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Introduction, Anatomical terms

اعداد:

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دكتوراه (بورد) اشعة تشخيصية

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General Objective

Introduce the primary terminology used in describing the position and movement of the human body.

Learning Objectives

The student is expected to be able to:

1. Define the anatomical position, the major planes of section, and the primary terms of direction used in anatomic descriptions.

2. Define the primary movements utilized in anatomic descriptions.

Definitions

- **Anatomy :**is the science of the structure and function of the body.
- **Clinical anatomy:** is the study of the macroscopic structure and function of the body as it relates to the practice of medicine and other health science.
- The accurate use of anatomic terms by medical personnel enables them to communicate with their colleagues both nationally and internationally. Without anatomic terms, one cannot accurately discuss or record the abnormal functions of joints, the actions of muscles, the alteration of position of organs, or the exact location of swellings or tumors.

Anatomical Position

All descriptions of the human body are based on a conventional reference posture termed the **Anatomical position**.

In this, a person is standing erect and facing forward, the upper limbs are by the sides, the palms of the hands are directed forward, the lower limbs are together, the soles of the feet are on the ground, and the toes are pointing forward (Fig. 1.1).

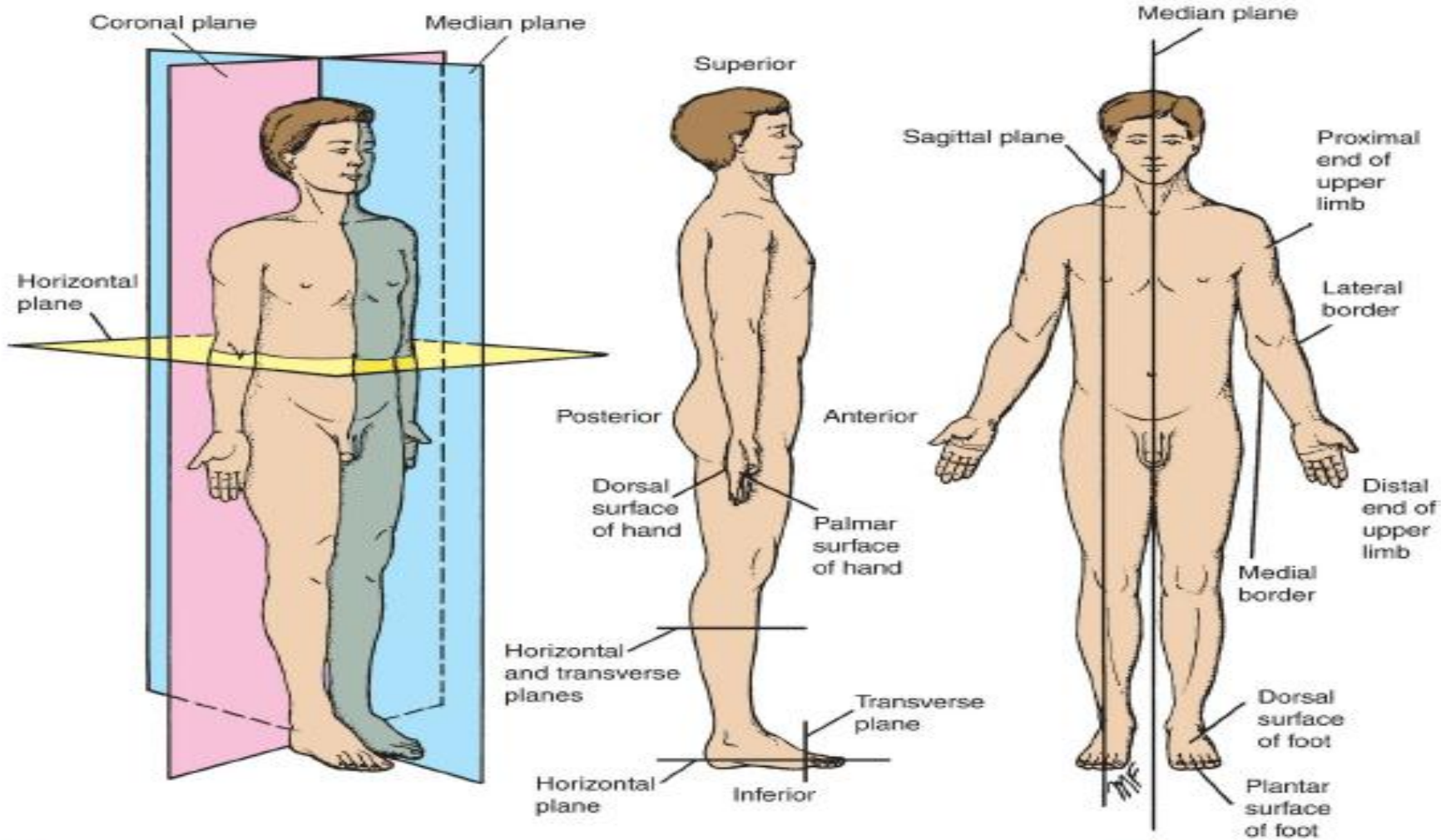

Figure 1.1 Anatomic terms used in relation to position. Note that the subjects are standing in the anatomical position. **A.** Illustration of the median, coronal, and horizontal planes. Note that these planes are aligned at 90° to one another. **B.** Lateral view, demonstrating anatomic planes and directional terms. Note that horizontal and transverse planes may or may not be equivalent. **C.** Anterior view, showing planes of section and anatomic directions.

Terms Related to Position

- The **median plane** is a vertical plane passing through the center of the body, dividing it into equal right and left halves (see Fig. 1.1A).
- A **sagittal plane** is any plane parallel to the median plane that divides the body into unequal right and left portions.

Terms Related to Position

- The **coronal** (**frontal**) **plane** is a vertical plane situated at a right angle to the median plane. The coronal plane divides the body into anterior (front) and posterior (back) portions.
- The **horizontal plane** lies at right angles to both the median and the coronal planes. A horizontal plane divides the body into upper and lower parts

Terms Related to Position

- A **transverse plane** lies perpendicular to the long axis of a given structure and divides that structure in a cross-sectional orientation.
- The terms “transverse plane” and “horizontal plane” are often used interchangeably. However, they are not necessarily equivalent. Consider the difference between horizontal and transverse planes in the leg versus the foot and in the abdomen versus the gut tube.

Terms Related to Position

- The terms **anterior** (**ventral**) and **posterior** (**dorsal**) are used to indicate the front and back of the body, respectively (see Fig. 1.1B).
- To describe the relationship of two structures, one is said to be anterior or posterior to the other, in so far as it is comparatively closer to the anterior or posterior body surface (e.g., the nose is on the anterior side of the head, whereas the buttocks are on the posterior side of the body).
- In describing the hand, the terms **palmar** and **dorsal** surfaces are used in place of anterior and posterior, respectively. In describing the foot, the term **plantar** surface refers to the sole of the foot and **dorsal** surface indicates the upper (top) surface (see Fig.1.1C).

Terms Related to Position

- A structure situated nearer to the median plane of the body than another is said to be **medial** to the other. Similarly, a structure that lies farther away from the median plane than another is said to be **lateral** to the other (e.g., in the head, the eyes are lateral to the nose, and the nose is medial to the eyes).

Terms Related to Position

- The terms **superior** (**cranial**; **cephalic**) and **inferior** (**caudal**) denote levels relatively high or low with reference to the upper and lower ends of the body (e.g., the head is at the superior end of the body, whereas the feet are at the inferior end of the body).

Terms Related to Position

- The terms **proximal** and **distal** describe positions relative to the core, root, or attached end of a reference point. Proximal is closer to the core and distal is further away from the core (e.g., in the upper limb, the shoulder is proximal to the elbow, and the hand is distal to the elbow).

Terms Related to Position

- The terms **superficial** and **deep** denote positions relative to the surface of the body or a given structure. Superficial is closer to the surface, whereas deep is farther away from the surface (e.g., the skin is superficial to the ribs, but the heart is deep to the ribs).

Terms Related to Position

- The terms **internal** and **external** are used to describe locations relative to the center of a structure or space. Internal is inside the structure and external is outside the structure (e.g., the thoracic cavity is an internal space in the trunk of the body, whereas the skin is the external layer of the trunk).

Terms Related to Position

- **Ipsilateral** and **contralateral** are terms referring to positions relative to a reference side of the body. Ipsilateral is on the same side as the reference point, and contralateral is on the opposite side from the reference point (e.g., the right eye is ipsilateral to the right ear; however, the right eye is contralateral to the left ear).

Terms Related to Position

- The **supine** position of the body is lying on the back. The **prone** position is laying face downward.
- The terms **afferent** and **efferent** refer to the direction of flow relative to a reference point. Afferent is flow toward the reference point, whereas efferent is flow away from the reference (e.g., venous blood flow is afferent to the heart, and arterial blood flow is efferent to the heart).

Terms Related to Movement

- In the musculoskeletal system, movement takes place at joints (Fig. 1.2).
- A joint is a site where two or more bones articulate, or come together. Some joints have no movement (e.g., sutures of the skull), some have only slight movement (e.g., superior tibiofibular joint), and some are freely movable(e.g., shoulder joint).

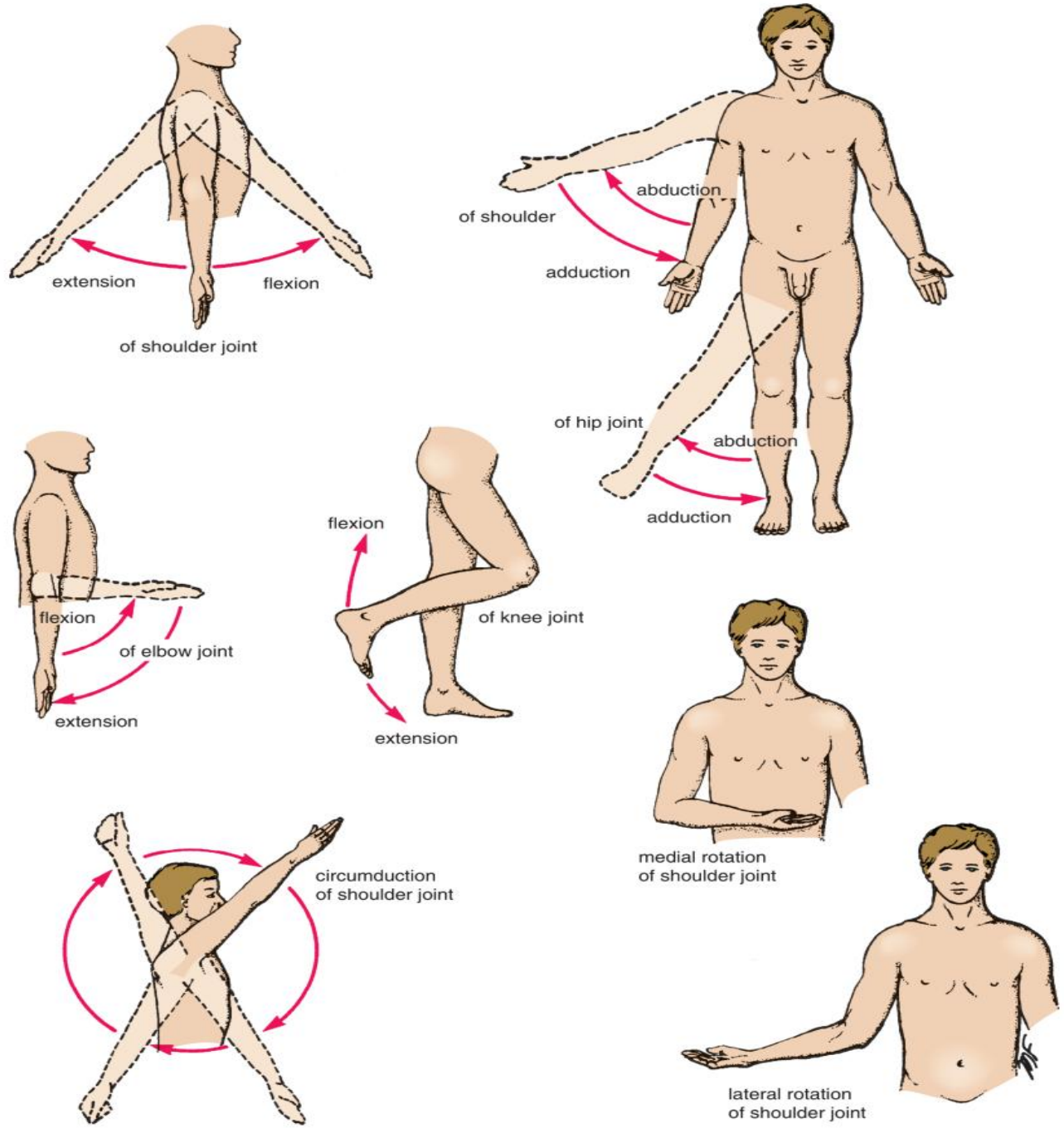

Figure 1.2 Some anatomic terms used in relation to movement. Note the difference between flexion of the elbow and that of the knee.

Terms Related to Movement

- **Flexion** is the movement in which a joint angle is decreased (closed) during motion occurring in a sagittal plane.
- **Extension** is the opposite movement in which the joint angle is increased (opened; straightened) in a sagittal plane (e.g., flexion of the elbow approximates the anterior surface of the forearm to the anterior surface of the arm; extension of the elbow is the reverse motion).
- Flexion usually is an anterior movement, but it is occasionally directed posteriorly, as in the case of the knee joint. Also, flexion typically implies a relatively more powerful, antigravity movement directed toward the embryonic ventral aspect of the body.

Terms Related to Movement

- **Dorsiflexion and plantar flexion** are special terms used to simplify descriptions of the movements of the foot.
- Dorsiflexion (the equivalent to extension) refers to lifting the top of the foot superiorly, toward the shin.
- Plantar flexion (the equivalent to flexion) refers to moving the sole of the foot inferiorly, as in standing on the toes.
- Lateral flexion is term sometimes used in clinical settings that refers to a sideways bending movement of the trunk in the coronal plane (Fig. 1.3).

Terms Related to Movement

- **Abduction** is movement away from the midline of the body in the coronal plane.
- **Adduction** is movement toward the midline of the body in the coronal plane (see Fig. 1.2). In the fingers and toes, abduction is applied to the spreading apart of the digits, and adduction is applied to the drawing together of these structures. The movements of the thumb, which are more complicated.

Terms Related to Movement

- **Inversion** and **eversion** are special terms used to describe certain movements of the foot (see Fig. 1.3).
- Inversion is turning the sole of the foot so that the sole faces in a medial direction, toward the midline, and eversion is the opposite movement of the foot so that the sole faces in a lateral direction.

Terms Related to Movement

- **Rotation** is the term applied to the movement of a part of the body around its long axis, with little to no movement through space.
- **Medial** (**internal**) **rotation** is the movement that results in the anterior surface of the part facing medially.
- **lateral** (**external**) **rotation** is the movement that results in the anterior surface of the part facing laterally (see Fig. 1.2).

Terms Related to Movement

- **Circumduction** is a complex sequence of movements combining flexion, extension, abduction, adduction, and rotation. The overall movement results in transcribing a cone through space, with the apex of the cone being the more proximal articular cavity of a joint and the base of the cone being the more distal end of a bone or limb segment. Circumduction is most easily envisioned at the shoulder.

Terms Related to Movement

- **Pronation** and **supination** are special movements of the forearm in which the radius moves around the ulna (see Fig. 1.3).
- Pronation is turning the forearm medially in such a manner that the palm of the hand faces posteriorly, and supination is turning the forearm laterally from the pronated position so that the palm of the hand comes to face anteriorly.
- These movements are composed of both rotation (at the proximal end of the radius) and circumduction (at the distal end of the radius).
- Some references describe pronation/supination of the ankle and foot. Clinically defined, pronation and supination of the foot are complex movements of the ankle region that include plantar flexion, dorsiflexion, eversion, and inversion.

Terms Related to Movement

- **Protraction** is the term used to describe moving a body part forward.
- **Retraction** is to move a part backward. Examples of these movements are the forward and backward movement of the jaw at the temporomandibular joints (as when jutting the chin forward) and the forward/backward motion of the scapula across the rib cage (as when reaching forward).

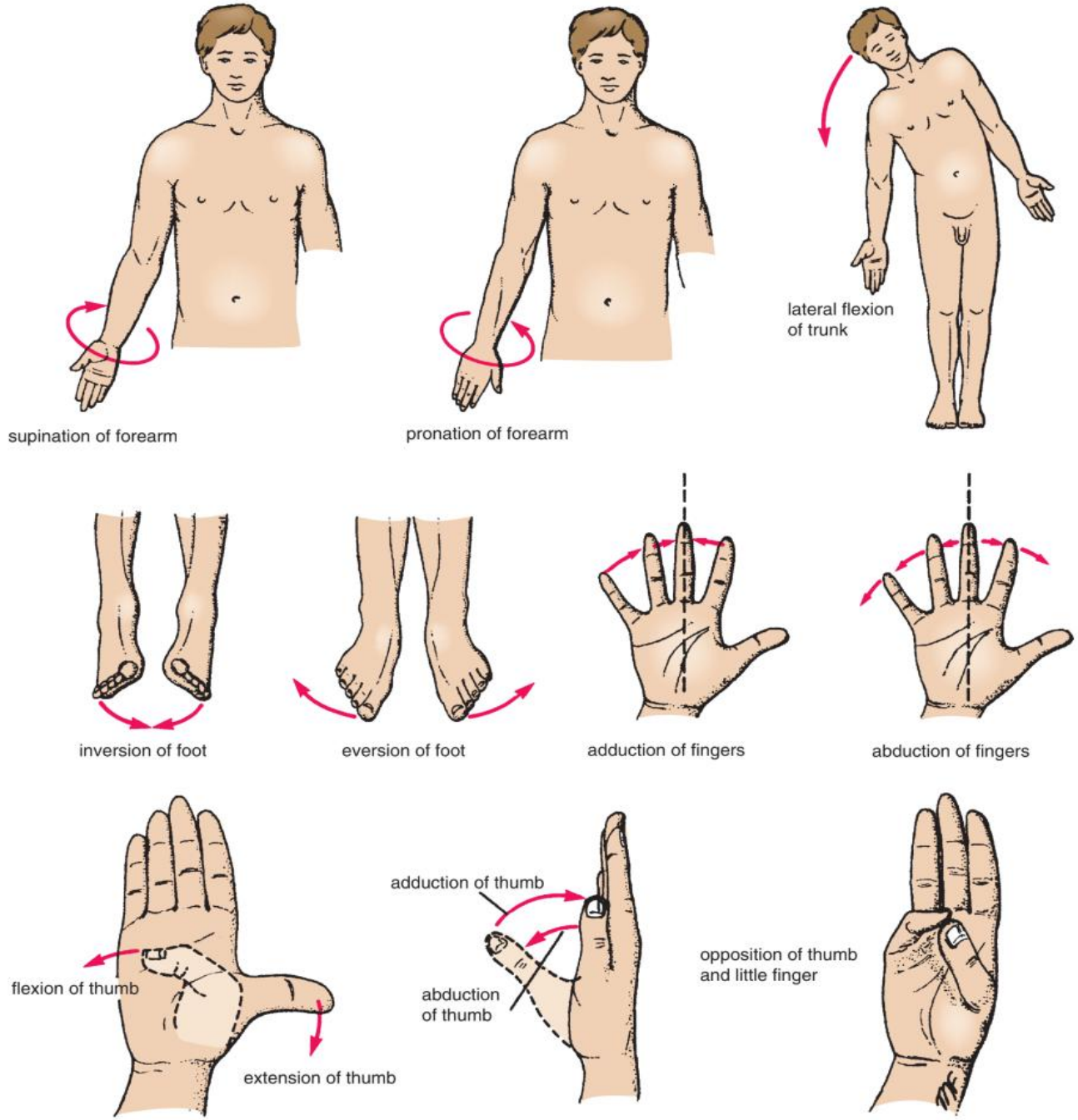

Figure 1.3 Additional anatomic terms used in relation to movement.

