Apley's System of Orthopaedics and Fractures

Sixth Edition

A. Graham Apley,

Louis Solomon,

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A. Graham Apley,
MB BS, FRCS
Consulting Orthopaedic Surgeon, St Thomas' Hospital, London
Emeritus Consultant Orthopaedic Surgeon, The Rowley Bristow Orthopaedic Hospital, Pyrford, and St Peter's Hospital, Chertsey, Surrey
Formerly Honorary Director, Department of Orthopaedics, St Thomas' Hospital, London

Louis Solomon,
MB ChB, MD, FRCS
Professor of Orthopaedic Surgery, University of the Witwatersrand, Johannesburg
Chief Orthopaedic Surgeon, Johannesburg Hospital

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Preface

The first outline of this book was written in 1954. The FRCS course at Pyrford was then six years old; but as it became more comprehensive the students could either pay attention or scribble notes – they couldn't do both. The obvious answer was to provide summaries of all the lectures. These were revised annually, but as the course grew longer, typed notes became unmanageable (and secretaries rebellious) so in 1959 the publishers had to take over.

For the printed version the notes were converted into more readable prose, but the systematic approach was left unchanged. Students seemed to like the idea of a standard pattern of headings and welcomed the logic of a consistent sequence for describing physical signs; learning to *look*, *feel* and *move* before turning to investigations is a habit they can profitably carry over from the lecture room (via the examination hall) to the consulting room. We like to think that in the process they will also discover that each of these deceptively simple words conveys a meaning beyond the obvious. 'Look' says more than 'inspect'; it implies contemplation of what is seen. Similarly, to 'feel' is more than to palpate, and 'move' is not merely an imperative.

Illustrations were a big problem. They are so helpful that profusion is desirable – and yet the book must not become unwieldy. The answer lay in selecting, pruning and arranging; picking only good quality illustrations, excising every scrap of surplus material, and then arranging the figures into groups so that each 'composite' tells a story. This fits in well with something every teacher knows: that, no matter how good a single illustration may be, it is more informative when combined with others in a meaningful set. Composites are the natural way of showing stages in a process, of highlighting important clinical signs, of summing up differential diagnosis and of contrasting different methods of treatment. There are some 2240 individual photographs, x-rays and drawings arranged into just over 500 composites. These can be used by themselves for quick revision; together with the text it is hoped that they provide a concise yet substantial presentation of orthopaedics and fractures in a single volume.

With the sixth edition the most important change is that there are now two authors instead of one. We have not simply divided the field; we have worked together on every chapter – differing, debating, arguing, agreeing – all the time prompting each other to further enquiry and fresh insights. In this way we have completely revised the whole *System of Orthopaedics and Fractures*. The essentially clinical character of the book has been firmly retained, but there are some changes of emphasis. The discussion of diagnostic procedures has been widened, histopathological descriptions have been enlarged and the basic sciences (notably biochemistry, biomechanics and applied anatomy) have received more attention.

Sections which have been entirely re-written include those on the rheumatic disorders, avascular necrosis of bone, the causes and pathology of osteoarthritis, metabolic bone disorders, endocrine disorders, the clinical approach to bone dysplasias, the surgery of stroke, the principles of orthopaedic operations, joint replacement and its complications, the rheumatoid hand, lumbar instability, spinal stenosis, Perthes' disease and club foot. With regard to trauma, the principles of fracture healing, cast-bracing, internal fixation, external fixation, compartment syndromes,

ligamentous injuries of the knee, acetabular fractures and ankle fractures receive fresh or more detailed attention. In short, the book has been completely updated to incorporate new concepts in orthopaedics and the interdisciplinary fields into which it extends. At the same time, since two heads can be more vigilant than one, enough dead wood has been uprooted to prevent a major increase in size.

The book is designed to be used by postgraduates (and their teachers), by undergraduates (who may ignore the small print), by casualty officers (whose dangerously exposed situation in the field of trauma has been kept in mind), by general practitioners (or at any rate those who seek further understanding of their orthopaedic patients) and by our colleagues in allied professions (physiotherapists, nurses, occupational therapists, social workers, orthotists and prosthetists), who ensure that orthopaedic surgeons never lose sight of the whole patient in their concentration on the defective part.

A. Graham Apley
Louis Solomon

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The exacting requirements of photography were carried out superbly at Pyrford by the late Ken Fensom (whose death, just as the book was nearing completion, is deeply mourned), at St Thomas' Hospital by Tom Brandon, at the Royal College of Surgeons of England by Cliff Redman, and in Johannesburg by Eric Norman.

