COLOUR ATLAS OF CLINICAL RHEUMATOLOGY

To my wife, Helen
and our three children,
Peter, Catherine and Christopher

COLOUR ATLAS OF CLINICAL RHEUMATOLOGY

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CONTENTS

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PREFACE

Patients with rheumatic diseases frequently exhibit a multiplicity of clinical and radiographic signs. The ability to correctly interpret these clues to diagnosis is an invaluable clinical skill, and an essential component of diagnostic decision making. This book is designed as a pictorial guide to clinical rheumatology and illustrates the principal clinical and radiographic signs of many musculoskeletal disorders. It is intended to supplement the more factual types of information found in standard textbooks and to provide the reader with a visual experience equivalent to that of several years in clinical practice.

The two initial chapters on history and physical examination are incorporated to provide a construct within which the relevance of subsequent sections can be viewed. The disease-oriented chapters which form the majority of the text illustrate many of the more complex problems encountered in routine rheumatologic practice. Descriptions of several rare and unusual conditions, of particular clinical importance, have been included in the final chapter.

It is the author's hope that this atlas will appeal to family practitioners, trainees in both rheumatology and general medicine, and senior medical students, as well as serve as a teaching resource for the general physician and specialty rheumatologist. Whether read chapter by chapter or used purely as a reference text it is intended to be kept on hand both in the clinic and on the ward.

Nicholas Bellamy

Chapter 1

Clinical History

The history and physical examination not only provide important diagnostic information, but also determine the nature and extent of subsequent investigations. In addition, these two elements of the musculoskeletal data base may be of value in identifying the aetiology and severity of the disease as well as the patient's prognosis. In certain conditions, e.g. fibromyositis, subacromial bursitis and flexor tenosynovitis, the only clues to diagnosis are those detected during the clinical assessment, since radiographs and laboratory tests are characteristically normal. In other diseases, e.g. a classical case of primary osteoarthritis, ancillary tests may be required to define the severity of disease and establish clinical priorities, but may not be essential for diagnosis. Finally, there are a number of diseases, e.g. polyarteritis nodosa and pigmented villonodular synovitis, in which a diagnosis can only be made by supplementing clinical information with the results of specific laboratory tests.

It is not the intention of this chapter to exhaustively describe all aspects of history taking since there are several excellent texts which meet this need. Instead the importance of different aspects of the history will be stressed, and basic strategies for obtaining a complete and accurate history discussed. Furthermore, it will be assumed that the reader is familiar with the principles of history taking and attention directed to specific issues relating to musculoskeletal disorders. A frequently used system for eliciting the history is illustrated in Figure 1.1 and described in the remainder of this chapter.

Demographic profile

The age, sex, occupation and hand dominance (left or right) are the most important features of the demographic profile. Age and sex are of some diagnostic value since a number of diseases have a predilection for a certain sex or age group. Gonococcal arthritis, systemic lupus erythematosus, rheumatoid arthritis and Reiter's syndrome, for example, predominantly affect the young and middle aged, while Forestier's disease and polymyalgia rheumatica are more usually encountered in the elderly. Similarly, rheumatoid arthritis and systemic lupus erythematosus are more common in females while ankylosing spondylitis, Reiter's syndrome and polyarteritis nodosa are more frequent in males. The patient's occupation may be of aetiologic importance, in that a number of associations have been recognized between certain types of employment and musculoskeletal disease, e.g.osteoarthritis of the elbow in foundry workers and Raynaud's phenomenon in pneumatic tool operators. Alternately the patient's occupation may aggravate the underlying condition, and in some cases necessitate

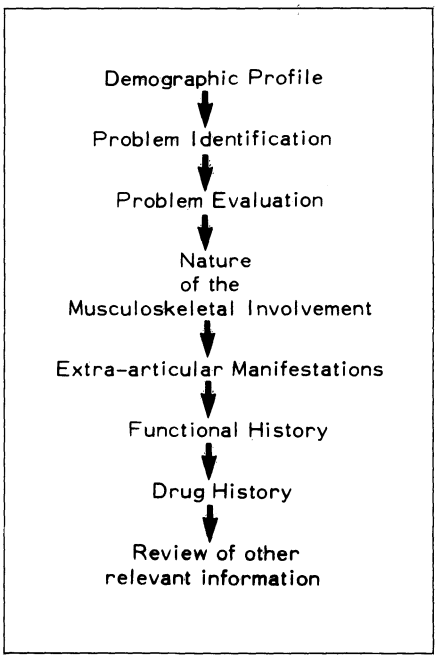

Figure 1.1 *A sequence for eliciting the musculoskeletal history*

job modification or a change in occupation, e.g. rheumatoid arthritis may totally disable a heavy manual worker. Questions regarding hand dominance are often neglected and yet in rheumatology are most important since (a) the dominant hand may be preferentially or more severely affected, and (b) the occurrence of pain and disability in, or related to, the dominant hand are frequently of greater consequence than equivalent symptoms in the contralateral hand.

Problem identification

It is essential at the beginning of the interview to identify the major clinical problem, i.e. the reason the patient sought consultation. Some patients attend the clinic for diagnostic purposes, while in others the diagnosis has been well established, and instead the problem is of a therapeutic nature. In yet other cases the patient may require a second opinion, prognostic information or request assessment for insurance or legal purposes. Once the interviewer has identified the reason for consultation then the location, and principal symptomatology, of the major clinical problem should be clearly and accurately identified. In particular, symptoms arising from articular structures should be differentiated from those due to tendonitis, bursitis, myalgia, vascular insufficiency, peripheral neuropathy or radicular or spinal compression. Furthermore, regional syndromes, e.g. adhesive capsulitis should be differentiated from more generalized musculoskeletal disorders, e.g. rheumatoid arthritis.

Problem evaluation

Having identified the principal clinical problem, the next step is to evaluate some of its characteristics. Five areas require exploration:

(1) Nature of the musculoskeletal involvement;
(2) Presence or absence of extra-articular disease;
(3) Functional history - The nature and severity of any physical, social, emotional or economic impairment;
(4) Drug history;
(5) Review of other relevant information.

Depending on the complexity of the problem, further evaluation may be limited to one specific area or encompass all the aforementioned items.

Nature of the musculoskeletal involvement

In addition to defining the duration of the disease, six areas should be investigated:

(1) Potential aetiologic factors,
(2) Number of joints involved,
(3) Distribution of joint involvement,
(4) Temporal profile,
(5) Inflammatory versus non-inflammatory characteristics, and
(6) Severity of symptoms.

Potential aetiologic factors

While arthritis is frequently spontaneous in its onset, in some patients specific factors of aetiologic importance can be identified. The most common factors are trauma, infection and drug ingestion. Trauma may precipitate an attack of gout or pseudogout without itself being the primary aetiologic factor, while in patients with post-traumatic synovitis, and some cases of osteonecrosis, it is the principal aetiologic agent. Infection may result in a number of different musculoskeletal syndromes including Reiter's syndrome, septic arthritis and rheumatic fever. Finally certain therapeutic agents, such as hydralazine and procainamide are associated with the development of systemic lupus erythematosus while others have been incriminated in the aetiology of hypersensitivity vasculitis (sulphonamides), Dupuytren's contracture (anti-convulsants), erythema nodosum (sulphonamides) and serum sickness reactions (penicillin).

Number of joints involved

Arthritis can be classified into one of three types:

(1) Monoarticular - one joint involved,
(2) Oligoarticular - four or less joints involved,
(3) Polyarticular - five or more joints involved.

It is important to identify the number of joints involved, irrespective of their anatomic location since diseases frequently display a tendency to involve either one, a few, or many joints. As a generalization diseases such as acute gouty arthritis, septic arthritis and osteonecrosis tend to be monoarticular, ankylosing spondylitis and enteropathic arthritis to be oligoarticular, and rheumatoid arthritis, rubella arthritis and systemic lupus erythematosus to be polyarticular.

Distribution of joint involvement

Rheumatology is one of several medical specialties in which pattern recognition is of key diagnostic importance. During history taking and physical examination the interviewer should clearly identify the distribution of the joint involvement with particular attention to the following four items:

(1) Peripheral versus axial involvement,
(2) Small versus large joint involvement,
(3) Upper extremity versus lower extremity involvement,
(4) Symmetrical versus asymmetrical involvement.

Once a map of the joint distribution has been constructed, it can be compared with the known target joints (i.e. preferentially affected areas) of a number of disease states (Figures 1.2–1.7). It is extremely useful to commit to memory the distribution diagrams of the common arthropathies, since the pattern of joint involvement

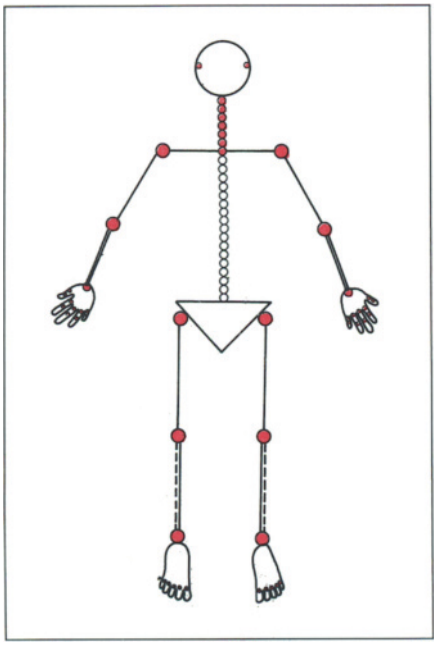

Figure 1.2 *Rheumatoid arthritis – distribution of target joints*

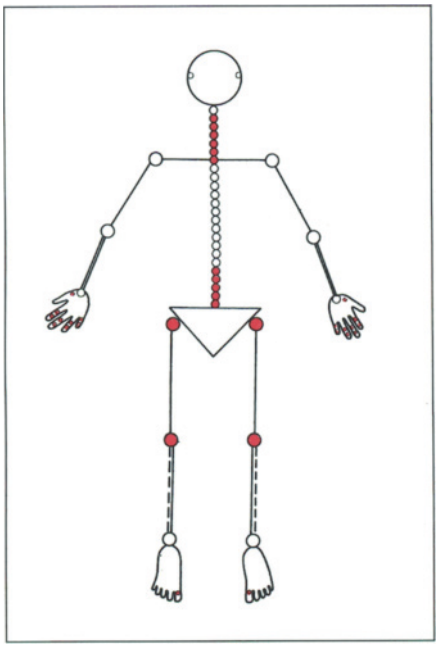

Figure 1.3 *Osteoarthritis – distribution of target joints*

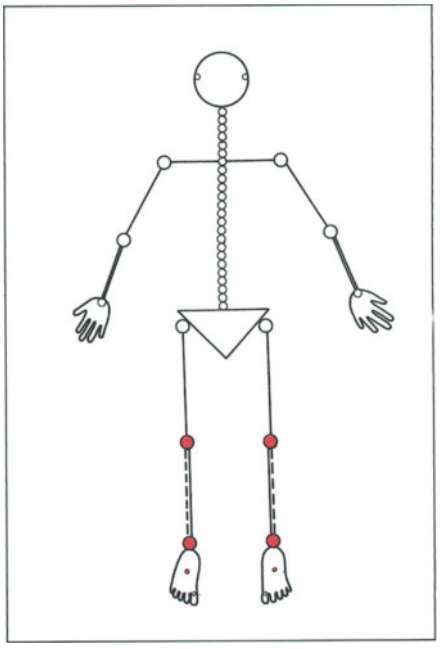

Figure 1.4 *Gout – distribution of target joints*

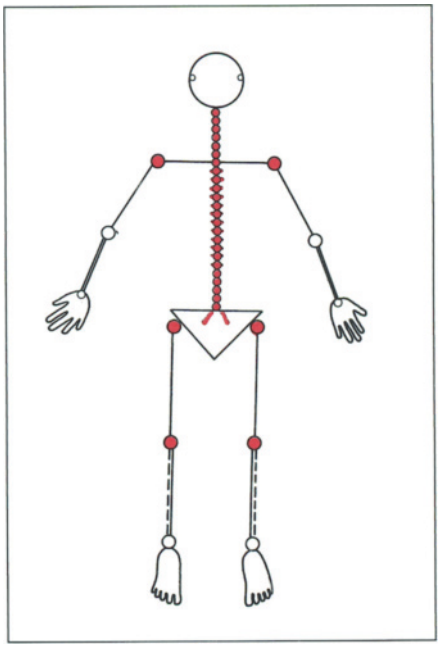

Figure 1.5 *Ankylosing spondylitis – distribution of target joints*

often indicates the correct diagnosis. Even in a single anatomic area, this distribution principle can be usefully applied. Thus in the hand, it is most important to recognize that rheumatoid arthritis tends to affect the metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints, while sparing the distal interphalangeal (DIP) joints (Figure 1.8). In contrast primary osteoarthritis involves the PIP and DIP joints as well as the first carpometacarpal (CMC) joint and tends to spare the MCP joints (Figure 1.8).

Temporal profile

Variation over time, in disease activity (i.e. symptomatology) provides useful diagnostic information, in that different groups of diseases display different temporal profiles (Figure 1.9). The interviewer should attempt to place the patient into one of the following three categories:

(1) Episodic arthritis (e.g. gouty arthritis),
(2) Relapsing and remitting additive arthritis (e.g. rheumatoid arthritis), or
(3) Persistent and often insidiously progressive arthritis (e.g. osteoarthritis).

Acute gouty arthritis shares with pseudogout, palindromic rheumatism, benign periodic hydrarthrosis, Behçet's syndrome and Familial Mediterranean Fever the

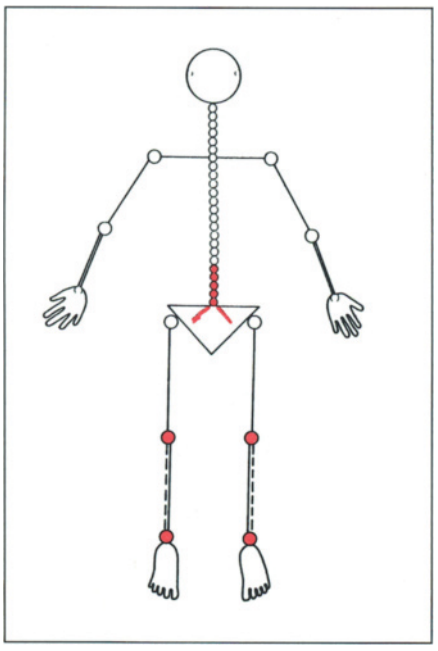

Figure 1.6 *Reiter's syndrome – distribution of target joints. Note – some patients develop an axial arthropathy indistinguishable from idiopathic ankylosing spondylitis*

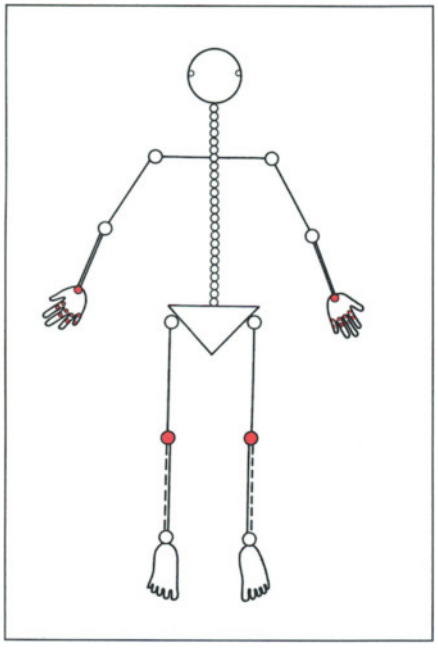

Figure 1.7 *Systemic lupus erythematosus – distribution of target joints*

characteristic of being episodic. Thus the early stage of gouty arthritis is characterized by recurrent, self-limited attacks of acute arthritis. Attacks are rapid in onset, resolve over several days to a few weeks and are punctuated by symptom-free inter-critical periods. In the late stage of the disease however, it is not unusual for attacks to increase in frequency and in some cases for a chronic arthropathy to develop (Figure 1.9). In rheumatoid arthritis and several of the seronegative spondyloarthropathies, arthritis is relatively fast in its onset and in all but a few patients persists in a fluctuating manner with occasional exacerbations (flares) and

Figure 1.8 *Comparison of target joints in rheumatoid arthritis (RA) and osteoarthritis (OA) of the hand*

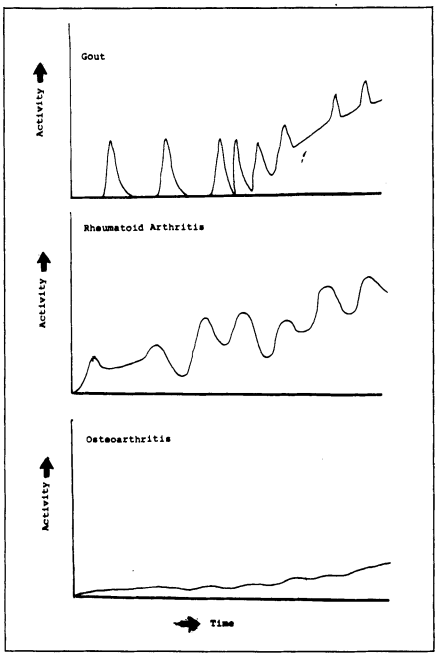

Figure 1.9 *Temporal profiles of disease activity in gout, rheumatoid arthritis and osteoarthritis*

partial (or occasionally complete) remissions (Figure 1.9). In contrast osteoarthritis is characterized by a gradual onset, monotonous symptomatology, slow progression and few if any acute exacerbations (Figure 1.9).

Inflammatory versus non-inflammatory characteristics

Four clinical features assist in differentiating inflammatory from non-inflammatory forms of arthritis:

(1) Joint stiffness,
(2) Acute swelling,
(3) Heat,
(4) Erythema.

Joint stiffness

Prolonged (i.e. greater than half an hour) morning stiffness (i.e. a subjective sensation of resistance to active joint movement felt on wakening), loosening, (i.e. improvement with activity) and gelling (i.e. return of stiffness with subsequent rest or inactivity) are indicators of active inflammation. In contrast, the majority of patients with degenerative forms of arthritis experience either no stiffness or stiffness which is of short duration, i.e. less than 15 minutes.

Acute swelling

Arthralgia (i.e. pain in a joint) should be clearly differentiated from arthritis in which there is definite swelling or other evidence of inflammation, e.g. heat or erythema. Swelling may occur in degenerative arthritis, but is usually insidious in onset (*cf* inflammatory forms of arthritis), or due to osteophyte formation.

Heat

Increased juxta-articular skin temperature is indicative of active inflammation and while occasionally encountered, to a mild degree, in some patients with degenerative arthritis, it is regarded as a feature of inflammatory forms of arthritis.

Erythema

Erythema is largely restricted to patients with crystal-induced and infectious forms of inflammatory arthritis and is rarely if ever encountered in patients with degenerative arthritis.

Severity of symptoms

While the first five items discussed have diagnostic importance, the severity of symptoms provides one method for grading the effect of a disorder. Pain is the principal symptom of musculoskeletal disease and can be graded according to the ease with which it is provoked (Table 1.1).

In practical terms, pain which results in loss of sleep or loss of work is usually of greater consequence than pain which is present only with strenuous activity. There are, of course, occasional exceptions to this generalization, e.g. pain on strenuous activity may effectively disable a heavy manual worker. It should also be noted that symptoms often spontaneously vary from one time to another or may be exacerbated by a number of factors including increased disease activity, damp weather, intercurrent infection and increased physical or psychological stress.

Table 1.1 ***A grading system for pain***

Grade 0	– No pain
Grade 1	– Pain only with strenuous activity
Grade 2	– Pain even with moderate activity
Grade 3	– Pain even with mild activity
Grade 4	– Pain even at rest
Grade 5	– Pain which results in loss of sleep

Extra-articular manifestations

Rheumatologic disorders are differentiated not only on the basis of their musculoskeletal characteristics but also on the presence or absence of certain extra-articular accompaniments (Table 1.2). These latter features are of such great importance in differential diagnosis that a series of questions should be posed to determine if any are present.

Table 1.2 ***Musculoskeletal diagnosis – principal extra-articular features***

Constitutional symptoms	– Fever, malaise, fatigue
Skin	– Rash, vasculitis, nodules, alopecia
Mucous membrane lesions	– Oral, genital
Urethritis	– Discharge, dysuria
Raynaud's phenomenon	– Triphasic colour changes, pain, paraesthesia, hypoaesthesia
Ocular symptoms	– Iritis, conjunctivitis, Sicca syndrome, visual disturbance
Gastrointestinal symptoms	– Dysphagia, pain, diarrhoea, weight loss
Axial skeletal symptoms	– Especially symptoms of spondylitis and sacroiliitis
Pleuropericardial symptoms	– Pain, dyspnoea
Myalgia	– Pain, tenderness, weakness
Neurologic Symptoms	– Symptoms of peripheral nerve, spinal or radicular compression, headaches

Constitutional symptoms

Malaise, low grade fever, fatigue and lassitude suggest the presence of an active systemic rheumatic disease (e.g. rheumatoid arthritis, systemic lupus erythematosus) rather than a degenerative disorder (e.g. osteoarthritis). Fever, chills and rigors are indicative of infection and should prompt a search for sepsis in articular as well as extra-articular locations.

Skin

Many musculoskeletal disorders are associated with dermatologic abnormalities. The most important lesions are:

(1) Photosensitivity – Associated with connective tissue disorders especially SLE
(2) Vasculitis – Associated with connective tissue disorders and RA
(3) Psoriasis – Psoriatic arthritis
(4) Nodules – Associated with RA, gout, hyperlipoproteinaemia, rheumatic fever
(5) Alopecia – Occasionally an accompaniment of SLE.

Mucous membrane lesions

Superficial oral ulceration is not infrequent in patients with SLE, Behçet's disease and Reiter's syndrome. The lesions in SLE and Reiter's syndrome are characteristically painless, (and may be overlooked), while those in Behçet's disease are usually quite painful. Superficial ulceration of the glans penis may occur in Reiter's syndome while in Behçet's disease, genital ulceration is often severe.

Urethritis

Urethritis (urethral discharge with or without dysuria) is associated with Reiter's syndrome and gonococcal arthritis.

Raynaud's phenomenon

Raynaud's phenomenon may occur in several systemic rheumatic diseases, but is most strongly associated with scleroderma and systemic lupus erythematosus. It should be differentiated from Raynaud's disease, which is a relatively benign vasospastic disorder of young women.

Ocular symptoms

The most important ocular symptoms are those which precede or accompany early musculoskeletal disease and may, therefore, be of diagnostic value. While many ocular associations exist, the most important are as follows.

(1) Iritis – Associated principally but not exclusively with the seronegative spondyloarthropathies, and one subgroup of juvenile chronic arthritis.
(2) Conjunctivitis – Part of the diagnostic triad of Reiter's syndrome.
(3) Sicca syndrome – A feature of Sjögren's syndrome.
(4) Visual disturbance – May indicate an impending ocular disaster in patients with giant cell arteritis.

Gastrointestinal symptoms

Dysphagia is a feature of both scleroderma and the dermatomyositis–polymyositis complex. In the latter there may also be difficulty in deglutition due to oropharyngeal muscle weakness. An acute diarrhoeal illness may precede the onset of Reiter's syndrome, while chronic diarrhoea, particularly when associated with cramping abdominal pain and/or blood loss, may indicate the presence of ulcerative colitis or Crohn's disease.

Axial skeletal symptoms

Low back pain of an inflammatory nature, is a strong indicator of an underlying seronegative spondyloarthropathy, and is of value in the differential diagnosis of patients with axial, as well as peripheral joint symptoms.

Pleuropericardial symptoms

Although pleuropericardial symptoms occur in a number of rheumatic disorders the strongest association is with the connective tissue disorders and in particular with SLE. Exertional dyspnoea may develop in any rheumatic disorder in which there is pulmonary infiltration or interstitial fibrosis, e.g. rheumatoid arthritis, SLE, scleroderma, sarcoidosis.

Myalgia

Myalgia may be associated with a variety of musculoskeletal disorders, but in polymyalgia rheumatica it is the predominant symptom. In this disorder, stiffness and discomfort in the shoulder and pelvic girdles are associated with an elevated sedimentation rate, and on occasion with features of giant cell arteritis (e.g. headaches, scalp tenderness, jaw claudication, visual disturbances or sudden loss of vision). Intrinsic muscle weakness is not a feature of polymyalgia rheumatica, and if present should direct attention to either a primary myopathy, (e.g. polymyositis) or a neurogenic disorder, (e.g. nerve root compression).

Neurogenic symptoms

Neurologic symptoms, particularly pain and paraesthesia, are frequently encountered in musculoskeletal patients. The following associations are of diagnostic importance:

(1) Radicular or spinal compression in patients with axial skeletal disease, e.g. cervical or lumbar spondylosis;
(2) Carpal tunnel compression in inflammatory disorders affecting the wrist, e.g. RA;
(3) Headaches and visual disturbance in giant cell arteritis;
(4) Mononeuritis multiplex due to vasculitis;
(5) Central neurologic involvement in SLE.

Functional history

Although of no diagnostic value, the functional history nevertheless provides essential information regarding the severity of disease, and identifies specific problems requiring the assistance of allied health professionals, (nurses, physiotherapists, occupational therapists, social workers, etc). This frequently neglected area of history taking is extremely important since (a) disability

is common and (b) response to drug therapy is often incomplete. Questions should be posed which specifically address the patient's physical, social, emotional and financial function (Table 1.3).

Table 1.3 ***Disability – principal areas requiring assessment***

Physical function	–	Ability to stand, walk and negotiate stairs Ability to dress and undress Ability to cope with toiletting, bathing and feeding Ability to perform usual duties in the home or workplace Ability to get to and from shops, the workplace or areas of social activity
Social function	–	Marital status and health of spouse and/or dependants Ability to interact with friends and relatives Ability to pursue leisure activities
Emotional function	–	Ability to cope with anxiety, frustration and depression
Financial function	–	Need for financial assistance from an external agency

Drug history

Drug prescribing can only proceed rationally once the response to and tolerance of prior and current anti-inflammatory agents have been determined. It is essential that the clinician obtain accurate information regarding the actual drugs prescribed, the dosages and duration of administration employed, and any unusual intolerance or drug allergy which may have been experienced. Treatment failure and drug intolerance should be differentiated, and in the former situation a judgement made as to whether the dosage employed was adequate. It is apparent that reliance purely on voluntary responses to open-ended questions results in a high degree of recall failure and some degree of inaccuracy. For this reason it is necessary to prompt the patient with the proprietary names of available agents. The use of a visual display (pillboard) of currently available anti-inflammatory agents is particularly useful in this respect (Figure 1.10). Information obtained using the pillboard is usually complete and accurate. In addition the pillboard circumvents many of the problems associated with poor recall, linguistic barriers and confusion regarding drugs with similar proprietary names (e.g. Indocid and Inderal).

A number of drug interactions have been reported with non-steroidal anti-inflammatory drugs (NSAIDs) and for this reason a comprehensive account of any concurrent drug therapy is required. Drug interactions have been reported between NSAIDs and the following:

(1) Anti-coagulants
(2) Diuretics

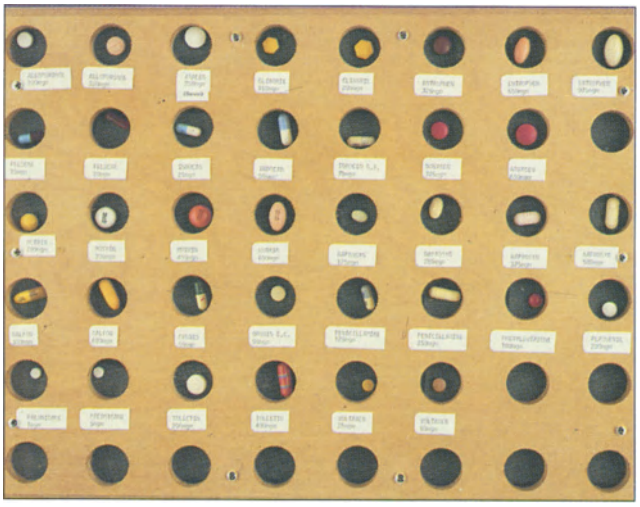

Figure 1.10 *The pillboard – a valuable adjunct in obtaining a complete and accurate drug history*

(3) Anti-hypertensive agents
(4) Anti-convulsants
(5) Oral hypoglycaemic agents
(6) Lithium.

Finally the physician should document any drug allergies which the patient has previously experienced.

Review of other relevant information

In addition to the musculoskeletal review, a more general evaluation of the patient is required and should follow a system-orientated approach. Symptoms in the cardiorespiratory, genitourinary, gastrointestinal, neurologic, haematologic and endocrine–metabolic areas are sought, the clinician noting any potential interactions between different systems, e.g. the arthritic patient who has restricted exercise tolerance by virtue of coexisting heart disease. Symptoms of peptic ulcer disease are of importance, since a number of medications commonly used in the treatment of arthritis have ulcerogenic potential. Family histories are generally of limited diagnostic value but the presence of a certain type of arthritis (e.g. ankylosing spondylitis) in a relative, may support the same diagnosis in the index case. The patient's past medical history may be of relevance both in diagnosis (e.g. a renal calculus in a suspected gouty patient) and in planning the treatment programme, (e.g. the asthma, nasal polyp, aspirin-hypersensitivity syndrome in a patient with active arthritis). Any serious disorders, particularly those involving organ failure, myocardial ischaemia, hypertension, asthma, diabetes mellitus, epilepsy or a coagulopathy should be identified since they may necessitate modification of medical or surgical therapy. Finally, details should be obtained of any orthopaedic surgical procedures that have been performed.

Chapter 2

Physical Examination

The physical examination of the musculoskeletal patient demands that the clinician direct attention not only to the principal site of involvement but also to the remaining components of the musculoskeletal system, and to those areas in which extra-articular features of specific diseases may be manifest. In addition, a general examination of other systems is required, in order to achieve a comprehensive evaluation of the patient's health status. As with the last chapter, strategy will take precedence over an elaborate description of technique, details of which can be found in most standard texts on physical examination. Before describing one method of conducting the examination, a few fundamental points will be made regarding joint assessment.

Cardinal signs of articular disease

While erythema, swelling and deformity can be appreciated by simple observation, increased skin temperature, tenderness, pain on movement, crepitus, range of movement and instability only become evident on palpation and movement of the joint.

Erythema. As noted in the previous chapter, erythema is usually associated with acutely inflamed gouty and septic joints, but is infrequent in other types of acute arthritis.

Swelling may arise from thickened and inflamed synovia, or from a synovial effusion or from proliferation of bone. Thickened synovium has a boggy feeling, in contrast to the hard, irregular, unyielding consistency of a bony spur or osteophyte. Synovial effusions may be demonstrated using a number of methods, each anatomic area requiring a slightly different technique.

Deformities in the musculoskeletal system are usually quite obvious and are classified as either fixed or reducible, and in accordance with their deviation from the normal anatomical position, (e.g. valgus, varus, ulnar, radial, flexion, etc.)

Increased skin temperature is a common accompaniment of active inflammation and is best detected clinically using the dorsum of the hand. Contralateral joints may be used for comparison in cases of subtle temperature elevation. The examiner should take care not to be misled by the effect of recent therapeutic applications of heat or ice.

Tenderness is an important and ubiquitous sign of joint disease and is elicited by direct pressure over the joint margin. It can be graded according to the degree of discomfort produced by a standard pressure. In assessing the activity of rheumatoid arthritis, as well as its response to treatment, it is useful to keep a record of the number, and activity of involved joints. These two components can conveniently be combined into a single numerical value using the Ritchie Index. In this index pre-defined joints (Table 2.1) are graded according to their degree of tenderness (Table 2.2) and a total score, or articular index, derived by adding the individual component scores. An increase in the articular index denotes a deterioration, while a decrease signifies an improvement. Since it is possible to elicit pain in most individuals given sufficient pressure it is important to learn, by experience, how much pressure to apply. As a general rule the pressure should be about 80% of that required to elicit a response in a non-affected area of the same individual. Tenderness is a valuable sign since it may aid in localizing the site of symptoms to a joint, tendon, bursa or muscle. In some cases, joint pain may be exacerbated by, or may only occur during joint movement. This movement is said to be active if performed by the patient alone and passive if performed entirely by the examiner.

Table 2.1 ***Ritchie index for rheumatoid arthritis***

Joints examined		*Maximum score attainable*
Temporomandibular*		3
Cervical spine*		3
Sternoclavicular*		3
Acromioclavicular*		3
Shoulders	– (l)	3
	– (r)	3
Elbows	– (l)	3
	– (r)	3
Wrists	– (l)	3
	– (r)	3
MCP	– (l)*	3
	– (r)*	3
PIP	– (l)*	3
	– (r)*	3
Hips	– (l)	3
	– (r)	3
Knees	– (l)	3
	– (r)	3
Tibiotalar	– (l)	3
	– (r)	3
Subtalar	– (l)	3
	– (r)	3
Midtarsal	– (l)	3
	– (r)	3
Metatarsals	– (l)*	3
	– (r)*	3
	Total	78

*These joint areas are considered as single units

Table 2.2 ***Grading system employed in the Ritchie index***

Grade 0	– No tenderness
Grade +1	– Patient complains of pain
Grade +2	– Patient complains of pain and winces
Grade +3	– Patient complains of pain, winces and withdraws

NB In joint areas considered as single units (e.g. MCP), the most tender joint determines the score for the entire unit

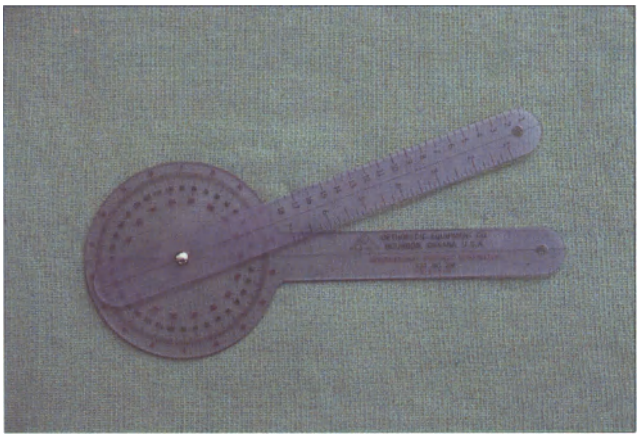

Figure 2.1 *Goniometer used to measure range of movement*

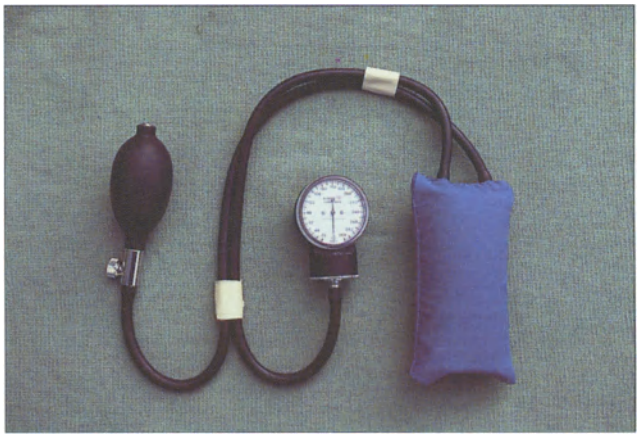

Figure 2.2 *Modified sphygmomanometer used to measure grip strength*

Crepitus is a crackling (fine) or grating (coarse) sensation which is felt (and sometimes heard) during joint movement. Inflamed and thickened synovia produce fine crepitation, while irregularities in bone and cartilage result in coarse crepitation. In the shoulder joint, crepitation may be confused with tendon snapping, a phenomenon thought to be due to periarticular tendons and ligaments slipping over adjacent bony and soft tissue structures.

Range of movement can be assessed either by visual inspection or by direct measurement using a goniometer (Figure 2.1). In either case the normal anatomical position is taken as the zero point and the range expressed in degrees of movement about that neutral position. Joint movement may be either normal, restricted (in one or more planes), or increased (hypermobile). Assessment of the range of movement is of value in identifying abnormal articular and periarticular structures, in following response to treatment and in assessing disease progression.

The stability of a joint is tested by stress manoeuvres which involve fixation of one component of the joint and attempted displacement of the other component. Instability may result from damage to the joint capsule or supporting ligamentous structures or from loss of bone or cartilage. In patients with progressive, persistent, inflammatory arthritis multiple aetiologic factors often coexist.

Atrophy, weakness and tenderness are the principal clinical signs of muscle disease. Atrophy may occur in muscle groups adjacent to chronically diseased joints, e.g. the quadriceps muscle in chronic inflammatory arthritis of the knee. In contrast, polyarthritis affecting the hand frequently results in muscle weakness. A modified sphygmomanometer (Figure 2.2) can be used to quantitate decrements in grip strength as well as in following response to treatment. The technique involves taking the bladder of a standard sphygmomanometer, folding it twice and enclosing it in a cloth bag of similar dimensions. The bag is then inflated to 100 mmHg and then deflated to 20 mmHg. The patient then squeezes the bag, and the maximum sustained pressure achieved (averaged over three attempts) recorded as the grip strength for that hand.

Table 2.3 ***Fourteen trigger points of fibromyositis***

Midpoint of trapezius muscle (left and right)
Second costochondral junction (left and right)
Lateral humeral epicondyle (left and right)
Origin of supraspinatus muscle near medial border of scapula (left and right)
Intertransverse spaces of lower cervical spine
Interspinous ligaments of lower lumbar spine
Greater trochanteric area of buttock (left and right)
Medial fat pad of the knee (left and right)

Muscle tenderness is unusual except in patients with myositis or those with moderate or severe myalgia. If generalized, and particularly if associated with weakness it may suggest a primary disorder of muscle such as polymyositis. In contrast the presence of specific areas of localized tenderness may indicate a diagnosis of fibromyositis. Twelve or more such trigger points (Table 2.3), skin roll tenderness over the mid-trapezius, widespread aching of more than 3 months duration and a non-restorative sleep pattern are some of the criteria used to diagnose this condition. Fibromyositis may arise *de novo* or be secondary to some other underlying musculoskeletal disorder.

A systematic approach to physical examination

A comprehensive and systematic examination, utilizing knowledge gained from the history, and integrating assessments of the musculoskeletal and other systems is the diagnostician's ultimate goal. While individual physicians may prefer to conduct the examination in different ways, a procedure is described which has proven to be both effective and efficient. It is assumed, in the remainder of this chapter, that the clinician will examine each affected joint for erythema, swelling, deformity, tenderness, crepitus, abnormal range of movement and instability. To avoid repetition, the discussion has, therefore, been restricted to specific points relevant to the examination of each joint area.

From the moment the patient enters the office the clinician is presented with a number of visual clues. The patient may (1) appear anxious, (2) be reluctant to shake hands for fear of pain, (3) have an abnormal gait, (4) experience difficulty sitting on, or rising from, a chair, or in getting onto the examination table or (5) have difficulty undressing. The patient should be completely undressed for the examination, but be provided with a gown which opens at the back (to facilitate examination of the axial skeleton and shoulders). Following assessment of the blood pressure, pulse and weight the examination proceeds from the fingertips to the shoulders, followed by the head and neck, heart and lungs, abdomen and lower extremity. The examination is completed by an assessment of the lumbar spine and sacroiliac joints and any special procedures such as a pelvic or rectal examination. This sequence is illustrated in Table 2.4 and described in the paragraphs which follow.

Table 2.4 ***A sequence for conducting the musculoskeletal examination***

Hand (including fingernails)
Wrist
Elbow
Shoulder
Head
Cervical spine
Thoracic spine
Hip
Knee
Ankle and foot
Sacroiliac joints and lumbar spine

Hand

The patient should initially be examined sitting on the edge of the examining table, as this facilitates pairwise comparison of joints in the upper extremities. The fingernails are a convenient point to start the examination of the hands, and may provide valuable clues to the presence of several rheumatologic conditions (particularly psoriatic arthritis and various forms of vasculitis). The presence of any finger clubbing, Raynaud's phenomenon or digital vasculitis should be noted. The diffuse, swollen digit of dactylitis should be differentiated from the tapered finger of scleroderma. Each joint in the distal interphalangeal, proximal interphalangeal (Figures 2.3, 2.4) and metacarpophalangeal rows (Figure 2.5) should be examined for evidence of erythema, swelling, warmth, tenderness, abnormal range of movement, crepitus and deformity. The first carpometacarpal joint may show evidence of crepitus, swelling and tenderness suggesting a diagnosis of osteoarthritis. Any knuckle pads, nodules, or skin rash should be noted. The palmar aspect of the hand may show evidence of Dupuytren's contracture, muscle atrophy, or flexor tenosynovitis (Figure 2.6). The patient should be specifically questioned regarding triggering if flexor tenosynovitis is detected. Loss of active joint movement may be due to an underlying arthropathy or alternately result from a tendon rupture or the restriction imposed by sclerodermatous skin. Interosseous muscle wasting can frequently be detected in patients with severe, deforming polyarthritis of the hand. In addition to signs of disuse atrophy, the examiner should also look for evidence of carpal tunnel syndrome, which may display any or all of the following features: (1) thenar muscle wasting, (2) hypoalgesia in the median nerve distribution, (3) positive Tinel's sign (Figure 2.7), and (4) positive Phalen's test (Figure 2.8). Finally grip strength should be tested either by having the patient attempt to squeeze the examiner's second and third digits, or more accurately by the use of the modified sphygmomanometer, as previously described (Figure 2.2).

