyles also carry 2 depressions close to the articular margin. Epicondyles are found on the corresponding side of the condyles of the femur a little above it. The former being more distinct while latter is less pronounced - each bearing the medial and lateral collateral ligament respectively. The distal extremity bears the condyles behind and the trochlea in front. The trochlea articulates with the patella. It is made up of two ridges separated by a groove thus forming an extensive surface for the ligament of the patella. The patella or knee cap is a sessamoid bone developed within the insertion of the quadriceps femoris. It is ovoid in the dog but prismatic in the horse and cattle.

**TIBIA AND FIBULA**

Unlike the analogous element of the fore-limb, they run side by side without any tendency to cross. The tibia is a long bone extending obliquely ventrocaudally from the stifle to the hock. It has a shaft and two extremities. The proximal extremity articulates with the femur and the distal extremity with the tarsal. The shaft is large which becomes reduced distally. It presents for description 3 surfaces (Medial, lateral and caudal surface) and 3 borders: the medial surface is broad above where it possesses rough prominence for the attachment of the medial ligament and the **sartorius** and **gracilis** muscle. The lateral surface is smooth and somewhat spiral while the caudal surface is rough and divided into 2 parts by the rough poptiteal line which runs obliquely from the proximal part of the lateral border to the medial border. The region above this line is occupied by the popilteus muscle while that below the line is marked by rough muscular lines and this serve as point of attachment of the deep flexor muscle.

The cranial border is very prominent forming the crest of the tibia (tibia crest). The medial; surface of this crest provides a prominence for the attachment of the tendons of the semitendinossus. The proximal half of the medial border serves as the attachment for the popliteus muscle while the proximal part of the lateral border together with the fibula forms the interosseous space. The proximal extremity is 3-sided and bears 2 articular eminences (the medial and lateral condyles) that articulate with the corresponding condyle of the femur.

The intercondyloid eminence of the spine of the tibia is a central projection between the lateral and medial condyles. This is made up of 2 parts: the high medial part and the lower lateral part. Before, on and behind the spine are intercondyloid fossae into which the cranial cruciate ligament and menisci are attached. Both condyles are separated by a deep popliteal notch. The lateral condyle bears an over-hanging outer margin below which there is a facet for articulation with fibula.

The distal extremity is much smaller than the proximal extremity. It is quadrangular in outline (4 angle) and relatively larger medially than laterally. It presents an articular surface that fits the trochlea of the tibial tarsus (talus) bone and consists of two groove separated by a ridge. These grooves are bounded on either side by a malleolus which furnishes the collateral ligament of the hock joint. The medial malleolus being more prominent than the lateral malleolus.

**FIBULA**

Like the classical long bone it has a shaft and two extremities. The shaft is a slender rod forming the lateral boundary of the interosseous space of the crus (leg). The proximal extremity or the head of the fibula is comparatively large with respect to the rest of the body with a narrow medial surface which presents along its dorsal border an articular surface for articulation with the lateral condyle of the tibia. The lateral surface is roughened providing attachment to the lateral ligament of the stifle joint. The distal extremity is fused with the tibia forming the lateral malleolus.

**PATELLA**

The patella is a large sessamoid bone that articulates with the trochlea of the femur. It possesses for description 2 surfaces, 2 borders a base and an apex. The free surface is quadrilateral, convex and rough for muscular ligament attachment. The articular surface is also quadrilateral but is not extensive as the free surface. This surface has a ventral rounded ridge which fits into the groove of the trochlea of the femur.

It has medial and lateral borders which converge at the apex below. The apex is the ventral portion in a standing animal and the base faces caudo-ventrally. The lateral and medial border of the patella both form angles at the base. The apex is directed distally while the base is directed dorsocaudally.

**TARSAL BONES (HOCK)**

These are arranged in 3 tiers; the proximal tier which consists of 2 relatively large bones, the talus medially and the calcaneus laterally. The middle tier consists of a single central bone while the distal layer comprises of up to 4 bones which are numbered medio-laterally

The lateral fourth tarsal bone is constantly present and being deeper than the other intrudes into the middle tier. The Talus has a proximal trochlear surface; the distal surface which articulates with the central tarsal bone is flattened in the horse and rounded in other species. The calcaneus lies mainly lateral to the talus but extends a shelf-like process that overlaps the talus on its plantar surface and this process is called sustentaculum tali which support the deep digital flexor tendon. The larger part of the calcaneus projects proximally behind the tibia as a free lever arm to which the common calcaneal tendon attaches. This projection ends in a thickening that forms the basis for the hock (tuber calcis or calcaneal tuber)

The distal extremity of the calcenous rests on the 4th tarsal bone. The central tarsal bone is interposed between the talus proximally and the first, second and third tarsal bones distally. Its proximal surface conforms to the talus being concave in most species except in the horse where it is flattened. Its distal articular surface is flattened. The central tarsal and forth tarsal is fussed in the ruminant. The distal tarsal bones are not always separate and present across species. In the horse I and II are fused, in the ruminant II and III are fused.

The metatarsal bones are longer than the metacarpals; the first metatarsal bone of the dog is rudimentary. The equine metatarsal bones are three in number with the 2nd and 4th metatarsal bone located on the long axis of the plantar surface of the 3rd metatarsal bone. In the bovine the 3rd and 4th metatarsal bones are thought to be fused being separated by a vascular groove and so often regarded to as the large metatarsal bone. A small metatarsal bone (2nd metatarsal bone) may be present on the plantar surface of the large metatarsal bone. The phalanges resemble those of the thoracic limb so closely as to render separate description unnecessary.

**THE PELVIS**

The pelvic peritoneum is continuous with that of the abdominal peritoneum which is then reflected into the viscera from one organ to other thus a number of folds and pouches are formed and are named accordingly. The peritoneum is the thin serous membrane which lines the abdominal cavity and the cranial part of the pelvic cavity and covers a greater extend or less the viscera contained there in. In the male, it is a completely closed sac but in the female, it has 2 small opening at its caudal portion. These openings are the abdominal orifices of the uterine tube. The structures that bound the outlet of the pelvis incloses the perineum.

1. **Mesorectum:** This suspends the rectum within the peritoneal cavity and its reflection of the peritoneum from the dorsal wall onto the rectum. A pouch is formed as a result of this and is called sacro-rectal pouch.
2. The **peritoneum** again passes thru the ventral aspect of the rectum to form a transverse fold which lies between the rectum and the urinary bladder and is called a **Urogenital Fold**. Its concave free part on either side passes into the inguinal canal. The formation of the genital fold produces a recto-genital pouch and in the male the genital fold contains the ductus deferens, part of the seminal-vesicles and the remnant of the uterus (uterus masculinus). In the female, the genital fold becomes enlarged in order to accommodate the uterus and part of the vagina. It forms fold externally and this is the broad ligament of the uterus which attaches the uterus to the side of the side of the pelvic cavity and the lumbar part of the abdominal wall. The broad ligament appears therefore to divide the peritoneal cavity into a dorsal and ventral compartment. The reflection of the ventral fold in the dorsal part of the urinary bladder produces a vesico-genital pouch.
3. The peritoneum passes from the ventral surface of the bladder to the pelvic floor forming the pubo-vesical pouch or vesico-pubic pouch. All these pouches communicates cranially, on passing or moving from the bladder into the pelvic, the peritoneum forms a median plane.
4. The middle ligament of the bladder. The peritoneum also passes on either side of the urinary bladder to form the lateral ligament of the bladder. The lateral ligament contains in its edge, the round ligament of the bladder

SEXUAL DIFFERENCE IN THE ANATOMY OF THE PELVIC GIRDLE

* The conjugate and transverse diameter is usually larger in females than in the male. Imaginary line from the shaft of a ilium to the shaft of another (transverse diameter) an imaginary line from the sacral promontory to the pubis (conjugate diameter)
* The pelvic floor of the female is more concave than the male
* The obturator foramen of the female is wider and bigger than the male.
* The ischiatic arch is deeper and larger in the bovine than in the equine

**ARTHROLOGY OF THE PELVIC LIMB/HIND LIMB**

The pelvic limb is joined to the trunk by the pelvic girdle. The hip bone is united mid-ventrally by the cartilage to form a pelvic symphysis. The cranial part of the pelvic symphysis ossifies with advancement in age whereas the caudal part remains unossified (Ischial symphysis) in most species. The ilium articulates dorsally with the sacrum to form the sacro-iliac joint. The bony pelvis is formed by the 2 hip bones, the sacrum and the first 2-3 caudal vertebrae. The obturator membrane is a thin layer of fibrous tissues which covers the obturator foramen. The major joints o the pelvic limbs are; sacro-iliac joint, coxo-femoral joint, stifle joint, hock joint (tarsal joint). The prime movers of the hip joint are the gluteus, medius, ilio-psoas and the biceps femoris muscle. The prime movers of the pelvic joint are the biceps femoris, quadriceps femoris and gastrocnemius muscle. The quadriceps femoris muscle forms the patella after it is fully ossified.

