

2

SKELETAL SYSTEM

Key Terms

Skeletal System: The rigid framework of bones and joints form the skeletal system of the body.

Osteology: The branch of science which deals with the study of bones is called osteology.

Axial Skeleton: It includes the bones of skull, neck, vertebral column and thorax. It consists of 80 bones.

Appendicular skeleton: It includes bones of shoulder (pectoral) girdle, upper limbs, pelvic (hip girdle) and lower limbs. It consists of 126 bones.

Vertebrae: The bones of the vertebral column are known as vertebrae.

Epiphyses: The proximal and distal ends of a typical bone are known as epiphyses.

Diaphysis: The shaft between the two ends ie-epiphyses is called diaphysis.

Articulation: The point at which two bones or bone and a cartilage are connected is called joint or articulation.

Periosteum: The outer membrane covering the bone is known as periosteum.

Bone marrow: The sponge like material present in the cavity of bones is known as bone marrow.

2.1 GROSS STRUCURE, FUNCTION AND CLASSIFICATION

(i) **Gross Structure:** Skeletal system is a rigid frame work of body, made up of bones, cartilage, ligaments, tendons and muscles. Tendons, ligaments and fibrous tissue bind the structures together to create stability, with ligaments connecting bone to bone. The entire skeletal system comprises 206 bones, the brief of which is given below:-

| S. No. | Part | No. of bones | Total |
|--------|-------------------|--------------|-------|
| 1. | Skull | 22 | 22 |
| 2. | Auditory ossicles | 6 | 6 |
| 3. | Neck | 1 | 1 |
| 4. | Vertebral column | 26 | 26 |
| 5. | Thorax | 25 | 25 |
| 6. | Upper limbs | 64 | 64 |
| 7. | Lower limbs | 62 | 62 |
| | | Grand total | 206 |

(ii) Functions of skeletal system: The main functions of skeletal system are:

- (a) It gives definite shape to the body.
- (b) It protects and supports the soft organs and tissues of the body.
- (c) It provides attachments for muscles.
- (d) It provides a system of levers essential for locomotion.
- (e) It helps in the formation of red blood cells in the bone marrow.
- (f) It acts as a storage house of mineral salts like calcium and phosphorus.
- (g) Yellow bone marrow serves as a food reservoir of triglycerides.

(iii) Classification of skeletal system: The skeletal system is divided into two groups viz. (a) Axial skeleton (b) Appendicular skeleton.

- (a) Axial skeleton:** It includes bones of head (skull) and trunk.
- (b) Appendicular skeleton:** It includes bones of upper and lower limbs.

2.2 BONES OF AXIAL SKELETON

- **Bones of Axial Skeleton:**

Axial skeleton consists of skull (Cranium + facial), auditory ossicles, hyoid bone, vertebral column, sternum and ribs. It includes 80 bones, the brief of which is given below:

| S. No. | Part | Region | Name of bone | Number of bones | Total |
|--------|-------------------------------|-----------------------------------|------------------|-----------------|-------|
| 1. | Skull | (i) Cranial (8) | Frontal | 1 | 8 |
| | | | Parietal | 2 | |
| | | | Temporal | 2 | |
| | | | Occipital | 1 | |
| | | | Sphenoid | 1 | |
| | | | Ethmoid | 1 | |
| | | (ii) Face (14) | Zygomatic | 2 | |
| | | | Maxilla | 2 | |
| | | | Nasal | 2 | |
| | | | Lacrimal | 2 | |
| | | | Vomer | 1 | |
| | | | Palatine | 2 | |
| | | | Inferior conchae | 2 | |
| | | | Mandible | 1 | |
| 2. | Auditory Ossicles (Ear bones) | Middle ear | Malleus | 2 | 6 |
| | | | Incus | 2 | |
| | | | Stapes | 2 | |
| 3. | Neck | Anterior part of the neck | Hyoid | 1 | 1 |
| 4. | Thorax | Chest | Sternum | 1 | 25 |
| | | | Ribs | 24 | |
| 5. | Vertebral column | Base of skull to the end of trunk | Cervical | 7 | 26 |
| | | | Thoracic | 12 | |
| | | | Lumber | 5 | |
| | | | Sacrum | 1 | |
| | | | Coccyx | 1 | |
| | | | Sub total | | |