Wrist

Six movements of the wrist should be examined: flexion, extension, radial and ulnar deviation, supination

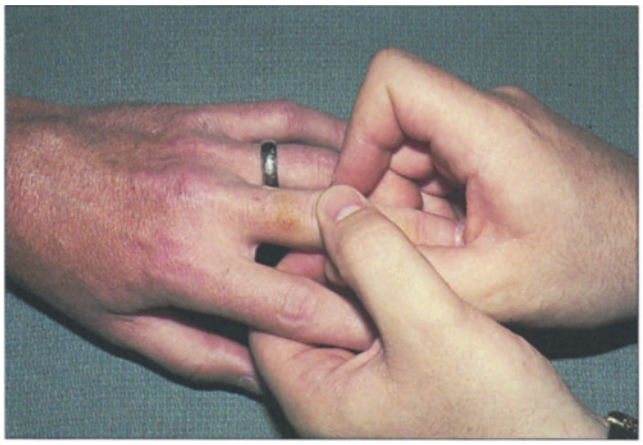

Figure 2.3 *Four-point technique for detecting swelling in interphalangeal joints*

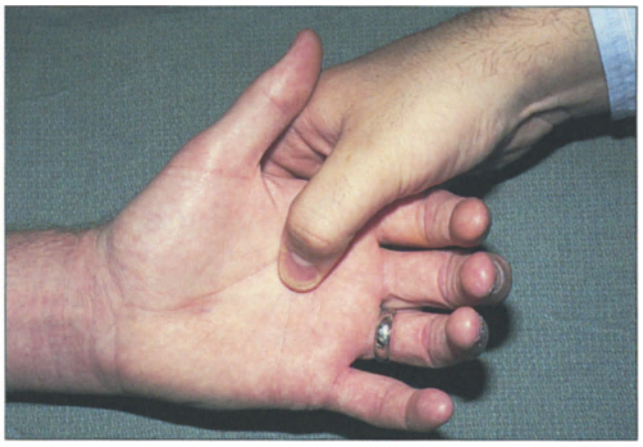

Figure 2.6 *Palpation of flexor tendons during active finger flexion – crepitus, nodularity or triggering are indicative of tenosynovitis*

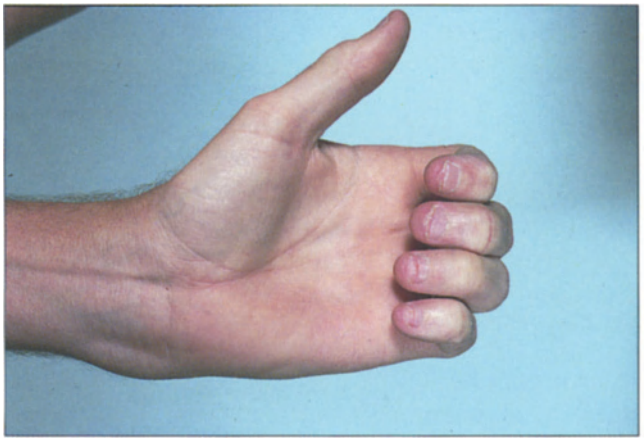

Figure 2.4 *Patient should be able to touch fingertips on palm of hand (MCP joints in neutral position) in this test of interphalangeal joint movement. Note poor approximation in this patient due to RA*

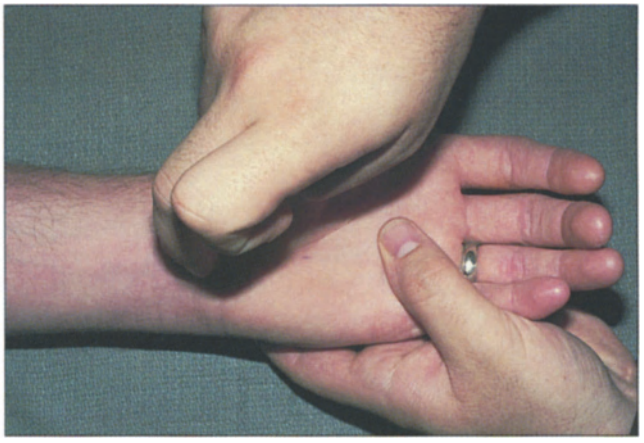

Figure 2.7 *Tinel's sign – percussing the median nerve results in pain or paraesthesia in the median nerve territory in carpal tunnel syndrome*

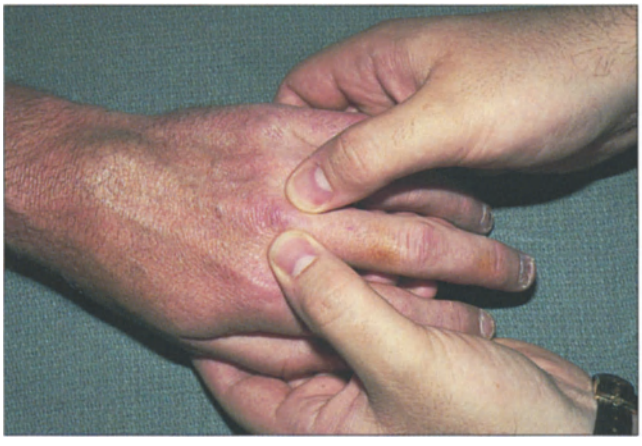

Figure 2.5 *Two-point technique for detecting synovial thickening in metacarpophalangeal joints*

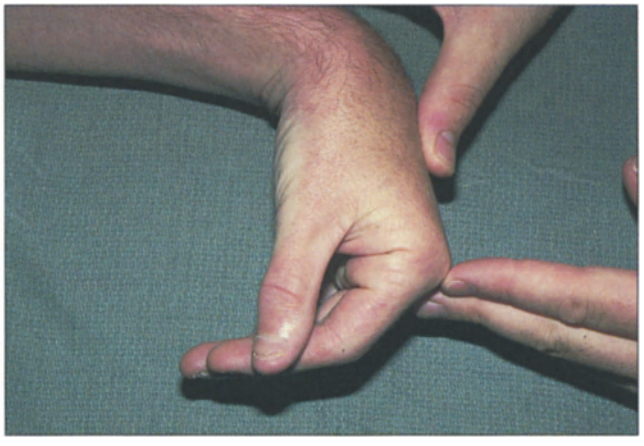

Figure 2.8 *Phalen's test – sustained (1 min) flexion of the wrist results in pain or paraesthesia in the median nerve territory in carpal tunnel syndrome*

Figure 2.9 *Active wrist extension (normal = 90°). Note limitation due to RA*

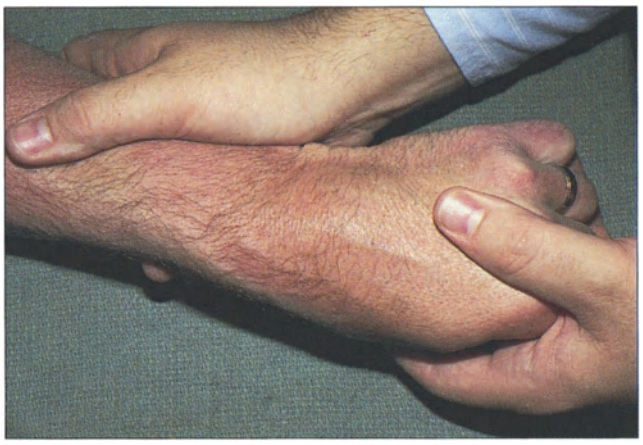

Figure 2.11 *Finkelstein's test for DeQuervain's tenosynovitis. The pain produced by this test is frequently quite severe*

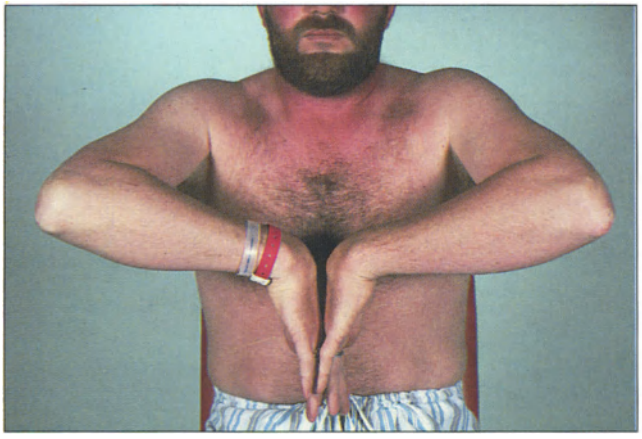

Figure 2.10 *Active wrist flexion (normal = 90°). Note limitation due to RA*

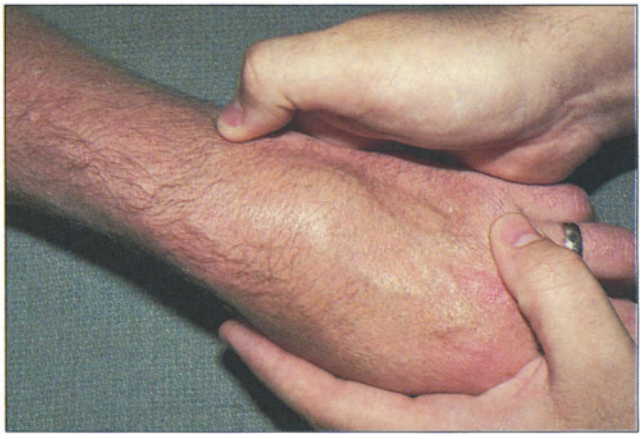

Figure 2.12 *Piano key sign – subluxation of the ulnar head during this test is indicative of joint instability*

and pronation. The active range of movement can be best appreciated by having the patient position the hands together and then attempt to bring the forearms into the horizontal position. In this fashion both extension (Figure 2.9) and flexion (Figure 2.10) of the wrist can be assessed. Synovitis of the wrist should be clearly differentiated from arthritis in the first carpometacarpal joint and from tenosynovitis of the flexor and extensor tendons. Tenderness over the extensor pollicis brevis or abductor pollicis longus tendons in association with a positive Finkelstein's test (Figure 2.11) indicates a tenosynovitis of one or both of these tendons. The stability of the ulnar head is tested by attempting to depress it with the examiner's thumb (Figure 2.12) and the stability of the wrist as a whole, by attempting to move the carpus on the radioulnar surface.

Elbow

The elbow should be examined for evidence of nodular swelling, particularly around the olecranon or over the ulnar surface of the forearm, as well as for the presence of arthritis. Articular swelling is best appreciated in a triangular area between the lateral humeral epicondyle, the radiohumeral articulation and the olecranon process, with the elbow held in 90° of flexion. Localized tenderness may occur at several points around the elbow: (1) the lateral epicondyle, (2) between the lateral epicondyle and the olecranon, (3) over the olecranon bursa or (4) over the medial humeral epicondyle. Epicondylar tenderness may occur as a regional syndrome (lateral = tennis elbow, medial = golfer's elbow), or as part of a more generalized enthesitis, or as one of the trigger points of fibromyositis. Should tenderness be found at either epicondyle, a stress manoeuvre should be applied to the relevant muscle group in order to determine whether this causes pain, or aggravates it. The normal elbow moves through a range of movement from 0 to 150°. Flexion contracture decreases, and hypermobility increases the limit of available extension. In severely diseased joints, crepitus may be evident both with flexion/extension and with supination/pronation manoeuvres.

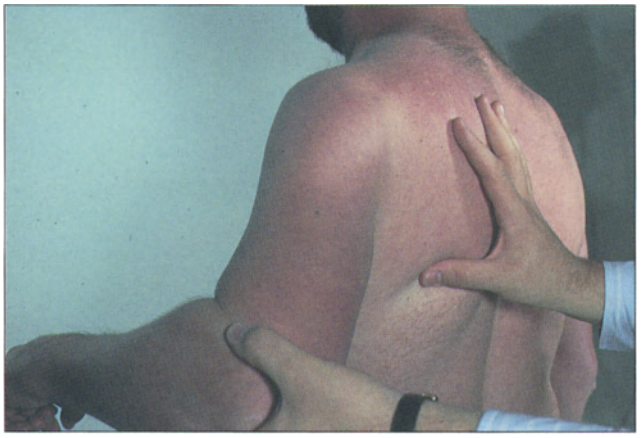

Figure 2.13 *The lateral border of the scapula should be anchored by the thumb (i.e. the scalpula fixed) before glenohumeral abduction is assessed*

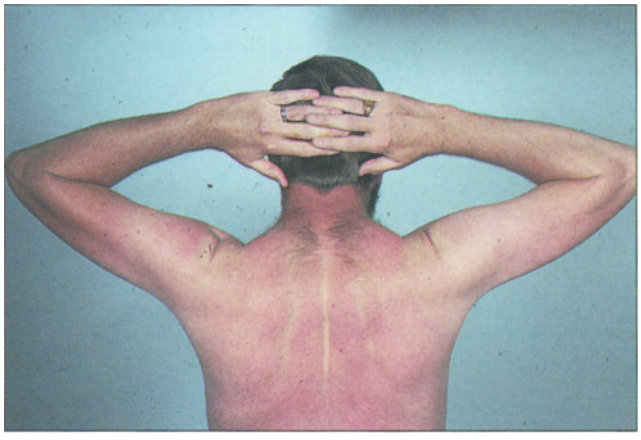

Figure 2.14 *Test of active external rotation of the shoulders*

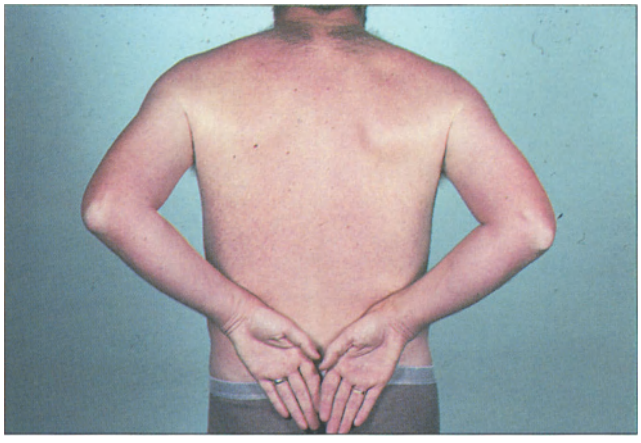

Figure 2.15 *Test of active internal rotation of the shoulders. Note limitation due to RA*

Shoulder

The shoulder is undoubtedly the most complex articulation the clinician is called upon to assess. Swelling, if present in the glenohumeral joint, is usually detected anterior and just lateral to the coracoid process. It is often useful for the examiner to compare the left and right shoulders, and also to look down on the shoulders while standing behind the patient, as this may facilitate appreciation of subtle degrees of asymmetry. The normal shoulder is capable of multiplanar movements, or of uniplanar movements in flexion, extension, abduction, adduction, internal or external rotation, elevation or depression, protraction or retraction. This wide range of movement is made possible by the co-ordinated activity of the glenohumeral, scapulothoracic, acromioclavicular and sternoclavicular articulations. Since scapulothoracic movement can compensate for glenohumeral restriction, pure glenohumeral movement should be evaluated by first fixing the scapula with the examiner's hand (Figure 2.13). With the scapula restrained in this fashion, the available range of glenohumeral abduction can be accurately assessed. Glenohumeral abduction to 90° is regarded as normal. Adduction is tested by bringing the arm across in front of the chest, flexion by moving the arm directly forward in a vertical arc and extension by moving it directly posterior. There should normally be 80–90° of external rotation (Figure 2.14) and internal rotation (Figure 2.15). Elevation and depression, protraction and retraction, rely on movements in the acromioclavicular and sternoclavicular joints as well as on some degree of scapulothoracic movement. The examiner should become familiar with pain patterns associated with active and passive movement in order to differentiate different types of shoulder disorders. As a general rule, intra-articular disease produces pain which occurs in all planes of movement, and which is associated with both active and passive movement. In contrast patients with peri-articular disease, e.g. supraspinatus tendonitis or bicipital tendonitis, experience pain which is (1) more severe on movement in a particular plane, and (2) more severe during active than passive movement. For these reasons it is important to test the shoulder during both active and passive movement, as well as with and without stabilization of the scapula. Following a comprehensive assessment of both shoulders the examiner should complete the evaluation of the upper extremity by performing a standard neurological examination.

Head

In addition to the conventional examination of this area, certain features require special attention. The scalp should be thoroughly examined for evidence of hair loss and particularly for the presence of psoriatic lesions. The superficial temporal and facial artery pulses should be palpable and the vessels painless and non-

tender. The pinna of the ear may show evidence of tophus formation or suggest a diagnosis of ochronosis or relapsing polychondritis. The temporomandibular joints may be affected by inflammatory arthritis and be tender, crepitant or have a restricted range of movement. Patients with scleroderma may have difficulty in fully opening the mouth, a disability which can be quantitated by measuring the vertical distance between the tips of the incisors at the maximum available aperture (incisor gap - Figure 2.16). The examiner should look for evidence of xerostomia and keratoconjunctivitis sicca and measure the adequacy of tear production, in symptomatic patients, using Schirmer's tear test papers (Figure 2.17). The facial skin may be affected by a number of dermopathies including the characteristic malar rash of systemic lupus erythematosus. The oral cavity should be inspected for evidence of mucosal ulceration which occurs in Reiter's syndrome, Behçet's disease and a number of connective tissue disorders, e.g. SLE. Finally the neck should be palpated for evidence of lymphadenopathy and thyroid enlargement.

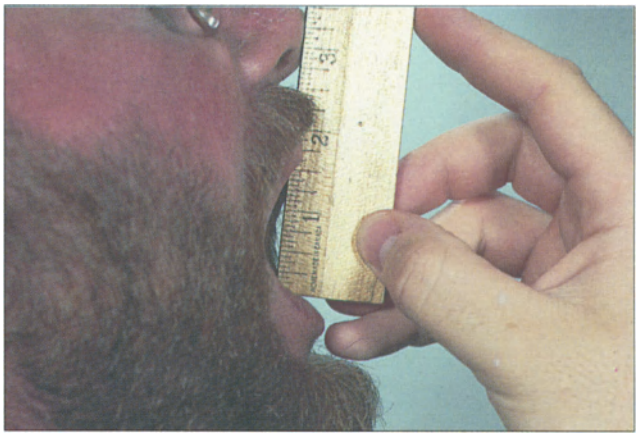

Figure 2.16 *Measurement of the incisor gap*

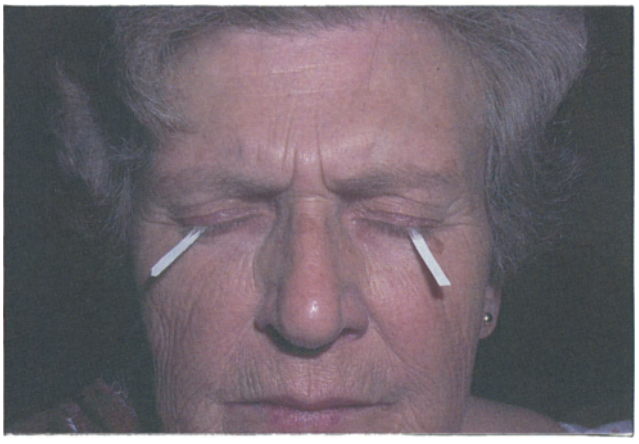

Figure 2.17 *Schirmer tear test for keratoconjunctivitis sicca*

Cervical spine

The range of movement of the cervical spine is tested in flexion (normal = 45°), extension (normal = 45°), lateral flexion to the left and right (normal = 45°) and lateral rotation to the left and right (normal = 60°). Any pain or restriction in range of movement should be noted. It is often necessary, when examining the cervical spine, to stress to the patient that they should attempt to achieve their maximum range of movement, otherwise the available range will be underestimated. Finally, the paraspinal muscles and trapezius should be palpated for evidence of tenderness or spasm. Any tenderness over the cervical spinous processes should also be noted.

Thoracic spine

During examination of the thoracic spine the presence of tenderness, kyphosis or scoliosis should be noted. Rotational movements are tested by asking the patient to remain seated, fold their arms across the chest and rotate the shoulders first in one direction and then the other while the examiner stands behind the patient and observes the movement. Respiratory examination should include measurement of chest expansion measured at the nipple line. The circumferential difference at the extremes of inspiration and expiration is a measure of costovertebral joint movement and should normally exceed 5 cm. Following cardiorespiratory examination the patient lies supine while the abdominal examination is performed.

Hip

The hip is a deep-seated joint, pain from which may be experienced in the groin, inner thigh, trochanteric area, buttock or lumbar spine. Pain in this joint should, therefore, be differentiated from referred pain from lumbar spinal disease and that due to sacroiliitis, trochanteric bursitis, ischial bursitis and adductor tendonitis. The hip, like the shoulder, is capable of multiplanar movements, or of uniplanar movements in flexion, extension, abduction, adduction, internal and external rotation. All of these movements should be separately assessed. Hip flexion is measured by moving the flexed knee towards the abdomen. If pain is elicited the examiner should note whether it is arising in the lumbar spine, hip or knee since all three areas may be stressed by this manoeuvre. A fixed flexion deformity of the hip may not be readily apparent because of compensatory lumbar lordosis. This can be unmasked using the Thomas test in which the contralateral hip is held in flexion (to reduce any lumbar lordosis), while an attempt is made to fully extend the hip under assessment (Figure 2.18). Inability to fully extend the hip indicates the presence of a fixed flexion deformity. Adduction is tested by moving the leg medially in front of the contralateral leg and abduction by moving the leg

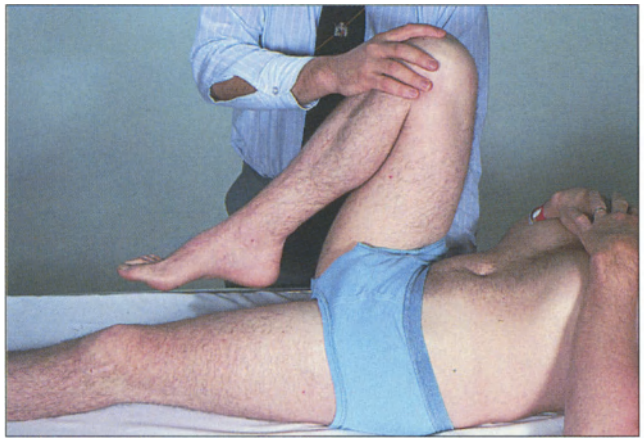

Figure 2.18 *Thomas test for detecting flexion contracture of the hip*

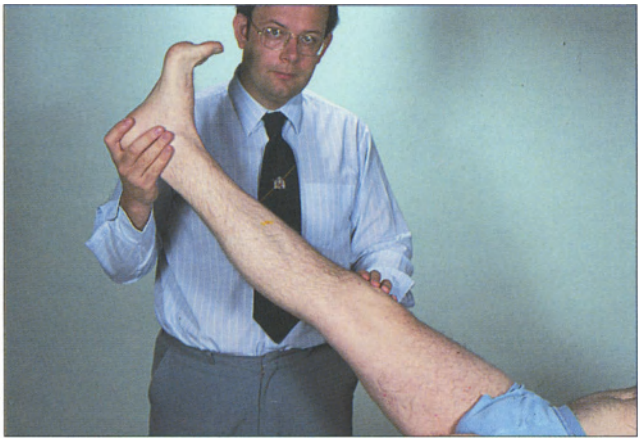

Figure 2.20 *Lasegues test – pain in the lumbar spine on passive flexion of a straight leg, may indicate the presence of nerve root irritation*

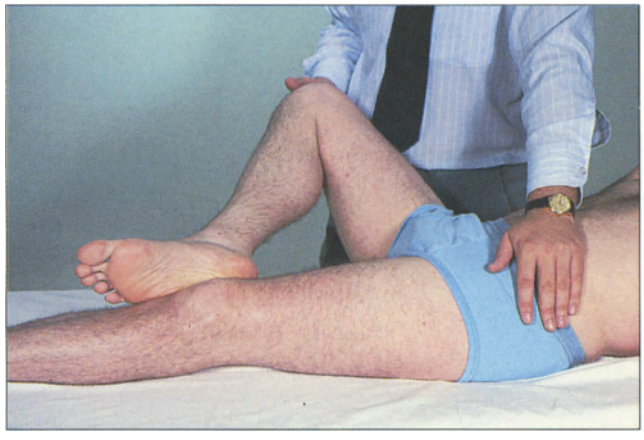

Figure 2.19 *Fabere–Patrick manoeuvre – a test of composite hip movement*

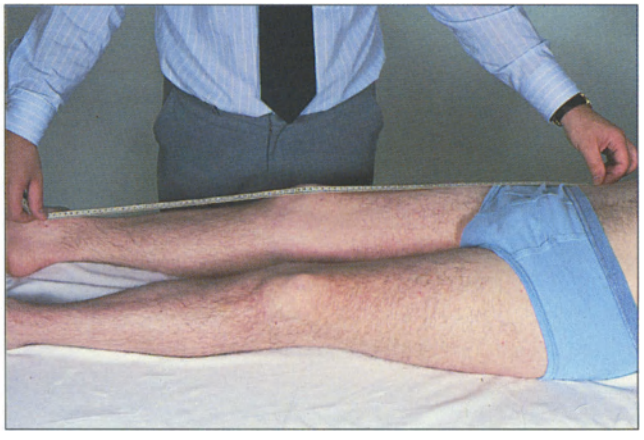

Figure 2.21 *The true leg length is the distance between the anterior superior iliac spine and the centre of the ipsilateral medial malleolus*

laterally. In order to assess abduction accurately, a firm hand should be placed on the contralateral anterior superior iliac spine to prevent rotation of the pelvis, otherwise this test of abduction may unwittingly become a test of hip flexion. Rotation may be assessed with the leg extended or with the hip and knee both flexed to 90°. In both situations the limb is rolled outward to test external rotation and inward to test internal rotation. The Fabere–Patrick manoeuvre (Figure 2.19) is a test of composite hip movement. In this manoeuvre the patient first places his heel on the contralateral knee and then externally rotates the ipsilateral hip in an attempt to bring the knee almost parallel to the examining table. This degree of movement should be attainable by the majority of individuals who have normal hip function and are free of disease in the ipsilateral trochanteric bursa and knee. Finally to test hip extension the patient is placed in the right and then the left lateral position and the upper leg drawn backwards on each occasion.

It is convenient to perform Lasegues straight leg raising test at this point in the examination, to look for evidence of nerve root irritation in the lumbar spine (Figure 2.20). A bow string sign may also be elicited. This sign is positive, if with the straight leg elevated, pain is induced or exacerbated in the lumbar region of the spine by passive dorsiflexion of the ipsilateral foot. Finally, leg length is assessed by measuring the distance between the anterior superior iliac spine and the centre of the medial malleolus (Figure 2.21 – true leg length). True leg length discrepancies generally arise as a result of disease in, or adjacent to, the hip joint. In contrast, discrepancies in apparent leg length (measured from the umbilicus to the centre of the medial malleolus) are often due to scoliosis or a pelvic tilt.

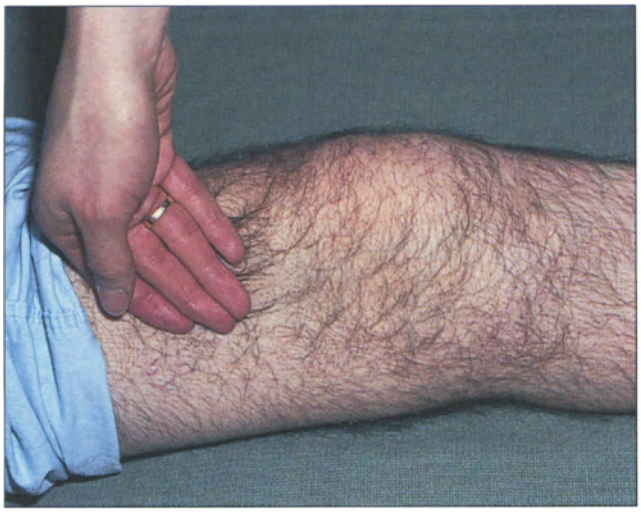

Figure 2.22 *Bulge sign – phase 1. Milking fluid into suprapatellar and lateral portions of the synovial cavity*

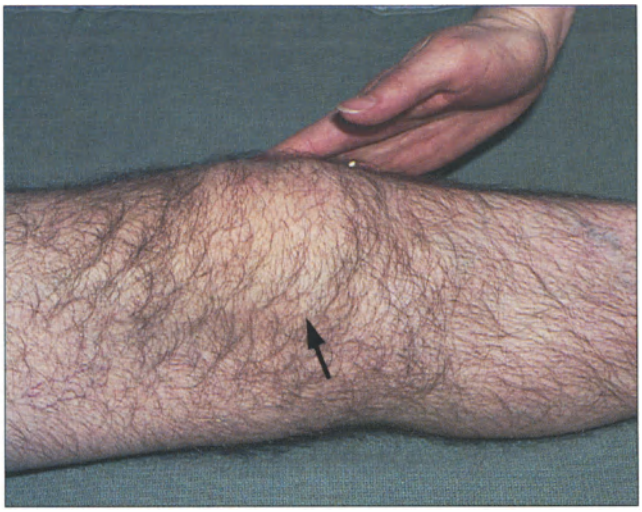

Figure 2.23 *Bulge sign – phase 2. Forcing fluid across to the medial portion of the synovial cavity results in a visible bulge (arrow)*

Knee

The knee joint is composed of three compartments (medial tibiofemoral, lateral tibiofemoral and patellofemoral), and is supported by four ligamentous structures (medial and lateral collateral, and anterior and posterior cruciate ligaments). This is the joint, *par excellence,* in which a full examination can easily be made. The knee should first be inspected for evidence of erythema, swelling, deformity and quadriceps wasting. Swelling may be apparent in the prepatellar area (in patients with prepatellar bursitis) or in the peripatellar and suprapatellar areas (in active inflammatory arthritis). Deformities frequently encountered in the late stage of severe arthritis include genu varus (bow leg), genu valgus (knock knee) and the fixed flexion deformity. The knee should be palpated for evidence of increased temperature and it should be noted, that in healthy individuals, the prepatellar area feels slightly cooler than the surrounding skin. The loss of this temperature differential indicates an underlying inflammatory process.

Four techniques are employed to search for synovial effusions: (1) the bulge sign, (2) patellar tap, (3) ballottement and (4) palpation of the popliteal fossa for a Baker's cyst.

Bulge sign – A sweeping movement (caudal to capital) of the dorsum of the examiner's hand on the medial aspect of the patellofemoral joint line is used to milk fluid from the medial to the lateral side of the synovial cavity (Figure 2.22). A second sweeping movement (capital to caudal) of the palm of the examiner's hand on the lateral aspect of the patellofemoral joint space forces fluid across to the medial side of the synovial cavity and produces a visible bulge (Figure 2.23). This sign is usually positive in the presence of small effusions but it disappears as larger quantities of fluid accumulate.

Patellar tap – The examiner's left hand compresses the suprapatellar pouch of the synovial cavity while the second digit of the right hand attempts to tap the patella on the underlying femoral condyle (Figure 2.24). This sign is negative with small effusions but positive with large effusions, unless they are extremely tense.

Ballottement – The first and second digits of the left hand are applied to the medial and lateral aspects of the suprapatellar pouch, while the corresponding digits of the right hand are placed on the medial and lateral aspects of the infrapatellar area (Figure 2.25). Using a standard ballottement technique, fluid is moved alternately between the left and right hands. This test is positive with moderate to large effusions and is also positive with tense effusions.

Popliteal fossa palpation – The popliteal fossa should always be palpated for the presence of a Baker's cyst. The assessment of the popliteal cyst and its complications is described in Chapter 3.

During palpation, swelling due to synovial effusion, synovial thickening and bony proliferation should be differentiated.

Three techniques are used to assess the patellofemoral articulation:

(1) During flexion and extension movements of the knee, any coarse crepitus, pain or abnormal patellar motion should be noted.
(2) Medial and lateral displacement of the patella (with the knee extended) may produce pain and crepitus.
(3) Apprehension test – the examiner's left hand is placed just above the patella and is used to compress the quadriceps tendon thus trapping the patella against the femoral condyles (Figure 2.26). The patient is then asked to contract the quadriceps

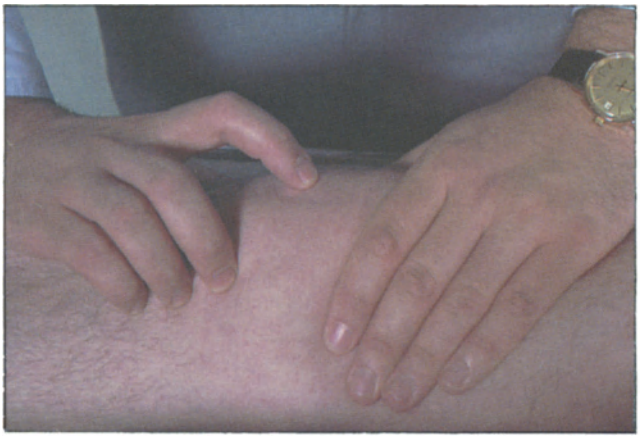

Figure 2.24 *Patellar tap for moderate and large effusions*

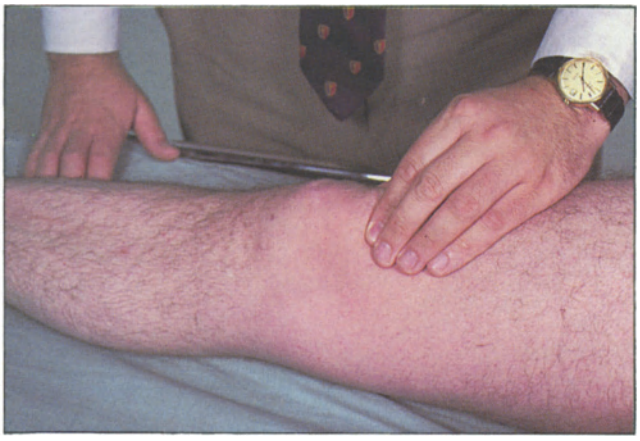

Figure 2.26 *Apprehension test for patellofemoral disease*

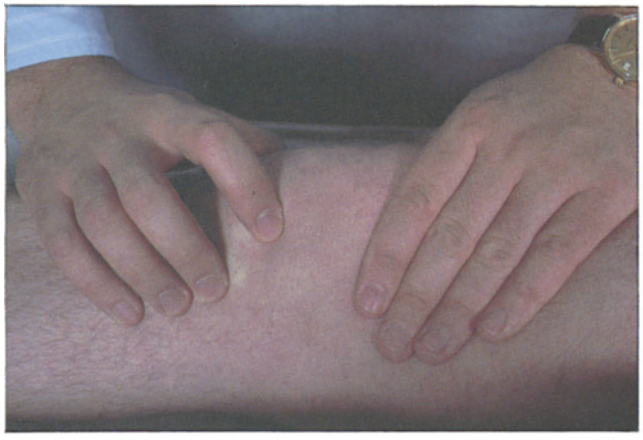

Figure 2.25 *Ballottement of knee for moderate, large and tense effusions*

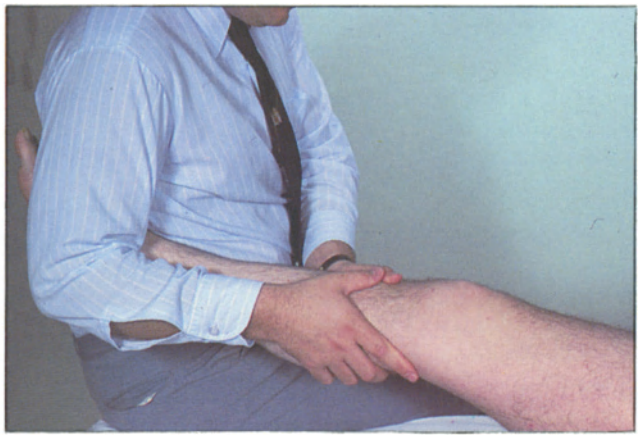

Figure 2.27 *Testing collateral ligament stability*

muscle. Intense pain (or reluctance to perform the manoeuvre for fear of pain, i.e. apprehension) indicates underlying patellofemoral pathology.

The range of flexion and extension of the knee joint may be visually estimated or more accurately measured using a goniometer. Bony and synovial crepitus should be differentiated, the former being a grating sensation and the latter likened to the feel of wet sand. The stability of the collateral ligaments is assessed with the patient in the supine position, the lower leg being taken under the examiner's axilla. With the knee flexed at 10°, the examiner grasps the lower leg (just below the knee), and applies stress first on the medial and then on the lateral side of the knee (Figure 2.27). Undue movement indicates laxity in the lateral and medial collateral ligaments respectively. Cruciate ligament stability is tested with the patient supine, the knee flexed at 90°, and the patient's foot resting on the examination couch. The lower leg is grasped just below the tibial tubercle and the tibia moved anteriorly (testing anterior cruciate stability) and posteriorly (testing posterior cruciate ligament stability) on the femoral condyles (Figure 2.28). Again undue movement (positive draw sign) indicates ligamentous laxity. McMurrays test is used to assess the integrity of the menisci. To perform this test the examiner's left hand is placed anteriorly over the patella, the thumb palpating one margin of the joint line and the second digit palpating the other margin. The examiner's right hand grasps the ankle and moves the knee repeatedly from flexion to extension, first applying medial rotation (testing the lateral meniscus) then lateral rotation (testing the medial meniscus) to the lower leg. A palpable or audible click associated with pain indicates meniscal pathology.

Ankle and foot

The ankle is composed of two joints: tibiotalar and subtalar. Plantarflexion and dorsiflexion occur at the tibiotalar joint, while inversion and eversion movements occur at the subtalar joint. The examiner should assess the range of movement of these two joints independently and look for evidence of crepitus, pain, decreased range of movement, joint line tenderness and swelling. Swelling due to arthritis requires differentiating from that due to tendonitis. In particular the Achilles tendon should be examined for evidence of tenderness as well as nodule formation, and the area of the plantar fascia

insertion should be palpated for tenderness. Both these areas may be the site of enthesitis and bone spur formation. Next the midtarsal joint is examined and the metatarsophalangeal and interphalangeal joints individually assessed. Finally, the skin (including the sole of the foot), and toenails are examined. Palpation of the peripheral arterial pulses and a comprehensive neurologic examination complete the examination of the lower extremity.

Sacroiliac joints and lumbar spine

Sacroiliitis frequently results in low back or buttock pain and localized sacroiliac tenderness which can be elicited by one of the following techniques:

(1) With the patient lying prone on the examining table, the examiner presses firmly with his hand on the body of the sacrum and attempts to distract the joints (Figure 2.29).
(2) Gaenslen's sign – With the patient lying supine near the edge of the examining table and the left leg held in flexion, the examiner moves the right leg laterally and below the level of the table, so that its weight acts as a lever on the ipsilateral sacroiliac joint. The test is repeated on the contralateral joint with the patient lying on the opposite edge of the table.
(3) Direct pressure may be applied to the joint margin although this is an inferior technique since no distracting force can be applied. The joint is in fact protected from direct palpation, by the overhanging iliac bone.

The production of localized pain with any of these three manoeuvres indicates underlying sacroiliac joint pathology.

Lumbar spinal tenderness is assessed with the patient lying prone, a pillow being placed beneath the abdomen to reverse the normal lumbar lordosis. Each vertebral level is palpated for evidence of tenderness. The patient is then asked to stand and spinal alignment is assessed, particular note being made of any kyphotic, scoliotic or excessive lordotic curves. The reversibility of any deformities should be assessed, since functional curves are generally corrected by spinal flexion whereas organic curves tend to persist. The range of flexion, extension and lateral flexion should also be assessed and any muscle spasm noted. In testing flexion, the patient should be instructed to keep the knees straight and the feet together, most healthy individuals being capable of touching or almost touching their feet in this position. The movement can be more accurately quantitated using a modified Schober's test. In this test, a mark is first made on the skin at the level of the Dimples of Venus. A line is then drawn 5 cm below and 10 cm above this mark, while the patient is standing in the neutral position (Figure 2.30). With subsequent forward flexion, this 15 cm gap should expand to at least 20 cm.

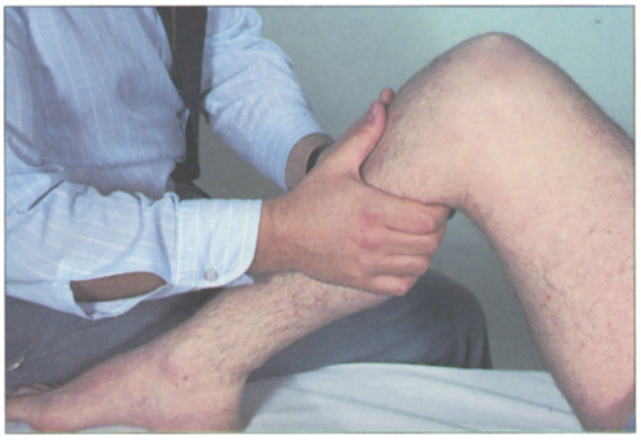

Figure 2.28 *Testing cruciate ligament stability*

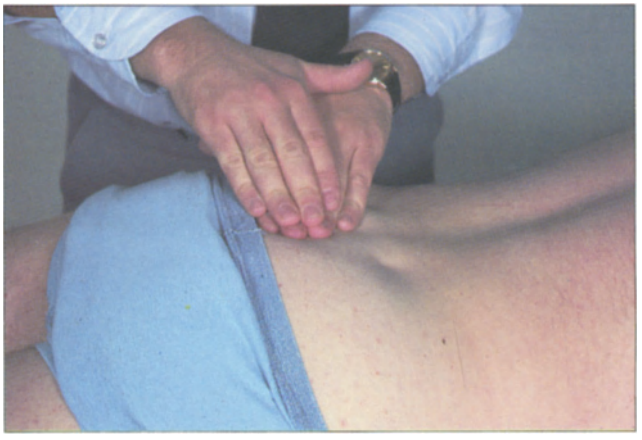

Figure 2.29 *Sacral pressure test for sacroiliitis*

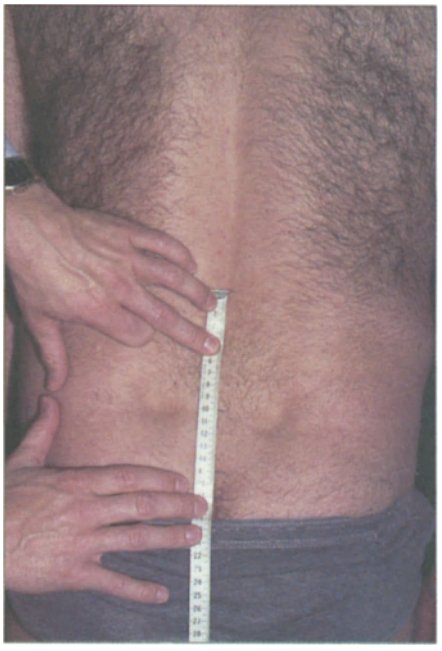

Figure 2.30 *Modified Schober's test for lumbar spinal flexion. Note Dimples of Venus at level of 10 cm mark*

Most healthy individuals are also capable of 25° of extension and 30° of lateral flexion.