Task

- **Define the following terms :**
  - Surface Anatomy .
  - Radiographic Anatomy .

Summary

- **Anatomy :**is the science of the structure and function of the body.
- Anatomical terms divided into :

➢ **Terms Related to Position.**

➢ **Terms Related to Movement.**

References

- Snell’s Clinical Anatomy by Regions(tenth edition)

Survey

https://forms.gle/rT3aJLy66LZQQ2DR9

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Skin Anatomy & its function

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General Objective

- To Know the Skin and its components.
- To know the function of the skin and its appendages.

Learning Objectives

The student is expected to be able to:

1.Identify the components of the skin and its appendages.

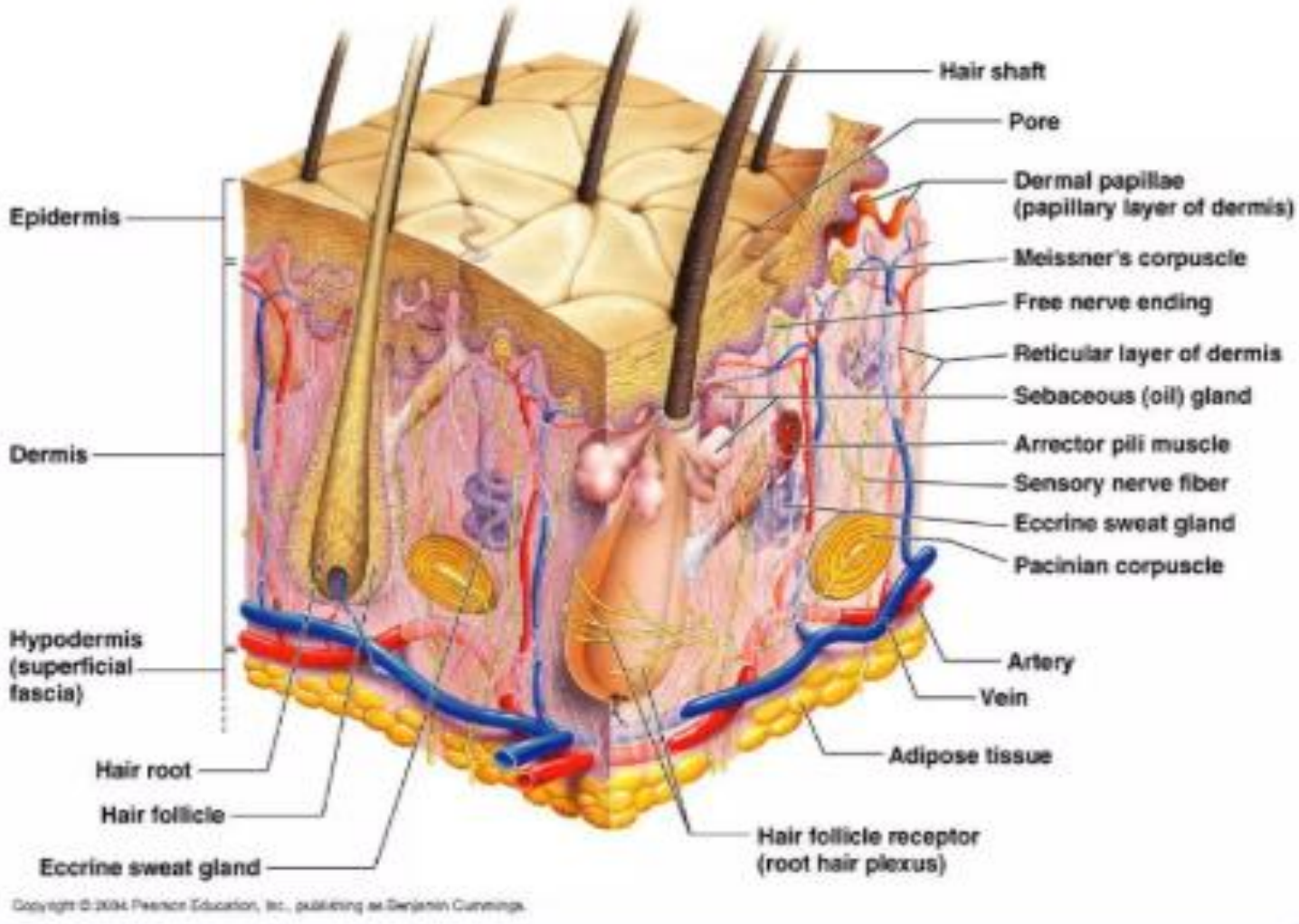
2. Identify the types and distributions of the fasciae of the body.

Function of the skin (cutis)

- It is outer covering of the body .
- It help to maintain constant body temperature (thermoregulation) , protect the body (immunological function) , excretory function and provide sensory information.
- Thickness of the skin ranges from 0.5 mm on the eyelid to 4 mm on feet .

Histology of Skin

- Epidermis
- Dermis
- Hypodermis



Components of the Skin

- The skin is divided into two parts: the superficial part, the **epidermis;** and the deep part, the **dermis** (Fig. 1.4).
- The epidermis is a stratified epithelium whose cells become flattened

as they mature and rise to the surface.

- On the palms of the hands and the soles of the feet, the epidermis is extremely thick, to withstand the wear and tear that occurs in these regions.
- In other areas of the body, for example, on the anterior surface of the arm and forearm, it is thin.

Epidermis

- It consist of principle types of cells :

❑Keratinocytes

❑Melanocytes

❑Langerhans cells

❑Markels cells

CELLS OF EPIDERMIS

Keratinocytes:

- About 90% of epidermal cells are keratinocytes
- Keratin is a tough, fibrous protein that helps to protect the skin and underlying tissues from heat, microbes and chemicals.

Melanocytes:

- About 8% of the epidermal cells are melanocytes and produce pigment ***melanin.***
- ***Melanin*** is the yellow red or brown black pigment that contribute the skin color and absorb damaging UV light.

CELLS OF EPIDERMIS

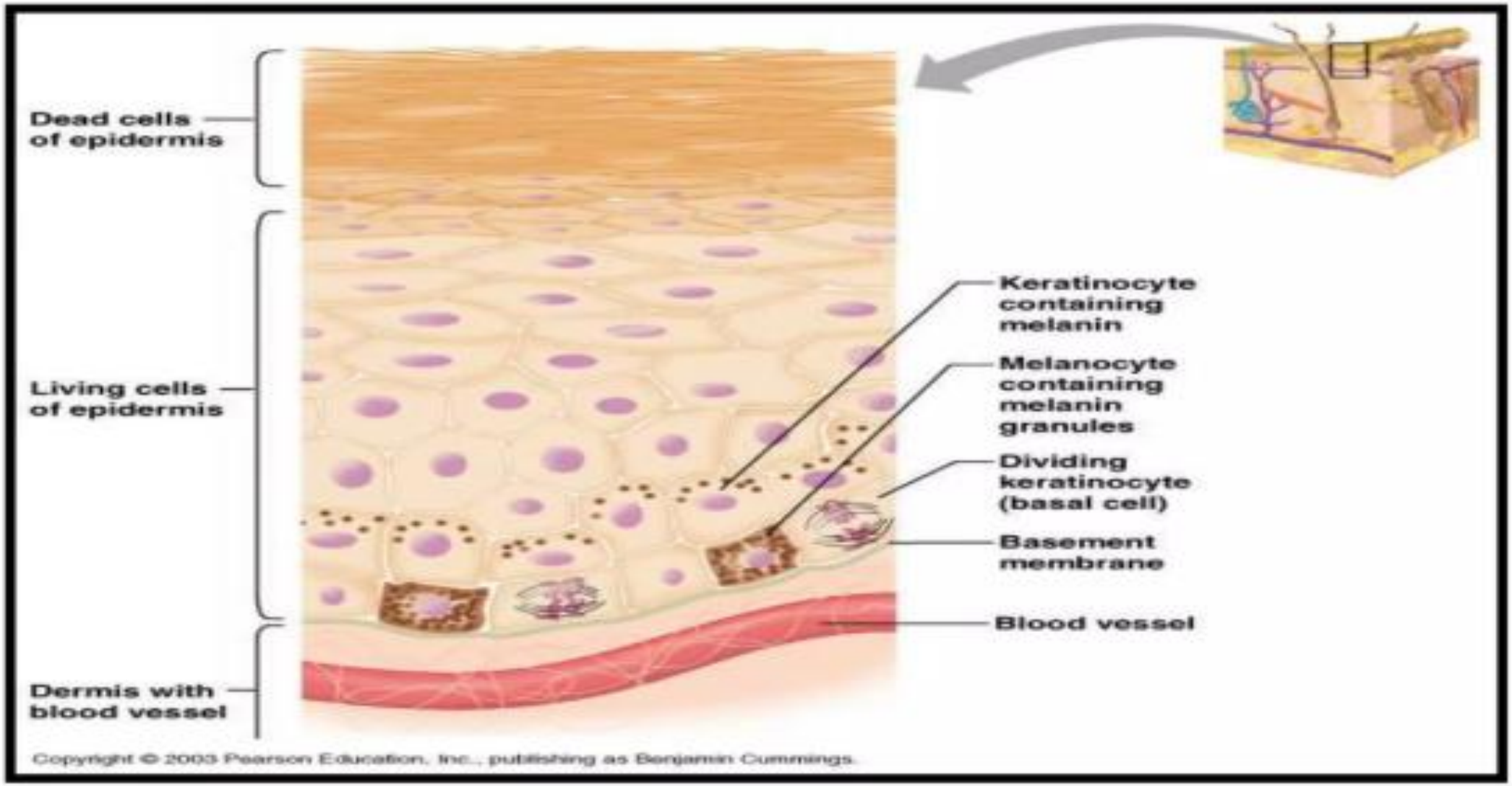
Langerhan's cells:

- They arise from red bone marrow and migrate to the epidermis & contribute a small fraction of the epidermal cells.
- They participate in immune responses mounted against microbes.

Markel cells:

- These are the least numerous epidermal cells.
- They are located in the deepest layer of epidermis.

CELLS OF EPIDERMIS



Dermis

- The dermis is composed of dense connective tissue containing many blood vessels, lymphatic vessels, and nerves.
- It shows considerable variation in thickness in different parts of the body, tending to be thinner on the anterior than on the posterior surface. It is thinner in women than in men.

Dermis

- The dermis of the skin is connected to the underlying deep fascia or bones by the **superficial fascia,** otherwise known as **subcutaneous tissue.**
- The skin over joints always folds in the same place, the **SKIN CREASES** (Fig. 1.5). At these sites, the skin is thinner than elsewhere and is firmly tethered to underlying structures by strong bands of fibrous tissue.

Skin Appendages

- The appendages of the skin are the **nails**, **hair follicles**, **sebaceous glands**, and **sweat glands.**
- The **nails** are keratinized plates on the dorsal surfaces of the tips of the fingers and toes. The proximal edge of the plate is the **root of the nail** (see Fig. 1.5). With the exception of the distal edge of the plate, the nail is surrounded and overlapped by folds of skin known as **nail folds.** The surface of skin covered by the nail is the **nail bed** (see Fig. 1.5).

Skin Appendages

- **Hairs** grow out of **follicles,** which are invaginations of the epidermis into the dermis (see Fig. 1.4). The follicles lie obliquely to the skin surface, and their expanded extremities, called **hair bulbs,** penetrate to the deeper part of the dermis. Each hair bulb is concave at its end, and the concavity is occupied by vascular connective tissue called **hair papilla**. A band of smooth muscle, the arrector pili, connects the undersurface of the follicle to the superficial part of the dermis (see Fig. 1.4).

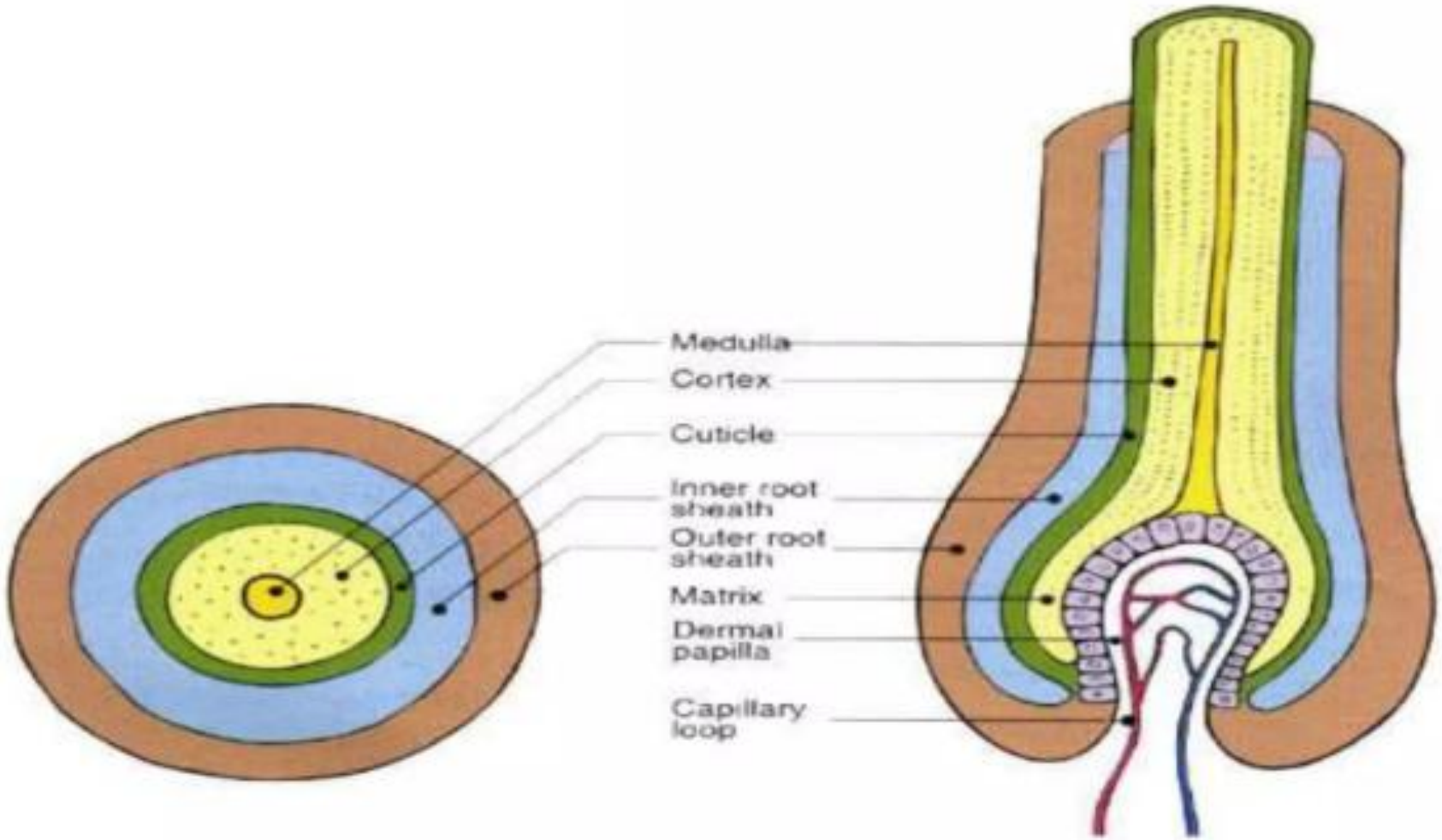
HAIRS (PILI)

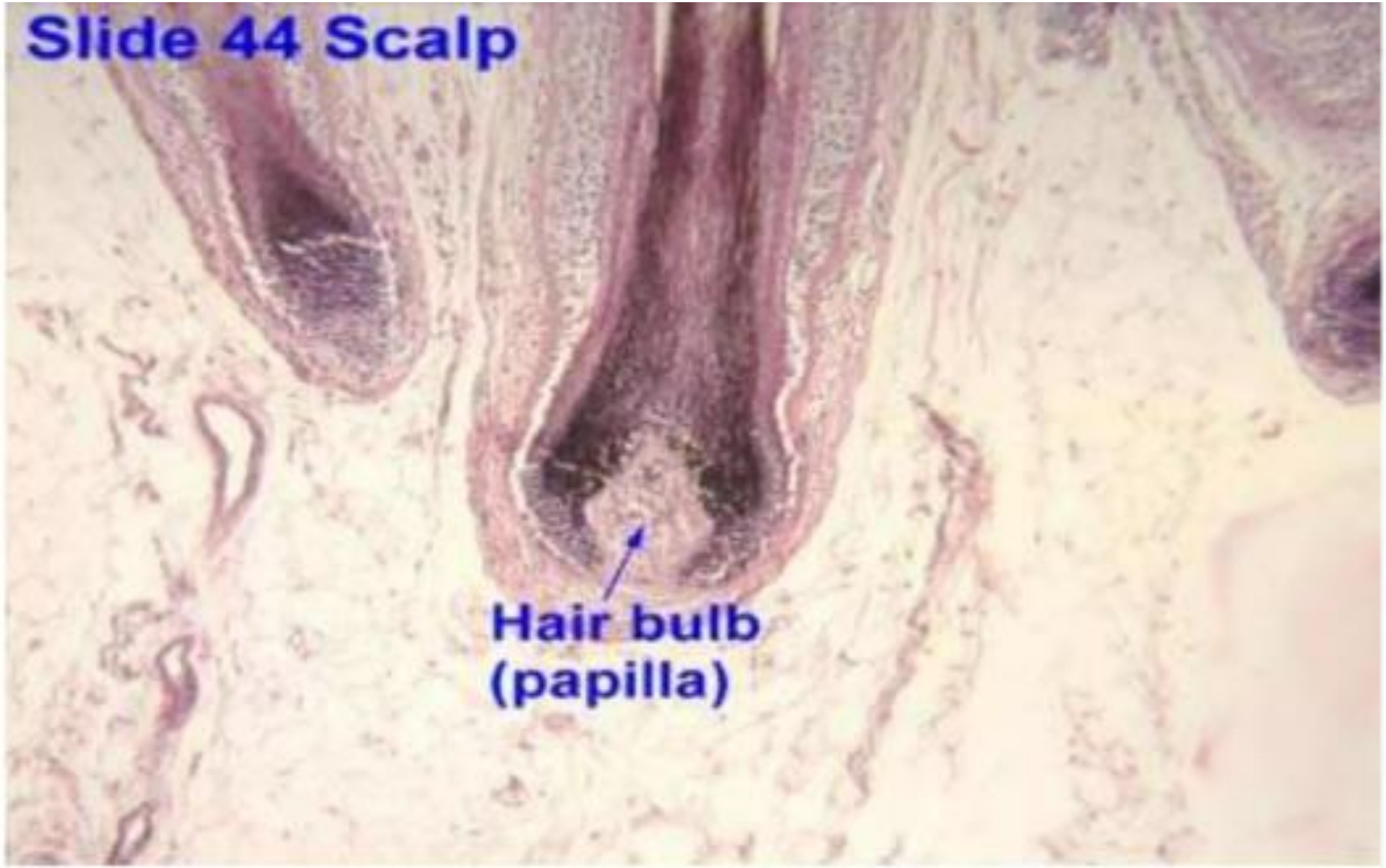
Hair anatomy:

- composed of dead columns of keratinized cells.
- shaft: is the superficial portion of hair.
- root: below the surface in the dermis.

- Shaft and root are composed of three layers: inner medulla, middle cortex and outer cuticle.
- Inner medulla has 2-3 rows of polyhedral cells where pigment is located.
- Cortex is major portion of shaft.
- Cuticle is scaly and heavily keratinized (shingles).

