



HUMAN ANATOMY

**Regional and Applied
(General, Head, Neck and Brain)**

Rama Shankhdhar

Foreword by

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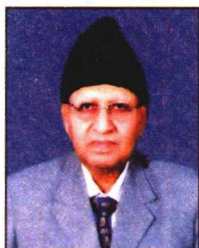
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*Dedicated to
my beloved family*

Foreword



It gives me great pleasure to focus on the book “**Human Anatomy – Regional and Applied**” by **Dr. Rama Shankhdhar**. I have carefully gone through the manuscript and in my considered opinion it reads well, documents essential anatomy required by the undergraduate medical students. The book opens with General Anatomy which, at the outset introduces desirable historical background and anatomical nomenclature. Easily reproducible line diagrams are pleasantly explanatory and enrich the text. The chapter dealing with ‘Skin and Fasciae’ deserves special mention as it embodies clinically pertinent information, not ordinarily emphasized by text-books of Anatomy available in our country. For example, structural-functional correlations have been admirably dealt with. Histomorphology and applied anatomy comprise the hallmark of this useful book. Regional anatomy of the Head and Neck has been comprehensively addressed to and will be useful for the postgraduate entrance examinations too. Over and above gross anatomy, essentials of embryology, histology and applied anatomy of the salivary glands, ear and teeth stand out prominently in this text. Tables have been judiciously used to highlight relations, origins insertion and branches of nerves and arteries in various regions of this book which will be adored by the students while revising the entire syllabus before professional examinations. Unequivocally, I recommend this book to the undergraduate students of medicine and surgery and dentistry. Those preparing for PGME may find it very useful too.

Prof. Dr. Mahdi Hasan

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Preface

First of all, I would like to express my gratitude to the Chairman, Dr. C.P. Chaudhary, M.D.S., President, and Mr. V.K. Sharma, Secretary of Chandra Dental College & Hospital, Safedabd, Barabanki for not encouraging academic work but also providing peaceful environment to achieve it and their co-operation and hospitality. During my tenure of teaching I feel that the students are finding difficulty in making diagrams and remembering the subject of anatomy. All the time, I was thinking how can I help them and make the subject easy and interesting, so that they can grasp more and succeed in examination. Every year they are getting photocopy of my diagrams and lectures. For the benefit of my students I thought I should work little more and present my work in the form of a book. All the diagrams in the book have been made by me after through study.

This book of "Human Anatomy" will provide as complete, comprehensive, upto-date, readable and informative textbook. General anatomy which is the foundation of understanding the medical science is included in the beginning. It is written in a clear, coinse and simple way to help the students in preparing for examinations.

All important details have been covered adequately. Every care has been taken to ensure the accuracy and correctness of each illustration. Though this book is essentially for undergraduate students, can be useful for various postgraduate entrance examinations and as a basic knowledge guide for postgraduate students.

It gives me extreme pleasure to acknowledge the support, assistance and co-operation rendered by all those who were closely involved in the making of this book. I hope the students will be more benefited by reading this book.

This book is made interesting by making emphasis on the clinical importance of what student studies in the anatomy classroom in the form of applied anatomy is included in the subject.

Dr. Rama Shankhdhar

Acknowledgement

At the outset, I want to acknowledge my respected Parents and Guru's, without their ambition, support and blessings, I could not achieve the heights, where I am today.

The most important person in my life always ready to extend his helping hand and taking me out from the jargon of darkness is none except Prof. Ramakant, MS, FICS, FLCS, Head of the Department of Surgery (Gen.), CSMMU, President of Teachers' Association, U.P. Chapter of A.S.I., UPMA and so many other societies, without his support it was not possible for me to do this work successfully. My children Mr. Bobby working in HDN & Seoul Times as Asian Correspondent, recipient of many national & international awards and Dr. Pooja, MS, DNB-SR in Endocrinology, SGPGIMS, Lucknow always loved and supported me. I am obliged for their patience and acceptance of lost evenings and week ends.

I am also grateful to the staff and students of the Chandra Dental College and Hospital, especially Dr. Kamlakant, Assistant Professor who extended their help in the form of respect, support and love. Without their support it was again a difficult task.

I highly appreciate the aptitude of Mr. Arohi Srivastava for his precious time for composing and organizing my work in the form of a book.

I am also thankful and obliged by those whose name must have been forgotten by me in giving their support in any form, please pardon me for that and accept my thanks and regards.

Last, but not the least, we extend our sincere thanks to Virender Kumar Arya of AITBS Publishers, India for his motivating guidance during the preparation of this book on several aspects.