On completion of the history and physical examination the clinician should have sufficient appreciation of the differential diagnosis, extent and severity of disease and therapeutic issues involved, that a problem list can be formulated, and investigative and management strategies planned.

Chapter 3

Rheumatoid Arthritis

Rheumatoid arthritis (RA) is an ubiquitous disorder of unknown aetiology. One of the most intriguing aspects of the disease is its apparent scarcity prior to the eighteenth century (in contrast to osteoarthritis, gout, and ankylosing spondylitis which are diseases of antiquity). In Western communities the prevalence of rheumatoid arthritis in the adult population is approximately 1%, females being more often affected than males (3 : 1). The onset of the disease is frequently between 20 and 60 years of age and is greatest between 35 and 45 years. While rheumatoid arthritis does not display a strong tendency to aggregate within families, nevertheless certain genetic influences operate. Thus it is more common in siblings of patients with erosive seropositive rheumatoid arthritis and occurs in some pairs of monozygotic and dizygotic twins. The association in monozygotic twins is greater than in dizygotic twins and more than 30 times that expected in controls.

Patients who are young at the time of onset, female, seropositive for IgM rheumatoid factor, or have multisystem involvement, have a less favourable prognosis than those who are elderly at onset, male, seronegative or in whom involvement is restricted to the musculoskeletal system. In general, patients experiencing an abrupt onset of arthritis have a better prognosis than those whose disease starts insidiously. Except in patients with severe multisystem involvement, rheumatoid arthritis does not decrease longevity. A minority of patients experience either a shortlived polyarthritis followed by sustained remission (less than 10%) or alternatively a relentlessly progressive polyarthritis (less than 10%). The majority (greater than 80%) of patients, however, follow a characteristic relapsing and remitting course. The cause of this spontaneous variation in disease activity remains unknown, although it is a common experience that remission frequently occurs during the first trimester of pregnancy and persists until 6–8 weeks post partum after which time the disease usually relapses. With modern management techniques the disease can be controlled in the majority of patients, and it is estimated that less than 10% of patients become totally disabled.

Rheumatoid arthritis usually takes the form of a symmetrical inflammatory polyarthritis showing a predilection to involve the PIP, MCP, wrist, elbow and shoulder joints, the cervical spine, hip, knee, ankle and MTP joints (Figure 1.2). Similar pathologic abnormalities to those seen in articular structures may develop in tendon sheaths and bursae. The principal extra-articular sites of involvement are the skin (nodules), arterial tree (vasculitis), the eye, the peripheral nerves and the lung.

Articular manifestations

Hand and wrist

The most common presentation of rheumatoid disease is that of a symmetrical polyarthritis in a young woman. Monoarticular and oligoarticular configurations occur although they are less frequent. Involvement of the hand is extremely common, the PIP, MCP and wrist joints being the principal target areas. Swelling is fusiform in the PIP joints (Figure 3.1), appears over the dorsal surface of the MCP joints and over the dorsal and volar surfaces and ulnar and radial margins of the wrists (Figure 3.2). Involved joints are tender, lack a full range of movement and may show evidence of synovial effusion or increased temperature. At the time of initial onset, radiographs are either entirely normal or only show evidence of soft tissue swelling (Figure 3.3). Continued disease activity over a period of several weeks results in periarticular osteopaenia. However, the characteristic radiographic changes of rheumatoid arthritis, i.e. loss of joint space and marginal erosion (Figure 3.4), only become apparent with persistent synovitis of many months duration. Since such lesions may be prevented but rarely reversed by the use of

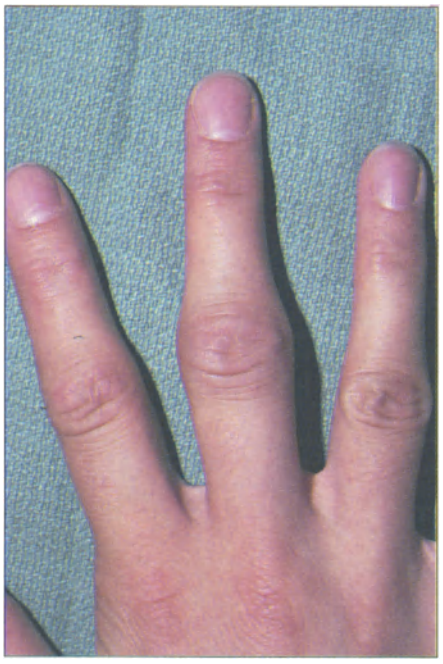

Figure 3.1 *Fusiform swelling in the third PIP joint*

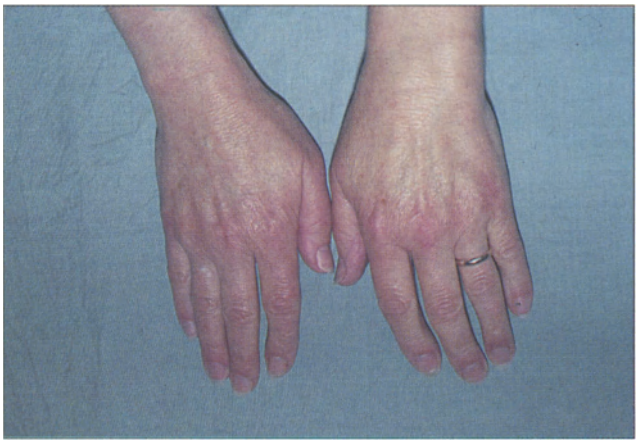

Figure 3.2 *Soft tissue swelling in the left wrist and MCP joints*

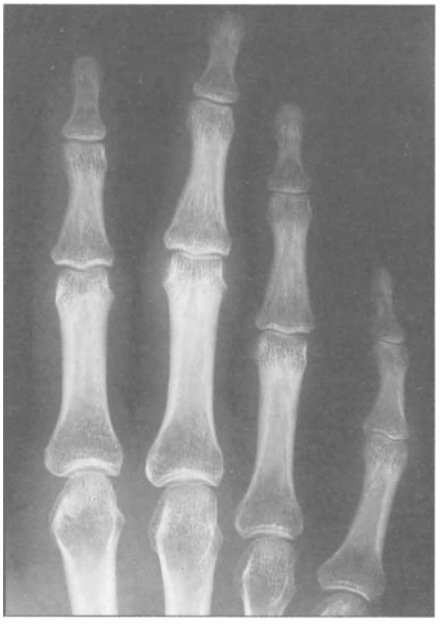

Figure 3.3 *Soft tissue swelling in the third PIP joint*

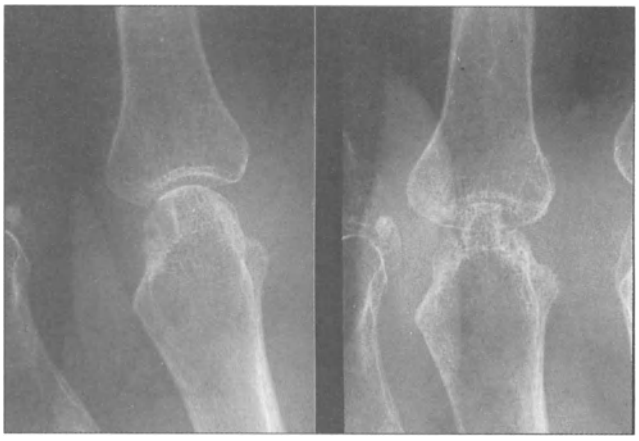

Figure 3.4 *Progressive erosion, loss of joint space and periarticular osteoporosis in second MCP joint. Interval of 20 months*

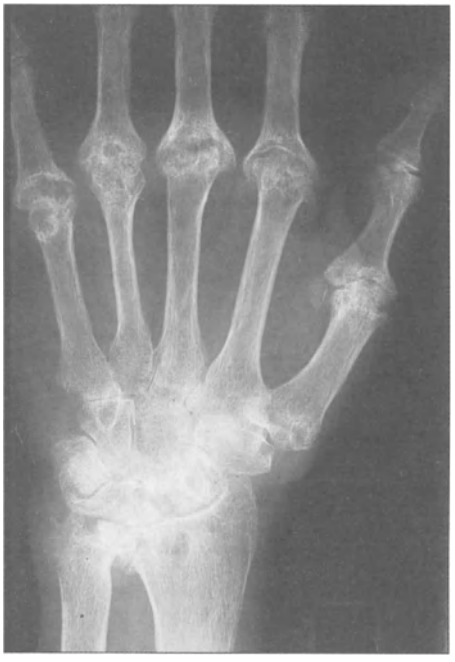

Figure 3.5 *Destructive changes in severe erosive RA involving the MCP joints, carpus and wrist. Note erosion of ulnar styloid*

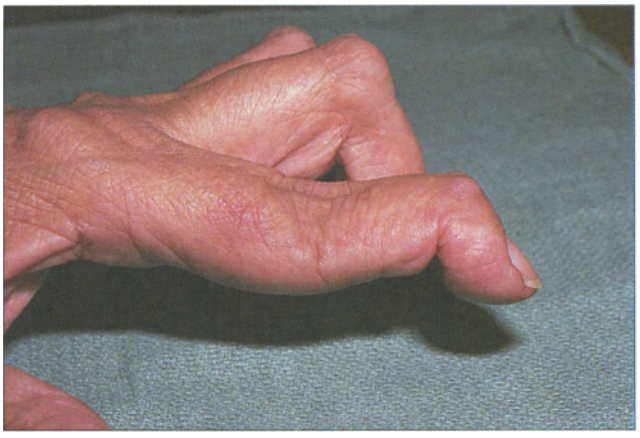

Figure 3.6 *Typical swan neck deformity with hyperextension of the PIP joint and flexion of the DIP joint*

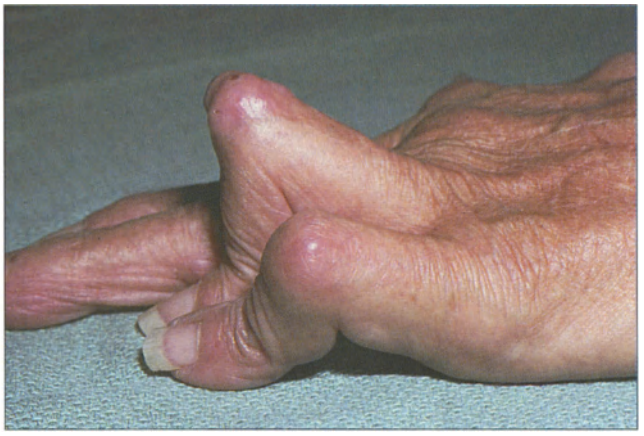

Figure 3.8 *Typical boutonnière deformity with flexion of the PIP joint and extension of the DIP joint*

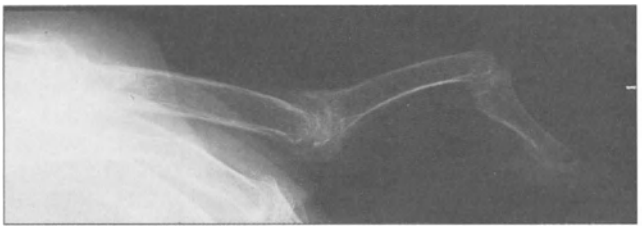

Figure 3.7 *Radiographic appearance of the swan neck deformity*

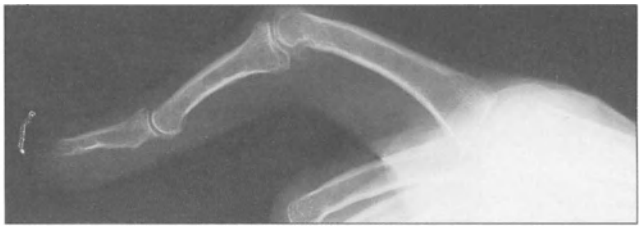

Figure 3.9 *Radiographic appearance of the boutonnière deformity*

disease modifying drugs such as gold, D-penicillamine and hydroxychloroquine, it is extremely important for the clinician to make a decision regarding the use of these agents before joint space narrowing and erosion are radiographically evident. Erosions may occur in any affected joint but are particularly common in the PIP and MCP joints, the carpus and the ulnar styloid (Figure 3.5). Bone cysts or geodes frequently accompany other radiographic features of the disease, and fibrous, or rarely bony, ankylosis may become apparent in later stages of the disease.

Six important deformities may develop in the rheumatoid hand.

(1) Swan neck deformities (Figures 3.6, 3.7) may arise due to one of the following abnormalities:
   Type 1 - Excessive tension in the intrinsic muscles of the hand
   Type 2 - Avulsion of long extensor tendor insertion
   Type 3 - Rupture of sublimis tendon.

(2) Boutonnière deformities (Figures 3.8, 3.9) may be of two types:
   Type 1 - Stretching/avulsion of middle slip of long extensor tendon
   Type 2 - Restricted sublimis tendon motion.

(3) Nalebuff deformities (Figures 3.10, 3.11) occur in the thumb and may be due to the following:
   Type 1 - Volar subluxation of thumb extensors
   Type 2 - Trapeziometacarpal volar-ulnar subluxation
   Type 3 - Type 2 + MCP dorsal subluxation.

(4) Ulnar deviation (Figure 3.12) is due to a combination of:
   (a) Attenuation and laxity of the radial collateral ligament
   (b) Attenuation of the metacarpoglenoidal ligament allowing drift of the volar plate and flexor tendon sling
   (c) Extensor tendon slippage to the ulnar side
   (d) Radial carpal rotation.

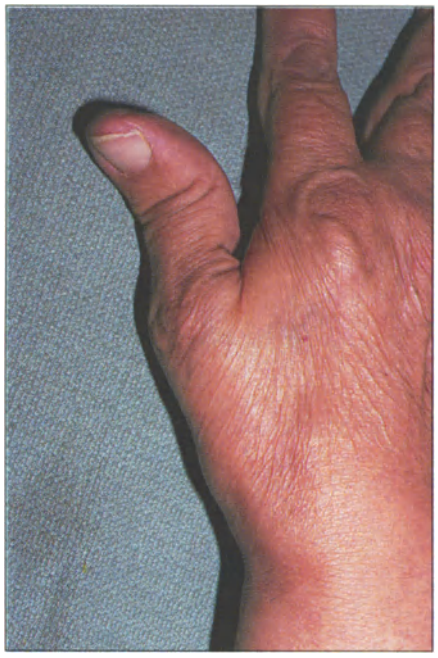

Figure 3.10 *Nalebuff deformity of the thumb in longstanding RA. Prominence and flexion of the first MCP joint is associated with extension of the interphalangeal joint*

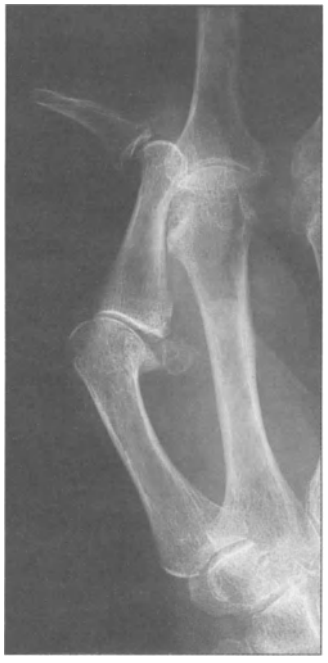

Figure 3.11 *Radiographic appearance of the Nalebuff deformity*

(5) Subluxation of the MCP joints. In severe disease the metacarpophalangeal joints may sublux, the proximal phalanges dropping down to partially or completely expose the metacarpal heads (Figures 3.13, 3.14). Arthritis mutilans (syn: *main en lorgnette,* opera glass hand) is an extreme type of deformity which may develop in the late stage of persistent aggressive rheumatoid arthritis, and is due to severe destruction of the small joints of the

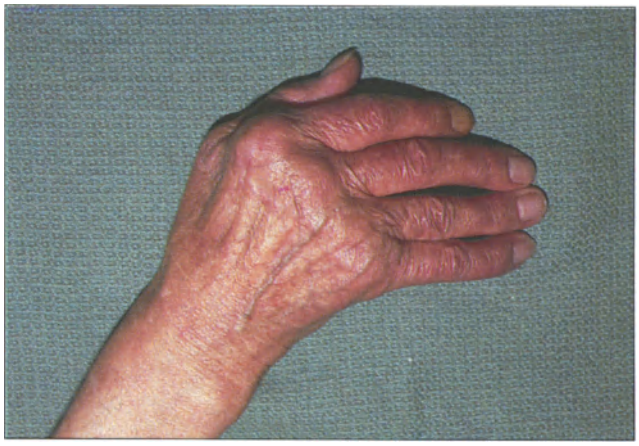

Figure 3.12 *Persistent synovitis of the MCP joints resulting in ulnar deviation and early subluxation*

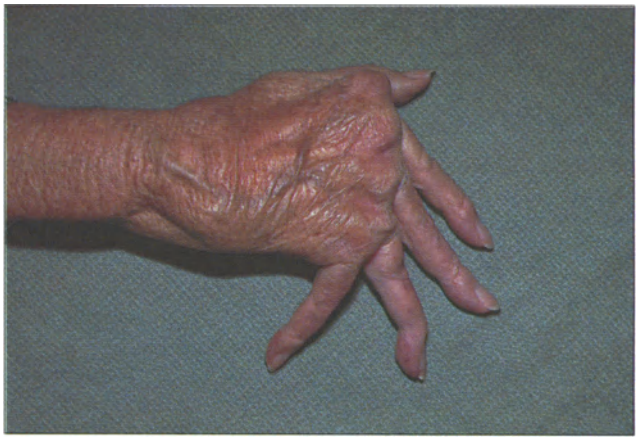

Figure 3.13 *Complete subluxation at the second to fifth MCP joints due to persistent aggressive seropositive nodular RA*

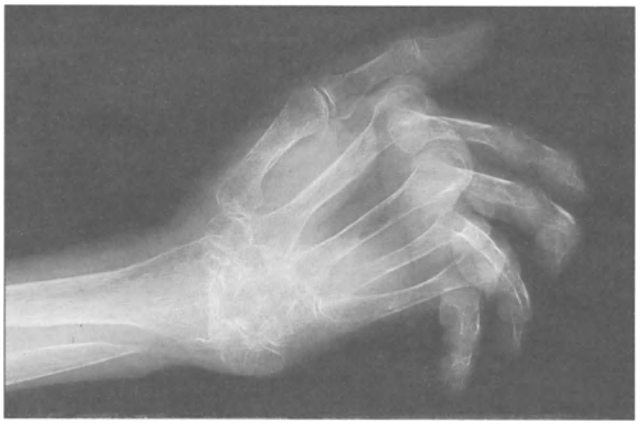

Figure 3.14 *Radiograph of hand shown in Figure 3.13. Note gross destruction of the distal ulna in association with generalized osteopaenia and severe disease in the IP, MCP, wrist and carpal joints*

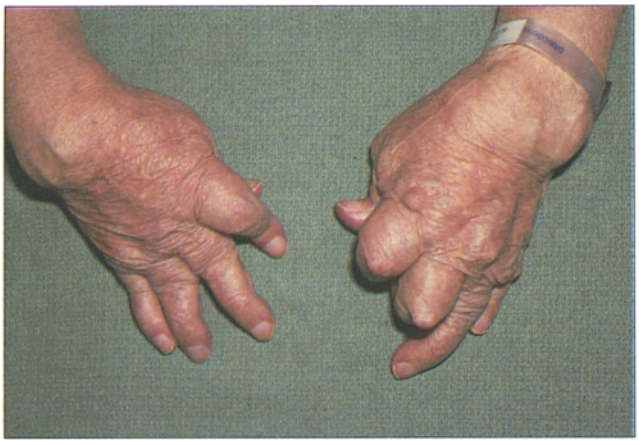

Figure 3.15 *Arthritis mutilans – subluxation, deformity and shortening of digits in seropositive nodular RA*

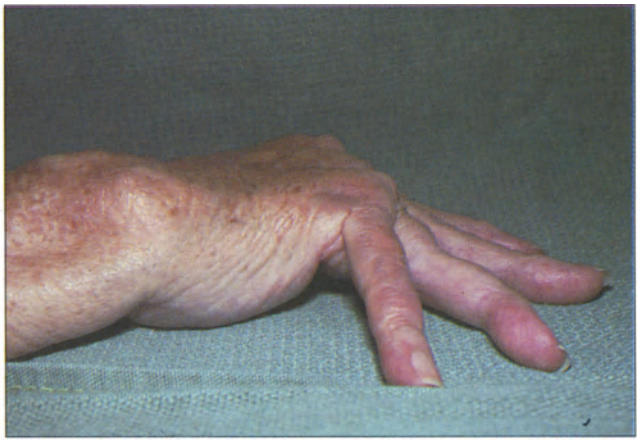

Figure 3.17 *Prominence of the distal radius and ulna due to subluxation of the wrist*

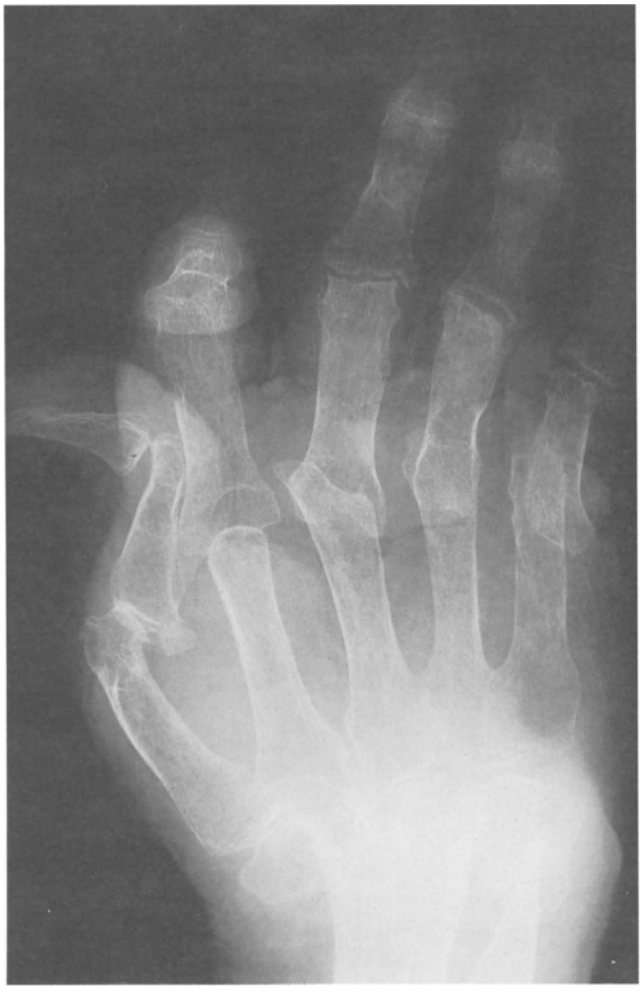

Figure 3.16 *Arthritis mutilans – radiograph of the hand shown in Figure 3.15. Note severe destruction of IP, MCP, carpal and wrist joints*

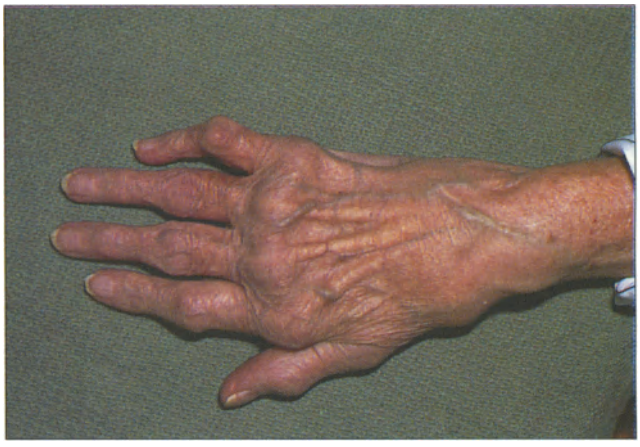

Figure 3.18 *Marked intraosseous wasting in severe seropositive nodular RA*

hand. Shortening or telescoping of the digits results from a combination of bone and cartilage loss and multifocal subluxations affecting the IP and MCP joints (Figures 3.15, 3.16).

(6) Subluxation of the wrist. A similar mechanism to that involved in MCP joint subluxation, may cause the carpus to sublux in a volar direction producing a step in the normally smooth outline of the dorsum of the wrist (Figure 3.17). Radiographs frequently show evidence of radiocarpal joint destruction which may be accompanied by tapering of the distal ulna (Figure 3.14).

In severe rheumatoid arthritis, restricted physical function results in muscle weakness and wasting. Interosseous muscle wasting may at times be severe and can be observed on the dorsal surface of the hand (Figure 3.18).

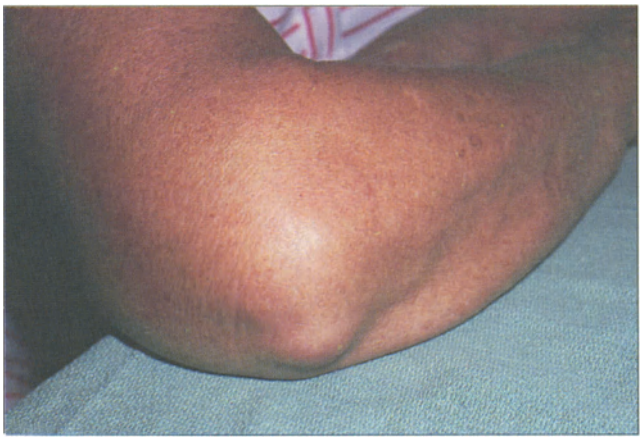

Figure 3.19 *Active synovitis of right elbow. Note swelling between lateral humeral epicondyle and olecranon*

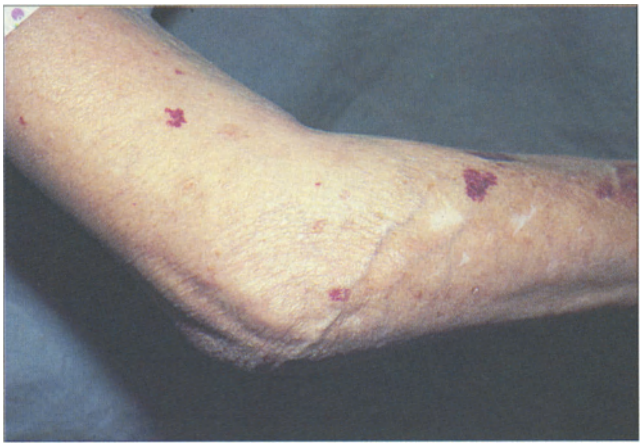

Figure 3.20 *Patient is unable to completely extend the elbow because of a well established flexion contracture*

Elbow

Synovial thickening and effusion of the elbow joint can most readily be appreciated in the area between the lateral humeral epicondyle and the olecranon when the elbow is flexed to 90° (Figure 3.19). Persistent synovitis frequently results in a restricted range of movement, flexion contracture (Figure 3.20), and in the long term to secondary osteoarthritis (Figure 3.21). Early treatment with physiotherapy and intra-articular steroid injections is important, since established flexion contractures are rarely amenable to such treatment. In addition to abnormalities in flexion and extension the patient may also experience pain and limitation during supination and pronation of the forearm. In affected patients, localized tenderness just distal to the lateral humeral epicondyle may be accompanied by crepitus arising from the lateral compartment of the elbow joint.

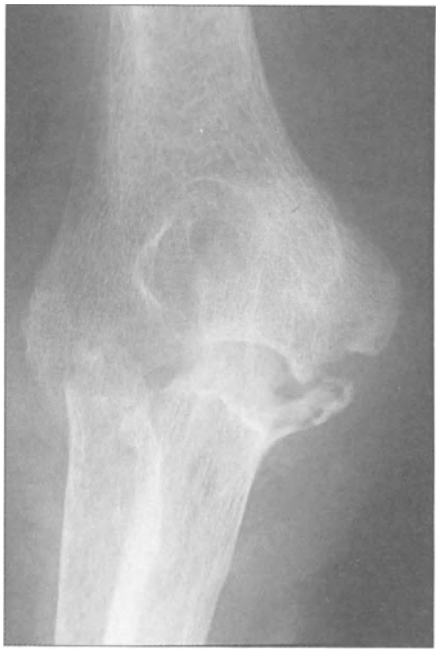

Figure 3.21 *Severe erosion of the elbow joint. Note marked destructive changes particularly in the radius and ulna*

Shoulder

The glenohumeral portion of the shoulder joint is commonly involved in rheumatoid arthritis. Pain and limitation in movement are the most frequent symptoms, although synovitis may on occasion result in a large effusion which can be detected anteriorly (Figure 3.22). Multiplanar reductions in the range of movements may occur, abduction and rotation being most commonly and most severely affected (Figure 3.23). During assessment of the shoulder, the examiner should beware of being misled by the patient who compensates for restricted abduction and external rotation by flexing the neck and adducting and flexing the upper arm and can, therefore, place both hands behind the head in spite of severe limitation in abduction and external rotation. If synovitis is not arrested, severe destruction of the glenohumeral articulation may occur with complete loss of joint space, erosion, cyst formation and deformity of the humeral head (Figure 3.24). In early disease, while the joint space is maintained and the humeral head of normal configuration, physiotherapy and local corticosteroid injections are usually beneficial. However, in advanced disease where there is a marked loss of joint space and deformity of the humeral head, surgery is the only alternative to purely symptomatic treatment.

Cervical spine

The odontoid process of the axis is normally held in approximation to the anterior arch of the atlas by the

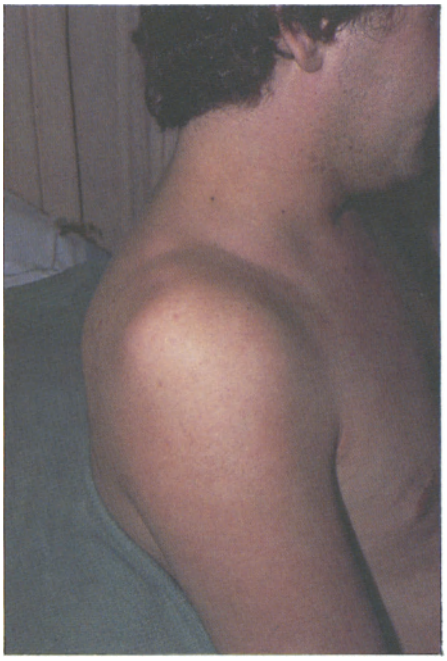

Figure 3.22 *Active rheumatoid synovitis with effusion resulting in swelling of the anterior aspect of the shoulder*

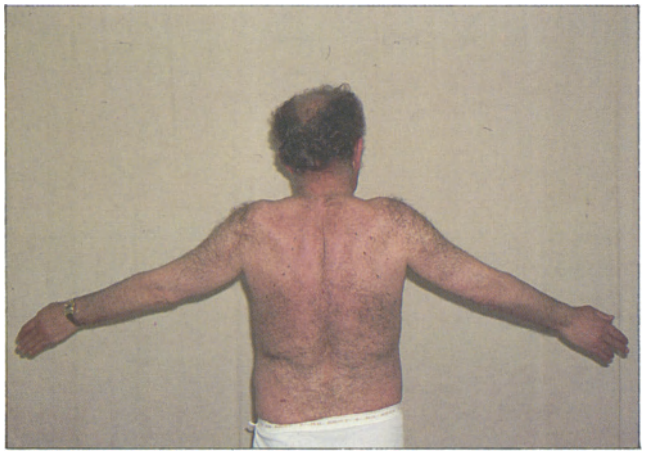

Figure 3.23 *Restricted glenohumeral joint movement. Patient attempts to compensate for severe restriction in abduction by elevating the shoulders and excessive scapulothoracic movement*

transverse ligament. Synovial membrane is interposed both between the anterior arch and the odontoid, and also between the odontoid and the transverse ligament. Rheumatoid synovitis may attenuate the transverse ligament allowing the odontoid to sublux. Since subluxation may be overlooked on plain lateral radiographs taken in the neutral or extended position (Figure 3.25), flexion views should be obtained in all patients with suspected atlantoaxial disease. Separation of the odontoid process and the anterior arch of the atlas by more than 2.5 mm in this view is indicative of subluxation (Figure 3.26). Atlantoaxial disease may be asymptomatic or cause pain which may be localized, or radiate

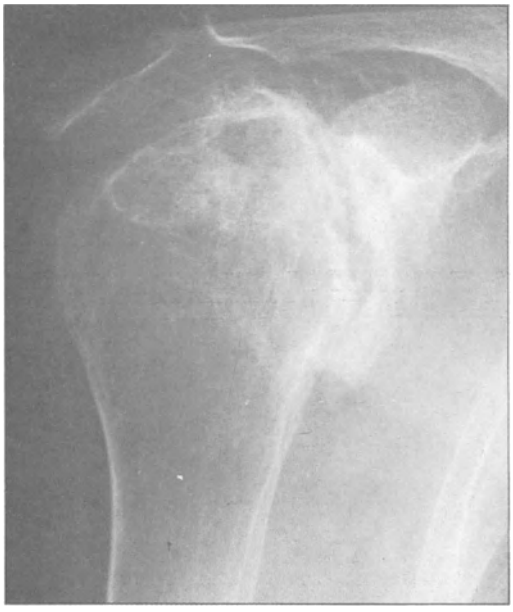

Figure 3.24 *Severe destruction of the glenohumeral joint. Note erosion, loss of joint space, subluxation and deformity of the humeral head*

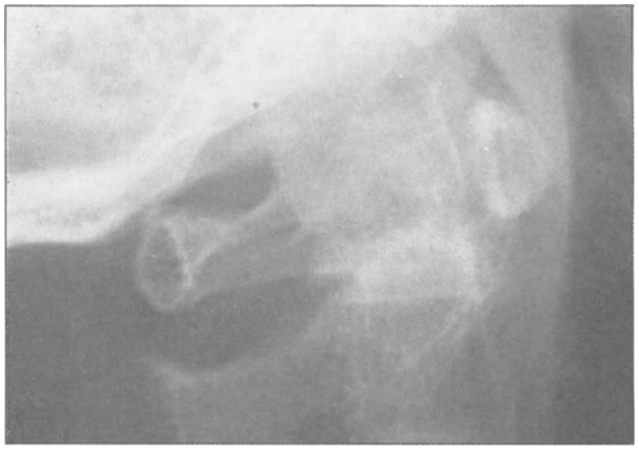

Figure 3.25 *Atlantoaxial subluxation is not apparent in this extension view of a patient with cervical spine instability*

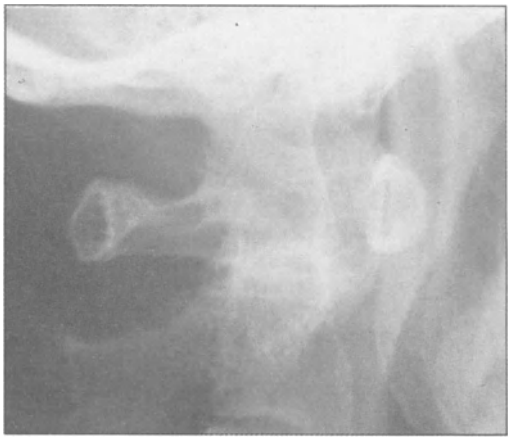

Figure 3.26 *Atlantoaxial subluxation – separation of the odontoid from the body of the atlas by more than 2.5 mm is evident in a flexion view of the patient shown in Figure 3.25*

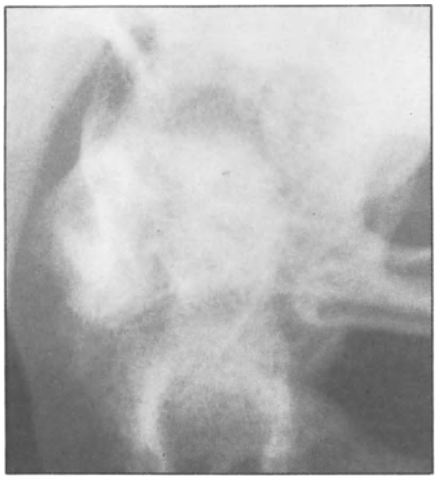

Figure 3.27 *Erosion of the anterior and posterior aspects of the odontoid*

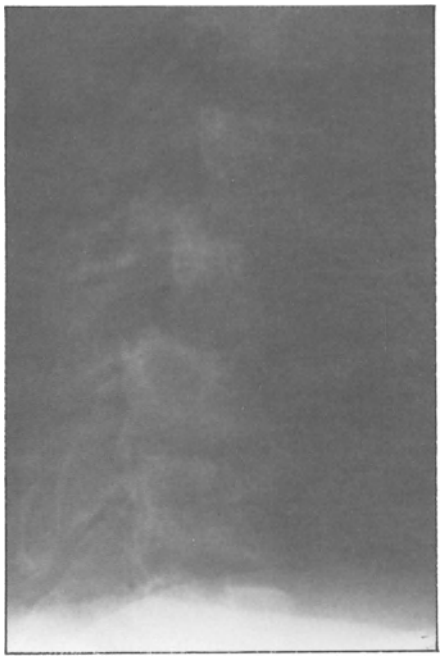

Figure 3.28 *Subaxial subluxation at multiple levels of the cervical spine*

over the occipital area of the skull. Subluxation at this level is clinically important, since it may result in severe cord compression and occasionally in death. In addition to attenuating the transverse ligament, synovitis may also result in erosion of the odontoid process and rarely may lead to fracture of the odontoid with subsequent impingement of the foramen magnum (Figure 3.27). Subaxial subluxation, particularly in the upper levels of the cervical spine (Figure 3.28), is quite common in severe rheumatoid arthritis, and may occur alone or be associated with atlantoaxial instability. Pain and restricted movement are the principal symptoms, although severe subaxial subluxation may occasionally result in quadriplegia or death.

Manubriosternal, sternoclavicular and temporomandibular joints

Manubriosternal subluxation is manifest clinically by swelling in the area of the articulation, and can be recognized radiographically on lateral views of the manubriosternal joint (Figure 3.29). Subluxation of the manubriosternal joint and severe cervical spine involvement may be associated in some patients. Synovitis of the sternoclavicular joint results in localized pain, tenderness and swelling. Pain is usually exacerbated by

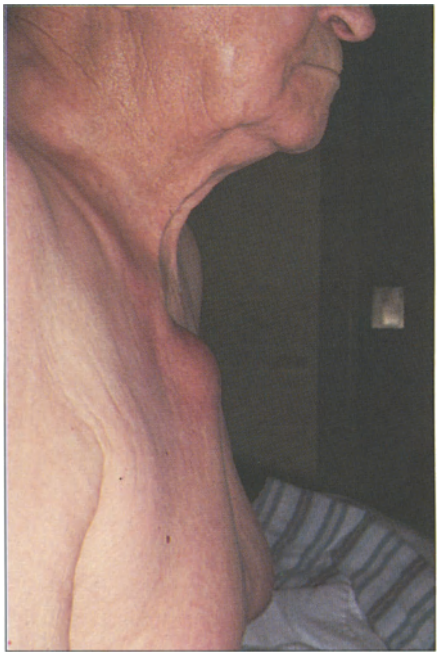

Figure 3.29 *Manubriosternal subluxation in seropositive RA*

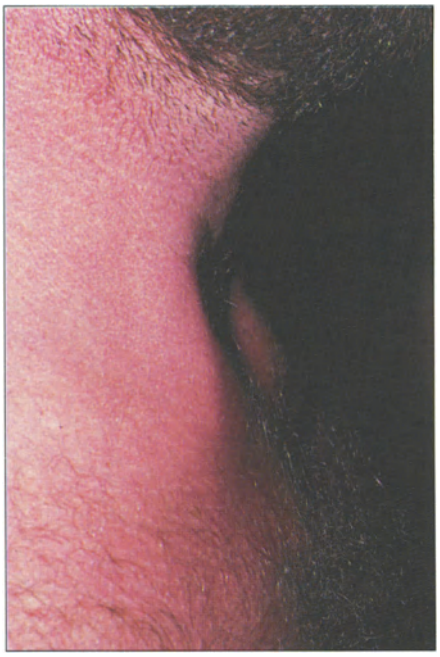

Figure 3.30 *Sternoclavicular joint swelling in RA*

elevation, depression, protraction and retraction of the shoulder (Figure 3.30). Temporomandibular joint involvement may cause localized pain (which is aggravated by jaw movement), tenderness, crepitus and occasionally swelling. Hoarseness may result from synovitis in the cricoarytenoid joint and requires differentiating from hoarseness due to other causes, especially malignancy arising either in the larynx or within the thoracic cavity.

