CHAPTER 1

Basic Terminology

NAMING BODY SEGMENTS

When naming parts of the body such as the head, neck, chest, and so forth, anatomical terms are generally the same as those in common usage. However, the anatomical names of certain limb regions differ from what we are accustomed to in everyday conversation. Thus, anatomists reserve the term **arm** specifically for that portion of the upper limb between the shoulder and elbow. The segment from the elbow to the wrist is called the **forearm**. In the lower limb, the term **leg** is reserved for that portion between the knee and the ankle. The segment from the hip to the knee is designated as the **thigh**.

Because the way anatomists use the words “arm and “leg” differs from common practice, it is prone to cause confusion. Clinicians have adopted the very sensible approach of specifying “upper arm” and “lower leg” for these two bodily regions. I will adopt clinical terminology, but you should not expect it to be used on the USMLE.

TERMS OF DIRECTION

General Considerations

Anatomists have special terms for discussing where things are positioned in the body. These terms enable one to describe unequivocally the location of lesion, or where to place a stethoscope, or where to feel for a tumor in a patient whether that person is standing, sitting, lying, or upside down. Therefore, one must learn these terms of direction well. Additionally, it will be seen that sometimes two or more bodily structures have the same basic name, and are distinguished from one another nomenclaturally by adding directional adjectives to this basic name. For example, there are three **serratus** muscles. One is anterior to the others and is, therefore, called **serratus anterior**. Of the two posterior serratus muscles, one is superiorly positioned and the other is inferiorly placed; thus, we have a **serratus posterior superior** and a **serratus posterior inferior**. Of course, there is no need for such directional adjectives unless two or more structures have the same basic name. Furthermore, logic demands that if there exists a structure with a directional adjective appended to its base name, there must exist another structure with the same base name and a contrasting directional adjective. In other words, if there is a **superior epigastric** artery, there must be another epigastric artery that is **inferior**. Directional adjectives are never gratuitous.

Although I should stress the importance of using the proper anatomical terms of direction in communicating the position of structures in the body, it is a fact that no one uses these terms all the time. When two English-speaking anatomists have a discussion, or when an English-speaking anatomist (such as I) writes a text, the precise and internationally accepted terms of direction are often replaced by more colloquial phrases. Thus, we say "in front of" instead of "anterior to." In the discussion that follows, I shall indicate common English equivalents of certain anatomical terms.

The Anatomical Position

All discussion of directions begins with a consideration of **the anatomical position**. The anatomical position is that assumed by a standing person with upper limbs at the sides and with the nose, palms, and feet pointing directly forward (Fig. 1-1*A*). By defining all terms of direction relative to the anatomical position, there will be no confusion when the head is turned, or the limbs are in working positions.

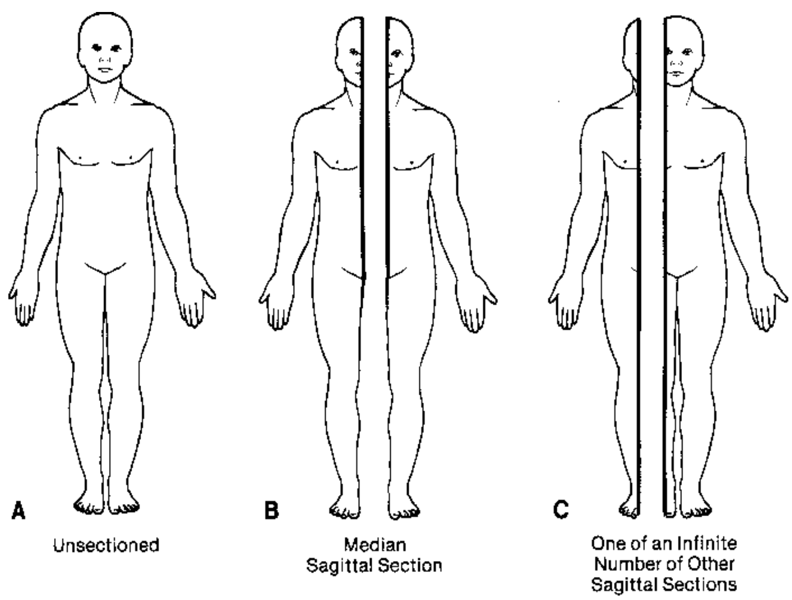

Figure 1-1. The anatomical position viewed from the front (*A*), and sections through sagittal planes (*B*, *C*).