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We are grateful also to colleagues elsewhere who willingly loaned illustrations to fill a few gaps. They include the following, but we apologize if, inadvertently, the name of some generous contributor has been omitted.

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Fig. 22.28: C. E. Holden, *Journal of Bone and Joint Surgery*, **61B**, 298

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Part 1 — General Orthopaedics

Diagnosis in Orthopaedics 1

'Information consists of differences that make a difference'
Gregory Bateson

Orthopaedics is concerned with bones, joints, muscles, tendons and nerves – the skeletal system and all that makes it move. An orthopaedic disorder is also part of a larger whole – a patient who has a personality, a mind and a body, a job and hobbies, a family and a home; all have a bearing upon the disorder and its treatment.

Diagnosis is not simply a process of labelling; it should also imply understanding – of the patient and how the disorder affects him and his way of life. And diagnosis begins, not with the patient on the examination couch, but from the moment we set eyes on him: we should be observing his appearance, his attitude, his gait – everything.

As the consultation and examination proceed, a cluster of symptoms and signs emerges and we begin homing-in on something we recognize. In orthopaedics this entity, the diagnosis, is likely to fall into one of seven easily remembered pairs: congenital and developmental abnormalities; infection and inflammation; injury and mechanical derangement; metabolic dysfunction and degeneration; arthritis and rheumatic disorders; sensory disturbance and muscle weakness; tumours and lesions that mimic them.

Symptoms

The word 'history' should be taken to mean 'his story' – not yours or mine. Unless the patient is allowed to tell his story in his own way, important facts can be missed and he may feel aggrieved. No matter if the story appears jumbled; it is the doctor's job to sort it out, and he should learn to think systematically. First he should consider any general symptoms; then local ones which, in orthopaedics, fall into three groups. The patient may complain that something *looks* wrong (deformity, swelling or a lump); that something *feels* wrong (pain, tingling or numbness); or that *movement* is wrong (limp, weakness, instability or stiffness). In practice, the common complaints are *pain, stiffness, swelling, deformity* and *disability*.

Moreover the history is, as the word implies, an unfolding train of events. We need to know if the onset was sudden or gradual; how long symptoms have been present; if they are constant or intermittent, static or increasing, and whether anything makes them better or worse. The patient's job and his hobbies, his previous illnesses or injuries, and any similar disorder in other members of the family also may be important.

Pain

Pain is the most common symptom in orthopaedics. Its precise location is important (ask the patient to point). So is severity; to the patient, pain is as bad as it feels. If only we could measure it! (Would the units be hells and decihells?) We can at least try to estimate severity, if only to assess therapeutic response.

Grade I	Trivial (easily ignored)
Grade II	Moderate (cannot be ignored, interferes with function and needs occasional attention)
Grade III	Severe (pain even at rest and demanding constant attention)
Grade IV	Incapacitating

1.1 'Point to where it hurts' In (a) and (b) the complaint would be of 'shoulder' pain; in (c) and (d) of 'hip' pain. The likely diagnoses are (a) supraspinatus tendinitis, (b) cervical spondylosis, (c) a disorder of the hip joint itself, (d) a prolapsed lumbar disc.

The term 'referred pain' is often misunderstood and incorrectly used. Pain arising in or near the skin is usually localized accurately and can be recalled with precision hours or days after it has disappeared. Pain arising in deep structures is more diffuse and is sometimes of quite unexpected distribution; thus, hip disease may manifest with pain in the knee (so might an obturator hernia!). This is not because sensory nerves connect the two sites; it is due to cortical confusion between embryologically related sites. A common example is 'sciatica' – pain at various points in the buttock, thigh and leg, supposedly following the course of the sciatic nerve. Such pain is not due to pressure on the sciatic nerve; it is 'referred' from any one of a wide variety of structures in the lumbar spine and pelvis.

Disability

Disability is not merely the sum of individual symptoms; it depends upon particular needs and is important in assessing requirements. Often symptoms are expressed in terms of disability: thus 'I can't sit for long', 'I can't hold a cup', or 'I can't put my socks on' may be offered rather than 'I have backache', 'my fingers are numb', or 'my hip is stiff'. Such disabilities suggest a more fruitful line of questioning than the mere checking of lists of symptoms.

Moreover, what to one patient is merely inconvenient may, to another, be incapacitating. Thus a doctor or a bank clerk may readily tolerate a stiff knee provided it is painless and he can walk well; but to a plumber or a parson the same disability might be economic or spiritual disaster.