HAIR


Medulla
Cortex
Cuticle
Inner root sheath
Outer root sheath
Matrix
Dermal papilla
Capillary loop


Slide 44 Scalp
Hair bulb
(papilla)

Hair

- The muscle is innervated by sympathetic nerve fibers, and its contraction causes causes the hair to move into a more vertical position; it also compresses the sebaceous gland and causes it to extrude some of its secretion. The pull of the muscle also causes dimpling of the skin surface, so-called **gooseflesh.**
- Hairs are distributed in various numbers over the whole surface of the body, except on the lips, the palms of the hands, the sides of the fingers, the glans penis and clitoris, the labia minora and the internal surface of the labia majora, and the soles and sides of the feet and the sides of the toes.

Sebaceous Glands

- Sebaceous glands pour their secretion, the sebum, onto

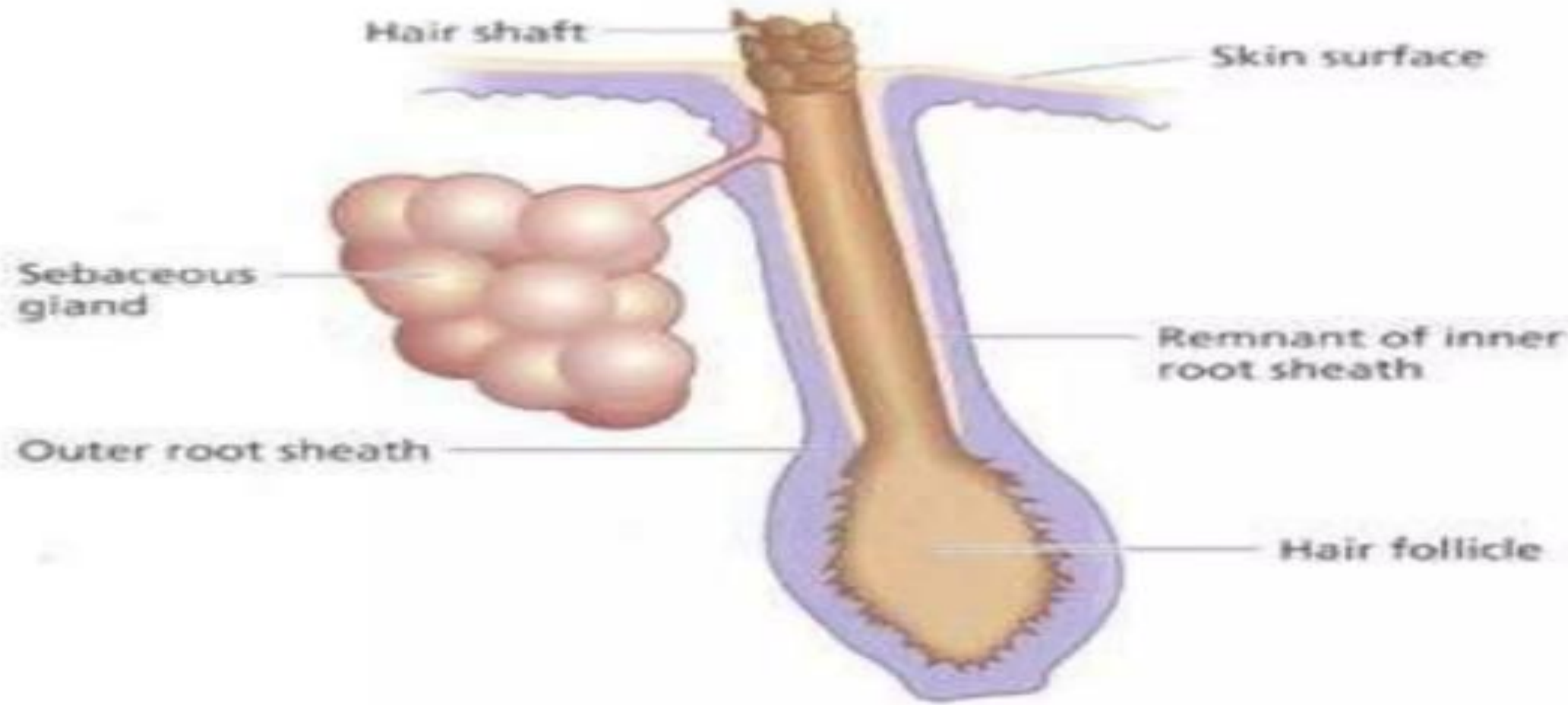
the shafts of the hairs as they pass up through the necks of the follicles.

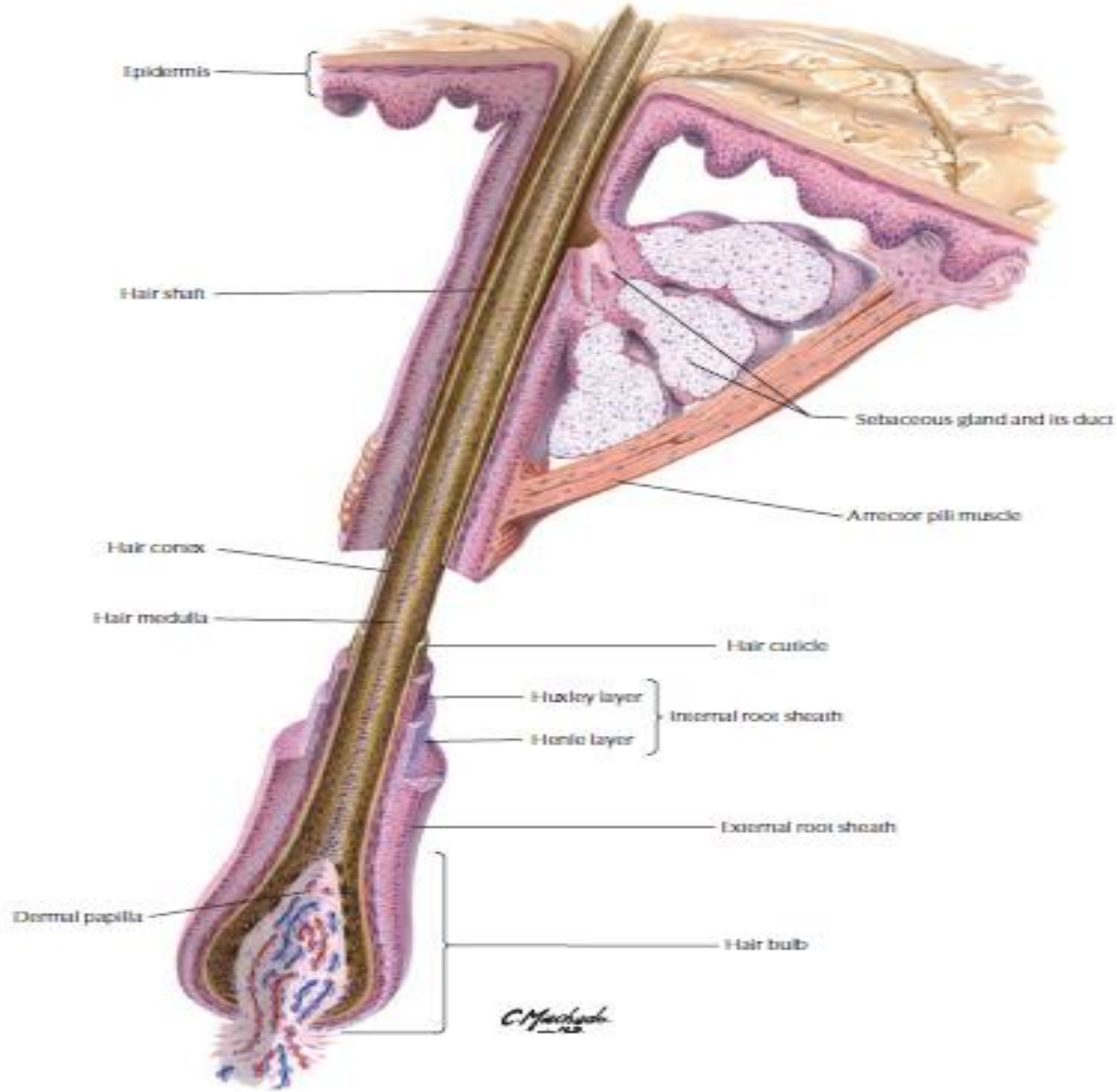
- They are situated on the sloping undersurface of the follicles

and lie within the dermis (see Fig. 1.4).

- Sebum is an oily material that helps preserve the flexibility of the emerging hair. It also oils the surface epidermis around the mouth of the follicle.

SKIN GLANDS


Hair shaft
Skin surface
Sebaceous gland
Remnant of inner root sheath
Outer root sheath
Hair follicle


Epidermis
Hair shaft
Sebaceous gland and its duct
Arrector pili muscle
Hair cortex
Hair medulla
Hair cuticle
Huxley layer
Henle layer
Internal root sheath
External root sheath
Dermal papilla
Hair bulb

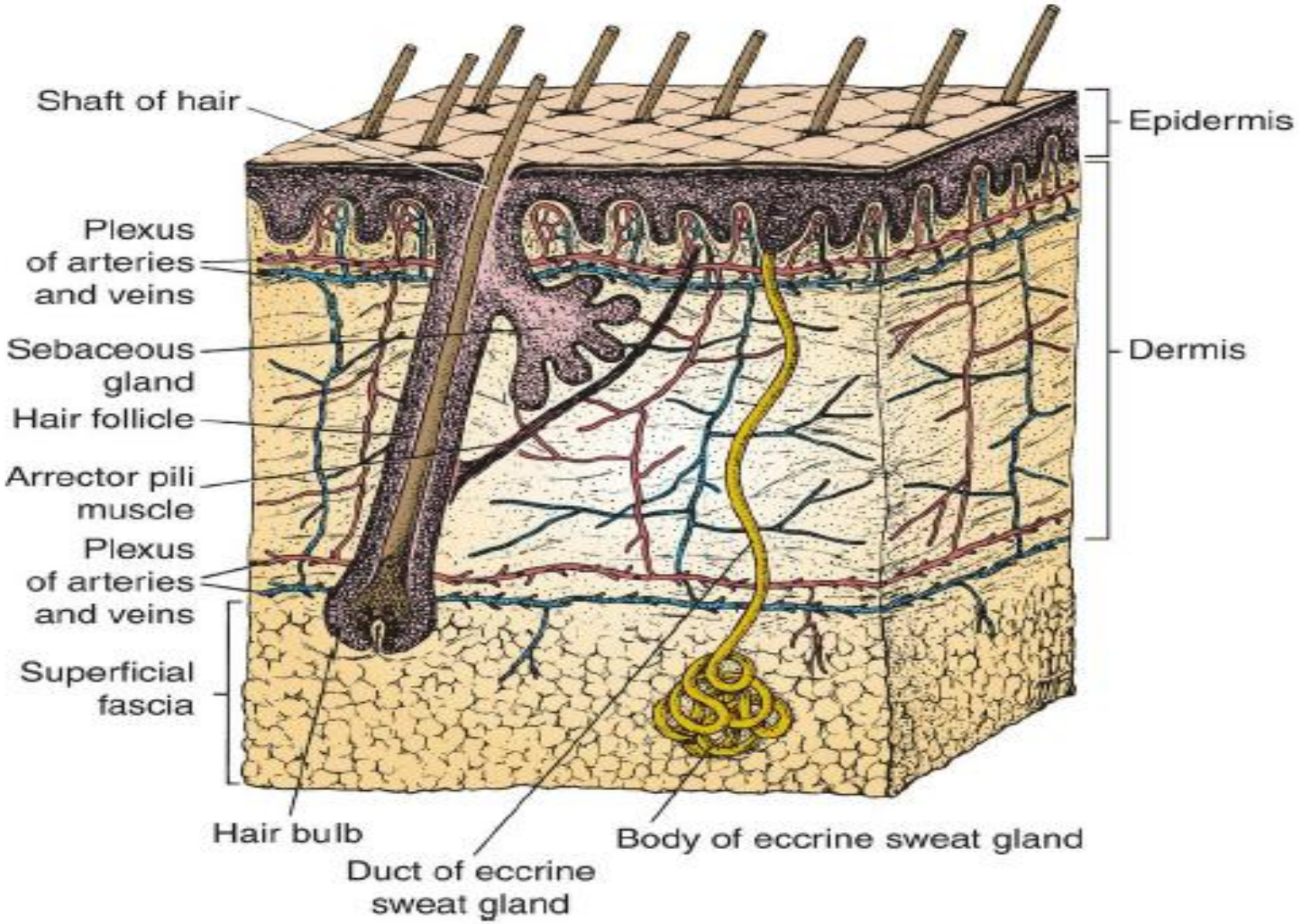
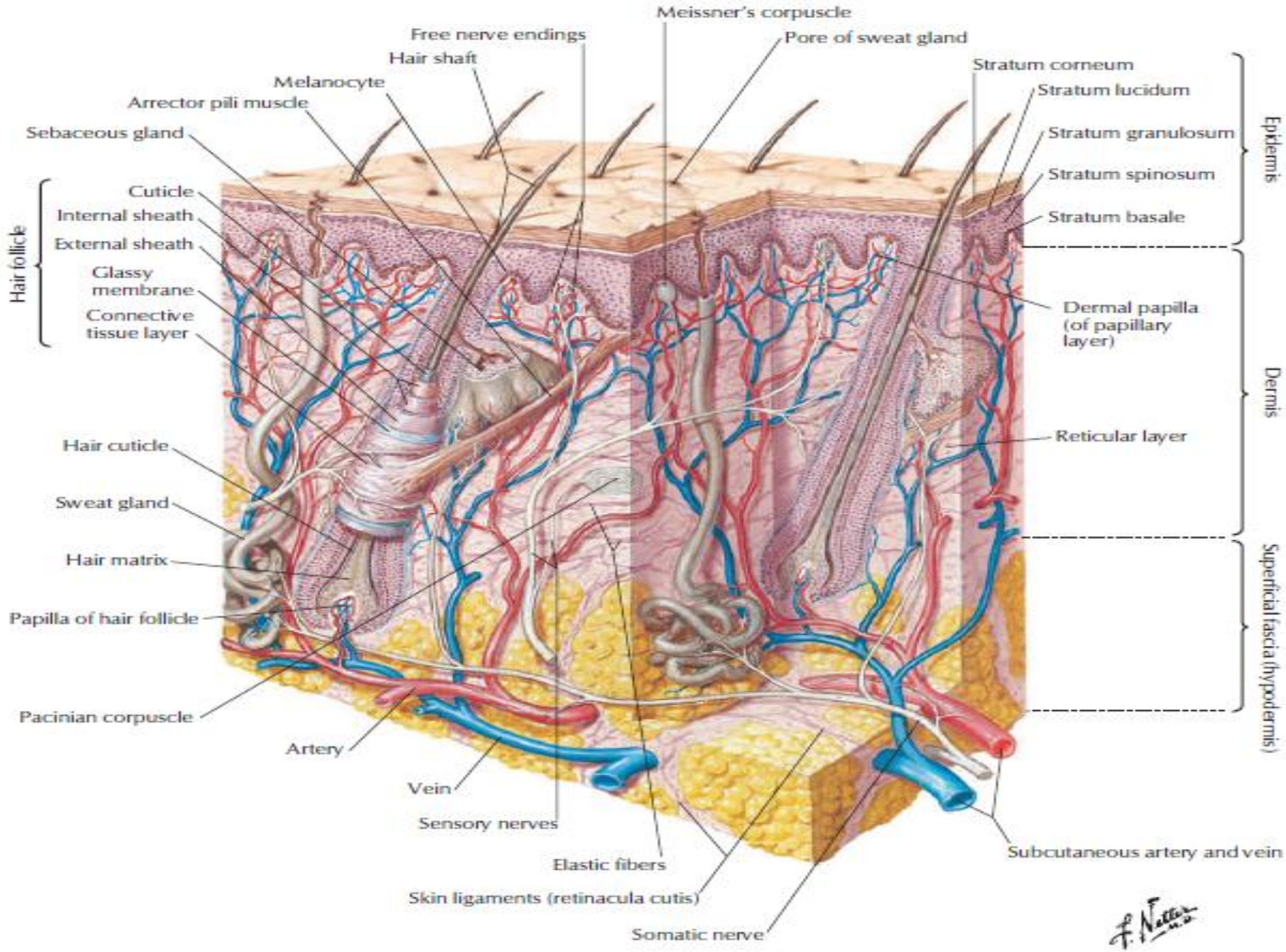


Figure 1.4 General structure of the skin and its relationship to the superficial fascia. Note that hair follicles extend into the deeper part of the dermis or into the superficial fascia, whereas sweat glands extend deeply into the superficial fascia.


Meissner's corpuscle
Free nerve endings
Pore of sweat gland
Hair shaft
Stratum corneum
Melanocyte
Stratum lucidum
Arrector pili muscle
Stratum granulosum
Sebaceous gland
Stratum spinosum
Epidermis
Cuticle
Stratum basale
Internal sheath
Hair follicle
External sheath
Glassy membrane
Dermal papilla (of papillary layer)
Connective tissue layer
Dermis
Hair cuticle
Reticular layer
Sweat gland
Hair matrix
Superficial fascia (hypodermis)
Papilla of hair follicle
Pacinian corpuscle
Artery
Vein
Sensory nerves
Subcutaneous artery and vein
Elastic fibers
Skin ligaments (retinacula cutis)
Somatic nerve

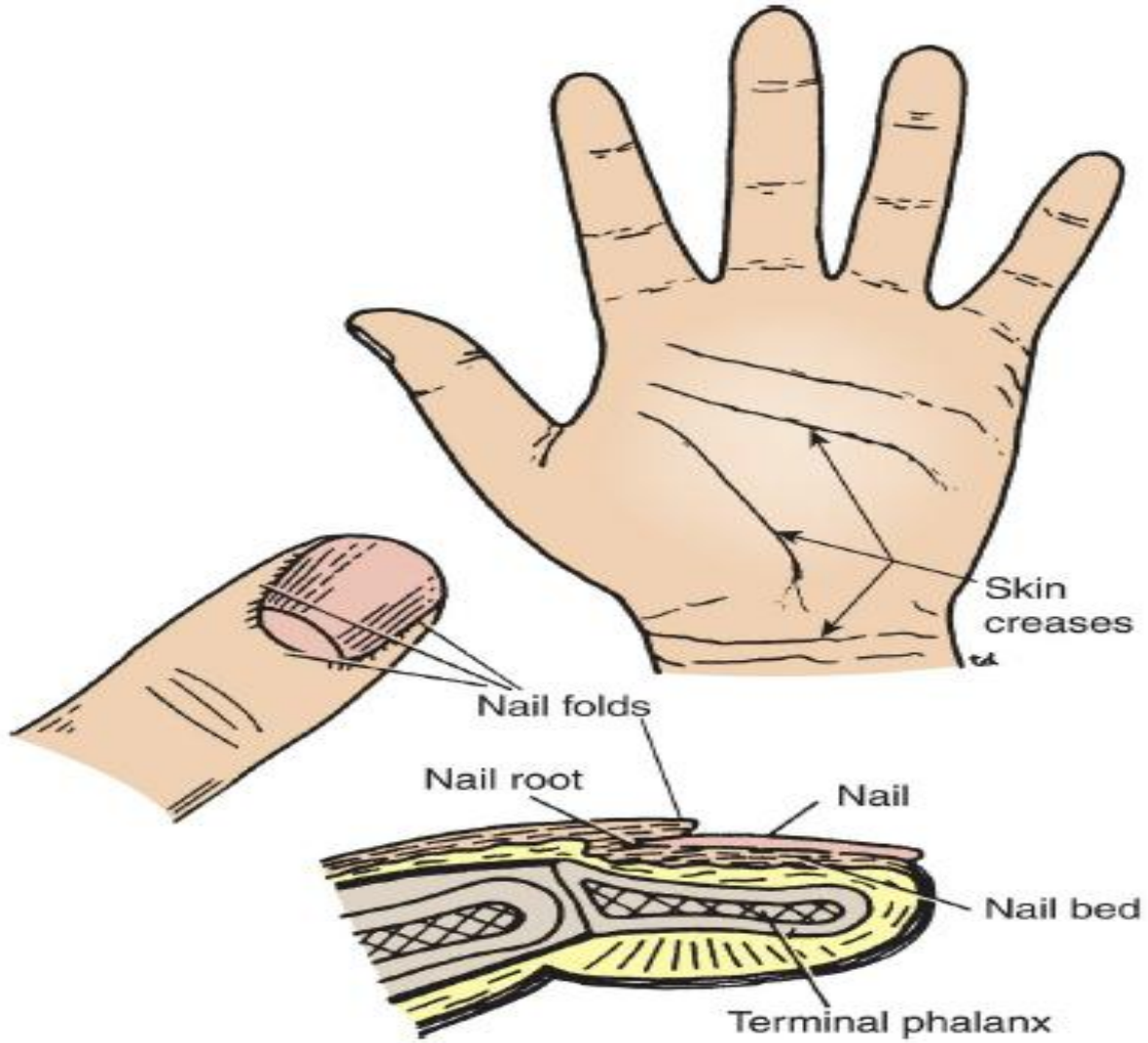


Figure 1.5 The various skin creases on the palmar surface of the hand and the anterior surface of the wrist joint. The relationship of the nail to other structures of the finger is also shown.