Planes

In order to understand directional terms, it is helpful to consider the "planes" of the body. The ability to form a mental image of these planes takes on added significance for the interpretation of pictures resulting from the techniques of Computerized Tomography (CT) and Magnetic Resonance

Imaging (MRI). The names of planes describe the independent ways you can separate a person into two parts.

Sagittal Plane

If you slice a person from top to bottom, separating the right half of the body from the left half, the knife is said to have passed through the **median sagittal plane** and to have made a median sagittal section (Fig. 1-1*B*). The word "median" refers to a position exactly halfway between the left and right edges of the body. It is obvious that you could shift the knife either to the right or left of the median position and thereby produce two unequal portions of the body when you make your slice (Fig. 1-1*C*). As long as the slice was kept parallel to the median sagittal plane, the path of the knife will be said to follow a sagittal plane (just not the median one) and to have made a sagittal section (just not a median one). Obviously, there are an infinite number of possible sagittal sections both to the right and to the left of the median sagittal plane.

Coronal Plane

If you slice a person from top to bottom, separating the back of the body from its front, the knife is said to have passed through a coronal plane and to have made a coronal section (Fig. 1-2). There is no such thing as a "median" coronal plane; there are only an infinite number of coronal planes all parallel to one another and all separating some fraction of the back part of the body from the remaining front part.

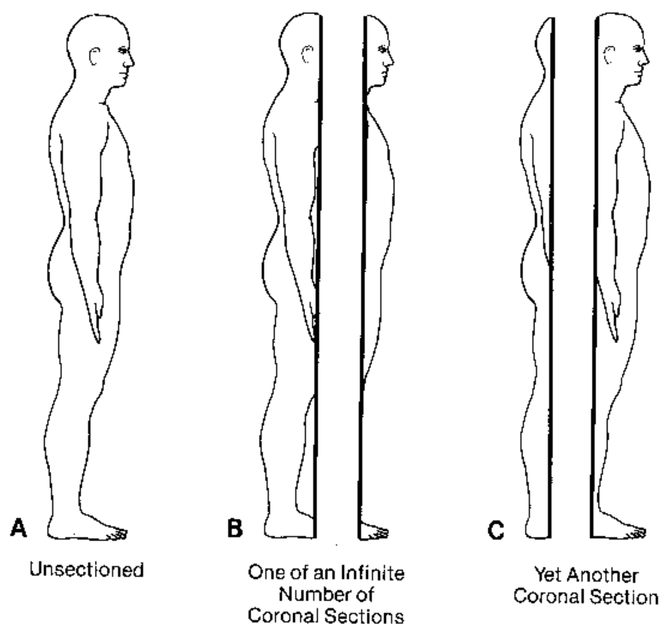

Figure 1-2. The anatomical position viewed from the side (*A*), and sections through coronal planes (*B*, *C*).

Transverse Plane

If you slice a person from side to side, separating the top of the body from its lower portion, the knife is said to have passed through a transverse plane and to have made a transverse section (Fig. 1-3). This is the kind of section most commonly produced by CT scans. There is no name for the transverse plane that separates the top half from the lower half; there are only an infinite number of transverse planes and corresponding transverse sections.

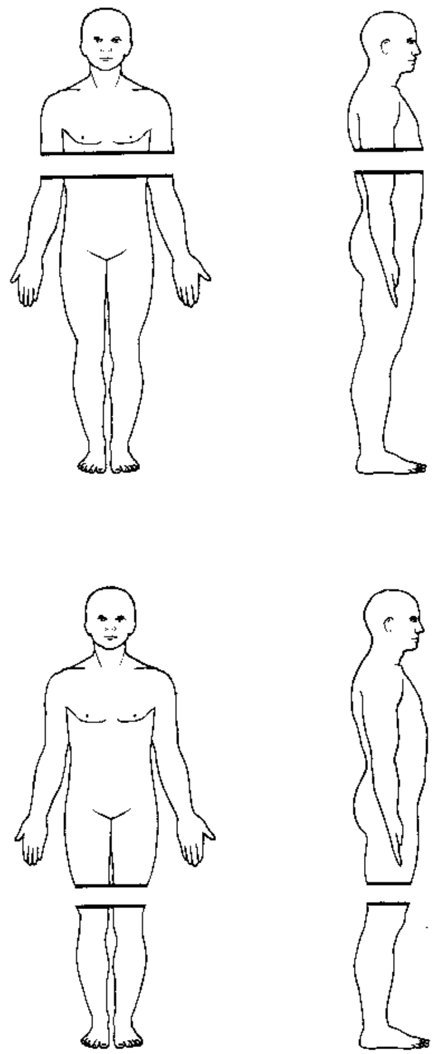

Figure 1-3. Two of an infinite number of possible sections through transverse planes.

