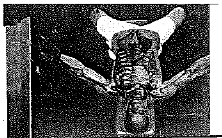
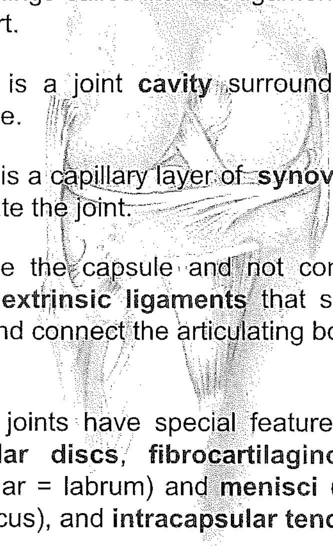


Joints may also be classified according to their motion capabilities; some allow for a great deal of movement, while others are severely restricted. The joints which exhibit the least mobility are **fibrous** and **cartilaginous**. These joints can absorb shock but permit little movement, if any (e.g., interosseous ligaments). There are also slightly movable joints that are cartilaginous and can also attenuate applied forces (e.g., *intervertebral joints* and the *symphysis pubis*). The joints that allow the greatest amount of motion are the **synovial joints,** which have only slight limitations to movement capability, making possible a wide array of movements. The characteristics of synovial joints are presented in the box on the right. The following discussion will therefore focus on synovial joints.

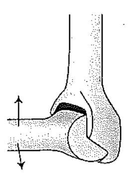
Characteristics of Synovial Joints



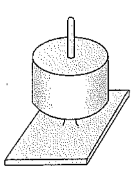
- There is a joint **capsule** lined with a **synovial membrane** that secretes the lubrication fluid for the joint. The capsule may or may not have thickenings called intrinsic ligaments that add support.
- There is a joint **cavity** surrounded by the capsule.
- There is a capillary layer of **synovial fluid** to lubricate the joint.
- Outside the capsule and not connected to it are **extrinsic ligaments** that support the joint and connect the articulating bones of the joint.
- Some joints have special features such as **articular discs**, **fibrocartilaginous labra** (singular = labrum) and **menisci** (singular = meniscus), and **intracapsular tendons**.

Types of Synovial Joints

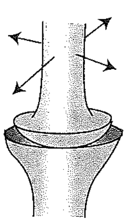
Synovial joints vary widely in structure and movement capabilities and may be classified in different ways – by the movements possible at the joint or simply by the axes around which the joint can be moved. The more common classification is based on the shape of the joint (Figure 2.14).



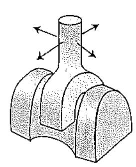
Hinge (Ginglymus) Joint This type of joint has one articulating surface that is convex, and another that is concave. Examples include the humero-ulnar joint at the elbow and the interphalangeal joints of the fingers.



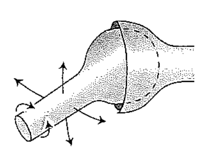
Pivot Joint In these types of joints, one bone rotates around one axis. For example during pronation–supination of the forearm, the radius rotates along its long axis and the ulna remains fixed.



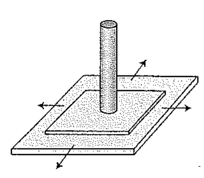
Condyloid (Knuckle) Joint The joint surfaces are usually oval as in the joint between your third metacarpal (bone of the hand) and the proximal phalanx (bone) of your third digit. One joint surface is an ovular convex shape, and the other is a reciprocally shaped concave surface. At this joint, flexion–extension, abduction–adduction, and circumduction are all possible.



Saddle Joint The bones are set together as in sitting on a horse. This is seen in the carpometacarpal joint of the thumb. Movement capability at this joint is the same as the condyloid joint, but with a greater possible range of motion permitted.



Ball and Socket Joint A rounded bone is fitted into a cup-like receptacle. This is the kind of joint found at the shoulder and the hip where rotation in all three planes of movement is possible.



Plane (Gliding) Joint This joint permits gliding movements as in the bones of the wrist. The bone surfaces

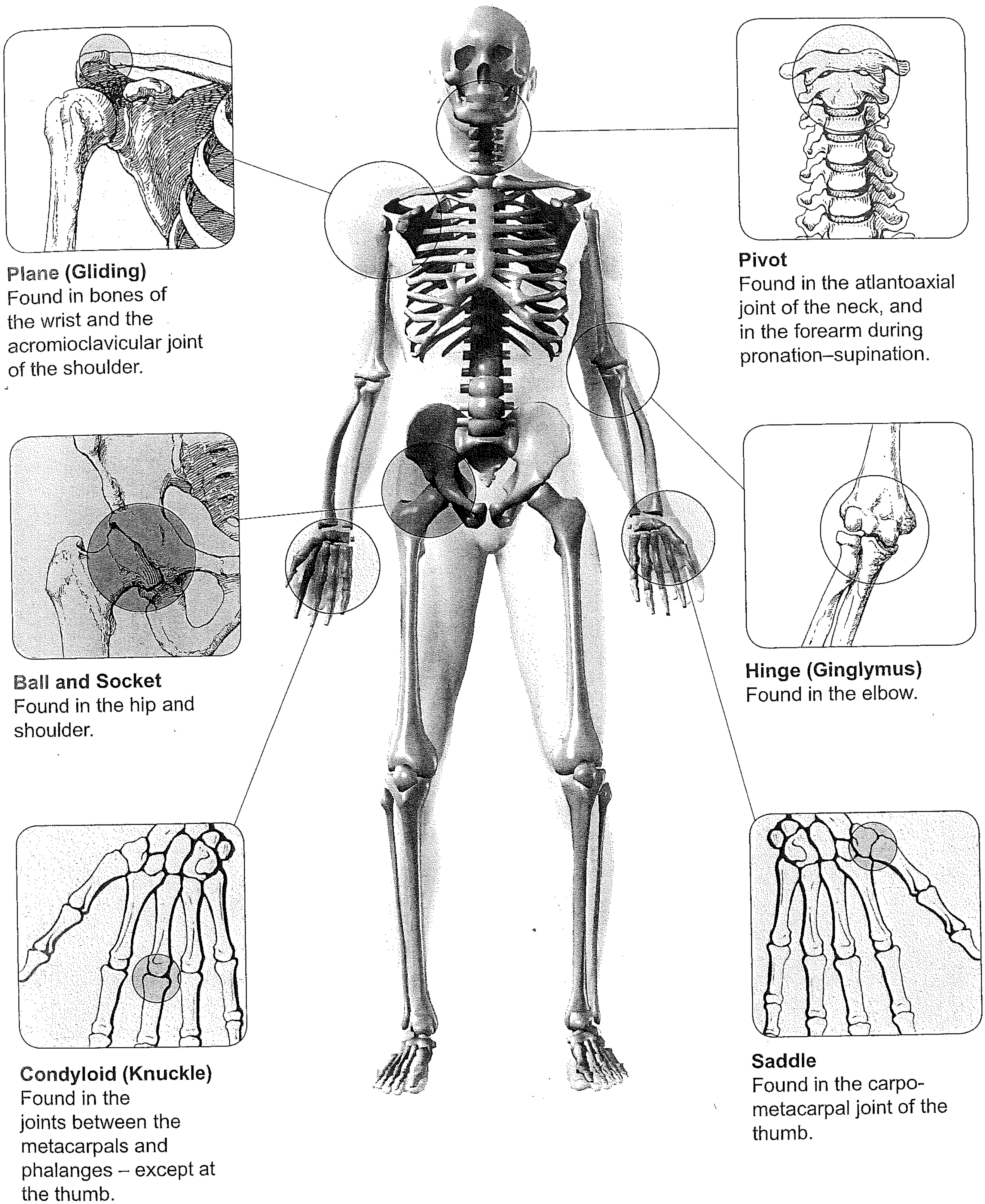
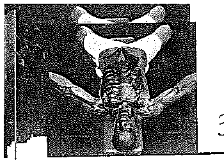


