Lecture 2 Human Anatomy د.ياسر رياض الخناق

Basic Structures

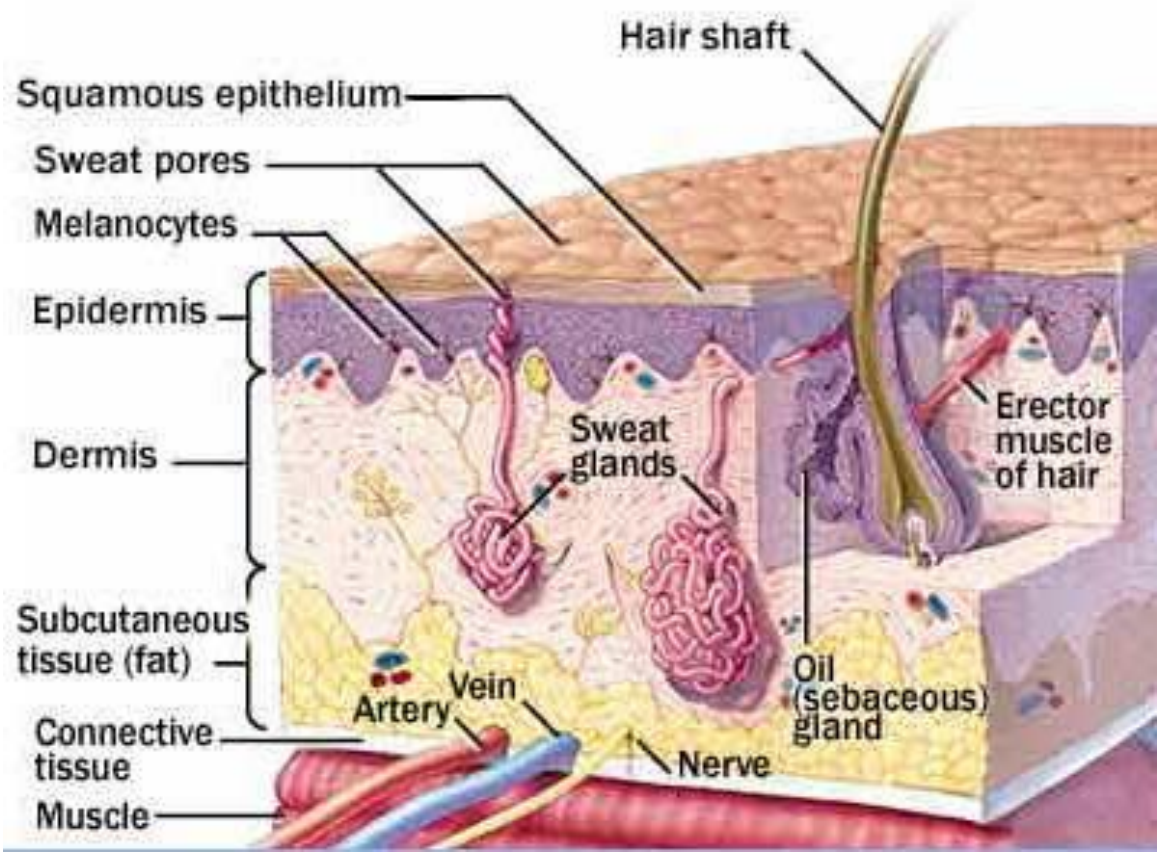
Skin

The skin is divided into two parts: the superficial part, the **epidermis;** and the deep part, the **dermis**. The epidermis is a stratified epithelium. 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, like on the anterior surface of the arm and forearm, it is thin.