SACRO-ILIAC JOINT: Is a highly apposed synovial joint (true joint) formed by the auricular surfaces of the wing of the ilium and the wing of the sacrum. The articular surfaces are covered by cartilages and a joint is enforced by the ventral sacroiliac ligament, and the interosseous sacro-iliac ligament (divided into 2 branches, a short branch which extends between the sacral tuber and the mammillary processes in the carnivores and pigs or the spinous process of the sacrum (ruminant and horses) and long branch which extends between the sacrum tuber and the lateral part of the sacrum. The sacro-tuberal ligament which is fibrous cord in the dogs absent in the cat extends between the transverse process of the last sacral vertebrae and the Ischial tuberosity. In the ungulates (hoofed animals), it is expanded to the broad sheet between the lateral part of the sacrum in the bovine or the transverse processes of the 1st caudal vertebrae in the equine and swine and the dorsal border of ilium and Ischium and it is thus called the broad sacro-lateral ligament. Both the greater and the lesser Ischiatic foramina remain uncovered to allow for the passage of vessels, nerves and tendons.

HIP JOINT (COXO-FEMORAL)

It is a spherical joint; it is formed by the head of the femur articulating with the acetabulum. The acetabulum forms the articular surface of the horse ox coxae and the head of the femur fills with the acetabulum rather closely. The acetabulum is depend by a band of fibro-cartilage (acetabular ridge) applied to the acetubular rim. Unlike in the dog and cat, the range of most of the hip joint is restricted in the ungulates to flexion and extension with limited capacity for abduction and adduction and rotation. This is due to the shape of the head of the femur, the intra-articular ligament and massive muscle of the thigh.

LIGAMENTS OF THE HIP JOINT

There are at least 3 ligament associated with the hip joint.

1. Cotyloid ligament
2. The ligament of the head of the femur/round ligament: This is a very short or strong ligament that originates from the floor of the acetabulum at the acetabular fossa and attaches to the head of the femur particularly at the fovea capitis. It is well developed in the horse where it gives a lot of strength to that joint. It is largely intra-scapular and is covered by the synovial membrane.
3. Accessory ligament of the femur: It is present only in the horse and is detached from the rectus abdominis muscle which has its origin at the pre-pubic tendon. Passes through the acetubular notch and inserts close to the ligament of the head of the femur in the fovea capitis.
4. Transverse acetabular ligament: It bridges the acetabular notch and keeps the other to 2 ligament in front and accessory ligament) in place.

In the dog, the ligament of the femoral head is well developed while in the bovine, it is weak or even absent.

**GLUTEUS SUPERFICIALIS MUSCLE**

In the ruminant it is widely incorporated is in to the biceps femoris to form gluteo-biceps muscle

**GLUTEO BICEPS MUSCLE**

It is a very large muscle, situated on the caudo-lateral aspect of the hip and thigh. It runs caudal to the femur, superficial to the gluteus medius and it is believed to mark the end of the gluteus superficialis. It is fused to the gluteus medius.

O: Sacral spine, broad sacro-tuberal ligament Ischiatic tuber, gluteal fascia by a strong tendon to the portion of the Ischium near the obturator foramen.

I: Cranially to the lateral patella ligament to the fascia lata, crural fascia and also the patella and the calcaneus.

A: Flexes the hip joint, the stifle and to rotate the limb away (abduct)

B.S: Cranial and caudal gluteal artery, medial circumflex femoral, lateral circumflex femoral and the popliteal arteries

N.S: Caudal gluteal nerve/tibia nerve

**GLUTEUS FEMORALIS**

A narrow band muscle between the gluteus superficialis and the biceps femoris. It is found only in the cat.

O: 2nd and 4th caudal vertebrae

I: lateral aspect of patella and fascia lata by means of an aponeurosis

A: Retraction and abduction on the limb and extension of the hip

**GLUTEUS MEDIUS**

Is a large, thick and fleshy muscle largely filling space between the tuber coxae and the greater trochanter of the femur. It has 2 heads (superficial and deep heads). The deep head is a band-like (gluteus-accessory muscle).

O: Lateral angle of the ilium (tuber coxae) on its gluteal surface, sacro-tuberal ligament and

gluteal fascia

I: Greater trochanter and the trochanteric ridge

A: It extends the hip joint, rotates the femur and abducts the hip

B.S: Cranial gluteal, deep circumflex iliac, medial and lateral circumflex femoral

N.S: Cranial gluteal nerve

**GLUTEUS PROFUNDUS**

It’s a thin wide fan-shaped muscle which crosses over the hip caudoventrally.

O: Tuber coxae, the lateral part of the shaft of the ilium, the ischiatic spine, broad sacro-tuberal, sacro-iliac ligament.

I: neck of the femur

A: Abduct the thigh and rotate it medially

B.S: Cranial gluteal and lateral circumflex femoral

N.S: Cranial gluteal nerve

**TENSOR FASCIA LATA**

Most cranial par muscle of the thigh

I: Fascia lata and femoral fascia

O: Tuber coxae as well as gluteal fascia

A: Tenses the fascia lata and flex the hip joint, extend the stifle, abducts the limb.

B.S: Deep circumflex iliac and lateral circumflex iliac art

N.S: Cranial gluteal nerve

**CAUDAL MUSCLES OF THE THIGH**

These muscles cover the caudal part of the thigh and extend from the Ischium to the tibia with their tendinous components continuing as part of the common calcaneal tendon. These muscles are multi-articular spanning the hip, stifle joint and in some the tarsus. In the ungulates, some of these muscles possess vertebral heads (origin: which arises from the sacral and caudal vertebrae in addition to their pelvic heads. The vertebrae heads are well developed in the horse and account for the specie-specific round appearance of the rump. They include; biceps femoris, abductor muscles of the thigh, semitendinosus and semimembranosus.

**BICEPS FEMORIS**

The largest and most lateral of the muscles of the thigh, it is superficially covered only by the fascia and skin. It consists of the strong cranial part which arises from the sacrum and sacro-tuberal ligament (vertebral head) and the smaller head (pelvic head) which arises from the Ischium. In the ruminant and pigs, the vertebral head is firmly fused to the gluteus superficialis to form the gluteo-biceps.

**ABDUCTOR MUSCLES OF THE THIGH**

Is a strap-like abductor muscle of the thigh; **found only in the carnivores.**

O: The sacro-tuberal ligaments extends distally under the caudal edge of the biceps femoris

I: Crural fascia

A: Assist the biceps femoris in the abduction of the limbs

N.S: Fibular nerve

B.S: Caudal gluteal artery

**SEMI TENDINOSUS MUSCLE**

Long fleshy fusiform muscle lying between the gluteo, biceps and the semimembranosus.

O: Caudo ventral surface of the ischiatic tuber and the gluteo biceps

I: By an aponeurotic tendon to the tibial crest the crural fascia and tuber calcis

A: Extends the hip and hock, flexes the stifle and rotates the leg medially

B.S: Deep femoral, medial circumflex femoral

N.S: same as the gluteo biceps

**SEMIMEMBRANOSUS**

Long and thick fleshy muscle lying on the caudal part of the rump

O: Ventral surface of the Ischiatic tuber, caudoventral surface of the Ischium

I: Medial epicondyle of the femur behind the medial collateral ligament and also the medial articular margin of the tibia

A: Extends of the hip joint and adducts the limb

B.S: femoral, caudal gluteal and the obturator arteries

N.S: Ischiatic nerve and tibia nerve

**MEDIAL MUSCLES OF THE THIGH**

Primarily responsible for the adduction of the limb and it prevents unwanted abduction. It extends between the pelvic floor and the femur on the medial surface of the thigh. They include the Sartorius muscle, gracilis, pectineus, adductor muscle, and the first two being the most medial muscle.

**SARTORIUS MUSCLE**

A narrow band-like muscle, extending from the cranio-medial surface of the thigh to the stifle.