Figure 2.14 Typical synovial joints of the human body.



involved are nearly flat, so the only movement allowed is a gliding action. Another example of such a joint is the facet joints of the vertebrae.

The principal synovial joints of the body are presented in the following sections. While some of the terms may seem confusing, just remember that anatomical terms can be figured out by identifying the root words involved. Junctions of bones are called joints. Some fibrous joints (e.g., sutures of the skull) allow no movement, cartilaginous joints (e.g., intervertebral discs) allow limited movement, and synovial joints (e.g., elbow and wrist) allow a large range of movement. In synovial joints, bone ends are covered with smooth **cartilage**, and the entire joint is enclosed in a capsule filled with **synovial fluid**. Ligaments and cartilage provide additional support.

Joints of the Pectoral Girdle

The pectoral girdle, comprised of the scapula and clavicle, has two joints. These joints are presented starting below.

Sternoclavicular Joint

This is the only joint connecting the pectoral girdle to the axial skeleton (the clavicle to the sternum). It is a true synovial joint strengthened by an intracapsular disc and extrinsic ligaments. This is important as this joint must absorb all

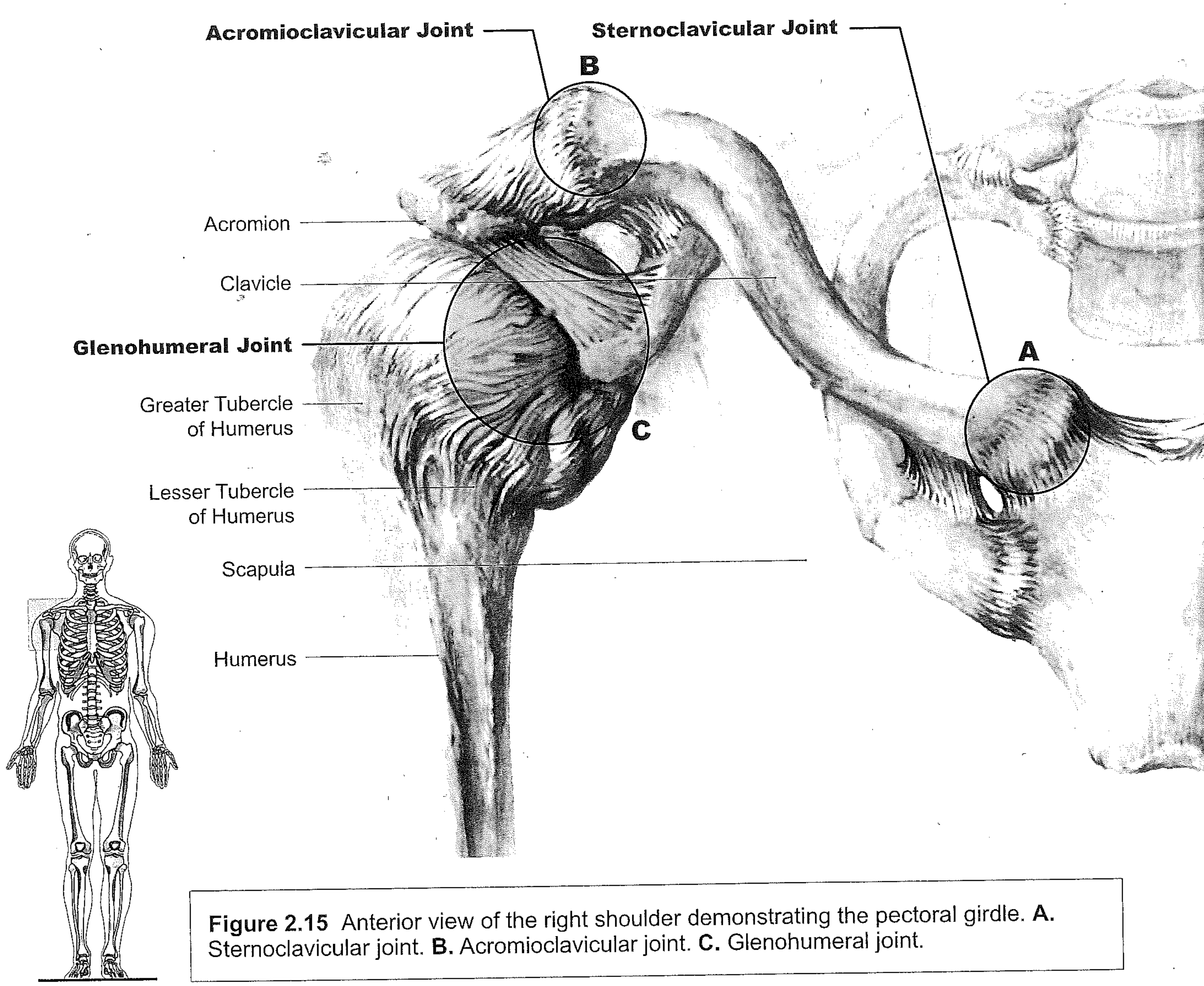
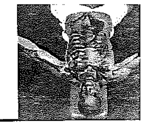