Hip

Joint space narrowing is the earliest radiographic sign of arthritis of the hip joint. In contrast to the selective supralateral cartilage loss seen in early osteoarthritis, narrowing is concentric in its distribution in rheumatoid disease (Figure 3.31). Pain and limitation in range of movement, particularly restricted abduction and rotation, commonly accompany active disease. Pain may be experienced in the groin and buttock or radiate to the lumbar spine, trochanteric area of the thigh or down the leg to the medial aspect of the knee. In mild cases it may only occur on weight bearing while in severe disease it is usually present at rest and may disturb sleep. Erosion, cyst formation, deformity of the femoral head and secondary osteoarthritis may occur in later stages of the disease. On occasion the femoral head may deform the thin and weakened floor of the acetabulum producing the clinical entity known as protrusio acetabuli (Figure 3.32). In patients with severe hip disease there is frequently a true leg length discrepancy due to loss of bone and cartilage and supramedial migration of the femoral head.

Knee

Synovial effusion of the knee joint is extremely common in rheumatoid arthritis. Swelling due to synovial thickening and effusion is often most pronounced in the suprapatellar area, and in long-standing disease contrasts with wasting in the adjacent quadriceps muscle (Figure 3.33). Synovial fluid obtained by arthrocentesis has a yellow, translucent, slightly turbid appearance, a low viscosity and forms a poor mucin clot (Figure 3.34).

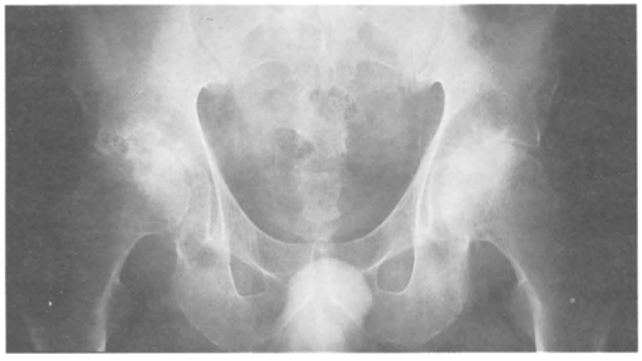

Figure 3.31 *Concentric joint space narrowing due to persistent rheumatoid synovitis*

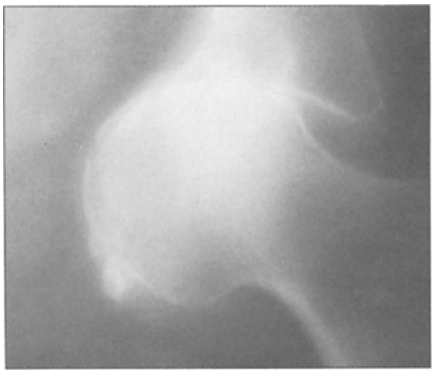

Figure 3.32 *Tomographic appearance of protrusio acetabuli. Following complete concentric loss of the joint space, the femoral head migrates supramedially and deforms the floor of the acetabulum*

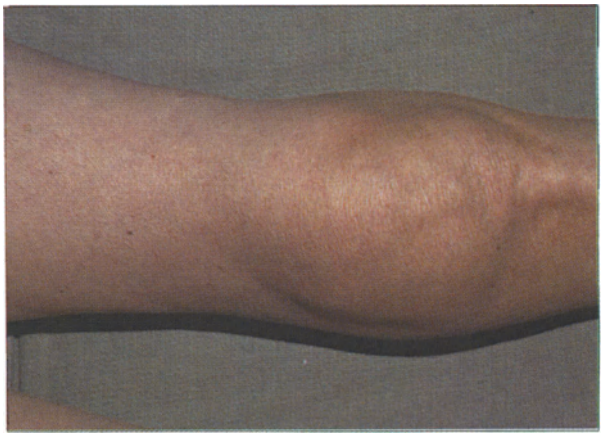

Figure 3.33 *Large synovial effusion with quadriceps wasting in a patient with active disease of several weeks duration*

Figure 3.34 *Moderately turbid appearance of synovial fluid from a rheumatoid knee*

Cell counts are usually in the order of 5000–75 000 white cells/mm^3, greater than 50% being polymorphonuclear leukocytes. In early disease, radiographs show evidence only of soft tissue swelling, while joint space narrowing frequently develops in patients with persistent synovitis. Bony erosions, while commonly encountered in radiographs of the hands and feet, are observed relatively infrequently in this articulation in spite of the knee being a frequently involved joint (Figure 3.35). Restriction in the range of movement is common in the presence of active disease, and may result in flexion contracture (Figure 3.36). With intense physiotherapy and intra-articular corticosteroid injections these contractures can often be considerably, if not completely, reduced. In advanced disease there may be radiographic evidence of complete or almost complete loss of joint space, cyst formation and secondary osteoarthritis (Figure 3.37). At this stage of the disease there is often a substantial functional deficit, intractable pain, collateral and cruciate ligamentous laxity, varus, valgus (Figure 3.38) or flexion deformities, and a need to consider surgical forms of therapy.

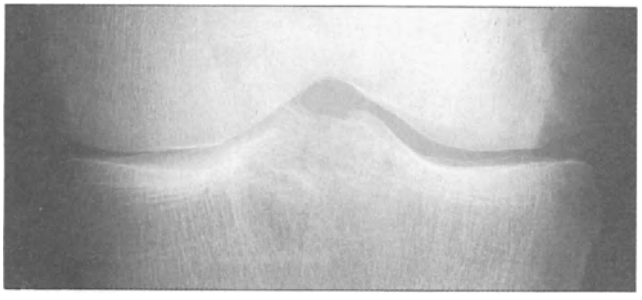

Figure 3.35 *Partial loss of joint space and marginal erosion due to persistent synovitis*

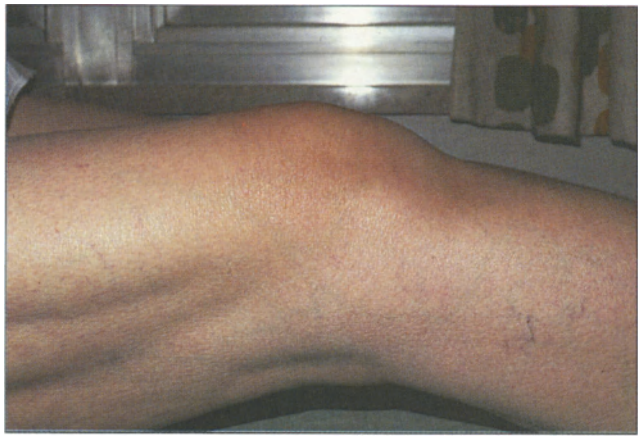

Figure 3.36 *Patient unable to fully extend knee due to flexion contracture*

Patients with chronic knee effusions are particularly at risk of developing popliteal (Baker's) cysts (Figure 3.39). These cysts generally arise as the result of a valve-like communication between the tibiofemoral joint space and one of several adjacent bursae.

The most frequent communication is between the joint space and the gastrocnemius–semimembranosus bursa. The communication is generally narrow, a flap-valve mechanism facilitating the flow of synovial fluid into, but not out of, the cyst. Popliteal cysts may also result from posterior herniation of the joint capsule or from fluid accumulation in a non-communicating bursa. If sufficiently large and tense, cysts may occasionally

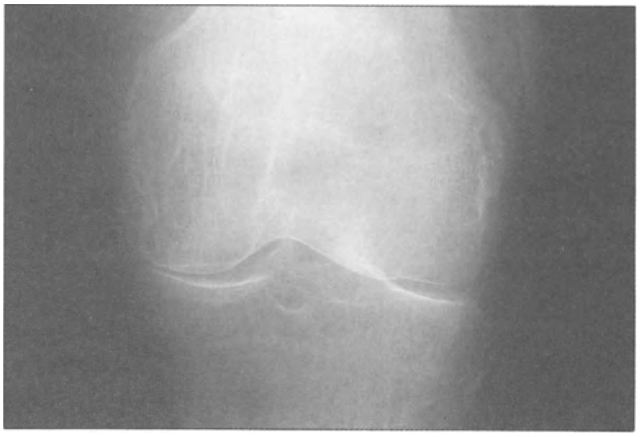

Figure 3.37 *Severe loss of joint space in medial and lateral tibiofemoral compartments in advanced RA*

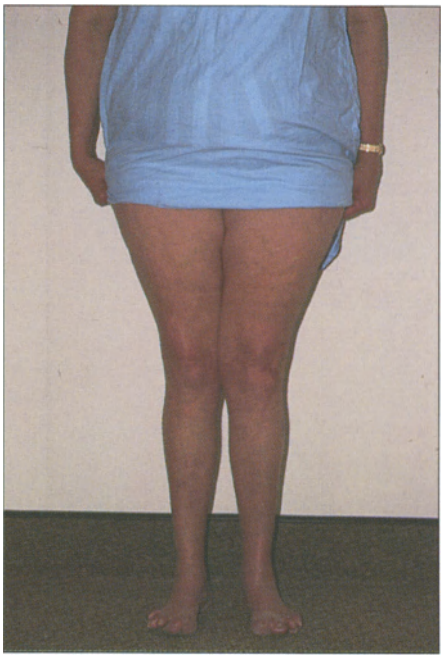

Figure 3.38 *Valgus deformity of left knee due to severe longstanding RA*

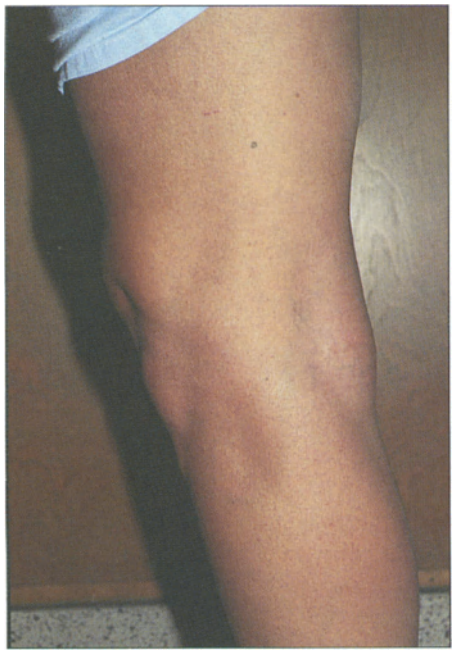

Figure 3.39 *Baker's cyst in association with a large joint effusion. Note suprapatellar and popliteal swelling*

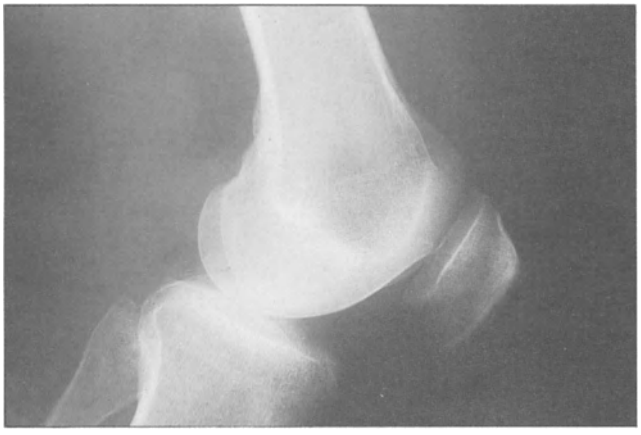

Figure 3.40 *Baker's cyst visualized in soft tissue of lateral radiograph*

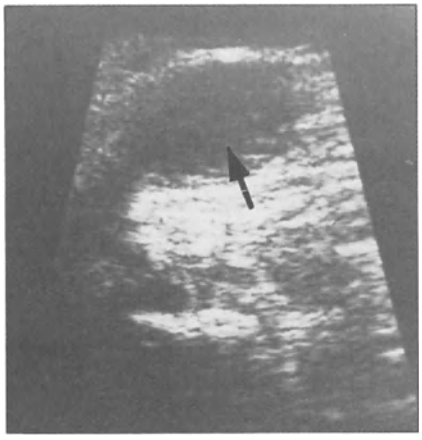

Figure 3.41 *Baker's cyst visualized by ultrasonography (arrow)*

be seen in the soft tissues on lateral radiographs of the knee (Figure 3.40). Ultrasound is a useful non-invasive method of detecting cysts in patients with calf pain, or in whom fullness is detected in the popliteal fossa (Figure 3.41). The importance of the popliteal cyst lies in its potential to rupture into the calf, causing pain, tenderness, swelling and increased skin temperature, and thereby mimicking the symptoms and signs of a deep venous thrombosis (Figure 3.42). Since a ruptured popliteal cyst and deep venous thrombosis may coexist, the differential diagnosis is even more difficult and frequently necessitates the use of contrast venography. However, the appearance of a haemorrhagic crescent (crescent sign) around the lateral or medial malleolus, (although infrequently seen), is highly suggestive of a ruptured cyst (Figure 3.43). This sign is probably caused by blood tracking from the site of rupture down the fascial planes of the calf. In the case of cysts which communicate with the joint space, contrast arthrography has traditionally been the diagnostic test of first choice, contrast being observed to leak posteriorly into the calf (Figure 3.44). More recently, however, joint scintigraphy has provided an alternate method of visualizing the joint space, popliteal cyst and leakage of synovial fluid (Figure 3.45). Most cyst ruptures respond to conservative medical treatment, although occasionally surgical therapy is required for recurrent or persistent leakage.

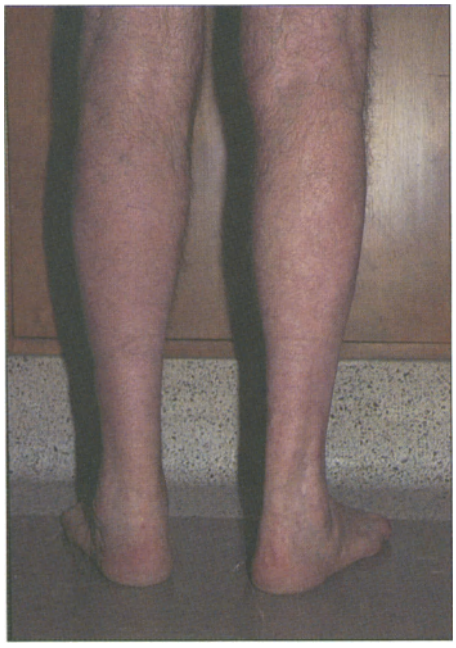

Figure 3.42 *Ruptured popliteal cyst (left knee) resulting in swelling from mid-calf to ankle*

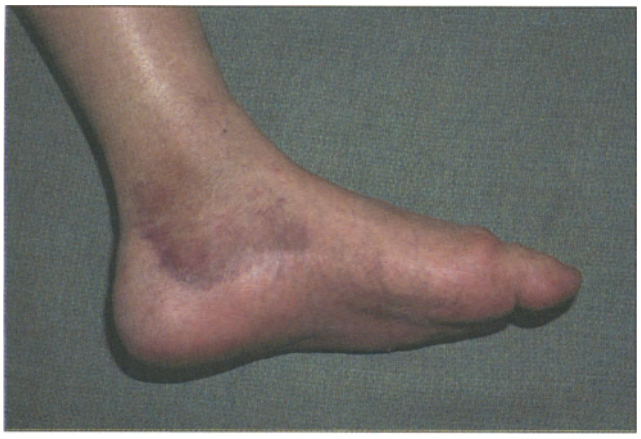

Figure 3.43 *Haemorrhagic crescent sign around medial malleolus*

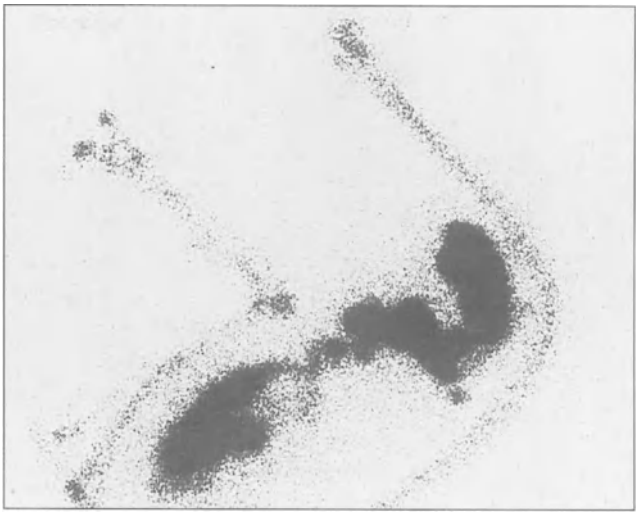

Figure 3.45 *Leakage of synovial fluid from ruptured cyst into calf visualized by joint scintigraphy*

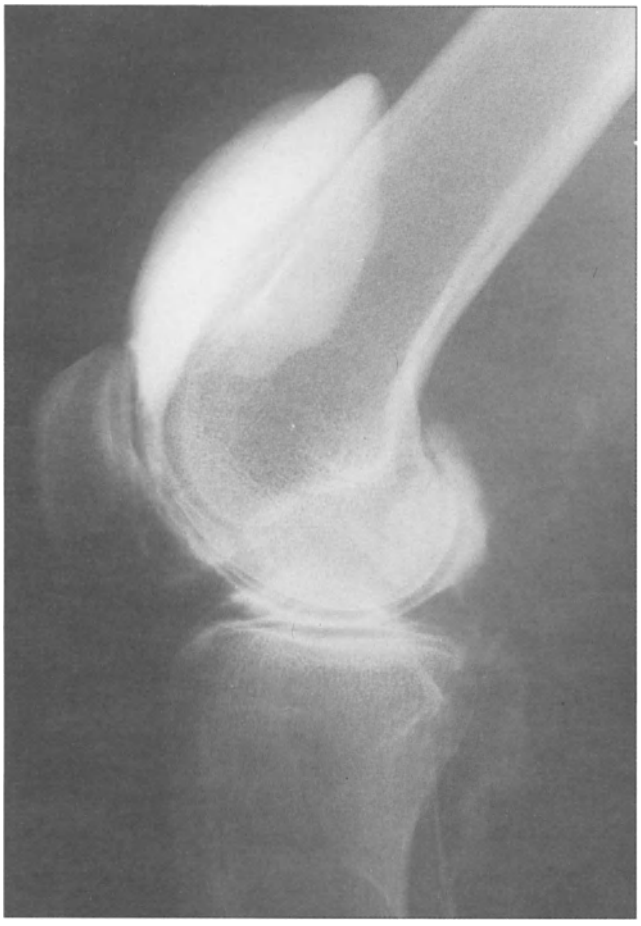

Figure 3.44 *Leakage of synovial fluid from ruptured cyst into calf visualized by arthrography*

Hind foot (ankle) and mid-foot

Pain and swelling due to synovitis in the tibiotalar and subtalar joints require differentiating from similar symptoms and signs related to tenosynovitis (Figure 3.46). The latter may be documented by careful examination of the invertor, evertor, dorsiflexor and plantar flexor tendons for localized tenderness and swelling. Pain and crepitus due to tibiotalar synovitis (Figure 3.47) should be differentiated from that arising in the subtalar joint (Figure 3.48). With tibiotalar involvement, pain is experienced on dorsiflexion and plantar flexion movements while in subtalar disease, symptoms are more prominent during inversion and eversion.

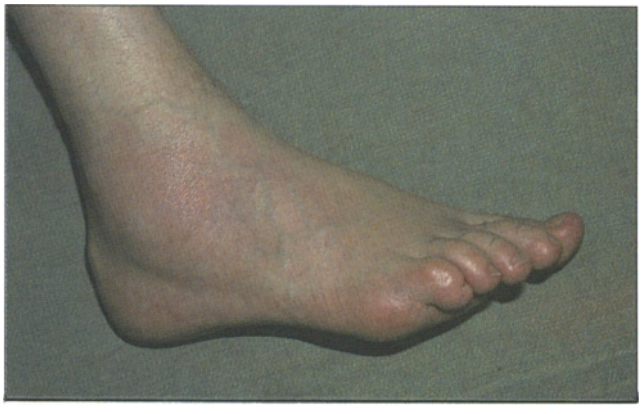

Figure 3.46 *Generalized swelling around the ankle due to acute synovitis. Erythema though present in this patient is infrequent in rheumatoid arthritis*

Persistent synovitis may ultimately result in loss of joint space, bony erosion and the development of secondary osteoarthritis. Similar changes may affect the midtarsal joint which consists of the talonavicular and calcaneocuboid joints (Figure 3.49). Rheumatoid disease may involve the hind, mid and forefoot and result in flattening of the medial longitudinal arch, i.e. a pes planus deformity (Figure 3.50). The pes planus deformity is frequently associated with eversion of the hind foot. Eversion is best appreciated with the patient standing, the examiner looking for any asymmetry of the heel about the Achilles tendon (Figure 3.51).

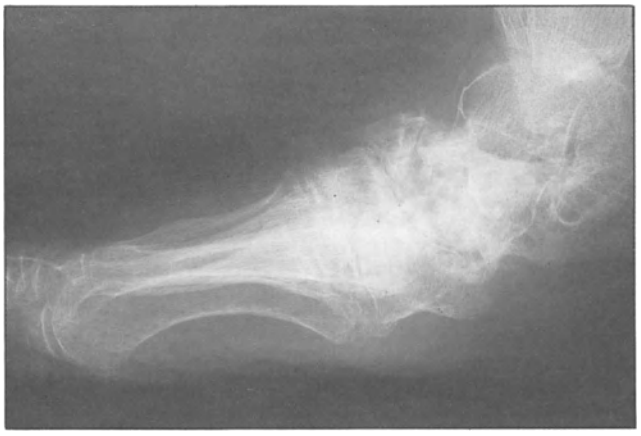

Figure 3.49 *Erosion, osteopaenia and loss of cartilage in the midtarsal joint*

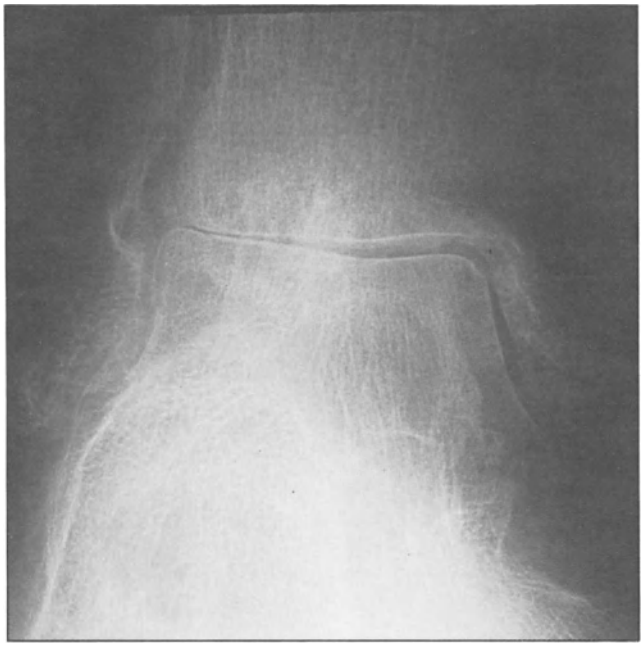

Figure 3.47 *Erosion and joint space narrowing in the tibiotalar joint (ankle mortice)*

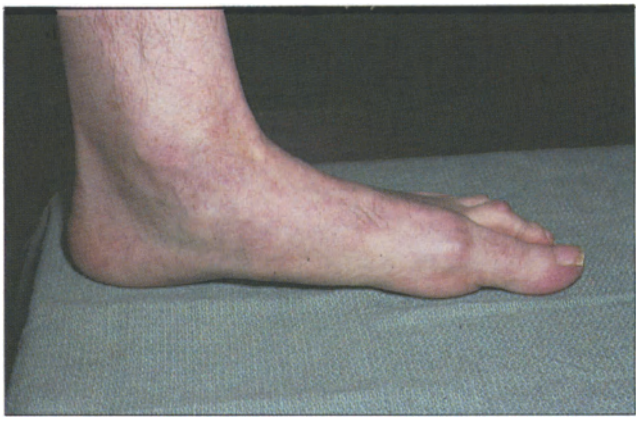

Figure 3.50 *Pes planus deformity due to loss of medial longitudinal arch*

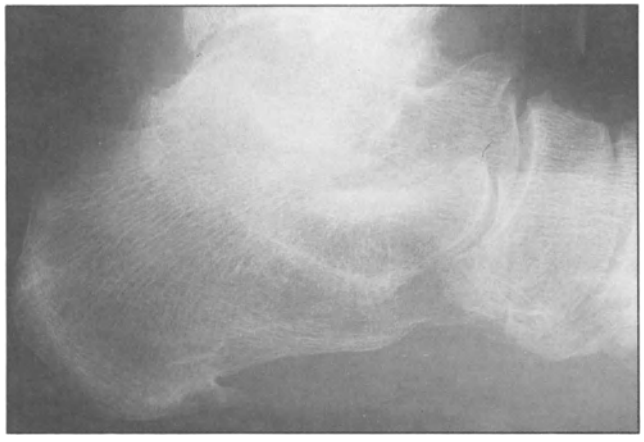

Figure 3.48 *Total obliteration of the subtalar joint in longstanding seropositive RA*

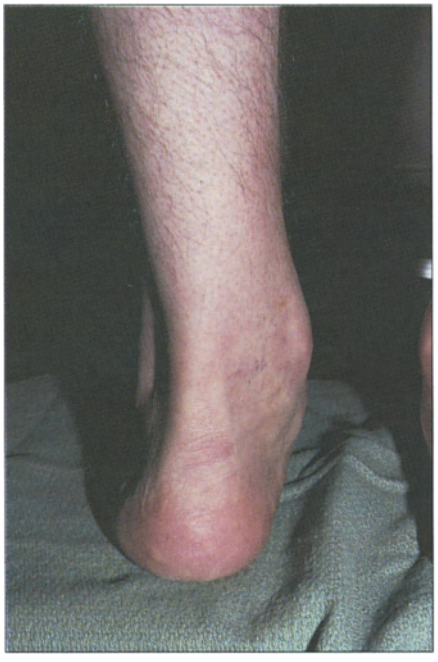

Figure 3.51 *Eversion of the hind foot*

Forefoot

The forefoot is frequently involved in rheumatoid arthritis, erosion sometimes developing in the MTP joints (especially in the fifth metatarsal head), before becoming radiographically evident in the hands (Figure 3.52). The radiographic features of peri-articular osteoporosis, joint space narrowing, erosion and cyst formation are similar to those found in other affected areas. Involvement of the MTP joints produces pain equated to that of walking on broken glass. This is frequently associated with localized tenderness particularly on the plantar aspect of the foot. In extreme cases MTP joint swelling results in separation of the toes creating the so-called window sign (Figure 3.53). With persistent disease the metatarsal heads sublux, the weight bearing characteristics of the forefoot change and callus develops under the subluxed metatarsal heads (Figure 3.54). Cock-up deformities may occur in association with metatarsal subluxation and are due to a combination of dorsiflexion at the MTP joints and plantar flexion at the IP joints (Figure 3.55). In patients with severe deformity, the tips of the toes may remain elevated from the floor when the patient is standing. Callosities often develop over the dorsal surface of the PIP joints and on the tips of the toes in patients with cock-up deformities. Metatarsal head subluxation may be associated with lateral deviation of the toes and the development of a bunion overlying the head of the first metatarsal. In some patients deviation of the great toe may be so severe that the digit rides over or under the adjacent toe (Figure 3.56).

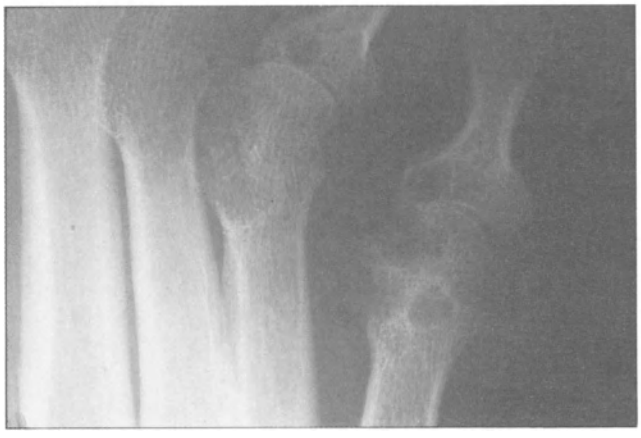

Figure 3.52 *Erosion, joint space narrowing and cyst formation in fourth and fifth MTP joints*

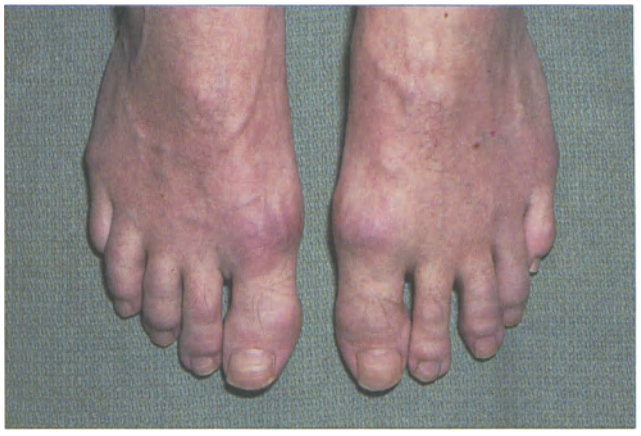

Figure 3.53 *Window sign – separation of second and third toes of left foot due to MTP joint synovitis*

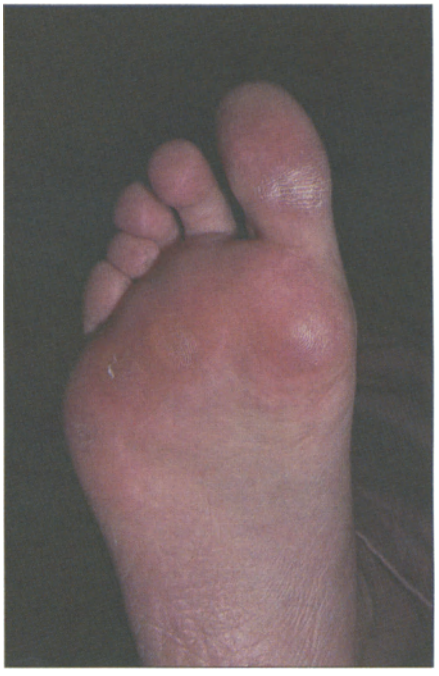

Figure 3.54 *Callus formation under the first, third, fourth and fifth metatarsal heads secondary to MTP subluxation*

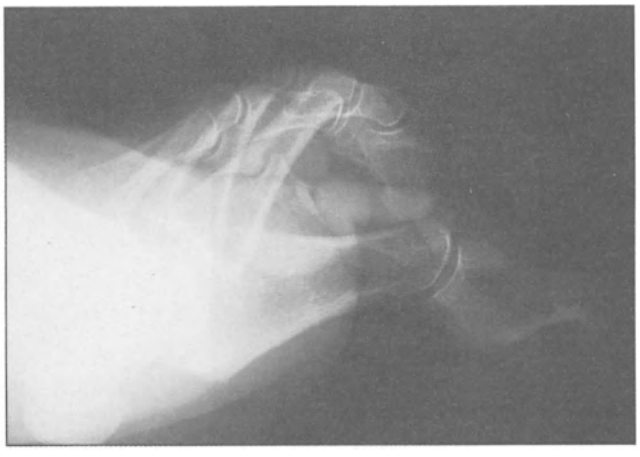

Figure 3.55 *Cock-up deformities of the toes. Note dorsiflexion of MTP joints and plantar flexion of IP joints*

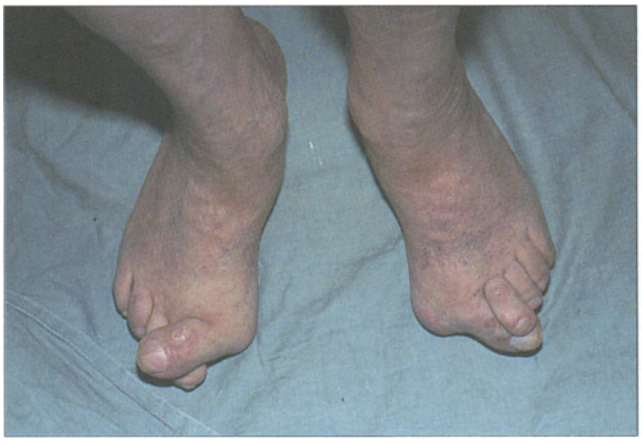

Figure 3.56 *Severe forefoot deformities. Note extreme valgus deviation of both first toes*

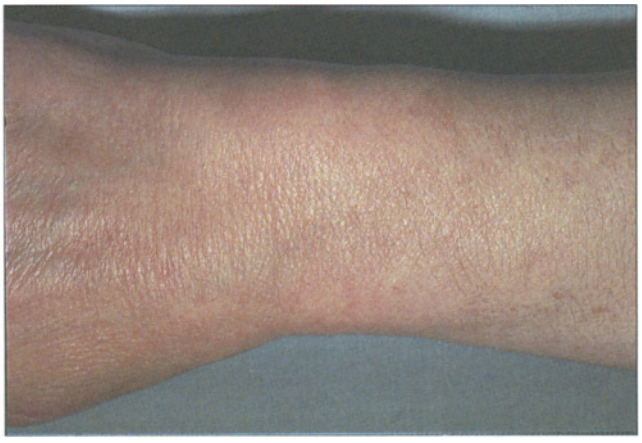

Figure 3.57 *Swelling of the ulnar border of the wrist due to extensor tenosynovitis*

Extra-articular manifestations

Tendons, bursae and muscles

Tenosynovitis particularly of the flexor tendons in the hands and the peroneal tendons in the feet is common. Tenderness, crepitus and swelling may be detected in affected tendons (Figure 3.57), and on occasion nodule formation and thickening of the tendon sheath may result in intermittent jamming or triggering during flexion–extension movements. Sudden rupture, particularly of the extensor tendons of the fingers may occur as a result of either (a) softening of the tendon due to tendonitis or (b) attenuation of the tendon by roughened bone surfaces especially on the dorsum of a subluxed wrist (Figures 3.58, 3.59). Following tendon rupture the patient complains of acute or subacute loss of the ability to properly extend the affected digit. On examination the digit is often partially flexed, and passive extension exceeds active extension by a considerable degree. Patients with a tendon rupture should be urgently referred for early surgical repair, since delay may allow tendon shortening to occur and prohibit successful surgery.

Inflammation of the olecranon bursa results in localized swelling, tenderness and warmth without limitation in the range of movement of the elbow joint (Figure 3.60). Similar lesions are encountered in traumatic, gouty and septic olecranon bursitis. The swelling of olecranon bursitis requires differentiating from that due to a rheumatoid nodule, the latter being firmer and tending to occur more distally on the ulnar border of the forearm.

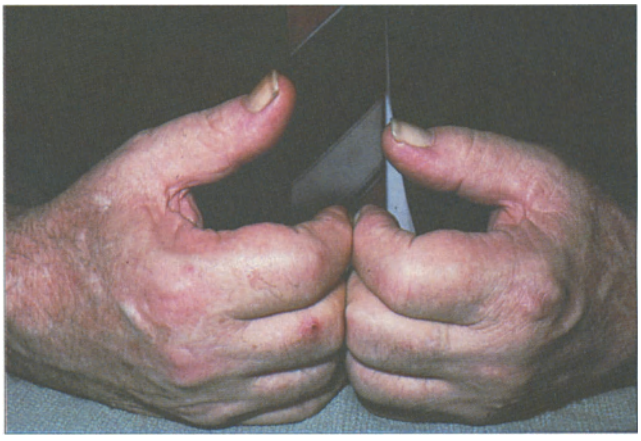

Figure 3.58 *Rupture of extensor tendon to the left thumb*

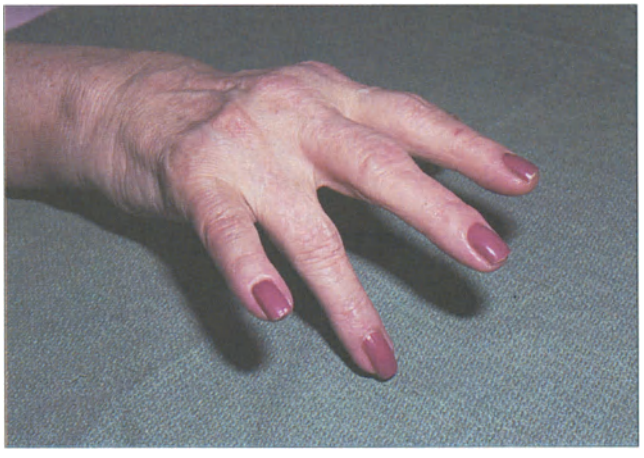

Figure 3.59 *Rupture of extensor tendon to the fourth digit*

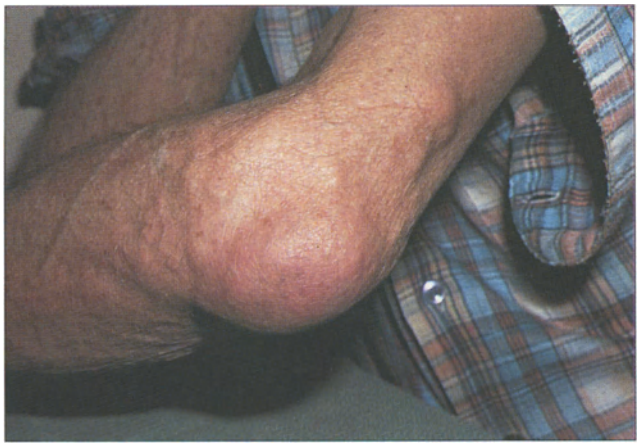

Figure 3.60 *Large fluctuant swelling over olecranon due to olecranon bursitis*

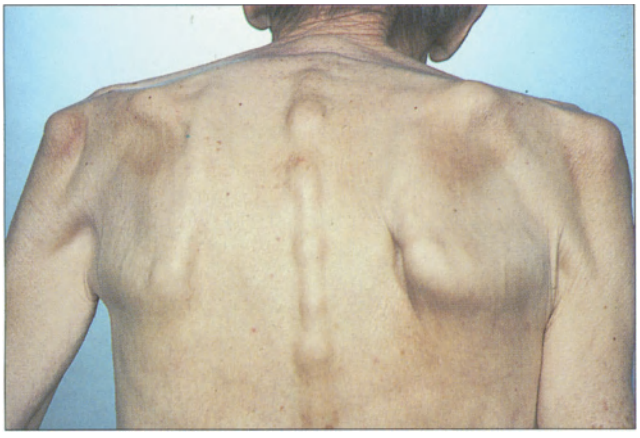

Figure 3.61 *Severe muscle wasting of the shoulder girdle due to rheumatoid myopathy*

A proximal myopathy may develop during the late stage of severe rheumatoid disease. It most commonly affects the shoulder girdle and results in severe wasting which is most apparent in the supraspinatus and infraspinatus muscles (Figure 3.61). This form of myopathy should be differentiated from that due to severe glenohumeral arthritis and prolonged systemic corticosteroid therapy.

The skin

Broken longitudinal ridging (beading) of the nails is more frequent in rheumatoid arthritis than in other musculoskeletal disorders or in the general population (Figure 3.62). Although absent in early disease, marked involvement of multiple nails may occur in later stages of the disease. The pathogenesis of this form of nail dystrophy is not presently known but it is thought to represent a vascular phenomenon. The texture and colour of the skin may undergo certain changes in rheumatoid arthritis. In particular the skin is often thin and atrophic over the carpus, particularly in elderly

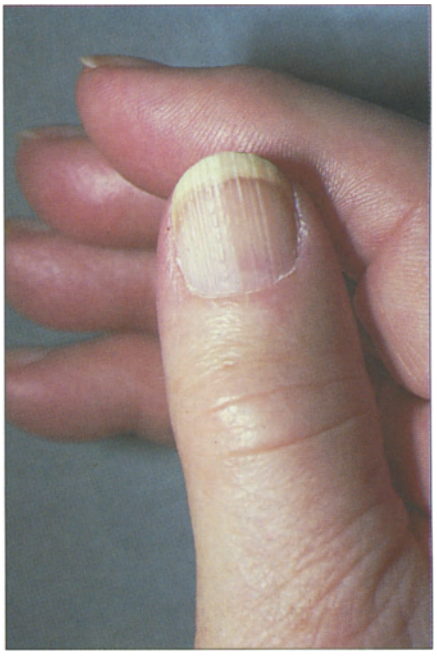

Figure 3.62 *Longitudinal beading of the thumb nail in established RA*

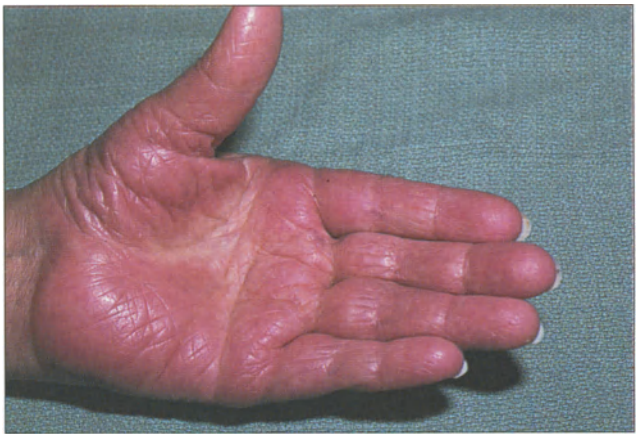

Figure 3.63 *Palmar erythema due to RA*

patients with severe disease of long duration, and in those who have received systemic corticosteroid therapy (Figure 3.18). Palmar erythema may be more common in rheumatoid arthritis than in the general population, and occurs in the absence of any underlying hepatic disease (Figure 3.63).