O: Iliac fascia and the tendon of the psoas minor and the shaft of the ilium

I: By aponeurosis, to medial surface of the proximal end of the tibia and the medial patella ligament

A: Flexes the hip joint and adduct the limb

B.S: Circumflex iliac

N.S: Femoral and saphenous nerve

**GRACILIS MUSCLE**

A broad flat muscle, quadrilateral in outline which lies superficially on the caudal portion of the medial aspect of the thigh behind the sartorius.

O: Ventral median raphe of the ilium formed by the symphyseal tendon, also the pre-pubic tendon

I: Medial patella ligament, crural fascia surrounding the tendon of the gastrocnemius muscle and the flexor digitorum superficialis

A: To adduct the limb & simultaneously flexes the stifle joint and extend the hock joint

B.S: Saphenous and femoral

N.S: Obturator nerve (for all medial thigh muscle)

**PECTINEAL MUSCLE (PECTINEUS)**

A long muscle in the bovine, somewhat triangular, it is fusiform in the equine

O: Pre-pubic tendon, cranial border of the pubic bone and the accessory ligament (in the equine)

I: the middle of the medial border of the femur near the nutrient foramen

A: Adduct the limb and flexes the hip joint

N.S: Obturator nerve

B.S: Femoral and saphenous nerve

**ADDUCTOR MUSCLE**

Is fleshy prismatic muscle which lies behind the pectineus and the vastus medialis

O: Ventral surface of the pubis and Ischium

I: Medial epicondyle of the femur, medial ligament of the stifle joint

A: To adduct the limb and to extend the hip joint and rotate the femur medially

B.S: Deep femoral art

N.S: Obturator nerve

The femoral canal is exposed in the dissection of gracilis and the Sartorius muscle. It is bounded cranially by the Sartorius caudally by the pectineus, laterally by ilio-psoas and the vastus medialis. The medial wall is formed by the femoral fascia and the gracilis muscle. It contains deep inguinal lymph node femoral artery and the saphenous nerve.

**INNER PELVIC MUSCLES**

They form a rather heterogeneous group of small muscles which are situated close to the hip joint. They have minor functions i.e. coordinating the movement of the hind limb. Except for the articularis coxae, they are called the small pelvic association. They are found between the pelvis and trochanteric fossa of the femur and they include; internal obturator muscle, quadrates femoris, Articularis coxae, Gemellus muscle and external obturator muscle.

**MUSCLES OF THE STIFFLE**

Most of the hip muscles especially the hamstring acts on the stifle joint because they insert on the structures found around the joint or part of the joint which is located distal to the stifle joint. There are only 2 muscles that act primarily on the stifle joint and they are quadriceps femoris (Vastus lateralis, Vastus medialis, vastus intermedius and rectus femoris). Popliteal muscle

**MUSCLES OF THE CRUS (LEG)**

They include the extensors and flexors of the tarsus and digits. They are grouped into 2 broad divisions according to the location of their bellies. They are muscles found on cranio-lateral aspect of the tibia, caudo-lateral aspect of the tibia whereas the medial aspect of the tibia is free of the muscle bellies. The muscles of the caudo-lateral aspect of the crus are the flexor of the digit extensors of the tarsus. The cranio-lateral muscles of the crus flex the tarsus and extend the digits. The flexors of the tarsus (hock joint) are on the dorsal surface of the leg while the flexors of the digits are on the plantar surface.

**THE CRANIO-LATERAL (OR DORSO-LATERAL) MUSCLES OF THE CRUS**

They are long with extended and fleshy belly. They arise from either the distal end of femur or from the proximal end of the tibia or fibula. Their tendons of insertions are multi articular and dib\vided into a branch for each functional digits they either to the metatarsus or phalanges. They are innervated by fibula nerve. Based on the actions of these muscles, they are divided into:

1. Flexors of the tarsus
2. Extensors of the digits

**FLEXORS OF THE TARSUS**

1. Tibialis cranialis
2. Fibularis longus
3. Fibularis brevis
4. Fibularis tertius

**EXTENSORS OF DIGITS**

Extensor digitorum longus

Extensor digitorum lateralis

Long extensor muscles of the 1st digit extensor

**PLANTAR MUSCLES OF THE CRUS AND DIGITS**

They arise from the distal end of the femur and/or from the proximal end of the tibia and fibula. The extensor of the tarsus insert on the calcaneus while the flexor of the digits is continued in the middle and distal phalanges. They are all innervated by the nerves while the muscles are gastrocnemius muscle and the soleus muscle.

The flexors of the digits are flexor digitorum superficialis, flexor digitorum profundus. This is deep are divide into 3 sub parts; tibialis caudalis, lateral digital flexor muscle and medial digital flexor muscles.

The interosseous muscle and lumbricale muscles are well developed in the carnivores as compared to other domestic animals and arranged like those of the thoracic limb.

**INNER PELVIC MUSCLES**

Internal Obturator Muscle

Origin: Pelvic surface of the pubis and Ischium around the obturator foramen

A: To rotate the femur outward

Insertion: The trochanteric fossa

B.S: Obturator & pudic arteries

N.S: Great sciatic nerve

**EXTERNAL OBTURATOR MUSCLES**

O: Ventral surface of the pubis and Ischium

I: The trochanteric fossa

A: To adduct the thigh and to rotate it outward

B.S: Deep femoral and obturator arteries

N.S: Obturator Nerve

**GEMELLIUS MUSCLE**

O: Lateral border of the Ischium near the Ischiatic spine

I: The trochanteric fossa and ridge

A: To rotate the femur outward

B.S: Obturator artery

N.S: Great sciatic nerve

**QUADRATUS FEMORIS**

O: The ventral surface of the Ischium

I: An oblique line on the caudal surface of the femur near the trochanter minor

A: To extend the hip joint and adduct the thigh

B.S: Deep femoral and obturator arteries

N.S: Great sciatic nerve

**MUSCLES OF THE STIFFLE**

**VASTUS MEDIALIS**

O: The medial surface of the femur

I: The medial border of the patella and its cartilage

A: To extend the stifle joint

B.S: Femoral and anterior femoral arteries

N.S: Femoral nerve

**VASTUS LATERALIS**

O: The lateral border and surface of the femur

I: The lateral part of the cranial surface of the patella

A: To extend the stifle joint

B.S: Iliaco-femoral and popliteal arteries

N.S: Femoral nerve

**RECTUS FEMORIS**

O: Two depressions on the shaft of the ilium

I: The base and cranial surface of the patella

A: To extend the stifle joint and flex the hip joint

B.S: Femoral and iliaco-femoral arteries

N.S: Femoral nerve

**THE ORAL CAVITY**

The oral cavity (O.C) and its accessory organs namely; *the tongue, teeth, salivary glands* are concerned with the *prehension, mastication* and *in salivation of food i*.e. they are involved in the conversion of food for palatability. The *O.C. extends from the lips into the entrance of the pharynx.* The osseous support of the mouth is provided by *premaxilla, palatine, alveoli processes of the maxilla, the horizontal* part of the palatine bone dorsally, the mandibular rami laterally of the body of the mandible ventrally.

The soft structures complying with the wall of the mouth are the cheeks laterally, the lips rostrally and the mylohyoid ventrally. Its *dorsal limit or roof is the hard palate.* Caudally, the oral cavity communicates with the oropharynx *by a narrow opening called the Isthmus faucium* formed by roof of the tongue and the soft palate, it is usually closed. *When the jaws are closed, the mouth is divided by the teeth and the alveolar processes into vestibule and oral cavity proper. T*hese two cavities communicate via the interdental spaces.

The part of the vestibule between the incisors and the lips is the *labial vestibule, while that* between the check teeth and the check is the buccal *vestibule.* Rostrally, two narrow incisive ducts connect the oral cavity and the nasal cavity. The duct opens on the incisive papillae. The mucus membrane of the O.C. is usually pink but may be pigmented (black) in some places. It is well supplied with blood vessels and in its sub mucosa it contains serous or mucous gland know as the labial, buccal and lingual glands (depending on their location). In addition, large salivary glands are present which feed their secretions into the O.C through special ducts.

LIPS

The entrance of the oral cavity-(*rima oris*) is bounded by the edges of the upper and lower lips to unite on each side at the angle of the mouth. The lips of the domestic mammals exist for sucking, prehension of food and also *act* *as a tactile organ* (sense organ). *They differ in shape and motility from specie to specie.* This is more pronounced in the upper lips (i.e. movement) of the horse. The Sheep, Goat and carnivores are quite motile while those of the Ox and Pig are not all that motile. *The lips are attached to the incisive bone* (premaxilla) and the incisive part of the mandible and consist of three layers, which are: - (1) *the skin externally* (2) *middle consisting of Tendon, connective and adipose tissue. (3) Internally the labial mucosa.*

The middle layer consists of the bulk of the lip, the internal and external layer meet at a sharp line at the edge of the lips. Labial mucosa is continuous with the base of the lip with the gum.