Figure 2.15 Anterior view of the right shoulder demonstrating the pectoral girdle. **A.** Sternoclavicular joint. **B.** Acromioclavicular joint. **C.** Glenohumeral joint.



forces transmitted to the upper limb in many activities, including many sports (Figure 2.15 A).

Acromioclavicular Joint

This joint unites the lateral end of the clavicle with the acromion process of the scapula. It is here that shoulder separations can, and often do, occur in sports such as hockey, baseball, and football (Figure 2.15 B).

Joints of the Upper Limb

Glenohumeral Joint

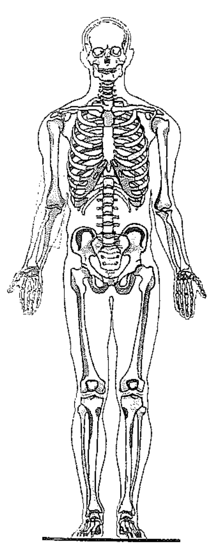
This is the joint between the upper limb and the scapula. Because we enjoy a wide range of movement at this joint, the compromise is a relative lack of stability. You have a large ball (of the humerus) articulating with a relatively shallow cup (of the scapula). The integrity of the joint depends on the rotator cuff muscles that **SSIT** on the greater and lesser tubercles of the humerus and cross the joint to attach to the scapula. These letters stand for the *Subscapularis*, *Supraspinatus*, *Infraspinatus*, and *Teres minor* muscles that hold the head of the humerus firmly against the *glenoid fossa* of the scapula. This area is commonly injured by water polo players (Figure 2.15 C).

Elbow Joint

There are actually three joints at the elbow: (1) the **humero-radial joint** between the capitulum of the humerus and the head of the radius (Figure 2.16 A); (2) the **humero-ulnar joint** between the trochlea of the humerus and the olecranon process of the ulna (Figure 2.16 B); and (3) the **radioulnar joint** between the radius and the ulna (Figure 2.16 C). Flexion–extension occurs at the first two, and pronation–supination occurs at the radioulnar joint.

Joints of the Wrist

The distal radius articulates with the proximal row of carpal bones at the **radiocarpal joint** (between the radius and the carpals). Flexion–extension as well as abduction–adduction occur here (Figure 2.17). As well, there are **midcarpal** and **intercarpal**, **carpometacarpal**, and **intermetacarpal joints.** There are gliding joints between the bones of the



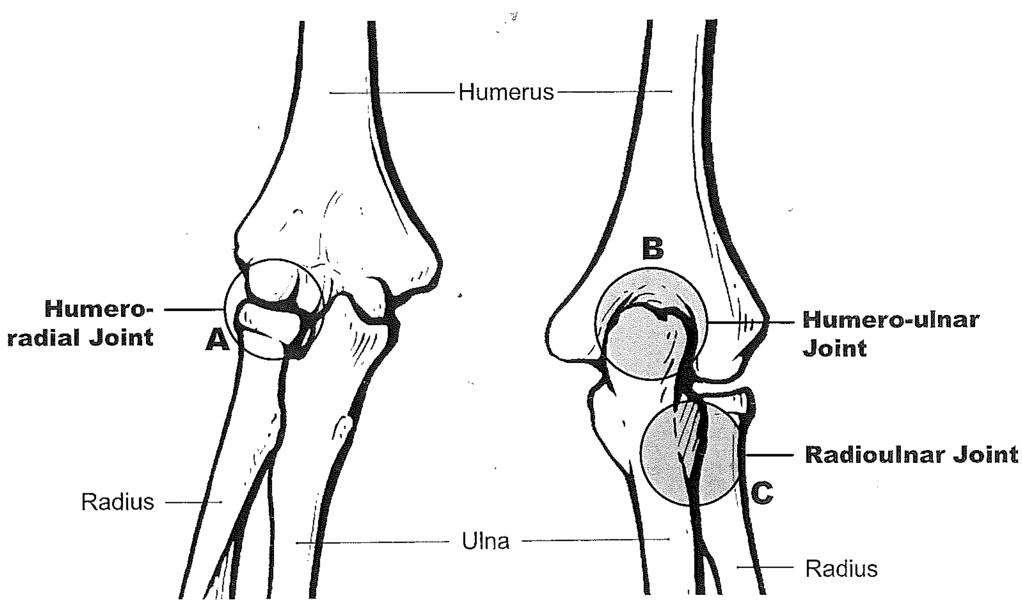


Figure 2.16 The right elbow joint. **A.** Humero-radial joint. **B.** Humero-ulnar joint. **C.** Radioulnar joint.