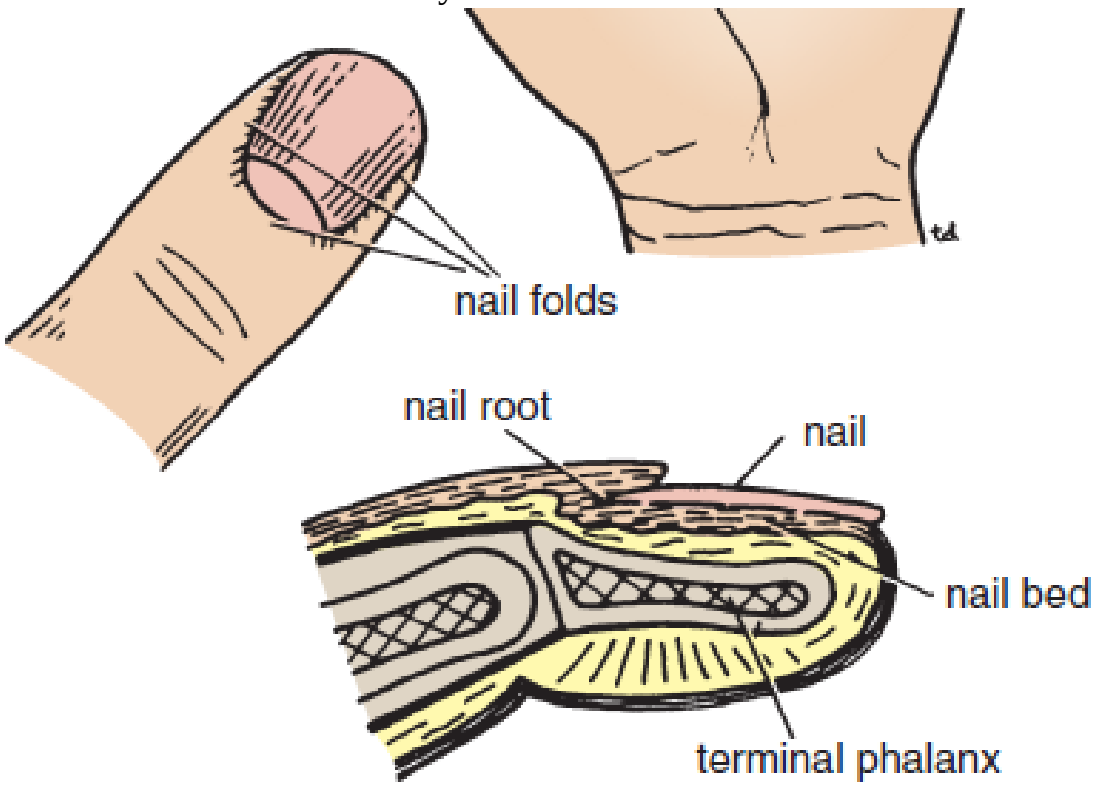
The dermis is composed of dense connective tissue containing many blood vessels, lymphatic vessels, and nerves. It shows considerable variation in thickness in different parts of the body, tending to be thinner on the anterior than on the posterior surface. It is thinner in women than in men. The dermis of the skin is connected to the underlying deep fascia or bones by the **superficial fascia,** otherwise known as **subcutaneous tissue.**

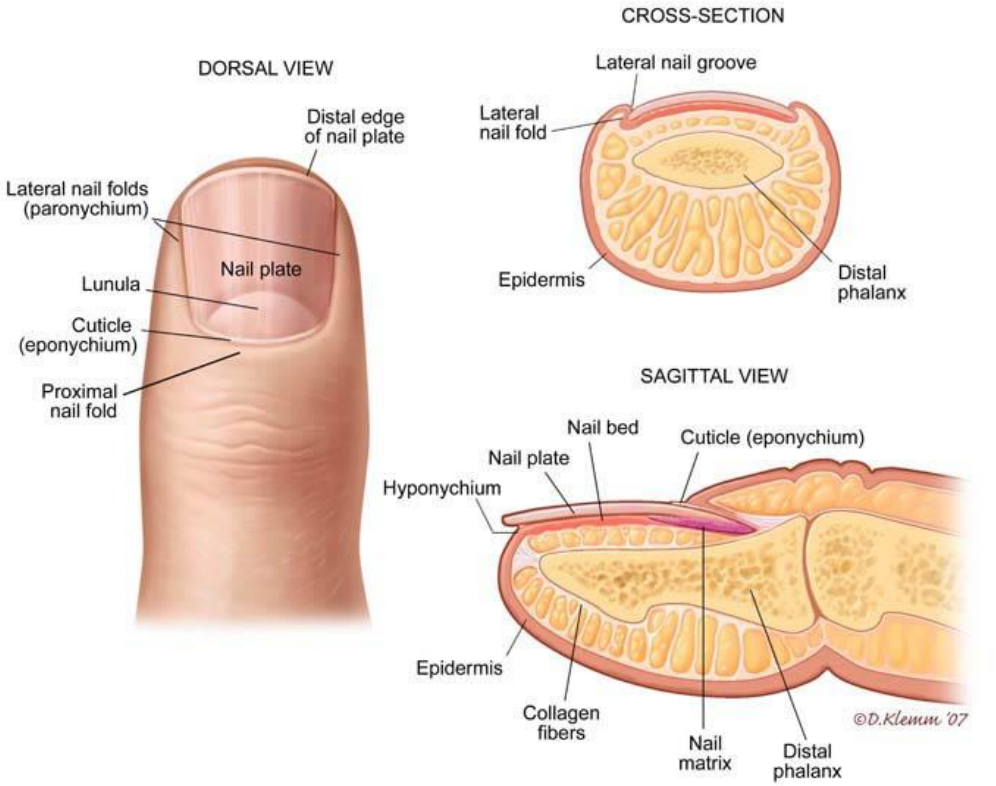
The skin over joints always folds in the same place, the **skin creases.**

The appendages of the skin are the nails, hair follicles, sebaceous glands, and sweat glands.

