CHAPTER - 4

Osseous system

Points to be covered in this topic

- **4.1 Introduction**
  - 4.1.1 Divison of skeleton system
  - 4.1.2 Functions of osseous system
- **4.2 Classification of osseous system**
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CHAPTER - 4

Osseous system

Points to be covered in this topic

- **4.6 The appendicular skeleton**
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Osseous system

4.1 INTRODUCTION

- Osteology is the study of the structure and function of the skeleton and bony structures.
- Bones and joints form the skeletal system of the body.
- The skeletal system consists of about 206 bones.

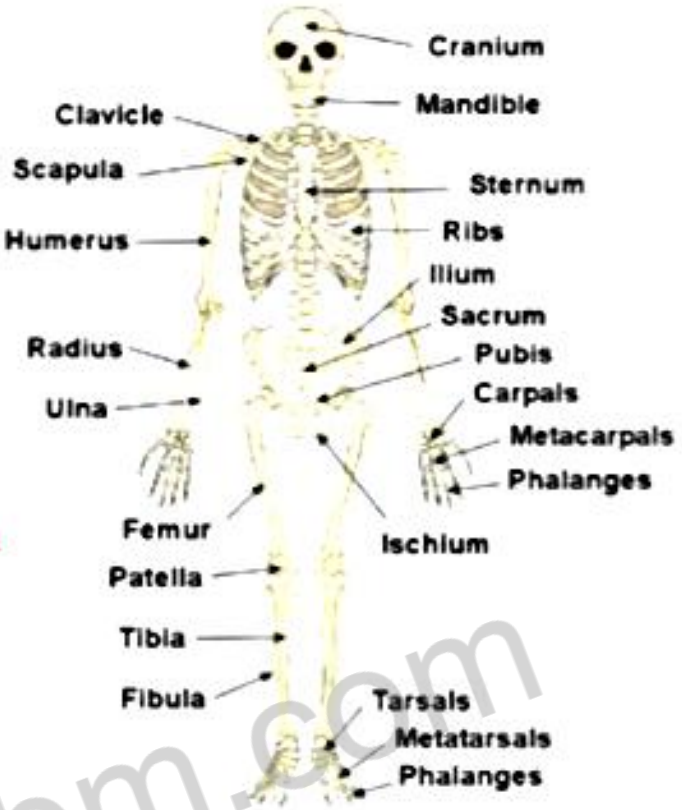
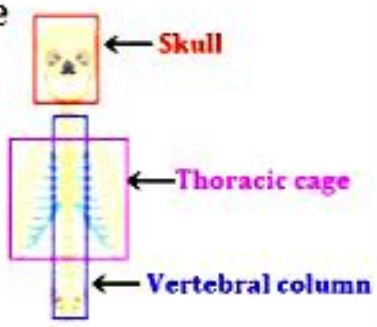
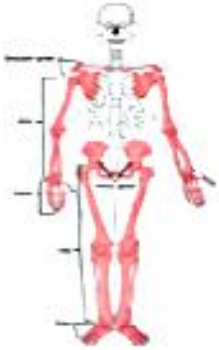


Fig.4.1: Skeleton system

4.1.2 Functions of osseous system

- Bones provide shape to the body.
- Bones act as a protection to internal organs like the brain, heart, lungs etc.
- Provides support to the body and anchors muscles.
- Bones serve as storage space for minerals like calcium and phosphate

4. 1.1 The Bones of the Skeleton are divided into two groups

THE AXIAL SKELETON	THE APPENDICULAR SKELETON
It consists of the bones which form the skull, the vertebral column and the thoracic cage 	It consist of shoulder girdles, upper limbs, pelvic girdle and lower limbs 

- Bones help in facilitating body movements.
- Bones serve as the birthplace for red blood cells.

4.2 CLASSIFICATION OF OSSEOUS SYSTEM

BONE CLASSIFICATION	FEATURES	FUNCTIONS	EXAMPLES
Long bones 	Cylinder-like shape, longer than it is wide	Movement, support	Femur, Tibia, Fibula, Metatarsals, Humerus, Ulna, Radius, Metacarpals, Phalanges
Short Cube-like shape 	Approximately equal in length, width, and thickness	Provide stability, support, while allowing for some motion	Carpals, Tarsals
Flat bones 	Thin and curved	Points of attachment for muscles; protectors of internal organs	Sternum, Ribs, Scapulae, Cranial bones
Irregular 	Complex shape	Protect internal organs, movement, support	Vertebrae, Facial bones
Sesamoid 	Small and round; embedded in tendons	Protect tendons from excessive forces, allow effective muscle action	Patellae

4.3 BONE CELLS

- There are three types of bone cell

Osteoblast
(forms bone matrix)

i. Osteoblasts (bone – building cells)

- These bone-building cells deposit both osteoid and inorganic salts in bone tissue.

- They are therefore present at sites where the bone is growing, repairing or remodeling, e.g –
  - ✓ In the periosteum
  - ✓ In the centers of ossification of developing bone
  - ✓ At each end of the diaphysis of long bones, adjacent to the epiphyseal cartilages, where they ossify growing cartilage
  - ✓ At fracture sites.

ii. Osteocytes (Mature bone cells)

- These mature bone cells do not divide.
- They monitor and maintain mature bone tissue.
- In the event of bone damage or disease, they de-differentiate into osteoblasts to rebuild or repair the bone.

Osteocyte (maintains bone tissue)

iii. Osteoclasts

- These cells break bone down, releasing calcium and phosphate.
- They are giant cells with up to 50 nuclei, formed from the fusion of many monocytes
- It is active growth, repair or remodeling.

Osteoclast (resorbs bone)

4.4 STRUCTURE OF BONE

- Bone is the hardest of the connective tissues. It consists of two kinds of connective tissues
  1) **Compact bone**
  2) **Cancellous bone**

1. Compact bone (Corticol)

- It makes up around 80% of adult bone mass and forms the outer layer of bone.
- It is hard and dense. It is found in flat bones, in the shafts of long bones and as a thin covering of all bones.