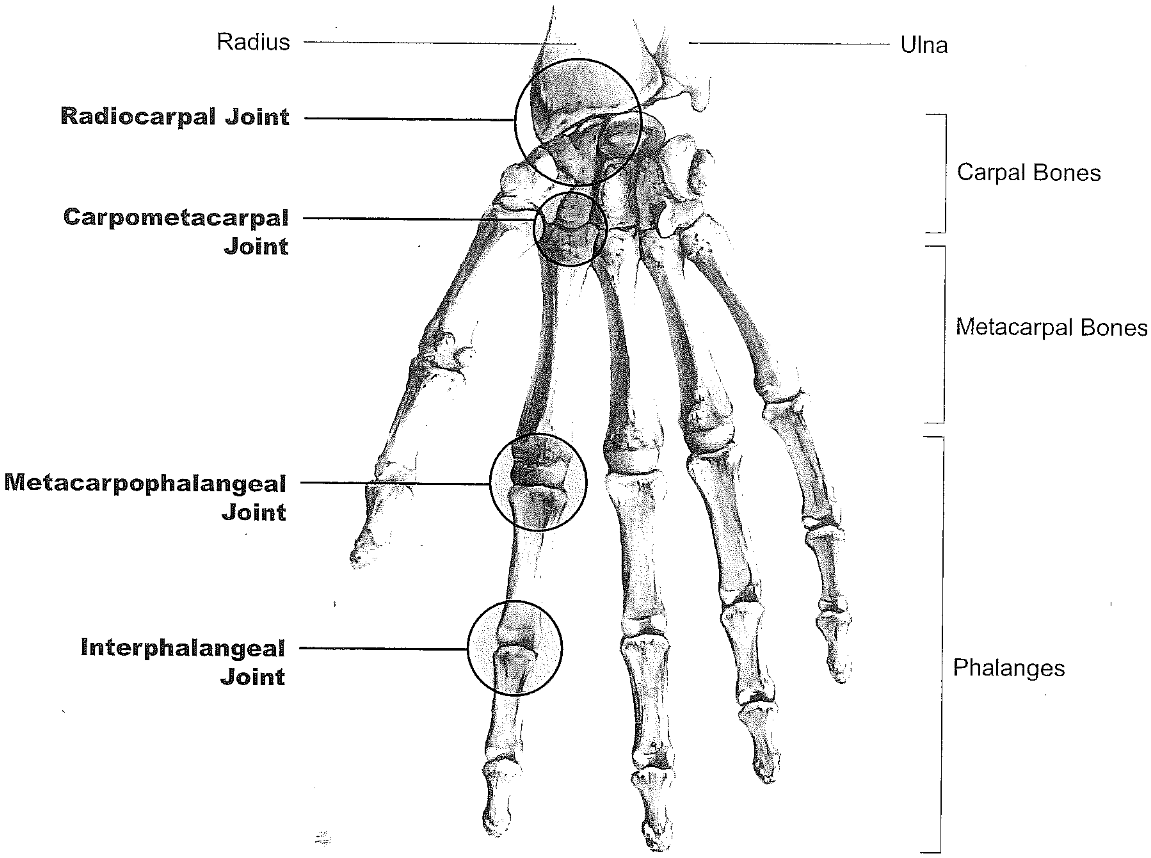


Figure 2.17 Major joints of the wrist and hand.

carpus. The metacarpal of the thumb sits in the saddle of the trapezium and lies at an angle of 90 degrees to the palm of the hand. This allows the range of movement necessary for *opposition*, the ability to touch your thumb tip to each of your finger tips.

Joints of the Hand

The knuckles are the **metacarpophalangeal joints** (Figure 2.17). Flexion–extension and abduction–adduction can occur here, allowing us to manipulate our hands with amazing dexterity. Between the phalanges are **interphalangeal joints** (recall that there are three phalanges per finger, while the thumb has only two) that also permit flexion–extension (Figure 2.17).

Joints of the Pelvic Girdle

The hip bones (os coxae), comprised of the ilium, pubis, and ischium, together with the sacrum, form the pelvic girdle. It has two joints.

Symphysis Pubis

This is a fibrocartilaginous joint uniting the two pubic bones and completing the pelvic girdle anteriorly. It can soften just before giving birth to permit a wider opening for the baby.

Sacroiliac Joint

This joint unites the sacrum with the paired ilia (singular = ilium). It has both a fibrous and a synovial component. Minor displacement of the fibrous component can result in excruciating sacroiliac pain.

Joints of the Lower Limb

Hip Joint

Between the head of the femur and the cup (acetabulum) of the hip bone (os coxae) is the **hip** or **iliofemoral joint**. As in all ball and socket joints, movements of flexion–extension, abduction–adduction, and circumduction can take place here, allowing for the greatest range of motion and mobility (Figure 2.18).

The hip joint is the body's most stable synovial joint as it is provided with a deepened socket (via a lip or fibrocartilaginous labrum) and intrinsic and very strong extrinsic ligaments. In contrast to the shoulder joint, another ball and socket joint, dislocation of the hip joint even in the most aggressive contact sports is rare. Dislocation usually occurs when someone sitting in the front seat of a car is involved in a head-on collision and the knees are driven into the dashboard. The force of