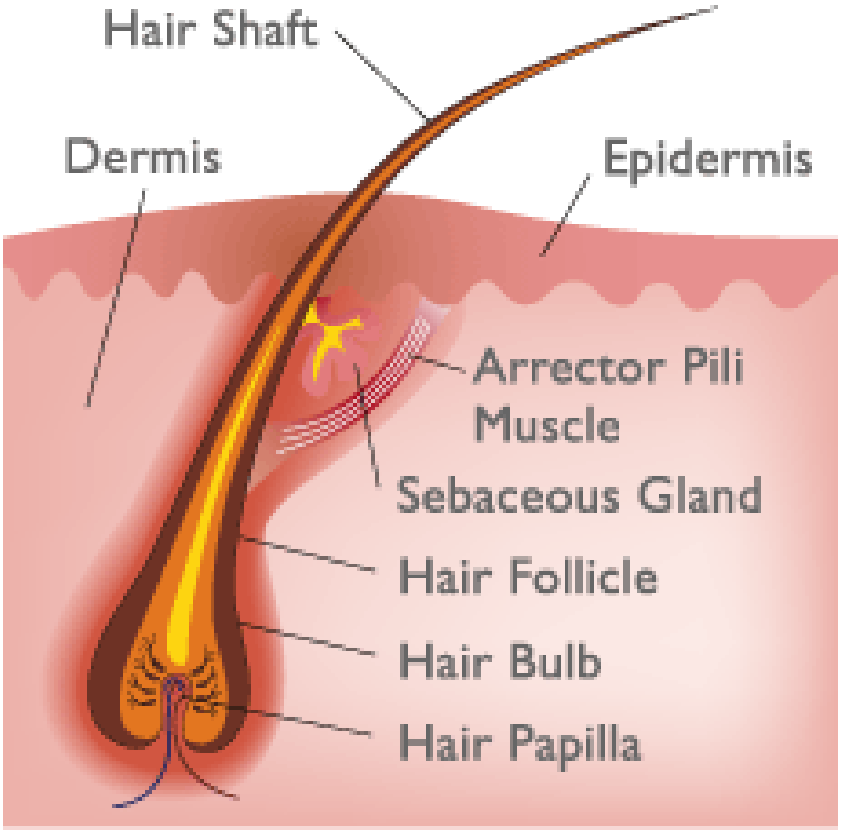


The **nails** are keratinized plates on the dorsal surfaces of the tips of the fingers and toes. The proximal edge of the plate is the **root of the nail.** With the exception of the distal edge of the plate, the nail is surrounded and overlapped by folds of skin known as **nail folds.** The surface of skin covered by the nail is the **nail bed**.





Hairs grow out of **follicles,** which are invaginations of the epidermis into the dermis. 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. The muscle is innervated by sympathetic nerve fibers, and its contraction 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, , and the soles and sides of the feet and the sides of the toes.



Sebaceous glands pour their secretion, the sebum, which is an oily material that helps preserve the flexibility of the emerging hair.

Sweat glands are long, spiral, tubular glands distributed over the surface of the body, except on the red margins of the lips, the nail beds, and the glans penis and clitoris. These glands extend through the full thickness of the dermis, and their extremities may lie in the superficial fascia. The sweat glands are therefore the most deeply penetrating structures of all the epidermal appendages.

Fasciae

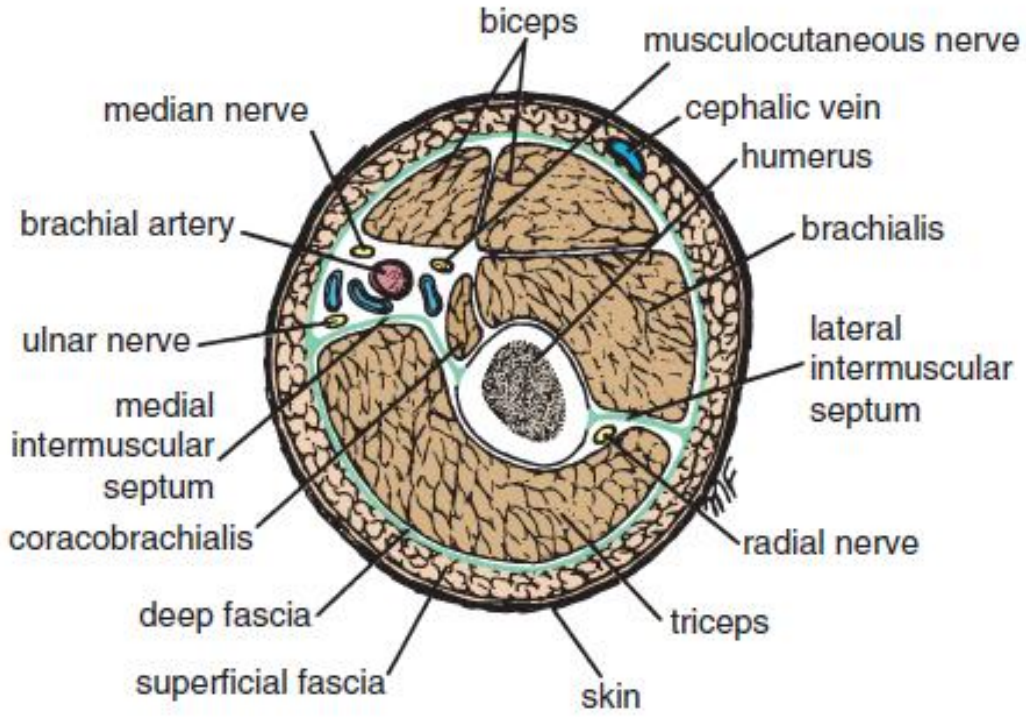
The fasciae of the body can be divided into two types— superficial and deep—and lie between the skin and the underlying muscles and bones.

