J. CRAWFORD ADAMS

OUTLINE OF ORTHOPAEDICS

EIGHTH EDITION

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BY

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Preface to the Eighth Edition

In this new edition, for which the text has again been completely revised and brought up to date, I have extended the principle of indicating by the use of smaller type those clinical conditions that I believe to be relatively unimportant to the medical student for examination purposes. Essential reading has thereby been reduced, and I hope thus to ease the burden of the undergraduate, who is faced with the task of becoming acquainted with an ever-widening field of medical knowledge. Yet the smaller-print material is still there—indeed it has been slightly expanded though the book as a whole is shorter—for those who require a deeper knowledge, whether for its own sake or in preparation for a higher examination. In short, there is less to read for the harassed; a little more for the diligent.

Once again I wish to thank the staff of the Publishers, Messrs Churchill Livingstone, for their ready cooperation.

J. C. ADAMS.

London,
1976.

Preface to the First Edition

This book is intended primarily to help students who are studying for the qualifying examinations. I hope that it may also be of use to practitioners whose work brings them into occasional contact with orthopaedic problems, and to physiotherapists and orthopaedic nurses.

My endeavour has been to present an easily read account of our present knowledge and thought on orthopaedic surgery in the shortest possible compass consistent with accuracy, and without resorting to the style of a synopsis. Rarities that are unimportant to the undergraduate student have been omitted, and descriptions of operative technique have been cut down to the barest essentials. Fractures have been excluded because the publishers and I

believe that they could be considered more appropriately in a companion volume.

Despite limitations of space I thought it right to include some notes on the methods of examining joints and limbs, because I believe that a clear exposition of clinical methods is the most important contribution that the orthopaedic surgeon can make to the student's surgical training. If the examination candidate can examine a limb competently and elicit the physical signs correctly, his battle is more than half won: and the knowledge will stand him in good stead throughout his clinical career.

J. C. ADAMS.

LONDON,
November 1955.

NOTE ON TERMINOLOGY

The anatomical nomenclature used in this book conforms to that recommended by the International Anatomical Nomenclature Committee and approved at the Eighth International Congress of Anatomists at Wiesbaden in 1965. This nomenclature, which differs only in minor respects from the earlier Birmingham revision of the Basle nomenclature, has been adopted at most schools of anatomy and it is to be hoped that it will become the standard terminology acceptable alike to anatomists and surgeons.

The recommended method of recording and expressing joint movement conforms to that laid down by the American Academy of Orthopaedic Surgeons in the booklet *Joint Motion* published by the Academy in 1965 and approved by most of the Orthopaedic Associations of the English-speaking world. The guiding principle of the method is that for any joint the extended 'anatomical position' is regarded as zero degrees, and movement at the joint is measured from this starting position. For example, in the knee the straight position is described as zero degrees and the fully flexed position is expressed as (say) 145 degrees of flexion. Likewise at the elbow. At the ankle the anatomical position, with the foot at a right angle to the leg, is the zero position, from which plantarflexion and dorsiflexion (extension) are measured.

The Academy booklet also gives figures for the normal range of movement at each joint. In some instances these do not accord with the author's experience and they have not always been followed in this text. Individual variations are common, so that any statement of the normal must necessarily be imprecise.

Contents

Introduction

THE term orthopaedic is derived from the Greek words ορθος (straight) and παις (child). It was originally applied to the art of correcting deformities by Nicolas Andry, a French physician, who in 1741 published a book entitled *Orthopaedia : Or the Art of Correcting and Preventing Deformities in Children : By such Means, as may easily be put in Practice by Parents themselves, and all such as are Employed in Educating Children.*

In Andry's time orthopaedic surgery in the form known to-day did not exist. Surgery was still primitive. Indeed, except for sporadic attempts by ingenious individuals, it is probable that little real progress had been made since the days of Hippocrates.

