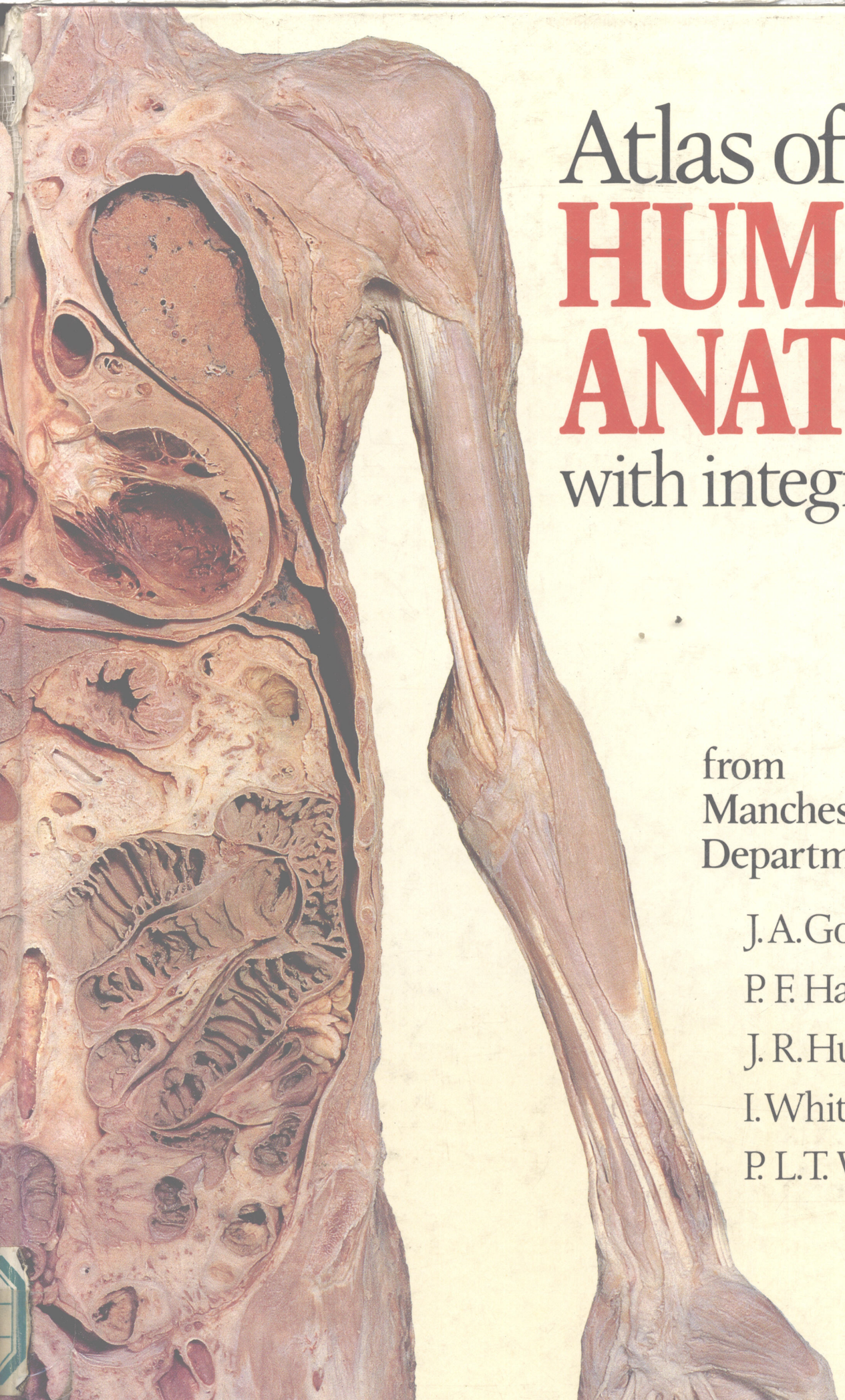

Atlas of HUMAN ANATOMY with integrated text

from
Manchester University
Department of Anatomy

J. A. Gosling
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Preface

Despite the many anatomical atlases and textbooks currently available, there appeared to be a need for a book which combined the advantages of each of these forms of presentation. This book was conceived with the intention of filling that need. With a unique combination of photographs of dissections, accompanying diagrams and concise text, this volume aims to provide the student with a better understanding of human anatomy.

The basis of this work is the cadaver as seen in the dissecting room; therefore, reference to surface and radiological anatomy is minimal. Likewise, comments on the clinical and functional significance of selected anatomical structures are brief. However, comparison is made where appropriate between the anatomy of the living and that of the cadaver.

Each dissection was specially prepared and photographed to display only a few important features. However, since photographs of dissections are inherently difficult to interpret, each is accompanied by a guide in the form of a drawing. Each drawing is coloured and labelled to highlight the salient features of the dissection and is accompanied by axes to indicate the orientation of the specimen. Adjacent photographs often depict different stages of the same dissection to help the student construct a three-dimensional image.

The first chapter introduces anatomical terminology, provides general information about the basic tissues of the body, and includes overall views of selected systems. Because the six subsequent chapters describe anatomy primarily through dissection, a regional approach has been employed. Features of bones are described only when considering their related structures, especially muscles and joints; osteology is not considered in its own right. The internal structure of the ear and eye are beyond the scope of this book since the study of these topics requires microscopy; the anatomy of the brain and spinal cord are also excluded as they are usually taught in special courses.

The level of detail contained in this book is appropriate for current courses in topographical anatomy for medical and dental undergraduates. In addition, it will be of value to postgraduates and to students entering those professions allied to medicine in which anatomy is part of the curriculum.

The terminology employed is that which is most frequently used in clinical practice. Where appropriate, alternatives (such as those recommended in *Nomina Anatomica*) are appended in brackets.

Preparation of the dissections and the text has occupied the authors for nearly five years. Our objective was to create a high quality and visually attractive anatomical work and we hope that the time and effort spent in its preparation is reflected in the finished product.

Acknowledgements

The authors are indebted to the mortuary technician of the Anatomy Department, Mr. J. Davis, who embalmed the cadavers and helped in cutting the sections. The secretarial staff have assisted greatly in typing various drafts of text, usually trying to meet a deadline already passed.

Other members of the Department of Anatomy have provided valuable comment and have graciously tolerated seemingly endless conversations on the quality of this or that dissection or portion of text.

Our families deserve a special mention, as without their untiring support and patience this volume would certainly not have come to fruition.

The staff at Gower Medical Publishing have worked extremely hard in drawing all the diagrams and executing the page layouts. Sharyn Wong, project editor, has been a stalwart communicator, providing guidance in publishing matters and correcting our English.

We thank them all.

J.A.G., P.F.H., J.R.H., I.W. & P.L.T.W.
Manchester, 1985

User Guide

ORGANIZATION

This book begins with a chapter on basic anatomical concepts which is followed by six chapters, each dealing with one of the anatomical regions. Within each chapter the information is presented usually in a dissectional order suitable for teaching, progressing from the surface to deeper structures. The limbs are described from proximal to distal with the joints considered at the ends of the appropriate chapters.