– Dr. Rama Shankhdhar

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PART 1

General Anatomy

- 1. Anatomy**
- 2. Cell and Its Components**
- 3. Tissues**
- 4. Muscular System**

- 5. Nervous System**
- 6. Cardiovascular System**
- 7. Skeletal System**
- 8. Skin and Fasciae**

1 Anatomy

INTRODUCTION

Human anatomy is a wide field of study, which deals with the structural organization of the human body. It is the lifeline and forms firm foundation of the whole art of medical science and introduces different varieties of medical terminology. Anatomy forms the basis of the practice of medicine, leads the physician towards an understanding of a patient's disease when he or she is carrying out a physical examination or using the most advanced imaging techniques. The ability to interpret a clinical observation correctly is therefore, the end point of a sound anatomical understanding.

Observation and visualization are the primary techniques a student should use to learn anatomy. Although the language of anatomy is important, the network of information needed to visualize the position of physical structures in a patient goes far beyond simple memorization.

History of Anatomy

1. Greek Period (B.C.)

Hippocrates of Cos (Circa 400 B.C.)

The father of Medicine is considered as one of the founders of Anatomy. Parts of his collection are the earliest anatomical description.

Herophilus (Circa 300 B.C.) is the “**Father of Anatomy**”. He was a Greek Physician, who first

dissected the human body. He distinguished cerebrum from cerebellum, nerves from tendons, arteries from veins and motor from sensory nerves. Herophilus was a very successful teacher and wrote a book on Anatomy.

2. Roman Period (A.D.)

Galen (Circa 130–200 A.D.)

“Prince of Physician” Practiced medicine at Rome. He demonstrated and wrote on Anatomy. His teachings were followed and considered as the infallible authority on the subject for nearly 15 centuries.

3. Fourteenth Century

Mundinus (1276–1326)

The “Restorer of Anatomy” was an Italian anatomist and Professor of Anatomy at Bologna. He wrote a book “Anathomia” which was the standard anatomical text for over a century. He taught anatomy by dissection for which his text was used as a guide.

4. Fifteenth Century

Leonardo da Vinci of Italy (1452–1519)

The originator of cross-sectional anatomy, was of the greatest geniuses. He was the first to describe the moderator band of the right ventricle. The most admirable of his work are the drawings of the things he observed with perfection and fidelity. His 60 note books containing 500 diagrams were published in 1898.

5. Sixteenth Century

Vesalius (1514–1564)

The “Reformer of Anatomy” was German in origin by birth and found an Italian University favourable for his work. He was professor of Anatomy at Padua. He was regarded as founder of Modern Anatomy because he taught that anatomy could be learned only by dissections. He opposed and corrected the erroneous concepts of Galen and fought against his authority, thus reviving anatomy after a dead lock of about 15 centuries. His great anatomical treatise “De Fabrica – Human Corporis”, written in 7 volumes, revolutionized the teaching of Anatomy and remained as authoritative text for two centuries.

6. Seventeenth Century

William Harvey (1578–1657)

Discovered the circulation of blood and published it as “*Anatomical Exercise on the Motion of the Heart and Blood in Animals*”. He also published a book on embryology. Other events of this century are –

- (a) First recorded human dissection in 1638 in Massachusetts.
- (b) Foundation of microscopic anatomy by Malpighi.
- (c) Introduction of alcohol as a preservative.

7. Eighteenth Century

William Hunter (1718–1783)

Was a London Anatomist and Obstetrician. He introduced embalming with the help of Harvey's Discovery and founded with his younger brother John Hunter the famous Hunterian museum.

8. Nineteenth Century

In Edinburgh (1826) and Maryland (1833)

Dissection by medical students was made compulsory.

Warburton Anatomy Act (1932) was passed in England under which the unclaimed bodies were made available for dissection. The ‘act’ was passed in America (Massachusetts) in 1831. Formalin was used as a fixative in 1890s, X-ray was discovered by Roentgen in 1895. Various endoscopes were devised between 1819 and 1899.

The anatomical societies were founded in Germany (1886), Britain (1887) and America (1888).

Anatomists of this century were – Astley Cooper (1768-1841), Cuvier (1769-1832), Meckel (1724-1774) and Henry Gray (1827-1861). The author of Gray's Anatomy.

The term anatomy is derived from a Greek word – “Anatome” – meaning cutting up (Ana = structure, tome = cutting up). In Latin – Greek Anatome means “dissection”.

Dissection is merely a technique where as anatomy is a wide field of study by using the technique of dissection.

Anatomy describes the theatre in which action takes place – means – anatomy is to physiology as Geography is to History.