Directions

Medial/Lateral

The closer is a structure to the median sagittal plane, the more **medial** it is said to be (Fig. 1-4). When a structure lies on the median sagittal plane, it has a **median** position. The further is a structure from the median sagittal plane, the more **lateral** it is said to be. There are no common terms that adequately substitute for medial and lateral.

It is clear that a proper understanding of the anatomical position is particularly important in using the terms medial and lateral as applied to the upper limb. The thumb is lateral to the little finger in the anatomical position. Even though the thumb and little finger may change relative positions in true space when the palms face backward, the thumb is still lateral to the little finger because "lateral" always refers to location when the body is in the anatomical position.

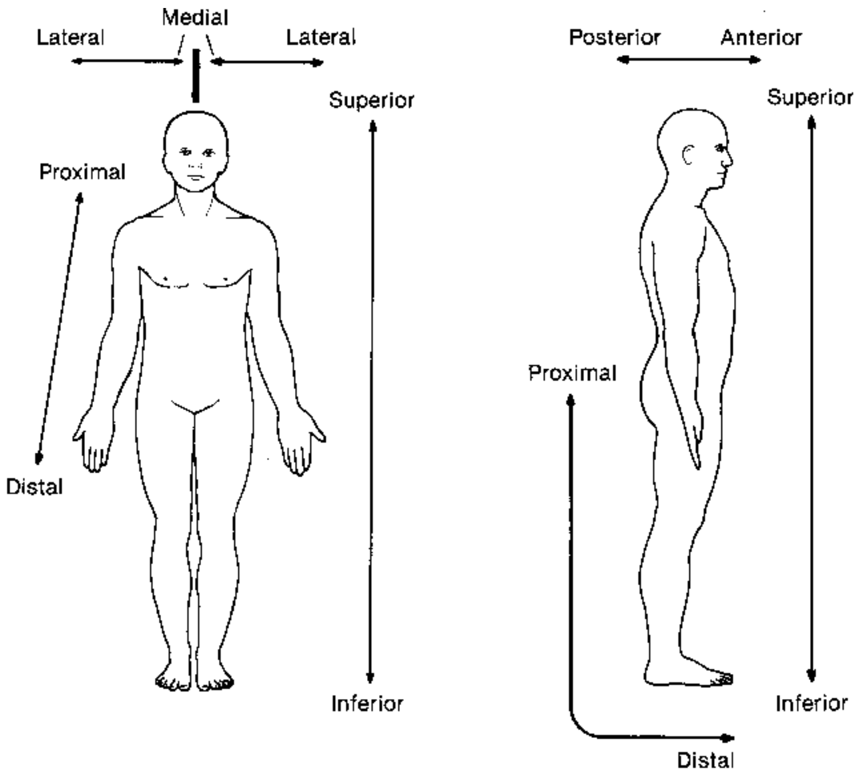

Figure 1-4. Anatomical terms of direction.

Anterior/Posterior

The more a structure lies toward the front of the body, the more **anterior** it is (see Fig. 1-4). The more a structure lies toward the back, the more **posterior** it lies. The umbilicus is anterior to the spine. The shoulder blades are posterior to the breastbone. The phrase "in front of" is an acceptable substitute for "anterior to;" the word "behind" is an acceptable substitute for "posterior to." In humans, the term **ventral** is synonymous with anterior, and **dorsal** is synonymous with posterior.

Again, an understanding of the anatomical position is important when considering parts of the body that can turn from side to side. By definition, the nose is anterior to the left ear even when a person turns the head far to the right. By definition, the palm is anterior to the back of the hand no matter how the hand is placed. To avoid confusion, anatomists often use the terms **palmar** or **volar** instead of anterior when referring to the hand.