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.

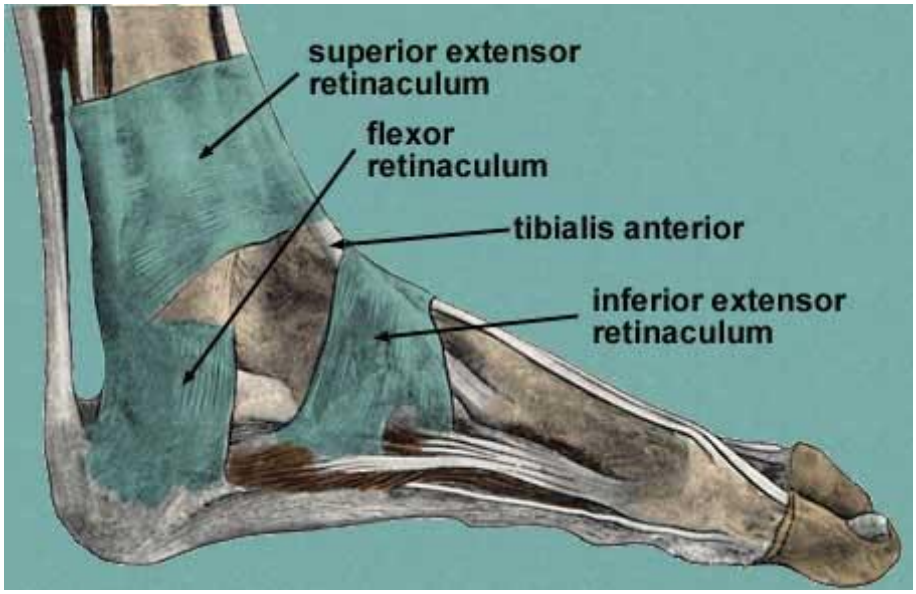
In the scalp, the back of the neck, the palms of the hands, and the soles of the feet, it contains numerous bundles of collagen fibers that hold the skin firmly to the deeper structures.

In the eyelids, auricle of the ear, penis and scrotum, and clitoris, it is devoid of adipose tissue.

The **deep fascia** is a membranous layer of connective tissue that invests the muscles and other deep structures. In the neck, it forms well-defined layers and in the thorax and abdomen, it is merely a thin film of areolar tissue covering the muscles and aponeuroses.



In the region of joints, the deep fascia may be considerably thickened to form restraining bands called retinacula. Their function is to hold underlying tendons in position or to serve as pulleys around which the tendons may move.



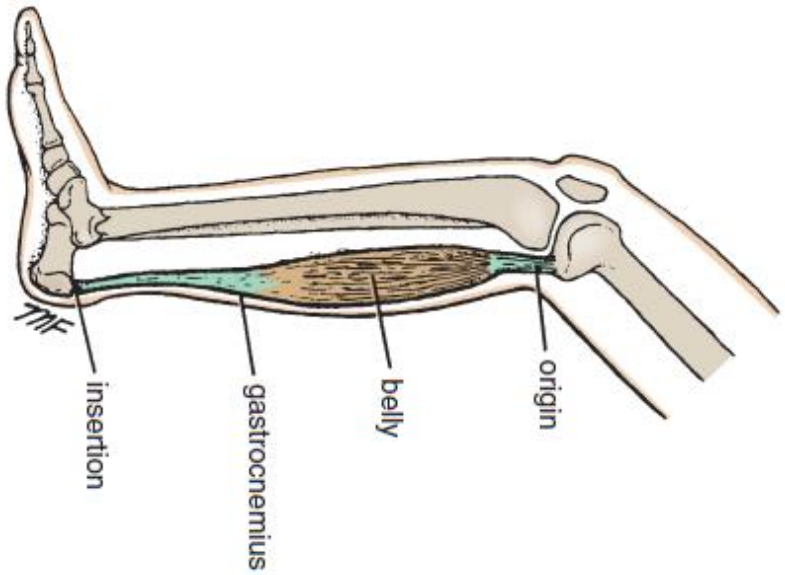
Muscle

The three types of muscle are skeletal, smooth, and cardiac.

