

**DYNAMIC ANATOMY  
AND  
PHYSIOLOGY**

# DYNAMIC ANATOMY AND PHYSIOLOGY

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## PREFACE

In the healing arts, where anatomy and physiology are essential components, an inexorable change is taking place. Yesterday the emphasis was on structure. Today it is focused on function. Anatomy, both gross and microscopic, is now recognized, not as an end in itself, but rather as a prerequisite for the comprehension of physiology, which in turn is essential for the total understanding of the human body. This textbook breaks with tradition. Not only is anatomy reduced, but the study of function—that is, physiology—is at all times integrated into the broader considerations of the student's major goal. It is questionable whether a textbook can ever stimulate a change. But it is beyond argument that a teaching text can and should keep step with a change that is definitely already on the march.

Students in the ancillary healing arts are taught in three different types of programs: (1) universities, (2) junior colleges, and (3) diploma schools conducted by hospitals. Regardless of the type of school, the graduate's preparation must be different from what it was only a few years ago. It is no longer adequate to possess didactic information concerning the human body. Now it is essential to have functional knowledge—understanding that permits one to appreciate the rationale of therapy rather than to follow orders blindly, mechanically, as would a robot.

It will become immediately apparent that this textbook has been written for students of diverse interests, of myriad backgrounds. For this reason anatomy and physiology have been, for the most part, separated. This should prove a useful organization for schools with progressive programs in which a core of fundamental anatomy and physiology is given early in the first year, to be followed by integration of additional anatomy and physiology in clinical courses. In addition, the peripheries of both subjects are explored so that each instructor may set his own

limits with the full awareness that there is present material to satisfy those exceptional students with more probing, insatiable minds.

A first edition, especially one that breaks with tradition, is always subject to criticism. We not only recognize that but we earnestly solicit comments from all who graciously take the time to read this text. Only through such aid can a book even approach the desired goals.

A textbook of this type is largely dependent on its illustrations. For this reason we are grateful for the outstanding photography of Joe Mineo and the striking drawings of Alice Baggett and John Desley. The chapters concerning sex and reproduction were graciously read and approved by Monsignor Thomas J. Riley, Rector of St. John's Seminary, Brighton, Mass.

We also wish to express our appreciation to Mary Swindle and Christine Bagley for their invaluable secretarial assistance.

*L. L. Langley*

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I

ORIENTATION





# 1

## SURFACE ANATOMY AND THE BODY CAVITIES

TO PLUNGE DIRECTLY into the detailed study of any one part of the body is to lose appreciation for the human being as an integrated, functional whole. One of the tragedies of teaching is that a subject must be dissected into its parts. This is particularly true in anatomy and physiology. Yet, the ultimate goal is for the reader to understand the total, intact body. It is for this reason that the first section is devoted to a general orientation. In this chapter an attempt is made to stand back from the human figure, to look upon it at sufficient distance so that all of it may be encompassed at one time. Later the individual muscles and the specific organ systems will be studied at close range, under higher magnification. But here only a very broad, very superficial survey is made. Practically all that is outlined at this point will be discussed again, and in greater detail. But this does not mean that this chapter should be omitted. Here the student will be introduced to anatomic descriptions and terms. Here one will become familiar with the over-all structure of the human body so that subsequently, when each part is taken up for analysis, its relationship to the remainder of the body will be appreciated. The reader is, of course, already familiar with much of the surface anatomy. However, strict attention must be paid to terminology. Many words are utilized in anatomy which are highly descriptive and specific. In order to be able to understand anatomic descriptions, one must become competent in this new language.

### ORGANIZATION OF THE HUMAN BODY

#### The Body Surfaces

**Anterior surface.** The anterior surface is the front of an individual. His face, chest, abdomen all constitute this aspect. Anterior is often used

interchangeably with ventral, a term which is derived from the French word meaning "belly." Since man assumes the upright position, the ventral surface is forward and therefore is synonymous with anterior. However, in lower animals the ventral surface faces downward. If these relationships are borne in mind, there will be no cause for confusion in subsequent descriptions.