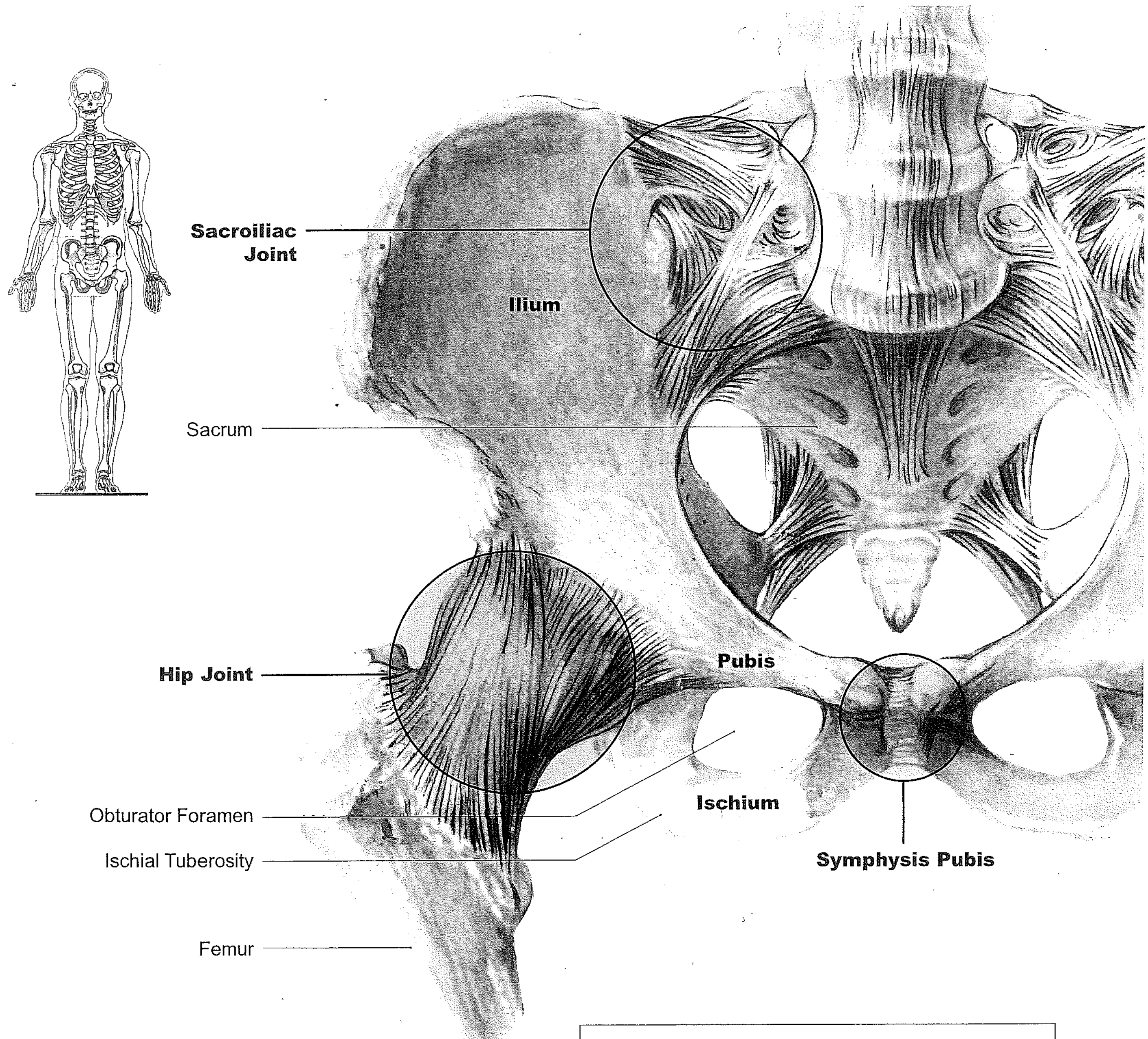


Figure 2.18 Anterior view of the pelvic girdle.

impact can either dislocate the head of the femur posteriorly or drive it through the posterior lip of the acetabulum.

Knee Joint

Despite its very shallow receptor surface on the tibial plateau for the medial and lateral condyles of the femur, the **knee (tibiofemoral) joint** is a relatively stable joint with an incredible range of movement (Figure 2.19). It has additional structural supports from the **menisci** (shock-absorbing fibrocartilaginous discs), **anterior** and **posterior cruciate ligaments** (in the centre of the joint), **lateral** and **medial collateral ligaments** (extending from the sides of the femur to the fibula and tibia), and the musculature that surrounds it. The primary action here is flexion–extension such as when performing a squat or jump, but when the knee is flexed, medial and lateral rotation can also occur at the joint. Try it out yourself.

When You Sprain an Ankle

As with bone and muscle, all joints have a rich nerve supply. The muscles that pass over a joint and give it movement have the same nerve supply as the joints over which they act.

Question: When a joint becomes swollen (as in an ankle sprain) what causes the swelling? Why is this painful?

Answer: Trauma causes the synovial membrane of the joint to secrete fluid. This causes the swelling that results in stretching of the joint capsule which can activate pain receptors in the joint. When the joint becomes painful, the surrounding muscles may go into spasm. Once the inflammation is reduced, the pain will subside and the muscles will have to be remobilized with physiotherapy.