Examination of a joint

General features	A brisk general appraisal of the patient is imperative
Local symptoms	Let the patient tell his story (with guidance), and point to the site of pain
Local signs	A system is the key to accurate diagnosis
Look	Observe the gait
Skin	
Shape	At this stage *shortening* is
Position	assessed
Feel	
Skin	Localized tenderness may be
Soft tissues	diagnostic. Be gentle – watch
Bones	the patient's face
Move	
Active	Examine the good limb first or
Passive	both simultaneously
Power	At this stage *function* is assessed
X-ray	Plus other investigations

For examination, a patient must be suitably undressed; no mere rolling up of a trouser leg is sufficient. Where one limb is to be examined, the opposite one must be adequately exposed, so that the two may be compared.

● LOOK

The student, or inexperienced doctor, is inclined to rush in with his hands – a temptation which must be resisted. His motto should be 'look before you feel'. And in looking he must follow a purposeful, orderly system; otherwise he will miss vital clues.

Skin This naturally comes first. We look systematically for colour changes, skin creases and scars. Redness usually implies inflammation; blueness, either cyanosis or bruising. Abnormal creases suggest underlying fibrosis or bony malposition (e.g. a dislocated hip); the absence of creases also may be significant. Scars reveal the past – the surgical archaeology, so to speak; they tell of natural events (e.g. an old sinus) or of operations.

Shape Changes in shape may be generalized (e.g. dwarfism), or localized (e.g. swelling, wasting or a lump).

Position While the position in which a joint is held may vary, if the joint is normal it 'looks natural'; any deviation from this natural appearance demands investigation. In many joint disorders and in most nerve lesions the limb adopts a characteristic attitude.

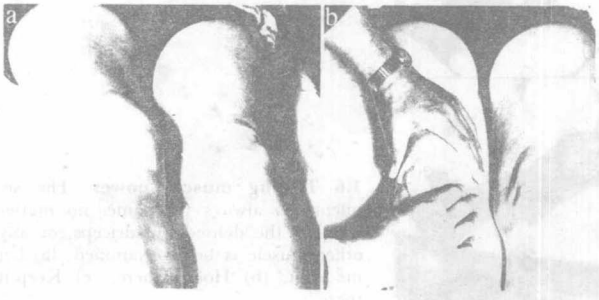
1.2 Feeling for tenderness (a) How not to do it. It is better to watch the patient's face (b), and to stop the moment she feels pain.

● FEEL

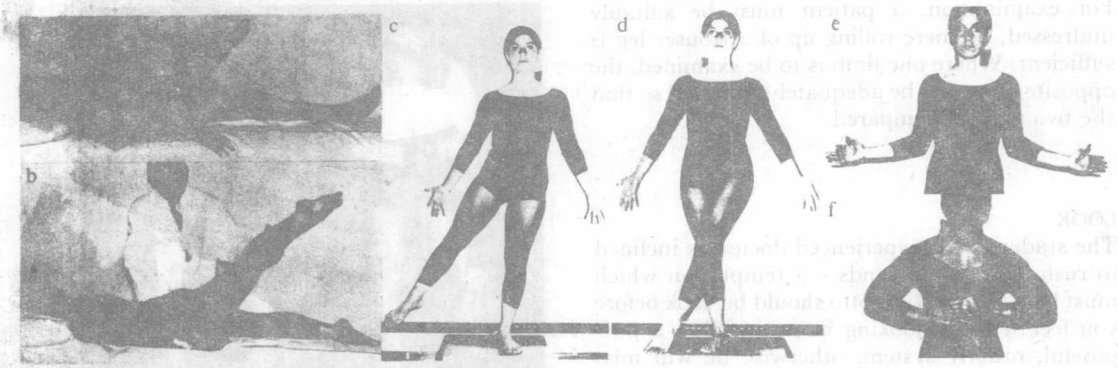
We must feel (as we should have looked) systematically: the good limb then the bad; the skin before the deep tissues; and the unaffected before the symptomatic area.

Skin Is the skin warm or cold, moist or dry, rough or smooth? and – equally important – can the patient feel you touching him, or is sensation abnormal?