- **Bones of Appendicular skeleton:**

It consists of bones of pectoral (shoulder) girdle, bones of upper limbs, pelvic (hip) girdle and bones of lower limbs. The total number of bones of appendicular skeleton are 126, the brief of which is given below:

| S. No. | Part | Region | Name of bone | Number of bones | Total |
|--------|------------------------------|-------------|--------------|-----------------|-------|
| 1. | Pectoral (shoulder) girdle | Upper limbs | Clavicle | 2 | |
| | | | Scapula | 2 | |
| 2. | Extremities | —do— | Humerus | 2 | 64 |
| | | | ulna | 2 | |
| | | | Radius | 2 | |
| | | | Carpals | 16 | |
| | | | Metacarpals | 10 | |
| | | | Phallenges | 28 | |
| 3. | Pelvic (hip) girdle | Lower limb | Hip (pelvic) | 2 | |
| 4. | Extremities | —do— | Femur | 2 | 62 |
| | | | Patella | 2 | |
| | | | Fibula | 2 | |
| | | | Tibia | 2 | |
| | | | Tarsals | 14 | |
| | | | Metatarsals | 10 | |
| | | | Phallenges | 28 | |
| | Subtotal | | | | 126 |
| Total: | (i) Axial skeleton | : 80 bones | | | |
| | (ii) Appendericular skeleton | :126 bones | | | |
| | Grand total : | =206 bones. | | | |
| | 80 + 126 | | | | |

(A) Bones of pectoral girdle and upper limbs

(a) **Bones of pectoral girdle:** Each pectoral girdle is made up of two bones ie-clavicle and scapula.

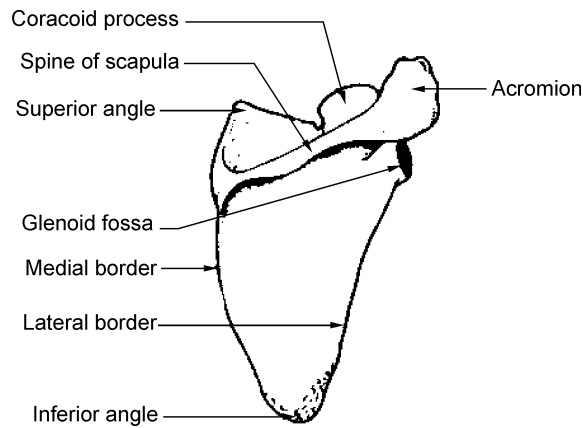
(i) **Clavicle:** It is also known as collar bone. It is a long slender curved bone. A pair of clavicle bones forms the front part of the shoulder girdle. Each clavicle articulates laterally with the scapula and medially with the manubrium of the sternum. It keeps the scapula in position. Each clavicle consists of two ends, four borders and a shaft.



The Clavicle

- (a) Two ends are *medial or sternal end* and *lateral or acromial end*. The sternal end articulates with the sternum. Acromial end articulates with the acromion process of scapula.
- (b) The four borders of clavicle are *anterior, posterior, superior* and *inferior* borders.
- (c) Shaft has two curves ie- *one concave* and the *other is convex*.

(ii) **Scapula:** It is also called shoulder blade. It is triangular in shape. A pair of these bones form the back part of the shoulder girdle. It has three borders ie- *medial superior* and *lateral*. It has two surfaces ie- *anterior or costal surface* and *posterior or dorsal surface*. It also has three angles ie- *superior, inferior* and *lateral*. Lateral angle has a glenoid cavity which receives the head of humerus to form the shoulder joint. It has two processes ie- *spinous process* and *coracoid process*. Both of these processes give attachment to muscles and keep the head of humerus in place.



Right Scapula (Dorsal Surface)

(b) Bones of Upper Limbs

Each upper limb consists of following bones:

- | | |
|----------------------|------|
| (i) Humerus | : 1 |
| (ii) Ulna | : 1 |
| (iii) Radius | : 1 |
| (iv) Carpals bones | : 8 |
| (v) Metacarpal bones | : 5 |
| (vi) Phalanges | : 14 |

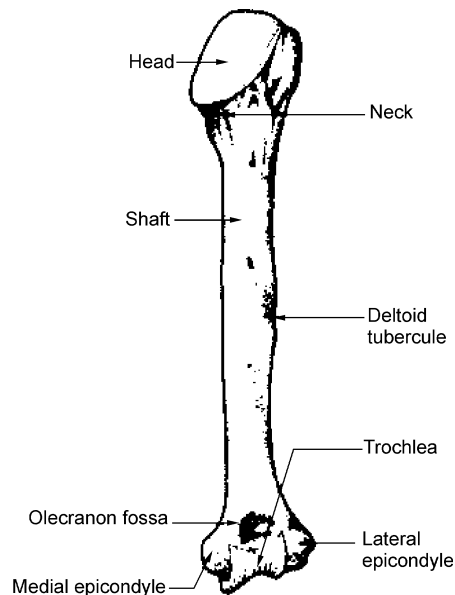
The brief description of upper limb bones is given as under:

(i) Humerus: It is the largest and longest bone of the upper limb. It articulates above with the scapula and below at the elbow with the radius and ulna. It consists of upper end, shaft and lower end.

- **Upper end:** It consists of head, neck and tubercles:
 - (a) Head fits into the glenoid cavity of the scapula forming the shoulder joint.
 - (b) Below the head, a slightly constricted part is known as neck.
 - (c) Between neck and shaft are present two tubercles i.e. greater and lesser tubercles.
 - (d) A groove between these two tubercles is called the bicipital groove.
 - (e) A narrow point of bone below the two tubercles is known as surgical neck.