2. Cancellous bone (Trabecular or Spongy)

- Bone makes up the remaining 20% of bone and consists of a network of trabeculae, or rod-like, structures.
- It is lighter, less dense, and more flexible than compact bone.

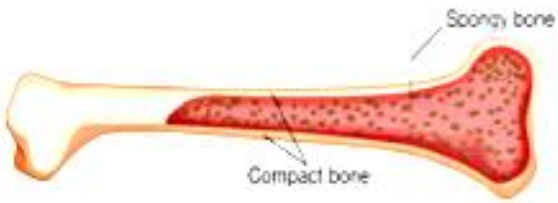


Fig.4.2: Structure of Bone

4.4.1 Microscopic structure of bone

- ✓ **Haversian canal-** Which lies at the center. It contains blood vessels, nerves and lymphatics.
- ✓ **Lamellae-** Which are plates of bone arranged concentrically around the Haversian canal.
- ✓ **Lacunae-** Which are spaces between the lamellae and they contain bone cells.
- ✓ **Canaliculi-** Which are fine channels. They radiate between the lacunae and the central Haversian canal.

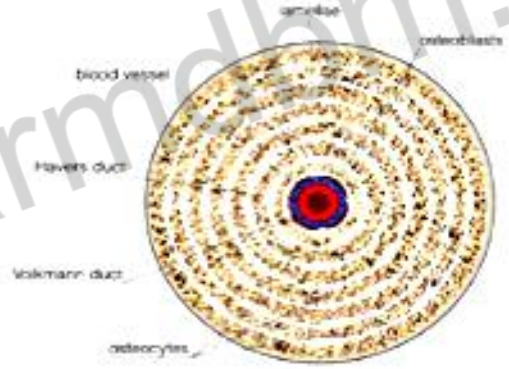


Fig.4.3: Microscopic Structure of Bone

4.5 THE AXIAL SKELETON

- The bones of the axial skeleton constitute the central bony core of the body.

4.5.1 THE SKULL

- The human skull consists of cranium and facial bones.

➢ THE CRANIUM

- It provides bony protection to the brain. It is described in two part : base and vault. The base is a part on which the brain rests and the surrounding part is termed as the vault.

CRANIUM

Frontal bone (1)	Occipital bone (1)	Ethmoid bone(1)	Sphenoid bone(1)	Parietal bone (2)	Temporal bone (2)

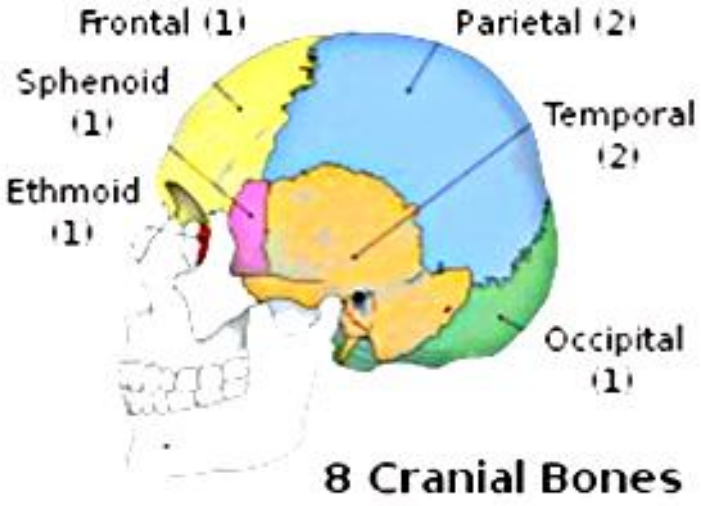
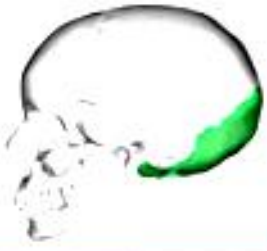


Fig 4.4. :- The cranium

i. FRONTAL BONE (1)

- This bone forms the forehead, part of the orbital cavities (eye sockets) and the prominent ridges above the eyes, the supraorbital margins.
- The eye and muscles that move it are protected within the orbital cavity.
- It contains two cavities called the frontal sinuses which lie one over each orbit.
- These sinuses give lightness to the bone and resonance to the voice, acting as sounding chambers.
- The frontal bone forms sutures with the parietal, sphenoid, zygomatic, lacrimal, nasal and ethmoid bones.
- It originates in the fetus in two parts, joined in the midline the frontal suture, and converted entirely to bone shortly after birth.

ii. THE OCCIPITAL BONE (1)



- The occipital bone forms the back of the head and part of the skull.
- It forms an immovable joint with parietal, temporal and sphenoid bones.

- Its inner surface is deeply concave to accommodate the occipital lobes of the cerebrum and cerebellum.
- On the outer surface, there is a roughened area called occipital protuberance.
- In this bone, there is a large opening known as the foramen magnum, for the passage of the spinal cord.

iii. ETHMOID BONE (1)

- The delicate ethmoid bone occupies the anterior part of the base of the skull and helps to form the orbital cavity, the upper part of the nasal septum and the lateral walls of the nasal cavity.
- On each side it has two projections into the nasal cavity: the superior and middle conchae or turbinated processes.
- It contains numerous sinuses that open into the nasal cavity.
- The horizontal flattened part, the cribriform plate, forms the roof of the nasal cavity and has numerous small foramina, through which nerve fibres of the olfactory nerve (sense of smell) pass upwards from the nasal cavity to the brain.

iv. SPHENOID BONE (1)