**LABIAL GLANDS**

These are small yellowish mass found in the muscular layer and are especially well developed near the angle of the mouth. They are most numerous in the horses and decreasing in no in the following sequence hose-cattle-goat-pig-dog-cats.

The skin covering the lips is similar to the skin elsewhere in the body of the carnivorous, small ruminant and the horses but usually they bear *hair.* In the pig and the Ox are areas of modified skin in the central part of the upper lips known as the rostral and the nasolabial plate respectively.

*The upper lip of the carnivores and small ruminant is divided by a distinct median cleft known as the philtrum.* The lower lip is usually smaller than upper lip in carnivore and pigs. In the ox and horse it presents the chin and this is a protuberance formed by muscular and adipose tissue. The osseous mental protuberance that forms the base of chin in man is absent on the mandible of domestic animal.

Blood Supply: Dorsal and deep ventral labial branch of mandibular artery:

Nerves: Mandibular and facial nerve

**THE CHEEK**

The cheeks form the lateral boundary of O.C and they extend from the angle of lips to a little posterior of the check teeth. The posterior part of the check is covered by the masseter muscle dorsally and they are attached to the maxilla ventrally to the rami of the mandible and blends with the labial curvature anteriorly. The checks, like the lips, consist of three layers which are (1) *the skin* (2) *buccal* *mucosa (3) intermediate layer of glands.*

The buccal mucosa is continuous with the gum of the check teeth, in ruminant and it forms cone shaped cornified papillae which are also present on the lips and are caudally directed. The buccal glands are located between the mucosa and the musculature. In addition, the middle buccal glands are found in the ox in the zygomatic arch and are called zygomatic glands. The duct of the buccal glands opens into buccal vestibule.

**THE HARD PALATE**

The *osseous palate and the mucosa that cover it oral surface are known as the hard palate or palatum durum.* The hard palate is bounded laterally and rostrally by the upper dental arch. Its tough mucosa in the horse has rich venous plexuses and is continuous laterally with the gums and caudally with the means of the mucous membrane of the soft palate. The hard palate is divided into two symmetrical halves by a medium palatine raphe which is usually in form of a shallow groove. In the dog it is an indistinct media crest. On either side of the palatine raphe are the transversely directed palatine ridges also called rugae palatine. The ridges are cornified in the Ox. The palatine ridges differ with species. It is 6-10pairs in dogs, 7 pairs in cats, 20-23pairs in pigs, 15-20pairs in Ox in sheep 14 pairs, goat 12 pairs, and horse 16-18 pairs. In the pig and horse, the palatine ridges extend to the soft palate.

Generally

(1) *Mucosa* *lacks glands but in dogs and ruminant, glands are found in the caudal portion and in the pigs glands are found in the rostral portion. (2) The mucosa is generally pigmented (black)* in all domestic animals. The incisive papillae is the central prominence just behind the dental pad in the ruminant. The incisive papillae is outrightly absent only in the horse. The hard palate lies opposite the dorsum of the tongue and with its ridges, its assist the tongue during prehension, mastication and bolus movement into the oropharynx.

**THE TONGUE**

Is a large muscular organ located in the floor of the month, between and above the rami of the mandible; the shape differs slightly from species to species.

**Function**

It is a very mobile and versatile organ, it is essential for

1. prehension
2. sorting of solid foods in some animals
3. intake of liquid in other (.e.g.) lapping of liquid in carnivores)
4. sucking in the new born,
5. Tactile organ capable of mechanical and chemical selection of food by means of the taste bud.
6. It is necessary in mastication and deglutition.
7. Some specie use the tongue to rid themselves of insect an in scratching themselves
8. Grooming of their hair coat.

**STRUCTURE OF TONGUE**

The tongue consist of (1) mucous membrane (2) glands (3) muscles, blood vessels and (4) nerves. The mucus member of the tongue has a dense submucosa by which it adheres to the adjacent tissue. Along the ventral and lateral surface, the mucous membrane is thin and delicate while on the dorsum where the wear is greatest, the mucosa is thick and rough bearing modifications of the epithelium more especially in the ruminant and the cat. Numerous papillae named according to their shape are found on the mucous membrane.

The *filiform and conical papillae have mechanical functions* while *fungiform, vallate and foliate papillae serve mainly a gustatory function* (taste).

**PAPILLAE OF THE TONGUE**

**1) Filiform papillae:**

They are soft, horny threads covering the dorsum of the tongue in pigs and horse giving a *velvety appearance.* In ox, sheep, cat and the filiform are small and directed caudally and heavily cornified.

Conical papillae are scattered among filiform papillae in the ox, goat and sheep especially on the torus linguae. The root of the tongue is generally free of filiform papillae except in carnivores and pigs.

**2) Fungiform Papillae**

These are less numerous but larger than filiform. They contain taste buds i.e. they are gustatory papillae, they are distributed over the dorsum especially along the borders.

**3) Vallate Papillae**

Located on the dorsum rostral to the root of the tongue they are large and surrounded by a circular clefts and they do not project above the surface. Serous glands are found in the neighbourhood of this papillae, and are either submucosa or intermuscular in position. *They* *are believed to provide neutral environment* for the taste bud. The number of vallate papillae varies with species: pigs and horse have a pair, carnivores have 2-3 on each side, ox have 8-17, sheep 18-24, goat 12 –18.

4) **Foliate Papillae**

This are located on the border of the tongue immediately rostral to the palatoglossal arch - a thick mucosa folding connecting the root of the tongue with the ventral surface of the soft palate. They form series of parallel leaves separated by small furrows. They are most prominent in pigs and horse, rudimentary in dogs, cats and ox, but absent in other ruminant. In the depth of the furrows are taste buds deep to the foliate papillae are also some, serves glands.

The mucosa over the root of the tongue is characterized by presence of lymphatic tissues and may appear as diffused, solitary and aggregated lymph nodules or tonsilar follicles. They are collectively called lingual tonsils.

**THE TONGUE MUSCLES**

Lingual muscles may be divided into to the (1) *intrinsic lingual muscles* and (2) *Extrinsic lingual muscles*

The *intrinsic are not attached to the skeleton while the extrinsic originate from the skeleton* and enter and tongue from behind and below then blend with fibres of lingual muscles proper inside the tongue. A thin median lingual septum divides the tongue into symmetrical halves.

**LINGUAL MUSCLES PROPER (INTRINSIC)**

These consist of deep and superficial; *longitudinal transverse and perpendicular fibre bundles,* the longitudinal bundles extend in both superficial and deep layer from the apex to the roof of the tongue. Transverse fibres run side to side and musclefibres acting singly or in unison can alter the shape of the tongue e.g. *contraction of the muscle and transverse fibers* simultaneously result in the *lengthening of the tongue.* The contraction of *the longitudinal fibre causes the shortening of the tongue.* The interaction of the extrinsic and intrinsic muscles leads to a range of lingual movements and shapes.

Extrinsic muscles include the (1) Genioglossus (2) Hyoglossus (3) Styloglossus

**FORM AND STRUCTURE OF THE TONGUE**

The surface of the tongue opposite the palate is *the dorsum lingual*. The free rostral portion is the apex. The apex presents the dorsal and ventral surface. Both meet in either a sharp or a rounded border. *The ventral surface is constricted to the floor of O. C. by a median fold called frenulum linguae.* Caudal to the apex and representing the bulk of the tongue is the body called *the corpus linguae* followed by the root called the *radix linguae.* Both the body and the root lie in the intermandibular space. *The tongue is anchored to the mandible and the hyoid apparatus by extrinsic muscles.* In the ruminant the caudal portion of the dorsum is raise to form an elliptical prominence called *torus linguae.* Rostral to *this* in the ox is a funnel shaped structure or depression called the *fossa linguae.* The tongue contain a slender bars of cartilage in the median plane just below its mucus membrane of it dorsal surface.

In the dog, the dorsum of the tongue is divided by a median groove called *sulcus* *medianus* into two equal halves, the apex contains the characteristic lyssa which is a median filiform structure embedded in the musculature along the ventral surface of the apex. They are (found) also at the lateral and ventral surface of the tongue.