The numbering of the pages and illustrations is sequential within each chapter; thus 'page 1.24' means the twenty-fourth page in Chapter 1 and 'Fig. 1.24' refers to the twenty-fourth picture in Chapter 1.

TEXT AND PHOTOGRAPHS

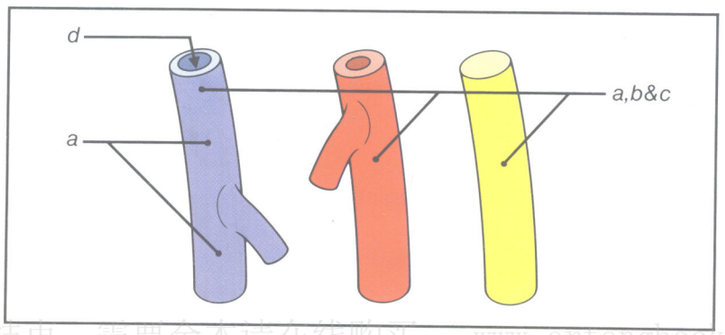
Usually each topic is presented on self-contained spreads, the photographs being accompanied by the relevant text. Within the text, cross-references are given to other relevant text and illustrations.

ACCOMPANYING DIAGRAMS

The line diagrams augment the photographs and each diagram uses a colour code to focus the attention of the reader on structures of particular importance in the dissection.

LABELS AND LEADER LINES

On each diagram only the structures of interest have been labelled. In many instances the leader line from a label is branched. If only one structure is named, the leader line and any branch(es) it may have indicates different parts of that structure. However, when more than one stucture is named, the first structure is indicated by the main leader line and the subsequent structures are indicated by branches given off the main leader line at progressively shorter distances from the label. A leader line ending with an arrowhead indicates a space or cavity (see below).



ORIENTATION GUIDES

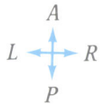
Each diagram is accompanied by a set of axes which indicates the orientation of the specimen. The abbreviations used in these axes are:

L	Left	*I*	Inferior	*l*	lateral
R	Right	*P*	Posterior	*m*	medial
S	Superior	*A*	Anterior	*d*	distal
				p	proximal

These axes show the direction in the plane of the page in relation to the anatomical position. Thus, when looking at the whole body the axes appear as follows:

(from in front)

(from behind)



(from above)

When views are oblique, the axis which emerges from the plane of the page towards the reader is shown with a large arrowhead and long shaft. Conversely, the axis which passes into the page away from the reader is shown with a small arrowhead and short shaft. Thus, the axes below indicate a left anterolateral view (as seen in Fig. 1.1).

TERMINOLOGY

The terminology is that used most frequently in clinical practice. Where appropriate, alternative names (including those recommended in *Nomina Anatomica*) are appended in brackets.

SELF ASSESSMENT

The photographs are unfettered by labels, leader lines and other superimposed markings; thus, the reader can readily use this book to test his knowledge by either masking the whole of the accompanying diagram and studying the photograph alone or covering only the labels around the diagram.

Contents

1

BASIC ANATOMICAL CONCEPTS

TERMS OF POSITION AND MOVEMENT

To avoid ambiguity and confusion, anatomical terms of position and movement are defined according to an internationally accepted convention. This convention defines the 'anatomical position' as one in which the human body stands erect with the feet together and the face, eyes and palms of the hands directed forwards (Fig. 1.1).