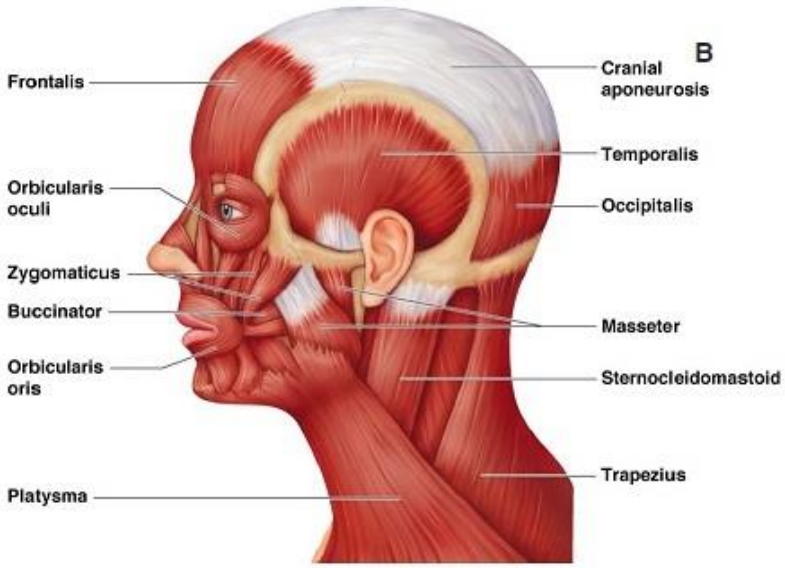
Skeletal Muscle

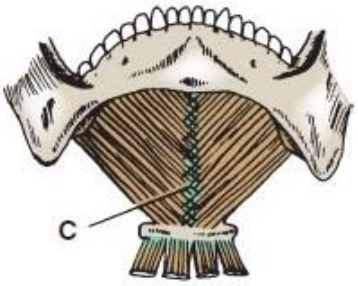
Skeletal muscles produce the movements of the skeleton; they are sometimes called **voluntary muscles** and are made up of striped muscle fibers. A skeletal muscle has two or more attachments. The attachment that moves the least is referred to as the **origin**, and the one that moves the most, the **insertion**. Under varying circumstances, the degree of mobility of the attachments may be reversed; therefore, the terms origin and insertion are interchangeable.

The fleshy part of the muscle is referred to as its **belly**. The ends of a muscle are attached to bones, cartilage, or ligaments by cords of fibrous tissue called **tendons.** Occasionally, flattened muscles are attached by a thin but strong sheet of fibrous tissue called an **aponeurosis**. A **raphe** is an interdigitation of the tendinous ends of fibers of flat muscles.



common tendon for the insertion of the gastrocnemius and soleus muscles



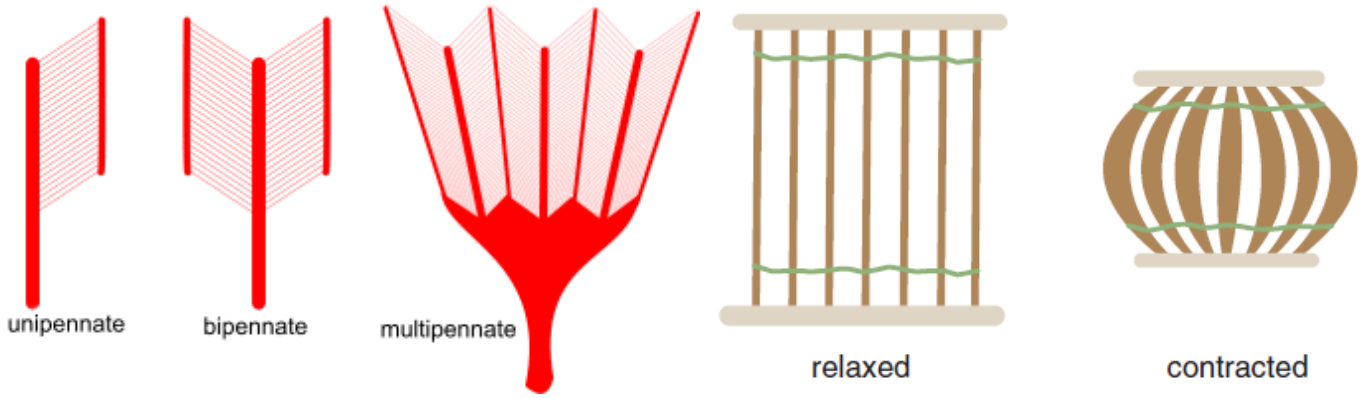


raphe of mylohyoid muscles

Examples of (**A**) a tendon, (**B**) an aponeurosis, and (**C**) a raphe.