**SUBLINGUAL FLOOR OF THE ORAL CAVITY**

This is a *crescent shaped space that becomes visible when the tongue is raised. It consists of a rostral prefrenular part and two lateral sublingual recesses which* extend caudally between the mandible and the tongue. The prefrenular part lies inside the arch of the incisor teeth and is supported ventrally by incisive part of the mandible. Its mucous membrane forms the median frenulum linguae for connection with the ventral surface of the tongue. On either side of the frenulum but slightly more rostral are sublingual caruncles. They vary with species in shape, size and position and are often absent in the pigs. *Mandibular and major sublingual salivary ducts open on the sublingual caruncles.*

In the horse and goat small para-caruncular glands are found near the sublingual caruncles.

The lateral sublingual recesses are bounded laterally by the lower check teeth and gum and medially by the lateral surface of the tongue. Along the floor of each recess lies the polysomatic sublingual salivary gland inside the fold of sublingual membrane. The duct of the polysomatic gland opens at the edge of the fold.

**PHARYNX**

The pharynx is a *funnel shaped musculo-membranous passage that connects the oral cavity with the oesophagus and the nasal cavity with the larynx, the* concave roof of the pharynx is related to the base of the cranium. The pharynx is related is pushed away from the sphenoid and the longus capitis and the rectus capitis ventralis muscles by the guttural pouch while the lateral wall of the pharynx is related to the stylohyoid and pterygoid and in the horse also the guttural pouches. The floor of the pharynx extend from the roof of the tongue over and around the laryngeal cartilages of the larynx. *The rostral portion of the pharyngeal cavity is divided by the soft palate into the dorsal naso-pharynx and ventral oropharynx.* The narrower *caudal portions of the pharyngeal cavity is known as the laryngopharynx. The free border of the soft palate and the paired pharyngeal arches surrounds the intra-pharyngeal opening which is located above the entrance to the larynx. Through this opening, the naso pharynx communicates with the laryngopharynx.*

**PHARYNGEAL OPENINGS**

1. A paired choanae rostrally connects the nasopharynx with the nasal cavity.
2. Paired pharyngeal opening of the auditory tube connects with auditory tube and thus the middle ear.
3. A slit like opening which is called aditus pharyngeus leads from the O.C into the oropharynx and bounded laterally by the palatoglossal arches, dorsally by the soft palate and ventrally by the root of the tongue. .
4. The entrance to the oesophagus which at the caudal end of the laryngopharynx.

*Both respiratory air and food are channel through the pharynx.* The air passes from the cavity to the larynx and in the opposite direction during expiration. Food passes from the oral cavity to the oesophagus during swallowing and in ruminant in a reverse direction during regulation. Food crosses the respiratory passage in the pharyngeal cavity in the laryngopharynx. The pharynx and related structure direct the air/food towards their proper destination.

**NASO-PHARYNX (dorsal part of pharynx when divided by soft palate)**

Is the part of respiratory channel its lie dorsal to the soft palate and extend from the choanae to the intra-pharyngeal opening. The roof of the naso pharynx is concave from front to back and from side to side. In ruminant it is divided dorsally by the medial pharyngeal septum. The slit-like pharyngeal opening of the auditory tubes are the lateral wall of the naso-pharynx.

**OROPHYARNX (ventral part of pharynx when divided by soft palate)**

It is also known as *isthmus faucium* is the part of the digestive track although air passes through it at times when animal cough or breathe through the mouth. The oropharynx extend from pharyngeal entering at the level of the palatoglossal arches to the base of epiglottis, it roof is formed by the soft palate and its floor is the roof of the soft palate contract the roof of the tongue and the lumen of the oropharynx is obliterated during swallowing however, the palate is lifted away from the tongue and the bolus can pass through oropharynx.

**LARYNGOPHARYNX**

This is common to respiratory and digestive channel is the caudal continuation of oropharynx and extend from the base of the glottis to the level of the cricoid cartilage, it contains the rostral part of the larynx on each side of the base of the epiglottis are the piriform recess that continues the floor of the oropharynx around the laryngeal entrance, *the caudal part of laryngopharynx that is covered by the caudal laryngeal constrictor is known as the vestibulum oesophagi.* In the carnivores the caudal extent of the laryngopharynx is marked by an annular fold of mucus membrane.

**WALL OF THE PHARYNX**

The pharyngeal wall consist from the inside out of

1. mucous membrane
2. fascia
3. layer of pharyngeal muscle
4. muscle fascia
5. Tunica adventitia

The mucus membrane lining the nasopharynx is similar to that of respiratory region of the nasal cavity, it is slightly folded and contains glands and regional accumulation of lymphoid tissue. The remaining pharyngeal wall is like that of the O. C. At the entrance of oesophagus the mucosa overlies an extensive venous plexus. The fascia between the mucosa and pharyngeal muscle is thin is attached to the pharyngeal raphe while the fascia on the outside of the pharyngeal muscle is thicker.

**Pharyngeal** muscles: they are striated and consist of series of bilateral pairs. They function under the swallowing reflex and are not under direct voluntary control except for stylopharyngeus caudalis which is a dilator. The pharyngeal muscles are constrictors and are also inserted on the pharyngeal raphe. As regards their insertions and origins there is little or no specie difference.

**The muscles are in two groups**

**ROSTRAL CONSTRICTOR**

Pterygopharyngeus: Origin: Pterygoid bone

Palatopharyngeus: Origin: Edge of the palatine and pterygoid bones.

Stylopharyngeus rostralis: O: - stylohyoid

Hyopharyngeus: O: - caudal end of thyrohyoid

**CAUDAL CONSTRICTOR**

Thyropharyngeus: O- Thyroid Lamina

Cricopharyngeus: O: lateral surface of cricoid cartilage

**DILATOR**

Stylopharyngeus caudalis

O: - medial surface of the dorsal 3rd of the stylohyoid

I: - lateral wall of the pharynx

*\*O – origin; I: insertion*

**SOFT PALATE**

Is a substantial musculo-mucosa cell forming the caudal conformation of the hard palate. *It extends to the pharyngeal cavity dividing the rostral portion into the nasopharynx and oropharynx. The soft palate of the horse is exceptionally long and* except during swallowing, its free border is wedged against the base of the epiglottis causing the rostral surface of the epiglottis to lie against the dorsal surface of the soft palate. The horse seems unable to raise the soft palate from this position. Hence, it is very difficult or impossible for the horse to breathe through its mouth.

**PALATOGLOSSAL ARCHES**

Two mucosa pillars that connect the soft palate with the wall of the tongue and form lateral boundaries of aditus pharyngeus. The mucosa of the ventral surface of the soft palate contains varying amounts of lymphoid tissue; deep to the mucosa is a thick layer of glands. *Three* *paired muscles are responsible for the movement of the soft palate.*

(1) Median palatinus

O: - free borders of palatine bone

I: - Caudal border of the soft palate

A: - to strengthen the palate

(2) Tensor veli palatini

O: muscular process of the tympanic part of the temporal bone

I: - in the aponeurosis of the soft palate

A: To tense and strengthened the rostral part of soft palate

(3) Levator Veli palatini

O: - Temporal bone

I: Medial plane of the soft palate

A: To raise the soft palate towards the base of the cranium.

**TEETH**

The dentition of domestic mammals consists of two dental arches but the shape, the arrangement and of teeth varies from species to species. Among the mammals generally the dentition is an *important criterion for identifications and classification,* also because of their permanent teeth are among the most *important paleontological features* ((development of animal relative to their evolution). The *teeth are the principal organ of mastication and function together with the* jaws, masticatory muscles, lips and tongue in the prehension or mastication of food.

The dentition of an animal is always *intimately related to its mode of nutrition*, hence such terms as carnivores, omnivores and herbivores dentitions. In some species the teeth has developed into a formidable weapon e.g. Lion, cats. The relatively simple *unspecialized brachydont tooth* consist of a *recognizable crown (*corolla dentis) which is the free dorsal portion of the tooth projecting into the mouth, *a root (radix dentis)* which is the embedded portion and a *slightly constricted neck (called) the collum-dentis) b*etween the crown and root at the gum line.

*In hypodont tooth i.e. the tooth that is more specialized than the brachydont tooth, the crown and the neck are not easily distinguished* so we have the body and the root. The body has a free portion that is surrounded at it base by the gum and an embedded portion that is usually long in the young animal. The tusks of a boar (pig) also consists a long body, partly exposed and partly embedded but has no root in the strict sense. The root is firmly implanted in the dental alveoli of the mandible, incisive bone, and the alveolar process of the maxilla. *The anchorage is by means of periodontum which* consist o the strong collagenous bundles transversing the space between the alveolar wall and the root *by their orientation they prevent the tooth from being pressed into it socked during mastication.*

The mammalian teeth are composed of three substances: (1) *the dentine (2) the enamel and (3) cement*

(1) The dentine is hard yellowish white osseous tissue constitute the bulk of the tooth and contain the dental cavity in its centre. *In the cavity is the dental pulp which is a mass of delicate connective tissues fines between vessel and nerves.*

(2) The enamel- is the hardest substance in the body. In *brachydont enamel is covered* by a thin cuticle and *envelopes only the short exposed crown.* In *hypsodont teeth the cuticle covers also the embedded* portion but not the short root. The enamel of the hypsodont cheek tooth usually form prominent longitudinal folds.

