CORE Textbook of ANATOMY

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Preface

This book is written for the medical student who, in today's shortened courses, must understand the basic principles of gross anatomy and retain sufficient knowledge to facilitate later study and clinical practice.

It is based upon many years of teaching medical students and seeing their problems in the course of close association in the laboratory. As a set of mimeographed notes, it was used by students over a period of five or six years, and it covers the material that might reasonably be learned in a course of 150 to 200 hours. The notes have been modified and corrected; clinical notes have been added to emphasize the relevance of the areas studied. The terminology, with few exceptions, is an anglicized version of that used in the internationally recognized *Nomina Anatomica.* Simplification has been stressed in order to promote easy understanding in a short time.

The detailed drawings found in standard atlases of gross anatomy are often difficult to understand. Therefore the illustrations in this book consist almost entirely of simplified line drawings which are intended more for comprehension than for the exhaustive depiction of structures and relationships. The book is designed to be used in conjunction with an atlas in which the form and the detailed relationships of structures can be visualized.

In general the drawings of bilaterally symmetrical structures are for those on the right side. However, occasionally a drawing of the left side is included to stimulate the realization that it is all too easy to become a "one-sided" doctor. Students must train themselves to understand the mirror-image relationship between the two sides of the body.

One shock that is in store for beginning students is the discovery that there are many variations of "normal" form and structure. These anomalies vary in frequency for different organs or parts of the body, and the student or practitioner must be aware of their existence. However, limitations of space required that most variations be ignored by the author. Consequently, although the student will know what to expect in the great majority of cases, he or she should realize that variations from normal can occur.

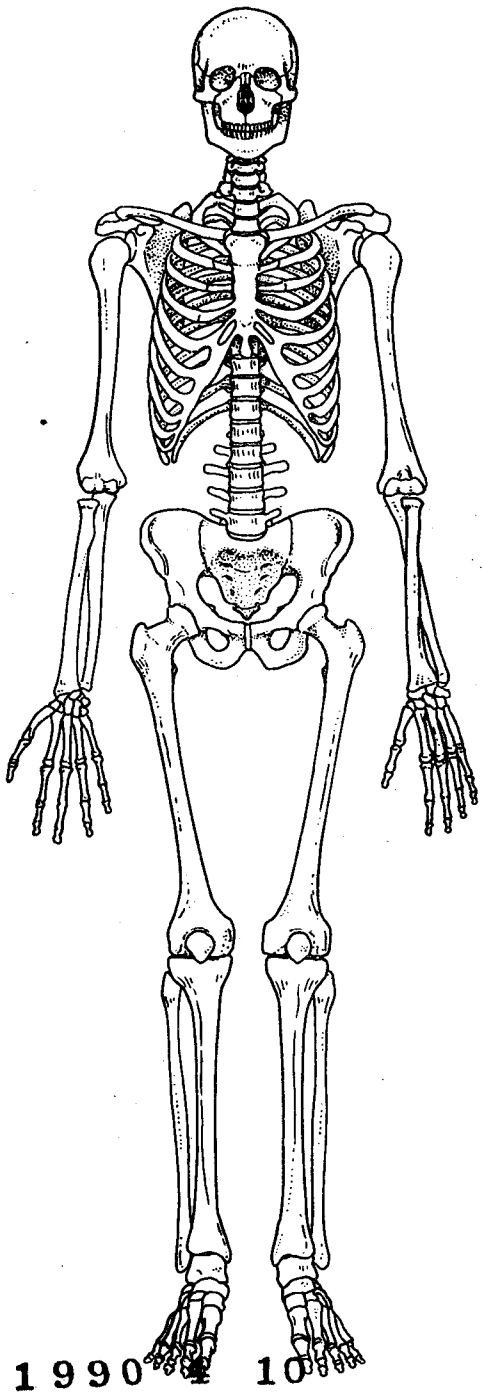
Towards the back of the book will be found a short list of suggested reading and references. Students may find these references helpful if they wish to have more information on particular topics. On occasion the individual books are referred to in the body of the text.