That is not to say that surgeons were unintelligent or that they lacked a capacity for careful study and research. Early writings prove that many of them were shrewd observers, and from the time of John Hunter (1728-93) onwards this was increasingly true. Take, for example, the words of Sir Astley Cooper (1768-1848) in his *Treatise on Dislocations and Fractures of the Joints* : " Nothing is known in our profession by guess ; and I do not believe, that from the first dawn of medical science to the present moment, a single correct idea has ever emanated from conjecture. It is right, therefore, that those who are studying their profession should be aware that there is no short road to knowledge ; that observations on the diseased living, examinations of the dead, and experiments upon living animals are the only sources of true knowledge ; and that inductions from these are the sole basis of legitimate theory."

The enthusiasm and the capacity for study were there. The real obstacle to progress was the lack of the essential facilities that we now take so much for granted—anaesthesia, asepsis, powerful microscopes, and x-rays. Any surgical operation that could not be completed within a few minutes was out of the question when the patient's consciousness could be clouded only by intoxication or exsanguination. And when every major operation was inevitably

followed by suppuration which often proved fatal it is small wonder that operations were seldom advised except in an attempt to save life.

Thus orthopaedic surgery, until relatively recent times, was confined largely to the correction of deformities by rather crude

FIG. 1

An early method of reducing a dislocated shoulder.
(From Scultetus: *Armamentarium Chirurgicum*, 1693.)

pieces of apparatus, to the reduction of fractures and dislocations by powerful traction (Fig. 1), and to amputation of limbs (Fig. 2).

LANDMARKS OF SURGERY IN THE NINETEENTH CENTURY

Fundamental advances in surgery were in fact dependent upon the development of other branches of science and of industry which provided, for instance, the high-powered microscope and the x-ray tube. It is therefore not surprising that, after centuries of stagnation, the facilities that were lacking were all made

available within the span of a single life-time, at the period of the Industrial Revolution.

The first epoch-making advance was the introduction of anaesthesia. The credit for this should be given jointly to Crawford Long, of Athens, Georgia, who was the first to use

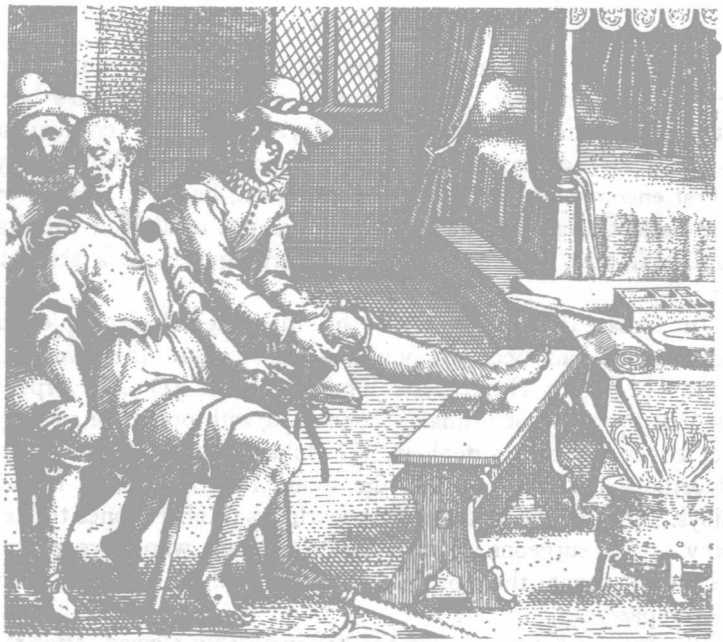

FIG. 2
A seventeenth-century amputation scene.
(From Fabricius: *Opera*, 1646.)

ether in 1842 but delayed publication of his observations for seven years; and to W. T. G. Morton, of Boston, Massachusetts, whose use of ether anaesthesia was reported in 1846.