- **Shaft:** It extends from upper end to lower end. It is cylindrical in shape at the proximal end but flattened at the distal end. It has three surfaces viz: anterior, posterior and lateral, for attachment of muscles.

- **Lower end:** It consists of following parts:
 - (a) **Trochlea:** It articulates with ulna.
 - (b) **Capitulum:** It articulates with radius.
 - (c) **Coronoid fossa:** It receives coronoid process of ulna when the fore arm is flexed.
 - (d) **Olecranon fossa:** It receives olecranon process of ulna during straightend fore arm.
 - (e) **Medial and lateral epicondyles:** These are rough projections on each side of the articulating surfaces to which muscles of the fore arm are attached.

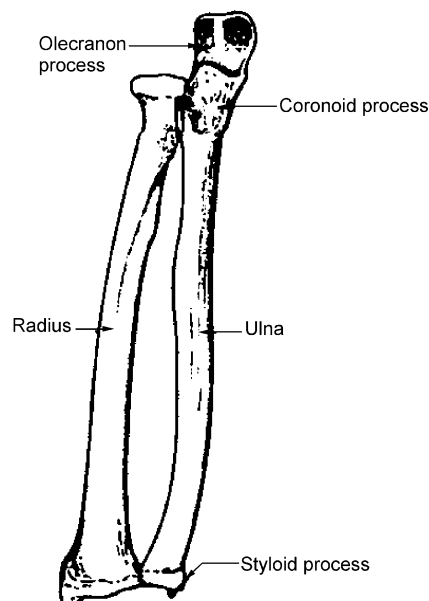


The humerus (Posterior Surface)

(ii) **Ulna:** It is the inner and longer bone of the fore arm. It is longer than radius. When palm of the hand faces forward, ulna and radius lie parallel to each other. It articulates above with the humerus at elbow joint and below with the carpal bones at the wrist joint. It

articulates with radius at the proximal and distal radioulnar joints. Each ulna consists of upper end, shaft and lower end.

- **Upper end:** It has the following important parts:
 - (a) **Trochlear notch:** It articulates with trochlear of the humerus.
 - (b) **Radial notch:** It articulates with the head of radius.
 - (c) **Coronoid process:** It fits into the coronoid fossa of humerus.
 - (d) **Olecranon process:** It fits into the olecranon fossa of the humerus.
- **Shaft:** It is triangular in shape. It tapers towards the lower end. It has three surfaces ie-*anterior*, *posterior* and *medial* for its attachment to the different types of muscles which control movements of wrist and fingers.
- **Lower end:** It bears the following important parts:
 - (a) **Head:** It is round in shape. It articulates with the lower end of radius to form the inferior radio-ulnar joint.
 - (b) **Styloid process:** It projects downward from back of lower extremity. It provides attachment for ulnar collateral ligament to the wrist.



Right Ulna and Radius (Front View)

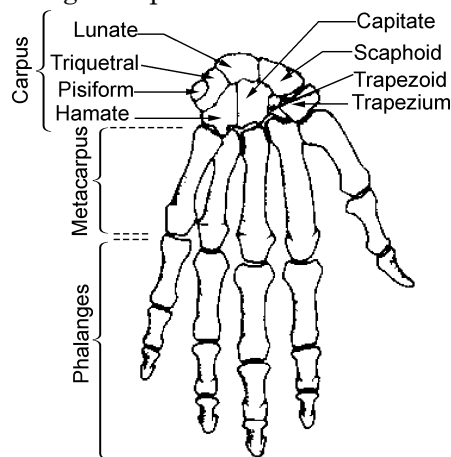
(iii) **Radius:** It is the outerbone of the fore arm. It is shorter than ulna. It partially revolves about the ulna and thus permits the movements of the hand in different directions. The radius has head, neck, shaft and lower end.

- (a) **Head:** It articulates with the capitulum of humerus.
- (b) **Neck:** It lies just below the head.
- (c) **Shaft:** It is narrow above and wider below. It widens distally to form a styloid process on the lateral side.
- (d) **Lower end:** It articulates both with the scaphoid and lunate bones of the wrist. It also articulates with the ulna via the ulnar notch.

(iv) **Carpal bones:** These bones are 8 in number. They unite to form corpus (wrist). They are also known as wrist bones. These are arranged in two rows ie-**first or proximal row** which is made up of *scaphoid, lunate, triquetral* and *pisiform bones* and the **second row** which is made up of *hamate, capitate, trapezium* and trapezoid bones.

(v) **Metacarpals:** These bones are five in number. They unite to form metacarpus ie-palm which is the intermediate region of the hand. Each metacarpal bone is made up of *distal head, shaft* and *proximal base*. The heads articulate with proximal row of phalanges whereas bases articulate with the distal row of carpal bones.

