SECTION 1

Anatomy

CHAPTERS

CHAPTER

1

Skeletal System

INTRODUCTION TO ANATOMY

Anatomy can be approached in different ways, with each perspective focusing on various aspects of the body. These approaches include:

- *Systemic anatomy:* This approach studies the body by organ systems, such as the digestive, nervous, and reproductive systems.
- *Regional anatomy:* In regional anatomy, the body is studied in terms of specific regions, such as the thorax and abdomen, focusing on the muscles, nerves, blood vessels, and their relationships within those regions.
- *Clinical anatomy:* This approach applies basic anatomical knowledge to clinical practices, including dissections and surgical procedures, helping in diagnosing and treating diseases.

SKELETAL SYSTEM—AN OVERVIEW

The skeletal system is a vital component of the human body, providing structural support, facilitating movement, and protecting internal organs. It is primarily made up of bones, joints, cartilage, and ligaments.

The skeletal system is divided into two main parts:

- *Axial skeleton:* Includes the bones of the head, vertebral column, ribs, and sternum.
- *Appendicular skeleton:* Includes the bones of the limbs and their attachments to the axial skeleton.

Bones

Functions of the Bones (Skeletal System)

Bones perform several critical functions, including:

- *Support and framework:* Bones form the structural framework of the body, bearing weight and enabling an upright posture.
- *Movement:* Bones anchor muscles, tendons, and ligaments, facilitating movement.
- *Protection:* Bones protect internal organs such as the brain, heart, and lungs.
- *Bone remodelling and homeostasis:* Bone cells like osteocytes and osteoclasts help in the continuous remodelling of bones. The bone matrix also contributes to maintaining calcium and phosphate homeostasis.
- *Mineral storage:* Bones store minerals such as calcium, phosphorus, and magnesium, contributing to the regulation of these ions in the body.
- *Blood cell production (hemopoiesis):* Bones serve as the site for blood cell production, including red blood cells (RBCs), white blood cells (WBCs), and platelets.
- *Endocrine function:* Bones secrete various factors that regulate metabolic functions, affecting adipocyte activity, eating behavior, and insulin sensitivity, with implications for conditions such as osteoporosis, obesity, and diabetes.

Structure of a Bone

A typical long bone consists of the following parts ***(Fig. 1.1):***

- *Diaphysis:* The tubular shaft of the bone, made of compact bone and containing the medullary cavity filled with yellow bone marrow. It provides structural support and facilitates movement.
- *Epiphysis:* The wider end of a long bone, filled with spongy bone and covered by articular cartilage. It facilitates smooth movement at the joints.
- *Metaphysis:* The area between the diaphysis and epiphysis, containing the growth plate in growing bones.
- *Periosteum:* A fibrous membrane covering the outer surface of bones. It contains blood vessels, nerves and plays a role in the nourishment and repair of bones.
- *Endosteum:* A thin membrane lining the medullary cavity and involved in bone growth and repair.
- *Articular cartilage:* A thin layer of hyaline cartilage that reduces friction and absorbs shock at freely movable joints, protecting the bone surfaces.

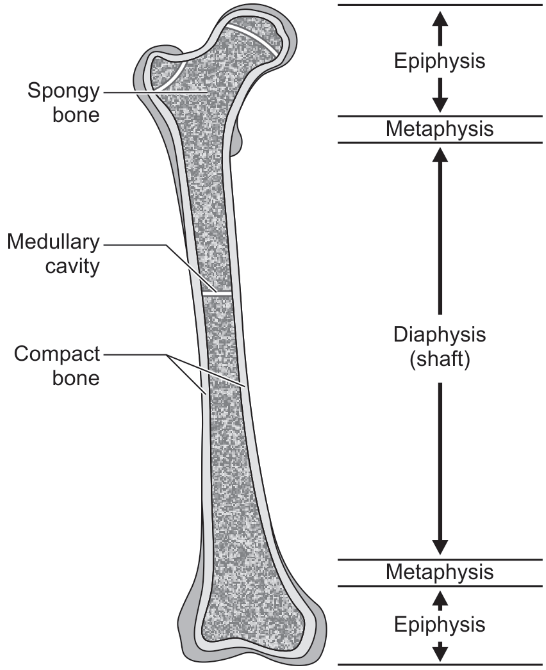

Fig. 1.1: Structure of a long bone

Types of Bones

Bones can be classified based on their shape. The main types of bones are as follows **(Table 1.1)**:

TABLE 1.1: Types of bones and their descriptions

Type of bone	***Description***	***Examples***
Long bones	These bones are longer than they are wide and are primarily found in the limbs. They support weight and facilitate movement	Humerus, radius, ulna, femur, tibia, fibula, metacarpals, and phalanges
Short bones	These bones are approximately equal in length and width, providing stability and support with limited movement	Carpal bones (wrist) and tarsal bones (ankle)
Flat bones	These bones are thin and flat, providing areas for muscle attachment and protection for internal organs	Ribs, sternum, scapulae, and bones of the skull
Irregular bones	These bones have complex shapes and serve various functions, including protection	Vertebrae, bones of the skull, and coxal bones
Sesamoid bones	These bones develop within tendons and help reduce friction, protecting tendons from excessive wear.	Patella (kneecap) and wrist bones

Joints

A joint, also known as an articulation, is the point where two or more bones meet and connect. Joints allow for flexibility and movement, such as bending, rotation, and straightening. Joints can be classified into three main types:

Types of Joints

- *Fibrous joints:* Connected by dense fibrous tissue made of collagen fibers, these joints have little to no movement. Examples include:
  - *Sutures:* Found between the flat bones of the skull.
  - *Syndesmosis:* An example is the inferior tibiofibular joint.
- *Cartilaginous joints:* These joints are connected by cartilage and have no joint cavity, permitting limited movement. Examples include:
  - Pubic symphysis
  - Intervertebral discs
- *Synovial joints:* These joints have fluid-filled spaces called synovial cavities, allowing for a wide range of movement. They consist of four key features: joint cavity, articular (hyaline) cartilage, synovial membrane, and an articular capsule. They are further classified as follows:
  - *Plane (gliding) joints:* Allow for sliding movements. Examples include the proximal tibiofibular, intertarsal, and intercarpal joints.
  - *Hinge joints:* Allow for bending and straightening movements. Examples include the elbow, ankle, and interphalangeal joints.
  - *Pivot joints:* Allow for rotational movement. Examples include the radioulnar joints and the atlantoaxial joint.
  - *Condylar joints:* Permit movement in two directions. Examples include the wrist (radiocarpal), metacarpophalangeal, knee (tibiofemoral), and atlantooccipital joints.
  - *Saddle joints:* Allow movement in two planes. An example is the carpometacarpal joint of the thumb.
  - *Ball and socket joints:* Allow the greatest range of motion in all directions. Examples include the shoulder and hip joints.

Important Clinical Conditions Associated with Joints

- *Osteoarthritis:* A degenerative disease where the protective cartilage that cushions the ends of bones wears down over time.

Commonly affects the hands, hips, knees, and spine, leading to pain, swelling, and reduced movement. Risk factors include age, obesity, joint injuries, and overuse.

- *Rheumatoid arthritis:* A chronic autoimmune disease that causes inflammation in the joints and surrounding tissues. It presents with morning stiffness, pain, and swelling and is influenced by genetic factors and immune responses.
- *Gout:* A type of arthritis caused by elevated levels of uric acid in the blood, leading to pain and swelling in a single joint, most often in the big toe.