A few years later Louis Pasteur (1822-95), working in Paris and equipped at last with an adequate microscope, was carrying out his fundamental research on bacteria as a cause of disease. Then in 1867 Joseph Lister (1827-1912), working in Glasgow, Scotland, on the basis of Pasteur's work introduced his antiseptic surgical technique which allowed the surgeon, for the first time in

history, to look for primary healing of his operation wounds. Finally, in 1895, came Roentgen's report from Würzburg in Germany of his discovery of x-rays, which within a short time were put to practical use in surgical diagnosis.

THE EMERGENCE OF ORTHOPAEDICS AS A DISTINCT SPECIALITY

Thus at the dawn of the twentieth century the stage was set for the phenomenally rapid evolution of surgery that has been witnessed by many still alive to-day. With the consequent widening of the scope of surgical practice orthopaedic surgery, at first encompassed by the general surgeon, began to branch off as a distinct science and art; but it was not until after the first world war that it came to be widely recognised as a separate speciality.

In Great Britain many of the fundamental principles of orthopaedics had been propounded, just before the twentieth century began, by Hugh Owen Thomas[1] (1834-91) of Liverpool. But Thomas was not primarily concerned with operative surgery, and it was left to his nephew, Sir Robert Jones (1857-1933) to set orthopaedic surgery upon the sound foundation that it now enjoys. During and after the first world war Robert Jones trained many of the surgeons, British and American, who were among the first to devote their professional lives entirely to the practice of orthopaedics.

To-day the tempo of advance has inevitably slowed, after the first great surge of discovery. Yet there remain a great many problems still to be solved, and in this challenge lies the peculiar fascination that orthopaedic surgery holds for its devotees.

THE PRESENT SCOPE OF ORTHOPAEDIC SURGERY

The orthopaedic surgeon is concerned with diseases and injuries of the trunk and limbs. His field is not confined to the bones and joints; it includes in addition the muscles, tendons, ligaments, bursae, nerves, and blood vessels. He is not concerned with injuries of the skull, which fall within the province of the neurosurgeon; or with injuries of the jaws, which are the responsibility of the facio-maxillary or dental surgeon.

[1] Thomas's name is remembered in the widely used Thomas's knee splint and in Thomas's test for fixed flexion at the hip.

References and bibliography, page 436.

CHAPTER ONE

Clinical Methods

IN this chapter an attempt will be made to indicate the correct line of approach to an orthopaedic problem, with particular reference to diagnosis and treatment.

As in all branches of medicine and surgery, proficiency in diagnosis can be acquired only from long experience. There is no short cut to a familiarity with physical signs or to skill in radiographic interpretation. Nevertheless the inexperienced surgeon who tackles the problem methodically step by step will often give a better account of himself than his more experienced colleague who makes a 'snap' diagnosis after no more than a cursory investigation.

In the choice of treatment the development of a sound judgment is also largely a matter of experience. Yet more than that is needed. Other essential qualities are common sense and a sympathetic appreciation of human problems. There are surgeons who never acquire a sound judgment however long their apprenticeship. Others seem to have a natural aptitude that quickly matures under proper guidance and training.

DIAGNOSIS OF ORTHOPAEDIC DISORDERS

Diagnosis depends first upon an accurate determination of all the abnormal features from 1) the history; 2) clinical examination; 3) radiographic examination; and 4) special investigations. Secondly, it depends upon a correct interpretation of the findings.

HISTORY

In the diagnosis of orthopaedic conditions the history is often of first importance. In cases of torn meniscus in the knee, for instance, the diagnosis sometimes depends upon the history alone. Except in the most obvious conditions, a detailed history is always required.

First the exact nature of the patient's complaint is determined. Then the development of the symptoms is traced step by step from their earliest beginning up to the time of the consultation. The patient's own views on the cause of the symptoms are always worth recording : often they prove to be correct. Enquiry is made into activities that have been found to improve the symptoms or to make them worse, and into the effect of any previous treatment. Facts that often have an important bearing on the condition are the age and present occupation of the patient, his previous occupations, his hobbies and recreational activities, and previous injuries.

