

THE SKELETAL SYSTEM

Definition

Osteology is the study of the bones and joints which make up or comprise the skeletal system.

Composition of Bone

1. The formation of bone is known as 'ossification'.
2. In the early embryonic stage most bones are composed of cartilage.
3. Within 2-3 months of embryonic life osteoblasts begin to manufacture the matrix which is found between the cells.
4. This material contains large amounts of collagen which gives resilience to the tissue.
5. Calcium is deposited within the matrix with the help of enzymes, these cells are referred to as osteocytes.
6. Calcium gives bone its strength
7. Osteocytes maintain bone but osteoblasts are responsible for remodelling and repair.

Bones are composed of two types of tissue:

Compact Bone:

1. This is hard dense bone that forms the outer layer of all bones.
2. It provides strength, support and protection.

Cancellous Bone:

1. This is sponge like in appearance formed by an interlacing network of bone tissue with spaces in between.
2. It is filled with red bone marrow which produces red blood cells.
3. Cancellous bone makes bones lighter.
4. It is found at the end of long bones and in irregular, flat and sesamoid bones.

Long Bone Formation

1. In the developing embryo all long bones are rods of cartilage covered with membrane.
2. The replacement of cartilage to bone during ossification begins at the centre of the shaft called the diaphysis.
3. Calcium is laid down in the matrix and bone cells develop.
4. Secondary ossification centres develop in the two ends (epiphyses).
5. The epiphyses have an outer covering of compact bone and internally consists of cancellous bone.
6. The epiphysis plate is the remaining cartilage between the diaphysis, (shaft) and each extremity or epiphysis. This persists until the bone is fully grown.
7. The shaft has a hollow centre called the medullar canal, this helps to lighten the weight of the bone and also contains yellow bone marrow which is mainly composed of fat.

8. Red bone marrow found at the epiphyses manufacture blood cells.
9. Examples of long bones are the femur and humerus.

Structure of long Bones

1. **Hyaline Cartilage** : covers the surfaces of articulating bones ,reduces friction and allows smooth movement.
2. **Epiphysis**: the wider end of long bones.
3. **Epiphyseal Cartilage**: Found in both ends of long bones between the epiphysis and diaphysis. New bone is laid down here during the growth period.
4. **Diaphysis**: this is the shaft of a long bones, it consists of an outer layer of compact bone covering cancellous bone.
5. **Periosteum**: tough outer covering of bones ,adheres tightly like a sheath, contains blood vessels which deliver oxygen and nutrients to the bone; it also contains lymphatics, nerve fibres and bone cells.

Composition of Flat Bones:

Consists of 2 layers of compact bone and a layer of cancellous bone covered by periosteum.
Examples of flat bones are the frontal and parietal bones of the cranium.

Classification of Bones:

Bones are classified by shape, there are FOUR main types:

1. **Long bones**: long shaft and 2 wider ends e.g. humerus, femur act as levers to enable the body to move.
2. **Short bones**: usually cube shaped, give strength rather than movement e.g. carpals, tarsal
3. **Flat bones**: protect organs e.g. skull protects the brain.
4. **Irregular bones**: where strength is needed e.g. vertebrae

Small bones called sesamoid bones are sometimes found within tendons to help their movement over bone surfaces e.g. the patella.

The Skeleton

Divided into two parts:

1. **Axial Skeleton** includes the bony framework of the head and trunk.
2. **Appendicular Skeleton** forms the framework for the limbs, shoulders and hips.

Axial Skeleton Consists of:

1. Skull (cranium and bones of the face)
2. Vertebral column
3. Sternum
4. Ribs
5. Hyoid bone (small bone in the neck below the mandible)

Appendicular Skeleton

Consists of:

Clavicle	Innominate or pelvic bone
Scapula	Femur
Humerus	Patella
Radius	Tibia
Ulna	Fibula
Carpals	Tarsal
Metacarpals	Metatarsals
Phalanges	Phalanges

Vertebral Column

1. Consists of 33 bones, some of them are fused so that there are only 26 bones.
2. The vertebrae are separated by inter vertebral discs of fibro cartilage which act as shock absorbers.
3. Bones and discs are bound together by strong ligaments

Regions of the Vertebral Column

1. Cervical (7 vertebrae)
2. Thoracic (12)
3. Lumbar (5)
4. Sacral (5)
5. Coccyx (4)

Bones of the Skull

1. The skull is made up of 22 bones
2. There are 8 cranial (head) bones: 1 frontal, 2 parietal, 1 occipital, 1 sphenoid, 1 ethmoid
3. There are 14 facial bones:
2 zygomatic, 2 maxillae, 1 mandible, 2 lacrimal, 1 vomer, 2 palatine, 2 nasal, 2 turbinator

The fibrous joints of the skull are called sutures:

Sutures of the skull are- sagittal, coronal, squamous, lamboidal

Functions of the bones of the skull

1. The function of the cranium is to protect the brain.
2. The frontal and zygomatic bones form the eye sockets.
3. The mandible aids chewing.
4. The temporal bones protect the inner structures of the ear.