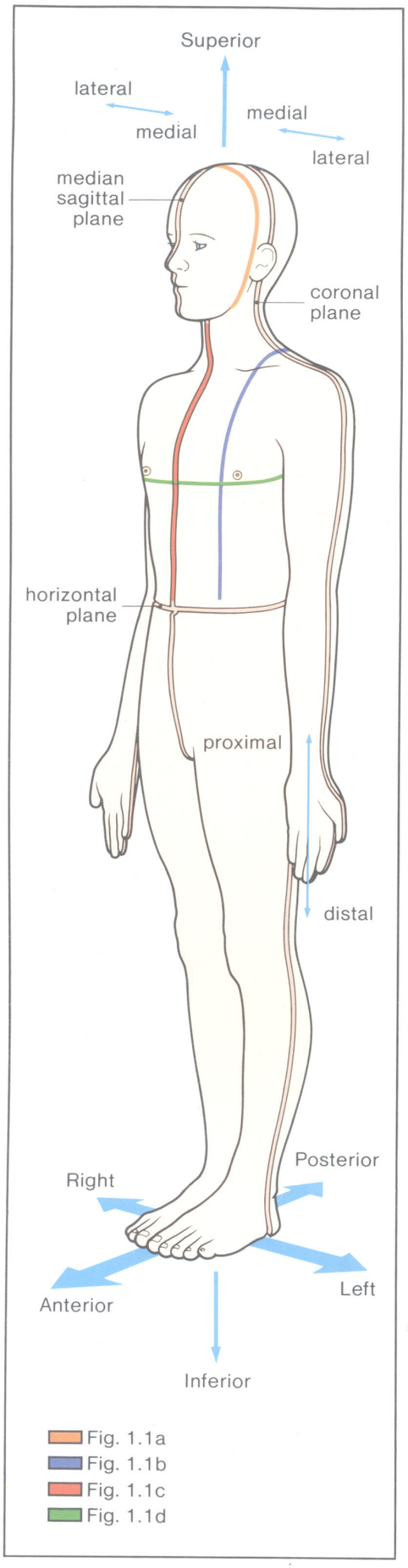


Fig. 1.1 *Basic terms conventionally used in anatomical description.*

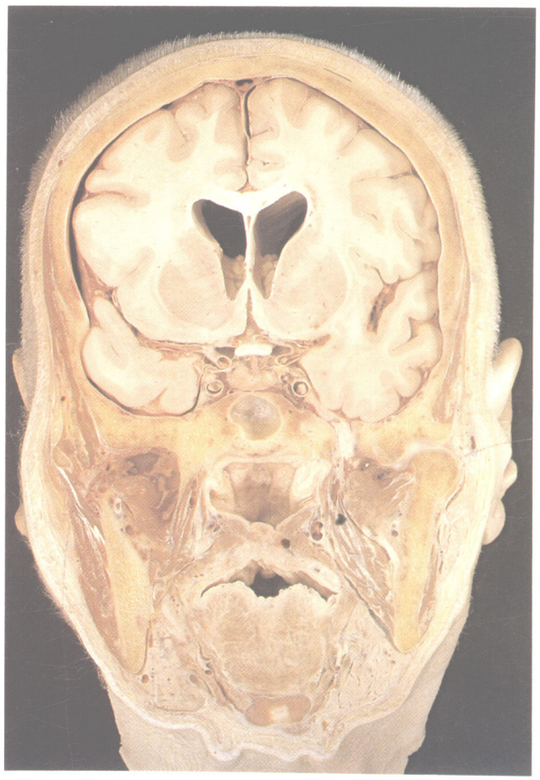


Fig. 1.1a *Coronal section through the head.*

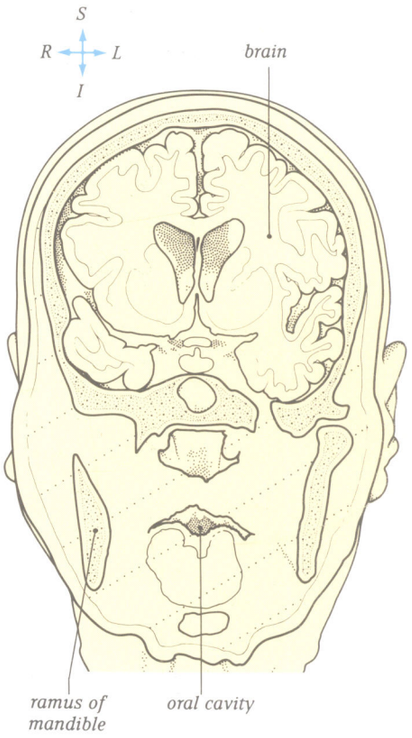
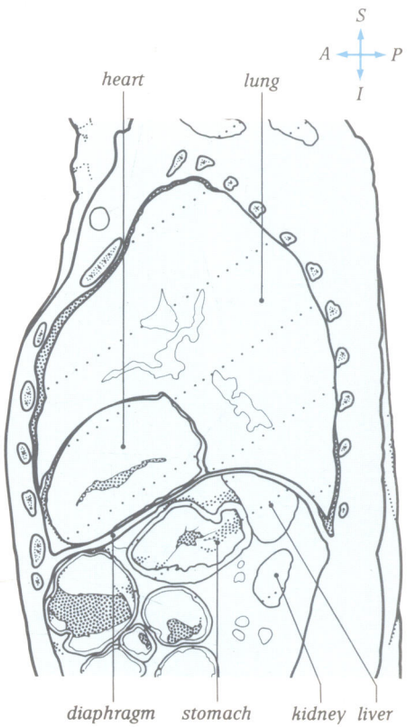


Fig. 1.1b *Sagittal section through the trunk. This section lies to the left of the median sagittal plane.*



With the subject in the anatomical position, three sets of planes, mutually at right angles, can be defined. **Horizontal** (or **transverse**) **planes** transect the body from side to side and front to back.

Vertical (or longitudinal) planes are termed either **coronal** or **sagittal**. **Coronal planes** pass from one side to the other while **sagittal planes** pass from front to back. One particular sagittal plane, the **median sagittal plane**, lies in the midline and divides the body into right and left halves (Fig. 1.1c).

A transverse section may be cut at right angles to the long axis of any organ or part of the body, and a longitudinal section along its long axis.

The terms **medial** and **lateral** are used to indicate the position of structures relative to the median sagittal plane. For example, the ring finger lies lateral to the little finger but medial to the thumb. The front and back of the body are usually termed the **anterior** (or ventral) and **posterior** (or dorsal) surfaces respectively. Thus, one structure is described as anterior to another because it is placed further forwards (Fig. 1.1).

Superior and **inferior** are terms used to indicate the relative head/tail positions of structures (Fig. 1.1). Those lying towards the head (or cranial) end of the body are described as superior to others which are inferior (or caudal). Thus, the heart lies superior to the diaphragm; the diaphragm is inferior to the heart. In the limbs the terms **proximal** and **distal** have comparable meanings. For example, the elbow joint is proximal to the wrist but distal to the shoulder.

The terms **superficial** and **deep** indicate the location of structures in relation to the body surface. Thus, the ribs lie superficial to the lungs but deep to the skin of the chest wall (Fig. 1.1d).