When a detailed history of the local symptoms has been obtained, do not omit to enquire whether there have been symptoms in other parts of the body, and whether the general health is affected. Ask also about previous illnesses.

Finally, in cases that seem trivial, a tactful enquiry why the patient decided to seek advice, and to what extent he is worried by his disability, will often give a valuable clue to the underlying problem. It should be remembered that very often a patient seeks advice not because he is handicapped by his disability (which is often insignificant) but because he fears the development of some serious disease such as cancer, tuberculosis, or progressive crippling deformity.

CLINICAL EXAMINATION

The part complained of is examined according to a rigid routine which is never varied. If this is done, familiarity with the routine will ensure that no step in the examination is forgotten. Accuracy of observation is essential : it can be acquired only by much practice and by diligent attention to detail.

The examination of the part complained of does not complete the clinical examination. It sometimes happens that symptoms felt in one part have their origin in another. For example, pain in the leg is often caused by a lesion in the spine, and pain in the knee may have its origin in the hip. The possibility of a distant lesion must therefore be considered and an examination made of any region under suspicion.

Finally, localised symptoms may be the first or only manifestation of a generalised or widespread disorder. A brief examination is therefore made of the rest of the body with this possibility in mind.

Thus the clinical examination may be considered under three headings: 1) examination of the part complained of; 2) investigation of possible sources of referred symptoms; and 3) general examination of the body as a whole.

EXAMINATION OF THE PART COMPLAINED OF

The following description of the steps in the clinical examination is intended only as a guide. The technique of examination will naturally be varied according to individual preference. Nevertheless, it is useful to stick to a particular routine, for a familiarity with it will ensure that no step in the examination is forgotten.

Exposure for Examination

It is essential that the part to be examined should be adequately exposed and in a good light. Many mistakes are made simply because the surgeon does not insist upon the removal of enough clothes to allow proper examination. When a limb is being examined the sound limb should always be exposed for comparison.

Inspection

Inspection should be carried out systematically, with attention to the following four points. 1) **The bones:** Observe the general alignment and position of the parts to detect any deformity, shortening, or unusual posture. 2) **The soft tissues:** Observe the soft-tissue contours, comparing the two sides. Note any visible evidence of general or local swelling, or of muscle wasting. 3) **Colour and texture of the skin:** Look for redness, cyanosis, pigmentation, shininess, or other changes. 4) **Scars or sinuses:** If a scar is present, determine from its appearance whether it was caused by operation (linear scar with suture marks), injury (irregular scar), or suppuration (broad, adherent, puckered scar).

Palpation

Again there are four points to consider. 1) **Skin temperature:** By careful comparison of the two sides judge whether there is an area of increased warmth or of unusual coldness. An increase of local temperature denotes increased vascularity. The usual cause is an inflammatory reaction; but it should be remembered that a rapidly growing tumour may also bring about marked local hyperaemia. 2) **The bones:** The general shape and outline of the bones are investigated. Feel in particular for thickening, abnormal prominence, or disturbed relationship of the normal landmarks. 3) **The soft tissues:** Direct particular attention to the muscles (are they in spasm, or wasted ?), to the joint tissues (is the synovial membrane thickened, or the joint distended with fluid ?), and to the detection of any local swelling (? cyst; ? tumour) or general swelling of the part. 4) **Local tenderness:** The exact site of any local tenderness should be mapped out and an attempt made to relate it to a particular structure.