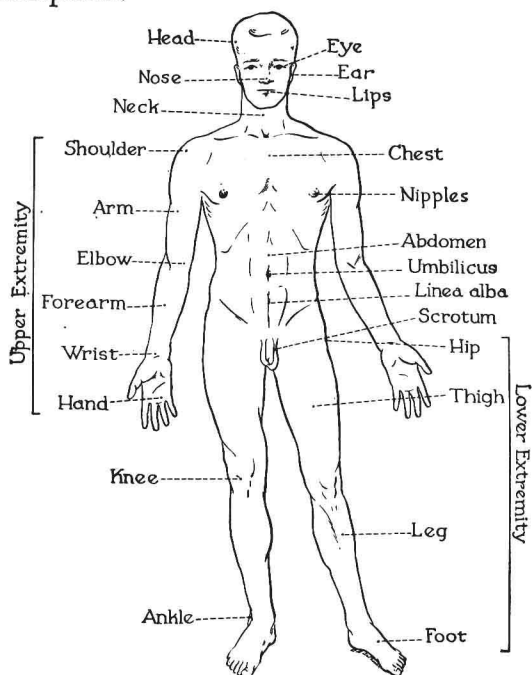


Fig. 1. The anterior surface of the body.

Figure 1 depicts the main subdivisions of the anterior surface. Most of the terminology is so well known that further comment is necessary only in relation to the extremities. It will be noted that the term arm is reserved for the part of the upper extremity between the shoulder and elbow. The area from the elbow to the hand, then, is known as the forearm. Similarly, the lower extremity is divided into the thigh and the leg.

**Posterior surface.** The back of man is referred to as the posterior surface. This area is also termed the dorsal surface. The expressions posterior and dorsal can be used interchangeably. In Fig. 2 this surface of the human body is portrayed. The major subdivisions are indicated and, again, they should be so familiar as to require no further elaboration.

### The Body Planes

**Sagittal plane.** If the human body were to be divided into a right and left side, the cut surfaces would present the sagittal plane or section.

Clearly, this cut could be made more to one side than the other, but it would still be correctly termed sagittal. On the other hand, if the body is divided exactly in half, then it would be described as a midsagittal section.

**Frontal plane.** It has been seen that the sagittal plane is vertical, that is, the cut runs with the long axis of the body. Another cut can be

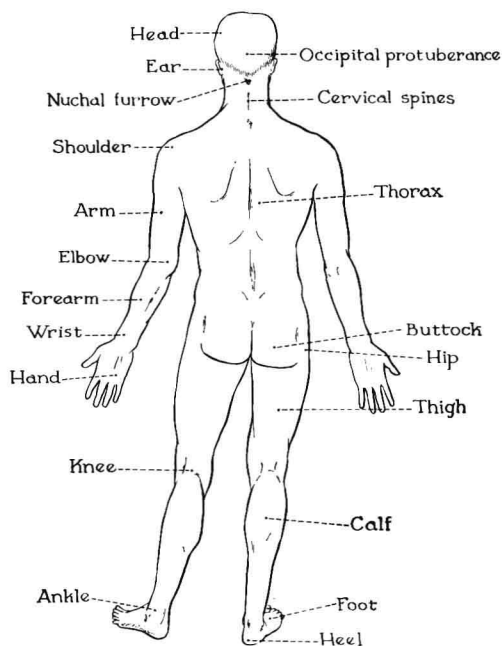


Fig. 2. The posterior surface of the body.

made that would also be vertical, but instead of dividing the body into a right and left side, the frontal or, as it is also called, the **coronal** section would separate the body into a front, or anterior, portion and a back, or posterior, part.

**Transverse plane.** Finally, a cut can be made that would be at right angles to both the sagittal and frontal planes, thereby dividing the body into an upper and lower part. Such a cut would be in the transverse plane.