Superior/Inferior

The nearer a structure lies toward the top of the head, the more **superior** it is (see Fig. 1-4). The nearer a structure lies toward the soles of the feet, the more **inferior** it is. The word "above" is an acceptable substitute for "superior to;" the word "below" is an acceptable substitute for "inferior to." Within the trunk, **cranial** is synonymous with superior, and **caudal** is synonymous with inferior. The analogy between the superior surface of the foot and the back of the hand causes anatomists to refer to the superior surface of foot as its **dorsum**. The term **plantar** is usually used instead of inferior when speaking of the foot.

Since the terms superior and inferior are defined in reference to the anatomical position, technically the elbow is superior to the hand even when a person is grasping an object above the head.

However, there is always the temptation to say that when a person reaches above the head, the upper limb assumes a position in which the hand is superior to the elbow. To avoid the confusion that such temptation spawns, when talking about limbs we often replace the superior/inferior dichotomy with the proximal/distal dichotomy.

Proximal/Distal

For a limb, the closer a structure lies to the site where that limb attaches to the trunk, the more **proximal** that structure is said to be (see Fig. 1-4). The further out along the limb is that structure, the more **distal** it is said to be. Thus the elbow is proximal to the hand, and this is clearly true even when a person is reaching for something above the head. Similar logic for the lower limb dictates that the toes are the most distal structures in the foot, even though they are no more inferior than is the heel. There are no adequate common words to replace proximal and distal.

The terms "proximal" and "distal" are often used for nonlimb structures if one can identify a beginning and end to the structure. Thus, the proximal part of the aorta is near the heart, whereas its distal part is in the abdomen. The use of proximal and distal for nonlimb structures is colloquial and, therefore, prone to generate confusion.

Superficial/Deep

In any section of the body, some structures will be closer to the external environment and others will lie more toward the center of the section, buried deep within the body. The closer to the external environment a structure is, the more **superficial** it is said to be; the closer to the center of the section lies a structure, the **deep**er it is said to be. Hair and epidermis are obviously the most superficial structures of the body. Everything else is deep to them. Muscles of the limb are deep to its skin, and a centrally positioned bone (such as the humerus) is the most deeply lying structure in a limb.

External is a synonym for superficial, and **internal** is a synonym for deep. The word "overlies" is an acceptable substitute for "is superficial to"; the word "beneath" is an acceptable substitute for "deep to."

Ipsilateral/Contralateral

While not strictly terms of direction, these words will be defined now. It is said that two structures are **ipsilateral** to one another if they are the same side of the body (i.e., both are on the left or both are on the right); they are **contralateral** to one another if they are on opposite sides of the body. Thus, damage to the left side of the spinal cord can cause ipsilateral paralysis (i.e., paralysis of muscles on the left side), whereas damage to the left side of the brain causes paralysis of contralateral muscles (those on the right side of the body).

LAYERS OF THE BODY

In any section of the body, as one passes from the most superficial aspect to the deepest point, several well-defined layers are encountered (Fig. 1-5).

Skin (Epidermis and Dermis)

The most superficial layer of the body is the **epidermis**, less than a millimeter thick everywhere except the soles of the feet. Sweat glands and hair are derivatives of the epidermis. It is virtually impossible to dissect the epidermis from the next deepest layer, the **dermis**. The dermis is a reasonably thick (1 to 2 mm on average) layer of dense irregular connective tissue. The name for the combined epidermis and dermis is **skin**.

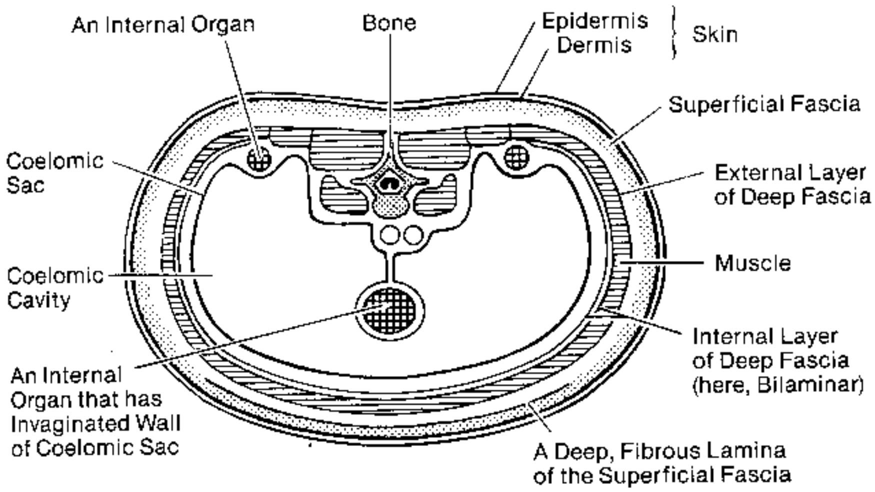

Figure 1–5. A schematic transverse section through the abdomen illustrating the different layers of the body.