Determining the cause of a diffuse joint swelling. The question often arises : what is the cause of a diffuse swelling of a joint ? The answer can be supplied after careful palpation. For practical purposes a *diffuse* swelling of the joint as a whole can have only three causes : 1) thickening of the bone end ; 2) fluid within the joint ; and 3) thickening of the synovial membrane. In some cases two or all three causes may be combined, but they can always be differentiated by palpation. *Bony thickening* is detected by deep palpation through the soft tissues, the bone outlines being compared on the two sides. A *fluid effusion* generally gives a clear sense of fluctuation between the two hands. *Synovial thickening* gives a characteristic boggy sensation—rather as if a layer of soft sponge-rubber had been placed between the skin and the bone. It is nearly always accompanied by a well marked increase of local warmth, for the synovium is a very vascular membrane.

Measurements

Measurement of limb length is often necessary, especially in the lower limbs, where discrepancy between the two sides is important. Measurement of the circumference of a limb segment on the two sides provides an index of muscle wasting, soft-tissue swelling or bony thickening. Details will be given in the chapters on individual regions.

Estimation of Fixed Deformity

Fixed deformity exists when a joint cannot be placed in the neutral (anatomical) position. Its causes are described on page 38. The degree of fixed deformity at a joint is determined by bringing the joint as near as it will come to the neutral position and then measuring the angle by which it falls short.

Movements

In the examination of joint movements information must be obtained on the following points : 1) What is the range of active movement ? 2) Is passive movement greater than active ? 3) Is movement painful ? 4) Is movement accompanied by crepitation ?

In measuring the range of movement it is important to know what is the normal. With some joints the normal varies considerably from patient to patient ; so it is wise always to use the unaffected limb for comparison. Limitation of movement in all directions suggests some form of arthritis, whereas selective limitation of movement in some directions with free movement in others is more suggestive of a mechanical derangement.

Except in two sets of circumstances passive movement will usually be found equal to the active. The passive range will exceed the active only in the following conditions : 1) when the muscles responsible for the movement are paralysed ; and 2) when the muscles or their tendons are torn, severed or unduly slack.

Power

The power of the muscles responsible for each movement of a joint is determined by instructing the patient to move the joint against the resistance of the examiner. With careful comparison of the two sides it is possible to detect gross impairment of power. By general convention, the strength of a muscle is recorded according to the Medical Research Council grading as follows: 0 = no contraction; 1 = a flicker of contraction; 2 = slight power, sufficient to move the joint only with gravity eliminated; 3 = power sufficient to move the joint against gravity; 4 = power to move the joint against gravity plus added resistance; 5 = normal power.

In the occasional instances when more precise information is required muscle strength can be measured against weights, spring balances, or deflection bars.

Stability

The stability of a joint depends partly upon the integrity of its articulating surfaces and partly upon intact ligaments. When a joint is unstable there is abnormal mobility—for instance, lateral mobility in a hinge joint. It is important, when testing for abnormal mobility, to ensure that the muscles controlling the joint are relaxed; for a muscle in strong contraction can often conceal ligamentous instability.

Peripheral Circulation

Symptoms in a limb may be associated with impairment of the arterial circulation. Time should therefore be spent in assessing the state of the circulation by examination of the colour and temperature of the skin, the texture of the skin and nails, and the arterial pulses. This examination is particularly important in the case of the lower limb. Further details are given on page 386.

Tests of Function

It is next necessary to test the function of the part under examination. How much does the disorder affect the part in its fulfilment of everyday activities? Methods of determining this vary according to the part affected. To take the lower limb as an example, the best test of function is to observe the patient standing, walking, running, and jumping. Special tests are required to investigate certain functions—for example, the Trendelenburg test for abductor efficiency at the hip (p. 311).

INVESTIGATION OF POSSIBLE SOURCES OF REFERRED SYMPTOMS

When the source of the symptoms is still in doubt after careful examination of the part complained of, attention must be directed to possible extrinsic disorders with referred symptoms. This will entail examination of such other regions of the body as might be responsible. For instance, in a case of pain in the shoulder it might be necessary to examine the neck for evidence of a lesion interfering with the brachial

plexus, and the thorax and abdomen for evidence of diaphragmatic irritation, because either of these conditions may be a cause of shoulder pain. Again, in a case of pain in the thigh the examination will often have to include a study of the spine, abdomen, pelvis, and genito-urinary system as well as a local examination of the hip and thigh.