- Internal Structure of Skeletal Muscle

The muscle fibers are bound together with delicate areolar tissue. The individual fibers of a muscle are arranged either parallel or oblique to the long axis of the muscle. Because a muscle shortens by one third to one half its resting length when it contracts, it follows that muscles whose fibers run parallel to the line of pull will bring about a greater degree of movement compared with those whose fibers run obliquely. Examples of muscles with parallel fiber arrangements are the sternocleidomastoid.
Muscles whose fibers run obliquely to the line of pull are referred to as **pinnate muscles** (they resemble a feather). A **unipennate muscle** is one in which the tendon lies along one side of the muscle and the muscle fibers pass obliquely to it.
A **bipennate** muscle is one in which the tendon lies in the center of the muscle and the muscle fibers pass to it from two sides. A **multipennate** muscle may be arranged as a series of bipennate muscles lying alongside one another.



- Skeletal Muscle Action

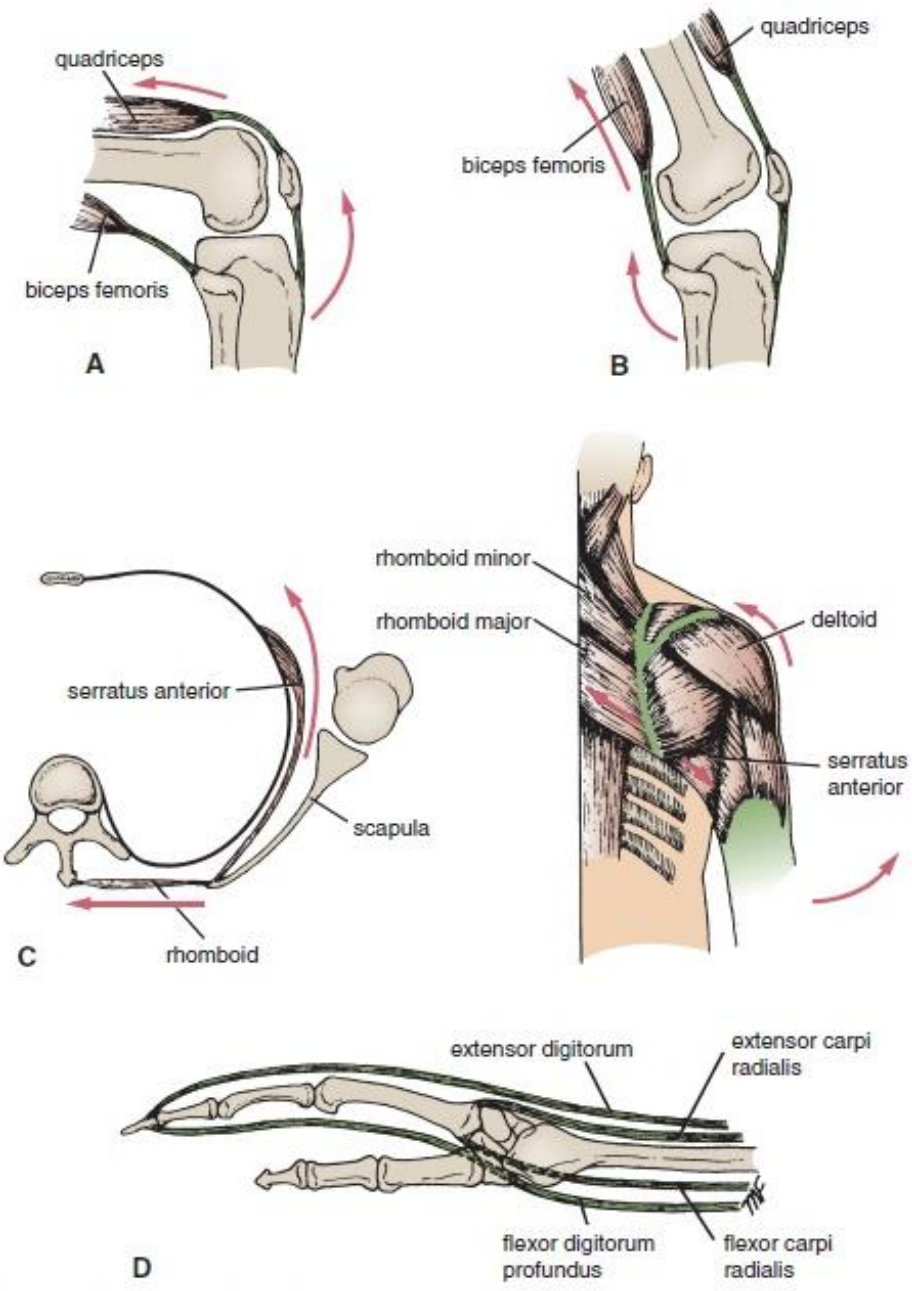
All movements are the result of the coordinated action of many muscles. A muscle may work in the following four ways:

Prime mover: A muscle is a prime mover when it is the chief muscle or member of a chief group of muscles responsible for a particular movement. For example, the quadriceps femoris is a prime mover in the movement of extending the knee joint.