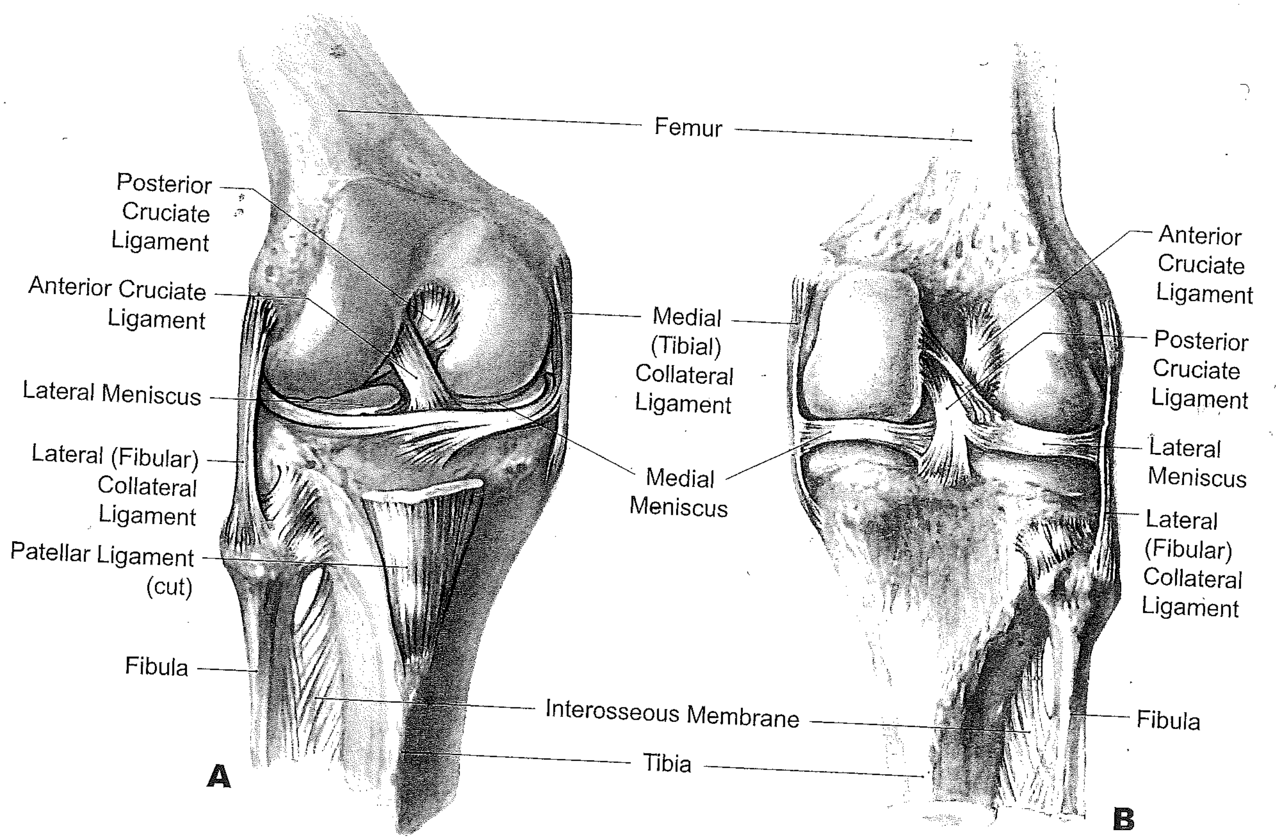
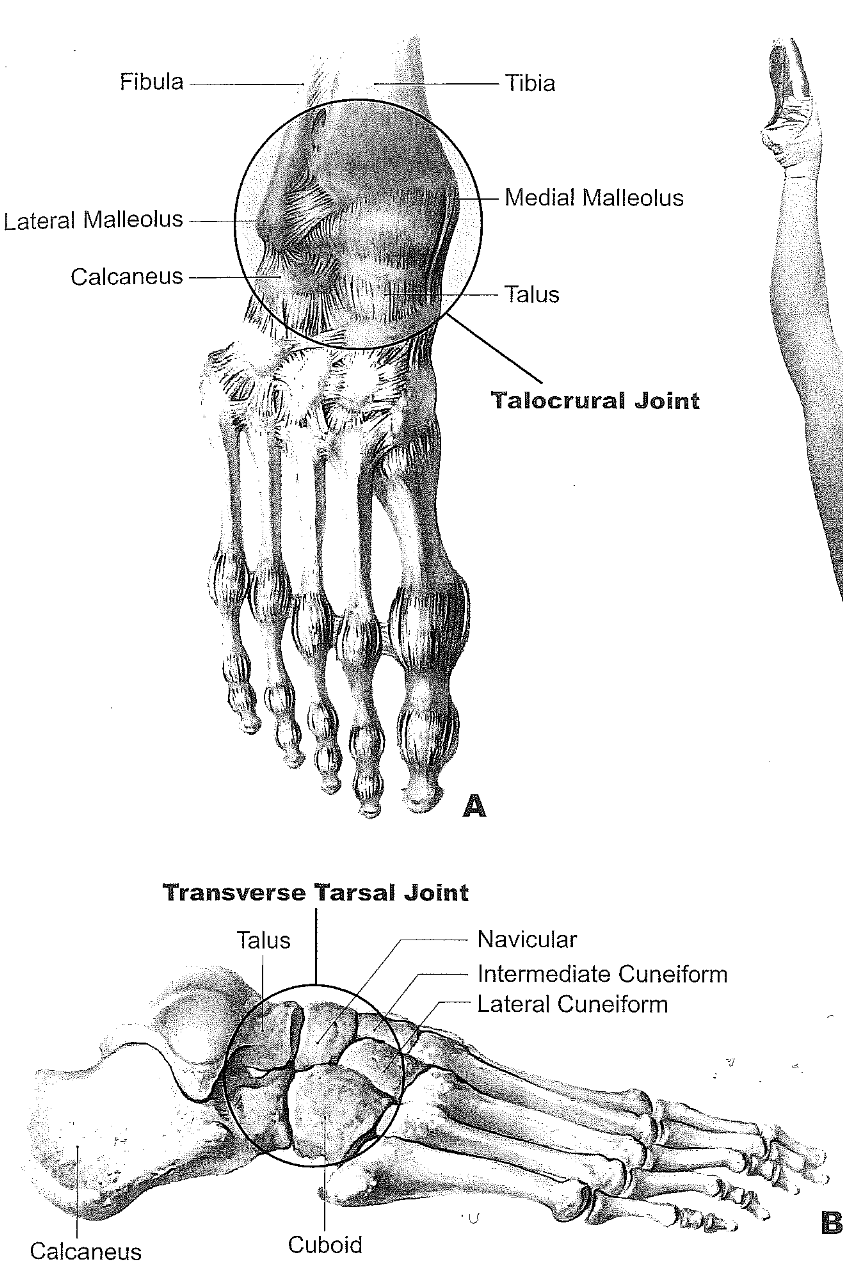


Figure 2.19 The right knee. **A.** Anterior view. **B.** Posterior view.