(3) The cement infest the root of the teeth

The surfaces of the tooth which faces its antagonist in the opposite jaw is the *occlusal surface.* While the surface. Facing the adjacent teeth is the *contract surface.* The one towards the 1st incisor is the *mesial surface and* the one the opposite side is the *distal contact surface.* The *vestibular surface* faces the lips and cheek, while the *lingual surface* is in contact with the tongue. The opening of the apex of the root is the apical foramen and it leads through the root canal into the dental cavity.

Brachydont teeth is one with well developed root and short crown, they complete their growth shortly after eruption. During development they have large dental cavity and wide root canals both of which are filled with a pulp rich in vessels and nerves. After growth ceases, there is deposition of secondary dentine which narrows 1st the apical foramen and later the entire dental cavity from the crown towards the root. In contrast to this are those that have no root in the strict sense e.g. *tusks of boar* and the *incisors of rodent.* The wide dental cavity remains wide open proximally and they continue to grow throughout the animal’s life time. Growth usually keeps pace with the wearing of the occlusal surface. If there is no wear at the distal end of teeth, the teeth will grow out of proportion. The check teeth of the ruminant and horse lies between the 2 extremities in shape and growth pattern.

**TYPES OF TEETH**

The incisor (i) are embedded in the incisive bone (part of mandible) they are followed caudally by canine (c) and these by a more complex check teeth which consist of a rostral group of premolar (PM) and the caudal group molar (M).

**DENTAL FORMULA**

*This is an abbreviated statement of the number of teeth of each dental type in an animal which helps in comparing dentition among mammalian species.* The formula uses I for incisor, C - canine, M – molar and PM - Premolar. The symbol is followed by number that indicate how many teeth of that type are present. Beginning at the median plane, the dental formula list the permanent teeth of one side. In the deciduous teeth the cover case letter is used for the symbol proceeded by a D e.g. Di 1 is the deciduous incisor next to the median plane. Because dentition is the same on both sides the formula lists only one side and is enclosed in parenthesis and multiplied by two to arrive at the number of teeth. The number above the lines are for the teeth of upper jaw and those below for the lower jaw. Pigs has the most complete dentition among domestic mammals and so dental formula is a follows

|  |  |  |
| --- | --- | --- |
| Species | Deciduous | Permanent teeth |
| Pigs |  |  |
| Dogs |  |  |
| Cats |  |  |
| Ruminant |  |  |
| Horse |  |  |

**Dogs**: For the list 1st three weeks of life the dog has no teeth, thereafter the deciduous begins this is complete after ½ months except p1 (1st premolar) upper and lower is appears 3½ to 6 month of age (in dog the list 1st premolar is not replaced) replacement of teeth in dogs.

Di 1-3 – 3-5months

D c 1 – 5-7 months

Dp 1 – not replaced

Dp 2-4 – 5-6 months

M 1-3 – 4-7 months

**Cats**: - In cat eruption and replacement are similar to the dogs.

**NB: -** In pigs Di 3 and Dc are present at birth and often cause injury to sow’s mammary gland during suckling.

**Ruminant**: Dental pad replaces the incisor and canine in the upper jaw.

The teeth of the upper jaw forms the upper dental arch and does of the lower jaw forms the lower dental arch. Each arch is interrupted between the incisors and check teeth by a white inter dental space called the *diastema. Animal are said to be isognathus (equal jaw)* when their upper and lower jaw are of the same width and when centric occlusion, the whole occlusal surface of the upper teeth makes contact with the whole occlusal surface of the lower teeth. Teeth are said to be *anisognathus* when the lower jaw and with it the dental arch is narrower than the upper jaw.

**MORPHOLOGY OF THE TEETH**

1. The Haplodont (Brachydont): - *Is the simple unspecialized tooth type* that has a conical crown, a slightly constricted neck and a simple conical root. In domestic animal except the horse this type with such slight modification as chisel shaped for shovel shaped crown is found in the I and C in shape and growth pattern they are *brachydont* i.e. they are fully developed and have ceased growth at the time of eruption. Check teeth of domestic mammals has a more complex type of two in terms of shape and growth pattern this include the following.

Tuberculosectorial Type: Characteristics of carnivores, it is a multi tubercular tooth capable with its antagonist in starting or cutting of food.

Bundodont Type: Characteristics of omnivores such as pigs. It is also multi tubercular but has a flatter occlusal surface. It is suitable for crushing food

These two brachydont types of teeth have low enamel covered crows and well developed root and their growth is completed at the time of eruption.

1. **Hyposdont**: This is *highly specialized type in the herbivores* resulting from an invagination of enamel on the occlusal surface of the tooth; *this invagination is known as infundibula.* This infundibula and their surrounding dentine are semi lunar on cross-section in ruminant: *their check teeth are known as selenodants (or moon shaped).* In solipeds the enamels on the occlusal surface form pronounced fold and ridges hence their teeth are known as *zophodont* (ridge shaped). This cheek tooth continues to grow in height for several years after eruption resulting in hypsodont type with a rather high toot body. When growth seizes a short root remains. During wearing of this type of tooth the enamel fold on the occlusal surface. Wears off living two enamel crest, this crest are harder than adjacent dentine and cement and they standout over the recessed substance providing coarse grinding surface. This surface is essential for mastication of hard fibrous plant food.

**GUMS**

The part of oral mucosa that are intimately united to the periosteum (covering of the bone) of the alveolar processes of the jaw are known as the gum (gingivae). The gum closely and encircle the neck of the teeth and exchanges fibre with the alveolar periosteum. In the ruminant the gum is modified to form the dental pad (Pulvinus dentalis) that replaces the upper incisors.

**ORBIT AND OCCULAR ADNEXA**

The bovine orbit is surrounded with bone; the bony covering is complete in bovine than that seen in the horse the eyes protrude beyond the margin of the orbit and with that aid of the eye movement has a visual field of about 3600. The bones that forms the orbit consist of the (1) *frontal bone, (2) the lacrimal bulla* which is a projection of the lacrimal bone. The bone covering provided by the lacrimal bone is quite thin. The *frontal bone forms the root of the orbit,* the maxilla assist in forming with the lacrimal bone the rostroventral wall of the orbit, the temporal bone does not form any portion of the orbit of the Ox unless the zygomatic process of squamous temporal bone would be considered as a protection for the orbit contact.

**ACCESSORY OCULAR ORGANS**

*The eyelids* are quite thick and consist of lower and upper lids. The eyelids have cilia, but the cilia are shorter at the lower lids. *The tarsal glands are* prominent but are well embedded within the tissue of the lids. The orbicularis oculi are well developed. The median and lateral attachment near the limbus of the eyelids may be found muscular fibres which takes a circular course around the palpebral fissure. The superficial muscles that act on the movement of the lids are the *Frontalis for the upper lid;* Malaris for lower lid and the orbicularis oculi

The superficial muscles are under the motor control of the 7th nerve.

The palpebral conjunctiva may be pigmented near the marginal of the lids but at the fornix pigmentation is lacking. The bulbar conjunctiva may show considerable pigmentation near the muscles of the eyes. The conjunctiva of the Ox may contain isolated nodules of lymphatic tissue or accessory lacrimal gland. The fold of mucosa that covers *the 3rd eyelid can be seen in the median angle of the eye.* This fold of tissue covers an underlining T shaped Cartilage surrounding the cartilage and particularly the shaft is the glandular tissue of the semilunar fold of the conjunctiva (Nictitating membrane). *Hardner’s gland which* is a special deep gland of the 3rd eye lid is found only in pigs.

**LACRIMAL APPARATUS**

Lacrimal apparatus consist of *(1) lacrimal gland, (2) lacrimal canal, (3) Lacrimal sac (4) Lacrimal caruncle (5) Naso lacrimal ducts*.