During the development of the manuscript the author has been assisted by the suggestions and criticisms furnished by others. In particular I should like to thank

Dr. R. G. MacKenzie who read the semicompleted manuscript and pointed out errors, inconsistencies, and places where the nomenclature differed from that of the *Nomina Anatomica.* Drs. W. M. Brown, J. W. A. Duckworth, and A. Roberts have offered many suggestions based upon the notes in mimeographed form, as they were used by students. Similarly many students called my attention to errors, which have been corrected, or made suggestions which have been incorporated as the years went by. Mrs. L. Wheeler and Miss P. Bryan have carefully and cheerfully typed and retyped the notes and the manuscript. To all of these I express my sincere thanks.

Finally I should like to thank the staff of the J. B. Lippincott Company for their suggestions and for the kindness and consideration shown during the preparation of the book.

J. S. THOMPSON, M.D.



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The human skeleton with pronated left forearm.

Contents

1 An Introduction To Gross Anatomy

TERMS AND CONCEPTS A STUDENT SHOULD UNDERSTAND

The human body is a complicated structure, and needs to be described in standard terms which can be understood by all practitioners and all students.

ANATOMICAL POSITION

The ***anatomical position*** (Fig. 1-1) is the "standardized" position of the body from which any part may be related to any other part through the use of defined descriptive terms. *It is used throughout clinical medicine* and the student can best learn this position by assuming it himself.

The anatomical position is as follows:

The individual is standing erect.
The face and eyes are directed forwards.
The hands are by the side with the palms directed forwards.
The heels are together, the feet are pointed forwards so that the great toes touch.

In this position, then, the eyes are ***lateral*** to the bridge of the nose, the lips are ***anterior*** to the incisor teeth, and the nose is ***superior*** to the mouth.

Danger. Students, on occasion, tend to relate one structure to another as if the body were lying on its back, as a cadaver on a dissecting table or a patient in bed. This can lead to serious errors and confusion when one tries to communicate information relating to the cadaver or patient to his colleagues.

PLANES

Certain planes of the body are defined, and should be known and clearly understood. In each case the description applies to the body *in the anatomical position.*

The ***median*** plane is that vertical plane which bisects the body into right and left halves.

A ***sagittal*** plane is any plane parallel to the median plane.

A ***coronal*** plane is any vertical plane at right angles to the median plane.

A ***transverse*** plane is any plane at right angles to both the median and coronal planes.

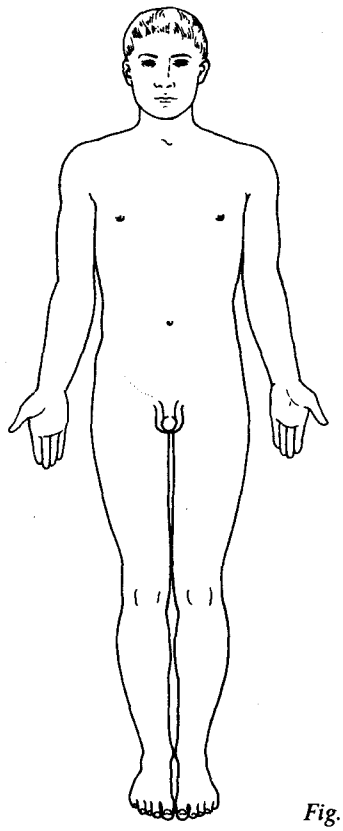

Fig. 1-1. The anatomical position.

Movements

Movement in joints may be around any one (or more) of three axes. The descriptions that follow are applicable to most joints, but for clarity of communication, it must be understood that, when applied to any one joint, they are specific to that joint.

Flexion-Extension. In general ***flexion*** of a joint, usually in a sagittal plane, is that movement which reduces the angle formed between the two bones. ***Extension*** increases the angle. In some joints (e.g., the shoulder) this is not a clear description but, ***by convention***, movement of the joint in a particular direction, is described as flexion rather than extension: in others (e.g., the ankle) to avoid confusion, there is said to be ***plantar-*** and ***dorsi-flexion***.

In the upper extremity, including the shoulder, flexion (in every joint except those of the thumb) is carried out in the sagittal plane and brings the extremity, or the appropriate portion of it, forwards.

Abduction-Adduction. In general, ***abduction*** (*ab* = from, *ducere* = lead) takes the structure (e.g., extremity or digit) away from the long axis (of the body or of some designated part of it) and ***adduction*** (*ad* = to) brings the structure back towards the long axis.

Circumduction. A combination of flexion-extension and abduction-adduction results in a cone of movement known as ***circumduction***. Circumduction is possible at any joint at which flexion-extension and abduction-adduction are both possible, for

instance, the metacarpophalangeal joint of the index finger. Note that rotation is not a component of circumduction.