- The sphenoid bone forms the middle part of the base of the skull and articulates with the occipital, temporal, parietal and frontal bones.
- It links the cranial and facial bones, and cross-braces the skull.
- On the superior surface in the middle of the bone is a little saddle-shaped depression, the hypophyseal fossa (sella turcica), in which the pituitary gland rests.
- The body of the bone contains some fairly large air sinuses that open into the nasal cavity.
- The optic nerves pass through the optic foramina on their way to the brain.

v. PARIETAL BONE (2)

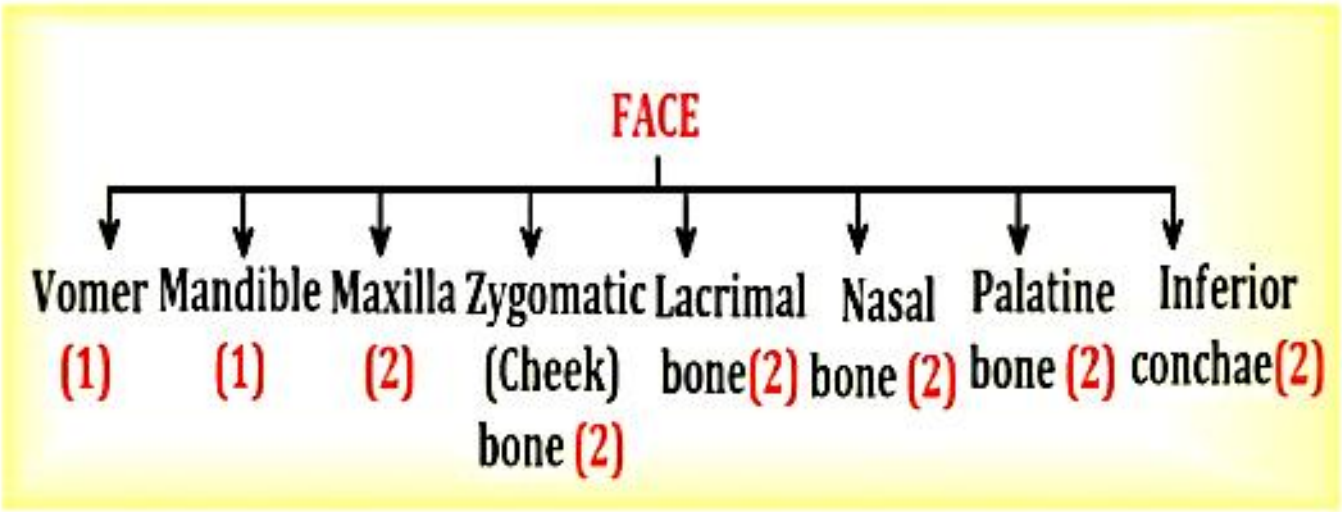
- These bones form the sides and roof of the skull.
- They articulate with each other at the sagittal suture, with the frontal bone at the coronal suture, with the occipital bone at the lambdoidal suture and with the temporal bones at the squamous sutures.

vi. TEMPORAL BONE (2)

- The temporal bones lie one on each side of the head and form sutures with the parietal, occipital, sphenoid and zygomatic bones.
- The squamous part is the thin fan - shaped area that articulates with the parietal bone.
- The mastoid part contains the mastoid process, a thickened region easily felt behind the ear. It contains a large number of very small air sinuses that communicate with the middle ear.
- The petrous portion forms part of the base of the skull and contains and protects the organs of hearing (the spiral organ of Corti) and balance (the semicircular canals).
- The temporal bone articulates with the mandible at the temporomandibular joint, the only movable joint of the skull.

➢ FACE

- The skeleton of the face is formed by 14 bones.



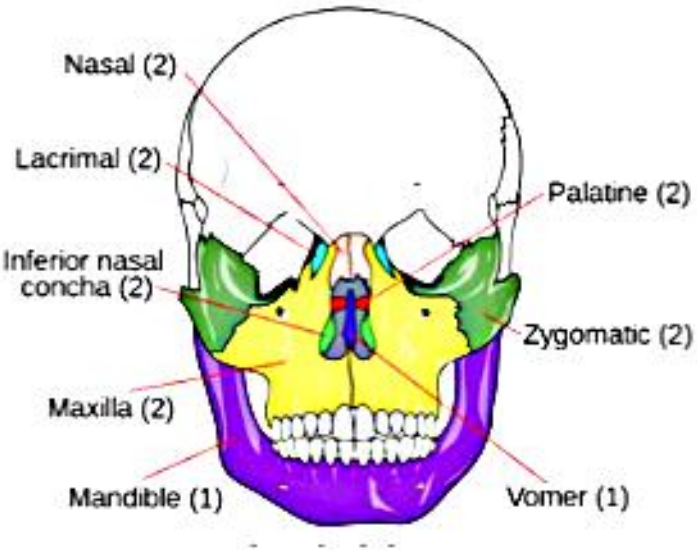


Fig 4.5: Facial bones

i. VOMER (1)

- The vomer is a thin, flat bone that extends upwards from the middle of the hard palate to form most of the inferior part of the nasal septum.
- Superiorly, it articulates with the perpendicular plate of the ethmoid bone.

ii. MAXILLA (2)

- The maxilla forms the upper jaw, the anterior part of the roof of the mouth, the lateral walls of the nasal cavity and part of the floor of the orbital cavities.
- The alveolar ridge, or process, projects downwards and carries the upper teeth.
- On each side is the largest of the sinuses, the maxillary sinus, which opens into the nasal cavity.

iii. ZYGOMATIC BONE (2)

- These bones form the prominences of the cheeks (the cheekbones) and part of the floor and lateral walls of the orbital cavities.

iv. LACRIMAL BONE (2)

- These two small bones are posterior and lateral to the nasal bones and form part of the medial walls of the orbital cavities.

