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A TEXTBOOK OF SYSTEMATIC ANATOMY

Soochow University Press

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PREFACE

The primary intention of editing this textbook of systematic anatomy in English is to meet the need of bilingual medical teaching and internationalization of medical science in our country. Nowadays, most medical colleges and universities have been developing bilingual medical teaching and some universities have begun to enroll students from abroad, but so far, it is hardly found a better adaptive teaching material of systematic anatomy in English to satisfy bilingual medical teaching. The original edition from abroad may not be adaptable to the situation of our country due to its high cost for the students to afford and the different teaching methods between home and abroad. In order to solve such contradictions, colleagues from more than ten medical colleges and universities but with identical points of view were organized to take part in editing this teaching material. Of them, most have abundant experiences in bilingual teaching and high level of writing ability in English and some are back from abroad. So a high quality publication for this textbook of human anatomy is certainly expectable.

This book is based on the teaching syllabus of the teaching materials programmed by the Ministry of Education, laying stress on basic knowledge, emphasizing qualitative education, aiming to cultivate all-round medical talents. The characteristics of this book are succinct writings, fluent sentences and accurate descriptions of pictures and words convenient for the students to understand and for teachers to lecture. This book is used mainly by the bilingual clinical medical students of five-year and seven-year systems, and also fit for other medical specialities and foreign students of clinical medicine to learn.

The members of the editorial committee come from different medical colleges and universities. Most of them are proficient in the bilingual teaching and experienced tutors of postgraduates. They make painstaking efforts and have done great amounts of fruitful jobs for this book. The genuine hope of all editors is that this book can meet the need of medical bilingual teaching as well as cultivating foreign students. They also want to show their genuine gratitude to the editors of A Textbook of Human Anatomy (Jilin Science and Technology Publishing House, 4th Edition) from whose productive works they obtained valuable references. Owing to the limited level of the editors, mistakes can hardly be avoided. We sincerely ask our colleagues and the users of this book—teachers and students to give us criticism and suggestions for improving the quality of this book along with the bilingual teaching of medical sciences and cultivating foreign students. We are appreciating and looking forward to your comments and please address them through e-mail at wu_ky@163.com.

Wu Kaiyun 5/5/2006

INTRODUCTION

Definition and Classification of Human Anatomy

Human anatomy is the science dealing with the morphology and structures of normal human body and its development closely related with functions. It is an important basic course of both fundamental and clinical medical sciences. According to different purposes and researching methods, human anatomy is classified generally into gross anatomy, microscopic anatomy (histology), and developmental anatomy (embryology). Gross anatomy includes the systematic anatomy and regional anatomy. In addition, radiographic anatomy, surface anatomy, surgical anatomy and sectional anatomy for clinical purposes are also included in gross anatomy.

General Structures of the Human Body

The human body is composed of cells, its smallest structural and functional units. Groups of cells and intercellular materials similar in morphology and function make up the tissues. There are four basic types of tissue including the epithelial tissue, connective tissue, muscular tissue and nervous tissue. These tissues exist in association with each other and in variable proportions to form organs and structures with different functions. A series of organs and structures are arranged in a system according to their related functions. There are nine systems in the human body: (1) locomotor system to support and protect the body, cause movements and store minerals; (2) alimentary system to ingest, digest food, absorb the nutritional material and eliminate metabolic residues; (3) respiratory system for gas exchange of the body by inhaling oxygen and exhaling carbon dioxide; (4) urinary system to excrete the waste products such as urea, uric acid, excess water and so on; (5) reproductive (genital) system to breed descendants and secret hormones; (6) circulatory system (angiology) being a hermetic canal, including cardiovascular system and lymphatic system; (7) sense organs being the receptor device which can feel the excited stimulations of the inside and outside environment; (8) nervous system, playing a key role in the integration and coordination of body functions along with the endocrine system; (9) endocrine system to harmonize the activity of each organ and system through humoral coordination.

The Anatomical Position, Relational Planes, Terms of Direction The anatomical position

For the purpose of suitably describing various parts of the body and their locations in clinical application, the standard anatomical position of the human body is assumed to be in erect position, with the face and toes directed forward, the heels and toes together, and the two upper limbs hanging by the two sides of the body with the palms of the hand facing forward. It is essential to learn the anatomical position because most of the directional terminology used in anatomy refers to this body position. The terms of the right and left always refer to those sides of the person or cadaver being viewed but not to the sides of the viewer. Whatever posture the observed object may take, one should still proceed the description as the standard anatomical position.

The axes and relational planes

There are three imaginary axes in the human body (the vertical axis, the sagittal axis and the coronal axis respectively), and three planes (the sagittal plane, the coronal plane and the horizontal plane).

Axes

Vertical axis: from cranial to caudal (from superior to inferior) at right angle with the horizontal plane. Sagittal axis: from ventral to dorsal (from anterior to posterior) at right angle with the vertical axis. Coronal (frontal) axis: from one side to the other side (from right to left) at right angle with the vertical

and sagittal axes and with horizon parallel.