In ancient days anatomy was studied mainly by dissection. But now a days scope of modern anatomy has become very wide and now it is studied by all possible methods which clarify and enlarge the boundaries of anatomical knowledge.

Sub divisions of Anatomy

It depends on the different methods by which we study the structure of human body, helping us in reaching correct diagnosis in patients and treating their diseases, for example –

1. Cadaveric Anatomy

Study is done on dead bodies – cadavers – by dissecting different parts of human body with the help of naked eye called “Gross Anatomy” or Macroscopic Anatomy.

This can be done by one of the two approaches –

- A. *Regional anatomy*: Body is studied in parts means regions like upper limb, lower limb, thorax, abdomen, head and neck and brain.
- B. *Systemic anatomy*: Body is studied system wise, for example –

- ♦ We study all bones of the body – called skeletal system – under heading of osteology.
- ♦ Study of muscular system – Myology.
- ♦ Study of vascular system – Angiology.

- ♦ Study of articulatory system – Arthrology or Syndesmology.
- ♦ Study of nervous system – Neurology.
- ♦ Pulmonology.
- ♦ Study of digestive system – Gastrology.
- ♦ Study of urogenital system – Urology, Gynaecology.
- ♦ Study of endocrine system – Splanchnology.
- ♦ Locomotor system – includes – osteology, arthrology and myology.

2. Living Anatomy

Study is done on living human being by using different techniques, for example –

- Inspection:** It is done with the help of eyes, here we inspect whole human being – in form of facial expression, gait and posture etc.
- Palpation:** It is done with the help of palm and fingers – we feel the lump, its consistency and tenderness.
- Percussion:** It is done with the help of fingers to know the different type of sounds produced in different situations, e.g., cystic, solid lesion etc.
- Auscultation:** It is done with the help of stethoscope – we listen different types of respiratory, heart and bowel sounds.
- Endoscopy:** It is done with help of endoscopes, e.g., bronchoscopy, gastroscopy, sigmoidoscopy, cystoscopy etc.
- Radiography:** We take the help of X-rays – plain and contrast.
- Electromyography:** We study the electrical waves produced by action of tissues, e.g., E.C.G., E.E.G. etc.

3. Embryology or Developmental Anatomy

Here we study prenatal and postnatal developmental changes in an individual. The developmental history is called ontogeny. The evolutionary history on the other hand is called phylogeny.

4. Histology (Microscopic Anatomy)

We study the different tissues and their structure with the help of microscope.

5. Surface Anatomy (Topographic Anatomy)

It is the study of deeper part of the body in relation to the skin surface. It is helpful in clinical practice and surgical operations.

6. Radiographic Anatomy

It is the study of deeper organs by plain and contrast radiography.

7. Comparative Anatomy

It is the study of anatomy of the other animals and compare them to explain the changes in the form, structure and function of different parts of the human body.

8. Physical Anthropology

It deals with the external features and measurements of different races and groups of people and with the study of the prehistoric remains.

9. Applied Anatomy (Clinical Anatomy)

It deals with the application of the anatomical knowledge to the medical and surgical practice.

10. Experimental Anatomy

It is the study of the factors, which influence and determine the form, structure and function of different parts of the body.

Anatomical Nomenclature

Galen (2nd century) wrote his book in Greek, and Vesalius (16th century) did it in Latin. Most of the anatomical terms, therefore are either in Greek or Latin.

In 1895, the German Anatomical Society held a meeting in Basle and approved a list of about 5000 terms known as *Basle Nomina Anatomica* (BNA).

The following six rules were laid down to be followed strictly –

1. Each part shall have only one name.
2. Each term shall be in Latin.
3. Each term shall be as short and simple as possible.
4. The terms shall be merely memory signs.

5. Related terms shall be similar, e.g., Femoral Artery, Femoral Vein and Femoral Nerve.
6. Adjectives shall be arranged as opposites, e.g., Major and Minor, Superior and Inferior, Anterior and Posterior, Lateral and Medial etc.

The drafts on *Nomina Histologica* and *Nomina Embryologica* prepared by the subcommittee of the International Anatomical Nomenclature Committee (IANC) was approved in a plenary session of the Eleventh International Congress of Anatomists held in Leningrad in 1970.

Descriptive Terms

1. Terms used for describing the position of the body –

Anatomical Position: In this position –

- (a) Body is erect.
- (b) Eyes look straight to the front.
- (c) Upper limbs hang by the side of the trunk with the palm directed forwards.
- (d) Lower limbs are parallel with the toes pointing forwards.

All the structures are described presuming the body in anatomical position, although during study the body may be placed in any position.