Rheumatoid nodules occur in approximately 25% of patients and are more frequent in those who are seropositive for IgM rheumatoid factor. Nodules may be intradermal, subcutaneous or subperiosteal in location. They are generally firm, non-tender, mobile and may spontaneously vary in size. Histologically there is a

central area of fibrinoid necrosis surrounded by a palisade of histiocytes and an outer layer of lymphocytes and occasional plasma cells. Nodules may occur at a variety of sites including the ulnar border of the forearm (Figure 3.64), the extensor surface of the MCP and IP joints (Figure 3.65), the extensor surface of the knees (Figure 3.66), the back of the head, the ears, the bridge of the nose, adjacent to the Achilles tendon (Figure 3.67) and over the ischial tuberosities and sacrum. Rheumatoid nodules particularly those located over the olecranon, should be differentiated from other nodular swellings, e.g. gouty tophi and xanthomata. Nodules, especially those overlying the sacrum, may ulcerate and become a major problem requiring intensive therapy (Figure 3.68). Nodule formation is not confined to the skin but may also occur in tendons, the lung parenchyma, pleura, pericardium, myocardium, heart valves, cerebral cortex, meninges, cerebellum and rarely, the sclera.

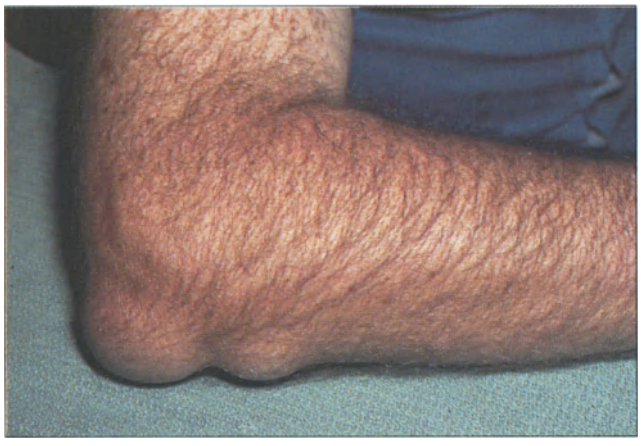

Figure 3.64 *Rheumatoid nodule on extensor surface of elbow adjacent to a more proximally located olecranon bursitis*

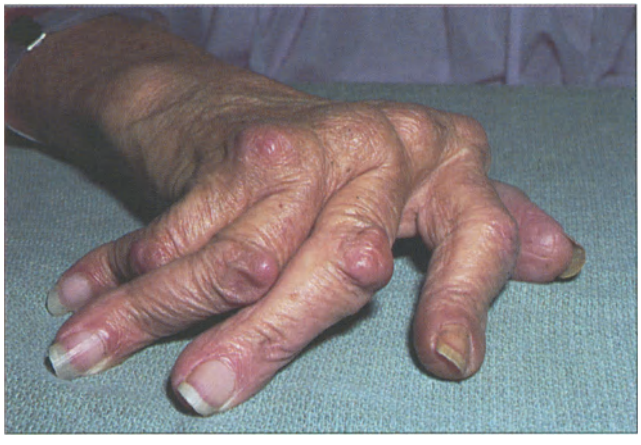

Figure 3.65 *Multiple nodules over extensor surface of the digits in seropositive RA*

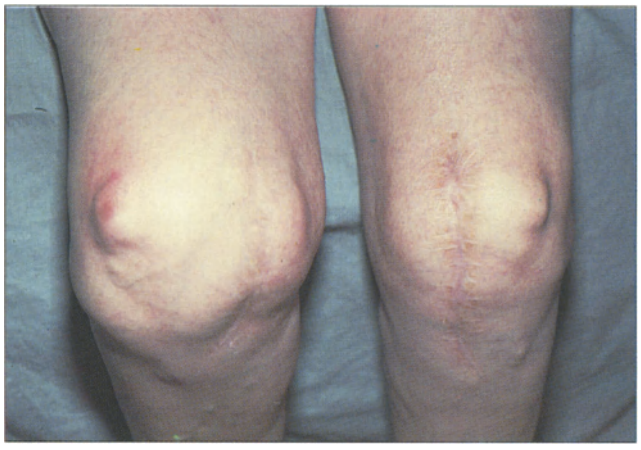

Figure 3.66 *Nodules over extensor surface of severely affected knees*

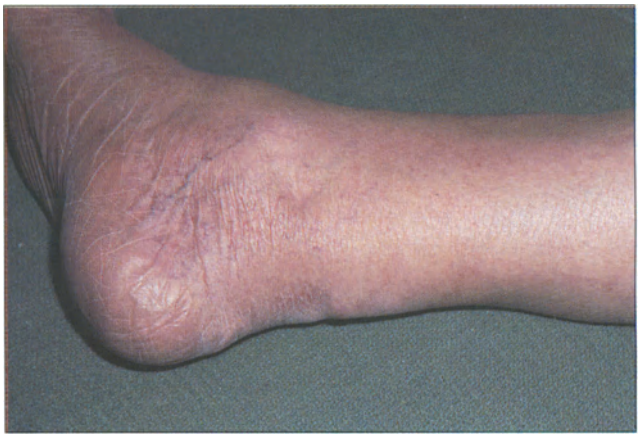

Figure 3.67 *Rheumatoid nodules adjacent to the Achilles tendon*

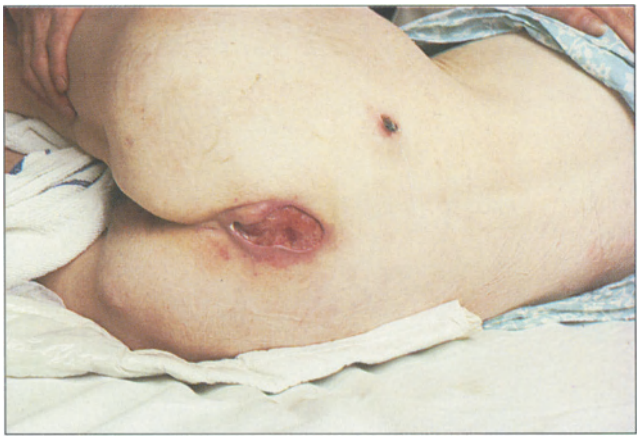

Figure 3.68 *Ulcerating rheumatoid nodule overlying the sacrum (Courtesy of Update Publications)*

Ulceration in the lower extremity of the rheumatoid patient may be due to trauma, vasculitis or Felty's syndrome (Figure 3.69). Felty's syndrome is a triad of a neutropaenia, splenomegaly (Figure 3.70) and severe but often inactive rheumatoid arthritis (Figure 3.71). Approximately 41% of patients with Felty's syndrome experience chronic ulceration in the lower extremity and 52% recurrent bacterial infection.

Vasculitis

Rheumatoid vasculitis may affect a number of organ systems including the skin, peripheral nerves, eyes, heart, lungs and the abdominal viscera.

Leukocytoclastic inflammation in affected blood vessels results in ischaemia and if severe leads to frank necrosis and gangrene. Nail fold vasculitis may occur as a prodrome to, or in association with, vasculitis elsewhere, or alternately may represent a localized and relatively stable process requiring no specific treatment (Figure 3.72). The detection of circulating immune complexes and evidence of complement consumption suggest that vasculitis is more likely to be generalized and, therefore, of serious prognostic importance. Rheumatoid vasculitis may also result in splinter hameorrhages (Figure 3.73), patchy erythematous lesions (particularly in the lower extremity) or palpable purpura (Figure 3.74). More severe forms of vasculitis lead to tissue necrosis (Figure 3.75) and in the most advanced cases to digital gangrene with partial or complete loss of digits (Figure 3.76). Involvement of the coronary vasculature or mesenteric vessels may be fatal, and is frequently associated with a sensory or mixed motor–sensory peripheral neuropathy.

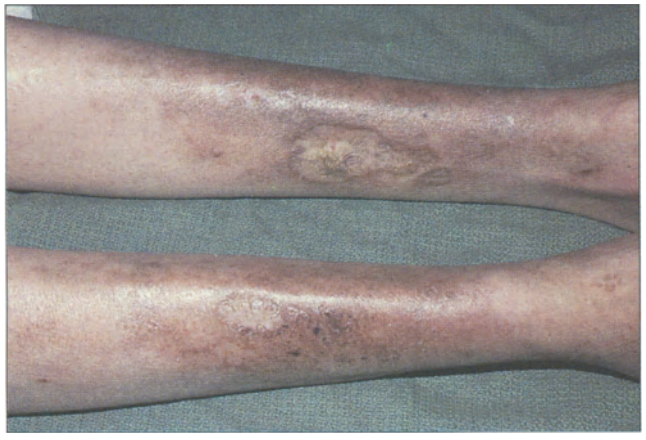

Figure 3.69 *Healed pretibial ulcers in Felty's syndrome*

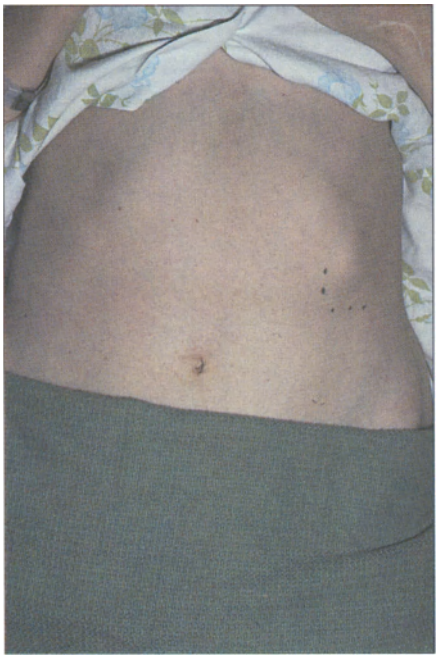

Figure 3.70 *Splenomegaly in leukopaenic (3000 cells/mm³) patient with Felty's syndrome*

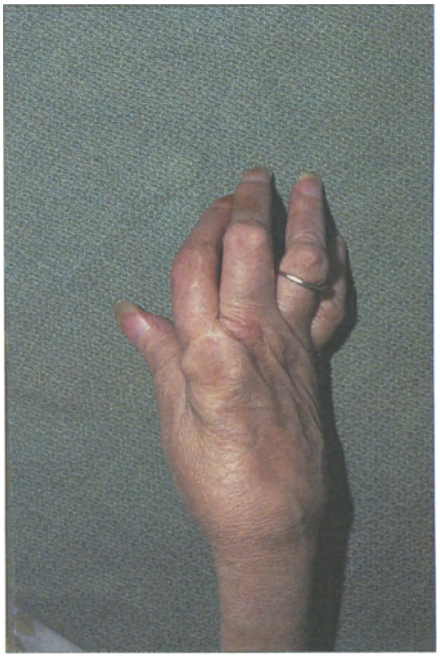

Figure 3.71 *Hand of patient in Figures 3.69 and 3.70. Note severe but inactive rheumatoid arthritis*

The eye

The eye may be affected by rheumatoid disease as well as by the drugs used in its treatment. Sjögren's syndrome (keratoconjunctivitis sicca, xerostomia and arthritis) is the most frequent ocular complication of rheumatoid arthritis and is present in up to one-third of patients. Although, itching, burning and dryness of the eyes and dryness of the mouth and oropharynx are the most common symptoms, bronchial and vaginal secretions may also be affected. Schirmer's tear test is a useful screening technique for detecting deficient lachrymal secretion (Figure 2.17). The degree of wetting of the test paper varies considerably, but less than 5 mm after 5 minutes is distinctly abnormal and more than

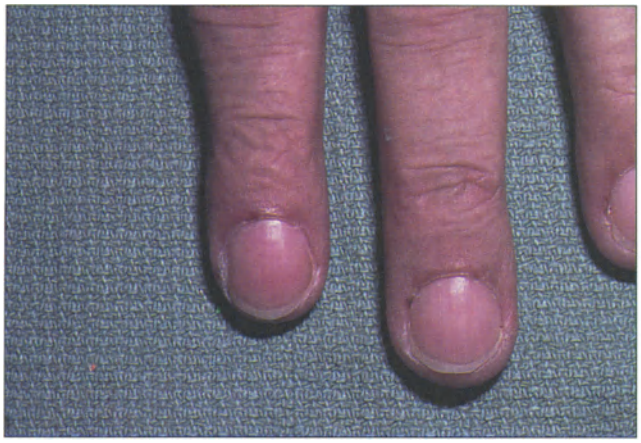

Figure 3.72 *Localized areas of nailbed vasculitis in RA*

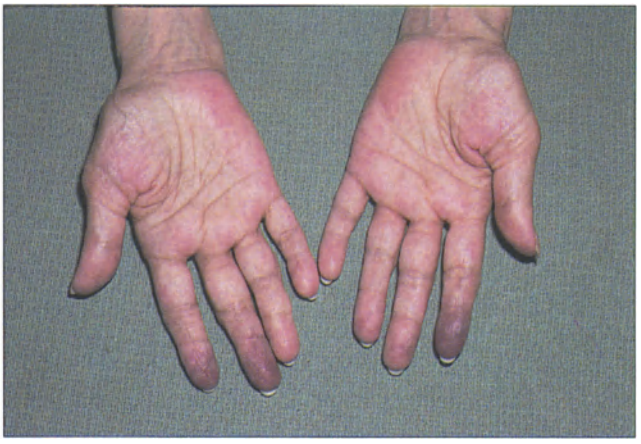

Figure 3.75 *Digital ischaemia in rheumatoid vasculitis*

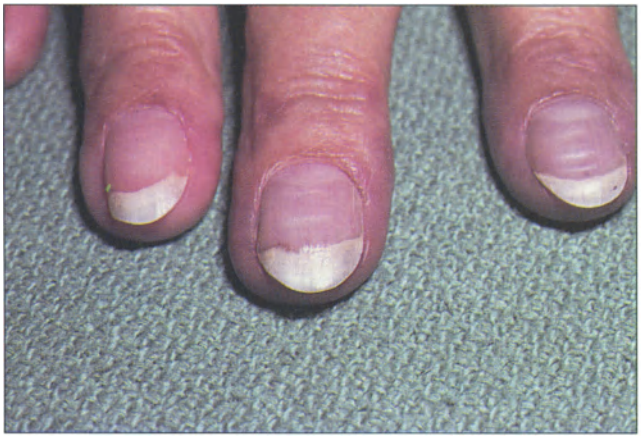

Figure 3.73 *Splinter haemorrhages and cyanosis of second and third nails due to rheumatoid vasculitis*

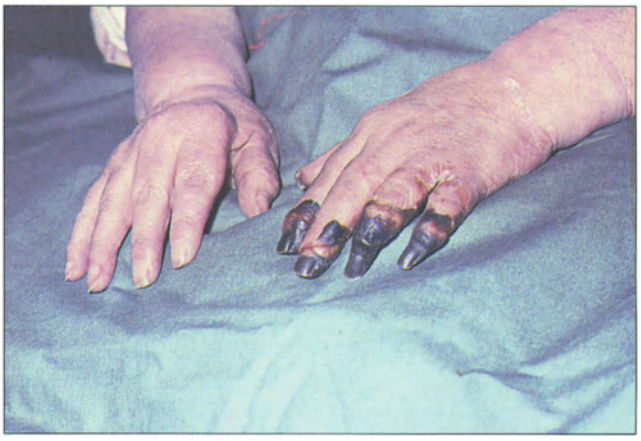

Figure 3.76 *Digital gangrene in advanced rheumatoid vasculitis. (Courtesy of Update Publications)*

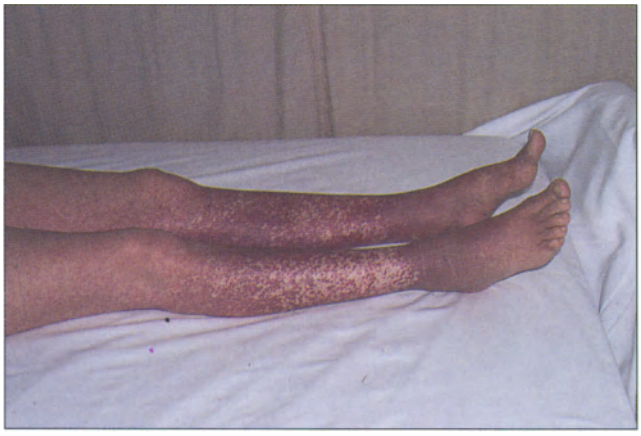

Figure 3.74 *Palpable purpura due to rheumatoid vasculitis. Note predilection for dependent areas*

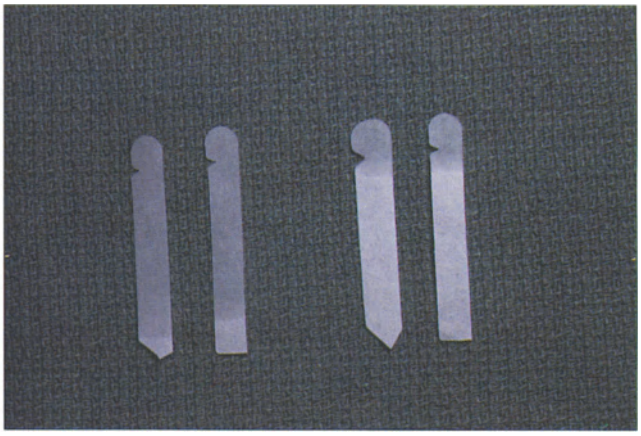

Figure 3.77 *Schirmer's tear test – normal wetting of papers on left. Minimal wetting of papers on right due to xerophthalmia in patient with sicca syndrome*

15 mm is regarded as normal (Figure 3.77). In selected cases the diagnosis of keratoconjunctivitis sicca may be substantiated by slit-lamp examination using fluorescein or rose bengal staining. The characteristic corneal lesions visualized are those of punctate keratopathy (common) and filamentary keratitis (infrequent). In some patients with xerostomia, examination of a minor salivary gland (obtained by labial biopsy) may be required to confirm the diagnosis of Sjögren's syndome, while in others parotid sialography or technetium scintigraphy may provide additional information regarding the structure and function of the parotid glands.

Episcleritis is a rare (0.17%), benign, self-limiting disorder characterized by mild pain, normal vision and erythema which is discernible usually in the nasal and temporal areas of the interpalpebral fissure (Figure 3.78). Scleritis while also being rare (0.67%) is more serious, in that it may lead to severe visual impairment or complete blindness. Pain is often intense, gradual in onset and associated with a purplish discoloration of the sclera which has a slight predilection for the upper quadrants of the eye (Figure 3.79). The sclera may become translucent, thinned or undergo necrosis, and allow the blue colour of the underlying choroid to show through (Figure 3.80). In severe cases, necrotizing scleritis may result in complete, albeit localized, loss of scleral tissue, a condition termed scleromalacia perforans (Figure 3.81). Scleritis usually occurs in female patients with seropositive nodular rheumatoid arthritis who frequently have evidence of more widespread systemic disease.

Brown's syndrome is a rare condition in which stenosing tenovaginitis of the superior oblique tendon results in vertical diplopia, associated with an ocular clicking sensation and an apparent inferior oblique palsy.

Antimalarial agents are used as disease-modifying drugs in the treatment of patients who fail to adequately respond to non-steroidal anti-inflammatory agents. Prolonged continuous administration of chloroquine in high dosage may cause retinopathy, and on rare occasion results in loss of vision. The characteristic retinal lesion is referred to as the bull's eye macula (Figure 3.82). The risk of retinopathy appears minimal with the use of 200 mg per day doses of the related compound

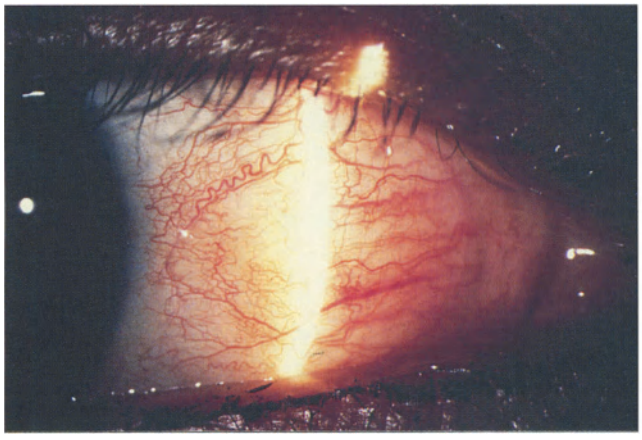

Figure 3.78 *Episcleritis. (Courtesy of Dr A. C. Tokarewicz)*

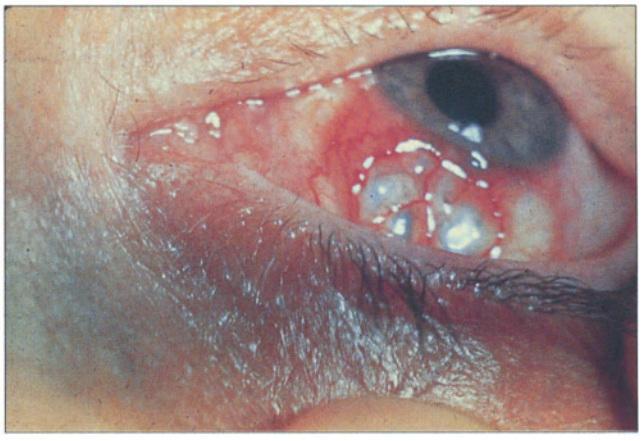

Figure 3.80 *Necrotizing scleritis. (Courtesy of Dr A. C. Tokarewicz)*

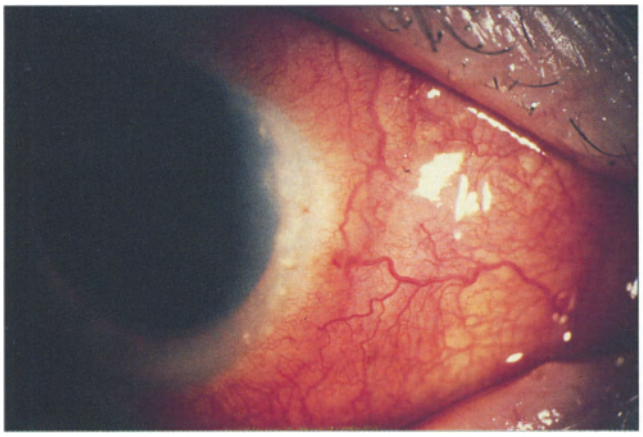

Figure 3.79 *Nodular scleritis. (Courtesy of Dr A. C. Tokarewicz)*

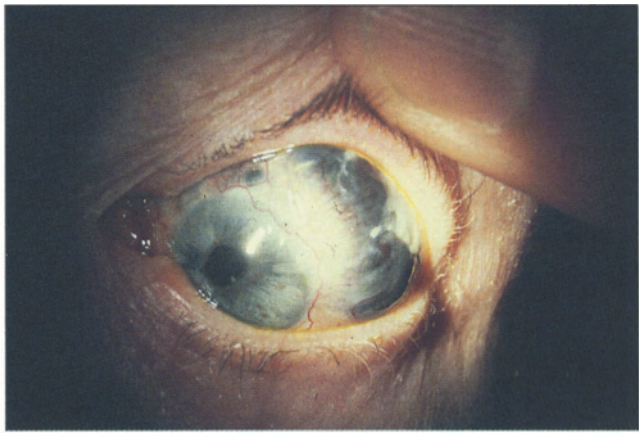

Figure 3.81 *Scleromalacia perforans. (Courtesy of Dr A. C. Tokarewicz)*

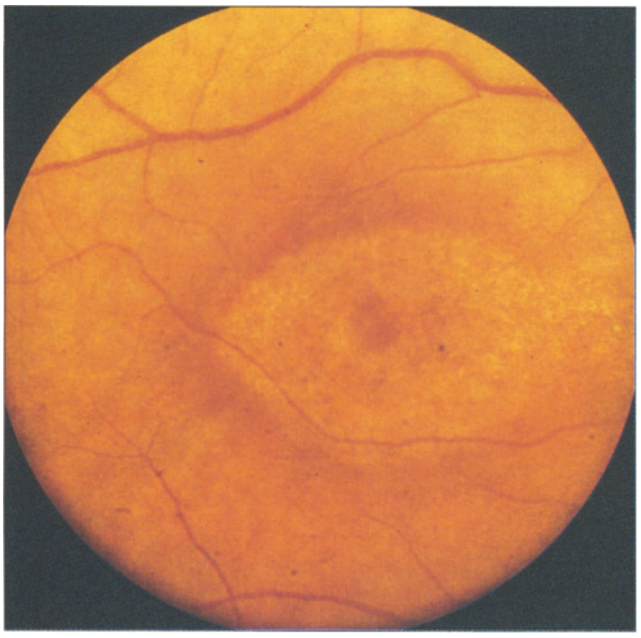

Figure 3.82 *Bull's eye macula due to chloroquine therapy. (Courtesy of Dr J. Gonder)*

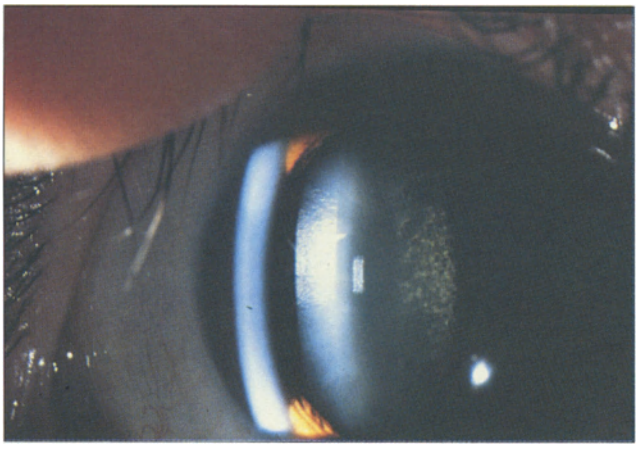

Figure 3.83 *Posterior subcapsular cataract due to corticosteroid therapy. (Courtesy of Dr C. Dyson)*

hydroxychloroquine, although it is not completely free of this potentially serious toxicity. An ophthalmologist should, therefore, check the eyes of every patient prior to the initiation of treatment, every 6 months thereafter and at any time in the interim if ocular symptoms should occur. Prolonged administration of systemic corticosteroid drugs may result in the formation of cataracts which are characteristically posterior and subcapsular in location (Figure 3.83).

Respiratory system

Rheumatoid disease may result in three pulmonary lesions: (1) pleural disease, (2) pulmonary nodules and (3) interstitial fibrosis. Pleural disease is usually asymptomatic and may take the form of a pleural effusion or pleural thickening. Pleural effusions are more common in males, the fluid being a typical serous exudate with a high protein and low glucose content (Figure 3.84). The cell count is usually in the order of 1000–3500 cells/mm^3, and the majority are mononuclear cells. Rheumatoid factor may on occasion be detected in the fluid.

Rheumatoid nodules may occur as single or multiple lesions in the lung parenchyma. They are usually asymptomatic, show spontaneous size variation and may cavitate (Figure 3.85). Rheumatoid nodules are more common in male patients, and their presence should prompt a thorough investigation to exclude other aetiologies (e.g. malignancy). This is especially important if the nodule is solitary and not associated with subcutaneous nodules. Caplan's syndrome is a rare and unusual entity in which rheumatoid arthritis, pneumoconiosis and pulmonary nodules coexist (Figure 3.86). It is rarely encountered other than in mining communities.

Interstitial fibrosis is relatively uncommon and has a predilection for males with longstanding disease. It may be asymptomatic or result in exertional dyspnoea, a dry cough and in some patients produces finger clubbing. Fibrosis initially affects the lung bases but may extend in time and become more generalized. In early disease the fibrotic pattern is fine and either reticular or reticulonodular in appearance, while in later disease, dense fibrosis, honeycombing and cyst formation may develop (Figure 3.87).

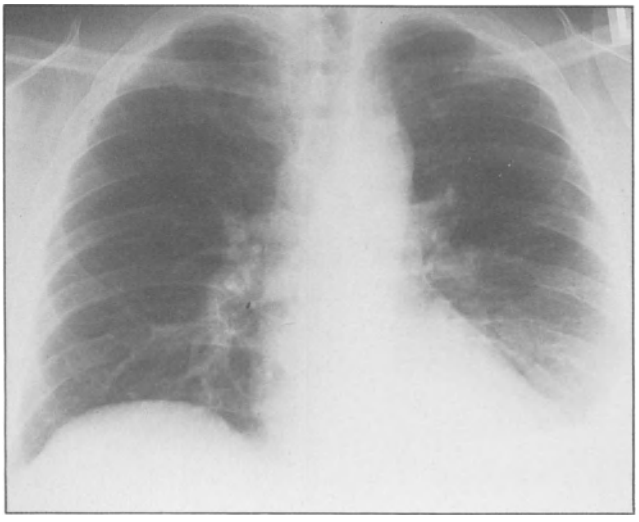

Figure 3.84 *Pleural effusion in male with seropositive RA*

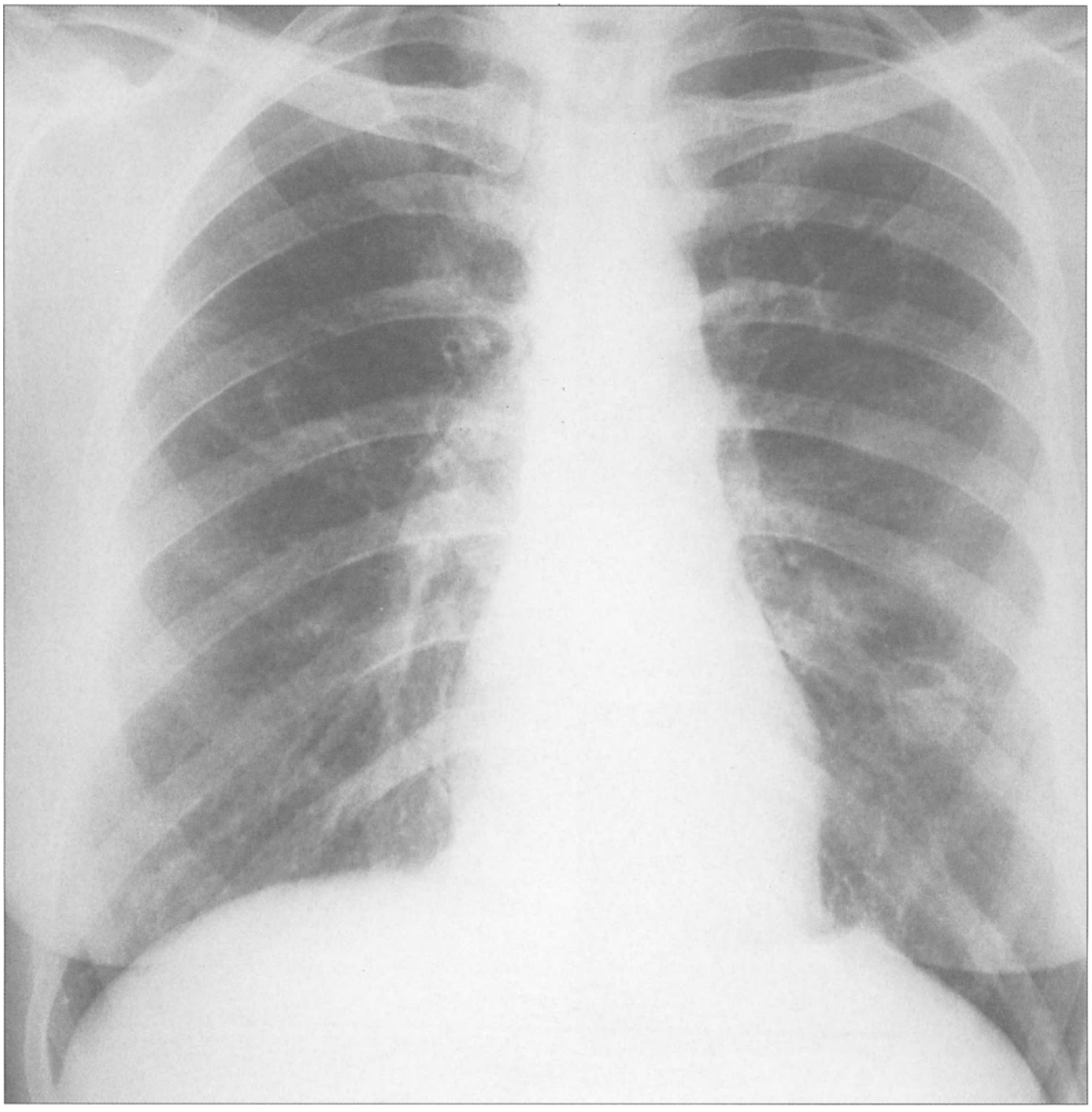

Figure 3.85 *Cavitating rheumatoid nodules. (Courtesy of* Am. J. Roentgenol. *and Dr W. K. C. Morgan)*

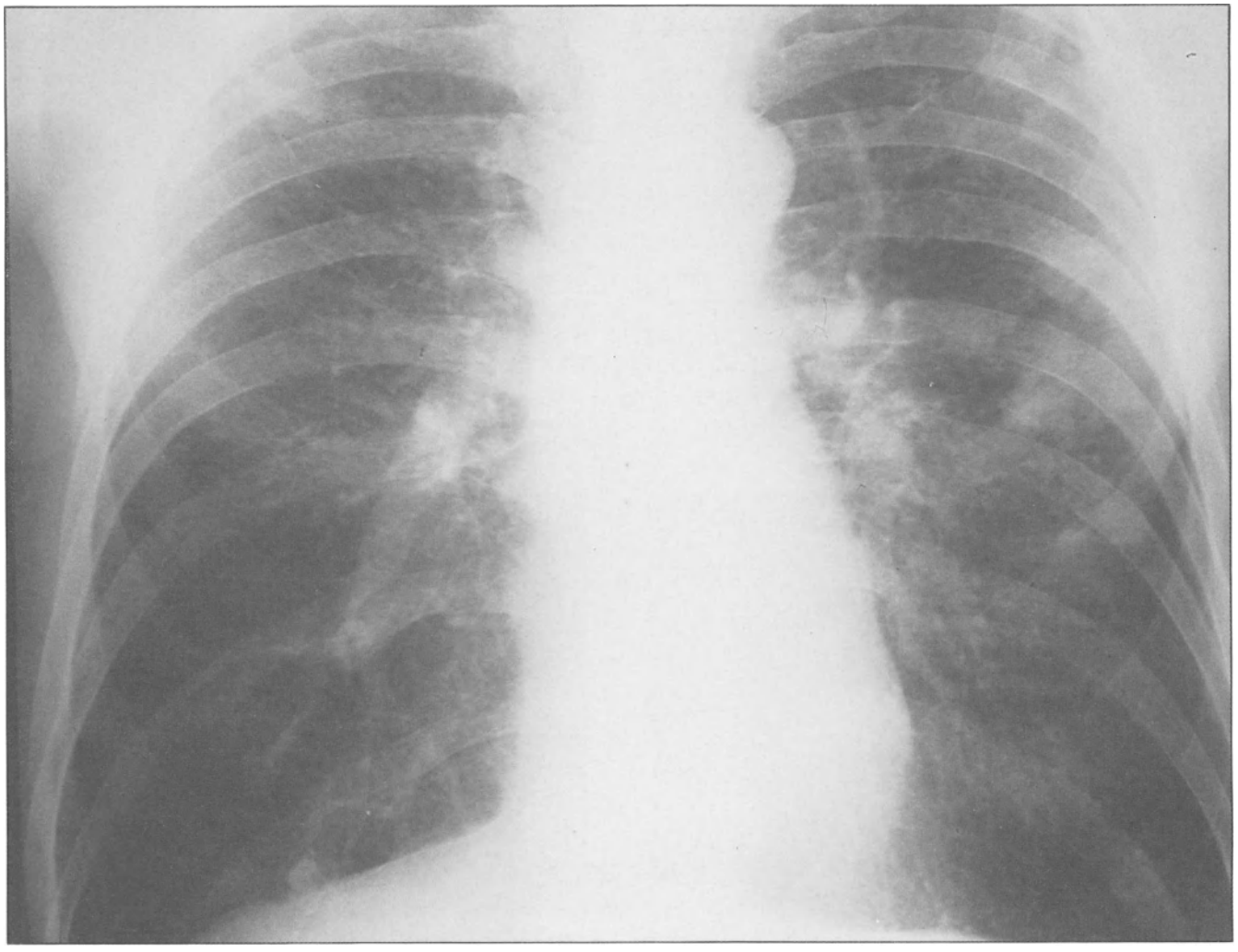

Figure 3.86 *Caplan's syndrome – rheumatoid pulmonary nodules in a patient with asbestosis. (Courtesy of* Thorax *and Dr W. K. C. Morgan).*

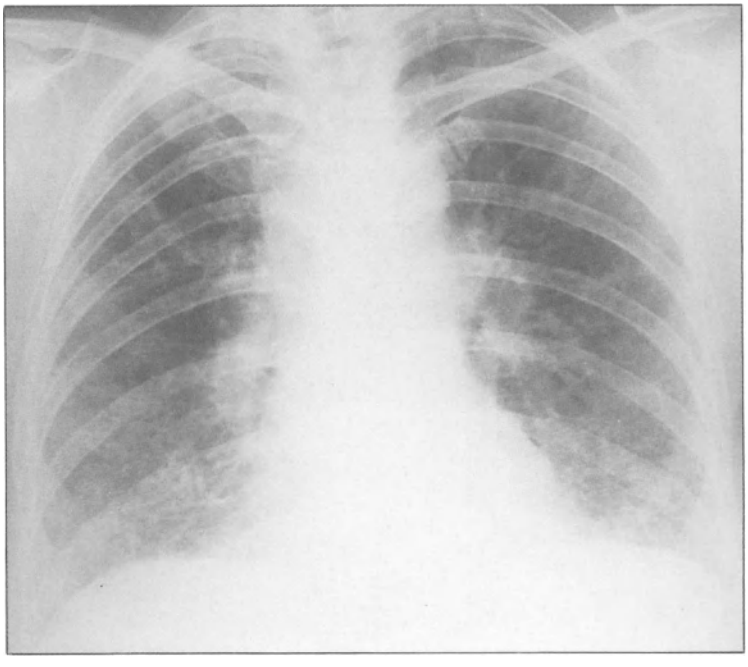

Figure 3.87 *Advanced interstitial pulmonary fibrosis. (Courtesy of Dr W. K. C. Morgan)*

The nervous system

Cervical spinal involvement may result in either radicular or spinal symptoms and has been described earlier in this chapter. The most common peripheral nerve abnormality is a mononeuropathy of the median nerve due to carpal tunnel compression. Sensory symptoms precede motor deficits, the patient usually experiencing numbness and tingling, particularly at night or when the wrist is held in a flexed position, e.g. when knitting, reading or driving. Hypoalgesia in a median nerve distribution, positive Tinel's and Phalen's signs and an abnormal nerve conduction study substantiate a diagnosis of carpal tunnel syndrome. Weakness and wasting of thenar muscles may develop (Figure 3.88) unless the median nerve is adequately decompressed.

Infrequently, a distal sensory neuropathy (in a stocking distribution) may develop in the lower extremity (Figure 3.89). It is usually symmetrical, may be associated with a similar abnormality in the hands and tends to occur in patients with longstanding seropositive disease. Both this type of neuropathy and the more serious mixed motor–sensory neuropathy (Figure 3.90) are thought to be due to vasculitic involvement of the vasa nervorum. Mononeuritis multiplex is a mixed motor–sensory neuropathy which involves two or more peripheral nerves. It often results in foot drop or wrist drop and has a poor prognosis.

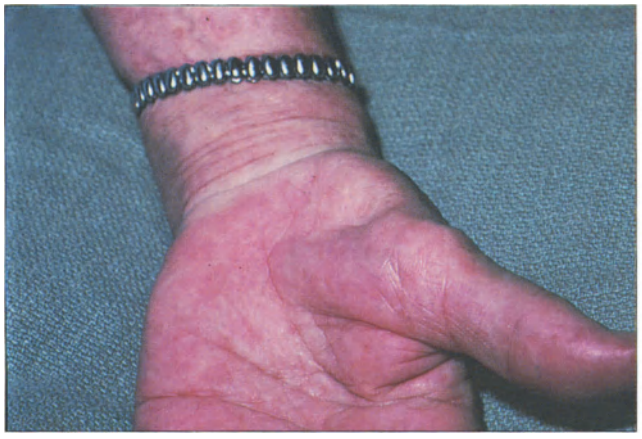

Figure 3.88 *Marked thenar wasting due to median nerve compression in the carpal tunnel*

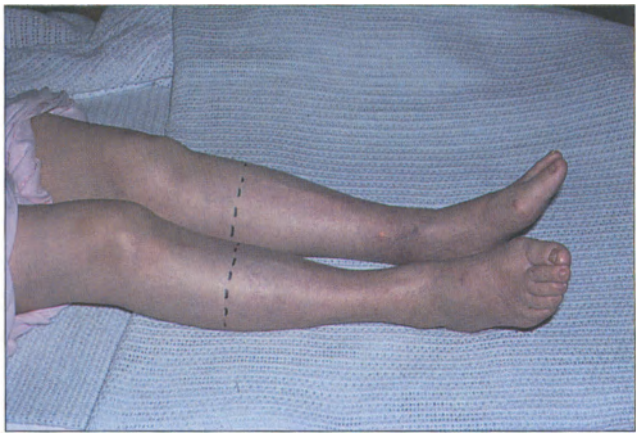

Figure 3.89 *Pure peripheral sensory neuropathy*

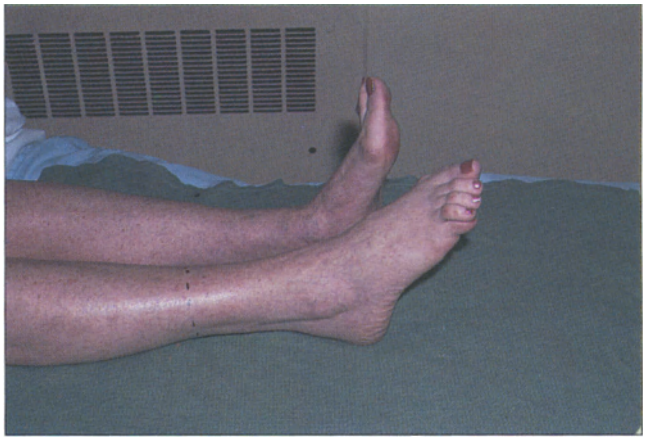

Figure 3.90 *Mixed motor–sensory neuropathy with hypoasthesia and foot drop*

Chapter 4

Juvenile Chronic Arthritis

Juvenile chronic arthritis (JCA) is a disease of unknown aetiology. As in the case of adult rheumatoid arthritis, infection, auto-immunity and heredity have been the principal aetiologic factors examined. The incidence is estimated at 0.01% of children at risk per year and the prevalence at 0.2–1 case per 100 000 children. Active controversy surrounds the correct terminology for the disease. Still's disease applies to only one variant of the disorder and is, therefore, considered inappropriate as a collective term. Juvenile chronic polyarthritis is equally inappropriate since it neglects those patients with oligoarticular disease. The term juvenile rheumatoid arthritis has been used for several years, however the disease differs from its adult counterpart in such a variety of ways, that it is best avoided in favour of the term juvenile chronic arthritis (JCA). In particular nodule formation and seropositivity for IgM rheumatoid factor are unusual in JCA, and at initial presentation large joints tend to be involved more prominently than small joints (*cf* rheumatoid arthritis). Furthermore, iritis and pericarditis are relatively common in JCA, compared to rheumatoid arthritis.