(vi) **Phalanges:** These bones are 14 in number. These make up the distal part of the hand. There are four fingers and one thumb. Each finger has three phalanges ie-proximal, middle end distal. The thumb has two phalanges ie-proximal and distal.



**Bones of the Left Wrist and Hand
(from the Front)**

The joints between the phalanges are called interphalangeal joints. The joints between the metacarpals and phalangeal bones are known as metacarpophalangeal joints.

B. Bones of Pelvic (hip) girdle and lower limbs

(a) Bones of Pelvic (hip) girdle: The bony structure to which the bones of the lower limbs are attached is called pelvic (hip) girdle. It is made up of following bones:

- | | |
|----------------------------|-----|
| (i) Innominate (hip) bones | : 2 |
| (ii) Sacrum | : 1 |
| (iii) Coccyx | : 1 |

The brief description of pelvic bones is given as under:

(i) Innominate bones: These bones are also known as hip/pelvic bones. These are two in number. Each hip bone has a cup shaped structure on the outer surface known as acetabulum. The head of femur fits into the acetabulum resulting in the formation of hip joint. Each hip bone is formed by the fusion of three bones i.e. ilium, ischium and pubis.

- **Ilium:** It is a wide bone forming the upper part of each side of the hip bone. It has following parts:

(a) Iliac crest: The upper margin of ilium is known as iliac crest. It has four spines i.e. *anterior superior iliac spine*, *anterior inferior iliac spine*, *posterior superior iliac spine* and *posterior inferior iliac spine*. The tendons of the muscles of the trunk, hip and thighs attach with these spines.

(b) Gluteal lines: There are three prominent markings known as gluteal lines i.e. *posterior gluteal line*, *anterior gluteal line* and *inferior gluteal line*. The tendons of gluteal muscles attach with these lines.

(c) Great sciatic notch: It is a deep notch on the posterior margin of ilium. It allows the passage of the sciatic nerve.

- **Ischium:** It forms the lower part of each side of the hip bone. It has two parts i.e. Body (superior) and ramus (inferior) Ramus fuses with the pubis. Its other important parts are:-

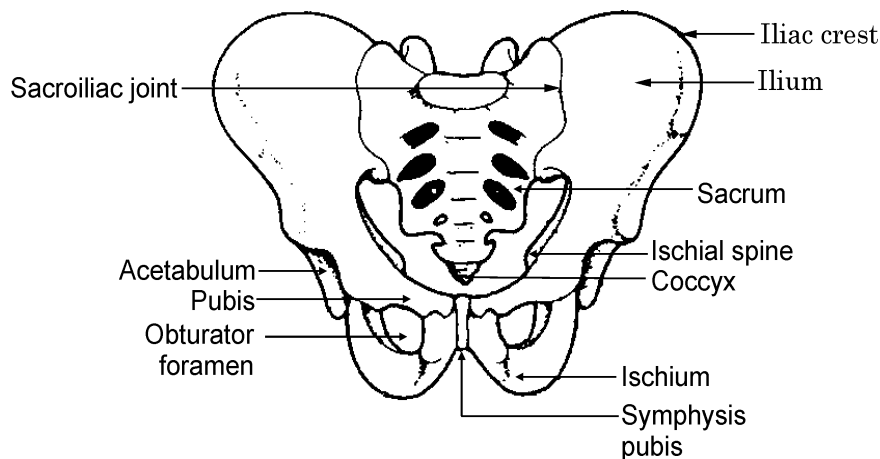
- *Ischial spine* for the attachment of muscles.
- *Tuberosity of ischium* for supporting the body weight while sitting.
- *Obturator foramen* is triangular opening surrounded by ramus and pubis.

• **Pubis:** It is the lower and anterior part of each side of the hip bone. The two pubes meet at the front of the pelvis. The joint so formed is called *pubic symphysis*. Each pubis consists of *superior ramus*, *body* and *inferior ramus*. Anterior border of body is known as *pubic crest*. A projection at the lateral end is called *pubic tubercle*.

Pelvis: The two hip bones unite posteriorly with the sacrum and coccyx to form a deep, rigid basin like structure known as pelvis. It protects the organs of the lower abdomen and provide attachments for the bones and muscles of the lower limbs. Pelvis is divided into two parts ie-false pelvis and true pelvis.

- *False pelvis* is the upper part.
- *True pelvis* is the lowest part.

Both these parts are separated by a pelvic brim.



The Male Pelvis (Ventral View)

Differences between Male and Female Pelvis

On account of pregnancy and child birth, the pelvis in females is different from males. The pelvis in females differs from males in the following aspects:

- Pelvic is wider and shallower.
- More space in pelvic inlet and outlet.
- Iliac crest less curved.
- Ilium is less vertical.
- Bones are short and lighter.
- Pubic arch is wider.
- Coccyx more curved and more movable anteriorly.
- Sacrum is shorter, wider and less curved.