Fascia

- Is the connective tissue that encloses the body deep to the skin and also envelops and separates individual muscles and groups of muscles as well as deeper organs.
- Think of fascia as the connective tissue sheaths that hold

the structures of the body together in organized arrangements.

- The fasciae of the body can be divided into two types, superficial and deep.

Superficial fascia

- The **superficial fascia**, or **subcutaneous tissue**, is a mixture of loose areolar and adipose tissue that unites the dermis of the skin to the underlying deep fascia (Fig. 1.6).
- In the scalp, the back of the neck, the palms of the hands, and the soles of the feet, it contains numerous bundles of collagen fibers that hold the skin firmly to the deeper structures.
- In the eyelids, auricle of the ear, penis and scrotum, and clitoris, it is devoid of adipose tissue.

Deep Fascia

- The **deep fascia** (muscular fascia; visceral fascia) is a membranous layer of connective tissue that invests the muscles and other deep structures.
- In the neck, it forms well-defined layers that may play an important role in determining the path taken by pathogenic organisms during the spread of infection.
- In the thorax and abdomen, it is merely a thin film of areolar tissue covering the muscles and aponeuroses.
- In the limbs, it forms a definite sheath around the muscles and other structures, holding them in place.

Deep Fascia

- Fibrous septa extend from the deep surface of the membrane between the groups of muscles and, in many places, divide the interior of the limbs into compartments
- In the region of joints, the deep fascia may be considerably thickened to form restraining bands called **retinacula** (Fig. 1.7). Their function is to hold underlying tendons in position or to serve as pulleys around which the tendons can move.

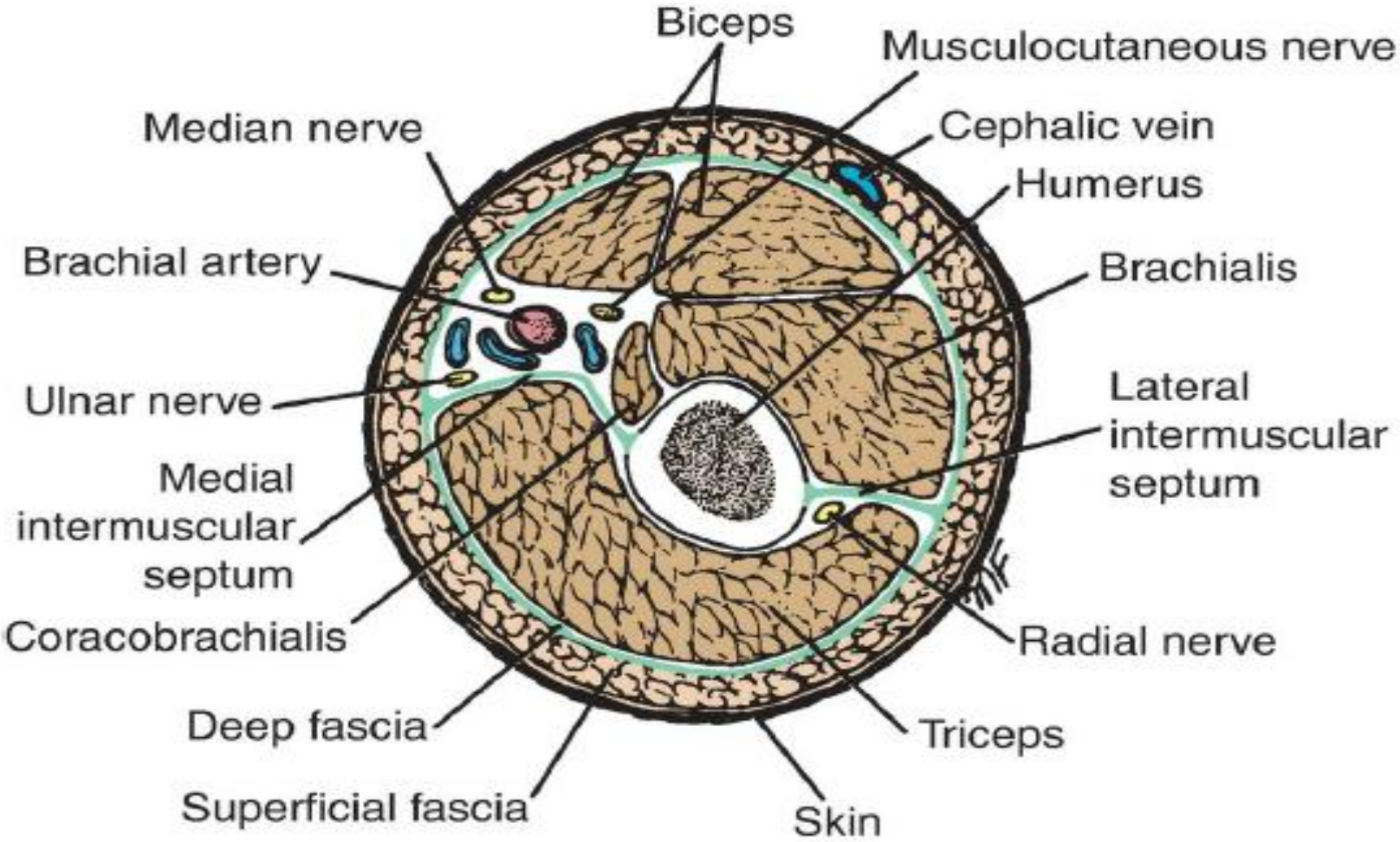


Figure 1.6 Section through the middle of the right arm showing the arrangement of the superficial and deep fascia. Note how deep extensions of the deep fascia extend between groups of muscles and form intermuscular septa, which divide the arm into fascial compartments.

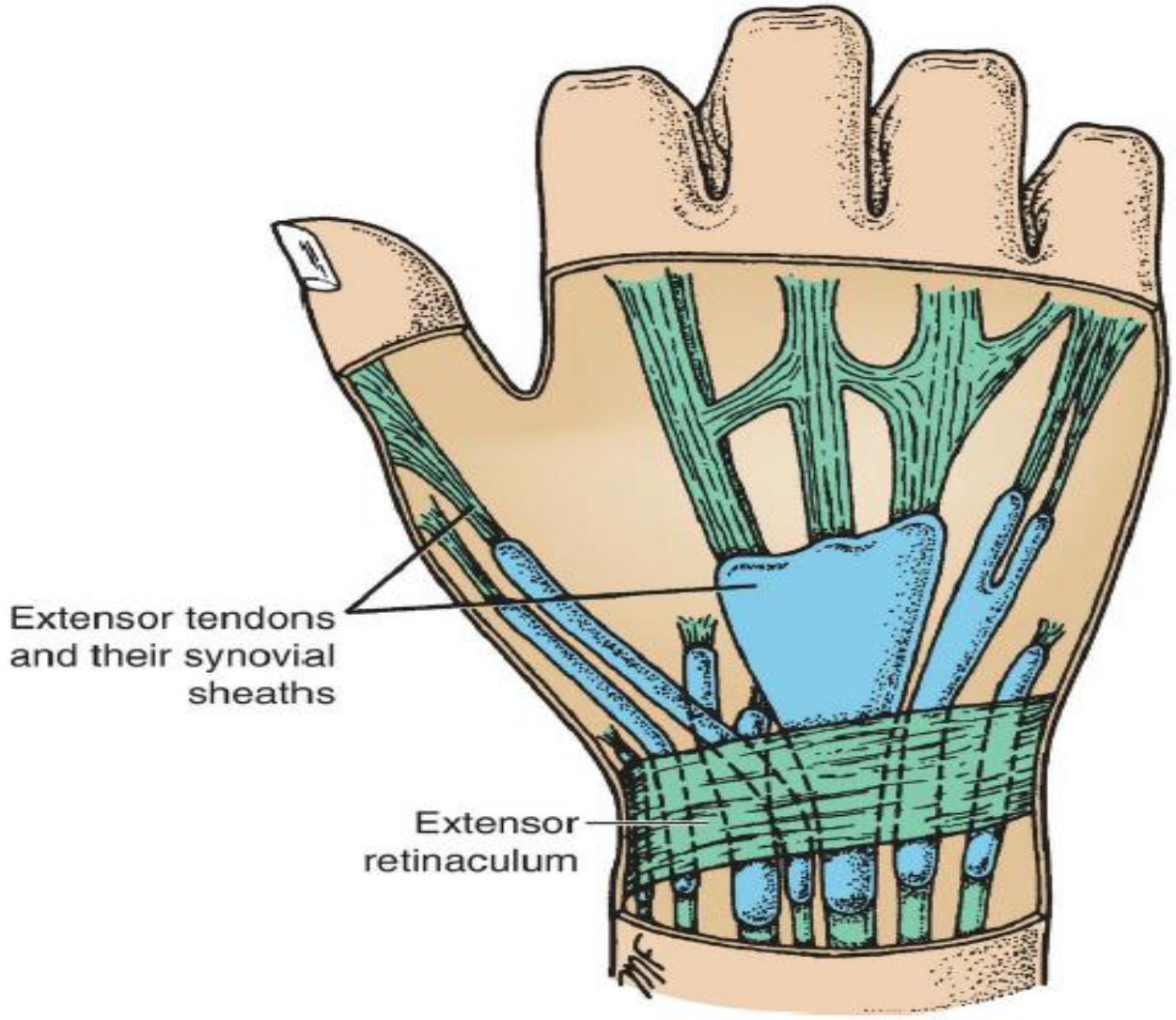


Figure 1.7 Extensor retinaculum on the posterior surface of the wrist holding the underlying tendons of the extensor muscles in position

Task

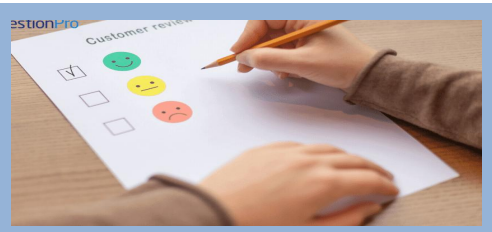
- **Define body surface area ?**
- **What is the importance of body surface area ?**

Summary

- **Skin** is cutaneous membrane cover the external surface of the body .
- Is the largest organ of the body in both surface area and weight .
- The skin composed of two layers :epidermis and dermis.
- The appendages of skin are : Hairs , Nail , Sebaceous glands and Sweat glands.

References

- Snell’s Clinical Anatomy by Regions(tenth edition)
- https://www.slideshare.net/slideshow/anotomy-of-skin/79969292
- https://www.slideshare.net/slideshow/skin-anatomy-57975803/57975803



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Muscles & Bones/ Joints & Cartilage

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General Objective

- Introduces some of the basic structures that compose the body, such as muscles, bones, cartilage , joints , blood & lymph vessels.

Learning Objectives

The student is expected to be able to:

1. Identify the three types of muscle and describe the basic structure of each type.

2.Identify the main structural features of bone. Describe the classification systems by which bones are organized.

2. Identify the major forms of cartilage and the locations where each form is generally found.

4. Identify the major categories of joints and the structures that characterize each type of joint.

Learning Objectives

The student is expected to be able to:

5. Define and differentiate a bursa versus a synovial sheath.
6. Identify the main types of blood vessels and their functional roles in transporting blood.
7. Identify the components of the lymphatic system. Trace the major routes of lymph drainage in the body.

Muscle

- The three types of muscle are skeletal, smooth, and cardiac :

Skeletal Muscle

- produce the movements of the skeleton; they are sometimes called voluntary muscles and are made up of striped muscle fibers.
- A skeletal muscle has two or more attachments. The attachment that moves the least is referred to as **the origin**, and the one that moves the most, **the insertion** (Fig. 1.8).
- The fleshy part of the muscle is referred to as its **belly** (see Fig. 1.8). The ends of a muscle are attached to bones, cartilage, or ligaments by cords of fibrous tissue called **tendons** (Fig. 1.9).
- Occasionally, flattened muscles are attached by a thin but strong sheet of fibrous tissue called **an aponeurosis** (see Fig. 1.9). **A raphe** is an interdigitation of the tendinous ends of fibers of flat muscles (see Fig. 1.9).