- Each is pierced by a foramen through which the nasolacrimal duct passes, carrying tears from the medial canthus of the eye to the nasal cavity.

v. NASAL BONE (2)

- These two small flat bones form most of the lateral and superior surfaces of the bridge of the nose.

vi. PALATINE BONE (2)

- These are two small, L-shaped bones.
- The horizontal parts unite to form the posterior part of the hard palate and the perpendicular parts project upwards to form part of the lateral walls of the nasal cavity.
- At their upper extremities they form part of the orbital cavities.

vii. INFERIOR CONCHAE (2)

- Each concha is a scroll-shaped bone that forms part of the lateral wall of the nasal cavity and projects into it below the middle concha.
- The superior and middle conchae are parts of the ethmoid bone.
- The conchae collectively increase the surface area in the nasal cavity, allowing inspired air to be warmed and humidified more effectively.

viii. MANDIBLE (1)

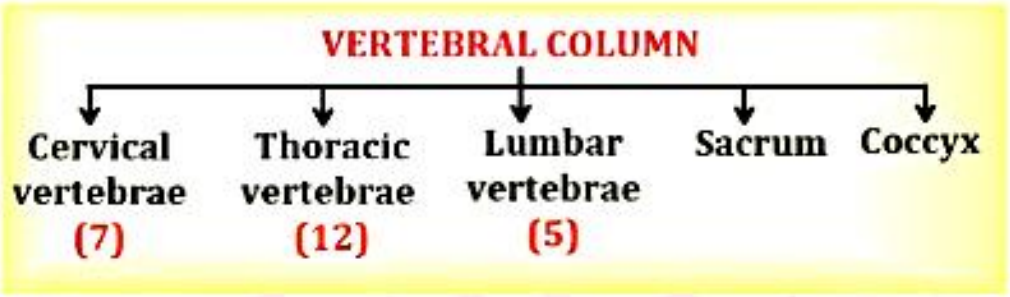
- This is the lower jaw bone, the only movable bone of the skull, permitting opening and closing of the mouth and chewing.
- The anterior part of the body, is curved and features the alveolar ridge, which anchors the lower teeth.
- On each side the bone curves sharply upwards almost at right angles to the posterior end of the body: this part is called the ramus.

✓ HYOID BONE

- This isolated horseshoe-shaped bone lies in the soft tissues of the neck just above the larynx and below the mandible.

4.5.2 THE VERTEBRAL COLUMN

- The vertebral column, also called the spine or backbone, is the central axis of the body, providing direct and indirect support for the entire skeleton and the skeletal muscles that move it.
- It contains 26 interlocking bones stacked on top of one another, and encloses the vertebral canal, through which the spinal cord descends from the brain.



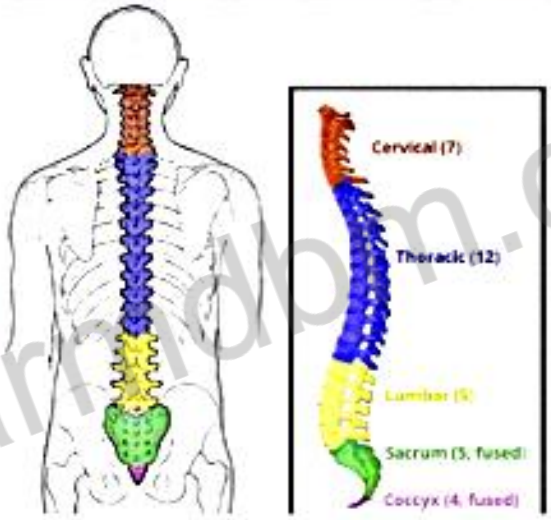


Fig.4.6: Vertebral column

i. CERVICAL VERTEBRAE

- They are 7 in number.
- The first cervical vertebra is called an atlas.
- The second cervical vertebra is called as axis.

➢ Atlas

- It is the first cervical vertebra.
- It does not have a body.
- It does not have a spinous process.
- On the upper surface, it has two facets. These facets articulate with the condyles of the occipital bone (to form Atlan to occipital joint)

➢ Axis

- It is the second cervical vertebra. It contains
  - ✓ Odontoid process which is an upward projection from the body.
  - ✓ It articulates with anterior arch of atlas.
  - ✓ Two Facets on the anterior surface. They articulate with atlas.
  - ✓ A Spine which is small and bifid.

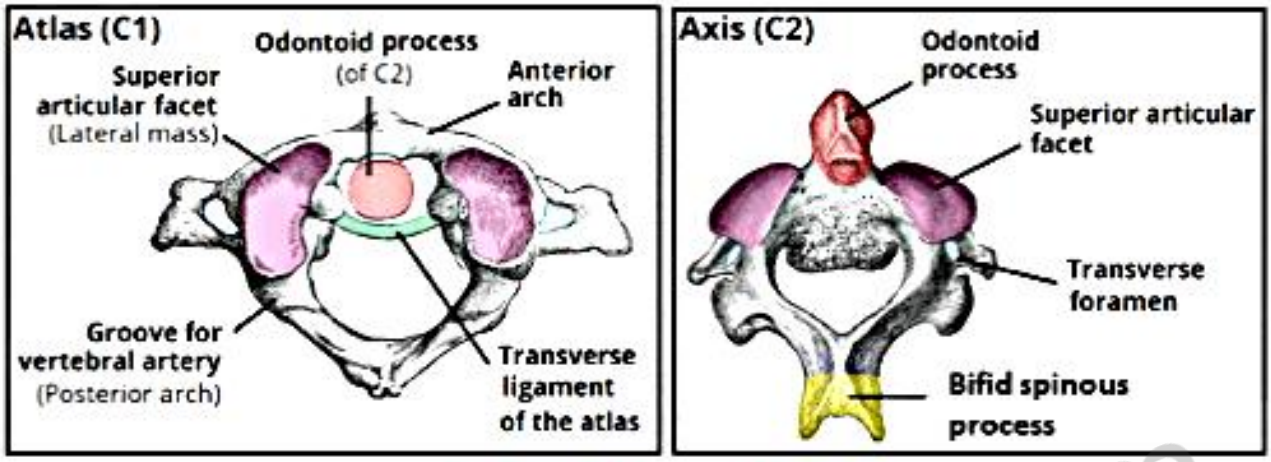


Fig.4.7: Atlas and Axis

✓ Other cervical vertebrae

- They are the lower five.
- Their features are :