Within the dermis are the small arteries that supply nutrients and oxygen to its own cells and (by diffusion) to the epidermis. Also within the dermis are, obviously, the small veins draining blood from the skin, and also lymphatic channels. The final major category of structures passing within the dermis are the nerves that carry sensory input from the skin and motor output to it. These are the **cutaneous nerves**.

One cannot emphasize strongly enough that cutaneous nerves are both motor and sensory. Students have no difficulty conceiving of the sensory roles (touch, temperature, pain) of cutaneous nerves, but many have never given thought to the fact that everywhere over the body the skin contains vessels with smooth muscle in their walls, and in most places also sweat glands and **arrector pili** smooth muscles that cause goose bumps. The smooth muscle cells require motor innervation to contract, and the sweat glands require motor innervation to secrete. The motor fibers within cutaneous nerves are part of the sympathetic portion of the autonomic nervous system (see further on). In some regions of the body, excessive activity in these fibers may lead to cutaneous vasospasm and, thus, necrosis of skin. In other regions of the body excessive activity in these fibers may lead to cutaneous vasodilatation and, thus, flushing. In all regions excess sympathetic activity causes profuse sweating (hyperhidrosis), whereas damage to the sympathetic fibers that enter cutaneous nerves will cause absent sweating (anhidrosis).

Subcutaneous Layer (Superficial Fascia)

Beneath the skin is a layer of loose irregular connective tissue called the **subcutaneous layer** or **superficial fascia**. I will use these terms interchangeably. The subcutaneous layer is found deep to the skin everywhere in the body except the glans of the penis or clitoris. It is a repository of fat cells everywhere, although these cells are few in number (or absent) in the areola, nipple, scrotum, penis, and clitoris. The subcutaneous layer is bound by collagen fibers to the overlying dermis and to the next underlying layer, but in most places superficial fascia is itself sufficiently loose to allow the skin to slide on deeper structures. Only in the scalp, palms of the hands, and soles of the feet does the collagen content of the subcutaneous layer become so dense that the skin itself is effectively bound to deeper structures.

Obviously, no vessel or nerve can reach the skin without first passing through the subcutaneous layer. Often, the larger cutaneous vessels and nerves run for a considerable distance in the deepest part of the superficial fascia before they send off smaller branches that actually enter the dermis. In dissection, it is within the superficial fascia that one looks for the named cutaneous vessels and nerves of the body.

It should also be obvious that any muscle arising from a bone but inserting into the dermis must pass through the superficial fascia. The muscles of facial expression fall into this category.

In some locations the deepest part of the subcutaneous layer is more heavily fibrous than usual, so that this layer then consists of a deep fibrous lamina and an overlying looser fatty tissue.

Deep Fascia

Aside from the muscles of facial expression, the striated muscles of the body lie deep to superficial fascia. These striated muscles have a clearly defined dense irregular connective tissue sheath that histologists call the **epimysium**, but gross anatomists call **deep fascia**. Where deep fascia and superficial fascia abut, they are bound together loosely by bridging collagen fibers. The deep fascial sheath of one muscle is loosely bound by collagen fibers to the deep fascial sheaths of adjacent muscles. Often one finds major nerves and vessels running in the deep fascial interval between two muscles. These nerves and vessels give branches to each other and to muscles and deep fascia. Sometimes, after muscular branches are given off, the remainder of the nerve or vessel will move superficially, pass out of the deep fascia, and enter the superficial fascia to distribute to the skin.

In some regions of the body the epimysium on either the superficial or deep surface of a muscle splits into two layers connected to one another by connective tissue bridges. The layer furthest from muscle tissue then becomes thickened to form a deep fascial sheet that will be given a special name (examples will be given later in the text).

Specializations of the Deep Fascia of Limbs

The epimysium on the outer surface of a superficially placed limb muscle blends with the epimysium on the outer surface of its neighbors to form a deep fascial sleeve that envelops the whole limb. More distally in a limb segment, where the muscles themselves are represented mainly by tendons, the integrity of this deep fascial sleeve is maintained despite the fact that it no longer serves as epimysium.