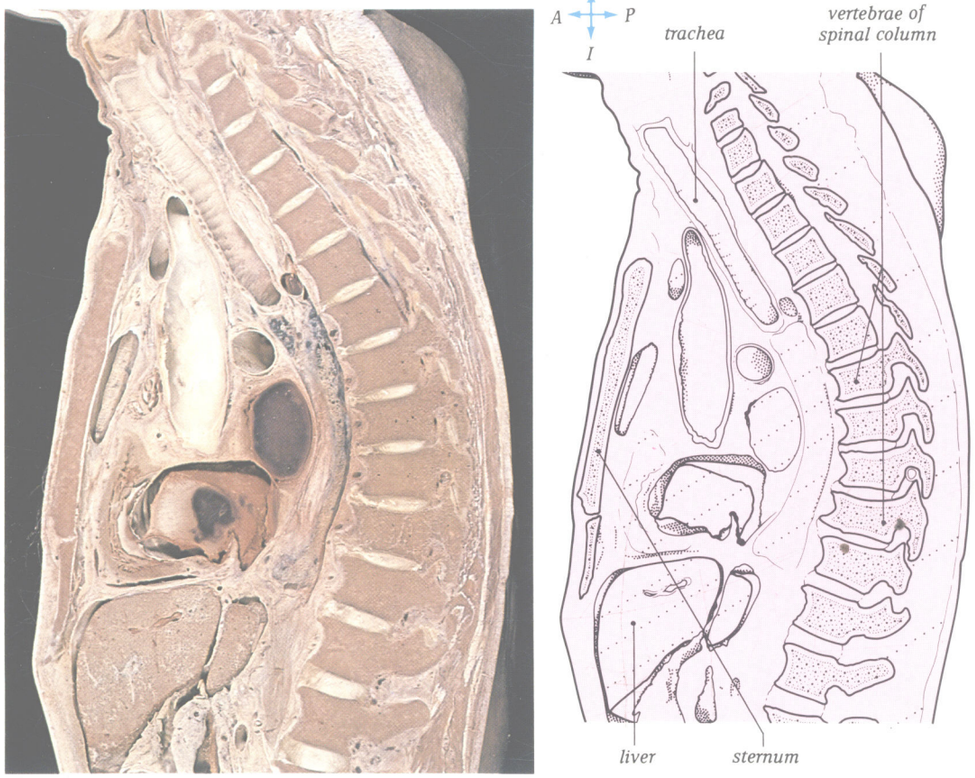


Fig. 1.1c *Median sagittal section through the trunk.*

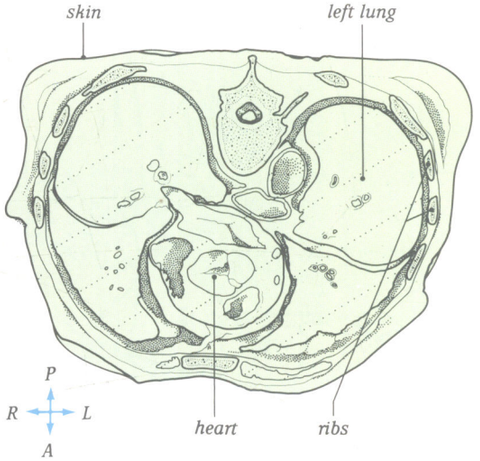


Fig. 1.1d *Transverse section through the thorax at the level of vertebra T6.*

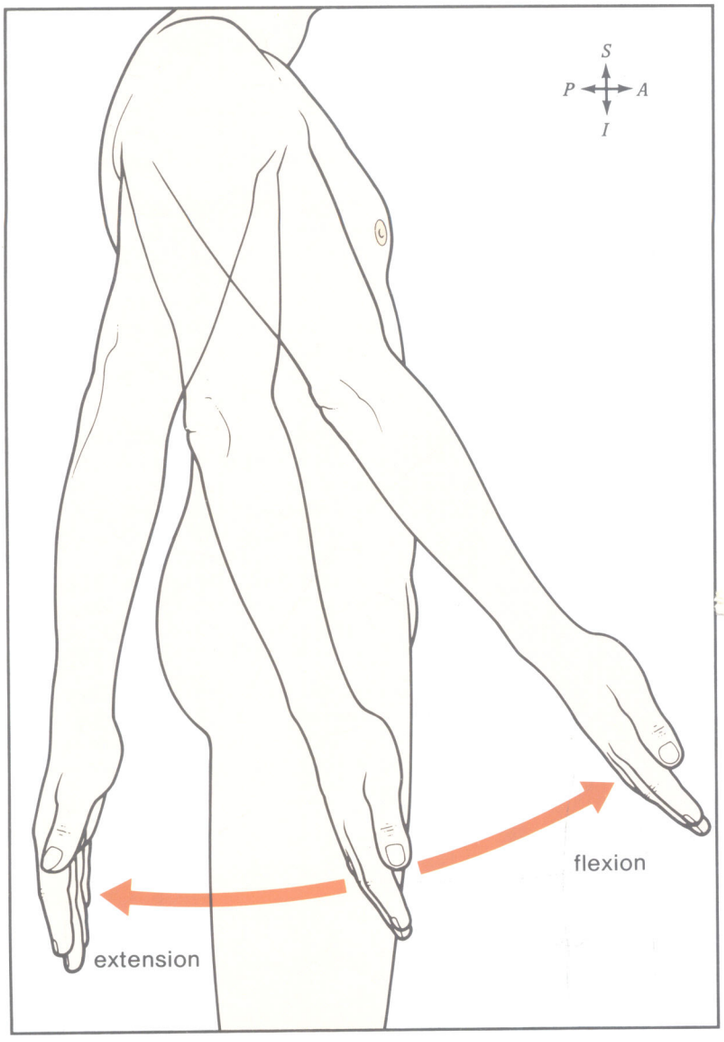


Fig. 1.2 *Movements of flexion and extension of the shoulder joint.*

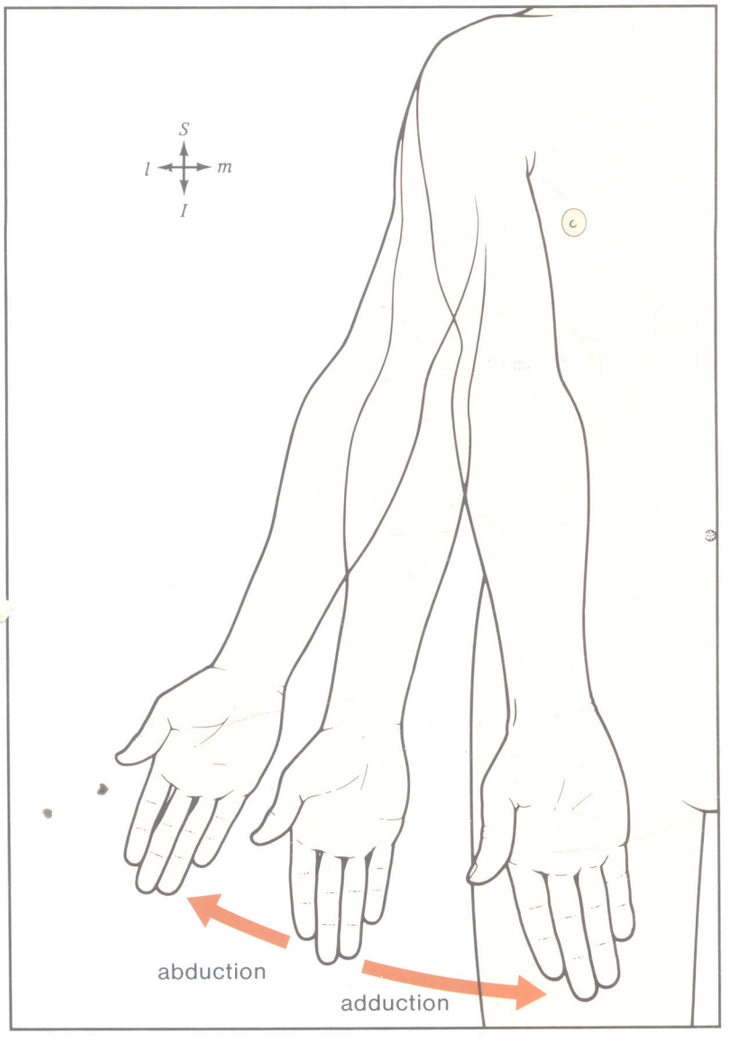


Fig. 1.3 *Movements of abduction and adduction. In adduction, flexion of the shoulder joint allows the limb to be carried anterior to the trunk.*

Movements at joints are also described by specific terms. From the anatomical position, forward movement of one part in relation to the rest of the body is called **flexion**. **Extension** carries the same part posteriorly (Fig. 1.2). However, because in the fetus the developing upper and lower limbs rotate in different directions, the movements of flexion and extension in all joints from the knee downwards occur in opposite directions when compared with the equivalent joints in the upper limb. In **abduction** the stucture moves away from the median sagittal plane in a lateral direction whereas **adduction** returns it towards the midline (Fig. 1.3). For the fingers and toes, the terms abduction and adduction are used in reference to a longitudinal plane passing along the middle finger or the second toe respectively. Movement around the longitudinal axis of part of the body is called rotation. In **medial** (or internal) **rotation** the anterior surface of a limb rotates medially whilst **lateral** (or external) **rotation** turns the anterior surface laterally (Fig. 1.4). Movements which combine flexion, extension, abduction, adduction, and medial and lateral rotation (for instance, 'windmilling' action seen at the shoulder joint) are known as **circumduction**.