1. A smaller body
2. Oblong shape
3. Triangular neural canal
4. Bifid spinous process
5. Vertebral foramen

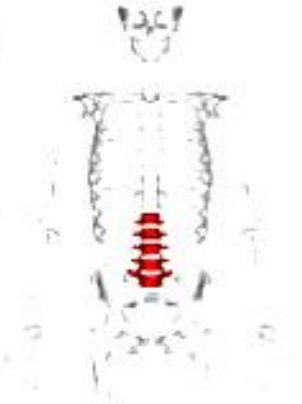
ii. THORACIC VERTEBRAE

- They are 12 in number.
- These vertebrae carry the ribs.
- The characteristic features of these vertebrae are:

1. The body is heart shaped
2. The body has facets, one on each side for the attachment of the head of ribs
3. The transverse process has facets at the tips for articulation with tubercle of the ribs,

4. Vertebral foramen is absent.
5. Pedicle and laminae are absent.
6. Spinous process is long and projects downwards.

iii. LUMBAR VERTEBRAE



- They are 5 in number. They have the following characteristics.

1. Body is big and kidney shaped:
2. Spinous process is short, stout and directed backwards.
3. No articular facets for ribs.
4. Pedicles and laminae are present.

iv. SACRUM

- They are 5 in number. All of them unite to form a single bone called a sacrum.
- The sacrum joins with the pelvic bone and takes part in the formation of the pelvic cavity. The features of the sacrum are:

1. Sacral foraminae which are four openings present in the anterior surface. Nerves pass through these openings.
2. Lateral masses on either side. They are formed by the union of transverse processes
3. Sacral promontory which is the projection of the upper part of sacrum.

v. COCCYX

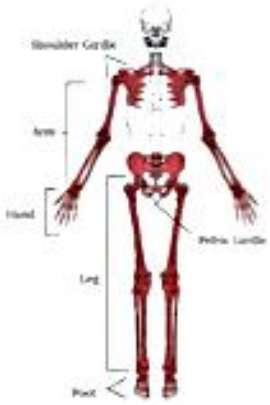
- This consists of the 4 terminal vertebrae, fused to form a very small triangular bone, the broad base of which articulates with the tip of the sacrum.

➢ Functions of vertebral column

- It provides strong bony protection for the delicate spinal cord lying within it. Spinal nerves, blood vessels and lymph vessels pass through intervertebral foramina.
- It supports the skull which is protected from shock by the presence of the intervertebral discs.

- It forms the axis of the trunk and gives attachment to the ribs, the shoulder girdle and the upper limbs, the pelvic girdle and the lower limbs.

4.6 THE APPENDICULAR SKELETON



- The appendicular skeleton consists of the

i. Shoulder girdle and Upper limbs

ii. Pelvic girdle and the Lower limbs

4.6.1 SHOULDER GIRDLE

- The shoulder girdle consists of two clavicles and two scapulae.

i. CLAVICLE (COLLAR BONE)

- The clavicle is a **slender S-shaped bone.**
- It articulates with the manubrium of the sternum at the sternoclavicular joint and forms the acromioclavicular joint with the acromion of the scapula.
- The clavicle is the only bony link between the upper limb and the axial skeleton.

ii. SCAPULA (SHOULDER BLADE)

- The scapula is a flat, triangular-shaped bone lying on the posterior chest wall, superficial to the ribs and separated from them by muscles.
- At the lateral angle is a shallow articular surface, the glenoid cavity, which with the humerus forms the shoulder joint.

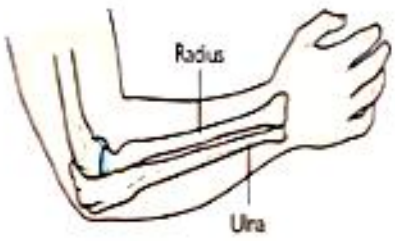
4.6.2 THE UPPER LIMB

i. HUMERUS

- The humerus is the bone of the upper arm.
- The head sits in the glenoid cavity of the scapula, forming the shoulder joint.

- Distal to the head are two roughened projections of bone, the greater and lesser tubercles, and between them is a deep groove, the bicipital groove, occupied by one of the tendons of the biceps muscle.
- The distal end of the bone has two surfaces that articulate with the radius and ulna to form the elbow joint.

ii. ULNA AND RADIUS



- These are the two bones of the forearm. The ulna is longer than and medial to the radius, and when the arm is in the anatomical position, i.e. with the palm of the hand facing forward, the two bones are parallel.
- They articulate with the humerus at the elbow joint, with the carpal bones at the wrist joint, and with each other at the proximal and distal radioulnar joints.
- In addition, an interosseous membrane, a fibrous joint, connects the bones along their shafts, stabilizing their alignment and preventing them from separating when force is applied from the elbow or wrist.

iii. CARPAL (WRIST) BONES

- There are eight carpal bones arranged in two rows of four. From outside inwards, they are:
- **Proximal row :** Scaphoid, lunate, triquetrum, pisiform
- **Distal row :** Trapezium, Trapezoid, Capitate, hamate
- These bones fit closely together and are held in position by ligaments that allow a limited amount of movement between them.
- The bones of the proximal row are part of the wrist joint and those of the distal row form joints with the metacarpal bones.
- Tendons of muscles lying in the forearm cross the wrist and are held close to the bones by strong fibrous bands called retinacula.

iv. METACARPAL BONES

- These five bones form the palm of the hand. They are numbered 1-5 from the thumb side inwards.