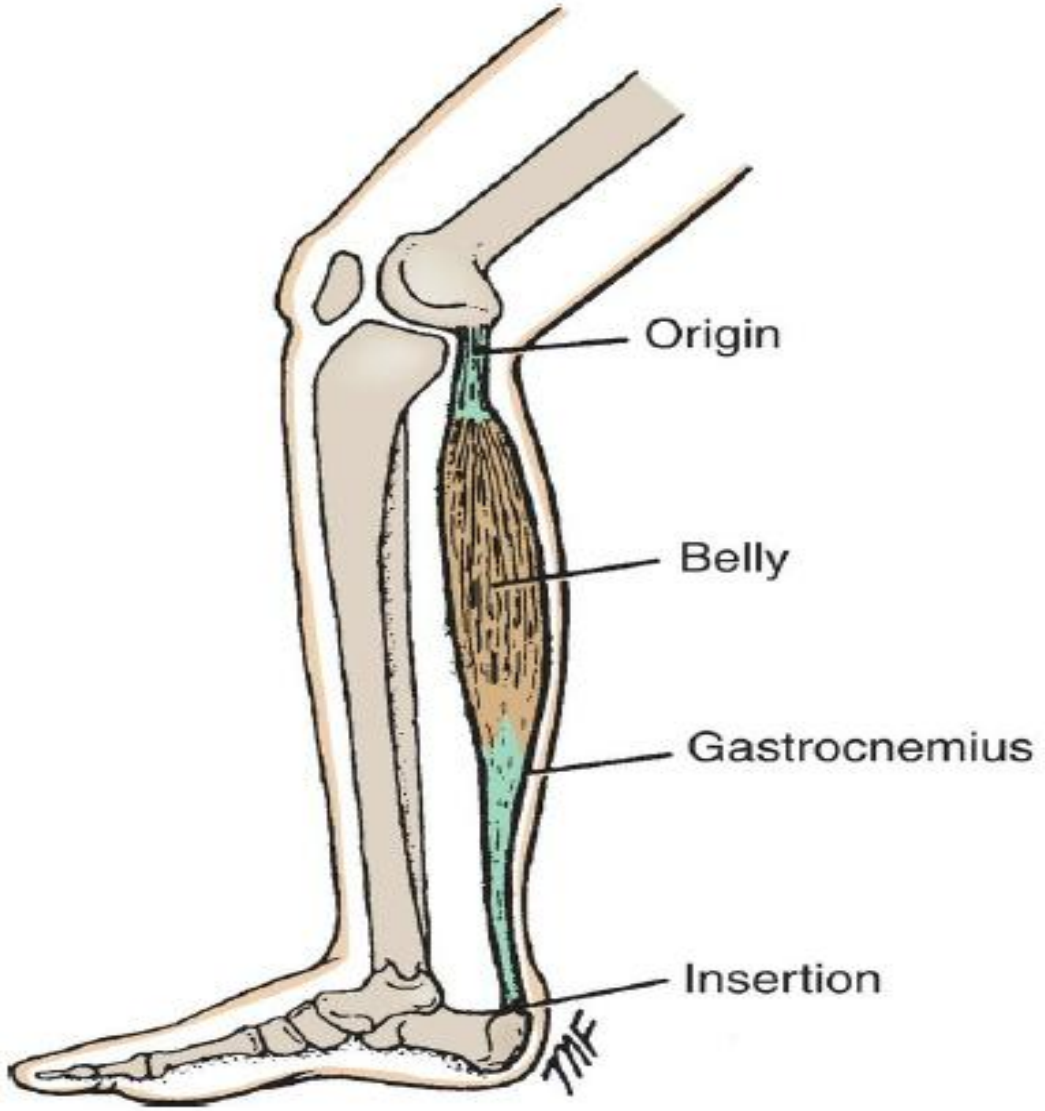


Figure 1.14 Origin, insertion, and belly of the gastrocnemius muscle

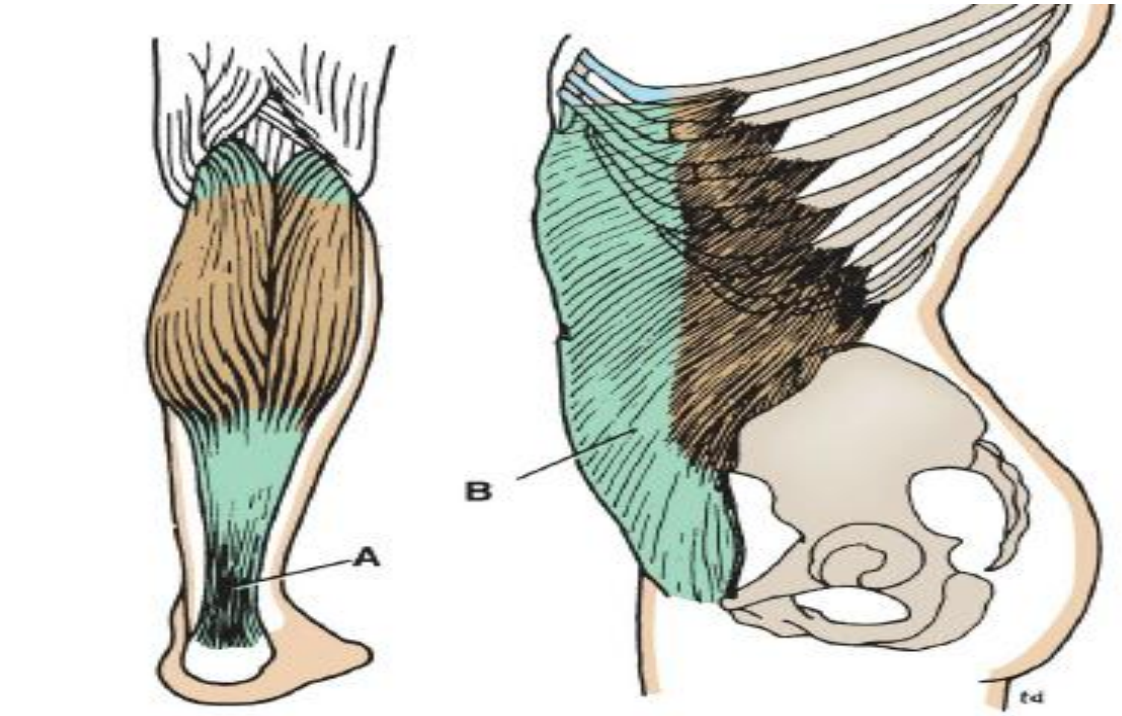


Figure 1.15 Examples of(A)a tendon,(B)an aponeurosis, and (C) a raphe

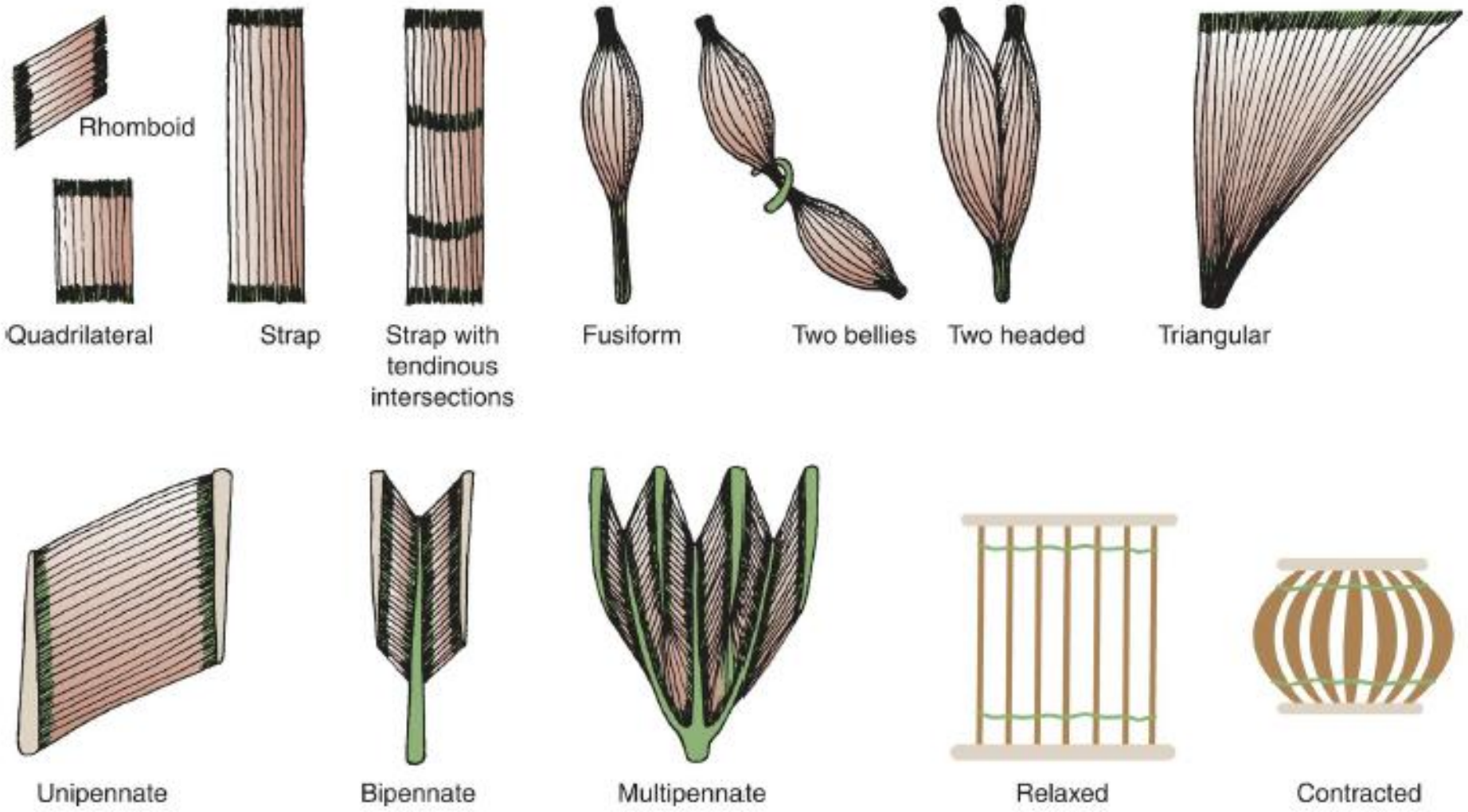


Figure 1.16 Different forms of the internal structure of skeletal muscle. A relaxed and a contracted muscle are also shown. Note how the muscle fibers, on contraction, shorten by one third to one half of their resting length. Note also how the muscle swells.

Muscle

Smooth Muscle

- Smooth muscle consists of long, spindle-shaped cells closely arranged in bundles or sheets.
- In the tubes of the body, it provides the motive power for propelling the contents through the lumen.
- In the digestive system, it also causes the ingested food to be thoroughly mixed with the digestive juices.
- A wave of contraction of the circularly arranged fibers passes along the tube, milking the contents onward. By their contraction, the longitudinal fibers pull the wall of the tube proximally over the contents. This method of propulsion is referred to **as peristalsis.**

Muscle

Cardiac Muscle

- Cardiac muscle consists of striated muscle fibers that branch and unite with each other. It forms the myocardium of the heart.
- Its fibers tend to be arranged in whorls and spirals, and they have the property of spontaneous and rhythmic contraction.
- Specialized cardiac muscle fibers form the conducting system of the heart.
- Cardiac muscle is supplied by autonomic nerve fibers that terminate in the nodes of the conducting system and in the myocardium.

NAME	SHAPE	SIZE	NUMBER OF HEADS OR BELLIES	POSITION	DEPTH	ATTACHMENTS	ACTIONS
Deltoid	Triangular						
Teres	Round						
Rectus	Straight						
Major		Large					
Latissimus		Broadest					
Longissimus		Longest					
Biceps			Two heads				
Quadriceps			Four heads				
Digastric			Two bellies				
Pectoralis				Of the chest			
Supraspinatus				Above spine of scapula			
Brachii				Of the arm			
Profundus					Deep		
Superficialis					Superficial		
Externus					External		
Sternocleidomastoid						From sternum and clavicle to mastoid process	
Coracobrachialis						From coracoid process to arm	
Extensor							Extend
Flexor							Flex
Constrictor							Constrict

[a]These names are commonly used in combination, for example, flexor pollicis longus (long flexor of the thumb).

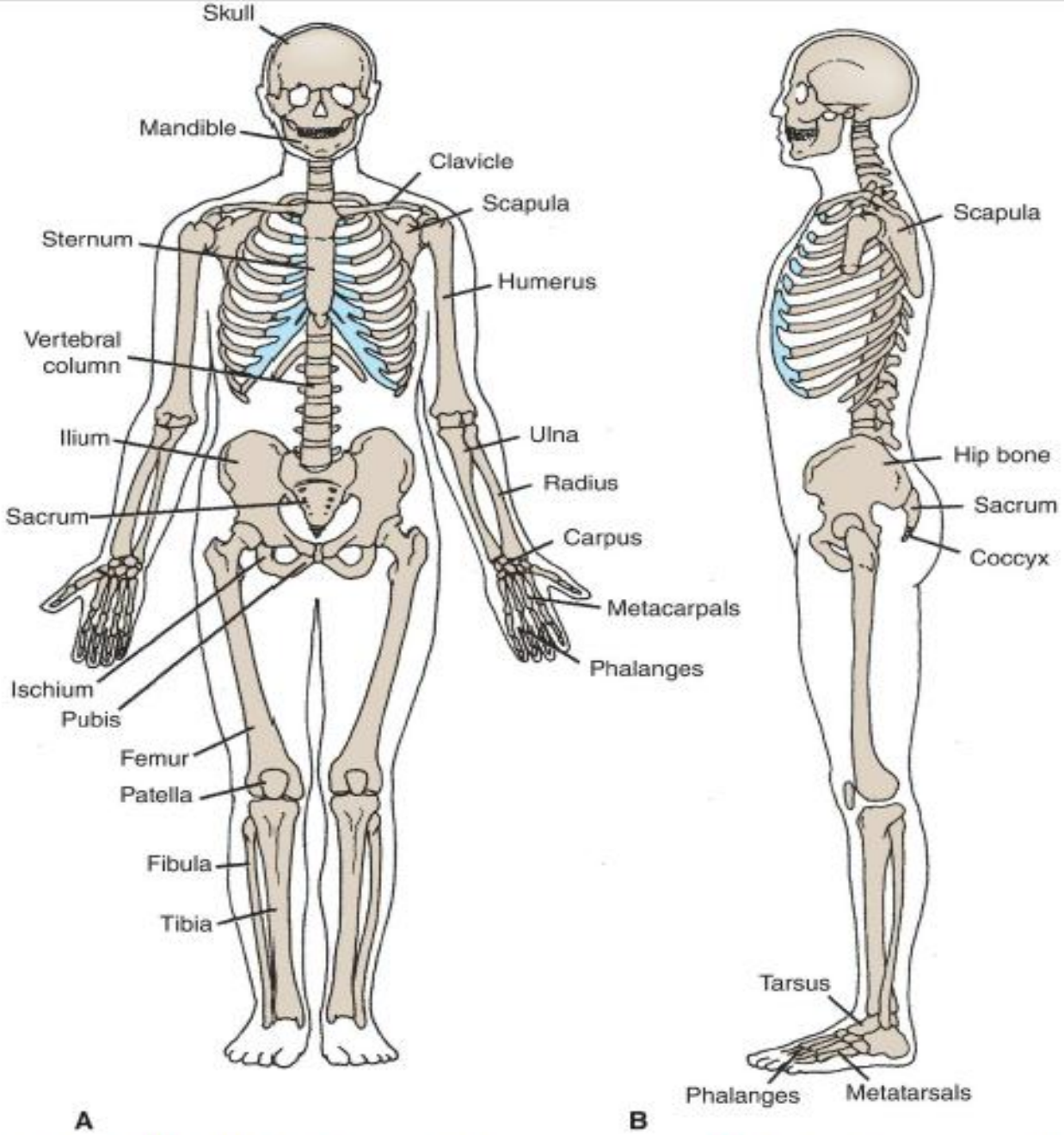
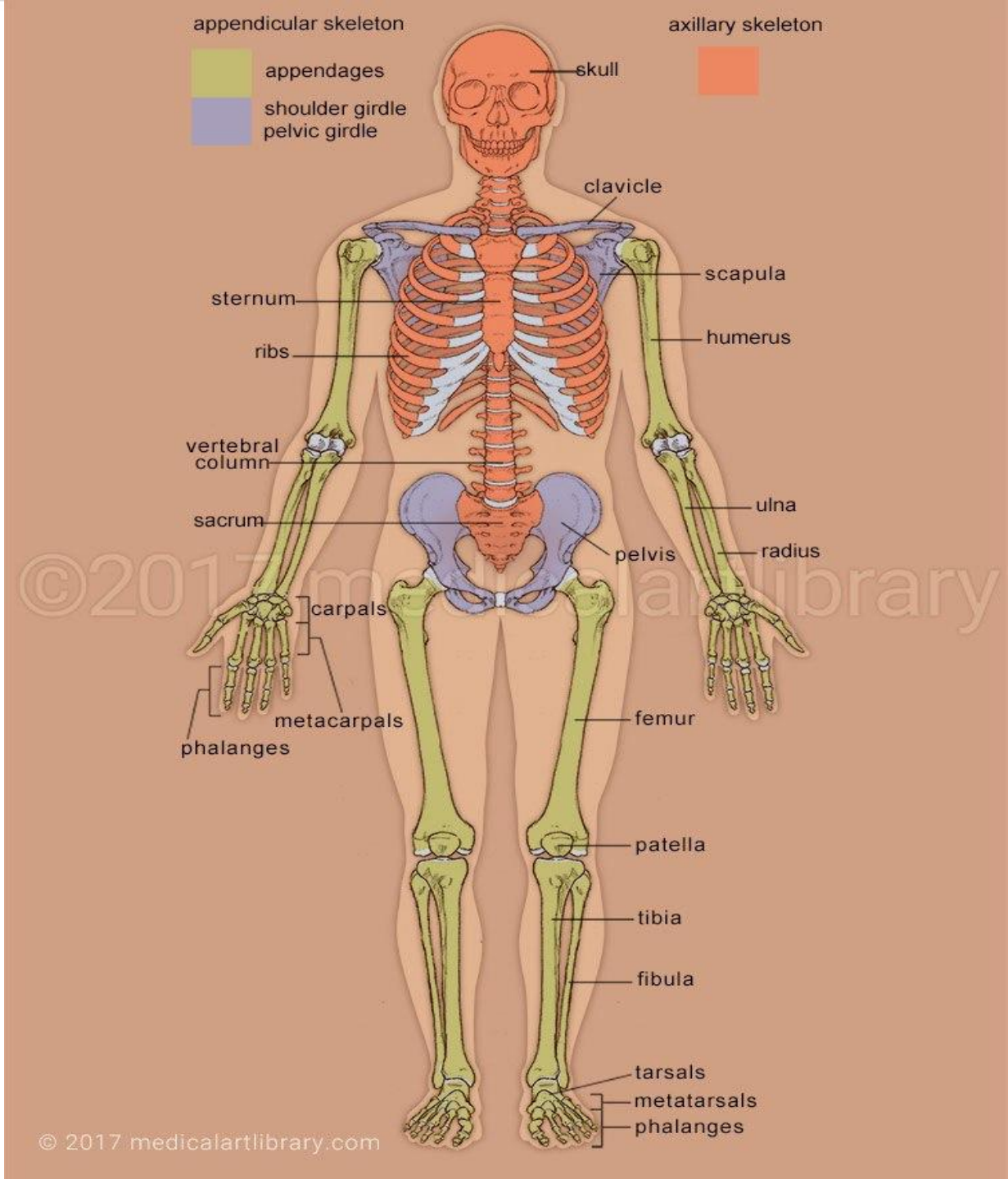


Figure 1.8 The skeleton. **A.** Anterior view. **B.** Lateral view with most of the upper limb removed.