Antagonist: Any muscle that opposes the action of the prime mover is an antagonist. For example, the biceps femoris opposes the action of the quadriceps femoris when the knee joint is extended. Before a prime mover can contract, the antagonist muscle must be equally relaxed.

Fixator: A fixator contracts isometrically (i.e., contraction increases the tone but does not in itself produce movement) to stabilize the origin of the prime mover so that it can act efficiently. For example, the muscles attaching the shoulder girdle to the trunk contract as fixators to allow the deltoid to act on the shoulder joint.

Synergist: In many locations in the body, the prime mover muscle crosses several joints before it reaches the joint at which its main action takes place. To prevent unwanted movements in an intermediate joint, groups of muscles called **synergists** contract and stabilize the intermediate joints. For example, the flexor and extensor muscles of the carpus contract to fix the wrist joint, and this allows the long flexor and the extensor muscles of the fingers to work efficiently.



Different types of muscle action.

A. Quadriceps femoris extending the knee as a prime mover, and biceps femoris acting as an antagonist.

B. Biceps femoris flexing the knee as a prime mover, and quadriceps acting as an antagonist.

C. Muscles around shoulder girdle fixing the scapula so that movement of abduction can take place at the shoulder joint.

D. Flexor and extensor muscles of the carpus acting as synergists and stabilizing the carpus so that long flexor and extensor tendons can flex and extend the fingers.

These terms are applied to the action of a particular muscle during a particular movement; many muscles can act as a prime mover, an antagonist, a fixator, or a synergist, depending on the movement to be accomplished.

- Nerve Supply of Skeletal Muscle

The nerve trunk to a muscle is a mixed nerve, about 60% is motor and 40% is sensory. The nerve enters the muscle at about the midpoint on its deep surface, often near the margin; the place of entrance is known as the **motor point**. This arrangement allows the muscle to move with minimum interference with the nerve trunk. Skeletal Muscles are named according to their shape, size, number of heads or bellies, position, depth, attachments, or actions.

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.

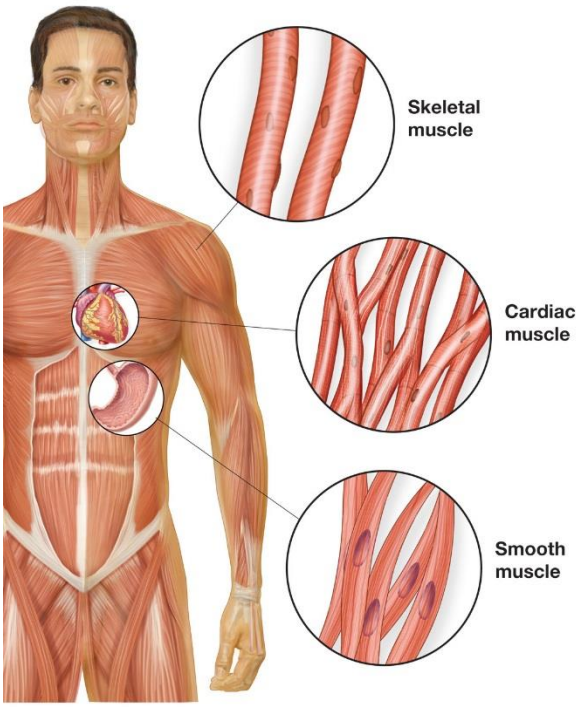
In storage organs such as the urinary bladder and the uterus, the fibers are irregularly arranged and interlaced with one another. Their contraction is slow and sustained and brings about expulsion of the contents of the organs.

In the walls of the blood vessels, the smooth muscle fibers are arranged circularly and serve to modify the caliber of the lumen.

Depending on the organ, smooth muscle fibers may be made to contract by local stretching of the fibers, by nerve impulses from autonomic nerves, or by hormonal stimulation.

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.

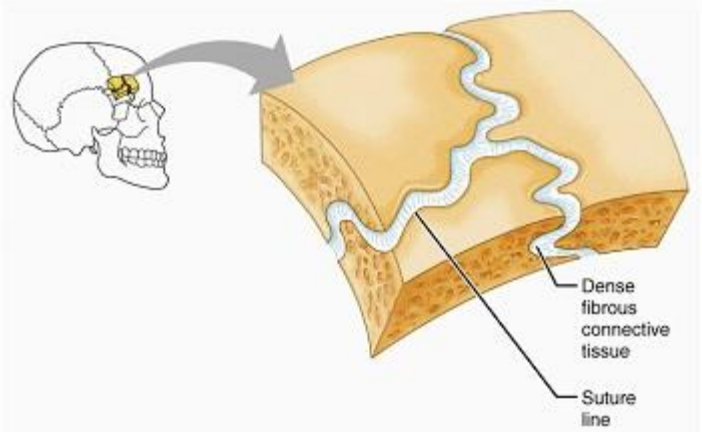


Joints

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.