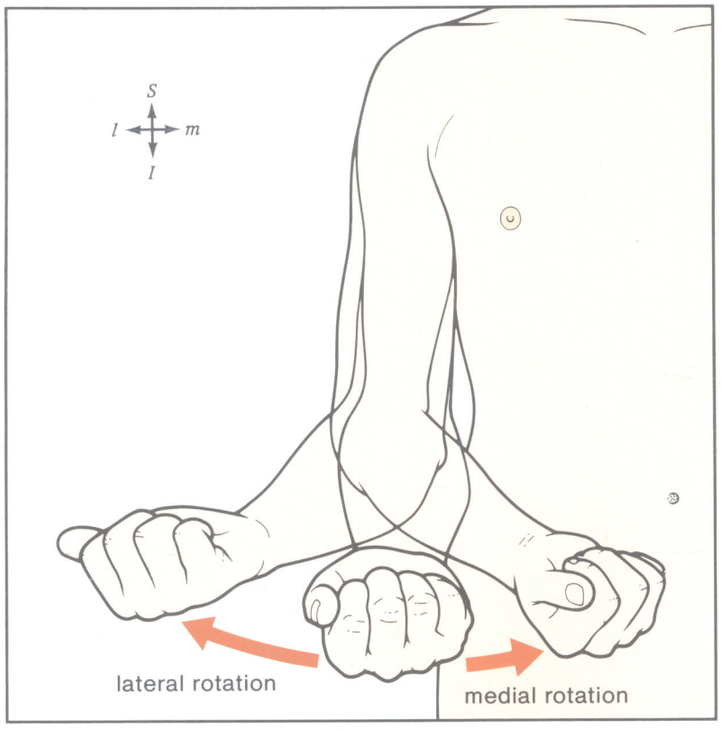
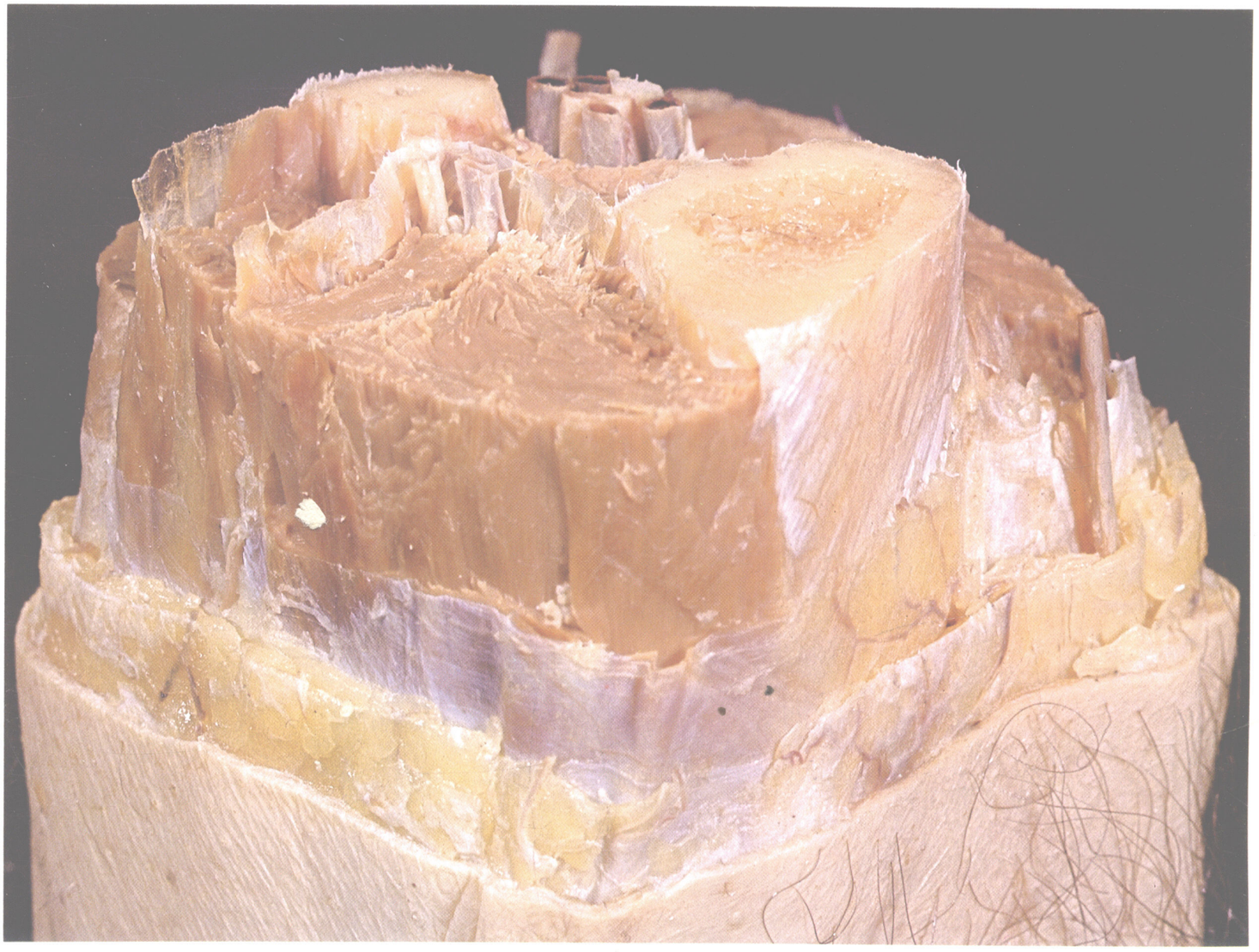


Fig. 1.4 *Movement of the forearm indicates medial and lateral rotation at the shoulder joint. The elbow is flexed.*



1. Skin

Skin (Fig. 1.5) is a protective covering for the surface of the body and comprises a superficial layer called the epidermis, and a deeper layer, the dermis. The epidermis is an epithelium consisting of a surface layer of dead cells which are continually shed and replaced by cells from the deeper germinal layer. The dermis is a layer of connective tissue containing blood vessels, lymphatics and nerves. In most areas of the body the skin is thin and mobile over the underlying structures. Specializations of the skin include finger- and toenails, hair follicles and sweat glands. On the palms of the hands and soles of the feet (and corresponding surfaces of the digits), hair follicles are absent and the epidermis is relatively thick. Also, the skin in these regions is firmly anchored to underlying structures, reducing its mobility during gripping and standing. Lines of tension occur within skin and are of importance to surgeons. Scars following surgical incisions made along these lines tend to be narrower than those made across the lines of tension.

Skin is usually well vascularized and receives blood from numerous subcutaneous vessels. Knowledge of this vascular supply is important when operations are undertaken which involve the use of skin flaps.
Skin has a rich nerve supply, responding to touch, pressure, heat, cold, vibration and pain. In certain areas such as the fingertips, the skin is especially sensitive to touch and pressure. Skin is innervated by superficial (cutaneous) branches of spinal or cranial nerves. The area of skin supplied by each cranial or spinal nerve is remarkably constant and is known as a dermatome (see Fig. 1.24).

2. Superficial fascia

Immediately deep to the skin is a layer of loose connective tissue, the superficial fascia (Fig. 1.5), which contains networks of superficial veins and lymphatics and is traversed by cutaneous nerves and arteries. It also contains fat, which varies considerably in thickness from region to region and between individuals. For example, over the buttock the fat is particularly thick whilst on the back of the hand it is relatively thin.