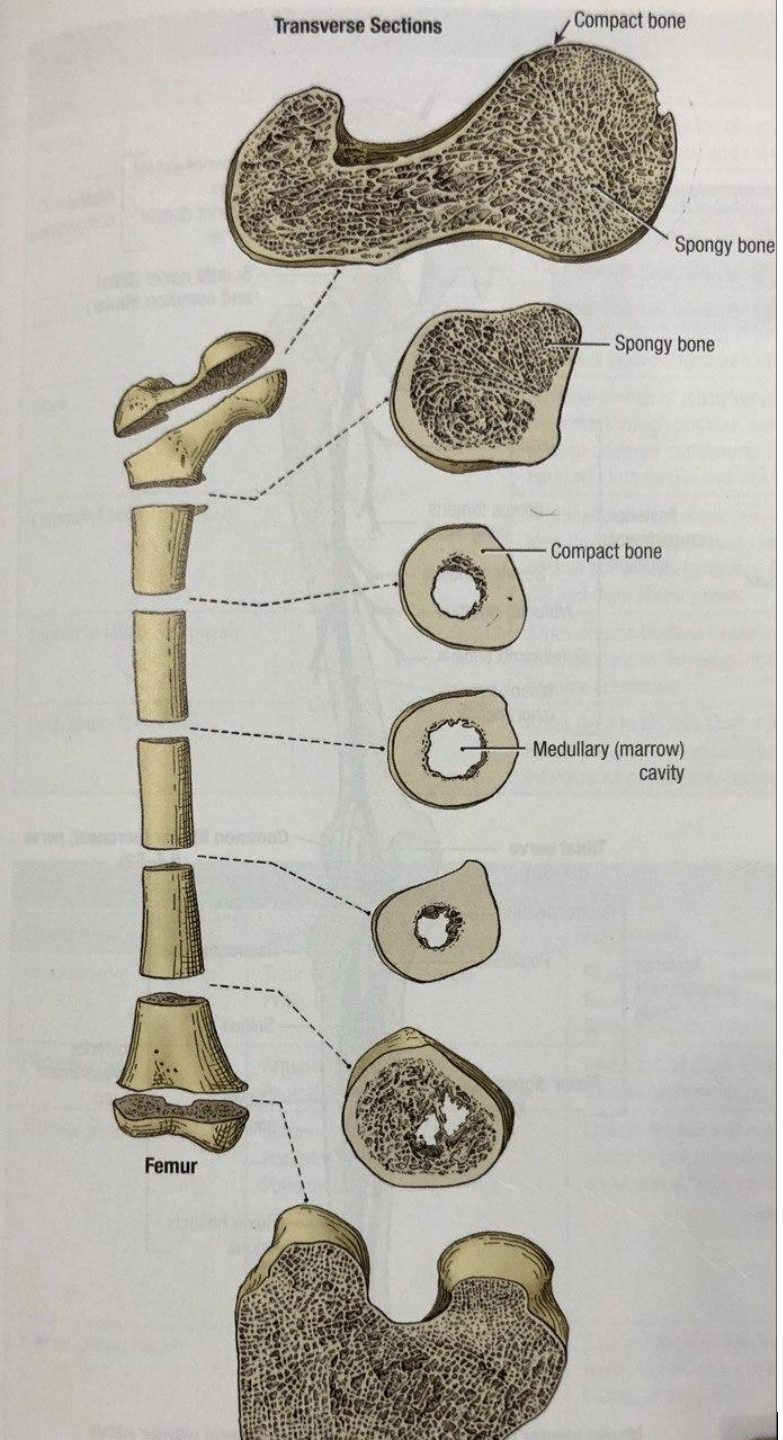


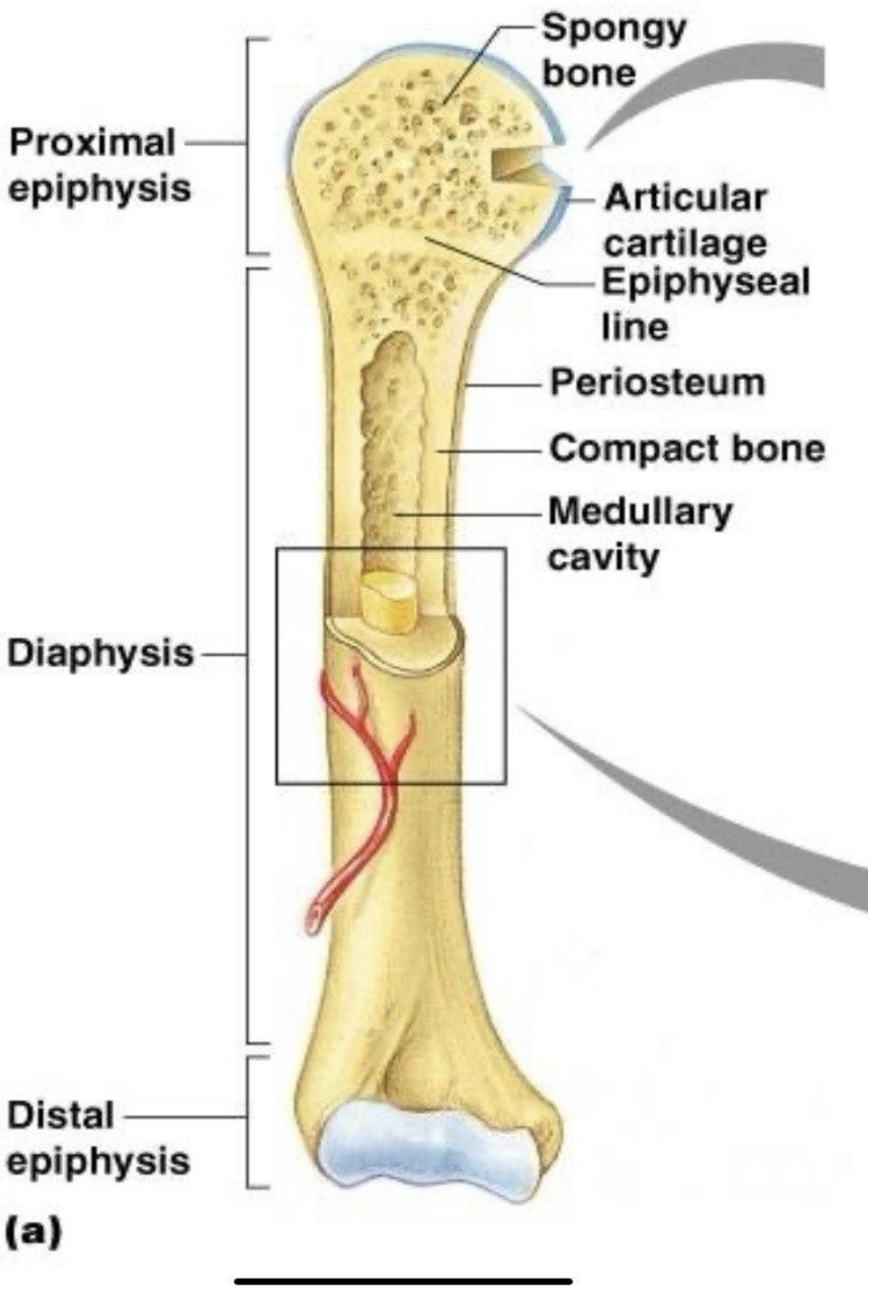
Bone

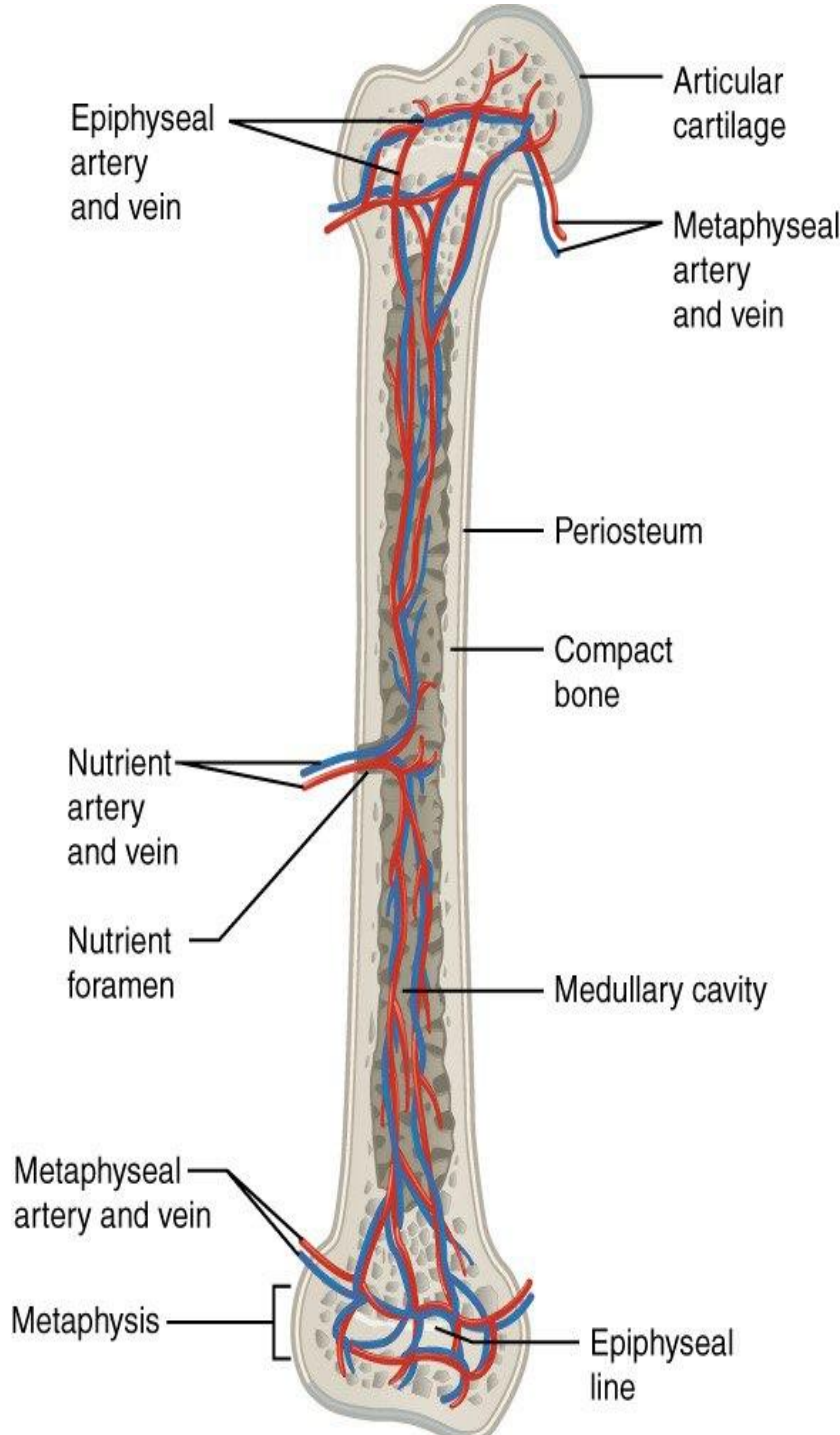
- Bone is a living tissue capable of changing its structure as the result of the stresses to which it is subjected. Like other connective tissues, bone consists of cells, fibers, and matrix. It is hard because of the calcification of its extracellular matrix and possesses a degree of elasticity because of the presence of organic fibers.
- Bone has a protective function; the skull and vertebral column, for example, protect the brain and spinal cord from injury; the sternum and ribs protect the thoracic and upper abdominal viscera (Fig. 1.29).
- It serves as a lever, as seen in the long bones of the limbs, and as an important storage area for calcium salts.
- It houses and protects within its cavities the delicate blood-forming bone marrow.

Bone

- Bone exists in two forms: compact and cancellous.
- **Compact bone** appears as a solid mass.
- **Cancellous bone** consists of a branching network of trabeculae (see Fig. 1.30).
- The trabeculae are arranged in such a manner as to resist the stresses and strains to which the bone is exposed.


Transverse Sections
Compact bone
Spongy bone
Spongy bone
Compact bone
Medullary (marrow) cavity
Femur


Spongy bone
Proximal epiphysis
Articular cartilage
Epiphyseal line
Periosteum
Compact bone
Medullary cavity
Diaphysis
Distal epiphysis
(a)


Epiphyseal artery and vein
Articular cartilage
Metaphyseal artery and vein
Periosteum
Compact bone
Nutrient artery and vein
Nutrient foramen
Medullary cavity
Metaphyseal artery and vein
Metaphysis
Epiphyseal line

Classification of Bones

- Bones may be classified regionally or according to their **general shape.**
- Bones are grouped as follows based on their general shape: **long bones, short bones, flat bones, irregular bones, and sesamoid bones**

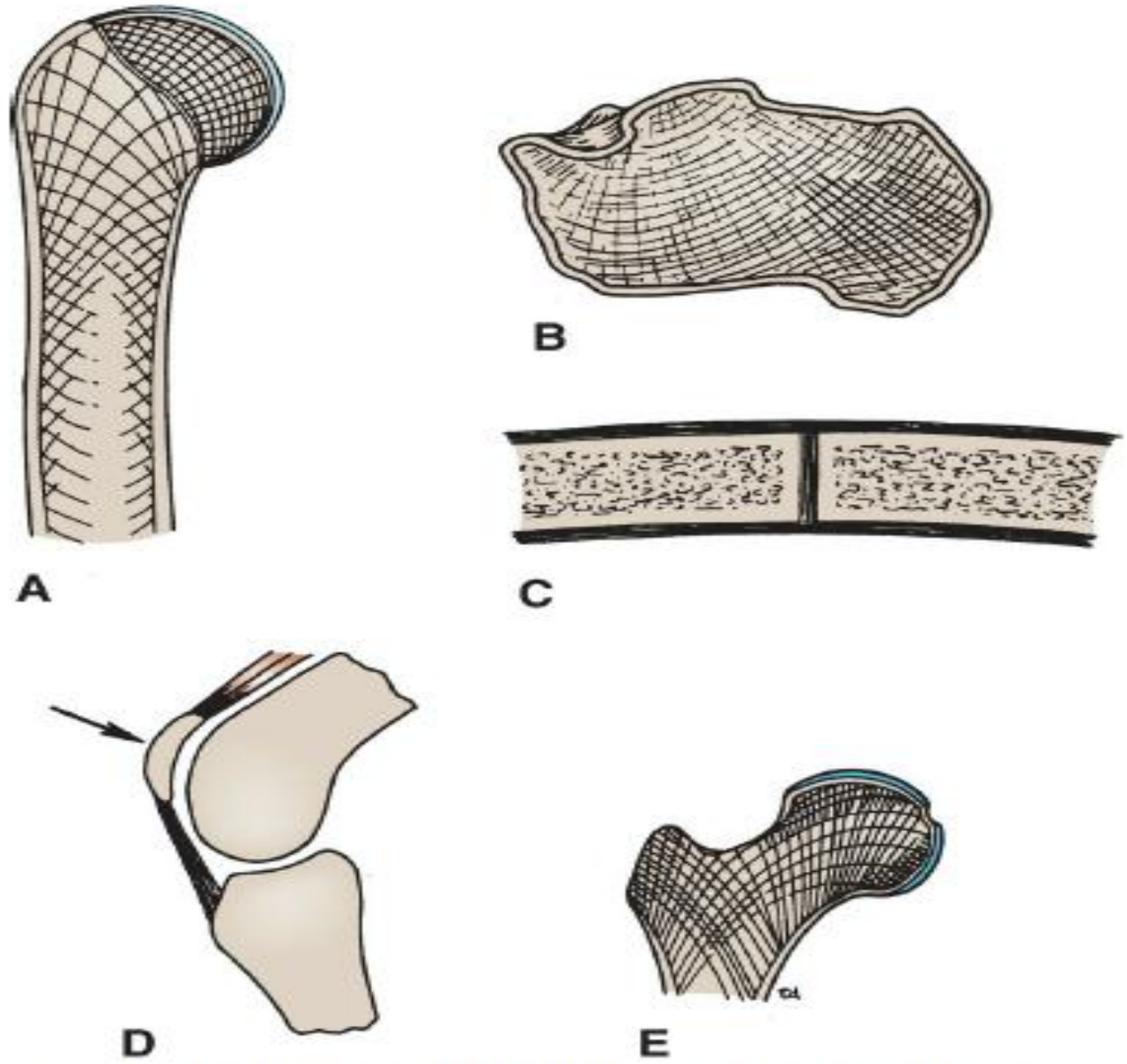


Figure 1.9 Sections of different types of bones. A. Long bone

Long Bones

- Long bones are found in the limbs (e.g., the humerus, femur, metacarpals, metatarsals, and phalanges). Their length is greater than their breadth. They have a tubular shaft, **the diaphysis**, and usually **an epiphysis** at each end.
- During the growing phase, the diaphysis is separated from the epiphysis by an epiphyseal cartilage. The part of the diaphysis that lies adjacent to the epiphyseal cartilage is called **the metaphysis.**
- The shaft has a central marrow cavity containing bone marrow. The outer part of the shaft is composed of compact bone that is covered by a connective tissue sheath, **the periosteum.**
- The ends of long bones are composed of cancellous bone surrounded by a thin layer of compact bone. The articular surfaces of the ends of the bones are covered by hyaline cartilage.

Short Bones

- Short bones are found in the hand and foot (e.g., the scaphoid, lunate, talus, and calcaneum).
- They are roughly cuboidal in shape and are composed of cancellous bone surrounded by a thin layer of compact bone.
- Short bones are covered with periosteum, and the articular surfaces are covered by hyaline cartilage.

Flat Bones

- Flat bones are found in the vault of the skull (e.g., the frontal and parietal bones).
- They are composed of thin inner and outer layers of compact bone, the tables, separated by a layer of cancellous bone, the diploë.
- The scapulae, although irregular, are included in this group.

Irregular bones

- Irregular bones include those not assigned to the previous groups (e.g., the bones of the skull, the vertebrae, and the pelvic bones).
- They are composed of a thin shell of compact bone with an interior made up of cancellous bone.

Sesamoid Bones

- Sesamoid bones are small nodules of bone that are found in certain tendons where they rub over bony surfaces.
- The greater part of a sesamoid bone is buried in the tendon, and the free surface is covered with cartilage.
- The largest sesamoid bone is **the patella**, which is located in the tendon of the quadriceps femoris.
- The function of a sesamoid bone is to reduce friction on the tendon; it can also alter the direction of pull of a tendon.

Bone Marrow

- Bone marrow occupies the marrow cavity in long and short bones
- At birth, the marrow of all the bones of the body is red and hematopoietic. This blood-forming activity gradually lessens with age, and the red marrow is replaced by yellow marrow.
- At 7 years of age, yellow marrow begins to appear in the distal bones of the limbs. This replacement of marrow gradually moves proximally, so that by the time the person becomes an adult, red marrow is restricted to the bones of the skull, the vertebral column, the thoracic cage, the girdle bones, and the head of the humerus and femur.
- All bone surfaces, other than the articulating surfaces, are covered by a thick layer of fibrous tissue called **the periosteum.**
- The periosteum has an abundant vascular supply, and the cells on its deeper surface are osteogenic.

Cartilage

- Cartilage is a form of connective tissue in which the cells and fibers are embedded in a gel-like matrix, the latter being responsible for its firmness and resilience.
- Except on the exposed surfaces in joints, a fibrous membrane called **the perichondrium** covers the cartilage.
- There are three types of cartilage :Hyaline , Fibrocartilage and Elastic Cartilage

1.Hyaline cartilage

- Hyaline cartilage has a high proportion of amorphous matrix that has the same refractive index as the fibers embedded in it.
- Throughout childhood and adolescence, it plays an important part in the growth in length of long bones (epiphyseal plates are composed of hyaline cartilage).
- It has a great resistance to wear and covers the articular surfaces of nearly all synovial joints.
- Hyaline cartilage is incapable of repair when fractured ; the defect is filled with fibrous tissue .

2.Fibrocartilage

- Fibrocartilage has many collagen fibers embedded in a small amount of matrix and is found in the discs within joints (e.g., the temporomandibular joint, sternoclavicular joint, and knee joint) and on the articular surfaces of the clavicle and mandible.
- Fibrocartilage, if damaged, repairs itself slowly in a manner similar to fibrous tissue elsewhere.
- Joint discs have a poor blood supply and therefore, do not repair themselves when damaged.

3.Elastic cartilage

- Elastic cartilage possesses large numbers of elastic fibers embedded in matrix. As would be expected, it is flexible and is found in the auricle of the ear, the external auditory meatus, the auditory tube, and the epiglottis.
- Elastic cartilage, if damaged, repairs itself with fibrous tissue.
- Hyaline cartilage and fibrocartilage tend to calcify or even ossify in later life.

Joints

- A site where two or more bones come together, whether or not movement occurs between them, is called **a joint.**
- Joints are classified according to the tissues that lie between the bones: **fibrous joints, cartilaginous joints, and synovial joints.**

1.Fibrous Joints

- The articulating surfaces of the bones are joined by fibrous tissue (Fig. 1.12), and thus very little movement is possible.
- The sutures of the vault of the skull and the inferior tibiofibular joints are examples of fibrous joints.

2.Cartilaginous Joints

- **Cartilaginous joints** can be divided into two types: primary and secondary.
- **A primary cartilaginous joint** is one in which the bones are united by a plate or a bar of hyaline cartilage. Thus, the union between the epiphysis and the diaphysis of a growing bone and that between the 1st rib and the manubrium sterni are examples of such a joint. No movement is possible.

2.Cartilaginous Joints

- **Secondary cartilaginous joint** is one in which the bones are united by a plate of fibrocartilage and the articular surfaces of the bones are covered by a thin layer of hyaline cartilage.
- Examples are the joints between the vertebral bodies (see Fig. 1.12) and the symphysis pubis. A small amount of movement is possible.

3.Synovial Joints

- The articular surfaces of the bones are covered by a thin layer of hyaline cartilage separated by a joint cavity (see Fig. 1.12).
- This arrangement permits a great degree of freedom of movement. The cavity of the joint is lined by synovial membrane, which extends from the margins of one articular surface to those of the other.
- The synovial membrane is protected on the outside by a tough fibrous membrane referred to as the **capsule of the joint.**

3.Synovial Joints

- The articular surfaces are lubricated by a viscous fluid called **synovial fluid**, which is produced by the synovial membrane. In certain synovial joints, for example, in the knee joint, discs or wedges of fibrocartilage are interposed between the articular surfaces of the bones. These are referred to **as articular discs**
- Fatty pads are found in some synovial joints lying between the synovial membrane and the fibrous capsule or bone. Examples are found in the hip (see Fig. 1.12) and knee joints

3.Synovial Joints

- The degree of movement in a synovial joint is limited by the shape of the bones participating in the joint, the coming together of adjacent anatomic structures (e.g., the thigh against the anterior abdominal wall on flexing the hip joint), and the presence of fibrous ligaments uniting the bones.
- Most ligaments lie outside the joint capsule, but in the knee some important ligaments, **the cruciate ligaments,** lie within the capsule (Fig. 1.13).

Classification of synovial Joints

- Synovial joints can be classified according to the arrangement of the articular surfaces and the types of movement that are possible.

❖ **Plane joints:** In plane joints, the apposed articular surfaces are flat or almost flat, and this permits the bones to slide on one another. Examples of these joints are the sternoclavicular and acromioclavicular joints (Fig. 1.14).

❖ **Pivot joints:** In pivot joints, a central bony pivot is surrounded by a bony–ligamentous ring (see Fig. 1.14), and rotation is the only movement possible. The atlantoaxial and superior radioulnar joints are good examples.

Classification of synovial Joints

- **Condyloid joints:** Condyloid joints have two distinct convex surfaces that articulate with two concave surfaces. The movements of flexion, extension, abduction, and adduction are possible together with a small amount of rotation. The metacarpophalangeal joints or knuckle joints are good examples (see Fig. 1.14).
- **Ellipsoid joints:** In ellipsoid joints, an elliptical convex articular surface fits into an elliptical concave

  Articular surface. The movements of flexion, extension, abduction, and adduction can take place, but rotation is impossible. The wrist joint is a good example (see Fig. 1.14).
- **Saddle joints:** In saddle joints, the articular surfaces are reciprocally concavoconvex and resemble a saddle on a horse's back. These joints permit flexion, extension, abduction, adduction, and rotation. The best example of this type of joint is the carpometacarpal joint of the thumb (see Fig. 1.14).

Classification of synovial Joints

- **Hinge joints:** Hinge joints resemble the hinge on a door, so that flexion and extension movements are possible. Examples of these joints are the elbow, knee, and ankle joints (see Fig. 1.14).

- **Ball-and-socket joints:** In ball-and-socket joints, a ball shaped head of one bone fits into a socket like concavity of another. This arrangement permits free movements, including flexion, extension, abduction, adduction, medial rotation, lateral rotation, and circumduction. The shoulder and hip joints are good examples of this type of joint (see Fig. 1.14).