At some locations, muscle fibers actually arise from the sleeve of deep fascia, giving it a tendinous quality. At other locations, the deep fascial sleeve of a limb may be strengthened by fibers sweeping off a tendon that has its primary insertion onto bone. Such tendons are then said to have **expansions** into deep fascia. Finally, there are sites in both the upper and lower limbs where the deep fascial sleeve is strengthened by the addition of transverse fibers to create **retinacula** that serve the purpose of holding tendons close to the surfaces of joints. All these specializations of the deep fascia of limbs will be discussed further in Chapters 9 and 10.

Bones

Bones are usually surrounded by the muscle layer of the body. The periosteum of the bone intervenes between osseous tissue and the epimysium of surrounding muscles. Sometimes a bone will have no muscle on its superficial surface, in which case its periosteum contacts superficial fascia. Such a bone is said to have a subcutaneous surface.

The Body Wall

The layers we have discussed so far, i.e., skin, superficial fascia, deep fascia with its enclosed muscles, and bone, are said to form the body wall. The limbs develop as outgrowths of the body wall and contain only these layers. In the trunk, head, and neck, there are other structures deep to the body wall. These structures are said to reside in the **body cavity**.

Structures Deep to the Body Wall

Deep to the body wall, within the body cavities of the trunk, head and neck, are the internal organs. Additionally, deep to the body wall of the trunk is a fluid-filled sac (the **coelomic sac**), the walls of which are composed of connective tissue lined on its inner surface by serous **mesothelial** cells. The serous mesothelial cells secrete (or allow passage of) a lubricating fluid that fills the cavity of the sac (the **coelomic cavity**). Over most of the surface of the coelomic sac, its wall is immediately subjacent to the body wall. The connective tissue of the coelomic wall is then loosely bound by bridging collagen fibers to the deep fascia of the overlying muscles, and the two can be dissected away from one another. At some sites, internal organs will exist in the space between the fluid-filled sac and the body wall. At other sites, organs will invaginate the connective tissue wall of the coelomic sac, encroaching on, but not actually entering, the fluid-filled coelomic cavity. When this happens, the connective tissue wall of the coelomic sac forms the outer sheath of such an invaginating internal organ, and it is not possible to dissect away cleanly the wall of the sac from the parenchyma of the organ.

The deeply placed fluid-filled coelomic sac is divided into three portions in the chest--two pleural sacs and one pericardial sac--and these are separate from a single peritoneal sac of the abdomen and pelvis. Detailed description of these sacs is presented later in the text.

JOINTS AND MOVEMENTS

Definition of a Joint

A functional definition of a joint is "a gap between two bones developed for the purpose of permitting motion between them." In some instances the gap is completely filled with connective tissue, as is the case with sutural joints between the skull bones of neonates, the joints between vertebral bodies, and the pubic symphysis. However, the functional definition of a joint excludes connective-tissue-filled gaps that exist for a reason other than permitting motion. Thus, following birth, cranial sutures are no longer to be considered functional joints. Neither are a variety of so-called syndesmoses (i.e., fibrous links) between limb bones.

Synchondroses, which are gaps between bones filled with hyaline cartilage, exist to allow rapid growth and are likewise not to be classified as joints in any functional sense (the 1st sternocostal synchondrosis being the only exception). In fact, any movement between the bones on either side of a growth cartilage is highly deleterious.

The most common type of motion-permitting gap between bones is a space occupied by lubricating fluid and surrounded by a fibrous capsule. The capsule is lined by a serous membrane that secretes the fluid. The ends of the bones facing the gap are covered by a cushion of articular cartilage. Such a joint is called a **synovial joint**; its serous membrane is called a **synovial membrane**; its fluid-filled gap is called a **synovial cavity**.

Synovial joints exist to permit motion, but this does not mean that any and all kinds of movement are desirable. First, all joints should resist major separations (i.e., dislocations) of their bony components. Second, at many joints the only useful motion is restricted to one or two planes. In our analysis of the synovial joints of the body, we will want to ask how any given joint is structured so as to prevent undesirable movements.