Planes

A sagittal plane is the vertical plane that passes through the body at right angle to the coronal plane and the horizontal plane, and divides the body into longitudinal left and right sections. The median sagittal plane passes through the midline of the body and divides the body into equal left and right halves.

A coronal plane or frontal plane is the vertical plane that passes through the body at right angle to the sagittal plane and divides the body into anterior and posterior parts.

A horizontal plane or transverse plane passes through the body at right angle to both sagittal and coronal planes, and divides the body into superior and inferior parts. There are, of course, many different horizontal planes existing at every possible level from head to foot.

The Terms of direction

Superior and inferior: According to the anatomical position, the superior means nearer to the crown or upper part of the body; inferior means nearer to the feet or toward the lower part of the body. In the comparative anatomy, the cranial and caudal is usually used instead of superior and inferior.

Anterior and posterior: Anterior (ventral) means nearer to the front surface of the body; posterior (dorsal) means nearer to the back surface of the body.

Medial and lateral: Medial means nearer to the median sagittal plane, and lateral means farther from it. In the anatomical position, the thumb is lateral to the little finger, whereas the big toe is medial to the little toe.

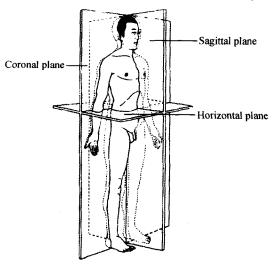
Internal and external: Internal and external are used to describe the position of the hollow organs. The internal means nearer to the center of lumen and the external is farther from it.

Superficial and profound: Superficial and profound are used to describe the relative distance from the surface of the body. The superficial means nearer to and profound means farther from the surface of the body.

Proximal and distal: Proximal and distal are used to indicate nearer to and farther from the limb root respectively.

Ulnar and radial: The medial of the upper limbs is called ulnar side, the lateral called the radial side.

Tibial and fibular: The medial of the lower limbs is called tibial side, the lateral called the fibular side.



The axes and planes of human body

(Wu Kaiyun)

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THE LOCOMOTOR SYSTEM

The locomotor system includes bones, joints (articulations) and skeletal muscles. The skeletal system consists of bones as well as the ligaments and cartilages which bind the bones together at joints. These parts provide the framework and protective shields for softer tissue, serving as attachments for muscles.

The locomotor system not only provides framework and protection, but also has other important functions: movement, maintaining posture, storage of minerals and formation of blood cells.

Skeletal muscles are attached to bones and extend across joints. When skeletal muscles contract, they exert force on the bones and cause movement. In movement, bones act as the levers of movement, joints as the axis, and skeletal muscles as the motive force. Therefore, the bones and the joints are the passive systems of movement; the skeletal muscles supplied by nervous system are the motive force system.

Chapter 1

The Osteology

Section 1 The General Description

Bones in the adult are 200 in number, with the exception 6 auditory ossicles. Bones can be divided into the skull, the bones of the trunk and the appendicular bones. The former two form the axial bone (Fig. 1-1).

The bone of a living human is hard and resilient a living thing with proper shape and certain functions. It has blood vessels, lymph vessels and nerves. It grows. It is subject to disease. When fractured it heals itself; and if the fracture is so improperly set that the parts have lost their previous alignment, its internal structure undergoes remodeling in order that it may continue to withstand strains and stresses as it did before. Unnecessary bone is resorbed: for example, following the extraction of a tooth, the walls of the socket, thus rendered empty, disappear; also, the bones of a paralysed limed limb atrophy (become thinner and weaker) from disuse. Conversely, when bones have increased weight to support they hypertrophy (become thicker and stronger).

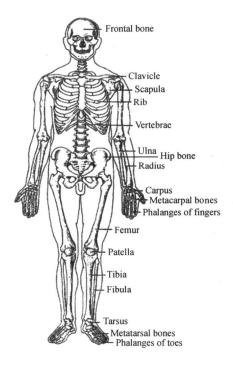


Fig. 1-1 The human skeleton

The Shape and Classification of Bone

These bones are classified according to their shape into four classes: long, short, flat, and irregular (Fig. 1-2).