- (i) *Supine position:* Lying down position with the face directed upwards.
- (ii) *Prone position:* Lying down position with the face directed downwards.
- (iii) *Lithotomy position:* Lying supine with the buttocks at the edge of the table, hips and knees fully flexed and the feet strapped in position.

2. Anatomical Planes

- (a) *Median or midsagittal plane:* Divides the body into right and left equal halves.
- (b) *Sagittal plane:* Any plane paralalled to the median plane.
- (c) *Coronal plane:* It is a vertical plane at right angles to the median plane.

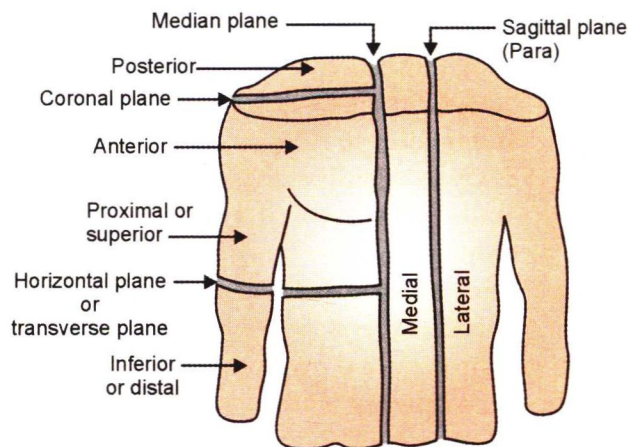


Fig. 1.1 The three planes in the body

- (d) *Transverse plane:* A plane at right angles to a vertical plane, or at right angles to the longitudinal axis of any part.
- (e) *Horizontal plane:* A plane parallel to the ground or transverse plane. It is at right angles to both sagittal and coronal planes.
- (f) *Oblique plane:* Any plane other than the aforementioned planes.

3. Terms of relations commonly used in gross anatomy

- (a) *Anterior:* Towards the front.
- (b) *Posterior:* Towards the back.
- (c) *Superior:* Towards the head.
- (d) *Inferior:* Towards the feet.
- (e) *Medial:* Towards the median plane.
- (f) *Lateral:* Away from the median plane.

4. Terms used in embryology and comparative anatomy, sometimes in gross anatomy

- (a) *Ventral:* Towards belly (anterior).
- (b) *Dorsal:* Towards back (posterior).
- (c) *Cranial or Rostral:* Towards head (superior).
- (d) *Caudal:* Towards tail.

5. Special terms for limbs

- (a) *Proximal:* Nearer to the trunk.
- (b) *Distal:* Away from the trunk.
- (c) *Radial:* Outer border of upper limb.
- (d) *Ulnar:* Inner border of upper limb.

- (e) *Fibular*: Outer border of lower limb.
- (f) *Tibial*: Inner border of lower limb.
- (g) *Preaxial border*: Outer border in the upper limb and inner border in lower limb.
- (h) *Postaxial border*: Inner border in the upper limb and outer border in lower limb.
- (i) *Flexor surface*: Anterior surface in the upper limb and posterior surface in the lower limb.
- (j) *Extensor surface*: Posterior surface in the upper limb and anterior surface in the lower limb.
- (k) *Palmar*: Pertaining towards the palm of the hand.
- (l) *Plantar*: Pertaining to the sole of the foot.

6. Certain other terms]

- (a) Terms used for hollow organs
 1. Interior or inner.
 2. Exterior or outer.
 3. Invagination or inward protrusion.
 4. Evagination or outward protrusion.
- (b) Terms used for solid organs
 - (i) *Superficial*: Towards the surface.
 - (ii) *Deep*: Inner to the surface.
- (c) Terms used to indicate the side
 - (i) *Ipsilateral*: to the same side.
 - (ii) *Contralateral*: of the opposite side.

7. Terms used for describing muscles

- (i) *Origin*: Relatively fixed end of a muscle during its contraction.
- (ii) *Insertion*: Moving end of a muscle during its contraction.
- (iii) *Belly*: Fleshy contractile part of a muscle.
- (iv) *Tendon*: Fibrous, cord-like, non-contractile part of a muscle.
- (v) *Aponeurosis*: Fibrous, flattened sheath of a muscle replacing tendon.
- (vi) *Raphe*: A fibrous band made up of interdigitating fibres of the tendon or aponeurosis. It is slightly stretchable.