JCA frequently presents between the ages of 6 months and 16 years, the peak onset being between 1–3 years. Three types of onset (recognizable during the first 6 months of illness) are currently used as the basis to categorize three subgroups of JCA: systemic (10–20%), polyarticular (50%), and oligoarticular (30–40%).

Systemic onset

Boys and girls are equally affected by this subgroup of JCA to which the term Still's disease is applied. Arthritis may precede, follow (10–20%) or occur concurrently with the onset of systemic features which include fever, rash, leukocytosis, hepatosplenomegaly, lymphadenopathy and serositis (pleurisy, pericarditis). A high, spiking, intermittent fever of 39 °C or more is usual, this quotidian pattern being characteristic of the disease (Figure 4.1). Fever tends to occur in the late afternoon or evening, and may be associated with chills but rarely with rigors. Fever is often accompanied by the appearance of discrete salmon-coloured macules which are most commonly distributed on the trunk and proximal extremities (Figure 4.2). Lesions are discrete, non-pruritic, evanescent and migratory. While this rash may also be seen in the polyarticular variant of the disease, it is rare in the oligoarticular subgroup. Hepatosplenomegaly may be striking, but abnormalities in liver function occur infrequently, except in a few patients who develop a biochemical intolerance to the salicylate compounds used in treatment of the disease. Lymphadenopathy is relatively common and has a predilection for the cervical, axillary and epitrochlear areas.

In the systemic subgroup, IgM rheumatoid factor is absent from the serum, and the anti-nuclear antibody (ANA) is positive in only 10% of patients. While extra-articular features predominate in this subgroup, chronic uveitis is rare. The arthritis usually involves variable

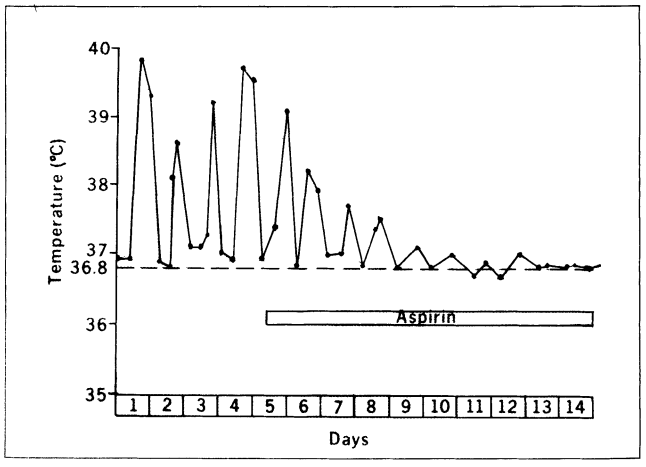

Figure 4.1 *Typical high swinging fever of Still's disease. (Note response to aspirin introduced on day 5)*

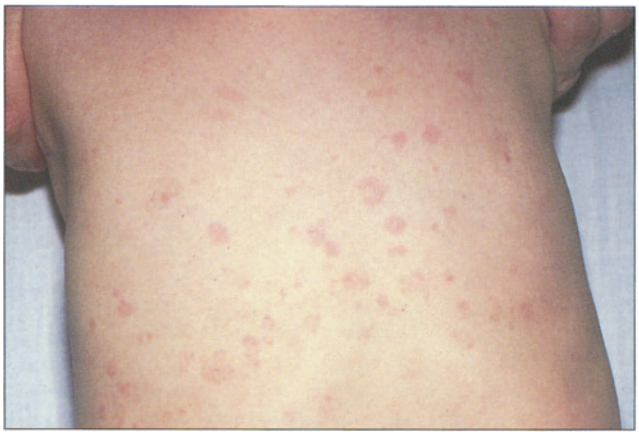

Figure 4.2 *Salmon-coloured macular rash. Frequently involves the trunk and proximal extremities. (Courtesy of Dr J. E. Boone)*

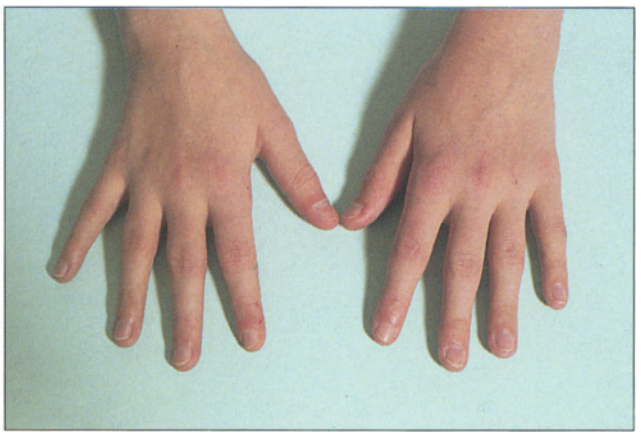

Figure 4.4 *Symmetrical polyarthritis involving PIP, MCP joints and left wrist. (Courtesy of Dr J. E. Boone)*

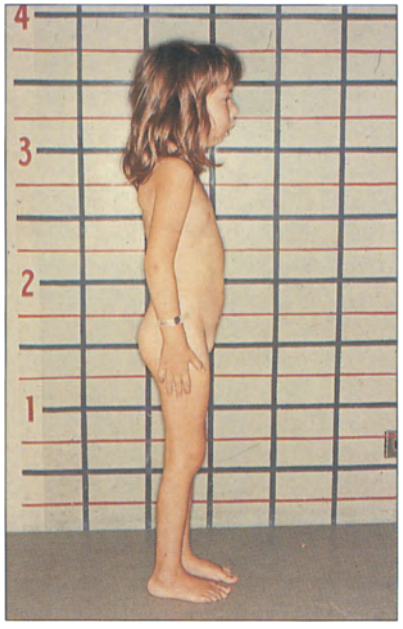

Figure 4.3 *Systemic-onset JCA. Note micrognathia and mild flexion deformities of elbow and knee. (Coutesy of* Pediatr. Clin. N. Am. *and Dr J. E. Boone)*

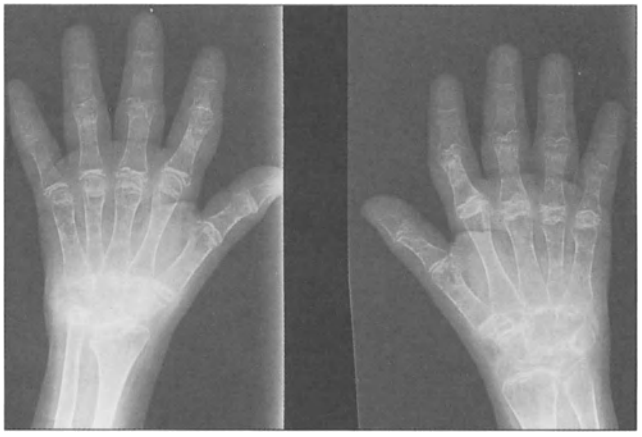

Figure 4.5 *Soft tissue swelling, osteopaenia and severe joint destruction with loss of cartilage space. (Courtesy of* Pediatr. Clin. N. Am. *and Dr J. E. Boone)*

numbers of large and small joints in the upper and lower extremity, and in up to 50% of children is both chronic and destructive (Figure 4.3). The cervical spine is also a target area for JCA. In recent years a similar systemic illness, characterized by fever, rash and arthritis, has been recognized in adults and has been termed Adult-Onset Still's disease.

Polyarticular onset

The polyarticular variant is more frequent in girls than boys (2:1). It tends to involve the knees, ankles, wrists, elbows and small joints of the hands and feet (Figure 4.4). Joint involvement is often symmetrical and additive, and displays a relapsing and remitting profile. Children differ from adults in the way they communicate and rather than complain of pain, they may be generally irritable, refuse to walk or guard affected joints. Articular involvement in the hand is similar to that in adults with rheumatoid arthritis, but in contrast, DIP joint involvement and radial drift at the MCP joints may also occur. In early disease there may be radiographic evidence of soft tissue swelling and juxta-articular osteoporosis. Marginal erosions and joint space narrowing do not appear in general prior to at least 2 years of active disease (Figure 4.5). Periosteal new bone formation may result in widening of the phalanges, while epiphyseal enlargement may produce bony overgrowth at the interphalangeal joints. Epiphyseal development may be accelerated causing bone lengthening, or alternately premature epiphyseal closure may result in bone shortening (Figure 4.6). Involvement of the cervical spine eventually occurs in 50% of children and results in pain and restricted spinal mobility. Radiographs may show evidence of atlantoaxial subluxation, disc space narrowing and ankylosis of the

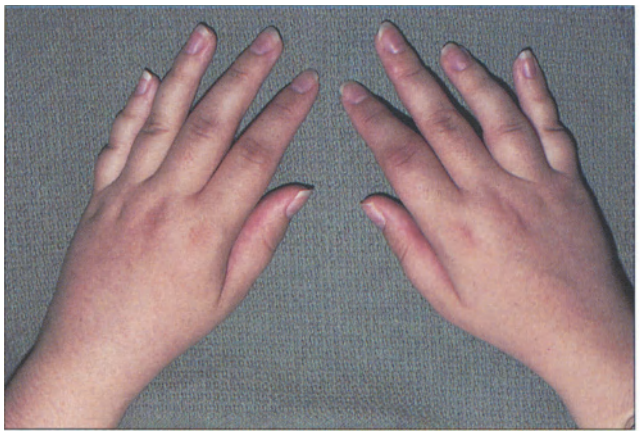

Figure 4.6 *Brachydactyly of right fourth digit due to premature epiphyseal closure*

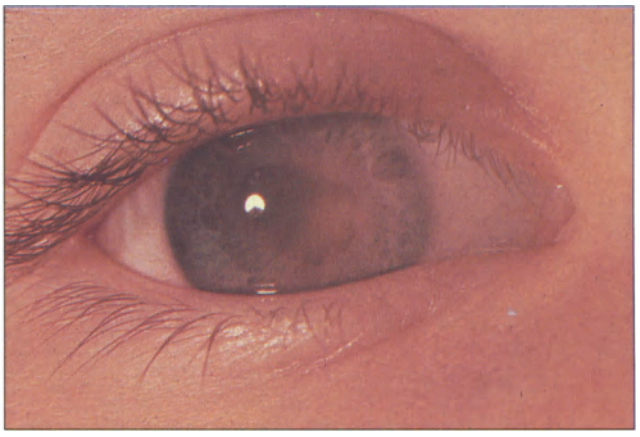

Figure 4.8 *Iritis – note irregular pupil due to formation of posterior synechiae. (Courtesy of Dr A. C. Tokarewicz)*

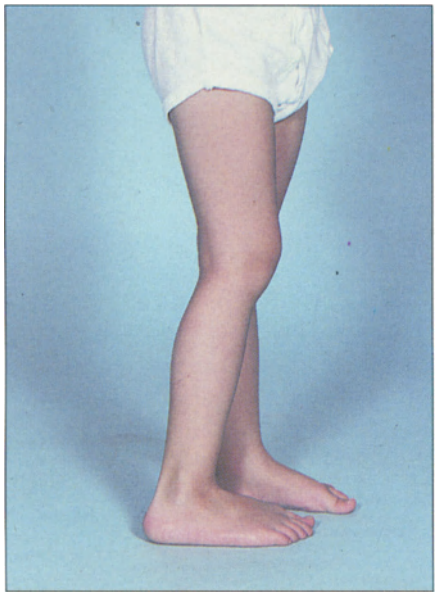

Figure 4.7 *Oligoarticular disease in right knee showing flexion deformity. (Courtesy of Dr J. E. Boone)*

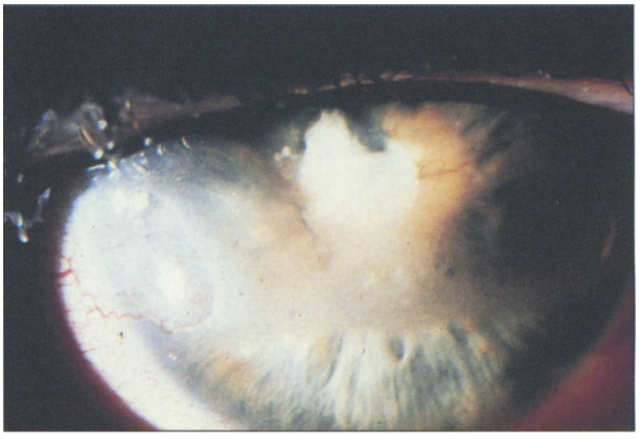

Figure 4.9 *Band keratopathy – note opaque band extending across the cornea. (Courtesy of Dr A. C. Tokarewicz)*

apophyseal joints. Temporomandibular joint involvement is relatively common in JCA but cricoarytenoid arthritis occurs infrequently. Systemic manifestations are less prominent in this variant than in systemic onset JCA. Ten percent of children are IgM rheumatoid factor positive, and 40% have antinuclear antibodies in their serum. Children with seropositive polyarticular disease resemble adults with rheumatoid arthritis, in that their disease tends to be both progressive, and erosive, and necessitate the use of disease modifying drugs, e.g. intramuscular gold.

Oligoarticular onset

The oligoarticular variant is more frequent in girls than boys (2:1) and tends to involve the knees, ankles and wrists. Monoarthritis is the presenting configuration in 50% of children, the knee being most usually affected (Figure 4.7). Other joint areas, including the small joints of the hands and the cervical spine may occasionally be affected. The hips are usually but not invariably spared. IgM rheumatoid factor is almost always absent, although 75% of girls with uveitis have antinuclear antibodies in their serum. Apart from uveitis, which occurs in 20% of cases, extra-articular involvement is infrequent in this variant. Uveitis characteristically involves the anterior uveal tract (iridocyclitis), becomes bilateral in two-thirds of children and tends to occur in young, ANA-positive girls who experience early-onset oligoarthritis. In contrast, only 5% of children with polyarthritis are affected by uveitis, and it is rare in the systemic variant. Since uveitis is frequently insidious in onset, and asymptomatic, it is essential to perform an ophthalmological examination in every newly diagnosed child with JCA, and to repeat this examination at frequent intervals, particularly in ANA-positive girls. Keratic precipitates, and an increased number of cells in the anterior chamber are features of early ocular disease. However, posterior synechiae may develop with time and produce an irregular and poorly reactive pupil (Figure 4.8). Band keratopathy (Figure 4.9), cataract

Figure 4.10 *Micrognathia – due to underdevelopment of the mandible. (Courtesy of Dr J. E. Boone)*

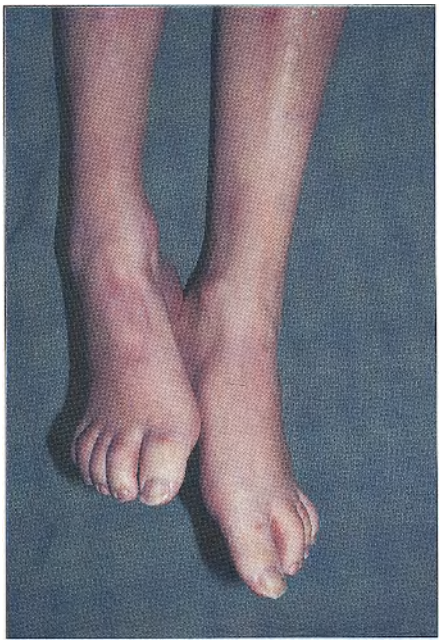

Figure 4.11 *True leg length discrepancy in adult with JCA of 21 years duration*

formation and secondary glaucoma are additional ocular complications of JCA. Cataract formation may be related to the disease itself or alternately to corticosteroid drugs used in its treatment. Unless the ocular complications of JCA are recognized early and treated effectively, blindness may ultimately supervene.

Extra-articular manifestations

As noted previously, extra-articular features are prominent in the systemic variant of the disorder, moderately common in the polyarticular variant and uncommon (with the exception of uveitis) in the oligoarticular variant. Disturbances in growth are characteristic of persistent disease and may compromise the attainment of full stature. Such growth disturbances are often more selective and result in a failure of normal development of the jaw (Figure 4.10), metacarpals, metatarsals or digits (Figure 4.6). Furthermore, a leg length discrepancy may develop due to enhanced growth adjacent to an affected knee (Figure 4.11). Other extra-articular features include pericarditis, myocarditis, interstitial pulmonary fibrosis, glomerular disease and symptoms referrable to the central nervous system. Tenosynovitis, particularly over the dorsum of the wrist and around the ankles may occur, and flexor tendon sheath involvement in the hand may result in stenosing tenosynovitis and a claw hand deformity. Rheumatoid nodules are unusual (5–10%) and tend to occur in IgM rheumatoid factor positive children with polyarticular disease. Vasculitis is exceedingly rare in juvenile chronic arthritis. Although amyloidosis is rare in North American children with JCA, it occurs in up to 8% of British children, particularly those with severe disease of long duration.

Chapter 5

Degenerative Joint Disease

Degenerative joint disease may affect the synovial joints of the peripheral and axial skeleton (osteoarthritis) as well as the fibrocartilaginous intervertebral discs, particularly in the cervical and lumbar areas of the spine (spondylosis). While osteoarthritis and spondylosis frequently coexist and share similar aetiologies, it is customary to consider them as separate clinical entities, and reserve the term osteoarthritis for a degenerative condition affecting synovial joints.

Osteoarthritis

Osteoarthritis is the commonest chronic joint disorder, the prevalence of which increases with advancing age. While the vast majority of cases are idiopathic and arise without a discernible aetiology, the remainder are secondary to a number of factors, particularly trauma, inflammatory joint disease and calcium pyrophosphate deposition disease (Table 5.1). Calcium hydroxyapatite

Table 5.1 ***Aetiologic classification of osteoarthritis***

Primary	Idiopathic osteoarthritis (localized or generalized) Erosive osteoarthritis
Secondary	
Congenital/development defects	Metaphyseal and epiphyseal dysplasias Hip dysplasia Spondyloepiphyseal dysplasia Slipped femoral capital epiphysis Mucopolysaccharidoses
Trauma	Acute – intra-articular fracture Chronic – occupational (footballers, dancers, foundry workers) – chronic disease – Ehler-Danlos syndrome – Marfan's syndrome – Charcot's arthropathy
Endocrine/metabolic	Acromegaly Calcium pyrophosphate deposition disease Haemochromatosis Paget's disease Ochronosis Haemoglobinopathies Diabetes mellitus Sex hormone abnormalities Hypothyroidism
Post-inflammatory and haemorrhagic	Chronic polyarthritis – rheumatoid arthritis – psoriatic arthritis – Reiter's syndrome Septic arthritis (bacterial, tuberculous and fungal) Recurrent gout or pseudogout Chronic inflammatory bowel disease-related arthropathy Haemophilia
Osteonecrosis	Idiopathic Trauma Iatrogenic hypercortisonism Haemoglobinopathies

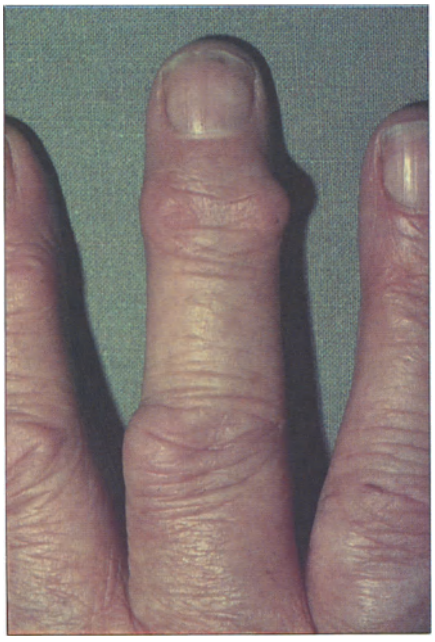

Figure 5.1 *Heberden (DIP) and Bouchard (PIP) node formation*

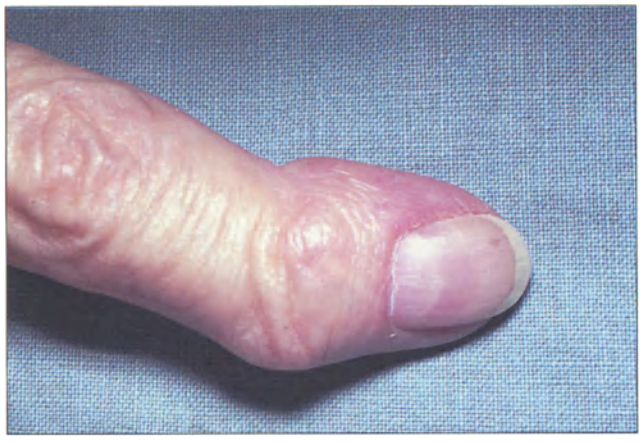

Figure 5.2 *Lateral deviation of distal phalanx associated with Heberden node formation*

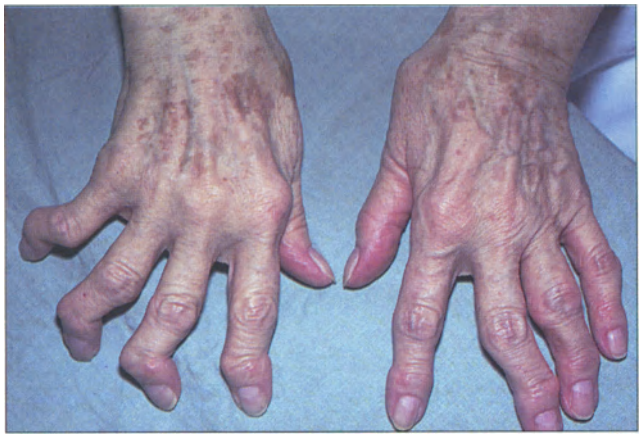

Figure 5.3 *Heberden and Bouchard node formation with associated snake-like deformity of the fingers*

crystals have been identified in the cartilage of several patients with idiopathic osteoarthritis, suggesting the possibility of an underlying biochemical abnormality, in some patients previously considered to have an essentially 'wear and tear' type of arthritis.

With the exception of the rare variant known as erosive osteoarthritis, the disease lacks several of the classical signs of inflammation. Pain, swelling and disability are the dominant clinical features of osteoarthritis, warmth being infrequent and erythema excessively rare. There are no constitutional symptoms or extra-articular features associated with this disease, and the sedimentation rate is characteristically normal. Serologic tests for IgM rheumatoid factor are usually negative, although low titre positive tests are found with the same frequency as in the general population. Softening, fibrillation and flaking of the articular cartilage are early pathologic features of osteoarthritis, while loss of joint space, sclerosis of subchondral bone, osteophyte formation and bone cysts develop at a later stage in the disease and can be detected radiographically. Symptoms do not always correlate with radiographic abnormalities, some patients having surprisingly few symptoms in the presence of advanced disease while others experience pain and disability which exceed the severity of the radiographic lesions.

Osteoarthritis has a predilection to affect the DIP, PIP and first CMC joints, the apophyseal joints of the cervical and lumbar spine, the hips, knees and first MTP joints (Figure 1.3).

The hand

Heberden's nodes are a characteristic feature of osteoarthritis, and appear as pea-like swellings over the dorsum of the distal interphalangeal joints (Figure 5.1). Initially gelatinous, cystic and lying either side of the extensor tendon, they later become hard, bony and may be associated with flexion and deviation (particularly ulnar deviation) of the distal phalanx (Figure 5.2). Similar changes may occur in the proximal interphalangeal joints and are termed Bouchard's nodes. Deformities associated with Heberden's and Bouchard's nodes often occur in combination and confer a snake-like or zig-zag configuration to the digit (Figure 5.3). In spite of severe degrees of deformity, hand function may be relatively well preserved and the patient capable of performing quite intricate manual tasks (Figure 5.4). Recognition of the disparity between appearance and function in this and other arthropathies should prompt the clinician to specifically inquire about function, and temper enthusiasm for surgical procedures in which the primary objective is of a cosmetic nature.

The first carpometacarpal joint is commonly involved, crepitus, bony swelling and a restricted range of movement in this location strongly suggesting a diagnosis of osteoarthritis. Swelling in particular imparts a

Figure 5.4 *Afghan produced by patient shown in Figure 5.3. Note disparity between appearance and function*

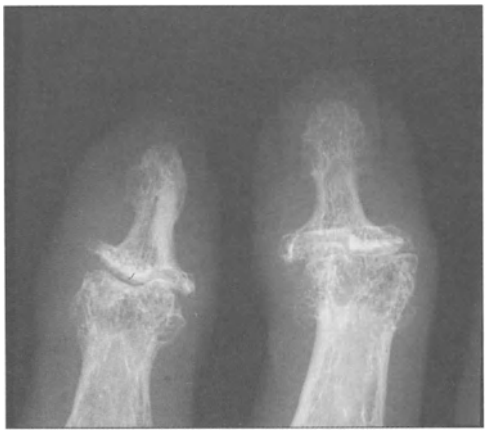

Figure 5.6 *Joint space narrowing, osteophyte formation and deformity in osteoarthritis*

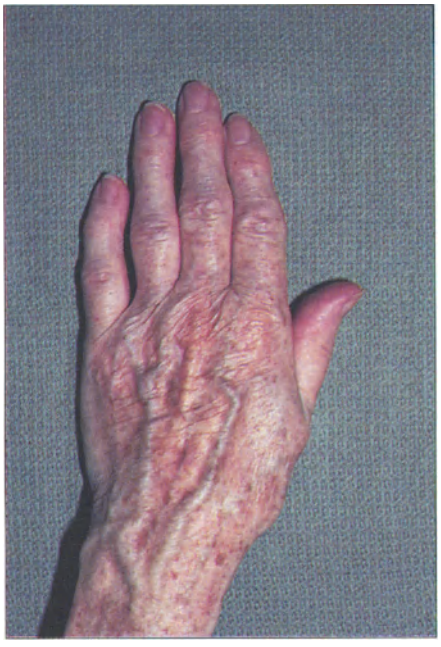

Figure 5.5 *CMC joint involvement results in the square hand of osteoarthritis*

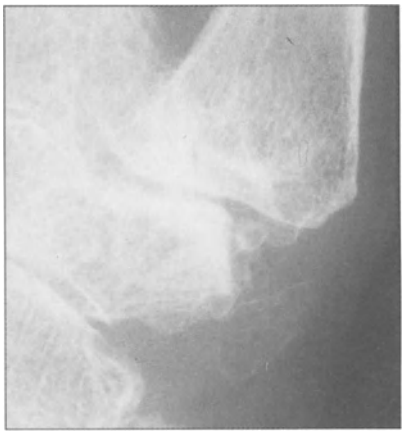

Figure 5.7 *Joint space narrowing, juxta-articular sclerosis and osteophyte formation in the first carpometacarpal joint*

square appearance to the hand and together with Heberden and Bouchard node formation contributes to the classical square hand of osteoarthritis (Figure 5.5). Radiographs of affected joints show the characteristic changes of osteoarthritis, i.e. periarticular sclerosis, joint space narrowing and osteophyte formation (Figures 5.6, 5.7).

Erosive osteoarthritis is a relatively infrequent condition, which tends to occur in post-menopausal females. It involves the interphalangeal joints, particularly the DIP joints, and is associated with clinical signs of inflammation (Figure 5.8) and radiographic evidence of erosion (Figure 5.9). It should be differentiated from psoriatic arthritis which may produce similar changes in the DIP joints.

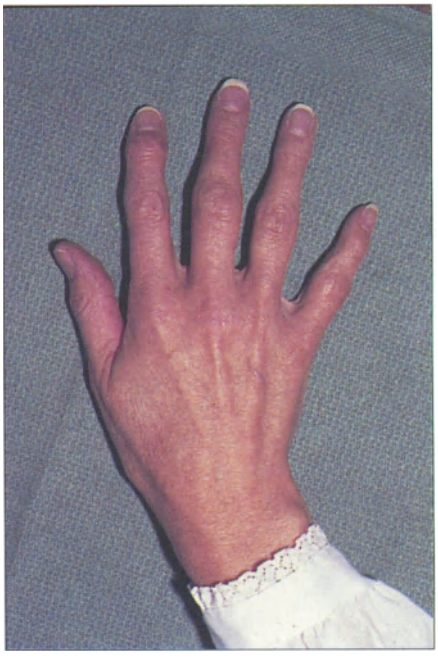

Figure 5.8 *Erosive osteoarthritis involving the DIP and PIP joints*

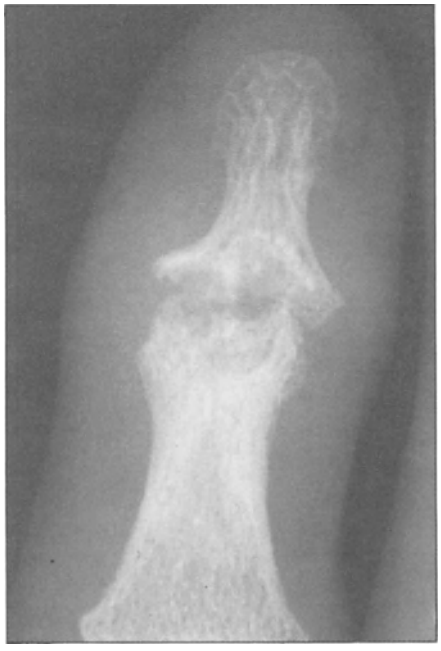

Figure 5.9 *Raidographic appearance of erosive osteoarthritis. Second DIP joint of patient shown in Figure 5.8. Note erosions compared with Figure 5.6*

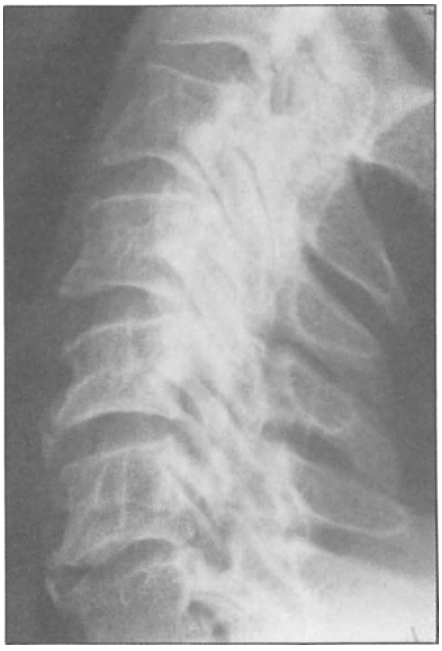

Figure 5.10 *Osteoarthritis in cervical apophyseal joints. Note joint space narrowing and sclerosis*

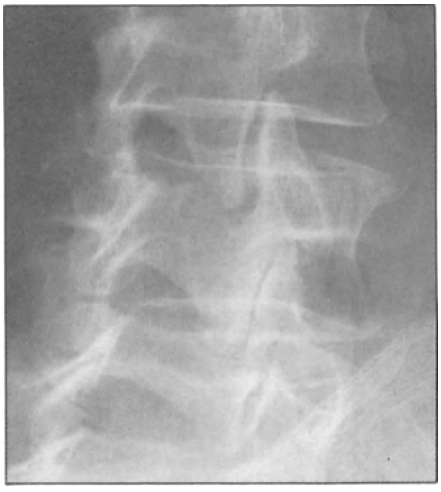

Figure 5.11 *Osteoarthritis in lumbar apophyseal joint. Note joint space narrowing and sclerosis*

Apophyseal joints

Osteoarthritis of the apophyseal joints frequently coexists with spondylosis in the same or adjacent levels of the cervical and lumbar spine. Localized pain in spinal and paraspinal areas is the principal symptom, although in patients with lumbar osteoarthritis it may radiate into the buttock or in a pseudosciatic distribution down the leg. The apophyseal joints are best visualized on lateral radiographs of the cervical spine (Figure 5.10) and oblique radiographs of the lumbar spine (Figure 5.11). The characteristic radiographic abnormalities are sclerosis and joint space narrowing.

Hip

Osteoarthritic involvement of the hip, particularly in the elderly, frequently results in significant pain and disability. Males are more commonly affected than females. Pain may be experienced in the groin, the inner aspect of the thigh, the greater trochanter or may radiate to the buttock, low back, or the inside of the knee. In some instances pain in the medial aspect of a normal knee may distract attention away from its true site of origin in the ipsilateral hip joint. A severely affected hip is frequently held externally rotated, flexed and adducted. A flexion contracture may insidiously develop and result in a compensatory lordosis of the lumbar spine. The earliest radiographic abnormalities are selective narrowing in the superolateral portion of the joint space (Figure 5.12) and osteophyte formation. Over a period of time there is a progressive joint space narrowing, bony sclerosis, subchondral cyst formation and the development of large osteophytes (Figure 5.13). Ultimately the femoral head deforms and protrusio acetabuli may develop.

Knee

The medial, lateral and patellofemoral compartments of the knee may all be affected by osteoarthritis. Pain and tenderness in early disease may be associated with

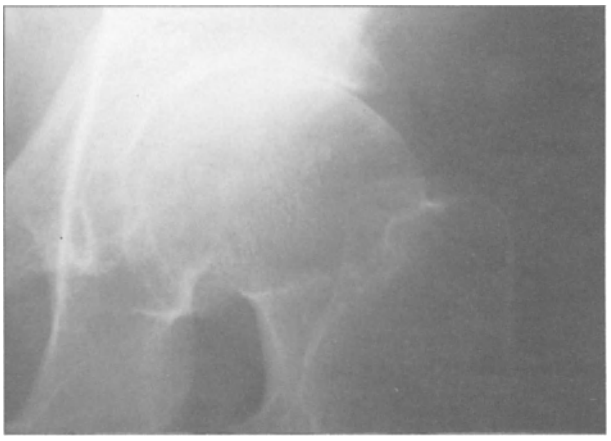

Figure 5.12 *Selective superolateral joint space narrowing and osteophyte formation in early osteoarthritis*

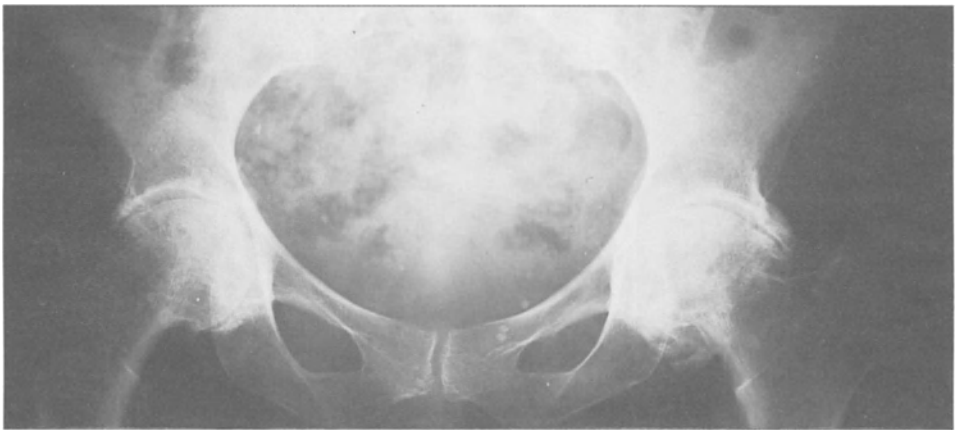

Figure 5.13 *Severe joint space narrowing and marked osteophyte formation in advanced osteoarthritis*

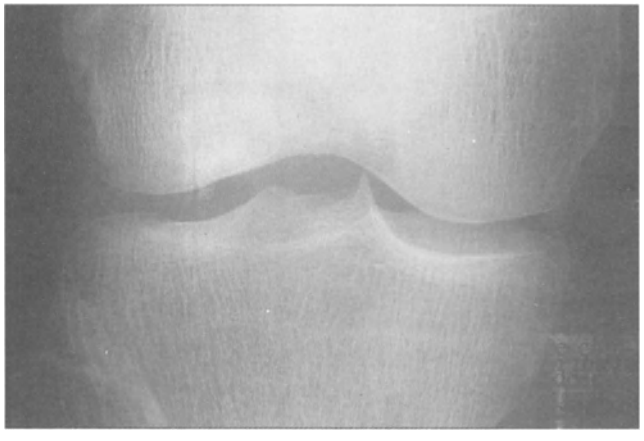

Figure 5.14 *Sharpening of tibial spines – an early sign of osteoarthritis*

radiographs which are entirely normal, or show evidence of soft tissue swelling or sharpening of the tibial spines (Figure 5.14). Arthrocentesis reveals a synovial fluid which is yellow, transparent, viscous and forms a firm mucin clot (Figure 5.15). The cell count is less than

Figure 5.15 *Typical appearance of synovial fluid from osteoarthritic joint*

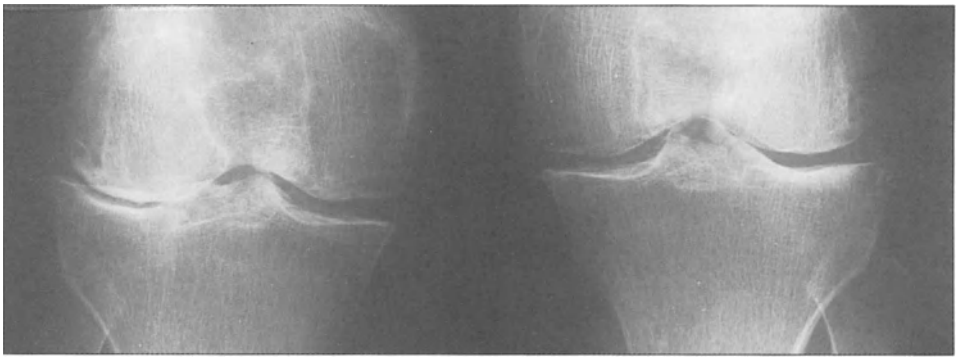

Figure 5.16 *Marked joint space narrowing in medial and lateral tibiofemoral compartments, osteophyte formation, sclerosis and sharp tibial spines in advanced osteoarthritis*

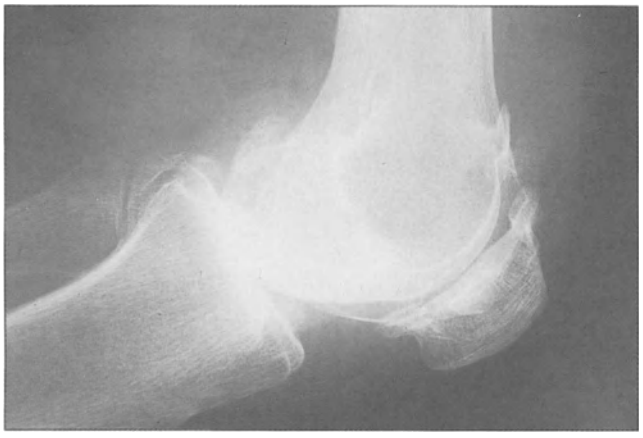

Figure 5.17 *Severe joint space narrowing and osteophyte formation in patellofemoral joint of patient with tri-compartment disease*

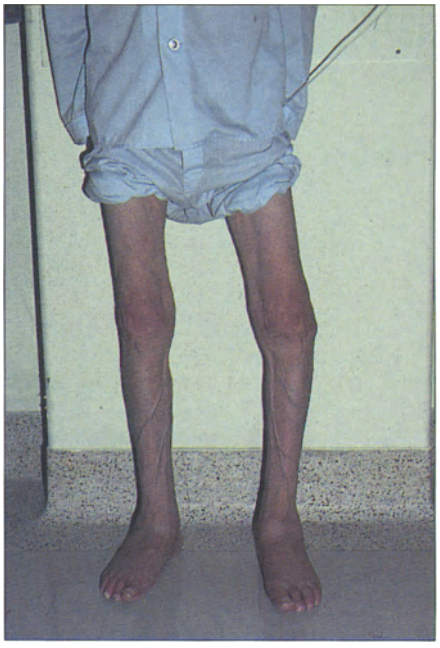

Figure 5.18 *Genu valgus (knock knee deformity)*

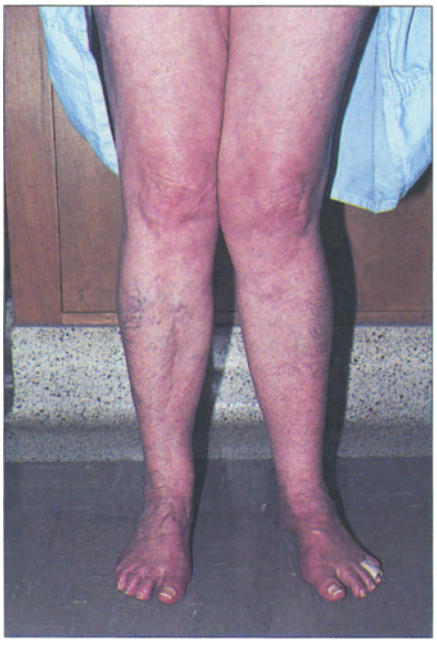

Figure 5.19 *Genu varus (bow leg deformity)*

2000 cells/mm^3 with fewer than 25% being polymorphonuclear leukocytes. Progression of disease in the tibiofemoral joint space results in joint space narrowing which is best appreciated on radiographs taken with the patient in the standing position, i.e. weight bearing (Figure 5.16). Joint space narrowing and exuberant osteophyte formation may also occur in the patellofemoral compartment and are best visualized on a lateral view of the knee (Figure 5.17). Disease in this compartment frequently results in retropatellar pain which is usually localized, but may radiate down the anterior portion of the lower leg. Pain is typically exacerbated by rising from the sitting to the standing position, by squatting and on negotiating stairs. Ligamentous instability, capsular distension and loss of cartilage ultimately result in the development of severe valgus (Figure 5.18) or varus (Figure 5.19) deformities.