(ii) Sacrum: Sacrum is a shield shaped bony structure that is located at the base of the lumbar vertebrae and that is connected to the pelvis.

(iii) Coccyx: It is the tail bone. It is made up of three or five fused vertebrae (bones). It lies beneath the sacrum, a bone structure at the base of the spine. Several tendons, ligaments and muscles connect to it.

(b) Bones of Lower Limbs:

Each lower limb is made up of 30 bones as given below:

| | |
|-----------------------|------|
| (i) Femur | : 1 |
| (ii) Patella | : 1 |
| (iii) Tibia | : 1 |
| (iv) Fibula | : 1 |
| (v) Tarsal bones | : 7 |
| (vi) Metatarsal bones | : 5 |
| (vii) Phalanges | : 14 |

The brief description of lower limb bones is given as under:

(i) Femur: It is also known by the name thigh bone. It is the longest, heavier and strongest bone of the body. It lies between the hip and the knee. It consists of upper end, shaft and lower end. The upper end bears the following parts:

- **Head:** It articulates with the acetabulum of hip bone. There is a small depression in the centre of the head for the attachments of ligaments.

- **Neck:** It is a constricted region just below the head. It joins the shaft at the other end.

- (a) **Greater and Lower Trochanters:** These are the projections at a point where the neck joins the shaft on the outer and inner side respectively. These are the points for the attachment of thigh and buttock muscles.

- (b) **Anterior and Posterior intertrochanteric Lines:** These lines unite with greater and lesser trochanters.

- **Shaft:** It is smooth and cylindrical in shape. It is narrow in the middle but broader at the ends. It bears:

- (a) Linea aspera ridge on the posterior side.

- (b) Gluteal ridge from linea aspera to the back of greater trochanter.

- (c) Spiral line from linea aspera to lesser trochanter.

Tendons of several thigh muscles attach to these three structures.

- **Lower end:** The lower end of the femur articulates with the tibia and fibula. The lower end of femur expands into:

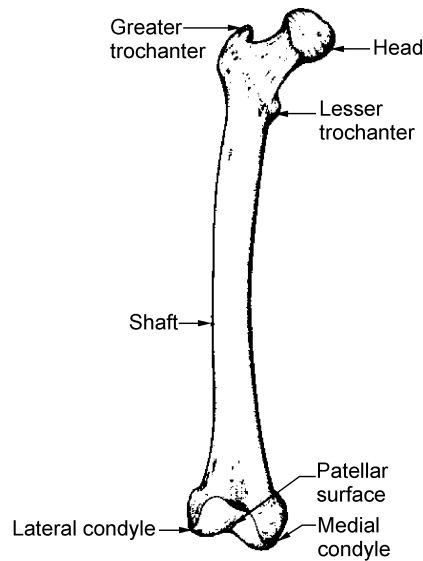
- (a) Medial and lateral condyle, one on each side.

- (b) Intercondyle notch separates the medial and lateral condyles.

- (c) Patellar surface separates the two condyles in front. The concave grooved surface accommodates knee cap.

- (d) Popliteal surface is a flat triangular area on the posterior side.

- (e) Lateral and medial condyles anteriorly articulate with the patella and inferiorly with the upper end of tibia forming the knee joint.



The Femur (Front View)

(ii) Patella: It is also known by the name knee cap. It is a lens shaped bone that forms the knee cap. It is a type of sesamoid bone. It is present in front of the knee joint in the tendons of the quadriceps muscles of the thigh. It slides over another bony surface. It maintains the position of the tendon, when the knee is bent. It also protects the knee joint.

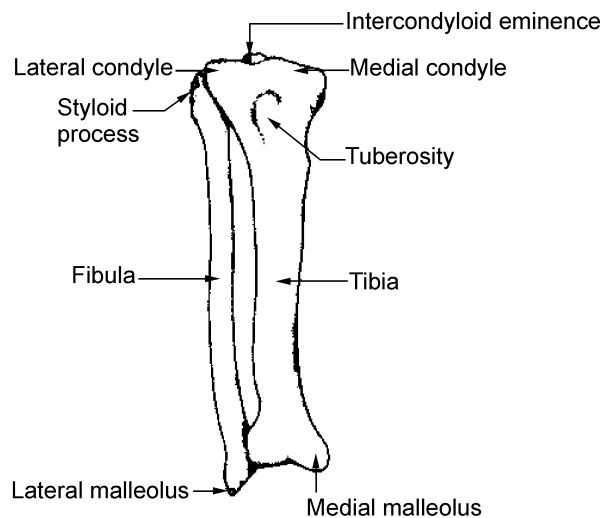
(iii) Tibia: It is also known by the name shin bone. It is the inner and larger bone of the lower leg. It articulates with the femur above, talus below and both ends of fibula, on sides. Tibia is a longer than fibula. The tibia and fibula are connected by an interosseous membrane. It is made up of upper end, shaft and lower end.