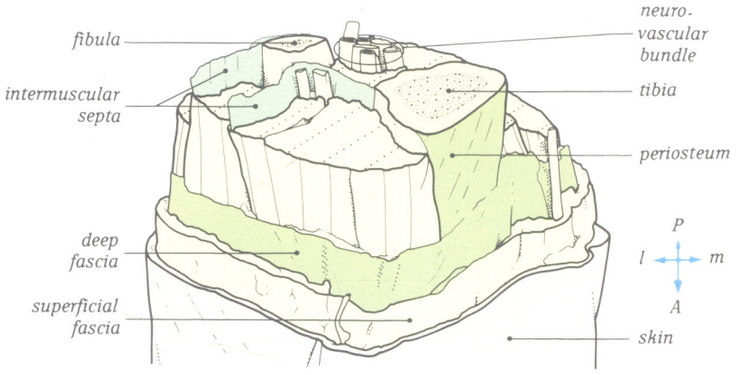
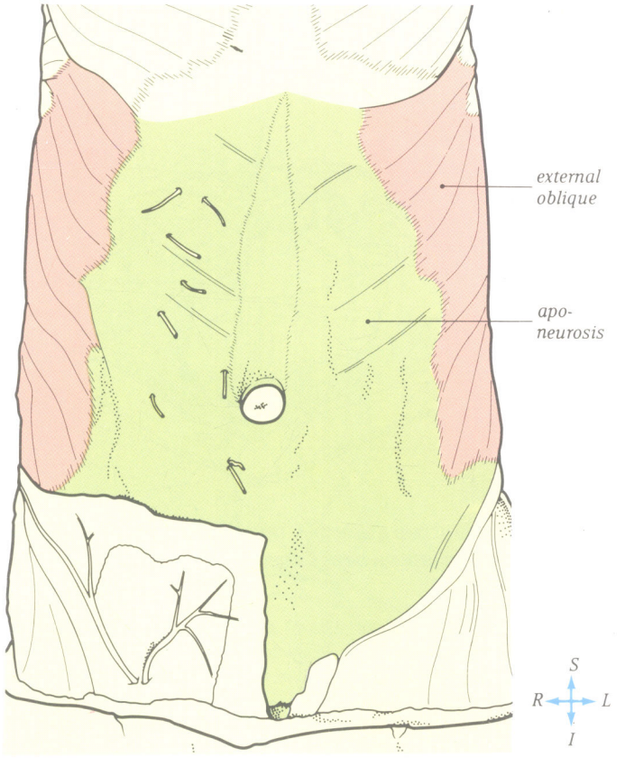


Fig. 1.5 *Multilevel 'step dissection' through the right midcalf to show layers of skin, fascia and intermuscular septa.*

3. Deep fascia

The deep fascia (Fig. 1.5) consists of a layer of dense connective tissue immediately beneath the superficial fascia. Although thin over the thorax and abdomen, it forms a substantial layer in the limbs (for example, fascia lata; see page 6.3) and neck (for example, investing fascia; see page 7.2). Near the wrist and ankle joints, the deep fascia is thickened to form retinacula which maintain the tendons in position as they cross the joints. Deep fascia also provides attachment for muscles and gives anchorage to intermuscular septa which separate the muscles into compartments.



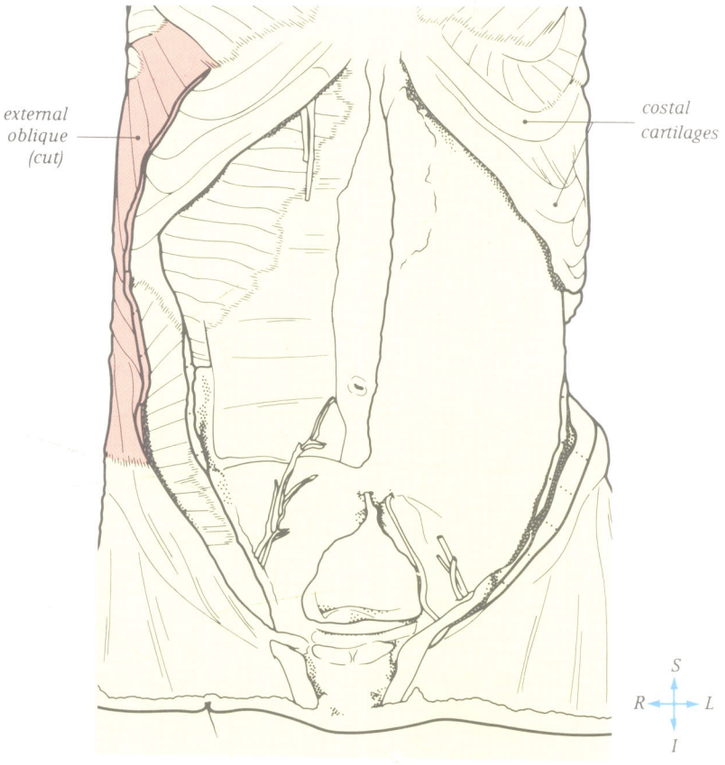


Fig. 1.6a *External oblique is a flat muscle with an extensive aponeurosis.*

Fig. 1.6b *External oblique cut to show its thickness.*

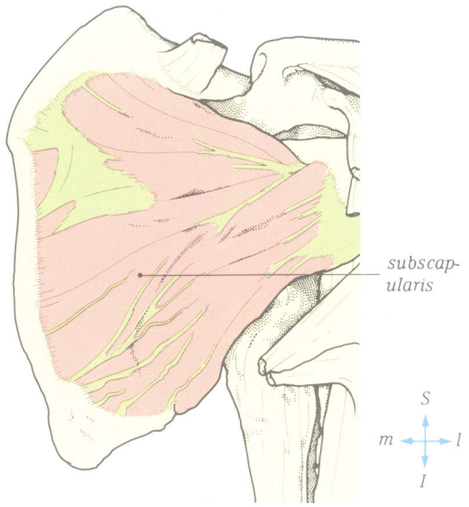


Fig. 1.6c *Subscapularis is a multipennate muscle.*

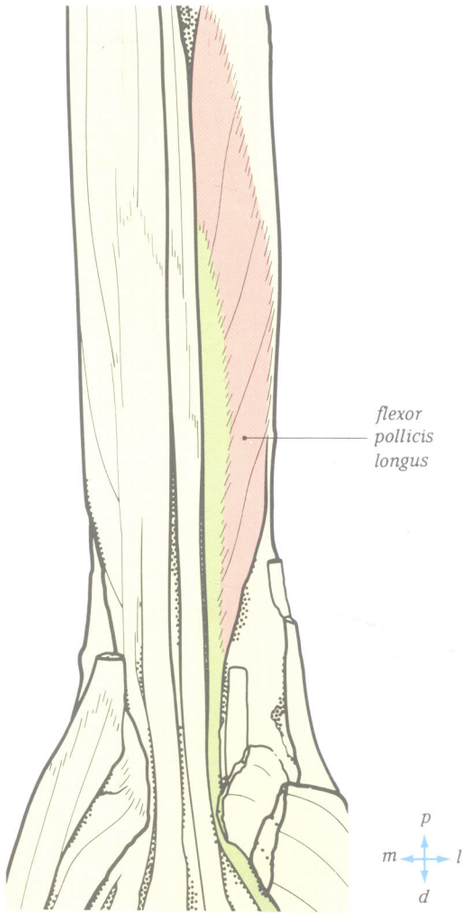


Fig. 1.6d *Flexor pollicis longus is a unipennate muscle.*

4. Muscle

Muscle is a tissue in which active contraction either shortens its component cells or generates tension along their length. There are three basic types: smooth muscle; cardiac striated muscle; and voluntary striated muscle. 'Striated' and 'smooth' describe the microscopic appearance of the muscle.

Smooth muscle is present in the organs of the alimentary, genitourinary and respiratory systems and in the walls of blood vessels. Capable of slow sustained contraction, smooth muscle is usually controlled by the autonomic nervous system (see page 1.18) and, in some organs, by endocrine secretions (hormones).

Cardiac striated muscle (myocardium) is confined to the wall of the heart and is able to contract spontaneously and rhythmically. Its cyclical activity is coordinated by the specialized conducting tissue of the heart and can be modified by the autonomic nervous system.