Rotation. A bone may rotate around its long axis. ***Medial*** rotation brings the anterior surface of the bone or extremity towards the median plane while ***lateral*** rotation takes the anterior surface away from the median plane.

Special movements occur in particular regions of the body.

Pronation-Supination. These terms are confined to movement of the forearm around its long axis in such a way that the palm may be directed anteriorly or medially or posteriorly. *In the anatomical position* the forearm is supinated. Movement of the forearm from the anatomical position so that the palm is directed first medially and then posteriorly is ***pronation.***

Inversion-Eversion. These terms are related to the movements of the foot. ***Inversion*** directs the sole of the foot towards the median plane of the body. ***Eversion*** directs the sole of the foot away from the median plane of the body.

BONE

Bone is the supporting structure of the body, and consists primarily of a network of connective tissue fibers interspersed with cells and the whole lying in a ground substance which is impregnated with calcium salts to produce rigidity. Bone is generally divided into two types, based on density:

Compact: dense bone usually forming a firmer outer shell around a central mass of cancellous bone.

Cancellous: bone which consists of a mass of spicules between which is bone marrow. This marrow may be active in blood formation (red marrow) or largely inert and fatty (yellow marrow). In most long bones, the central portion of the shaft has a lumen (opening) where there is no cancellous bone, only yellow marrow.

Bones may also be classified by shape:

Long bones are tubular with a shaft and two extremities (e.g., humerus).
Short bones are cuboidal in shape (e.g., bones of the wrist).
Flat bones consist of two plates of compact bone with cancellous bone between (e.g., ilium).
Irregular bones have various shapes (e.g., bones of the face).
Sesamoid bones are round or oval and are found within tendons.

Bone is living tissue capable of growth and repair. Since it is living it requires a blood supply and ***nutrient arteries*** can be seen to enter the bone. These arteries leave foramina in the bones, many of which are readily identifiable in skeletal material.

BONE GROWTH

A long bone grows in diameter by new bone being deposited under the periosteum and by old bone being removed from the area adjacent to the lumen.

A long bone grows at both its ends (Fig. 1-2). Each end contains a plate of cartilage called the ***epiphyseal plate***, and growth occurs on both sides of this plate. The shaft of the bone is the ***diaphysis***, where bone forms first, in the ***primary center*** of ossification. The end of the diaphysis, i.e., that part that is adjacent to the epiphyseal plate, is the ***metaphysis***. The center of ossification that is separated from the diaphysis by the

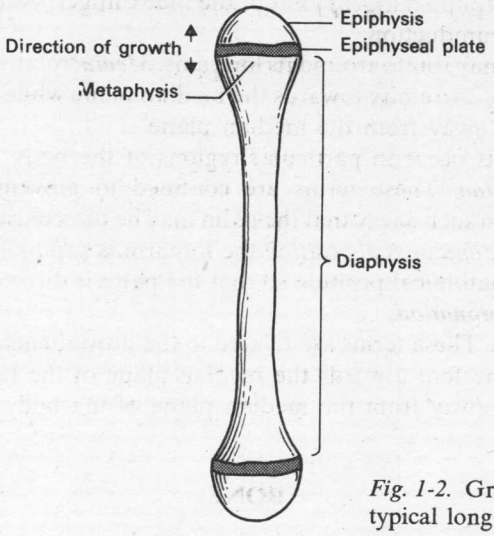

Fig. 1-2. Growth, in length, in a typical long bone.

epiphyseal plate is the ***epiphysis*** or ***secondary center*** of ossification. Epiphyses may occur in short, flat and irregular bones as well as in long bones.

BONE AGE

Different epiphyses show ossification (with calcium deposition) at different, characteristic times. Epiphyseal bone deposition usually starts before birth or soon after it. In contrast the epiphysis is united to the diaphysis ***by bone*** when the cartilage becomes ossified. This is usually sometime in adolescence but again the time of union is *characteristic for the particular union concerned.*

Clinical Note. These characteristics of bone growth mean that there are two types of change detectable by x-ray:

(a) The appearance of calcium in either the primary or secondary center of ossification.
(b) The disappearance of the cartilaginous epiphyseal plate.