- **The upper end:** It consists of:

- (a) **Head:** It has medial and lateral condyles which articulate with the respective condyles of femur.
- (b) **Popliteal Notch:** It separates the two condyles at the back.
- (c) **Tubercle of Tibia:** It lies in the front for the attachment of muscles.

- **Shaft:** The shaft is triangular in shape. It has three surfaces i.e. *medial*, *lateral* and *posterior*. It has sharp ridges i.e. *crest of tibia* and *soleal line* for the attachment of muscles.

- **Lower end:** At the lower end, there is a projection known as the *medial malleolus* which forms the part of articulation with talus.



Right Tibia and Fibula

(iv) Fibula: It is a long thin outer bone of the lower leg. It consists of upper end, shaft and lower end. The upper end consists of:

- Head:** It articulates with the tibia just below the knee.
- Styloid process:** It is attached with the ligament of knee joint.
- Shaft:** It is ridged for the attachment of muscles.
- Lower end:** It projects laterally as the *lateral malleolus* which articulates with one side of talus.

(v) Tarsal Bones: These are seven in number. These bones unite to form tarsus (ankle). They form the posterior part of the foot. These are named as given below:

Calcaneous : 1

Talus : 1

Navicular : 1

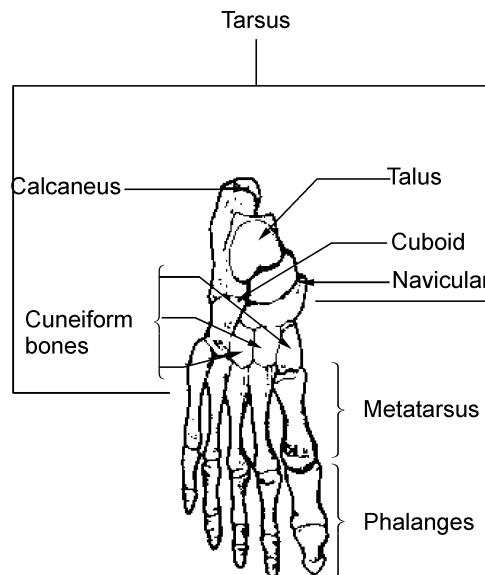
Cuboid : 1

Cuneiform : 3

- Calcaneus:** It is also known by the name heel bone. It is the large bone in the ankle of the foot. It forms the projection of

the heel behind the foot. It articulates with the cuboid bone in front and with the talus above. It forms the heel of a foot.

- (b) **Talus:** It is also known as ankle bone. It forms the main and highest point of the foot. It articulates with the tibia above, fibula to the lateral side and calcaneous below.
- (c) **Navicular:** It is a boat shaped bone of the ankle. It articulates with the three cuneiform bones in front and talus behind.
- (d) **Cuboid:** It is the outer bone of the ankle. It articulates with 4th and 5th metatarsal bones in front and with the calcaneus (heel bone) behind.
- (e) **Cuneiform:** These bones are three in number ie-lateral (external), intermediate (middle) and medial (internal). They articulate respectively with the 1st, 2nd and 3rd metatarsal bones in front and navicular bone behind.



Bones of the Right Ankle and Foot

(vi) **Metatarsal Bones:** These bones are five in number. They unite to form metatarsus. They form the intermediate region of the foot. Each metatarsal bone consists of *proximal base*, *intermediate shaft* and *distal head*. All are long bones. They connect ankle with phalanges (toes). Bases of 1st, 2nd and 3rd metatarsals articulate

with navicular bone while 4th and 5th with the cuboid bone. The first metatarsal is thick while second is larger than others.

(vii) Phalanges: These bones are 14 in number. These are bones of toes. The first toe has two large heavy phalanges while other four have three phalanges each. Each phalanx consists of *proximal base*, *intermediate shaft* and *distal head*.

2.3 JOINTS AND ARTICULATION

(Type of Joints and functional classification)

The point at which *two bones or bone and cartilage* are connected is called *joint or articulation*. The branch of science which deals with the study of joints is called arthrology. The joint may permit free movement, slight movement or no movement.

CLASSIFICATION OF JOINTS

Depending upon the degree of movements permitted by the joints, they are classified into the following three groups:

- (i) Synarthrosis (Fibrous joint)
 - (ii) Amphiarthrosis (Cartilagenous joint)
 - (iii) Diarthrosis (Synovial joint)
- (i) Synarthrosis (Fibrous) Joint:** It is an immovable joint. The bones are united by fibrous tissue. eg. sutures of skull.
- (ii) Amphiarthrosis (Cartilagenous) Joint:** It is a slightly movable joint. In this type of joint, the surfaces are separated by fibrocartilage or hyaline cartilage. eg. intervertebral joints.
- (iii) Diarthrosis (Synovial) Joint:** It is freely movable joint. The ends of the joining bones are covered with a thin cartilagenous sheet. The bones are linked by ligament (capsule) lined with synovial membrane. The membrane secretes the synovial liquid. Such type of joints are further classified depending upon the type of connection and possible type of movement as given below:-
- (a) Gliding joint
 - (b) Ball and socket joint
 - (c) Hinge joint
 - (d) Pivot joint
 - (e) Saddle joint
 - (f) Condylloid joint.