I) THE LONG BONES

Each long bone consists of a shaft and two extremities. The **shaft** is a hollow cylinder, with its walls consisting of dense compact tissue of great thickness in the middle, and becoming thinner towards the extremities; the spongy tissue is scanty, and the bone is hollowed out in its interior to form the **medullary cavity**. The cavity contains bone marrow in living bones. At each end of a long bone is an expanded portion called the **epiphysis** (*pl.* **epiphyses**), which articulates (or forms a joint) with another bone. They are made of cancellous or

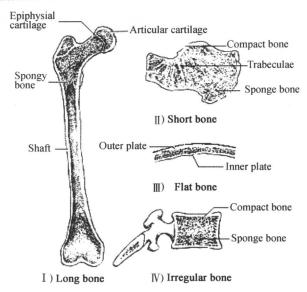


Fig. 1-2 The shape and structure of the bones

spongy bone covered with a thin layer of compact bone, the smooth surface of the end is called **articular surface** which is coated with a layer of hyaline cartilage called **articular cartilage**. The shaft is connected with the epiphyses by cartilage known as **epiphysial cartilage** in young people. After ossification of the epiphysial cartilages in the adult, the epiphyses fuse with metaphyses of the shaft and become the **epiphysial lines**. The long bones are found in limbs, where they form a system of levers, which have to sustain the weight of the trunk, and to confer the power of locomotion.

II) THE SHORT BONES

They are somewhat cube-like, with their lengths and widths roughly equal. The bones of the wrists and ankles are examples of this type. These bones, in their structure, are spongy throughout, except at their surface, where there is a thin crust of compact substance. The short bone is divided into a number of small pieces united together by ligament, and its motion is at the same time slight and limited. The short bones can bear stronger pressure and play an important role in supporting.

III) THE FLAT BONES

They are plate-like structures with broad surface protection and muscular attachment, as it is seen in the ribs, scapulae, and some bones of the skull. Most flat bones help to form the walls of rounded cavities and are curved. The functions of them are usually to protect the important organs such as the brain, the heat, and the lungs.

IV) THE IRREGULAR BONES

They have a variety of shapes and are usually connected to several other bones, carrying out different functions. The irregular bones are the vertebrae, sacrum, coccyx and some bones of the skull. Some cranial bones contain air-filled cavities or sinuses and are known as the **pneumatic bones**, such as the maxilla, ethmoid, frontal and sphenoidal bones.

II The Structure of Bones

Living bones consist of bony substance, periosteum and bone marrow, and are abundant in blood and nerve supply (Fig. 1-3).

I) THE BONY SUBSTANCE

The bony substance includes compact or dense bone and cancellous or spongy bone. The **compact bone** forms the shaft of the long bone and the external layer of the epiphyses. The flat bone is composed of two thin layers of compact bone enclosing between them a variable quantity of cancellous tissue. In the cranial bones, these layers of compact bone are known as the plates of the skull; the outer one is thick and tough; the inner one is thinner, denser, and more brittle, and hence is termed the vitreous plate. The intervening cancellous bone is called the **diploë**. The compact bone is capable of resisting stresses and bending. The **cancellous bone** or the **spongy bone** consists of numerous branching bony plates, called the **trabeculae**. Irregular interconnecting spaces between these plates help to reduce the

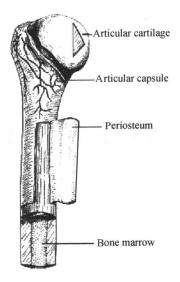


Fig. 1-3 The structure of the bone

weight of the bone. Spongy bones provide strength, and their bony plates most highly develop in the regions of the epiphyses that are subjected to compressive forces. A bone usually has both compact and spongy tissues. Short, flat, and irregular bones typically consist of a mass of spongy bone that is either covered by a layer of compact bone or sandwiched between plates of compact bone.

II) THE PERIOSTEUM

Internal and external surfaces of bones are covered by layers of connective tissue named endosteum and periosteum. The **periosteum** is a layer of dense connective tissue. The periosteum envelops all parts not covered with articular cartilage and not giving attachment to ligaments and tendons. It consists of two layers: an out, fibrous membrane and an inner, vascular one lined with bone-forming cells, the osteoblasts. The periosteal cell with morphologic characteristics of fibroblasts is easily transformed into osteoblasts and then, through mitosis, into osteocytes, periosteal cells play a prominent role in bone growth and repair. The **endosteum** has the same components as the periosteum, and nearly the same structure, but it is considerably thinner and does not have two layers as the periosteum does. With the connective tissue of the periosteum and endosteum, blood vessels are found which penetrate within the bone itself through canals called Volkmann's canal. The principal function of the periosteum and endosteum are nutrition of osseous tissue and provision of a continuous supply of new osteoblastic cells for the repair or growth of bone. For this reason, special attention is given to the periosteum and endosteum in bone surgery.

III) THE BONE MARROW

The bone marrow is a soft, netlike mass of connective tissue within the medullary cavity of long bones, in the irregular space of cancellous bone, and in the large ossteonic canals of compact bone. There are two kinds of the marrow: the red marrow and the yellow marrow. The **red marrow** functions in the formation of red blood cells (erythrocytes), white blood cells (leukocytes), and blood platelets (thrombocytes). It is red because of the red, oxygen-carrying pigment hemoglobin contained within the red blood cells. The red cells have but a short life, about 120 days, and the birth rate necessarily keeps pace with the death rate. At birth spongy bone, which