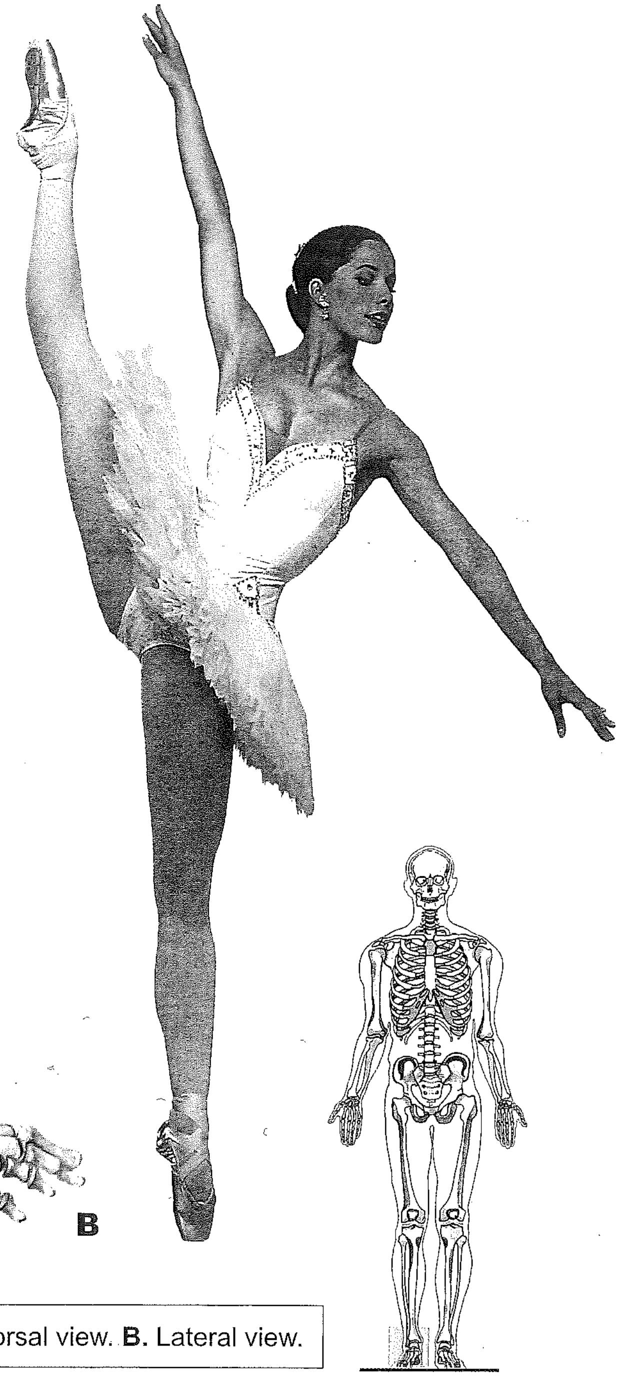


Figure 2.20 Ankle and foot joints. **A.** Dorsal view. **B.** Lateral view.

Ankle Joint

Several bones, the medial and lateral malleoli of the tibia and fibula, the head of the talus, and the calcaneus (heel bone), are involved in the **ankle (talocrural) joint** (Figure 2.20).

The talus is wedged into the mortise formed by the medial and lateral malleoli. Because the talus is wider anteriorly than posteriorly, when you dorsiflex at the ankle, you put the ankle into its most stable position. This is the reason for the forward cant in a downhill ski boot. The ankle is least stable in the "en pointe" position in ballet, putting great pressure on dancers' ligaments and tendons, and increasing the risk of injury.

Foot and Toe Joints

There are two rows of tarsal bones of the **transverse tarsal joint**. Movement between the proximal and distal rows of the transverse tarsal joint is inversion–eversion of the sole of the foot. This action enables you to adjust to uneven ground when walking or running. As in the hand, there are joints between the tarsal bones, metatarsals, and phalanges. They are strengthened by plantar ligaments that aid in maintaining the arch of the foot (weakened ligaments result in "flat foot," although you may be born with flat feet that cause you no discomfort).

Muscles of the Human Body

Muscles allow the skeleton to move. Most muscles are attached from one bone to another with a joint in between. The attachment closer to the centre of the body is the muscle's **origin** (also known as its *proximal attachment*). The attachment away from the centre of the body is the muscle's **insertion** (also known as its *distal attachment*). The origin of the muscle is usually attached to more stationary parts, whereas the insertion is attached to more mobile structures of the skeleton. Remember, muscles can only act on the joints they cross.

There are over 600 muscles present in the human body. It would be impossible to describe here all the muscles, so keep in mind that a short section in this chapter cannot do justice to the vast number and functions of these muscles. Only the major superficial muscles will be identified (Figures 2.24 and 2.25) as they relate to the bony regions discussed in the previous section.

Muscles of the Face

Facial muscles enable you to change expression and display your emotions outwardly; but most importantly, they allow you to close your eyes and your mouth (Figure 2.21). Closing the eyelids, as in blinking, acts to move tears across the cornea of the eye, keeping it moistened. When the eyeball is not kept moist, it will dry out and ulcerate, leading to discomfort and irritation, even blindness. People with paralysis of facial muscles will put artificial tears in their eyes to prevent this.