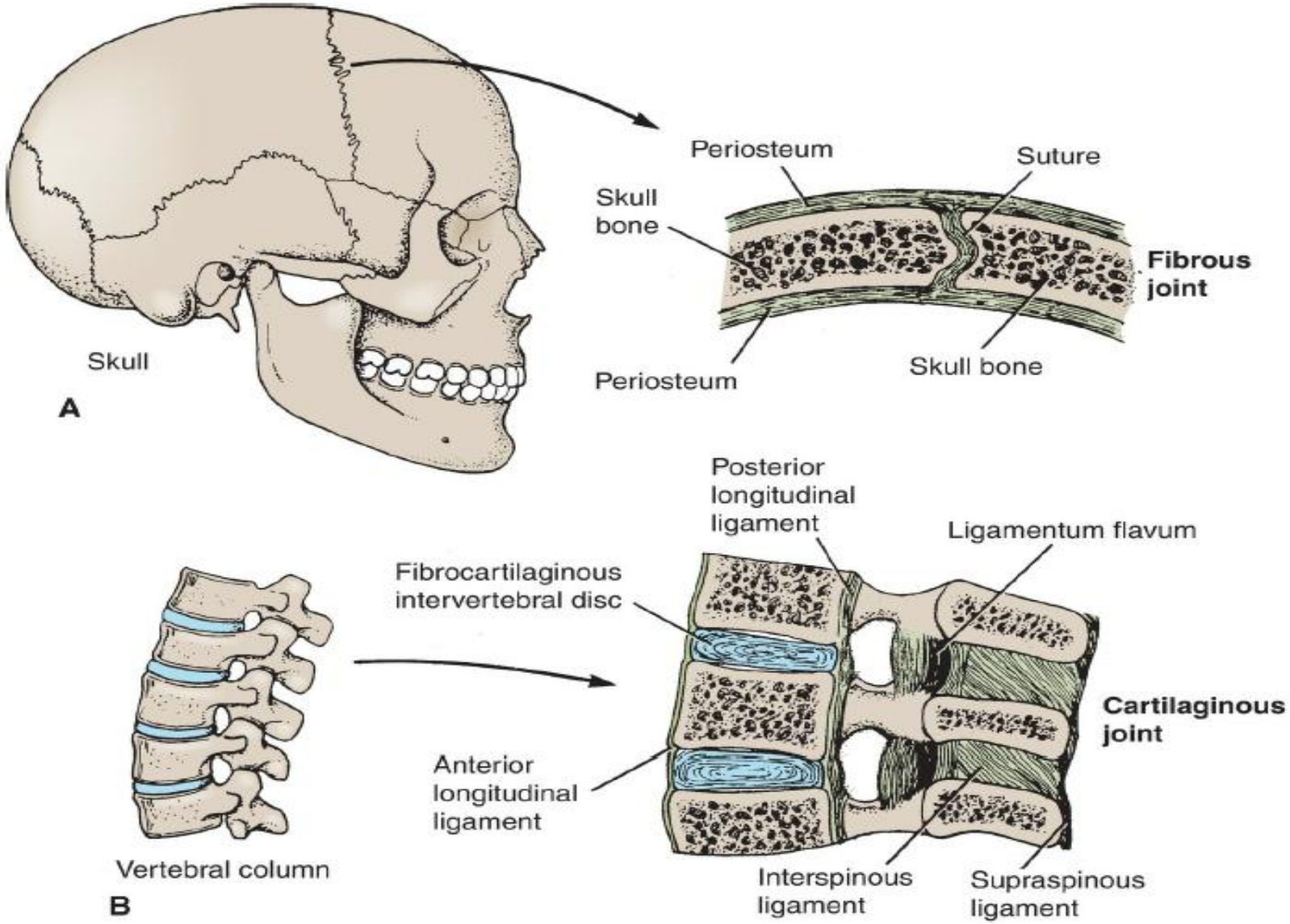


FIGURE 1.12 Examples of three types of joints. A. Fibrous joint (coronal suture of skull). B. Cartilaginous joint (joint between two lumbar vertebral bodies).

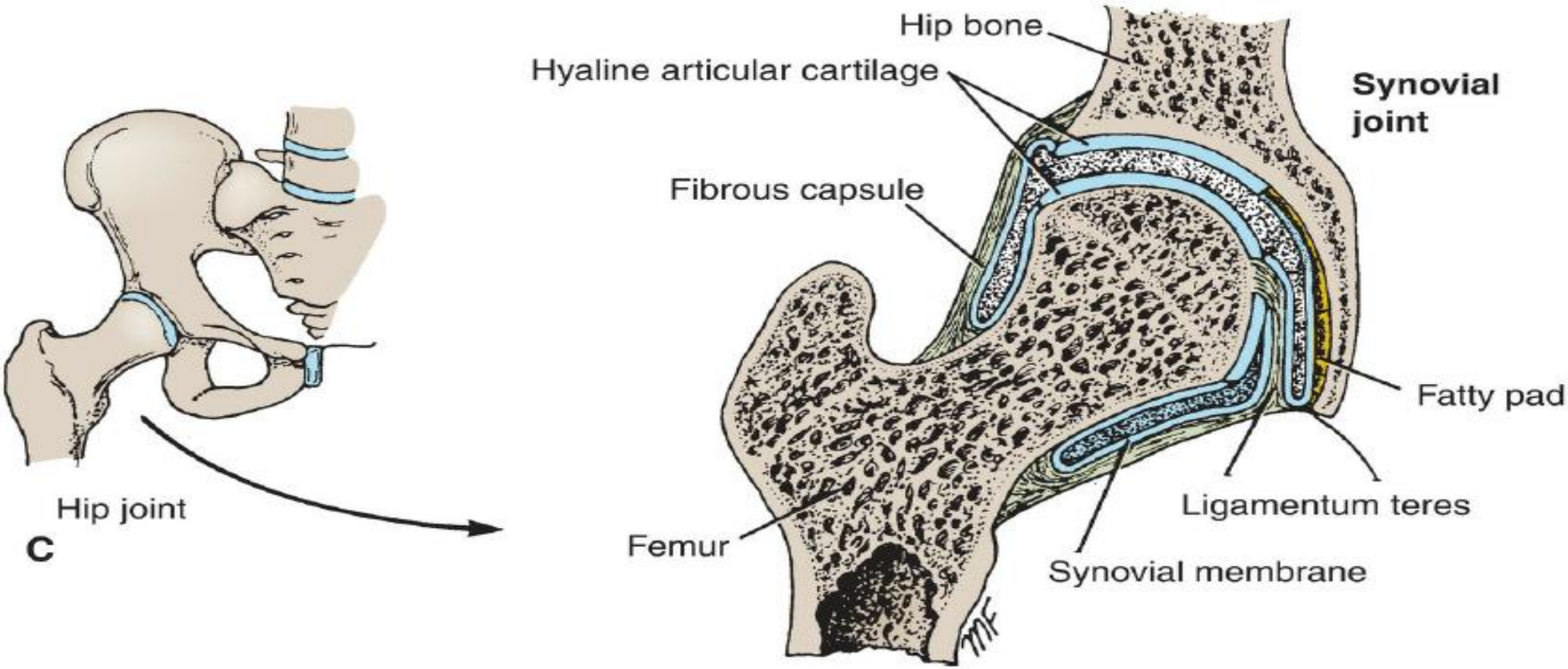


FIGURE 1.12 C. Synovial joint (hip joint).

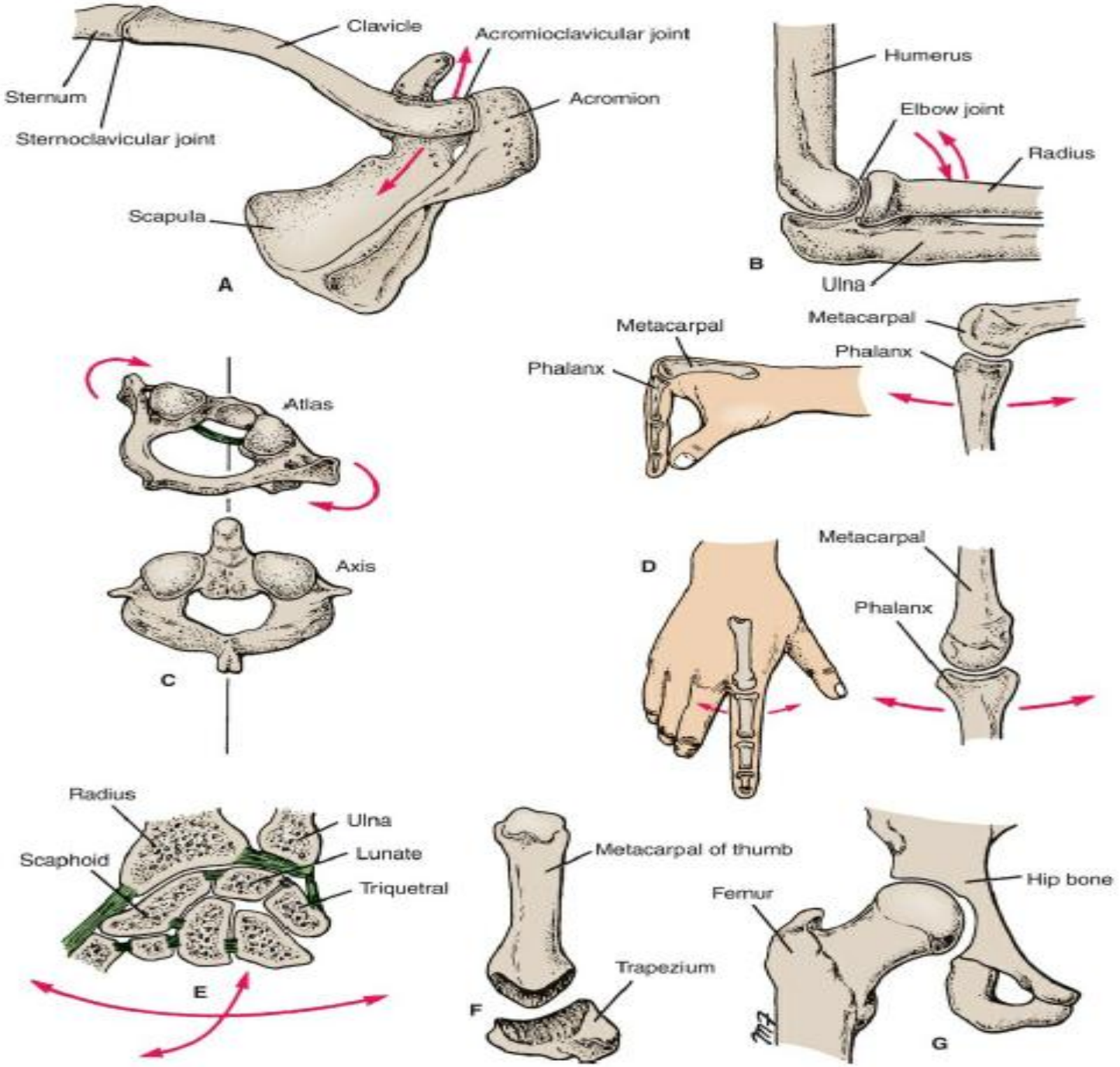


Figure 1.11 Examples of different types of synovial joints.

A.Plane joints (sternoclavicular and acromioclavicular joints).

B.Hinge joint (humeroulnar part of the elbow joint).

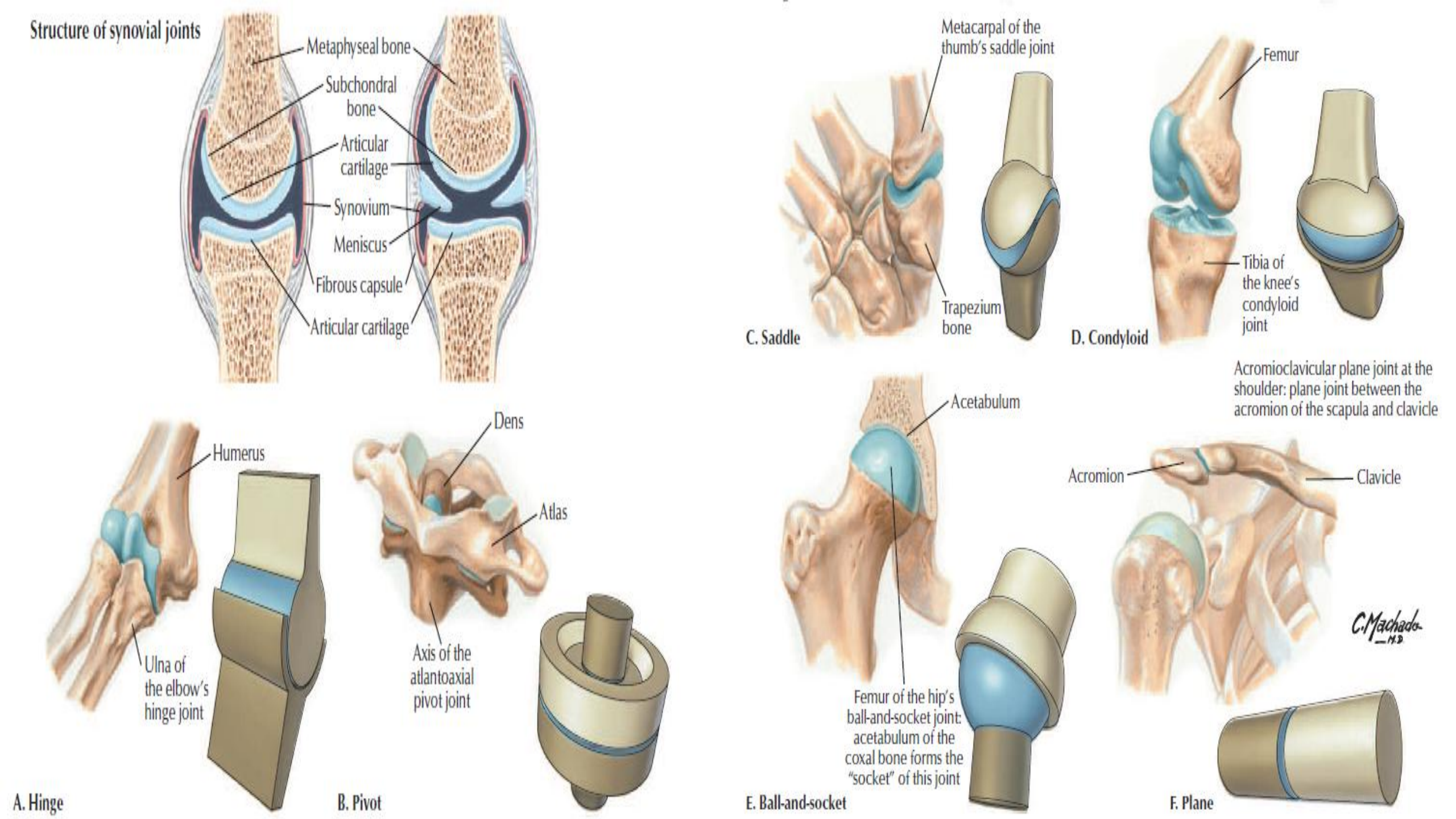
C. Pivot joint (medial atlantoaxial joint).

D. Condyloid joint (metacarpophalangeal joint).

E. Ellipsoid joint (radiocarpal part of the wrist joint).

F. Saddle joint (carpometacarpal joint of the thumb).

G. Ball-and-socket joint (hip joint).


Structure of synovial joints
Metaphyseal bone
Subchondral bone
Articular cartilage
Synovium
Meniscus
Fibrous capsule
Articular cartilage
Humerus
Ulna of the elbow's hinge joint
A. Hinge
Dens
Atlas
Axis of the atlantoaxial pivot joint
B. Pivot
Metacarpal of the thumb's saddle joint
Trapezium bone
C. Saddle
Femur
Tibia of the knee's condyloid joint
D. Condyloid
Acetabulum
Femur of the hip's ball-and-socket joint: acetabulum of the coxal bone forms the "socket" of this joint
E. Ball-and-socket
Acromioclavicular plane joint at the shoulder: plane joint between the acromion of the scapula and clavicle
Acromion
Clavicle
C. Machado M.D.
F. Plane

Ligaments

- A ligament is a cord or band of connective tissue uniting two structures. Commonly found in association with joints.
- Ligaments are of two types. Most are composed of dense bundles of collagen fibers and are unstretchable under normal conditions (e.g., the iliofemoral ligament of the hip joint and the collateral ligaments of the elbow joint).
- The second type is composed largely of elastic tissues and can therefore, regain its original length after stretching (e.g., the ligamentum flavum of the vertebral column and the calcaneonavicular ligament of the foot).

Ligaments

- **Fibrous ligaments** prevent excessive movement in a joint(see Fig. 1.13), but if the stress is continued for an excessively long period, then fibrous ligaments stretch. For example, the ligaments of the joints between the bones forming the arches of the feet will not by themselves support the weight of the body. Should the tone of the muscles that normally support the arches become impaired by fatigue, then the ligaments will stretch and the arches will collapse, producing **flat feet.**

Ligaments

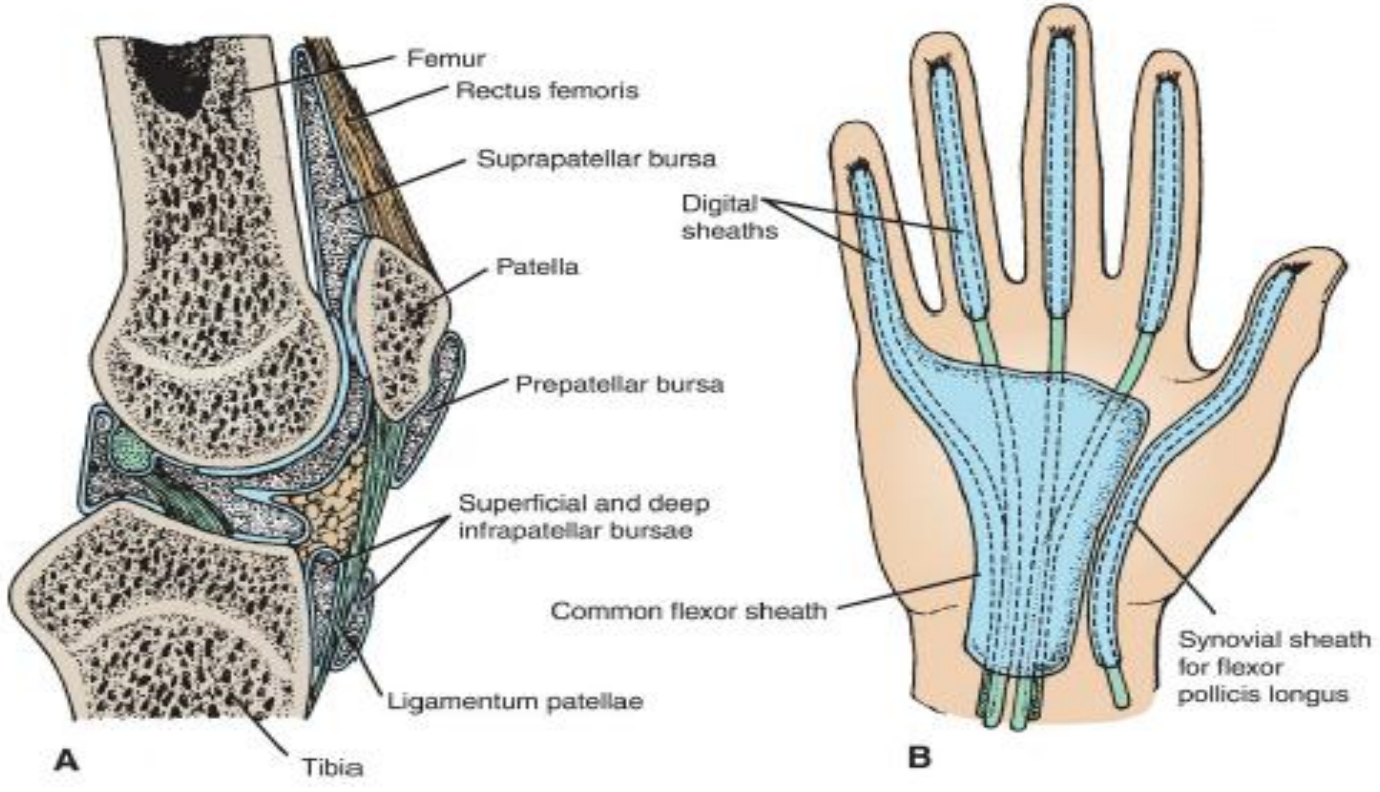
Elastic ligaments, conversely, return to their original length after stretching. The elastic ligaments of the auditory ossicles play an active part in supporting the joints and assisting in the return of the bones to their original position after movement.