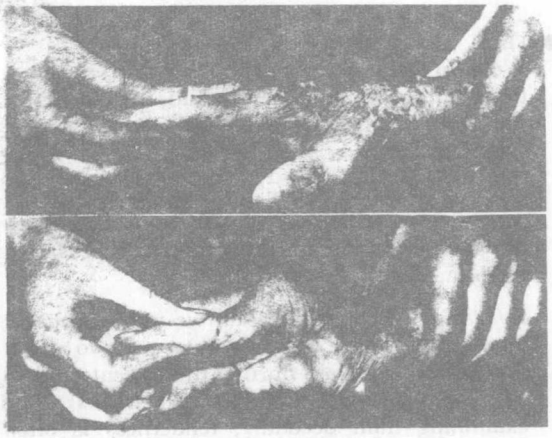
Soft tissues Deep to the skin we may encounter tenderness, which is important – in two ways. First, we must avoid hurting the patient; and so we watch his face and not our hands while examining him. Secondly, tenderness is often sharply localized; if so, it may immediately locate the site of the lesion.



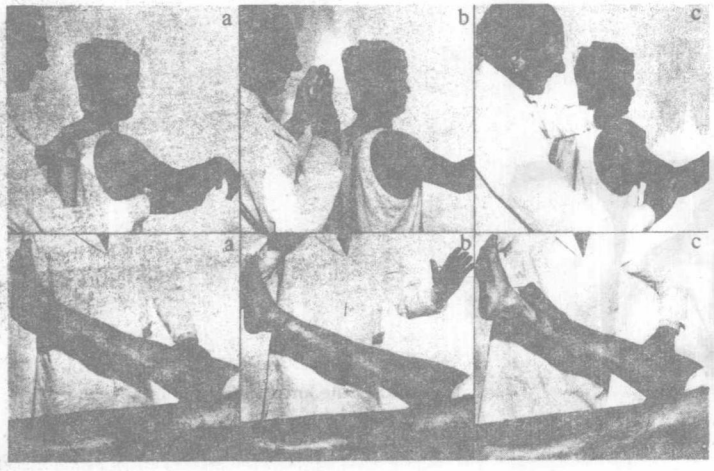
1.3 Fluid in the knee (a) The suprapatellar pouch is bulging and the thigh wasted; (b) cross-fluctuation (see page 278).



1.4 Active movements (a) Flexion, (b) extension, (c) abduction and (d) adduction at the hip; (e) external (lateral) and (f) internal (medial) rotation at the shoulder.



1.5 Passive movement Stability is tested by moving the joint passively across the normal planes of action – in this case by thrusting the entire finger volarwards, thus demonstrating abnormal movement at the metacarpophalangeal joint.



1.6 Testing muscle power The sequence is always the same, no matter whether the deltoid, quadriceps, or any other muscle is being examined. (a) 'Let me lift it.' (b) 'Hold it there.' (c) 'Keep it there.'

With superficial joints we can also feel if the synovial membrane is thickened (by rolling its edge under the fingers) and we can detect excess fluid (Fig. 1.3).

A soft tissue lump always demands careful examination to determine its size, shape, surface, consistency, edge and attachments.

Crepitus Strictly speaking this is a crackling sound which accompanies movement, but it is usually more sensitively felt than heard. Joint crepitus is fairly coarse, while tendon crepitus is fine and precisely localized to the affected tendon sheath.

● MOVE

Active The advantage of testing active movements first is that the patient is not likely to hurt himself; he stops when the point of pain is reached.

Passive We need to know if a particular movement is limited (and by how much), or painful (and at what angle); we must also be on the lookout for increased movement and for abnormal movements. To assess stability the limb is held above and below the joint and deliberately (but gently) stressed across the normal anatomical planes of movement.

Power Muscle testing is not as easy as it sounds; few patients have mastered *Gray's Anatomy*, and we must make ourselves understood. The easiest way is shown in Fig. 1.6. The sequence is important: you lift – he holds – you push – he resists while you feel. The normal limb is examined first, then the affected limb and the two are compared.

Examination of the muscle tells us something about the function of the limb. We can learn even more by watching the patient perform certain specific activities. With his upper limb he can try reaching for a high object or we can test him picking up weights and handling fine objects. To test the lower limb we can watch him stand, walk, run or hop.

The range of movement at a joint should be recorded in degrees; the eye soon acquires sufficient accuracy and a goniometer is needed only for special purposes.

Each joint moves through a characteristic range of positions in various planes, as follows.

Flexion/extension – movements in the sagittal plane towards the ventral or dorsal surface of the body. Joints that move only – or predominantly – in flexion and extension are the knee, elbow, ankle and the joints of the fingers and toes.

Adduction/abduction – movements in the coronal plane, towards or away from the midline. The hip and shoulder have considerable ranges of adduction and abduction.

External rotation/internal rotation – torsional movements around a fixed longitudinal axis. These are seen mainly in the hip and shoulder, but some rotation takes place also at the knee.

Pronation/supination These, too, are rotatory movements, but the terms are applied only to movements of the forearm and the foot.