## THE HEAD AND NECK

### The Cranium

The term *cranium* means "skull," but specifically it is the region of the skull which encloses the brain. Thus the head may be subdivided for the sake of description into the cranium and the face.

**The scalp.** The scalp, loosely speaking, is the part of the cranium which is usually covered with hair. More accurately it includes the skin, the subcutaneous tissues, the occipitofrontalis muscle, and the cranial periosteum.

**The ears.** The ears are prominent appendages on either side of the cranium. Each ear is composed of three major parts: (1) the outer ear, (2) the middle ear, and (3) the inner ear. Only the outer ear will be considered here in this brief anatomic orientation. This part consists of the pinna and the external auditory meatus. In man these structures possess more of a cosmetic than a physiologic value. Animals can focus the pinna so as better to gather sound waves. Man cannot do this, and it has been shown that removal of the pinna does not significantly impair hearing. The external auditory meatus protects the vital structures of the middle and inner ear. A bitter wax, termed **cerumen**, is secreted in the canal. It has been claimed that this substance repels insects. At the internal end of the external auditory meatus is the eardrum, called the **tympanic membrane**.

### The Face

The face is covered by skin that is remarkably thin, highly vascular, and liberally supplied with sebaceous and sweat glands. Beneath the skin is the subcutaneous tissue in which are found the facial muscles and main blood vessels. From a surgical viewpoint it is fortunate that the facial skin possesses not only a rich blood supply but also a very pliable subcutaneous tissue since this permits excellent healing, even when the edges of an incision must be drawn tight, with resultant tension. The surgeon, when making an incision, tries to follow existent wrinkles so as to make the scar almost invisible. The loose skin and subcutaneous tissue, though ideal, as just mentioned, for surgery, by the same token permit marked swelling due to inflammatory processes. Everyone is familiar with the swelling which follows a difficult dental extraction. In this case, the trauma of the extraction results in damage to the blood vessels so that fluid pours into the tissue spaces, a process termed **edema**. Since the skin is loose, it provides little opposition to the accumulation of fluid and the swelling becomes quite marked.

**The nose.** The nose is a cartilaginous protuberance which contains two passageways, or nostrils, separated by the septum. The nose is composed of both bone and cartilage. It is well to note at this time that bleeding from the nose, technically known as **epistaxis**, usually comes from small vessels in the septum. Ordinarily this bleeding can be controlled by either plugging the nostrils or pinching the nose firmly.

**The paranasal sinuses.** The term sinus has several meanings. On the one hand, it may have reference to a cavity in a bone, while on the

other, it can describe a channel for venous blood. In many of the bones which make up the cranium and face there are sinuses. The more important ones include the frontal sinuses, the sphenoidal sinus, the maxillary sinuses, and the ethmoidal sinuses (Fig. 3). Of most immediate concern are the frontal and maxillary sinuses, because it is these cavities which so readily become inflamed and give rise to the so-called "sinus"