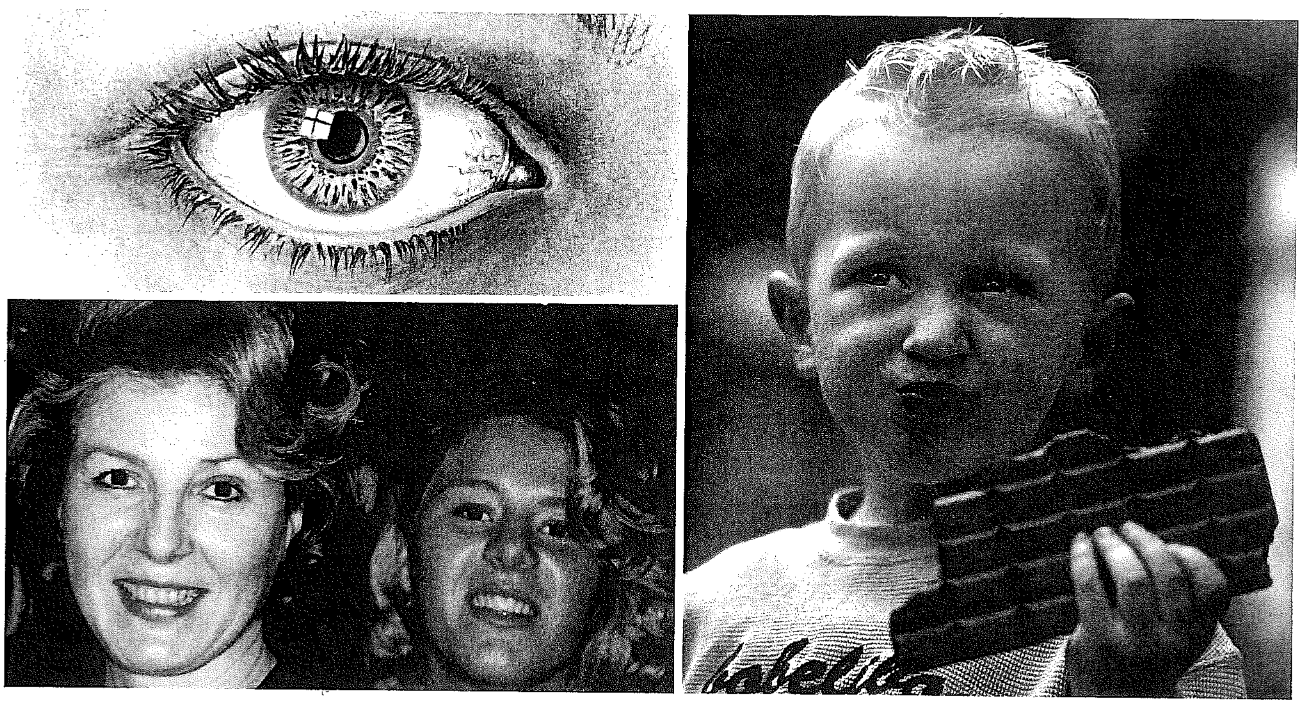


Figure 2.21 Facial muscles are essential for a variety of tasks, from smiling and blinking to chewing and speaking.

Facial muscles are also essential for opening and closing the mouth, thereby keeping food in the mouth and allowing you to move it between the teeth during chewing, to say nothing of forming words in speaking.

Muscles of the Neck and Back

The head sits on the first cervical vertebra (C1) called the atlas. To maintain this position there are muscles posterior, lateral, and anterior to the neck or cervical region that allow you to hold up your head, and also permit a wide range of movement. Try turning your own head while keeping your shoulders in a fixed position. The most important anterior pair of neck muscles are the **sternocleidomastoids** (Figure 2.22). Acting together, they are the muscles that allow you to flex your head towards your chest. Without them you cannot get up from a supine position (lying down). Individually, each sternocleidomastoid muscle tilts the face up and towards the opposite side.

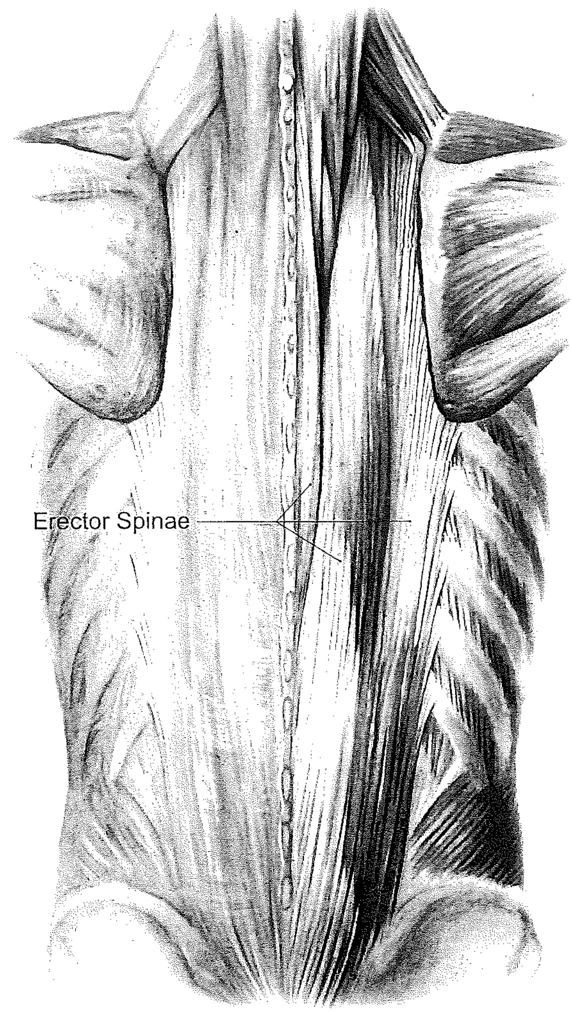


Figure 2.23 Deep posterior back muscles.

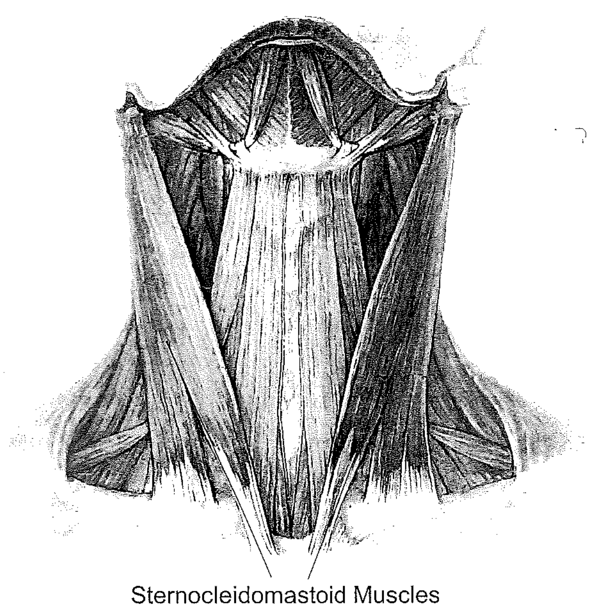


Figure 2.22 Anterior neck with sternocleidomastoid muscles.

Posteriorly, there is a large muscle mass reaching in segments from the sacrum inferiorly, and to the skull superiorly, called the **erector spinae muscles** (Figure 2.23). They do what their name suggests – maintain your erect position. They are sometimes called the **anti-gravity muscles**. When someone faints, these muscles no longer function and the body falls face forward to the ground. Just imagine what it would be like if we were unable to keep our bodies upright – this ability to stand erect and walk on two feet is one feature that sets us apart from most other species.