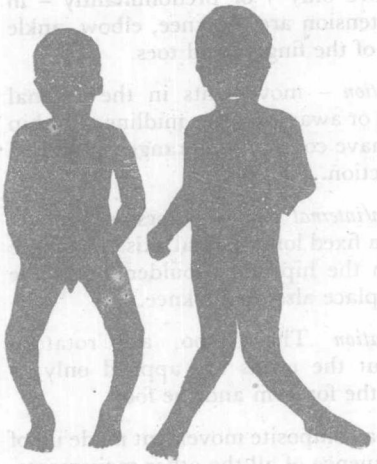
Circumduction – a composite movement made up of a rhythmic sequence of all the other movements. This is possible only for ball-and-socket joints (hip, shoulder). The appearance of circumduction may be given by multiple joints acting in series (e.g. the cervical spine).

Certain specialized movements, such as opposition of the thumb, lateral flexion and rotation of the spine, and inversion and eversion of the foot, will be described under the relevant regions.

Deformity

The word 'deformity' may be applied to a person, a bone or a joint. Shortness of stature is a kind of deformity; it may be due to shortness of the limbs, or of the trunk, or both (page 83). A bone also may be abnormally short; this is rarely important in the upper limbs, but it is in the lower (page 245); or a bone may be abnormally bent (page 10). A joint is said to be deformed when it is held in an unnatural position either because of faulty alignment (e.g. knock knee) or because it lacks full movement (e.g. fixed flexion). The terms describing the commoner deformities are so much a part of the everyday language of orthopaedics that a few definitions may be helpful.

Varus and valgus It may seem pedantic to replace 'bow legs' and 'knock knees' with terms such as genu varum and genu valgum. But comparable descriptive colloquialisms are not available for similar deformities of the elbow, hip or big toe. Moreover, 'varus' and 'valgus' refer not to the affected joint, but to the part distal to the joint:



1.7 Valgus and varus These boys look like brothers; they are in fact unrelated, but came from the same village and both had a deficiency disease causing bone softening. The shorter boy has developed varus deformity, the taller one is valgus; possibly pre-existing minor deformities have become exaggerated.

varus means that the part distal to the joint is displaced towards the midline, *valgus* away from it.

Kyphosis and lordosis The spine is normally constructed as a series of rhythmic curves in the sagittal plane – concave anteriorly in the dorsal region (kyphosis), and convex anteriorly in the cervical and lumbar regions (lordosis). If any of these curves are excessive they may constitute a kyphotic or lordotic deformity.

Scoliosis Looked at in the anteroposterior plane the spine is straight. Any curvature in this (coronal) plane, whether in the dorsal or the lumbar region, whether fixed or correctible, is called a scoliosis. A combination of kyphosis and scoliosis is called kyphoscoliosis.

'Fixed' deformity This does *not* mean that the joint is fixed and unable to move. It means that movement in one plane is impossible beyond a certain point; thus a joint may flex fully but not extend fully – at the limit of its extension it is still 'fixed' in a certain amount of flexion; similarly, there may be fixed adduction, abduction or rotational deformity of a joint. In the spine a fixed deformity is often called a structural deformity; it differs from a postural deformity, which the patient himself can, if properly instructed, correct by his own muscular effort.

Hysterical deformity This is usually bizarre and should not be diagnosed unless other causes of deformity have been excluded and other stigmata of hysteria are present.

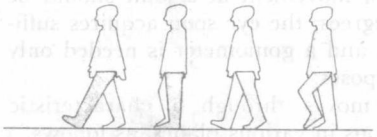
Causes

Deformities affecting many joints may be due to congenital disorders (e.g. Morquio–Brailsford disease), or to acquired disease (especially rheumatoid arthritis).

In deformity of a single joint or localized group of joints, it is often possible to identify which tissue is responsible – skin, fascia, muscle, tendon, ligaments, capsule or bone. These are considered under the appropriate joints.

Gait and limp

The gait cycle (the sequence of events in each step), consists of four parts: heel strike; stance phase; toe off; and swing phase. A limp is simply an abnormal gait. Its possible causes range from a tight shoe to a 'tight' person, but the orthopaedic causes (fortunately more limited) are best analysed by noticing the point in the gait cycle at which the abnormality occurs (though if the patient is inco-ordinate or is wearing a prosthesis his limp may be obvious at more than one point in the cycle).



1.8 The gait cycle This oddly dressed individual's left leg shows the stages: 'heel strike' is followed by the 'stance phase'; next is 'toe off' (almost) and finally the 'swing phase'.