Voluntary striated muscle (often called skeletal) is the basic component of those muscles which produce movements at joints. These actions are controlled by the somatic nervous system (see page 1.17) and may be voluntary or reflex. Each muscle cell (fibre) has its own motor nerve ending which initiates contraction of the fibre. Muscles may be attached to the periosteum of bones either directly or by fibrous connective tissue in the form of deep fascia, intermuscular septa or tendons. Direct fleshy attachment can be extensive but tendons are usually attached to small areas of bone. Muscles with similar actions tend to be grouped together; and in limbs these groups form compartments (for instance, extensor compartment of forearm).

Usually each end of a muscle has an attachment to bone. The attachment that remains relatively fixed when the muscle performs its prime action is known as the origin whereas the insertion is the more mobile attachment. However, in some movements the origin moves more than the insertion; therefore these terms are only of limited significance.

The muscle fibres within voluntary muscle are arranged in differing patterns which reflect the function of the muscle (Figs. 1.6a–1.6e). Sometimes they are found as thin flat sheets (as is external oblique). Strap muscles (such as sartorius) have long fibres which reach without interruption from one end of the muscle to the other. Pennate muscles are characterized by fibres that run obliquely. Unipennate muscles (for example, flexor pollicis longus) have fibres running from their origin to attach along only one side of the tendon of insertion. In bipennate muscles (such as rectus femoris), the fibres are anchored to both sides of the tendon of insertion.

Multipennate muscles (for example, subscapularis) have several tendons of origin and insertion with muscle fibres passing obliquely between them. Some muscles, for instance digastric, have two fleshy parts (bellies) connected by an intermediate tendon.

Most tendons are thick and round or flattened in cross-section, although some form thin sheets called aponeuroses (Fig. 1.6a). When tendons cross projections or traverse confined spaces they are often enveloped in a double layer of synovial membrane (see page 1.12) to minimize friction. Where they cross joints, tendons are often held in place by bands of thick fibrous tissue which prevent 'bowstringing' when the joints are moved. Examples include the retinacula at the wrist and ankle joints, and tendon sheaths in the fingers and toes (Figs. 1.7 & 1.8).

The nerve supply to a skeletal muscle contains both motor and sensory fibres which usually enter the fleshy part of the muscle. Groups of muscles with similar actions tend to be supplied by nerve fibres derived from the same spinal cord segments.

As metabolically very active tissue, muscle has a rich arterial blood supply usually carried by several separate vessels. The contraction and relaxation of muscles in the limbs compresses the veins in each compartment. As the veins contain unidirectional valves, this 'muscle pump' action assists the return of venous blood from the limbs to the trunk.

5. Cartilage

Cartilage is a variety of hard connective tissue which gains its nutrition by diffusion from blood vessels in the surrounding tissues. It is classified by its histological structure into hyaline cartilage, fibrocartilage and elastic cartiliage.

Hyaline cartilage occurs in costal cartilages (Fig. 1.6b), the cartilages of the larynx and trachea, and in developing bones. In synovial joints (see Fig. 1.13) it forms the glassy smooth articular surfaces which reduce friction during movement. Articular cartilage is partly nourished by diffusion from the synovial fluid in the joint cavity.

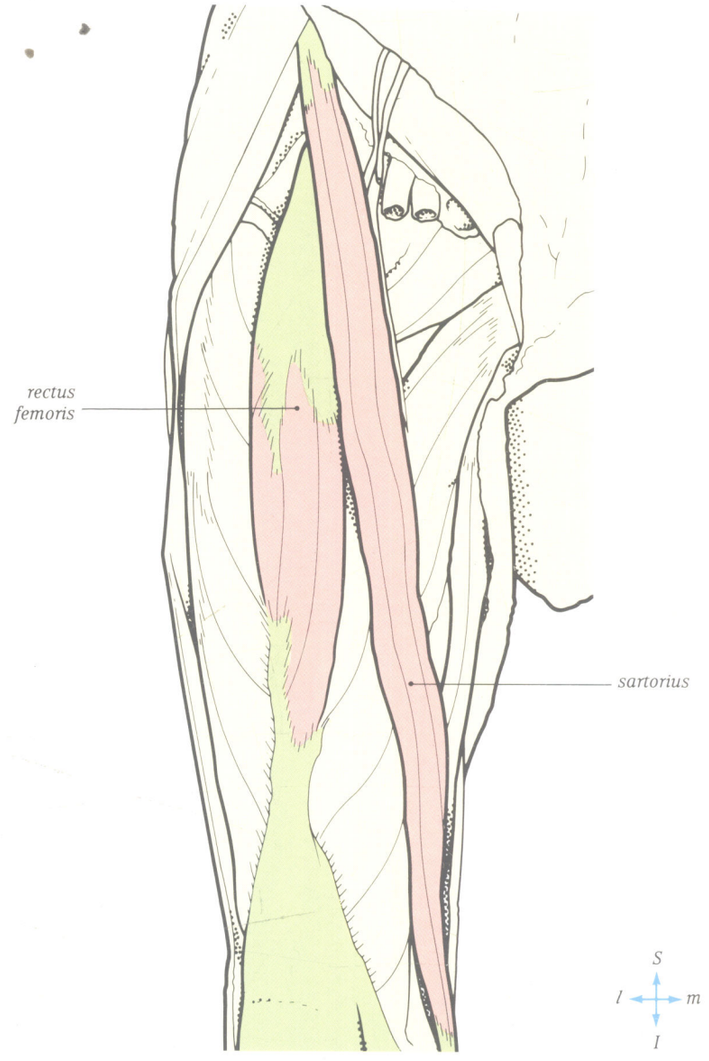


Fig. 1.6e *Rectus femoris is a bipennate muscle and sartorius is a strap muscle.*

The inclusion of tough inelastic collagen fibres in the matrix constitutes fibrocartilage, which is stronger and more flexible than the hyaline type. Fibrocartilage is found in intervertebral discs (see Fig. 1.12), the pubic symphysis, the manubriosternal joint, and as articular discs in some synovial joints (for example, knee and temporomandibular).

Elastic cartilage, which occurs in the external ear and epiglottis, is the most flexible form of cartilage. It contains predominantly elastic fibres and has a yellowish appearance.

Cartilage may become calcified in old age, becoming harder and more rigid.