- The proximal ends articulate with the carpal bones and the distal ends with the phalanges.

iv. PHALANGES (FINGER BONES)

- There are 14 phalanges (singular: phalanx), 3 in each finger and 2 in the thumb.
- They articulate with the metacarpal bones and with each other by hinge joints.

4.6.3 PELVIC GIRDLE

- The pelvic girdle is formed from two innominate bones. The pelvic is the basin shaped structure formed by the pelvic girdle and the sacrum.

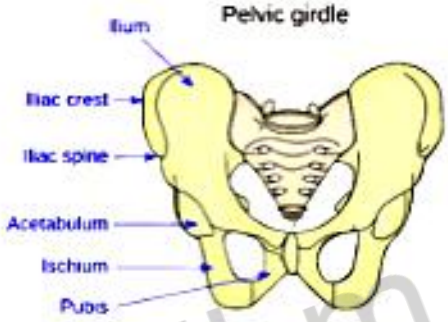


Fig 4.8 :- Pelvic girdle

i. INNOMINATE BONE

- Each hip bone consists of three fused bones, the ilium, ischium and pubis.
- These fuse on its lateral surface to form a deep depression, the acetabulum, which forms the hip joint with the almost spherical head of the femur.
- The ilium forms the upper flattened 'wings of the hip bone.
- Its superior border is called the iliac crest, the anterior curve of which is called the anterior superior iliac spine.
- Both the iliac crest and the anterior superior iliac spine are easily felt through the skin and are important bony landmarks of the pelvis.
- The ilium forms a synovial joint with the sacrum; this is the sacroiliac joint, a strong joint capable of absorbing the stresses of weight bearing and which tends to become fibrosed in later life.
- The pubis is the anterior part of the bone and it articulates with the pubis of the other hip bone at a cartilaginous joint, the symphysis pubis (also called the pubic symphysis).

- The ischium is the inferior and posterior part. The rough inferior projections of the ischia, the ischial tuberosities, the so-called 'sitting bones', bear the weight of the body when the individual is seated.

ii. THE PELVIS

- The pelvis is formed by the hip bones, the sacrum and the coccyx.
- It is divided into upper and lower parts at the pelvic inlet by the brim of the pelvis, an imaginary line drawn around the interior of the pelvis through the sacral promontory and the iliopectineal lines of the innominate bones.
- The greater (false) pelvis lies above the brim and the lesser (true) pelvis is below.

✓ **There are distinct differences between pelvis of males and females.**

CHARACTERISTICS	FEMALE	MALE
Bones	Lighter and smaller	Heavier and longer
Cavity	Shallow and round	Deep and funnel-shaped
Sacrum	More concave anteriorly, making the true pelvis broader	Less concave, making the true pelvis narrower at the outlet
Pubic – arch	• The angle made at the symphysis pubis is wider. • The bones are movable for convenience in delivery	• The angle of the pubic arch is narrower. • The bones are immovable

4.6.4 LOWER LIMB

i. FEMUR (THIGH BONE)

- Femur or a thigh bone is the longest and strongest of all the bones of the body.
- Proximal extremity consists of head, neck and greater and lesser trochanters.
- The head is almost spherical and fits into the acetabulum of the hip bone.

- Two trochanters and intertrochanteric line give attachment to muscles which move hip joint.
- The shaft of the bone is slightly convex anteriorly and is broader towards its distal end Posterior surface forms a flat triangular area called popliteal surface.
- Distal extremity presents two condyles which take part in the formation of a knee joint. Between the condyles, there is a depression called intercondylar fossa

ii. TIBIA (SHIN BONE)

- The tibia is the medial of the two bones of the lower leg.
- The proximal end is broad and flat and has two condyles for articulation with the femur at the knee joint.
- The head of the fibula articulates with the lateral condyle, forming the proximal tibiofibular joint.
- The distal end of the tibia forms the ankle joint with the talus and the fibula.
- The medial malleolus is a downward projection of bone medial to the ankle joint, easily felt through the skin at the inner ankle.

iii. FIBULA

- The fibula is the slender lateral bone in the lower leg.
- The head articulates with the lateral condyle of the tibia, forming the proximal tibiofibular joint, and the lower end articulates with the tibia, projecting beyond it to form the lateral malleolus. This is easily felt through the skin at the outer ankle and helps to stabilize the ankle joint.

iv. PATELLA (KNEE CAP)

- This roughly triangular-shaped sesamoid bone forms part of the anterior wall of the knee joint.

- It is embedded in the patellar tendon, i.e. the tendon of the quadriceps femoris muscle, and its posterior surface articulates with the patellar surface of the femur in the knee joint.

v. TARSAL (ANKLE) BONES

- The seven tarsal bones forming the posterior part of the foot (ankle) are the talus, calcaneus, navicular, cuboid and three cuneiform bones.
- The talus articulates with the tibia and fibula at the ankle joint.
- The calcaneus forms the heel of the foot.
- The other bones articulate with each other and with the metatarsal bones.

vi. METATARSALS (BONES OF THE FOOT)

- These are five bones, numbered from inside out, which form most of the sole (dorsum) of the foot.
- At their proximal ends they articulate with the tarsal bones and at their distal ends with the phalanges.
- The enlarged distal head of the 1st metatarsal bone forms the ball of the foot.

vii. PHALANGES (TOE BONES)

- There are 14 phalanges, arranged in a similar manner to those in the fingers, i.e. two in the great toe (the hallux) and three in each of the other toes.

JOINTS

4.7 INTRODUCTION

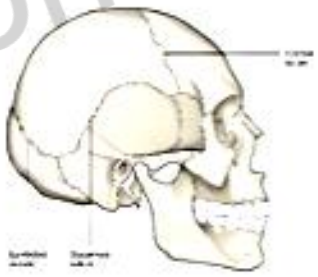
- Any connection between bones of the skeleton is called a joint or articulation. Arthrology is the term applied to the study of joints.
- It consists of bones and connective tissue, including cartilage, tendons, and ligaments.