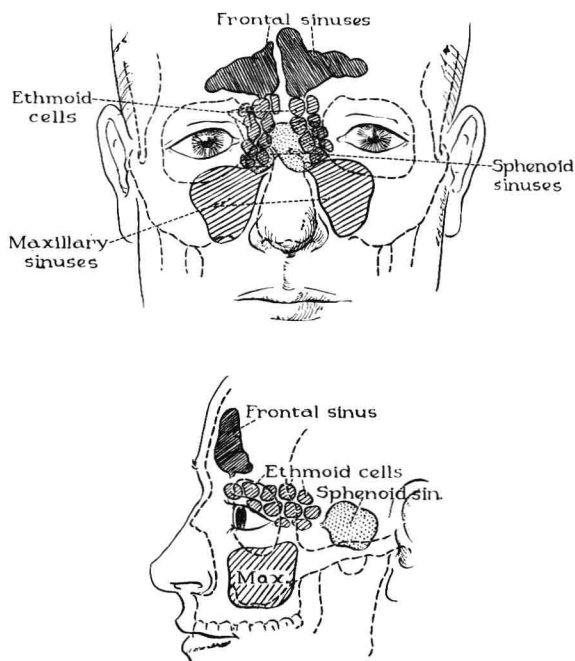
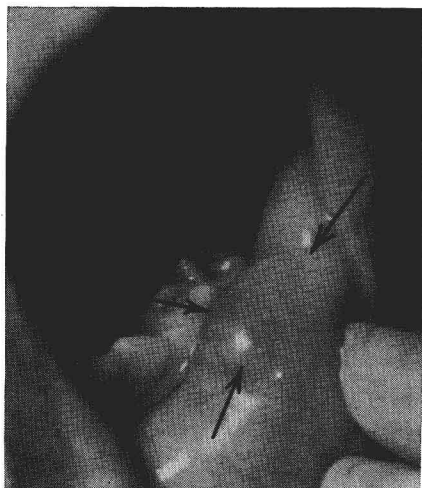


Fig. 3. The paranasal sinuses.

conditions. The maxillary sinus is the largest. There is an orifice at the uppermost part of this sinus which connects it to the nasal passageways. Under normal conditions, secretions of the mucous lining of the sinus are swept toward the orifice by the cilia of the epithelial covering of the mucous membrane. When the sinus is inflamed, the orifice is occluded. The secretions then fill the sinus, often exerting considerable pressure with resultant pain. The frontal sinuses also drain into the nasal passages. Since the sinuses are above the nose, drainage is aided by gravity. If the opening should become clogged, however, the secretions will accumulate in the sinuses and may evoke pain.

**The eyes.** The skin which covers the eyelids is very thin, and like the skin over the rest of the face it has beneath it a very loose subcutaneous tissue. This arrangement, as explained above, is highly favorable to processes which produce swelling. The edema which accompanies a "black eye" is a well-known example.

When the eyelids are separated, the eyeballs may be seen. Of primary note is the colorful iris with the pupil at its center. The iris is really a contractile diaphragm situated in front of the lens. This diaphragm, composed of smooth muscle, varies the size of the pupil in relation to the intensity of the light.



**Fig. 4.** A labial gland cyst.

**The mouth.** The lips guard the entrance to the mouth. They are two mobile folds covered externally with skin and internally with mucous membrane. When the lips are separated, there exists an opening which is known as the **oral fissure**. The point of junction of the upper and lower lips is called the **angle of the mouth**. There are numerous labial glands which secrete a mucous substance that serves to

protect the lips. Quite often, however, cysts form in these glands (Fig. 4). During embryological development, the lips, nose, and palate are formed



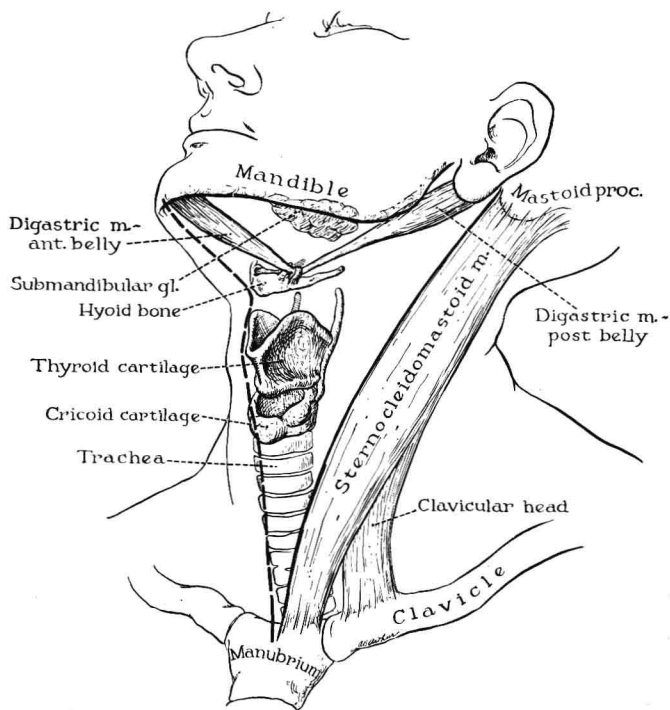
**Fig. 5.** A typical case of harelip. (E. Cheraskin and L. L. Langley, *Dynamics of Oral Diagnosis*, The Year Book Publishers, Inc., Chicago, 1956.)