These changes occur at known ages and these ages differ for the different centers. Thus a radiologist can estimate the age of an individual by noting whether or not certain epiphyses have appeared or whether or not they have fused. Memorizing the exact dates of appearance or fusion of individual epiphyses is, for a student, an exercise in futility, but he should know that bone age can be determined in this way and also that certain disease processes can slow or accelerate bone age as compared with chronological age. Those desiring detailed information on ages of ossification are referred to *Gray's Anatomy* (1973) or *Cunningham's Textbook of Anatomy* (1964).

MUSCLES

Basically muscles are of two types. ***Striated*** muscle, so-called because of its appearance under the microscope, is under the conscious control of the somatic nervous system and therefore is also called ***voluntary*** muscle. ***Smooth muscle*** does not appear striated under the microscope and is not under voluntary control. It may be called

involuntary and it forms a major portion of the wall of many hollow ***viscera***. ***Cardiac muscle*** is a special type of striated muscle found in the heart.

The following description largely applies to striated muscle.

A muscle has only one possible action: it can ***contract***. Normally this contraction causes the ***insertion*** of a striated muscle to move towards the ***origin***. By definition the attachment closest to the long axis of the body is the origin. In an ***isometric*** contraction tension increases but origin and insertion do not move.

Important. *A muscle cannot push.*

A muscle can contract perhaps one-third of its relaxed length. A ***motor unit*** is one motor nerve cell and the muscle cells (2–2,000) that it can cause to contract. As a rule the *fewer muscle cells* per nerve fiber the *more precise the movement* produced by the muscle.

MUSCLE ACTION

A muscle may be classified on the basis of its effect upon any desired movement.

Prime Mover. A prime mover or agonist is the muscle producing the desired movement.

Antagonist. An antagonist opposes a prime mover and for normal movement must relax smoothly while the agonist contracts smoothly.

Synergist. A synergist prevents movement of joints over which prime movers pass, if these joints are not involved in the desired movement. Thus muscles that act to

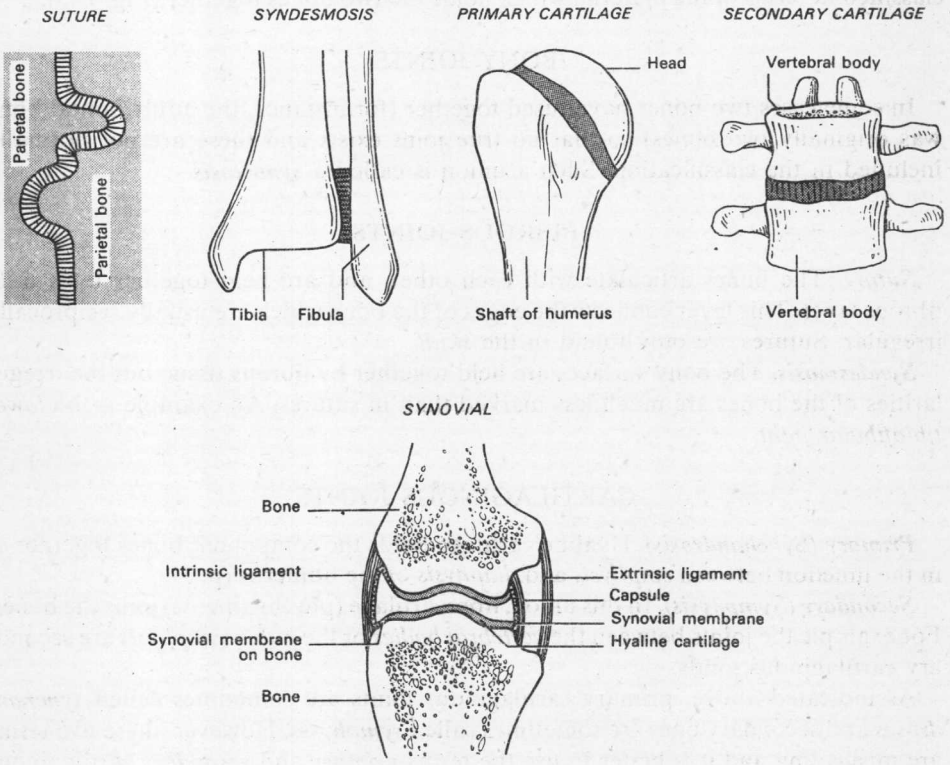

Fig. 1-3. Typical joints of different types.