✓ **Tendons-** Tendons are joint bones to skeletal muscles.
✓ **Ligaments-** Ligaments join two bones together.
✓ **Cartilage-** Cartilage provides protection of bones at the joints from wear and tear.

4.8 CLASSIFICATION OF JOINTS

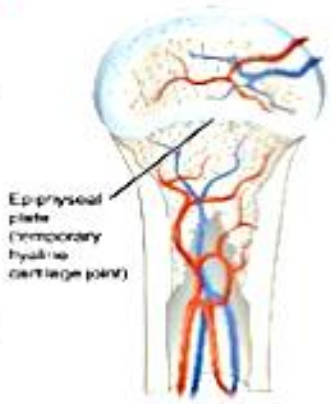
- Fibrous joint
- Cartilaginous joints
- Synovial joint

4.8.1 FIBROUS JOINT (SYNARTHROSES)



- They are also called fixed or immovable joints. In these joints, there is a tight union between the bones.
- So, no movement is possible at these joints e.g. sutures of the skull and teeth in their sockets.

4.8.2 CARTILAGENOUS JOINTS (AMPHIARTHROSES)



- They are also called movable joints. In this type:

1. The articular ends of the bones are covered by hyaline cartilage.
2. There is a pad of fibrocartilage between the joint.
3. The joint is covered by ligaments.

- Symphysis pubis and intervertebral joints are examples of cartilaginous joints.

4.8.3 SYNOVIAL JOINTS (DIARTHROSES)

- They are called freely movable joints. The characteristics of these joints are

i. The articular ends of bones are covered by hyaline cartilage.
ii. Bones are bound together by ligaments.
iii. The joint is enclosed by a fibrous capsule.
iv. The capsule of the joint is lined by a synovial membrane.
v. The cavity of the joint contains synovial fluid.

Table 1.1: Classification of Synovial joints

SYNOVIAL JOINTS	DESCRIPTION
Gliding joint (plane joint)	Here two flat surfaces of bones glide on each other, e.g. joint between carpal and tarsal bones.
Hinge joint	Here, movement is possible in one plane only e.g. elbow joint.
Pivot joint	In this joint, rotation is the only possible movement, e.g. joint between radius and ulna.
Ball and socket joint	Articula, end of one bone is ball like. It fits into the socket like cavity of another bone. Movement in all directions is possible in this type e.g. shoulder joint and hip joint.
Condyloid joint	It is similar to hinge joint but movement occurs in two planes e.g. wrist joint.
Saddle joint	It has one concave surface. This results in free movement in all directions e.g. joint between metacarpal bone of thumb and trapezium.

4.9 MOVEMENTS OCCURRING AT JOINTS

- The movements which occur at the joint are classified into three major types

i. GLIDING MOVEMENTS

- They occur when two flat surfaces move on each other. e.g. movements between carpal and tarsal bones.

ii. ANGULAR MOVEMENTS

- They bring about an increase or decrease in the angle between bones.
- Depending on the direction in which the movement occurs, they are further classified into:

✓ Flexion

- A movement where similar surfaces come nearer to each other. This reduces the angle between two bones e.g. bending the fore. arm at the elbow.

✓ Extension

- A movement where similar surfaces go apart. Here the angle between two bones is increased. It is the opposite of flexion e.g. straightening of the bent forearm.

✓ Adduction

- A movement that brings the limb towards midline.

✓ Abduction

- It is the opposite of adduction. Here the limb is drawn away from the midline.

iii. ROTATION OR CIRCULAR MOVEMENTS

- They occur when one bone moves around or within another bone, The movement occurs around a central axis. It is further classified into

✓ Medial rotation which occurs towards medial di-rection.
✓ Lateral rotation which occurs towards lateral direction.

4.10 JOINTS OF THE UPPER LIMB

i. STERNO – CLAVICULAR JOINT

- It is a gliding joint between the sternum and the clavicle. A pad of cartilage is present in the joint cavity between the bones

ii. ACROMIOCLAVICULAR JOINT

- Formed by outer end of clavicle articulating with the acromion process of the scapula. There is a pad of cartilage between the ends of bones.
- There is a limited amount of movement in all directions.

iii. SHOULDER JOINT

- It is a ball and socket type of joint.
- It occurs between the head of humerus and glenoid cavity of scapula.

- The bones are united together by ligaments.
- These ligaments form a very loose capsule. Also, the shoulder joint has a synovial cavity.
- The tendon of the long head of the biceps passes through this.

✓ Movements

- All types of movements like flexion, extension, abduction, adduction, rotation, and circumduction are possible at this joint.

iv. ELBOW JOINT

- It is a hinge joint. It is formed by the humerus above and the radius and ulna below. It is composed of different joints. They are :

1. Humero-ulnar joint formed by trochlear notch ulna and trochlear surface of humerus.
2. Humero-radial joint formed by head of radius capitulum of humerus.

✓ Movements

- Flexion and extension occur at this joint

v. RADIO – ULNAR JOINT

- This is formed by the articulatio of radius and ulna at their upper and lower extremity The interosseous membrane joins them throughout the shaft. This joint is further classified as:

1. Superior radio-ulnar joint formed by head of and radial notch of ulna.
2. Inferior radio-ulnar joint formed by head of ulna lower end of radius.

✓ Movements

- Pronation and supination occur at the joints

Fig 4.9 :- Radio – ulnar joint

vi. WRIST JOINT

- It is a condyloid joint.
- It is formed by lower end of radius and three carpal bones. (lunate and triquetrum)

✓ Movements

- Flexion, extension, abduction and adduction are the movements that occur at this joint.