by the fusion of several processes. In some instances there is a failure of union. Harelip is the result of such failure (Fig. 5). The deformity may

be only on one side, or it may be bilateral. It may also extend up into the nose or back into the palate to produce a cleft palate.

## The Neck

**Front of the neck.** In the midline of the neck, many prominent structures are visible (Fig. 6). The most outstanding is the thyroid carti-



**Fig. 6.** The topography of the neck.

lage, popularly referred to as the Adam's apple. It is larger and protrudes more in men than in women. Just above this cartilage, the hyoid bone may be easily felt. Immediately below the thyroid cartilage is the cricoid cartilage. If the head is held back as in Fig. 6, two heavy muscle bundles coursing into the lower part of the chin may be palpated. These masses form the anterior belly of the digastric muscle. In this position, two other muscles become quite apparent. They are directed at an angle from behind the ears, sweeping forward to end on the sternal bones close to the midline. These muscles are the right and left sternocleidomastoids. They constitute one of the most important landmarks in the neck.

**Side of the neck.** If the subject is viewed from the side, the sternocleidomastoid muscle is seen to form one limb of a triangle (Fig. 6).



This muscle is made even more prominent when the subject bends his head to the opposite side. The jaw and the midline of the neck complete the triangle. In this triangle, just below the mandible, the submandibular, or submaxillary, salivary gland may often be palpated. From the side, the thyroid prominence is seen in clear outline.

**Back of the neck.** From the rear of the subject, the nape of the neck, termed **nuchal furrow**, may be located (Fig. 2). At the upper part of this furrow, about 2 in. below the occipital protuberance, the spine of the second cervical vertebra may be palpated. From this point on down the cervical vertebrae may be counted.

## THE THORAX

The thorax is that part of the body situated between the neck and the abdomen. The thoracic cavity is separated from the abdominal space by the diaphragm. Within the thorax are the lungs, heart, great vessels, and esophagus. These structures will be considered in detail in appropriate chapters. Here, major attention will be paid to the anatomy of the thoracic cavity itself.

### The Thoracic Cavity

The thoracic cavity, or cage, is the space located above the diaphragm. It is enclosed by ribs and muscles and is lined on its inner surface by the pleura. During respiration, the size of the thoracic cage is varied, increasing on inspiration and decreasing during expiration. This alteration in thoracic size changes the intrathoracic pressure and thereby is responsible for the expansion and contraction of the lungs.

**The mediastinum.** The mediastinum effectively separates the thoracic cavity into a right and left chamber. It is a thick mass of tissue extending between the lungs the length of the cavity and passing from the vertebral column forward to the sternum. In this region (Fig. 7) are embedded the heart, great vessels, trachea, esophagus, and many of the major nerves. Because of the greater size of the left side of the heart, the mediastinum is pushed to this side to encroach on the left lung which, accordingly, is reduced in width.

**The pleura.** Each of the two chambers of the thoracic cavity is lined by a delicate membrane called the pleura. This membrane lines the walls, the diaphragm, and the mediastinum. It then sweeps back over the outer surface of the lungs. In other words, the pleura is a double membrane lining both the cage and the lungs. Between the two pleural layers is the cavity of the pleura. In this cavity, or space, there is normally serous fluid which serves as a lubricant for respiratory movements. It also creates considerable surface tension between the two pleural