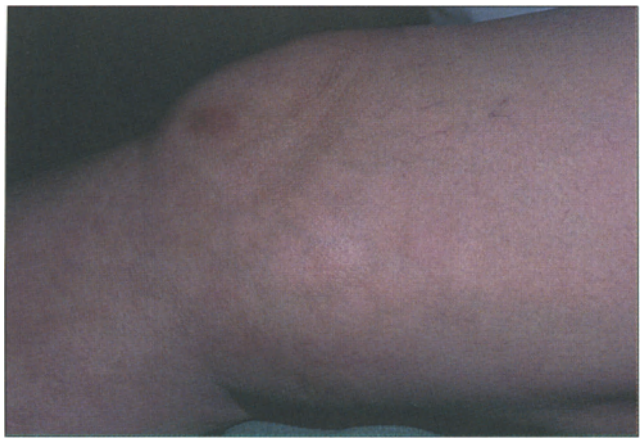

Figure 5.20 *Erythema abigne due to chronic application of heating pad*

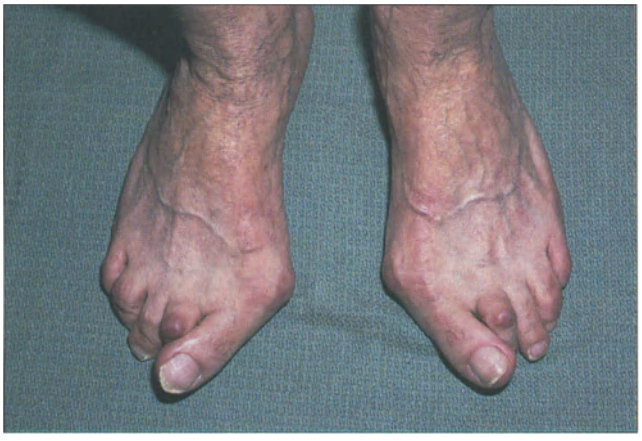

Figure 5.21 *Severe bilateral hallux valgus*

Many patients use repeated local applications of heat to help alleviate their pain, and as a consequence may develop the rash of erythema abigne (Figure 5.20). This characteristic lesion, known in Scotland as the 'Tinkers Tartan' owing to its tendency to occur in individuals who live out of doors and huddle close to open fires, bears some similarity to the rash of livedo reticularis. However, while it is reticular in nature, it is by contrast brown in colour and of no prognostic importance.

Metatarsophalangeal joints

Hallux valgus is a ubiquitous deformity, induced by wearing certain types of shoes (Figure 5.21). The habitual wearing of high heeled narrow fitting shoes is of particular aetiologic importance. A primary metatarsal varus usually precedes the development of valgus deviation of the great toe. Severe degenerative disease may result in immobility of the first MTP joint, a condition known as hallux rigidus.

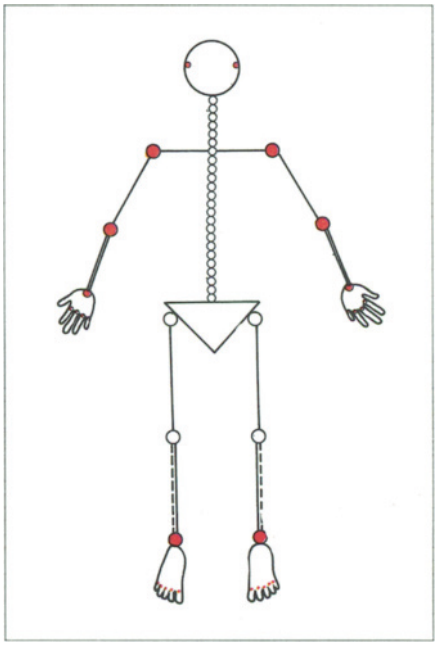

Figure 5.22 *Atypical osteoarthritis – distribution of target joints*

Atypical osteoarthritis (Figure 5.22)

While primary osteoarthritis may affect any joint in the peripheral skeleton, the occurence of degenerative disease in the MCP, wrist, elbow (Figure 5.23), shoulder (Figure 5.24) or ankle joint is regarded as atypical. In such cases a history of prior trauma, infection, inflammatory arthritis or another arthropathy, particularly calcium pyrophosphate deposition disease, should be sought. Workers in certain occupations are at increased risk of degenerative disease in specific atypical locations, e.g. bus drivers (shoulders), foundry workers (elbows), pneumatic tool operators (elbows, wrists, shoulders), professional football players and ballet dancers (talar joints).

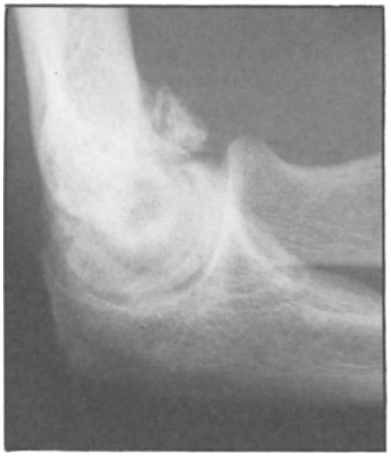

Figure 5.23 *Joint space narrowing, sclerosis and osteophyte formation in osteoarthritic elbow*

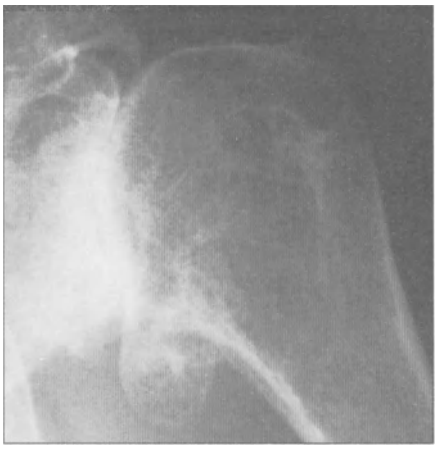

Figure 5.24 *Joint space loss, sclerosis and marked osteophyte formation in advanced OA of shoulder*

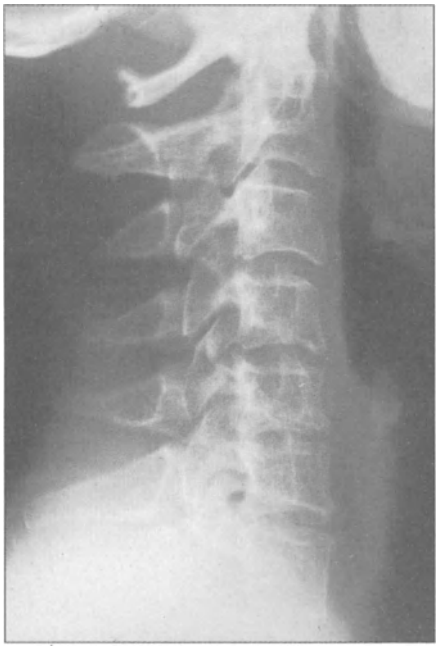

Figure 5.25 *Mild osteophyte formation in early cervical spondylosis. Note straightening of spine due to muscle spasm*

Spondylosis

Degenerative disease in the intervertebral discs may occur at any level, but is particularly frequent in the mid-cervical and lower lumbar spines (L4–5, L5–S1), and at the apices of kyphotic (T8) and lordotic (C5, L3–4) curves. Spondylosis may exist alone or in association with (1) osteoarthritis of the apophyseal joints, (2) osteophytosis of the neurocentral joints or (3) osteoarthritis in the peripheral skeleton. The prevalence of spondylosis increases with advancing age and although frequently asymptomatic, it can be radiographically detected in the majority of elderly subjects.

Early involvement of the cervical spine is characterized by mild joint space narrowing and osteophyte formation. During acute exacerbations of pain, muscle spasm may result in straightening of the cervical spine (Figure 5.25). As the disease progresses, disc space

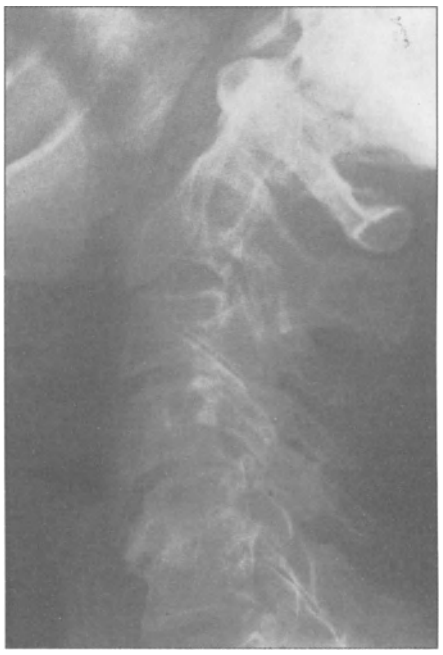

Figure 5.26 *Subluxation of cervical spine*

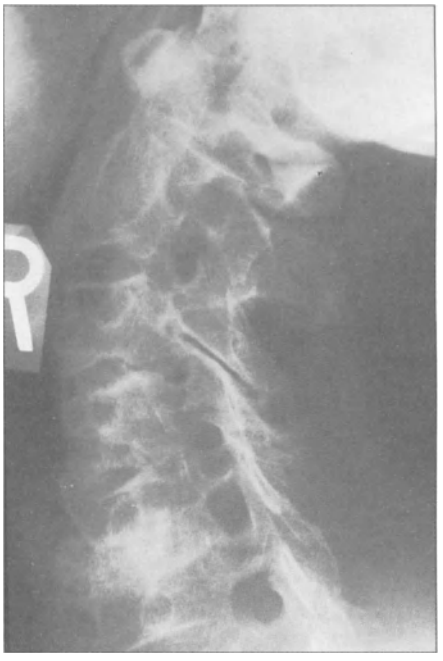

Figure 5.27 *Severe foraminal encroachment in advanced cervical spondylosis*

narrowing, osteophyte formation and sclerosis become more prominent. Subluxation (Figure 5.26) and foraminal encroachment (Figure 5.27) are features of advanced cervical spondylosis and may result in neurogenic symptoms and signs. A radiculopathy may develop due to (1) foraminal encroachment by osteophytes, (2) lateral intervertebral disc prolapse or (3) apophyseal joint subluxation, while compression of the spinal cord may be due to (1) central disc prolapse or (2) posterior osteophyte formation. Large osteophytes may

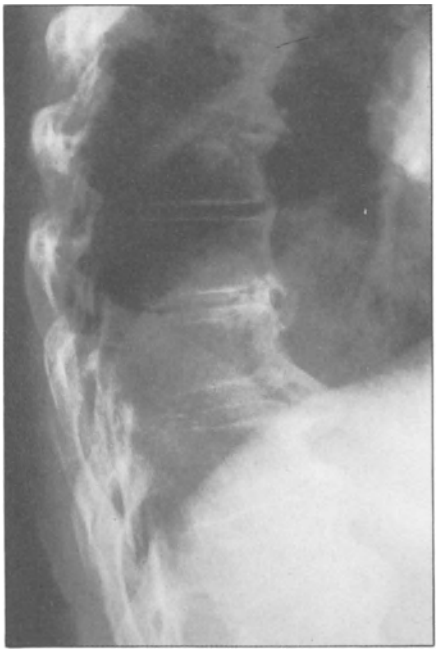

Figure 5.28 *Forestier's disease – flowing ossification over at least four consecutive thoracic vertebrae with preservation of disc spaces*

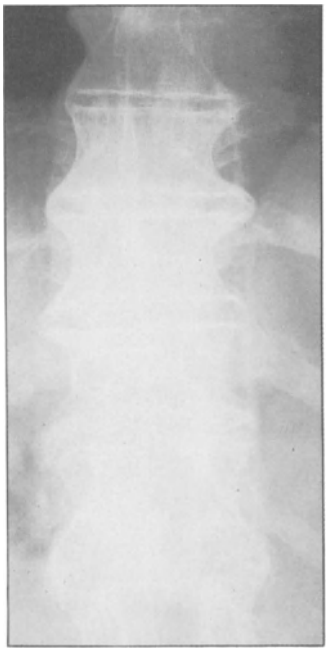

Figure 5.29 *Forestier's disease – note flowing ossification (slightly more prominent on the right) and preservation of disc spaces*

occasionally compress the vertebral arteries and produce a syndrome similar to that of basilar artery insufficiency, or rarely compress the anterior spinal artery producing a central cord syndrome.

Although usually mild in degree, the features of degenerative disc disease in the thoracic spine are similar to those in the other spinal areas. Forestier's disease (syn: DISH, Diffuse Idiopathic Skeletal Hyperostosis) is a variant of degenerative disc disease, and has a predilection to involve the lower portion (T7–T11) of the thoracic spine (Figures 5.28, 5.29). It can be differentiated from both spondylosis and ankylosing spondylitis by a number of clinical and radiographic features (Table 5.2). In Forestier's disease, exuberant flowing ossification across consecutive intervertebral discs is associated with L, Y and T-shaped radiolucent disc extensions (Figure 5.30). Ossification is more common on the right side of the thoracic spine, formation being inhibited on the left by the presence of the aorta (the converse is true in *situs inversus*). This disease is more common in

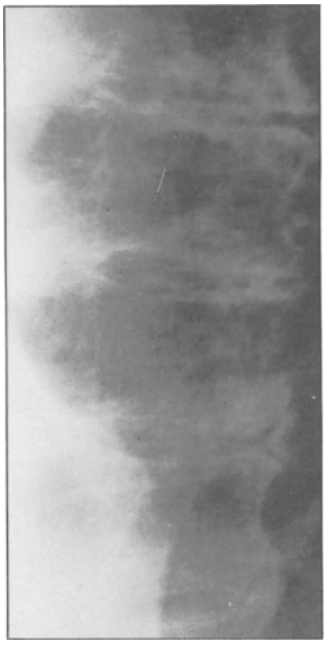

Figure 5.30 *Y-shaped radiolucent disc extension in diffuse idiopathic skeletal hyperostosis*

Table 5.2 ***Differentiation of Forestier's disease, spondylosis and anyklosing spondylitis***

	Forestier's disease	*Spondylosis*	*Ankylosing spondylitis*
Age at onset	elderly	elderly	young and middle aged
Type of back pain	mechanical	mechanical	inflammatory
Sacroiliitis	–	–	+
Significant loss of disc space	–	+	–
Osteophytes	flowing ossification	+	–
Target areas of involvement	lower thoracic	cervical, lumbar	ascends spine in a continuum
Enthesitis	+	–	+

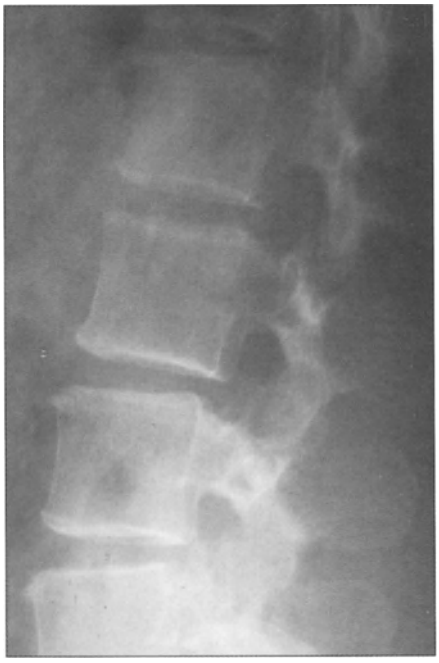

Figure 5.31 *Mild osteophyte formation in early lumbar spondylosis. (Courtesy of Update Publications)*

elderly males and has an association with diabetes mellitus. The cervical and lumbar areas of the spine may also be affected, and whisker-like hyperostoses may develop around the pelvis as well as in more remote extraspinal areas.

Lumbar spondylosis is extremely common in middle aged and elderly patients with chronic low back pain. Mild osteophyte formation in early disease (Figure 5.31) may be later complicated by the development of joint space narrowing, end-plate sclerosis and marked osteophytosis. In some patients, a vacuum phenomenon may appear and is due to gas formation in a degenerated disc (Figure 5.32). Severe degrees of degeneration may result in spondylolisthesis, a condition in which one vertebra subluxes anteriorly over the vertebra immediately inferior (Figure 5.33).

Lateral disc protrusion or osteophytic foraminal encroachment may produce a radiculopathy while central disc protrusion, spondylolisthesis or exuberant osteophyte formation may result in spinal stenosis or the cauda equina syndrome (Figure 5.34).

The elderly are at risk of developing lumbar scoliosis (Figures 5.35, 5.36) due to a combination of loss of intervertebral disc space, degenerative disease in the apophyseal joints, poor muscle tone and vertebral compression secondary to osteoporosis.

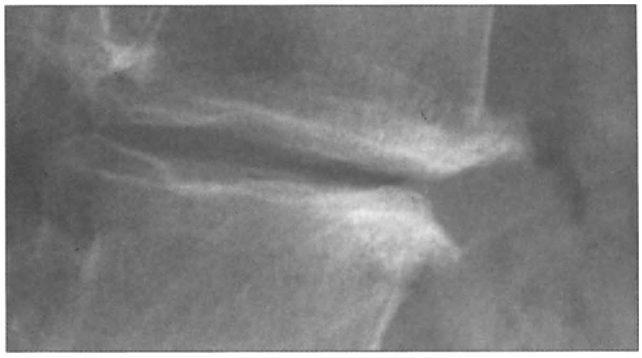

Figure 5.32 *Vacuum phenomenon in a degenerative disc with associated joint space narrowing, sclerosis and osteophyte formation*

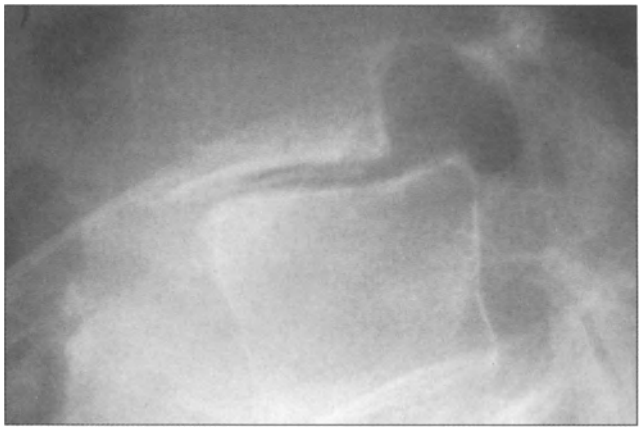

Figure 5.33 *Spondylolisthesis – Note subluxation of L4 on L5 due to severe degenerative disease*

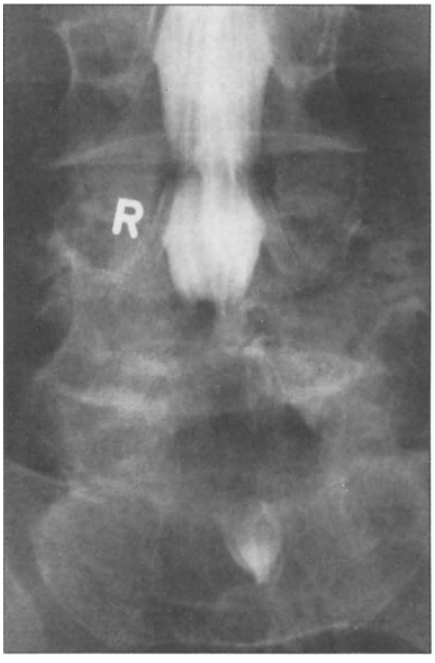

Figure 5.34 *Metrizamide myelogram showing complete occlusion at L4–L5 due to central disc protrusion*

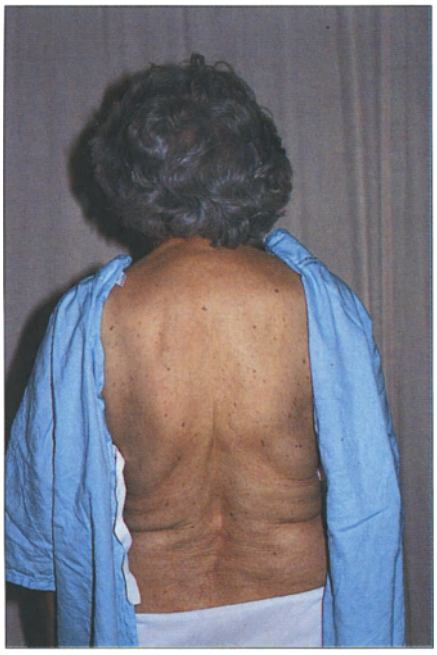

Figure 5.35 *Lumbar scoliosis to right in patient with lumbar spondylosis*

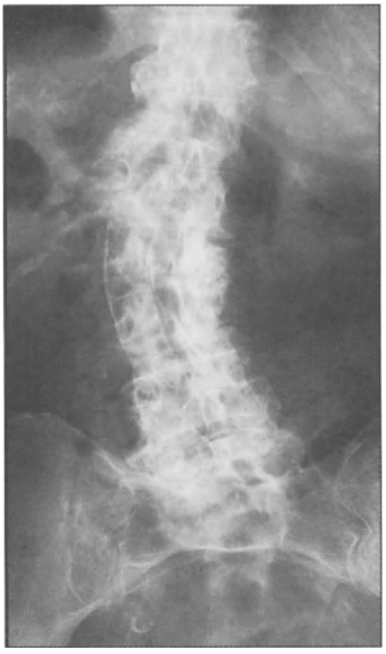

Figure 5.36 *Radiograph of patient shown in Figure 5.35. Note severe degenerative disease and lumbar scoliosis*

Chapter 6

Crystal Synovitis

The crystals of monosodium urate and calcium pyrophosphate dihydrate are of considerable aetiologic and pathogenetic importance. The former cause gouty arthritis while the latter result in calcium pyrophosphate deposition disease. However, several other types of crystal have been identified in synovial fluids. Cholesterol crystals may be observed in chronic effusions, while crystals of steroid esters may be seen in joints recently injected with corticosteroid drugs. Although calcium hydroxyapatite crystals cannot be seen on light microscopy, they can be visualized by electronmicroscopy, and may be found in the joints of some patients with degenerative arthritis.

Gouty arthritis

Hyperuricaemia may be asymptomatic or result in the clinical syndromes of acute gouty arthritis, chronic tophaceous gout or nephrolithiasis. In the majority of patients hyperuricaemia is idiopathic, and related to an increased production and/or decreased renal clearance of uric acid (Table 6.1) A number of disease states may predispose to the development of gouty arthritis, the most frequent being alcohol abuse and diuretic therapy (particularly with thiazide compounds). Occasionally hyperuricaemia may be the result of an underlying malignancy or rarely is due to a genetically determined abnormality in purine metabolism.

Monosodium urate crystals are negatively birefringent, needle-shaped structures (Figure 6.1), and are best visualized using a polarizing microscope with a first-order red plate compensator. With this light source, the crystal appears yellow when the light path is parallel to its long axis (Figure 6.2). However, when the light path is rotated at 90° to the long axis, the crystal appears blue (Figure 6.3).

Gouty arthritis may be acute or chronic and occur in the presence or absence of tophus formation. Males are more often affected than females and the onset frequently occurs at night. Trauma, dieting, alcohol abuse, thiazide diuretics, the recent introduction of urate-lowering drugs such as probenecid, sulphinpyrazone

Table 6.1 ***Gouty arthritis – principal aetiologic factors.***

Idiopathic	increased production and/or decreased excretion of uric acid
Inherited	increased PP-ribose-P synthetase activity partial or complete HGPRTase deficiency glucose-6-phosphatase deficiency
Secondary	
Malignancy	lymphoproliferative and myeloproliferative disorders multiple myeloma, polycythaemia rubra vera
Drugs and Toxins	alcohol thiazide diuretics chronic lead poisoning (Saturnine gout)

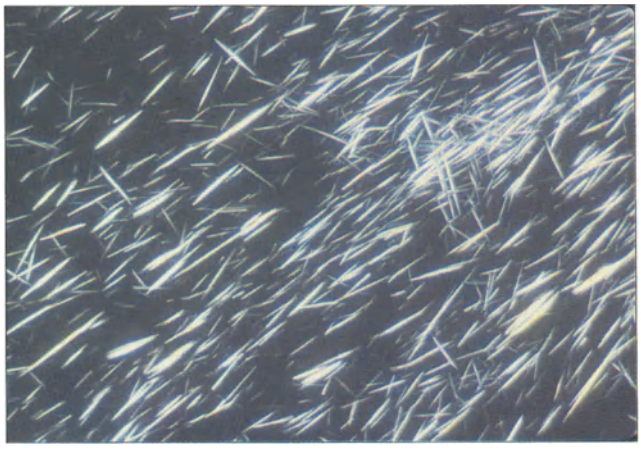

Figure 6.1 *Appearance of monosodium urate crystals under plain polarized light*

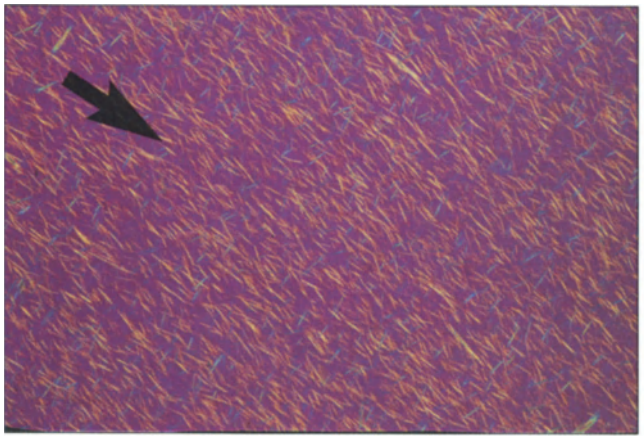

Figure 6.2 *Monosodium urate crystals appear yellow when light path is parallel to long axis of the crystal (arrow)*

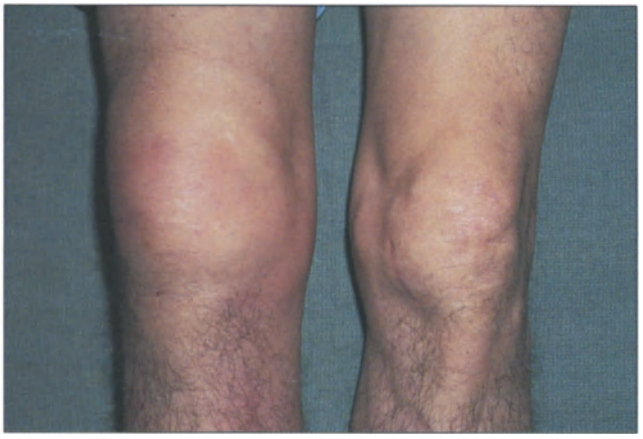

Figure 6.5 *Acute gouty arthritis – swelling and mild erythema in right knee*

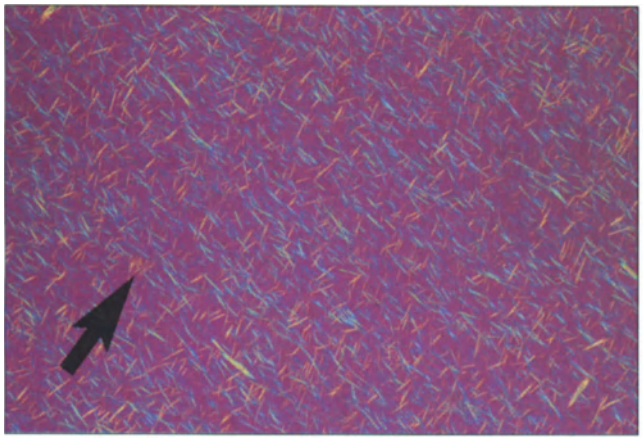

Figure 6.3 *Monosodium urate crystals appear blue when light path is at 90° to long axis of crystal (arrow)*

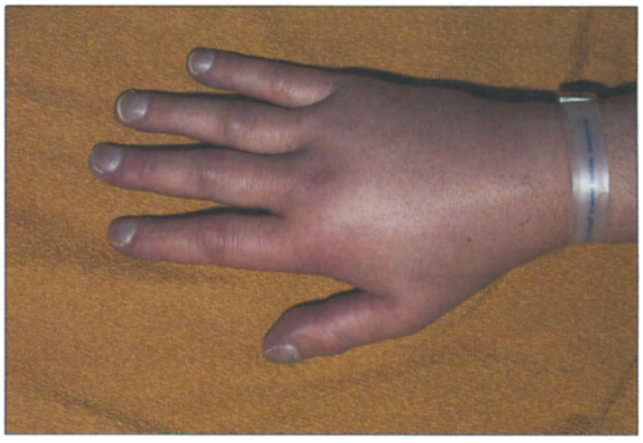

Figure 6.6 *Acute gouty arthritis in wrist of patient with cyanotic congenital heart disease*

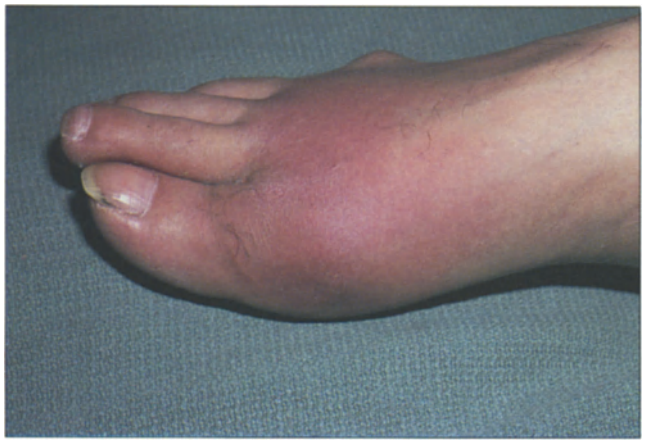

Figure 6.4 *Podagra – note swelling and erythema over first MTP and adjacent forefoot*

and allopurinol or the stress of surgery may precipitate an attack. Acute gout commonly affects the first metatarsophalangeal joint producing the condition known as podagra (Figure 6.4). Thereafter, the foot, ankle, knee (Figure 6.5) and joints of the upper extremity (Figure 6.6) are affected in decreasing order of frequency (Figure 1.4). Pain is rapid in onset, severe and associated with marked swelling, tenderness, erythema and loss of function. In fact the intensity of the erythema, articular and extra-articular swelling and warmth that attends acute gouty arthritis may resemble that of septic arthritis. For this reason, and except in classical cases of podagra, joint fluid must be aspirated and examined for evidence of infection (by Gram stain and culture), as well as for its crystal and cellular content. It is important to note that even a drop of fluid from the needle of an apparently failed aspiration, if carefully extruded

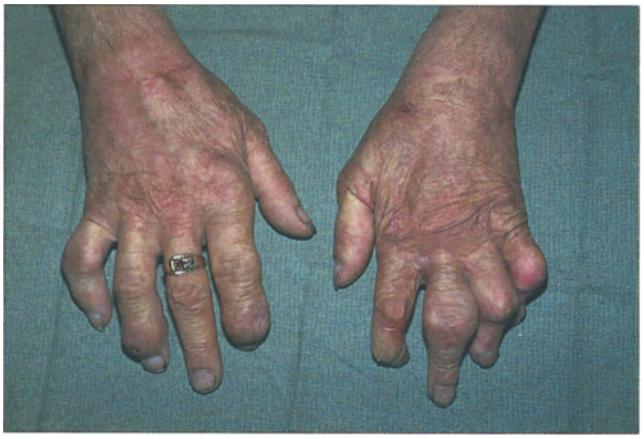

Figure 6.7 *Chronic tophaceous gout showing evidence of severe swelling, deformity and tophus formation*

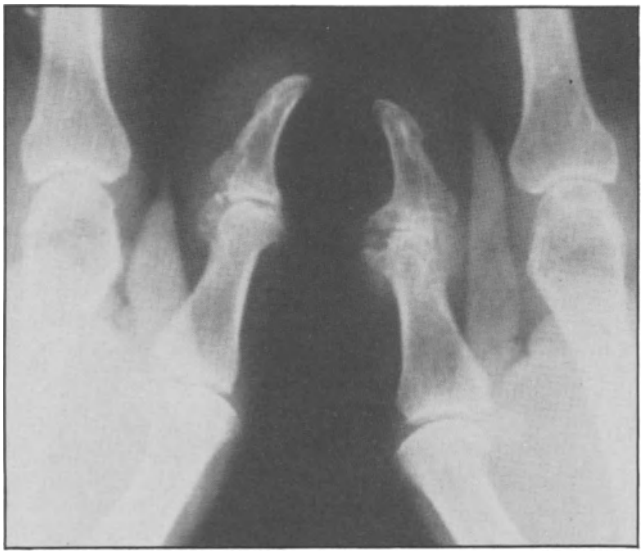

Figure 6.8 *Chronic tophaceous gout showing evidence of destructive disease in IP joint of thumb*

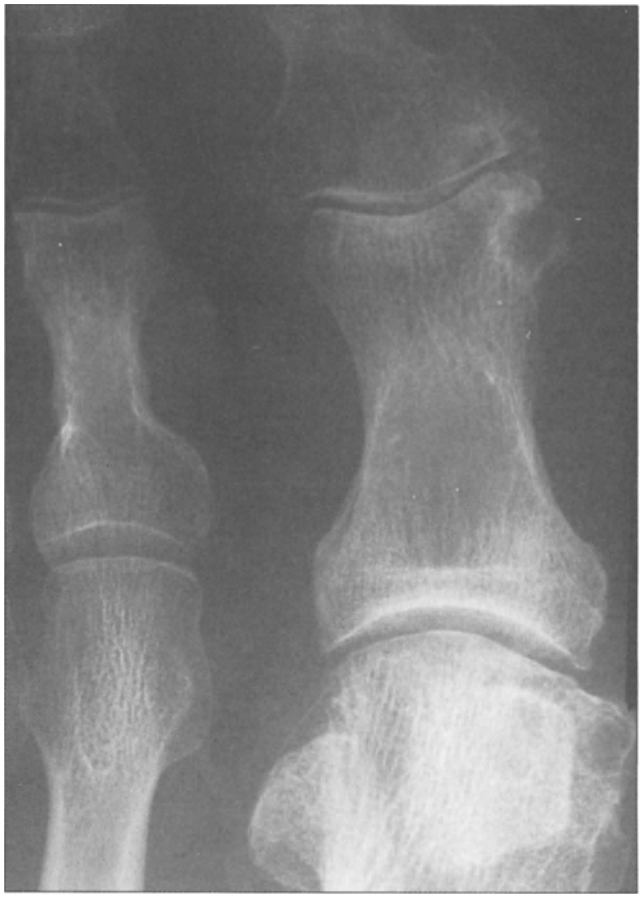

Figure 6.9 *Shelf sign. This characteristic radiographic sign of gout is due to a tophaceous deposit*

onto a glass slide, will frequently allow a diagnosis of gouty arthritis to be established. Gouty synovial fluid is typically inflammatory in nature and has a high cell content in which polymorphonuclear leukocytes predominate. The characteristic crystals of monosodium urate may be observed in both intracellular (engulfed by polymorphs) and extracellular locations. Untreated the acute attack of gout usually resolves over 2–3 weeks, recovery being markedly accelerated by the use of an anti-inflammatory drug such as indomethacin or naproxen.

Failure to control hyperuricaemia may result in further attacks of gouty arthritis which increase in frequency and intensity. Over a period of time the temporal profile of acute flares followed by complete remissions, changes to that of chronic tophaceous gout (Figure 1.9). At this stage of the disease, signs of arthritis persist (Figure 6.7), and affected areas frequently show grotesque swelling, deformity and tophus formation. Well-defined punched-out areas of bone lysis particularly in the subchondral bone of the heads and bases of the phalanges are typical of chronic gouty arthritis (Figure 6.8). The characteristic radiographic lesion is a sharply marginated defect, associated with an overhanging margin (Shelf sign) that protrudes from the bone (Figure 6.9). In some patients the arthropathy is extremely destructive.

Tophi consist of multicentric deposits of urate crystals contained within an intercrystalline matrix and an area of inflammatory reaction. They may develop in relatively avascular areas such as the helix or antihelix of the ear (Figure 6.10), but often appear on the olecranon, and occasionally on the fingers and the toes (Figure 6.11). They may also be found adjacent to tendons (Figure 6.12), in the tarsal plates of the eyelids and on the cornea. Tophi, particularly those located over pressure areas may ulcerate (Figure 6.13) and discharge a chalky white material containing large quantities of monosodium urate crystals (Figure 6.14). In

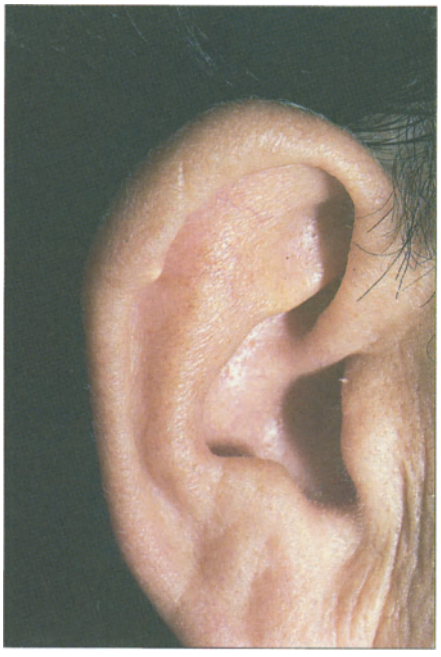

Figure 6.10 *Tophus on helix of ear in patient with chronic tophaceous gout and nephrolithiasis*

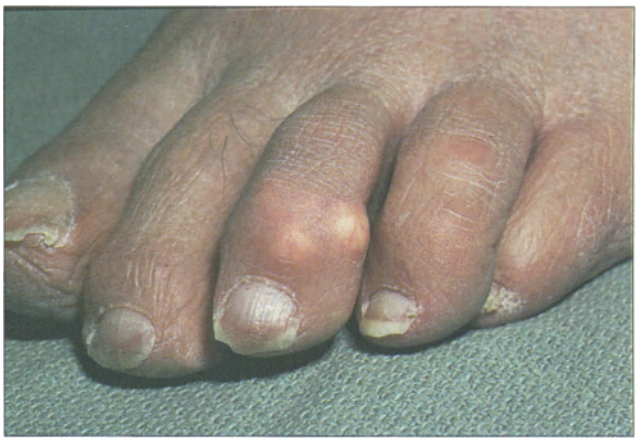

Figure 6.11 *Tophus formation in third left toe – note cluster of subcutaneous tophi*

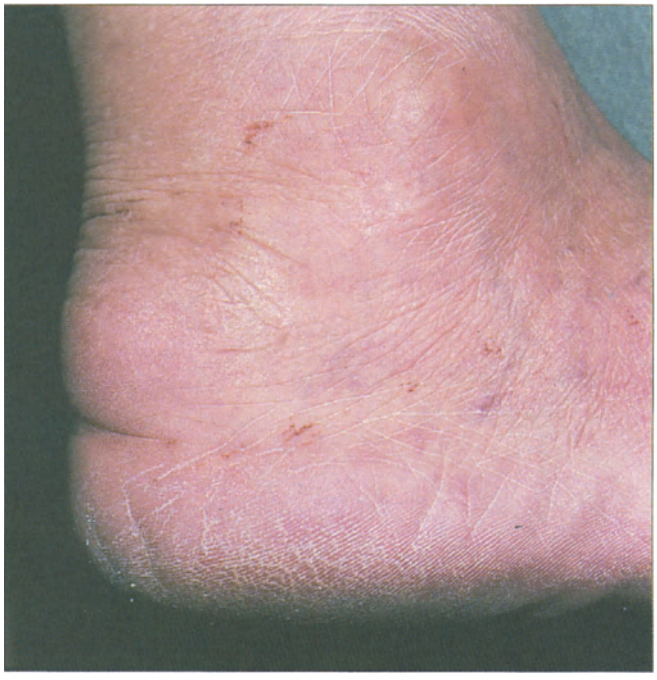

Figure 6.12 *Tophus formation adjacent to Achilles tendon*

addition to being the site of tophus formation, the extensor surface of the elbow may also be affected by olecranon bursitis (Figure 6.15).