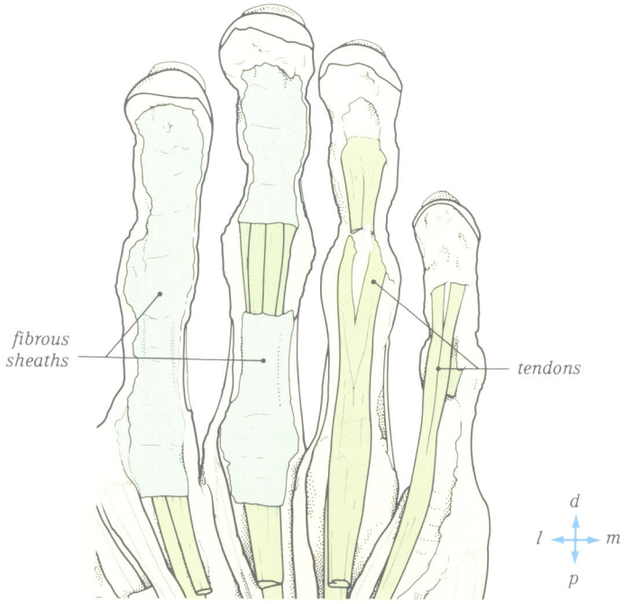


Fig. 1.7 *Anterior view of the left hand dissected to reveal its fibrous sheaths and tendons.*

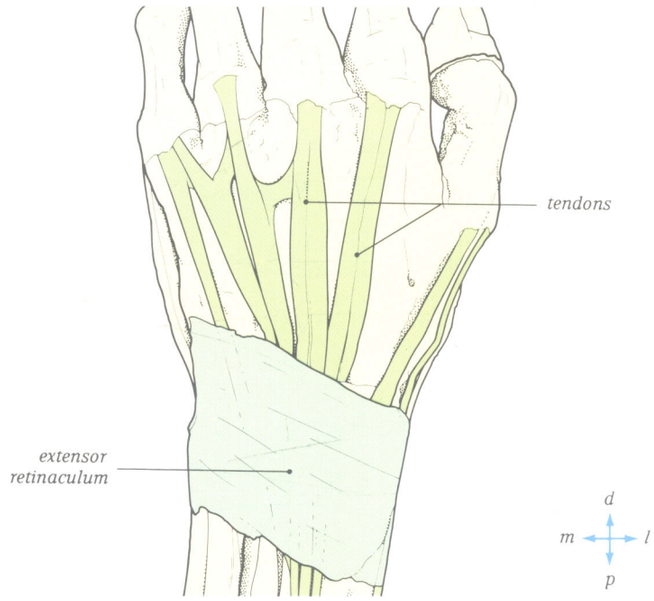
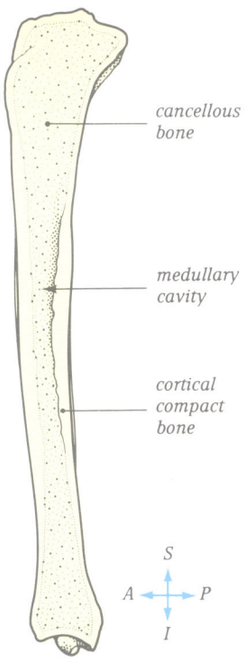


Fig. 1.8 *Posterior view of the left hand dissected to show the extensor retinaculum at the wrist.*



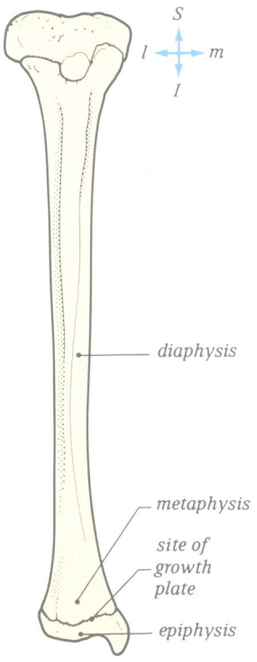


Fig. 1.9 *Longitudinal section of an adult tibia.*

Fig. 1.10 *Anterior view of a child's tibia.*

6. Bone

Bone forms the basis of the skeleton and is characterized by a hard calcified matrix which gives rigidity. In most bones two zones are visible. Near the surface the outer cortical layer of bone appears solid and is called compact bone whereas centrally the bone appears spongy and is known as cancellous bone. Many bones contain a cavity (medulla) occupied by the bone marrow, a potential site of blood cell production (Fig. 1.9).

The numerous bones comprising the human skeleton vary considerably in shape and size and are classified into long bones (for example, femur), short bones (bones of the carpus), flat bones (parietal bone of skull), irregular bones (maxilla of skull) and sesamoid bones (patella). Sesamoid bones develop in tendons, generally where the tendon passes over a joint or bony projection. Some bones are described as pneumatized because of their air-filled cavities (for instance, ethmoid).

Bone is enveloped by a thin layer of fibrous tissue called periosteum (see Fig.1.5) which provides anchorage for muscles, tendons and ligaments. Periosteum is a source of cells for bone growth and repair and is richly innervated and exquisitely sensitive to pain.

Bone has a profuse blood supply which is provided partly via the periosteal vessels and partly by nutrient arteries, which enter bones via nutrient foramina and also supply the marrow. Fractured bones often bleed profusely from damaged medullary and periosteal vessels.

Several names are given to the different parts of a long bone in relation to its development (Fig. 1.10). The shaft (or diaphysis) ossifies first and is separated by growth plates from the secondary centres of ossification (or epiphyses) which usually lie at the extremities of the bone. The part of a diaphysis next to a growth plate is called a metaphysis and has a particularly rich blood supply. When increase in bone length ceases, the growth plates disappear and the epiphyses fuse with the diaphysis.

7. Joints

Joints are classified according to their structure into fibrous, cartilaginous and synovial types. In fibrous joints (Fig. 1.11) which are relatively immobile, the two bones are joined by fibrous tissue (for example, sutures seen between the bones of the skull).

Cartilage is interposed between bone ends in cartilaginous joints. Primary cartilaginous joints contain hyaline cartilage, are usually capable of only limited movement, and occur between the ribs and sternum. In secondary cartilaginous joints (Fig. 1.12), fibrocartilage unites the bone ends. These joints, which generally allow more movement than those of the primary type, all lie in the midline. Examples include the intervertebral discs, the manubriosternal joint and the pubic symphysis.

Fig. 1.11 *The inferior tibiofibular joint is an example of a fibrous joint.*

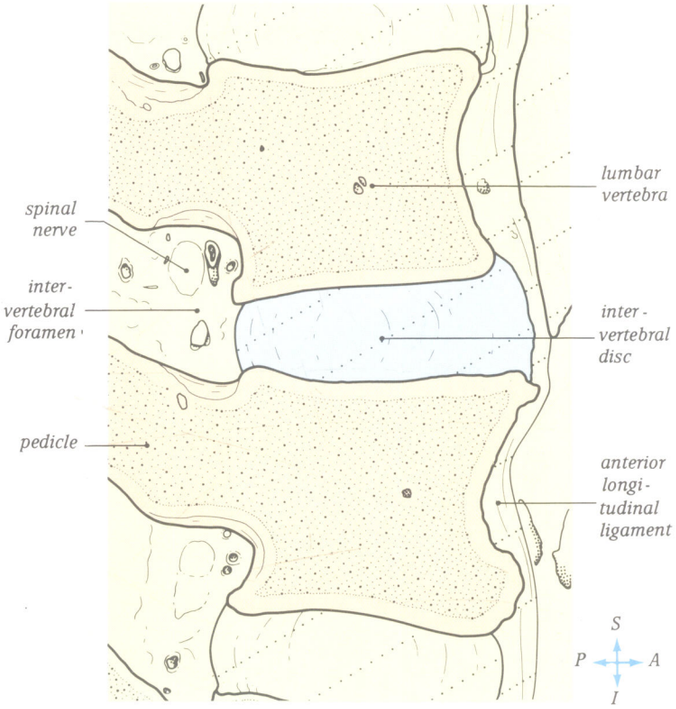


Fig. 1.12 *Sagittal section to show an intervertebral disc, a secondary cartilaginous joint.*