Sinuses

1. Within the skull are air spaces lined with a mucous membranes known as sinuses.
2. This mucous membranes can become infected, swollen, painful and sore, known as sinusitis.
3. The condition may be acute as a result of flu, cold, etc, this is relieved when the infection and swelling clears up, or the condition may be chronic when the swelling does not subside or if there are polyps (little growths) present. This can result in headaches which are sometimes very severe.

Classification of Joints

A joint is where two or more bones join or articulate.

There are THREE main types of joints in the body:

1. Fibrous Joints – immovable, tight fit joints, held together by fibrous tissue; e.g. sutures of the skull.
2. Cartilaginous Joints – slightly moveable, joined by a disc of cartilage; e.g. inter vertebral joints.
3. Synovial – freely moveable joints -most numerous in the body. There are SIX different types of synovial joint:
 - a. Ball & Socket
 - b. Hinge
 - c. Saddle
 - d. Pivot
 - e. Condylloid/ Ellipsoid
 - f. Gliding

Joint	Example
Ball and Socket	Shoulder joint
Hinge	Elbow
Pivot	Atlas and axis
Gliding	Clavicle and sternum
Saddle	Joint at base of the thumb between trapezius and first metacarpal
Condylloid	Joints between the metacarpals and phalanges

Movement

Flexion, extension, adduction, rotation, (medial and lateral) circumduction
Flexion and extension

Rotation

Gliding

Flexion, extension, adduction, abduction, rotation (limited), circumduction

Flexion, extension, adduction, abduction, circumduction

Ligaments

Consist of strong bands of fibrous connective tissue that hold bones together at joints.

Tendons

Consist of strong white fibrous bands that attach muscle to bone.

Joint Movements

The following terms are used to describe the direction of joint movement:

Movement	Description
Flexion	bringing together of 2 surfaces, the body part bends
Extension	opposite of flexion, the body part straightens
Abduction	movement away from the mid line of the body
Adduction	movement towards the mid line of the body
Rotation	movement around a long axis, medial rotation or lateral rotation
Circumduction	circling movement to include: flexion, abduction, extension and adduction

Movements of ulna & radius:

Supination	turns the hand forwards or upwards
Pronation	turns the hand backwards or downwards

Movements of the ankle joint:

Dorsi-flexion	bending the foot upwards
Plantar flexion	pointing the foot downwards

Movements of the foot:

Eversion	turning the foot away from the mid line
Inversion	turning the foot towards the mid line

Diseases and Disorders of Joints

Arthritis inflammation of the joint, maybe acute or chronic

Osteoporosis weak, brittle bones due to the changing levels of oestrogen and progesterone

Disc Prolapse

also known as a slipped disc, fibrocartilage disc protrudes from between the vertebrae. This presses on a nerve causing pain.

Anatomical Position and Terminology of Surfaces or Structures

There are certain terms used to describe:

1. Surfaces of the body in the anatomical position
2. Position of structures

The correct anatomical position is:

- a. Body erect
- b. Hands by the sides
- c. Palms facing forward

There is an imaginary vertical line that runs through the middle of the body called the midline.

Term	Surface	Structure
Anterior	Faces forwards	Further forward than another
Posterior	Faces backwards	Further back than another
Superior		Higher than others, e.g. nearer the head
Inferior		Lower than others, e.g. nearer the foot
Medial	Nearer to the midline of the body	Nearer to the midline of the body
Lateral	Further away from the midline of the body	Further away from the midline of the body
Superficial		Nearer the surface than others
Deep		Further from the surface
Proximal		Towards the origin
Distal		Further away from the origin

Functions of the Skeleton

1. Provides a framework and supports the weight of the whole body
2. Protects major organs
3. Acts as a framework for the attachment of muscles to provide movement
4. Provides a store of minerals, calcium and phosphorus
5. Produces red blood cells from red bone marrow
6. Provides a store of fat for energy in yellow bone marrow