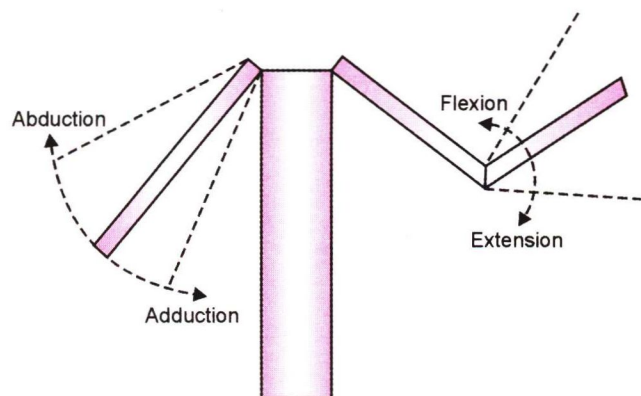


Fig. 1.2 Angular movements

- (vii) *Ligaments*: They are fibrous, inelastic bands which connect two segments of a joint.

8. Terms used for describing movements

- (i) *Flexion*: Approximation of flexor surfaces in which the angle of the joint is reduced.
- (ii) *Extension*: Approximation of extensor surfaces, in which angle of the joint is increased.
- (iii) *Adduction*: Movement towards the central axis.
- (iv) *Abduction*: Movement away from the central axis.
- (v) *Medial rotation*: Inward rotation.
- (vi) *Lateral rotation*: Outward rotation.
- (vii) *Circumduction*: Combination of various foregoing movements.
- (viii) *Pronation*: Rotation of the forearm so that the palm is turned backwards.
- (ix) *Supination*: Rotation of the forearm so that the palm is turned forwards.
- (x) *Protraction*: Forward protrusion.
- (xi) *Retraction*: Movement reverse of protrusion, i.e., backward retraction.

9. Terms used for describing vessels

- (i) *Arteries*: Carry oxygenated blood away from heart with the exception of pulmonary and umbilical arteries, which carry deoxygenated blood. Arteries

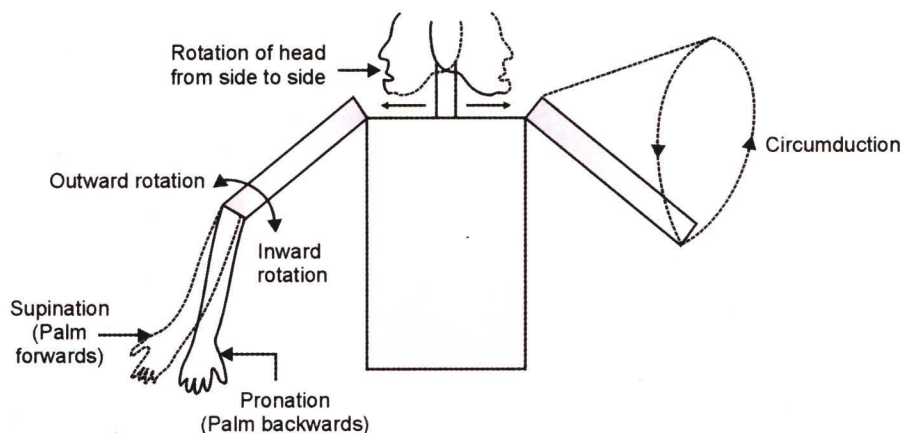


Fig. 1.3 Rotatory movements

resembles trees because they have branches (arterioles).

- (ii) *Veins*: Carry deoxygenated blood towards heart with the exception of pulmonary and umbilical veins – carry oxygenated blood. Veins resemble rivers because they have tributaries (venules).
- (iii) *Capillaries*: These are network of microscopic vessels connecting arterioles to venules.
- (iv) *Anastomosis*: It is a pre or post capillary communication between the neighbouring vessels.

10. Terms used for describing bony features

- (i) *Elevations*:
 - (a) Linear elevation – For example: Line, lip, ridge or crest.
 - (b) Sharp elevations – For example: Spine, styloid process, cornu etc.
 - (c) Rounded or irregular elevations – For example: Tubercle, tuberosity, epicondyle, malleolus, or trochanter etc.

- (ii) *Depressions*: For example: Pit, impression, fovea, fossa, groove, sulcus or notch etc.
- (iii) *Openings* – For example: Foramen, canal, hiatus etc.
- (iv) *Cavities*: For example: Sinus, cell or antrum etc.
- (v) *Smooth articular areas*: For example: Facet, condyle, head, capitulum or trochlea.

Arrangement of structures in the body: from within outwards

1. Bony framework of the body.
2. Muscles are attached to bones.
3. Blood vessels, nerves and lymphatics form neurovascular bundles which run in between the muscles, along the fascial planes.
4. Thoracic and abdominal cavities contain several internal organs – called viscera.
5. Whole body has three general coverings –
 - (a) Skin
 - (b) Superficial fascia
 - (c) Deep fascia.