General rules concerning the innervation and blood supply to joints: Any deep nerves and arteries that course past a synovial joint will send branches to it. Also, any nerve that innervates a muscle crossing the joint is likely to innervate the joint. I state these now to explain why later sections of the text will not describe the specific innervation or arterial supply to a given joint.

Movements

The movements of any one body segment relative to another have specific names. When naming a movement, the anatomical position is designated as the starting point. The movement itself is described in reference to the one of the planes of the body. Although general rules exist for naming movements, there are exceptions, particularly for the thumb and parts of the lower limb.

Flexion

The movement of any part of the body from its location in the anatomical position to a more anterior location is called flexion. Such movements occur about a transverse axis and in a sagittal plane. As you bend your head forward, this is flexion of the head and neck. Flexion of the back carries the upper trunk anteriorly as in touching the toes. Flexion of the fingers brings them anteriorly, as in a grip.

The general rule for naming flexion is violated in three instances. Look at your thumb. Its position in the hand is rotated 90 degrees to that of a finger. Consequently, the movement of the thumb that corresponds to flexion of the fingers actually sweeps the thumb medially across the palm. Nonetheless, this is called flexion of the thumb. Because embryonic development of the lower limb involves a rotation opposite to that undergone by the upper limb (see Chapters 9 and 10), the motion at the knee that is analogous to flexion at the elbow actually brings the lower leg posterior to its location in the anatomical position. Nonetheless, it is called flexion. The foot, being at a right angle to the lower leg, adds yet another complication. In order to be analogous to flexion of the hand at the wrist, flexion of the foot at the ankle ought to describe a movement that brings the ball of the foot inferiorly, as in standing on your toes. But since this movement makes the lower limb longer, no one likes to use "flexion" in this case. The problem is avoided by using the term **plantarflexion** to describe the movement at the ankle that occurs when standing on the toes. One may use either "flexion" or "plantarflexion" to describe curling of the toes.

Extension

The opposite movement to flexion is extension. Except for the thumb, lower leg, and foot, this movement carries a part of the body from its anatomical position to a more posterior location. Extension of the thumb moves it laterally; extension of the lower leg carries it anteriorly. In order for extension of the foot at the ankle to be analogous to extension of the hand at the wrist, it ought to describe a superior movement of the ball of the foot, as in standing on your heels. But no one wants to use "extension" in this case, because the movement diminishes the length of the lower limb. Thus, the term **dorsiflexion** has been adopted to describe this movement, which is opposite to plantarflexion. One may use either "extension" or "dorsiflexion" to denote straightening of the toes.

It is worth emphasizing that any movement bringing a part of the body that is already flexed back toward the "neutral" anatomical position is also called extension, just as a movement from the extended state back to the neutral is called flexion.

Abduction and Lateral Flexion

The movement of any part of the body from its location in the anatomical position to a new location further away from the median sagittal plane is called abduction. Such a movement occurs around an anteroposterior axis and in a coronal plane. However, there are more exceptions than followers to this rule. Among the followers are the movements at the shoulder, wrist, and hip, where swinging the upper arm, hand, or thigh to the side is called **abduction**. When speaking of movements at the wrist, the phrase **radial deviation** is synonymous with abduction.

The first exception to the rule on naming abduction concerns movements of the vertebral column that cause the trunk, neck, or head to shift to the side. These movements are not called abduction but are called **lateral flexion**. The trunk may be laterally flexed either to the left or to the right. A second exception concerns the fingers. Here it is a plane through the long (middle) finger, rather than the median sagittal plane, that is the reference. Movement of any finger away from a sagittal plane through the neutral long finger is called abduction. Any side-to-side movement of the long finger must be called abduction, since such movement always carries the middle finger away from its neutral position; it may be abducted to either the medial (ulnar) or lateral (radial) side. A third exception concerns side-to-side movement of the toes. Here it a sagittal plane through the 2nd toe that is the reference. Movement of a toe away from the 2nd toe is abduction. The 2nd toe (like the long finger) is said to abduct when it moves either medially or laterally away from its neutral position. A final exception to the general rule about using the term "abduction" is presented by movements of the thumb. Again, because of the thumb's 90-degree rotation relative to the fingers, movement of the thumb analogous to abduction of the index finger actually carries the thumb anteriorly away from the palm, not laterally. Anterior movement of the thumb is called abduction.