The lacrimal gland is lobulated in appearance but have two distinct areas: the thick dorsal portion and the thin ventral portion. The glands cover the lateral and dorsal surface of globe and empties through a number of ducts: 6-8 large ducts and several smaller ducts near the fornix of the conjunctiva of the upper lid. Lacrimal gland secretes tear. Lacrimal caruncle is seen in the medial angle of the eyes, it may be yellow or dark brown in color depended on pigmentation.

Lacrimal canal of Ox measures to 1-1-15 cm in length and have an arch shaped course from the puncta lacrimalia to the lacrimal sac.

Lacrimal sac is formed by the confluence of lacrimal canal which may be 5-8mm in diameter.

Nasolacrimal duct is about 12-15 in length and usually takes a straight course; the terminal portion, 3-4 mm wide, is found between the two cartilagenous sheets of the alar cartilage and rostral projection of the parietal cartilage. It opens near the lateral wall of the nostril.

**THE PERIORBITA**

This is *a fibrous sheath covering the eye ball; it has a deep and superficial layer. The deep layer of the fascia is attached at the base of the trochlear cartilage. The deep fascia joins with the superficial after passing under the rectus dorsalis is muscle and the lacrimal gland.*

**EXTRINSIC MUSCLES**

The 7muscles of the orbit include:

dorsal, ventral, medial, and lateral recti muscles

Dorsal and ventral oblique muscles

And the retractor bulbar muscle

**EYEBALL**

The eyeball is made up of three tunics enclosing refracting area. The three times are the (1) external fibrous middle vascular and (3) inner nervous tunics.

The external fibrous tunic consist of the anterior avascular transparent *cornea* and the posterior vascular *opaque sclera* (white of the eye) The cornea project well beyond the bony orbit in the ox and posses five layers just as in other animals. The conera may have some pigment in it periphery the cornea and iris it is not extensive in ox.

The vascular tunic consist of three parts:

(1) choroids (2) culinary body (3) Iris

The choroids of the ox does not vary from the choroids of other dominant animal except that the layers are distinct and the connective tissues are pigmented. *Tapetum is present in nocturnal animal* but absent in man, monkey and pigs. The tapetum in cattle is roughly triangular.

Inner nervous tunics is the *retina; the nervous coat consist o sports:* (1) pars optical retina (2) Par ciliary retina and (3) pars iridica retinae

*The ciliary and iridica part lack photoreceptor celss.*

There are blood vessels in the fibrous layer of retina. The ox has pigment epithelium in the retina except the areas where the retina overline the tapetum, the optical disc is the part of emergence of the optical nerve after its fibres have penetrated the outer layer of the bulb.

**CHAMBER OF THE EYES**

The anterior chamber of the eyes is enclosed anteriorly by the cornea and posteriorly by the iris and lens.

**DIGESTIVE SYSTEM**

This consists of organs which are involved in the ingestion, mastication, digestion and absorption of food as well as the expulsion of the unabsorbed remnant. It consists of the mouth, pharynx, oesophagus, stomach and the intestine. The accessory organs which aid the functions of the digestive systems are the teeth, the salivary glands, the liver and pancreas.

**THE MOUTH**

The cavity of the mouth is divided by the teeth into an outer part which is called vestibule (between the teeth and lips) while the oral cavity proper is enclosed by the teeth and dental pad.

In the ruminants, the cavity of the cheek is capacious but the vestibule is small because the rima oris (opening to the teeth) is short. The remarkable feature of bovine oral cavity is the large number of sharp, modified projections directed towards the back of the mouth.

The tongue and palate are not so rough in the sheep and goat. Lips in the Bovine are thick and comparably immobile. The tongue is wide and thin rostrally. It is very mobile and non-pigmented but has a bright red colour.

**DENTAL FORMULAR OF SOME DOMESTIC ANIMALS**

Ruminants 2 (I 0/4, C 0/0, P 3/3, M 3/3) = 32

Pig 2 (I 3/3, C 1/1, P 4/4, M 3/3 ) = 44

Horse 2 (I 3/3, C 1/1, P 3-4, M 3/3) = 40 or 42

Dog 2(I 3/3, C 1/1, P 4/4, M 2/3 ) = 42

Cat 2(I 3/3, C 1/1, P 3/2, M 1/1) = 30

**PHARYNX OF THE RUMINANT**

The pharynx is attached dorsally by its muscle and abaxial to the bone of the skull.

**OESOPHAGUS**

It is highly dilatable of varying diameter. In the bovine, it is about 90 – 105 cm in length from its junction with the pharynx to the caudal of the stomach. There are cervical and thoracic parts of the oesophagus that because the stomach is in close contact with the diaphragm, there is no abdominal part of the oesophagus.

**THE STOMACH**

This is dilatable between the oesophagus and small intestine.

**Functions**

(i) Microbial activities (ii) Digestive of foods

(iii) Absorption of food (iv) Reservoir for ingester

There are two type of stomach

(i) Simple and Complex Stomach.

The simple stomach – There are three regions in the simple stomach.

(i) Cardiac: Into which the oesophagus empties

(ii) Fundus: It represents the body of the stomach

(iii) Pylorus: It is the outlet from the stomach.

The cardiac and pylorus are closer to each other, thereby turning the stomach into a curved tube. The greater length of tube is called greater curvature while the lesser length is called lesser curvature. The oesophageal fascia is at the cardiac while that of the duodenum is at the pylorus and both are guided by the sphincter consisting of smooth muscle.

**THE RUMINANT STOMACH**

The ruminant stomach is complex and different from that of other types of animals. It consists of 4 parts:

(i) Reticulum (ii) Rumen (iii) Omasum (iv) Abomasum

The first three parts are lined by stratified squamous epithelium. They are non-glandular and represent the fore stomach while the abomasum is the true glandular stomach. The entire stomach in cattle is very large and occupies about ¾ of the abdominal cavity. At birth, the abomasum is about twice other 3 compartments. Differentiation and growth takes place gradually and it is intensified when dry feed becomes the staple diet. In the adult, total capacity of the stomach is highlighted below:

Rumen 80% Omasum 7. 8 %

Reticulum 5 % Abomasum 7. 8%

**RUMEN**

The rumen extends from the 7th to 8th inter coastal space to the pelvic area. It divided into dorsal and ventral sacs by the right and left longitudinal grooves at the respective side of the rumen.. Caudally, there is a dorsal blind sac as well as ventral blind sac which are demarcated from the dorsal and ventral sacs proper by the dorsal and ventral coronary grooves and from each other by the other grooves.

The reticulum is separated from the rumen by the rumino-reticular groove which is prominent laterally and ventrally but not dorsally.

**RETICULUM**

This is the smallest and the most cranially placed of the four compartments. It is the blind sac which binds with the dorsal part of the rumen. It is wholly placed more on the left and its convex surface faces cranially and it’s in close contact with the diaphragm and the liver. It is usually called ***honey comb***

**OMASUM**

It is clearly marked off from other three compartments and can only be observed from the right side of the animal. It is a round ball–like structure attached by its other ends to the reticulum and by a short neck on the lesser curvature of the abomasum. Because of the presence of several plicae it contains, it is literally called bull stomach in many plies.

**ABOMASUM**

This is an elongated sac resting on the abdominal floor. It extends from the xiphoid cartilage to the 10th intercoastal space. It then turns dorsally to lie between the omasum and the central part of the rumen.The parts of the abomasum are similar to those of a typical glandular stomach.

**INTERNAL APPEARANCE**

The grooves that are found externally correspond to pillars internally. In the reticulum, the mucous membrane is raised into pillars which are about 4cm high and enclose 5 to 6 sided cells. The omasum is occupied by convex longitudinal pillars which spring from the side. These pillars are called lamellae and they are absorptive. The abomasum is the true glandular stomach consisting of the same features as the simple stomach.

**SMALL INTESTINE**

Generally, the total length of the large and small intestine is about 20 times the length of the body in the horse, 25 times the length of the body in sheep and goats. The small intestine consists of the following parts:

(i) Duodenum (ii) Jejunum (iii) Ileum

The **duodenum** has 3 sections – The 1st part is continuous in pylorus of the stomach and form an S-shaped curve which makes contact with the liver. The emphatic and pancreatic duct opens into the part. The second part of the duodenum moves caudally in the right side of the median plane and extends as far as to the kidney. The 3rd part crosses to the left of the median plane and moves cranially to the roof of the greater mesentery.

The **Jejunum and Ileum:** these portions are fairly freely movable and there is no clear demarcation between them. The ileum terminates at the caecum.

**Large Intestine:** Generally, it performs some absorptive functions and helps to lubricate and transport ingesta. It is also a major site for microbial activities. It consists of these parts.