Fibrous Joints

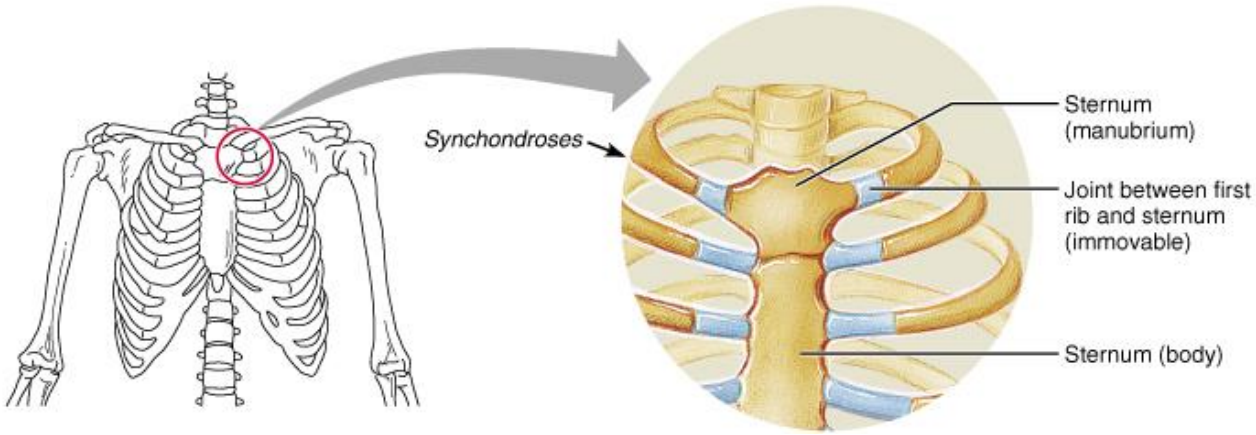
The articulating surfaces of the bones are joined by fibrous tissue, and thus very little movement is possible. Example: The sutures of the vault of the skull.



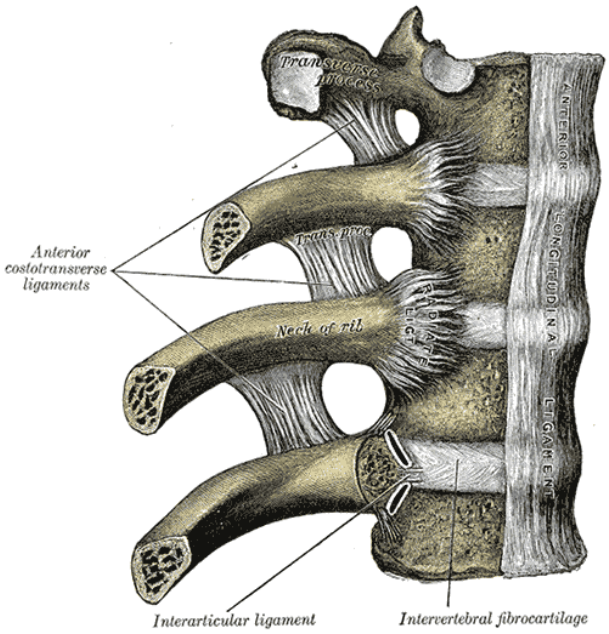
Cartilaginous Joints

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, like, the union between the 1st rib and the manubrium sterni. No movement is possible.

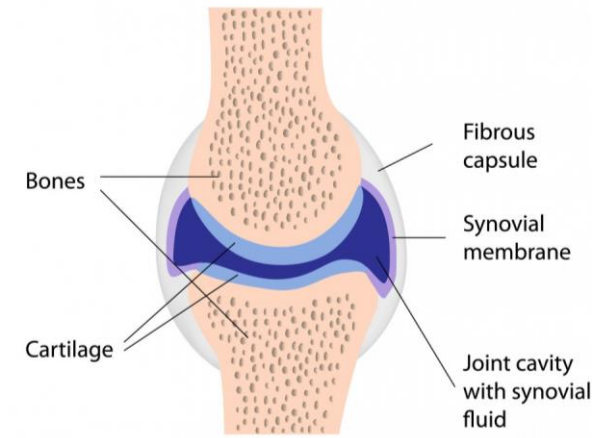


A secondary cartilaginous joint is one in which the bones are united by a plate of fibrocartilage and the articular surfaces of the bones are covered by a thin layer of hyaline cartilage like the joints between the vertebral bodies. A small amount of movement is possible.



Synovial Joints

The articular surfaces of the bones are covered by a thin layer of hyaline cartilage separated by a joint cavity. 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**. 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.



- Nerve Supply of Joints

The capsule and ligaments receive an abundant sensory nerve supply. A sensory nerve supplying a joint also supplies the muscles moving the joint and the skin overlying the insertions of these muscles

Ligament:

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).

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. Occasionally, the cavity of a bursa communicates with the cavity of a synovial joint, For example, the suprapatellar bursa communicates with the knee joint