Bursae

- A bursa is a lubricating device consisting of a closed fibrous sac lined with a delicate smooth membrane. Its walls are separated by a film of viscous fluid. Bursae are found wherever tendons rub against bones, ligaments, or other tendons.
- They are commonly found close to joints where the skin rubs against underlying bony structures, for example, the prepatellar bursa (Fig. 1.15). Occasionally, the cavity of a bursa communicates with the cavity of a synovial joint. For example, the suprapatellar bursa communicates with the knee joint (see Fig. 1.15) and the subscapularis bursa communicates with the shoulder joint.

Synovial Sheath

- Synovial sheath is a tubular bursa that surrounds a tendon. The tendon invaginates the bursa from one side so that the tendon becomes suspended within the bursa by a mesotendon (see Fig. 1.15).
- The mesotendon enables blood vessels to enter the tendon along its course.
- Synovial sheaths occur where tendons pass under ligaments and retinacula and through osseofibrous tunnels. Their function is to reduce friction between the tendon and its surrounding structures.



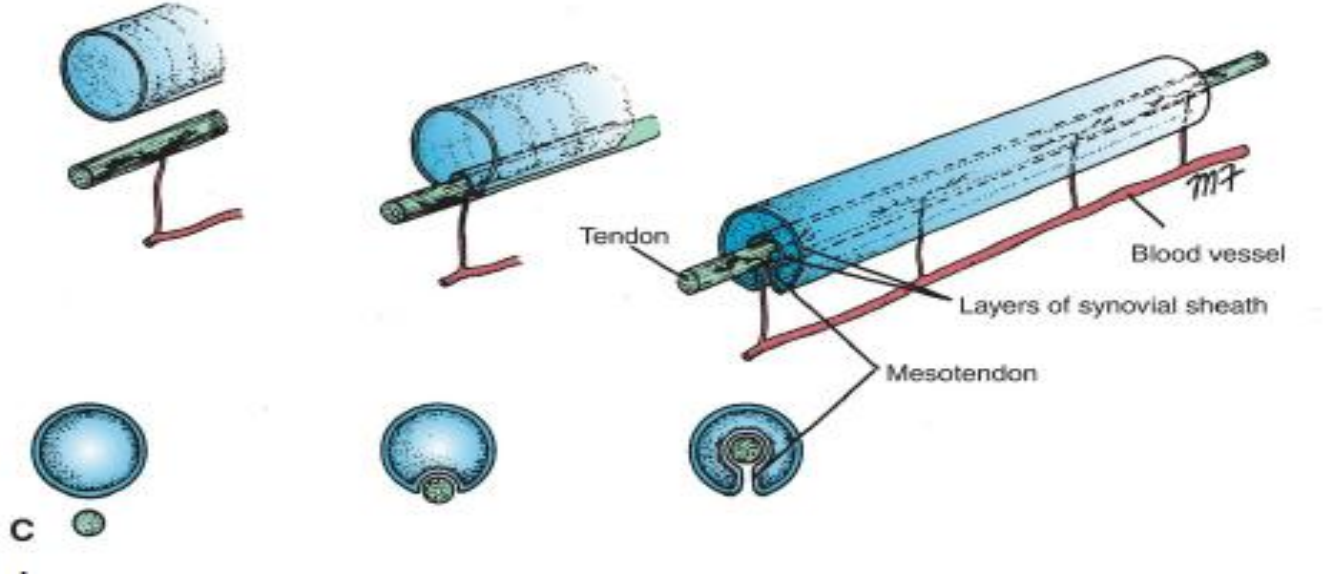


Figure 1.13 Examples of bursae and synovial sheaths.

A. Four bursae related to the front of the knee joint. Note that the suprapatellar bursa communicates with the cavity of the joint.

B.Synovial sheaths around the long tendons of the fingers.

C. How a tendon indents a synovial sheath during development, and how blood vessels reach the tendon through the mesotendon.

Blood Vessels

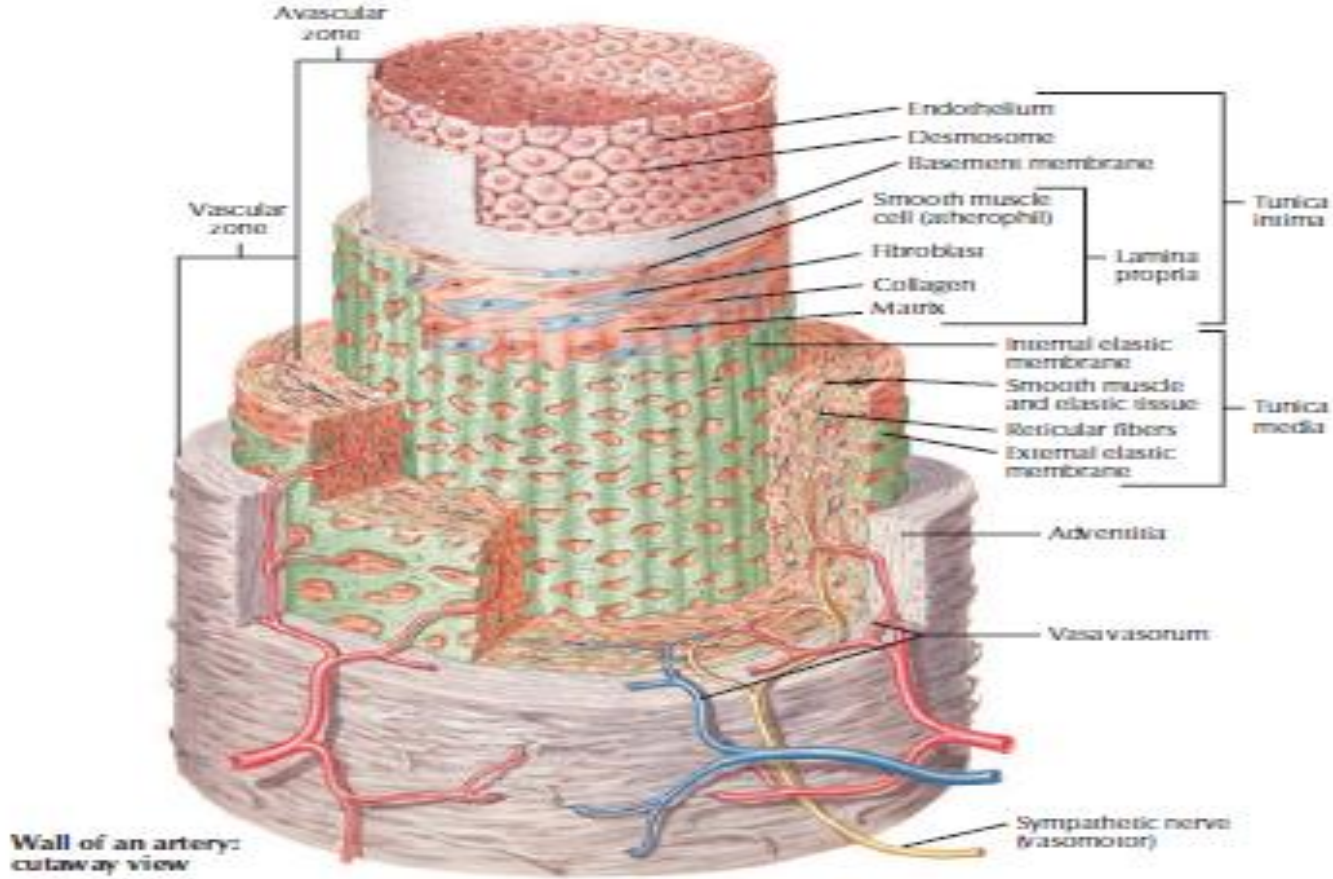
- **Blood vessels** are of three types: arteries, veins, and capillaries (Fig. 1.16).
- Arteries transport blood from the heart and distribute it to the various tissues of the body by means of their branches (Figs. 1.16 and 1.17). The smallest arteries, <0.1 mm in diameter, are referred to as arterioles.
- The joining of branches of arteries is called an anastomosis.
- Arteries do not have valves.

Veins

- Veins are vessels that transport blood back to the heart; many of them possess valves.
- The smallest veins are called venules (see Fig. 1.17). The smaller veins, or tributaries, unite to form larger veins, which commonly join with one another to form venous plexuses.
- Medium-size deep arteries are often accompanied by two veins, one on each side, called venae comitantes.

Capillaries

- Capillaries are microscopic vessels in the form of a network connecting the arterioles to the venules (see Fig. 1.17).
- **Sinusoids** resemble capillaries in that they are thin-walled blood vessels, but they have an irregular cross diameter and are wider than capillaries. They are found in the bone marrow, the spleen, the liver, and some endocrine glands.
- In some areas of the body, principally the tips of the fingers and toes, direct connections occur between the arteries and the veins without the intervention of capillaries.
- The sites of such connections are referred to as **arteriovenous anastomoses.**



Wall of an artery: cutaway view

Healthy artery

Healthy vein

Lymphatic System

- The lymphatic system consists of lymphatic tissues and lymphatic vessels (Fig. 1.18).
- Lymphatic tissues are a type of connective tissue that contains large numbers of lymphocytes.
- Lymphatic tissue is organized into the following organs or structures: the thymus, the lymph nodes, the spleen, and the lymphatic nodules.
- Lymphatic tissue is essential for the immunologic defenses of the body against bacteria and viruses.

Lymphatic System

- Lymphatic vessels are tubes that assist the cardiovascular system in the removal of tissue fluid from the tissue spaces of the body; the vessels then return the fluid to the blood. The lymphatic system is essentially a drainage system, and there is no circulation.
- Lymphatic vessels are found in all tissues and organs of the body except the central nervous system, the eyeball, the internal ear, the epidermis of the skin, the cartilage, and the bone.

Lymphatic System

- **Lymph** is the name given to tissue fluid once it has entered a lymphatic vessel. Lymph capillaries are a network of fine vessels that drain lymph from the tissues. The capillaries are in turn drained by small lymph vessels, which unite to form large lymph vessels.
- Lymph vessels have a beaded appearance because of the presence of numerous valves along their course. Before lymph is returned to the bloodstream, it passes through at least one lymph node and often through several.
- The lymph vessels that carry lymph to a lymph node are referred to **as afferent vessels** (see Fig. 1.18); those that transport it away from a node are **efferent vessels.**
- The lymph reaches the bloodstream at the root of the neck by large lymph vessels called the right lymphatic duct and the thoracic duct .

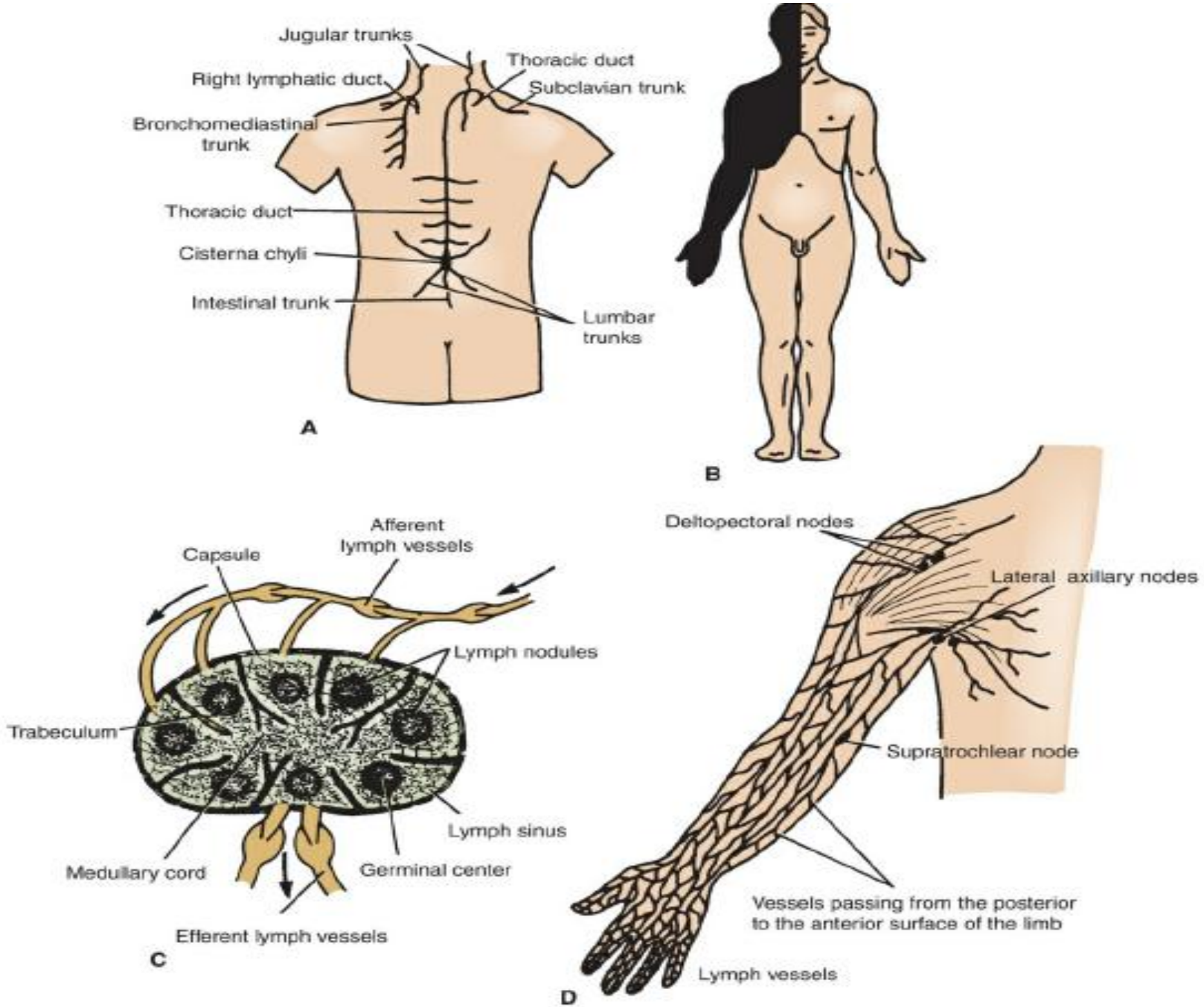


Figure 1.29 General plan of the lymphatic system.
A. The thoracic duct and right lymphatic duct and their main tributaries.
B. The areas of body drained into thoracic duct (clear) and right lymphatic duct (black).
C. General structure of a lymph node.
D. Lymph vessels and nodes of the upper limb.

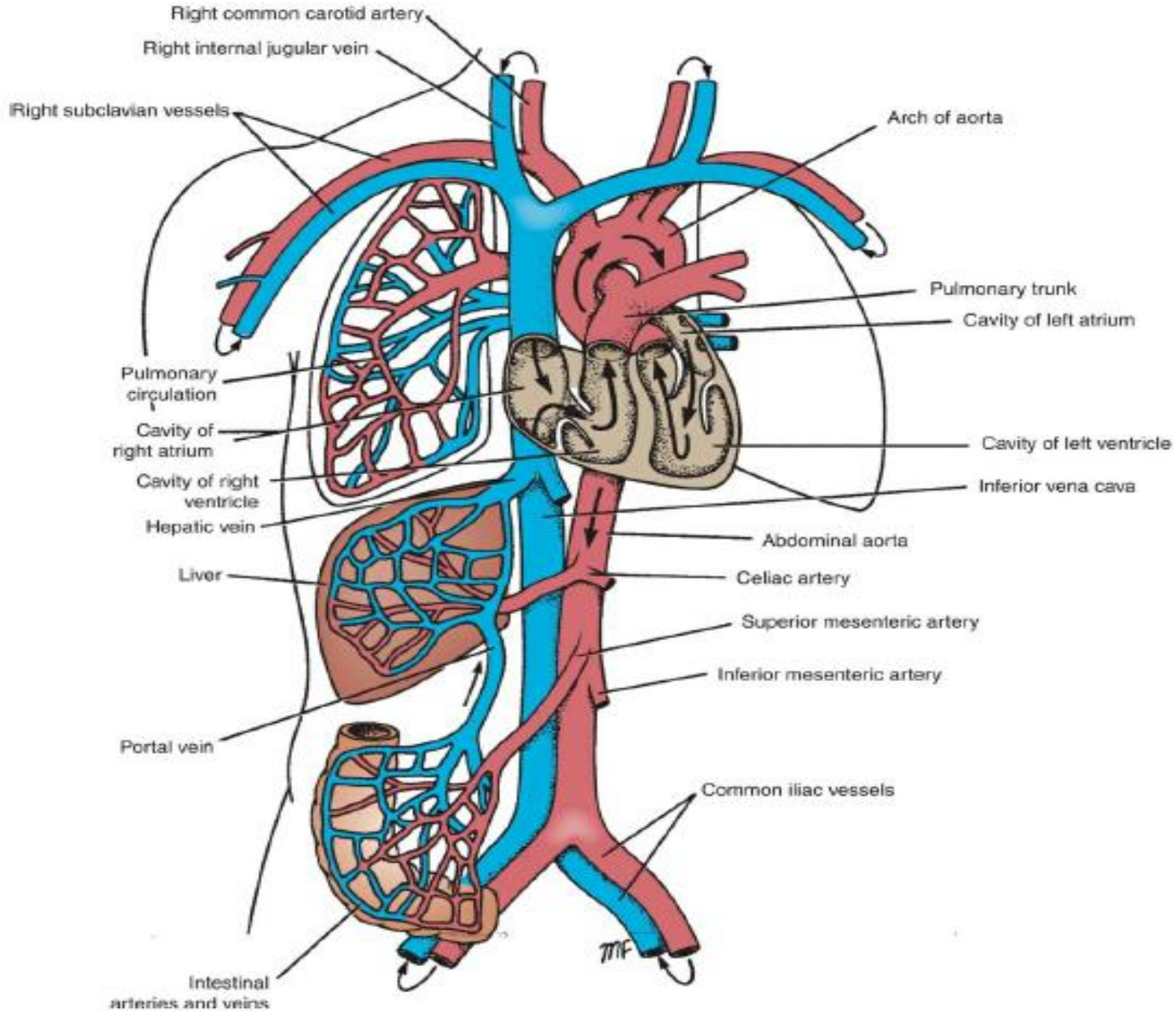


Figure 1.27 General plan of the blood vascular system.

Task

- Enumerate the types of tissue in human body ?
- Write short notes about their functions?

Summary

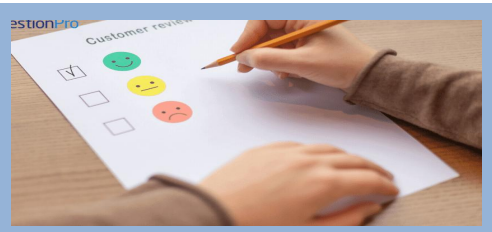
- Muscles are contractile tissues that cause movement.
- The three types of muscle are skeletal, cardiac, and smooth.
- Bone is the hardened connective tissue that forms the framework of the body, protects many internal organs, and provides the mechanical base for movement.
- Cartilage is the form of connective tissue in which cells and fibers are embedded in a gel-like matrix.
- The three types of cartilage are hyaline, fibrocartilage, and elastic.
- Joints are the sites where two or more bones come together. Joints may or may not permit movement between the articulating elements. The three main types of joints are fibrous joints, cartilage joints, and synovial joints.
- Synovial joints are the most complex-type joints and normally permit the greatest degrees of movement.

Summary

- Ligaments bind bones to bones and limit movement between bones.
- Bursae are fluid-filled sacs that reduce friction and enhance movement between hard or soft tissue structures.
- Lymph is clear tissue fluid that drains mainly into the venous system.
- Lymphatic organs (lymph nodes, tonsils, thymus, spleen) and lymphatic vessels (ducts and trunks) are the two major components of the lymphatic system.

References

- Snell’s Clinical Anatomy by Regions(tenth edition).
- Atlas of Human Anatomy (Netter 7 edition).



Survey

Thank you