GENERAL EXAMINATION

The mistake is sometimes made of confining the attention to the patient's immediate symptoms and failing to assess the patient as a whole. It should be made a rule in every case, however trivial it may seem, to form an opinion not only of the patient's general physical condition but also of his psychological outlook. In simple and straightforward cases this general survey may legitimately be brief and rapid, but it should never be omitted.

RADIOGRAPHIC EXAMINATION

The correct interpretation of radiographs becomes easier if the films are examined methodically according to a standard routine. In this way abnormalities are far less likely to be missed than they are if one simply gazes hopefully but haphazardly into the viewing box. The following routine is suggested. 1) Set the films in the anatomical position on a viewing box; simply to hold the films up against the light is to invite mistakes. 2) Note what part of the body is shown and by which projections the films have been made. 3) Stand back from the viewing box to assess the *general density* of the bones (Fig. 3): judge from experience whether the density seems normal, or whether it is reduced (rarefaction[1]) or increased (sclerosis). 4) Look more closely for any *local changes of density*. 5) Examine the *cortex* of each bone: run the eye round the outline of the bone, looking for breaks in the continuity of the cortex, and for irregularities or areas of erosion; then examine the substance of the cortex for thickening, thinning, alteration of texture, or new bone formation. 6) Examine the *medulla* of each bone: look for alterations of texture and for areas

[1] The term rarefaction is used here to include osteoporosis and osteomalacia. Pathologically, *osteoporosis* implies increased porosity of bone from attenuation of its trabeculae: the matrix is deficient as well as the bone salts. In *osteomalacia*, which is distinct pathologically, the matrix remains but its mineralisation is deficient, the trabeculae being composed largely of osteoid tissue. Radiologically, there is nothing to distinguish osteoporosis from osteomalacia: in both states the bone looks 'thin.' For this radiological appearance the all-embracing term *rarefaction* is the most appropriate.

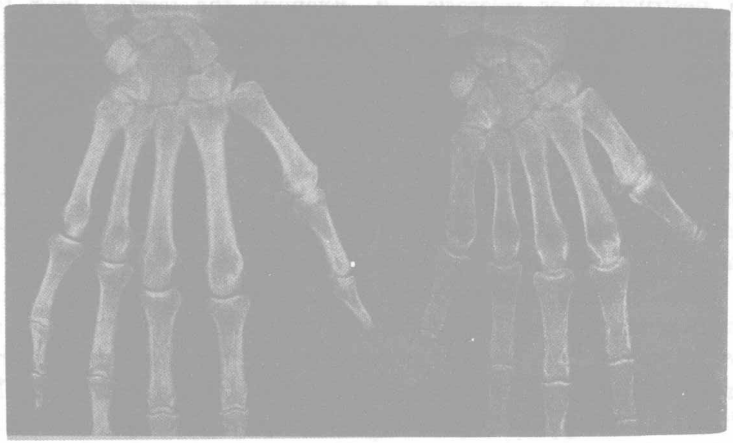

FIG. 3

To show the importance of assessing bone density in the study of radiographs. The two hands were exposed simultaneously on the same film. The one on the left is the hand of a normal person. That on the right is the hand of a patient with osteomalacia complicating idiopathic steatorrhoea. Note the marked general rarefaction of the bones.

FIG. 4

FIG. 5

Figure 4—It is important to study the soft-tissue areas as well as the bones. The shadow between the metacarpal heads in this radiograph is a calcified deposit. It might at first be mistaken for a displaced fragment of bone, but it is distinguished from bone by the fact that it is homogeneous and lacks the trabecular pattern that is characteristic of bone. Figure 5—Myelography is an important aid in the study of certain spinal lesions, especially tumours. This example shows a filling defect due to an intrathecal tumour.