- (a) **Gliding Joint:** It is a form of freely movable joint. The bony surfaces slide over each other without angular or rotational movements eg-joints of the carpus and tarsus.
- (b) **Ball and socket joint:** It is a form of freely movable joint. The ball like surface of one bone fits into the cup shaped depression of another bone. It allows movements in all planes eg. shoulder joint, hip joint etc.
- (c) **Hinge joint:** It is a form of freely movable joint. It allows angular movement in one plane only. Thus it increases or decreases the angle between the bones eg. knee joint, elbow joint.
- (d) **Pivot Joint:** It is form of freely movable joint. In this case, bone moves around a central axis, allowing rotational movement, eg joint between the atlas and axis vertebrae.
- (e) **Saddle joint:** It is a form of freely movable joint. In this type of joint, articulating surfaces of the bones are reciprocally saddle shaped. eg. carpo-metacarpal joint of the thumb.
- (f) **Condyloid joint:** It is a form of freely movable joint. In this case, oval shaped condyle of one bone fits into the elliptical cavity of another bone. It allows side to side, back and forth movements. eg. knee joint, joint between mandible and temporal bone.

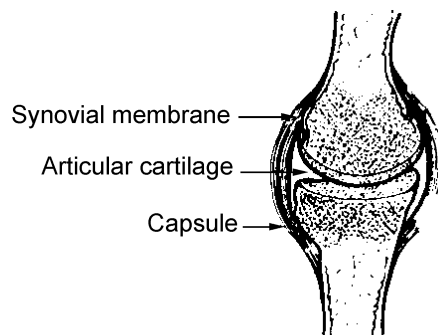


Diagram of a Synovial Joint

JOINTS OF UPPER AND LOWER LIMBS

The joints of upper and lower limbs are briefed as under:

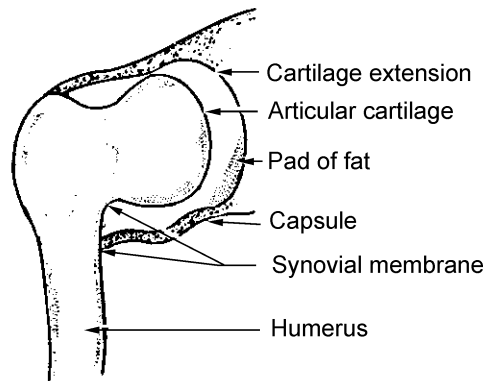
A. Joints of upper limbs:

| S. No. | Name of the Joint | Location | Type of Joint |
|--------|---------------------------------|--|---------------------------------|
| 1. | Sterno-clavicular joint | Between sternum and clavicle | Synovial (Saddle type) |
| 2. | Acromio-clavicular joint | Between lateral end of clavicle and acromion process of scapula. | Synovial (Gliding type) |
| 3. | Shoulder joint | Head of humerus and glenoid cavity of scapula | Synovial (Ball and socket) type |
| 4. | Elbow joint | Between humerus above and radius, ulna (below) | Synovial (Hinge joint) |
| 5. | Radio-ulna joint | | |
| | (i) Superior radio-ulnar joint | Between head of radius and radial notch of ulna. | Synovial (pivot type) |
| | (ii) Inferior radio-ulnar joint | Head of ulna and lower end of radius | Synovial (Pivot type) |
| 6. | Wrist joint | Between lower end of radius and three carpal bones i.e. navicular, lunate and triquetral | Synovial (condyloid) type |
| 7. | Metacarpophalangeal joints | Between metacarpals and phalangeal bones | Synovial (condyloid) type |
| 8. | Interphalangeal joints | Between phalanges | Synovial (Hinge type) |

| B. | | Joints of Lower Limb | |
|----|-----------------------------|---|---|
| 1. | Hip joint | Between head of femur and acetabulum of hip bone. | Synovial (Ball and socket) type |
| 2. | Knee joint | Patella and condyles of femur and tibia | Synovial (Hinge type) |
| 3. | Tibio-fibular joint | (i) Upper ends of tibia and fibula (ii) Shafts of tibia and fibula (iii) Lower ends of tibia and fibula | Synovial (Gliding type) Fibrous (immovable) Syndesmosis |
| 4. | Ankle joint | Between talus and (i) Tibia and its medial malleolus. (ii) Lateral malleolus of fibula (both forming socket) | Synovial (Hinge) type |
| 5. | Tarsal joints | Between talus and calcaneus and also between other tarsals | Synovial (gliding type) |
| 6. | Tarso-metatarsal joints | Between tarsal and metatarsal bones | Synovial (Gliding) type |
| 7. | Metatarso-phalangeal joints | Between metatarsal and phalangeal bones | Synovial (Condyloid type) |
| 8. | Inter phalangeal joints | Between phalangeal bones. | Synovial (Hinge type) |