(i) Caecum (ii) Colon (iii) Rectum

**LARGE INTESTINE**

However, the large intestine of cattle is very long and is for most of its length not greater in diameter than small intestine. It has no longitudinal bands and sacculations. These two feature are absent in the ruminant intestine except for the caecum.

**The Caecum** is about 30 inches long with a blind end that points caudally. The blind end usually lies on the right side of pelvic inlet. The caecum opens to the colon at the caeco-colic orifice which is not guarded by a sphincter.

**The Colon** consists of the following segment –

(i) Proximal loop (ii) Spiral loop (iii) Distal loop (iv) Transverse colon and

(v) Descending colon.

The proximal loop begins as a direct continuation of the caecum which moves caudally and then flexes upon itself and moves craniodorsally to enter into the spiral loop. The spiral loop in the Ox usually consists of 2 full centripetal turns as well as 3 full centrifugal turns and a central flexure.

In the sheep and Goat, there may be up to 3 centripetal turns as well as 3 centrifugal turns each. The distal loop continues from the last centrifugal turn caudally and dorsally. It is transforms into the transverse colon which is rather short and is in turn continued as the descending colon. The descending colon moves caudodorsally to form a sigmoid flexure at the pelvic inlet where it joins the rectum.

**The Rectum** is the terminal part of the large intestine and is located in the pelvic cavity. Mesorectum ligament support the rectum. The intestinal tract terminates at the anus where the presence of 2 sphincters namely an internal sphincter of smooth muscles and an external sphincter of striated muscles. It is the external sphincter that closes the anus.

**LIVER**

It is one of the accessory organs of the digestive system. It is the largest organ in the body situated on the abdominal surface of the diaphragm. In ruminants due to the size of the stomach, the liver is pushed to the right than the median plane. The liver has 2 surfaces: the diaphragmatic surface and the visceral surface.

The ***diaphragmatic surface*** is generally molded to the shape of the diaphragm and is therefore convex. The ***visceral surface*** is concave and represents the portal entry through which the portal veins, hepatic artery and veins and lymphatic vessels enter or leave the liver. The visceral surface also represents many impressions of other structures that are in close contact with the liver from the abdominal cavity. The liver is held in position largely by the pressure of the other viscera and also by its close attachment to the diaphragm. Furthermore, this attachment is facilitated by ligaments which may be up to 6 in number.

(i) *Coronary ligament* - This is present in all animals and attaches the liver to the diaphragm.

(ii) *Falciform ligament* - This is continuous with the coronary ligament and attaches the liver to the floor of the abdominal cavity as well as the sternal part of the diaphragm.

(iii) *Right and left lateral ligament* - When present they attach the dorsal border of the respective portion of the liver to the diaphragm.

(v) *Caudate or Hepatorenol Ligament* - This is rather inconsistent, when present, it attaches the caudate lobe of the liver to the right kidney and base of the caecum.

**LOBATION OF THE LIVER**

The liver has four major lobes: the left lobe and the right lobe. Interposed between the 2 lobes are the caudate lobe and the Quadrate lobe. The proximal lobe which is cranial to the portion is the caudate lobe and the distal one is the Quadrate lobe.

**REPRODUCTIVE SYSTEM**

The male reproductive system consists of the following:

(i) Scrotum (ii) Testes (iii) Epididymis (iv) Penis and Prepuce (v) Accessory sex gland

**THE SCROTUM**

This is a cutaneous sac which houses the two testes. The two scrotal sacs are often symmetrical, though the left is likely longer than the right. The division of the scrotal sac is marked centrally by a longitudinal raphe.

**THE TESTES**

This represents the essential reproductive organ responsible for the production of spermatozoa and testosterone. Structures to be transected from without inward of the scrotum are:

(i) Skin (ii) Fascia (iii) Cutaneous muscles (iv) Parietal Tunica vaginalis

(v) Peritoneal cavity (vi) Visceral Tunica vaginalis (vii) Tunica albuginae.

**ORIENTATION OF THE TESTES**

In the Bull, Ram and Buck, the testis is cranial to the sigmoid flexure and the long axis is vertical and lies cranial to the sigmoid flexure.

In the Horse and Dog, the long axis of the testes is nearly horizontal and the testis is close to the abdominal wall near the external inguinal ring.

In the Boar, the testes descend much further caudally than in others. The testis is caudal to the sigmoid flexure. The long axis of the testes is nearly vertical.

**EPIDIDYMIS**

This is responsible for maturation and transportation spermatozoa. It is closely attached to the testicles along caudal boarder. It is made up of three parts.

(i) Caput or head (ii) Corpus body (iii) Caudal or Tail

The tail is largest and is mostly attached to the ventral extremity of the testes. It is continuous by ductus deferens. The ductus deferens ascends into the inguinal canal as part of the spermatic cord.

**THE PENIS**

This is the main organ of copulation. It consists of three parts: The root (crural) the body (shaft). The terminal part (glands)

The root of the penis is in form of 2 crura which are attached to ischiatic arch. The body is the portion that contains the erectile tissues which are organized into 2:

(i) Corpus cavernosum (ii) Corpus spongiosum

When the corpus cavernosum and spongiosum are engorged with blood, they become turgid. In some animals, the penis presents a flexure at about the middle of its length. This flexure is called sigmoid flexure.

**THE ACCESSORY SEX GLAND**

They produce secretory fluid which contributes to the formation of semen. The secretions are usually formed into the urethra. They develop under the influence of androgen. In castrated animal, the accessory sex glands undergo atrophy (i.e. reduction in size). All the accessory sex glands are paired except the prostate gland. The male accessory sex glands includes –

(1) Ductus deferens (2) Seminal vesicle (3) Prostrate gland

(4) Bulbourethral gland

**FEMALE REPRODUCTIVE SYSTEM**

Consists of the following –

(1) Paired ovaries (2) Vagina (3) Vestibule (4) Mammary gland (5) Vulva

(6) Oviduct (7) Uterus (8) Cervix (9) Uterine horns.

**THE OVARIES**

The two ovaries are the essential reproductive organ from which the ova are produced. The oviducts convey the ova to the uterus. The development of the fertilized ovum takes place in uterus and foetus is expelled from the uterus through the vagina. The vestibule is the ventral part of the gentalia into which the urethra opens. The Vulva is the caudal external limit of the gentalia while clitoris which is the homologue of the male penis. The vestibule of the vagina is enclosed by loose skin folds called labia. This may be well developed in carnivores and primate, however, only primate posses’ true labia majora.

**THE OVIDUCT**

This is a slender structure where fertilization of the ovum usually occurs at its upper end so that the trophoblast is developed before it reaches the uterus. The oviduct is considered to have 3 parts – (i) Isthmus (ii) Infundibulum (iii) Ampulla

**THE UTERUS**

This is a thick muscular structure in which the embryo develops. It is enclosed within with a vascular epithelium called the endometrium. Its growth pattern is controlled by the hormones of ovarian origin. The placenta, which provides the maternal nourishment for the developing embryo, is formed as a result of fusion of the uterine endometrium and extra-embryonic membrane embryo. Generally, the uterus is bi–horned in most domestic animals.

**THE CERVIX**

This assumes a special importance in parturition and artificial insemination and separates the vagina from the uterus. The cervix is closed at all time except at estrus and parturition.

**THE VAGINA**

The vagina receives the penis. It extends from the cervix to the vulva. The vulva represents the terminal part of the reproductive tract.

**THE MAMAMARY GLAND**

The mammary glands are of economic importance in the female animal because of the milk they produced. There are 3 group of mammary glands:

(i) Pectoral group (ii) Abdominal group (iii) Inguinal group

In many domestic animals, it is the inguinal groups that develop. In some, like dogs and pig, there is a complete development.

**MAMMARY GLAND OF COW**

This consists of 2 halves. Each has a cranial and caudal quarter. Each quarter is a separate mammary gland and develops on its own. There is an inter mammary group which separate the half. Often there is a shallow transverse furrow separating the two halves quarter but each quarter is completely separated from the other quarter. In duct formation unlike the different between 2 halves, the quarter of 2 halves have a common blood vessel supplied and lymph drainage. The suspensory ligament of the udder consists of median suspensory ligament and lateral suspensory ligament.

In the mare (female horse) the mammary has two steat canal in the inguinal region. In the Bitch, there are 5 pairs of mammary gland. In the sow there are 10 to 14 pairs of glands. In the ewe as in the cow there are 2 glands one in either side as in the mare. Only the inguinal paired developed.

**GROSS ANATOMY OF THE BOVINE SPECIES**





