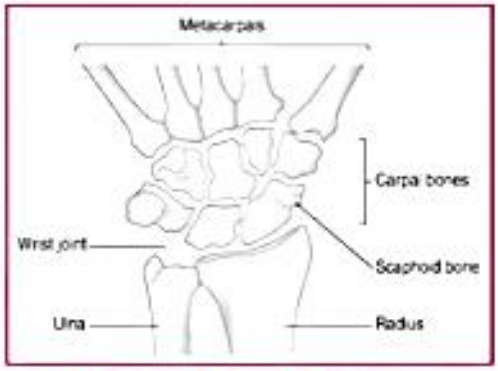


Fig 4.10 :- Wrist joint

vii. METACARPAL – PHALANGEAL JOINTS

✓ Metatarsophalangeal joints

- They occur between metacarpal and phalangeal bones. The movements at these joints are flexion, extension, adduction and abduction.

✓ Interphalangeal joints

- They occur between phalangeal bones of the same finger. Flexion and extension are the movements possible.

4.11 JOINTS OF LOWER LIMB

i. HIP JOINT

- It is a ball and socket type of joint. It occurs between acetabulum of innominate bone and head of femur.
- The acetabulum is deepened by a ring of fibro cartilage called acetabular labrum

➢ The joint capsule is strengthened by three ligaments. They are :

✓ **Ilio-femoral ligament in the front**

✓ **Pubo-femoral ligament below**

✓ **Ischio-femoral ligament at the back**

- The head of femur is connected to the sides of acetabular notch by means of a ligament. It is called ligamentum teres.

✓ Movements

- Flexion, extension, abduction, adduction, rotation and circumduction occur at this joint.

ii. KNEE JOINT

- This very stable hinge joint is the body's largest and most complex joint.
- The joint capsule contains two joints: one between the condyles of the femur and the tibia, and one between the femur and posterior surface of the patella

➢ The structures of knee joint are

1. Medial and lateral semilunar cartilages

- They are attached to the upper surface of tibia. They deepen the articular surface.

2. Cruciate ligaments

- Upper attachment is intercondylar notch of femur.
- Lower attachment is the upper surface of tibia.

3. Synovial membrane

- Which is the largest in the body.

✓ Movements

- Flexion and extension occur at knee joint.

iii. ANKLE JOINT

- It is a hinge joint formed by:

1. Tibia and its medial malleolus
2. Lateral malleolus of fibula
3. Talus below, which fits into the socket.

- The capsule of the joint is strengthened by medial and lateral ligaments.

✓ **Movements**

- Dorsiflexion, (bending the foot up towards the leg)
- Plantar flexion (bending the foot downwards)

4.12 JOINTS OF THE FOOT

i. TARSAL JOINTS

- They occur between talus and calcaneum and also between other tarsal bones.

ii. TARSO – METATARSAL JOINTS

- Occur between tarsal and metatarsal bones.

iii. METATARSO – PHALANGEAL JOINTS

- Occur between metatarsal and phalangeal bones.

iv. INTER PHALANGEAL JOINTS

- They occur between phalangeal bones themselves

Fig 4.11 :- Joints of the foot

4.13 JOINT DISORDERS

i. ARTHRITIS

- It is an inflammation occurring at a joint or joints.
- It can occur at any age but commonly occurs in middle and old age groups.

➢ **The common types of arthritis are**

✓ Rheumatoid arthritis

✓ Osteoarthritis

✓ Rheumatoid arthritis

- It is a polyarthritis. The commonly affected joints are those of hands and feet. In severe cases, most of the synovial joints are involved. It is an autoimmune disease initiated by microbial infection, probably viruses. As the disease progresses, it leads to intermittent fever. Later, there is a deformity of joint leading to a decrease in movement and pain. Steroids are usually given to treat this condition.

✓ Osteoarthritis

- It is a disease occurring due to degenerative changes in the cartilages of joints. The articular cartilage becomes thinner. So the articular surfaces of bones come in contact with each other. Later the bones start degenerating. This produces pain, stiffness and a decrease in movement. Physiotherapy and reduction in body weight are advised in this condition. Also, steroids are beneficial.

ii. GOUT

- It is caused by the deposition of sodium urate crystals in joints and tendons. It occurs in people with high uric acid levels due to overproduction or decreased excretion by the kidneys. There is arthritis, lasting for several days or weeks with some remission in between. After repeated attacks, permanent damage may occur. Joints commonly affected are ankle, wrist, knee and elbow.

iii. DISLOCATIONS

- A dislocation is a complete separation of joint surfaces due to tearing of the joint capsule. Dislocation commonly occurs at the shoulder and hip joint.

✓ Shoulder joint

- It is more liable for dislocation than any other joint because of:

1. Shallow articulating cavity
2. Large size of the head of humerus
3. Laxity of the capsular ligament

✓ Sternoclavicular joint

- A forward or backward dislocation may occur as a result of a heavy fall on the shoulder e.g. horse riding.

✓ Elbow joint

- Backward dislocation can occur at elbow joint. It may be accompanied by a fracture of the coronoid process.

✓ Hip joint

- Dislocation of hip joint may occur in any direction. However backward and medial dislocation is more common since the capsule is weak at these sites. Forword dislocation is rare since the iliofemoral ligament crossing the front of hip joint is very strong. Congenital dislocation of hip joint may also occur.

✓ Knee joint

- The knee joint is surrounded by strong ligaments and powerful muscles.
- It is one of the strongest and most stable joints in the body.
- So dislocation of knee joint is very rare. But the following disorders may occur at knee joint.

Slipped cartilage

- It occurs due to tearing, detachment or displacement of one of the semilunar cartilages of knee joint.

Acute synovitis

- It may occur at knee joint due to trauma. Since the synovial membrane of the knee joint is extensive, swelling occurs on each side above the patella.

Bursitis

- Enlargement and inflammation of one of the bursae may occur. The bursa between patella and skin is mostly affected.