The most important joints of the upper and lower limbs are briefed as under:

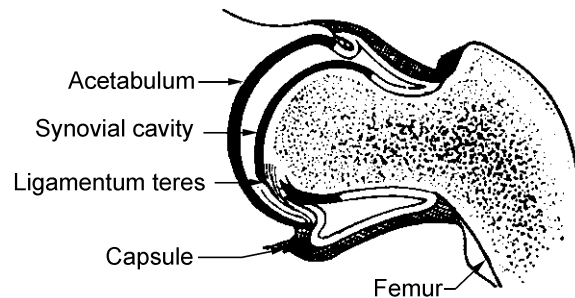
1. Shoulder joint: The joint between the head of humerus and glenoid cavity of scapula is known as shoulder joint. It is one of the joints of upper limbs. It is a ball and socket type of synovial joint. The bones are united by ligaments. The possible movements of shoulder joint are flexion, extension, abduction, adduction, rotation, circumduction, medial and lateral rotation etc.



Section of shoulder joint

2. Elbow joint: The joint between trochlea and capitulum of humerus and the trochlear notch of ulna and head of radius is known as elbow joint. It is one of the joints of upper limbs. It is a hinge type of synovial joint. The bones are united by ligaments. The possible movements of elbow joint are flexion and extension.

3. Hip joint: The joint between the head of femur and acetabulum of hip bone is known as hip joint. It is one of the joints of lower limbs. It is a ball and socket type of synovial joint. The bones are united by ligaments. The possible movements of hip joint are flexion, extension, abduction, adduction, rotation and circumduction.



Section of hip joint

4. Knee joint: The joint between the patella and condyles of femur and tibia is known as knee joint. It is one of the joints of lower limbs. It is the largest and most complex joint of the body. It is a complex and compound type of condylar type of synovial joint. The bones are held together by ligaments. The possible movements of knee joint are flexion, extension, slight medial and lateral rotation.

5. Ankle joint: The joint between the inferior surface of lower end of tibia, medial and lateral malleoli and trochlea of talus is known as ankle joint. It is one of the joints of the lower limbs. It is a hinge type of synovial joint. The bones are held together by ligaments. The possible movements of ankle joint are dorsiflexion and plantar flexion.

2.4 BONES FORMING MAJOR SYNOVIAL JOINTS

(i) Shoulder:-

- Humerus
- Scapula
- Clavicle
- Sternum
- Ribs

(ii) Elbow:-

- Humerus (distal end)
- Radius and ulna (proximal ends)

(iii) Wrist

- Radius and ulna (distal ends)
- 8 carpal bones
- 5 metacarpal bones (proximal portions)

(iv) Hip joint:- Articulation between:-

- Pelvic acetabulum
- Head of femur

(v) Knee

- Femur
- Tibia
- Fibula
- Patella (Knee cap)

(vi) Ankle:-

- Humerus
- Fibula
- Talus

(vii) Intervertebral joints (Intervertebral symphyses):-

- Extend between C₂ and S₁ vertebral levels.
- There are no intervertebral discs at C₀ – C₁ and C₁ and C₂ vertebral levels.

REVISION EXERCISES

1. Give in brief gross structure, function and classification of skeletal system.
2. Briefly discuss bones of pelvic girdle. Enumerate the differences between the female and male pelvis.
3. Give a brief account of lower limb bones along with suitable diagrams.
4. Give a brief account of bones of upper limbs.
5. Define the term articulation of bones. Classify various joints. Enlist various synovial joints. Briefly discuss any two synovial joints.
6. Enlist important joints of upper and lower limbs. Discuss in brief one joint of upper and lower limb.
7. Enlist bones forming major synovial joints:-
 - (i) Shoulder joint
 - (ii) Hip joint
 - (iii) Knee joint
8. **Fill in the blanks:-**
 - (i) The rigid frame work of bones and joints form the system of the body.
 - (ii) The branch of science which deals with the study of bones is known as
 - (iii) The total number of bones in the skeletal system of human body are
 - (iv) The skeletal system of human body is classified into two groups ie skeleton and skeleton.
 - (v) The point at which two bones or bone and cartilage are connected is called

ANSWERS

- | | | |
|--------------------------|----------------|-----------|
| (i) Skeletal | (ii) Osteology | (iii) 206 |
| (iv) Axial, Appendicular | (v) Joint | |

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