Abduction of the forearm at the elbow, abduction of the lower leg at the knee, and abduction of the foot at the ankle are all legitimate movements describing motion of the respective body part away from the median sagittal plane. However, such movements do not occur unless there is rupture of ligaments that ordinarily prevent them. An examiner may attempt to abduct the forearm, lower leg, or ankle in order to test the integrity of such ligaments, but there is no point in asking a patient to perform such movements.

Adduction

The opposite movement to abduction is **adduction**. The upper and lower limbs are carried toward the median sagittal plane; the fingers are carried toward the middle finger; the toes are carried toward the 2nd toe; the thumb is moved posteriorly into contact with the lateral edge of the palm. Adduction of the middle finger or 2nd toe means no more than bringing it from the abducted position to its neutral position. There is no such thing as adduction of the trunk. When speaking of movement at the wrist, the phrase **ulnar deviation** is synonymous with adduction.

Rotation

Movement of any part of the body around a supero-inferior axis is called rotation. The trunk, neck, and head may rotate so that a person faces more to the right or more to the left. Rotation of limb segments is further specified by what happens to the anterior border of the segment during the rotation. If a limb segment is rotated so that its anterior border moves medially from where it lay in the anatomical position, this is **medial rotation**. If the limb segment is rotated so that its anterior border moves laterally from where it lay in the anatomical position, this is **lateral rotation**. Clinicians often use the terms **internal rotation** to substitute for medial rotation, and **external rotation** to substitute for lateral rotation. This is one instance in which I believe anatomists' usage is preferable. Everybody refers to medial rotation of the forearm as **pronation**; lateral rotation of the forearm is called **supination**.

Rotatory Movements of the Foot. Because the long axis of the foot is at right angles to the supero-inferior axis of the body, rotation of the foot occurs around an anteroposterior axis (i.e., from heel to tips of toes). However, the complexity of the joints between foot bones prohibits a simple rotatory movement around such an anteroposterior axis. Rather the foot can be twisted so that the sole faces somewhat medially--a movement called **inversion**--or so that the sole faces somewhat laterally--a movement called **eversion**. The terms "inversion" and "eversion" usually refer to movements that occur when the sole of the foot is off the ground. Similar movements at the relevant joints can occur when the sole of the foot contacts the ground. In this case, the term **pronation** replaces "eversion", and the term **supination** replaces "inversion."

Opposition

When the thumb is moved as if to touch its tip to the tip of the little finger, the thumb undergoes an abduction, medial rotation, and flexion. This threefold combination of movements is called **opposition**.

DEFINITIONS OF MUSCLE ACTION AND MUSCLE FUNCTION

Muscles are able to shorten and thereby produce movement, or they can resist being lengthened and thereby prevent (or retard) movement. The **action** of a muscle is defined as those motions produced by its *shortening*. If one knows the attachment sites of the muscle, its action can be deduced by a simple consideration of what happens when these sites come closer together.

The **function** of a muscle is something different; it is the reason that the brain chooses to stimulate (i.e., recruit) a muscle. Now it is certainly the case that a muscle may be recruited because its action is desired. For example, the action of certain muscles is to flex the forearm, and they are often used for this purpose. In such instances, the function and action are the same. On the other hand, the reason for using a particular muscle may be that its ability to resist lengthening can stop some undesirable aspect of another muscle's action, or even stop a tendency for gravity or momentum to alter limb position. For example, the abductors of the thigh are used more often to stop gravity from producing adduction at the hip than to swing the lower limb out to the side. The distinction between action and function is not confined to limb muscles: what happens when the pelvic diaphragm shortens is not as important as the fact that by resisting being lengthened it allows a buildup of pressure within the abdominal body cavity. Never forget that you may not have learned the function of a muscle if all you know is its action.

LYMPH

There is a net movement of water and plasma proteins (mainly albumin) out of blood capillaries into surrounding tissues. The lymphatic system returns these items to the blood. Lymphatic vessels begin as highly permeable blind capillaries situated between the cells of a tissue. The water and proteins that enter these capillaries constitute the **lymph**. In the bowel, absorbed fat also enters lymphatic capillaries. Fatty lymph is called **chyle**. Lymphatic capillaries join to form larger vessels, which in turn join to form dissectible lymphatic trunks. The trunks empty their contents into large veins in the neck in a manner to be described later.

Along the path of certain lymph vessels are **lymph nodes** - encapsulated collections of lymphocytes that represent a line of defense against bacteria and cancer cells that can readily enter lymphatic capillaries.