Hyperuricaemia may result in the formation of radiolucent uric acid stones (Figure 6.16) and also facilitate the development of radio-opaque calcium containing stones. Nephrolithiasis frequently results in pain and haematuria, and may occur in the absence of arthritis or antedate it by a period of several years. Finally, hyperuricaemia may result in urate deposition in the renal interstitium (urate nephropathy) or in the collecting system (acute tubular obstruction), the latter usually being associated with the treatment of an underlying malignancy.

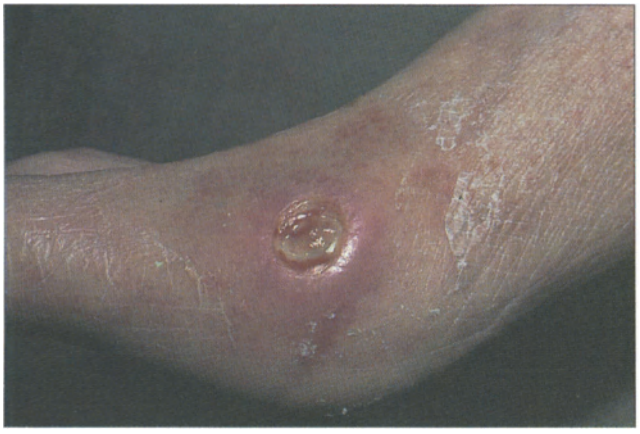

Figure 6.13 *Ulcerating tophus adjacent to first MTP joint*

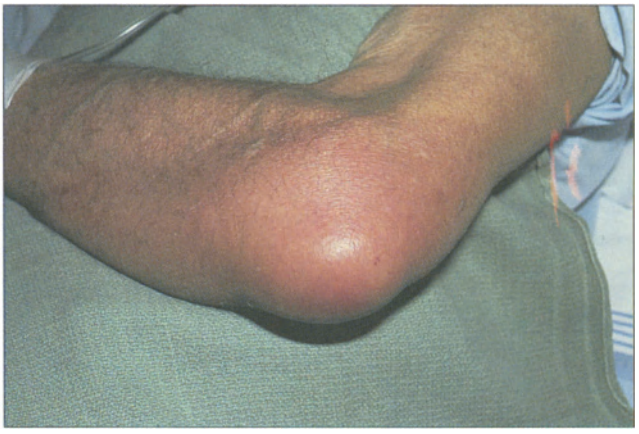

Figure 6.15 *Acute gouty olecranon bursitis*

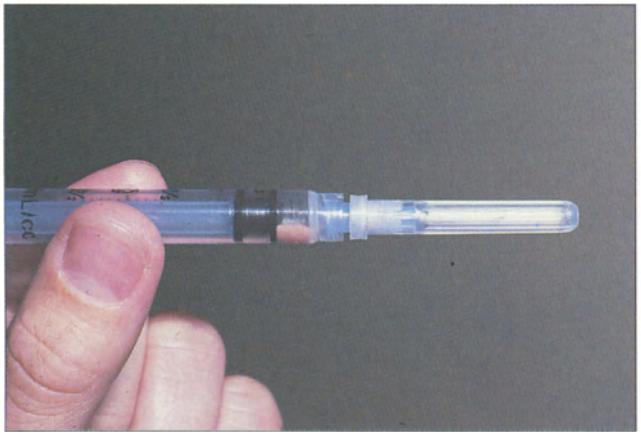

Figure 6.14 *Aspirate from gouty tophus*

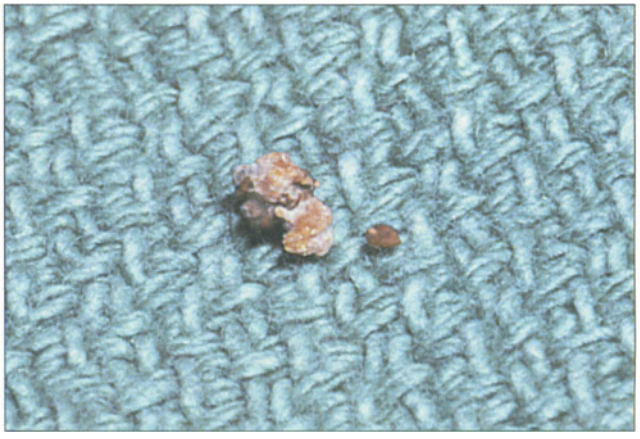

Figure 6.16 *Urate-containing kidney stone (2 mm diameter)*

Calcium pyrophosphate deposition disease

Calcium pyrophosphate deposition disease (CPPD) results in the deposition of calcium pyrophosphate dihydrate crystals in cartilage and synovium. The majority of patients show no evidence of underlying disease, while in the remainder there may be evidence of an underlying metabolic abnormality such as hyperparathyroidism, hypothyroidism, or haemochromatosis (Table 6.2). Rarely the disease may be familial in nature or coexist with gouty arthritis.

CPPD crystals differ from those of monosodium urate in that they are rhomboidal in shape (Figure 6.17)

Table 6.2 ***Calcium pyrophosphate deposition disease – principal aetiologic factors***

Idiopathic	no known aetiology
Inherited	Chilean, Czech, Dutch family aggregates
Secondary	hyperparathyroidism hypothyroidism haemochromatosis hypophosphatasia

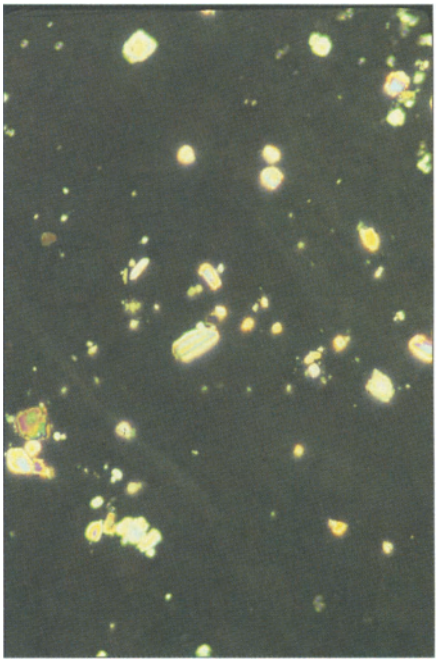

Figure 6.17 *Appearance of calcium pyrophosphate dihydrate crystals under plain polarized light*

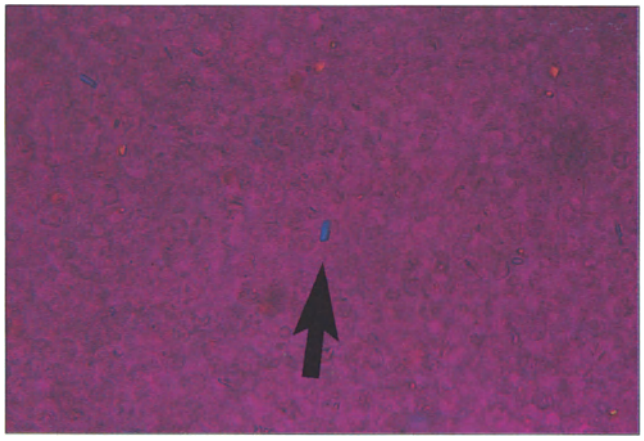

Figure 6.18 *Pyrophosphate crystals appear blue when light path is parallel to long axis of crystal (arrow)*

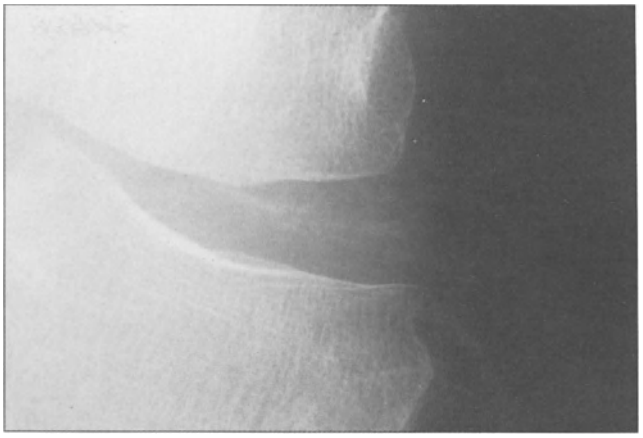

Figure 6.21 *Close up of chondrocalcinosis in knee joint*

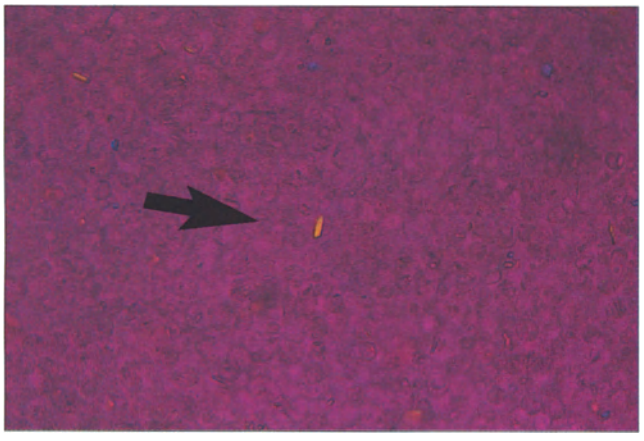

Figure 6.19 *Pyrophosphate crystals appear yellow when light path is at 90° to long axis of crystal (arrow)*

and show weakly positive birefringence. Under the polarizing microscope they appear blue when the light path is parallel to the long axis of the crystal (Figure 6.18) and yellow when at 90° to it (Figure 6.19). The diagnosis of calcium pyrophosphate deposition disease is made by finding the characteristic pyrophosphate crystals in synovial fluid or, alternatively, by detecting chondrocalcinosis (cartilage calcification) in a number of locations including the triangular cartilage of the wrist and the cartilage of the knee.

Six types of CPPD have been recognized.

Type A

Pseudogout – Type A resembles gouty arthritis although the onset is somewhat slower and the course may be milder. The knee is the most commonly affected joint, attacks being self-limited, and responding to non-steroidal anti-inflammatory drugs such as indomethacin and naproxen.

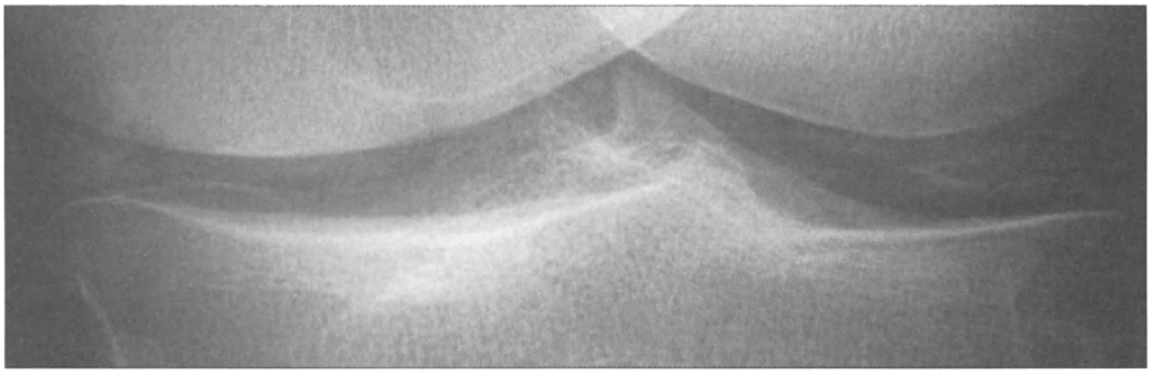

Figure 6.20 *Chondrocalcinosis affecting the hyaline and fibrocartilage of the knee*

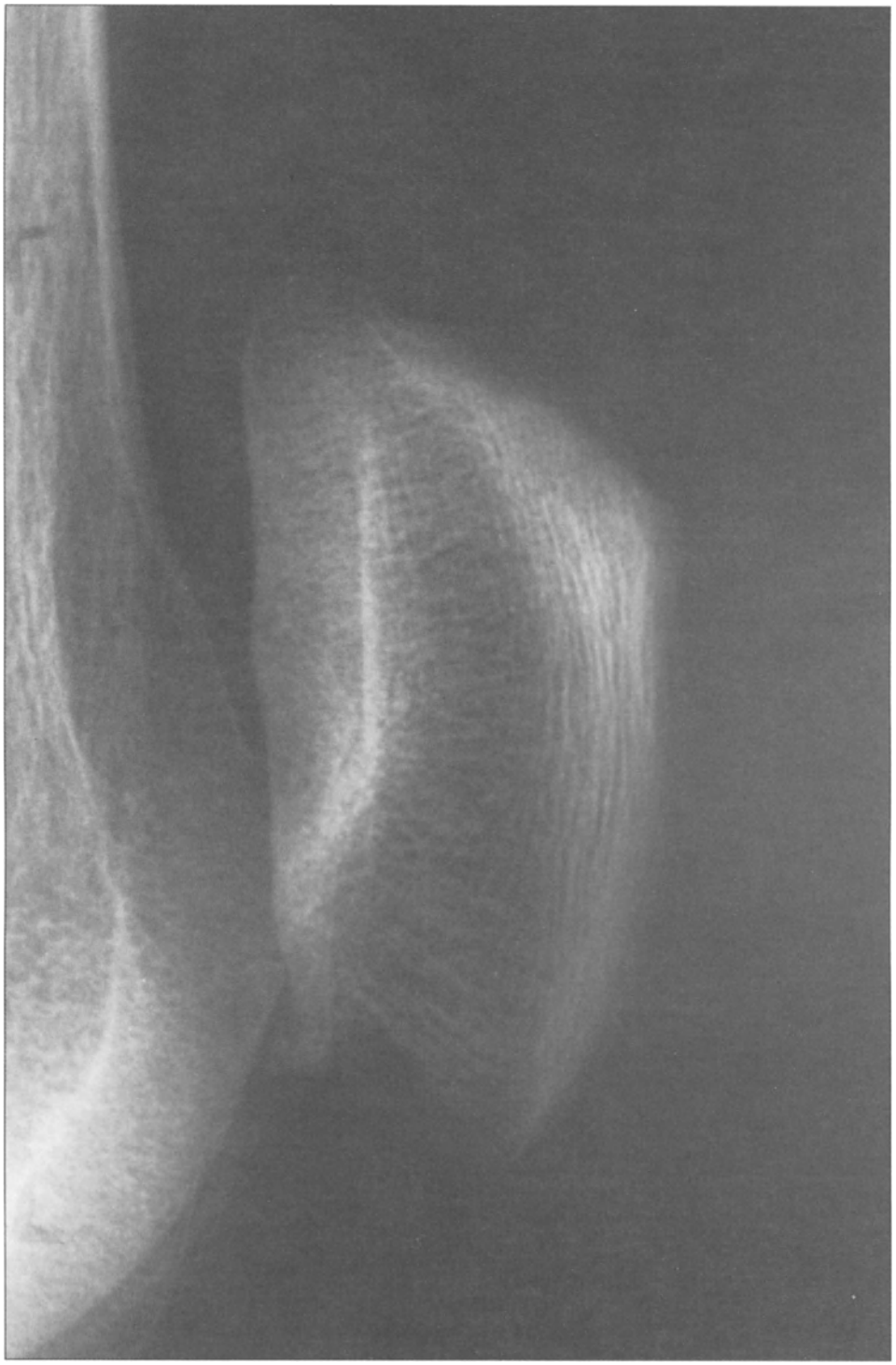

Figure 6.22 *Chondrocalcinosis in the patellofemoral joint space*

Type B

Pseudorheumatoid arthritis - Subacute atacks of an inflammatory polyarthritis resembling rheumatoid arthritis characterize this variant. In contrast to rheumatoid arthritis, active joints in pseudorheumatoid arthritis are frequently out of synchrony with one another and the rheumatoid factor is negative.

Types C and D

Pseudo-osteoarthritis - Types C and D both result in clinical syndromes resembling osteoarthritis. However, in Type C there are superadded attacks of acute arthritis which by definition are absent in Type D. It is these types of CPPD which should be considered in patients with atypical osteoarthritis. Radiographs of affected joints and in particular of the knees (Figures 6.20, 6.21,

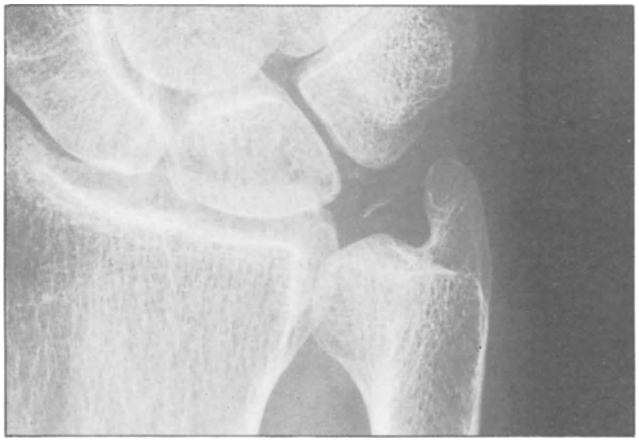

Figure 6.23 *Chondrocalcinosis affecting the triangular cartilage of the wrist*

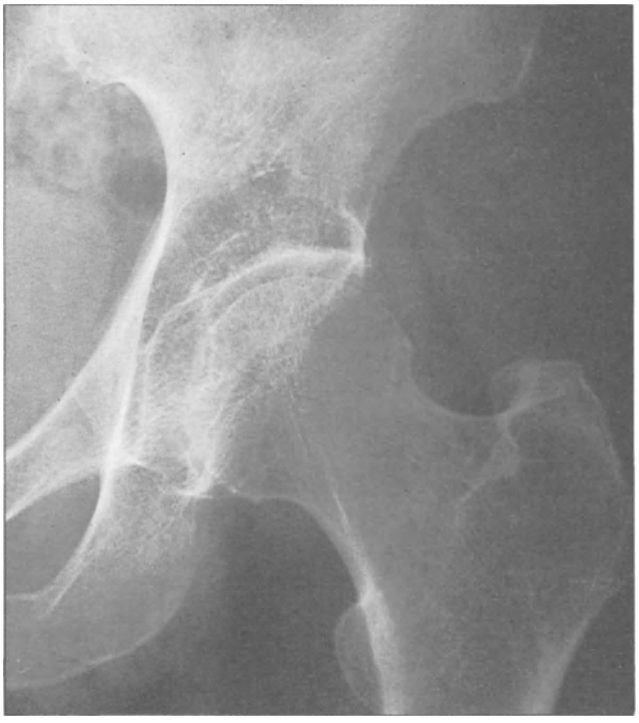

Figure 6.24 *Chondrocalcinosis in the hip joint*

6.22), wrists (Figure 6.23) and hips (Figure 6.24) may show evidence of chondrocalcinosis. The shoulder (Figure 6.25), symphysis pubis (Figure 6.26) and MCP joints (Figure 6.27) may be involved in this process which affects both hyaline and fibrocartilage. Crystal deposition may result in severe secondary osteoarthritis with joint space narrowing, sclerosis, cyst and osteophyte formation and bony deformity (Figure 6.28).

Type E

Asymptomatic (lanthanic) - This common form of CPPD is usually recognized incidentally during the screening of asymptomatic elderly patients.

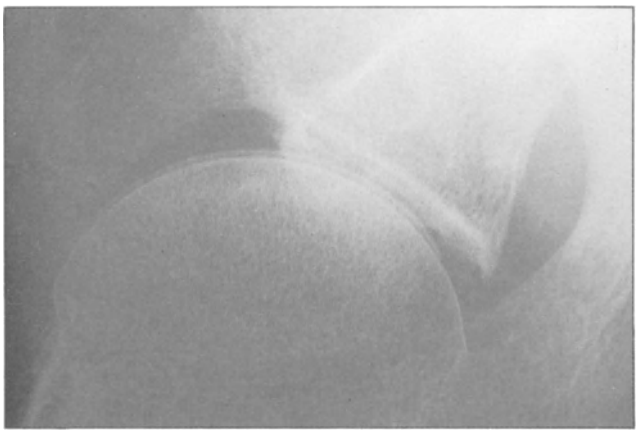

Figure 6.25 *Chondrocalcinosis in the shoulder joint*

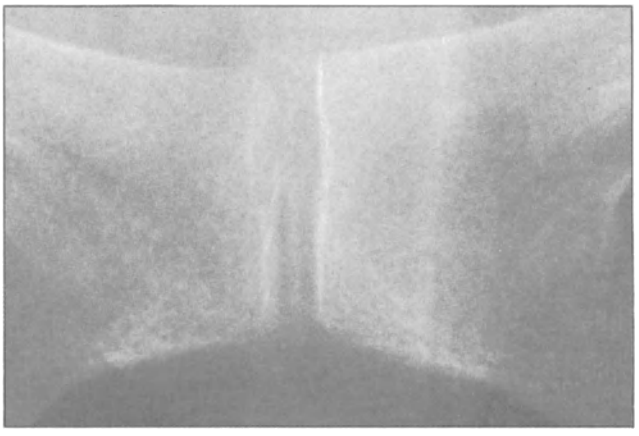

Figure 6.26 *Chondrocalcinosis in the symphysis pubis*

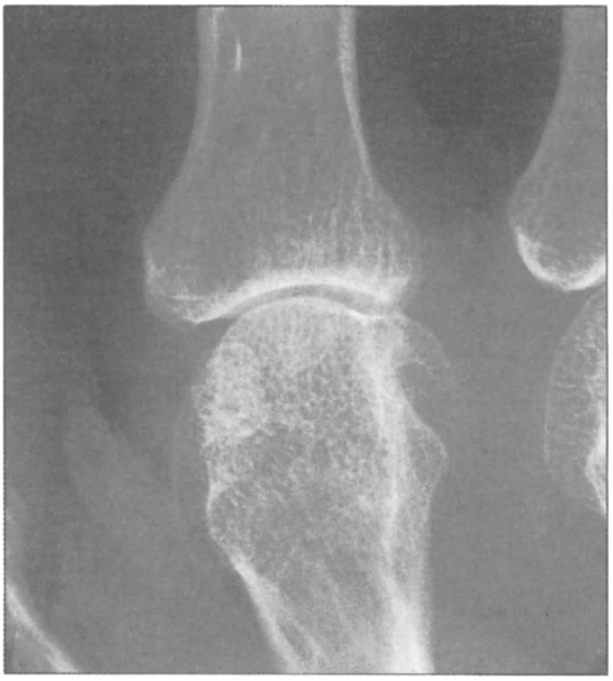

Figure 6.27 *Joint space narrowing, sclerosis and hook osteophyte formation in CPPD*

Type F

Pseudoneuropathic - Calcium pyrophosphate crystal deposition has been recognized in some patients with neuropathic arthritis. Conversely, a severe destructive Charcot-like arthropathy has been described in some patients having CPPD but no neurologic abnormality.

It can readily be appreciated from reviewing the preceding six types of CPPD why this entity has acquired the reputation of being a great mimicker of other types of arthritis.

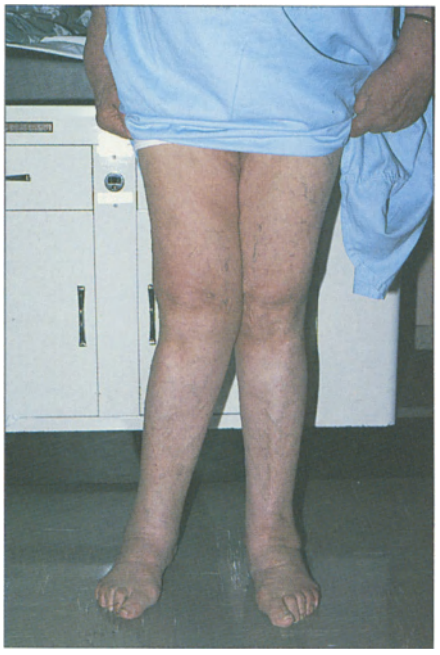

Figure 6.28 *Genu valgus in CPPD*

Chapter 7

Seronegative Spondyloarthropathies

The seronegative spondyloarthropathies are a group of disorders characterized by a propensity to involve the axial skeleton, an absence from the serum of IgM rheumatoid factor and an association with the histocompatibility antigen HLA-B27. The group is composed of ankylosing spondylitis, psoriatic arthritis, Reiter's syndrome and the arthropathies related to Crohn's disease, ulcerative colitis and Whipple's disease (Figure 7.1). Although causal agents have not been identified for most of these disorders, association with an infectious agent has been demonstrated in a number of patients, and the pattern of disease in some has suggested an acquired infection occurring in a susceptible host.

Ankylosing spondylitis

While the aetiology of ankylosing spondylitis remains unknown, the recent observation of cross reactivity between specific Klebsiella serotypes and HLA-B27-positive cells from patients with ankylosing spondylitis may represent an important advance in understanding the relationship between genetic and environmental factors. Radiographic evidence of sacroiliitis in asymptomatic relatives of patients with ankylosing spondylitis further strengthens this genetico–environmental postulate.

Ankylosing spondylitis is more common in males than females, although previously reported ratios of 10:1 likely reflect underdiagnosis of the disease in females with low back pain who typically may display a milder form of the disorder. The disease prevalence (<1–4.7%) varies in accordance with geographic area, and the local prevalence of HLA-B27 (<1% in Japan–50% in the Canadian Haida Indians). HLA-B27 is found in 90–95% of affected Caucasian individuals, the disease usually becoming symptomatic between 15–35 years of age.

Low back pain which characteristically disturbs sleep and is associated with morning stiffness is by far the most frequent presenting symptom. It is commonly insidious in its onset, and although centred in the low back may be poorly localized. Inflammatory back pain is differentiated from mechanical types of back pain principally by its association with moderate to marked morning stiffness and its tendency to improve with exercise and worsen with prolonged rest. In the majority of patients the disease starts in the sacroiliac joints and produces localized tenderness (Figure 2.29) together with the aforementioned symptoms. Scintigraphic abnormalities may precede radiographic abnormalities although controversy has surrounded the sensitivity and specificity of sacroiliac scanning, and abnormalities must, therefore, be interpreted with some degree of caution (Figure 7.2). Furthermore, patients with positive scintiscans may show no evidence of ankylosing spondylitis in follow-up, while patients with well-documented longstanding ankylosing spondylitis, as well as those who have received non-steroidal anti-inflammatory drugs, may have normal scans.

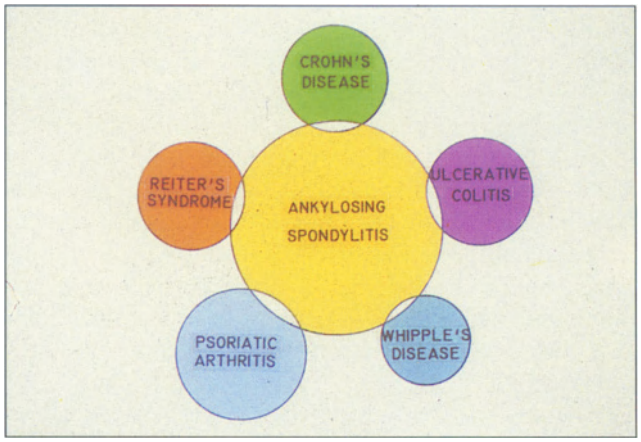

Figure 7.1 *Inter-relationship between ankylosing spondylitis and the other seronegative spondyloarthropathies*

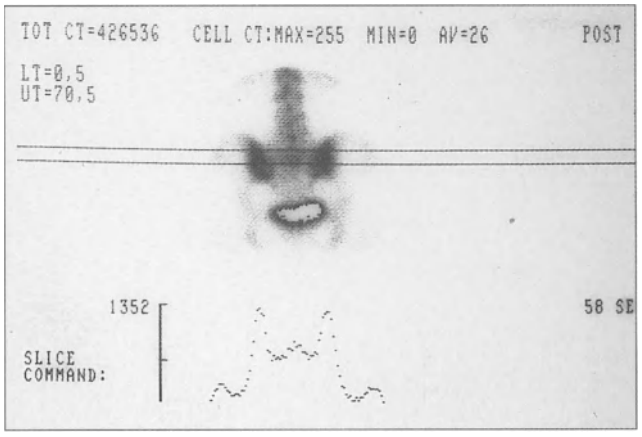

Figure 7.2 *Quantitative sacroiliac joint scintiscan showing evidence of increased uptake of technetium in the sacroiliac joints compared with the body of the sacrum. (Courtesy of Dr A. Driedger)*

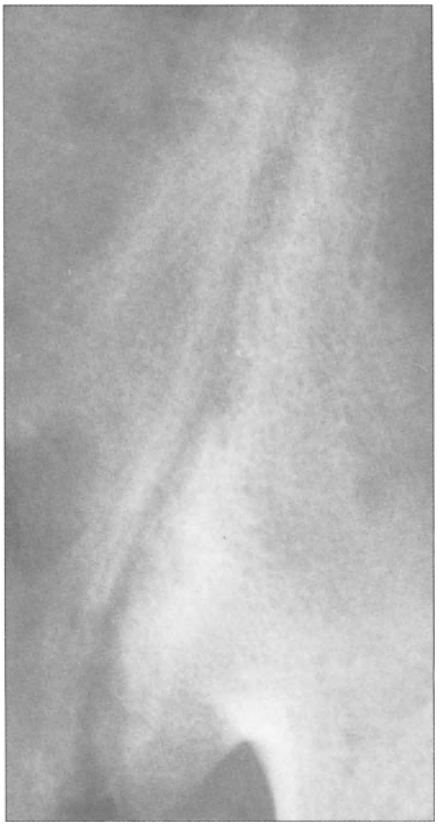

Figure 7.3 *Marginal blurring, erosion, sclerosis and areas of joint space narrowing in established sacroiliitis*

The earliest radiographic abnormality is that of blurring of the joint margin. This is followed in a variable period of time by the development of erosion, widening of the joint space and bony sclerosis (Figure 7.3). These abnormalities, seen initially in the lower one-third of the joint, are the combined result of osteitis, chondritis and synovitis. Changes tend to be symmetrical, and gradually extend to involve the remainder of the joints. Erosion is usually more prominent on the iliac side of the joint due to the relative thinness of the iliac cartilage. These abnormalities should be differentiated from those of osteitis condensans ilii, a condition most frequently encountered in parous females and which results in sclerosis confined to the iliac side of the joint. In contrast to sacroiliitis, the joint margin is clear, there is no evidence of erosion and the sacral side of the joint is entirely normal (Figure 7.4).

Persistent sacroiliitis results in progressive erosion and sclerosis, and ultimately in bony ankylosis (Figure 7.5). In the late stage of ankylosing spondylitis the sacroiliac joints become totally ankylosed (Figure 7.6) and rendered painless and immobile. At this stage of the disease joint scans show relatively normal uptake (*cf* early disease), and radiographs show either a residual area of sclerosis or ultimately a bone density which is undistinguishable from that of the adjacent sacral and iliac bones, i.e. the joint disappears. The symphysis pubis is the anterior counterpart of the sacroiliac joint, and may be similarly affected by erosion and sclerosis (Figure 7.7).

Ankylosing spondylitis displays a tendency to ascend the spine involving progressively higher levels of the axial skeleton from the lumbosacral junction up to the

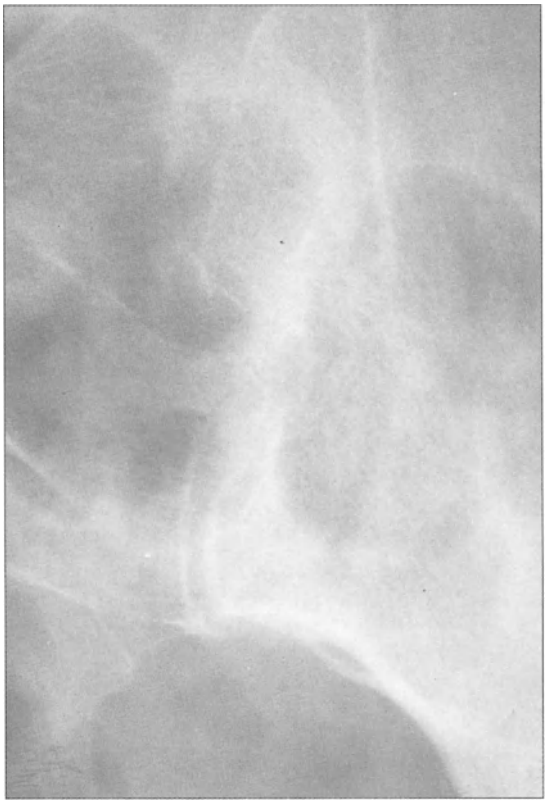

Figure 7.4 *Osteitis condensans ilii. Note triangular area of iliac sclerosis adjacent to inferior margin of sacroiliac joint*

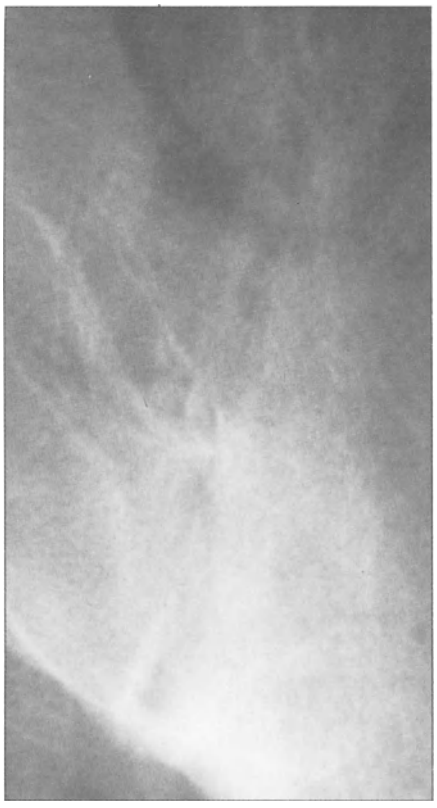

Figure 7.5 *Advanced ankylosing spondylitis with sclerosis and partial ankylosis of the sacroiliac joint*

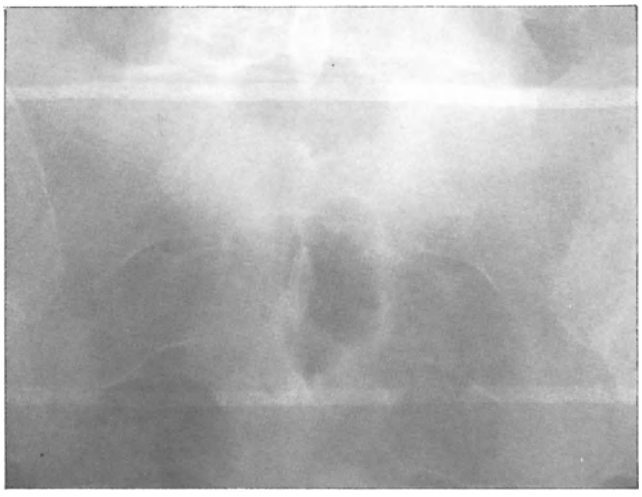

Figure 7.6 *End-stage ankylosing spondylitis with obliteration of both sacroiliac joints*

atlanto-occipital articulation. Lumbar spondylitis results in loss of the normal lumbar lordosis, osteopaenia and squaring of the vertebral bodies (Figure 7.8). A Romanus lesion is occasionally observed at one or other corner of a vertebral body and is due to subchondral osteitis. Syndesmophytes are the hallmark of the seronegative spondyloarthropathies. In contrast to osteophytes they are vertically orientated and tend to bridge adjacent vertebrae. Syndesmophytic bridging, ossification of the posterior and anterior longitudinal and

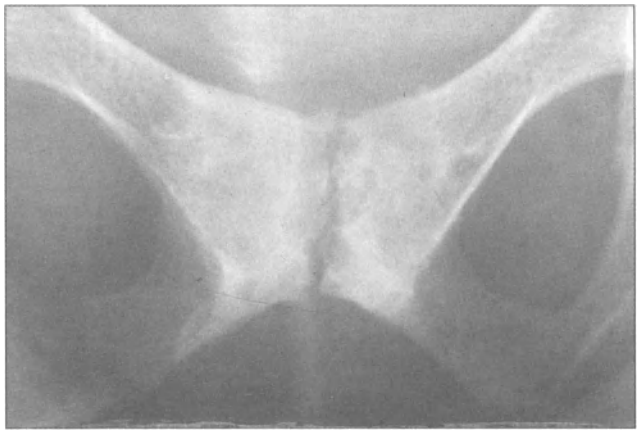

Figure 7.7 *Erosion and sclerosis of the symphysis pubis*

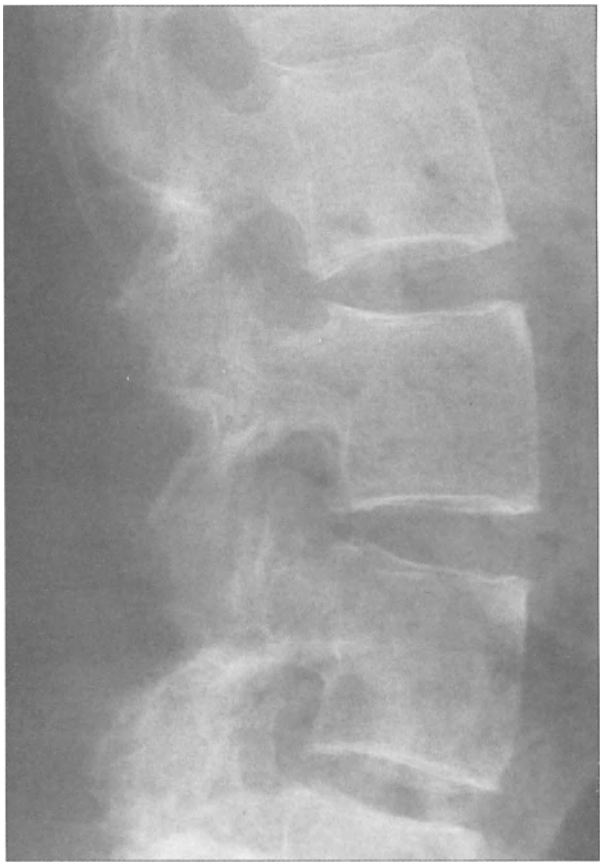

Figure 7.8 *Squaring of the lumbar vertebrae with evidence of marginal osteitis (Romanus lesion). (Courtesy of Update Publications)*

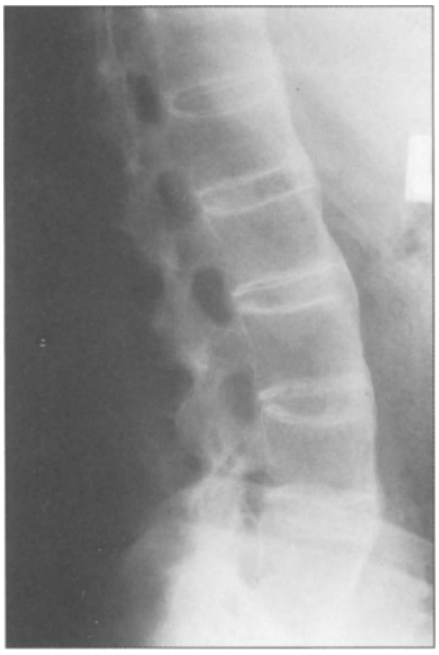

Figure 7.9 *Straightening of the lumbar spine, squaring of lumbar vertebrae, osteopaenia, longitudinal ligament calcification and flowing syndesmophytes in advanced ankylosing spondylitis*

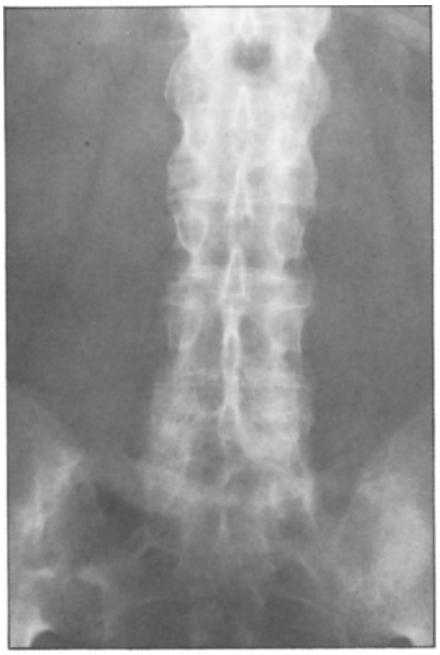

Figure 7.10 *The bamboo spine of ankylosing spondylitis*

interspinous ligaments (Figure 7.9), and sclerosis and fusion of the apophyseal joints all contribute to the typical appearance of the bamboo spine, which is characteristic of advanced ankylosing spondylitis (Figure 7.10). Pain and multiplanar reductions in spinal mobility often attend these radiographic signs of disease. In particular the normal lumbar lordosis is lost, and on forward flexion the normal spinal curvature is interrupted by an area of flattening (Figure 7.11). Schober's test (Figure 2.30) is abnormal, the patient having difficulty touching his toes unless he is able to compensate by hyperflexing the hip joints. Similarly, lumbar spinal extension is limited and compensatory knee flexion may be employed in an attempt to rotate the upper body (Figure 7.12). Finally, restricted lateral flexion may prohibit the patient from sliding his fingertips down the outside of his leg as far as the knee (Figure 7.13). Involvement of the thoracic spine results in restricted spinal rotation, the development of a kyphosis (Figure 7.14), and in patients with costovertebral joint involvement to reduced chest expansion.

Cervical spinal involvement is characterized radiographically by loss of the normal lordotic curve, ligamentous ossification, syndesmophyte formation and apophyseal joint fusion (Figure 7.15). Atlantoaxial joint subluxation similar to that seen in rheumatoid arthritis may occur, atlanto-occipital abnormalities also having

Figure 7.11 *Lumbar spinal immobility showing evidence of failure to reverse the normal lumbar lordosis, i.e. flattening of spinal contour*

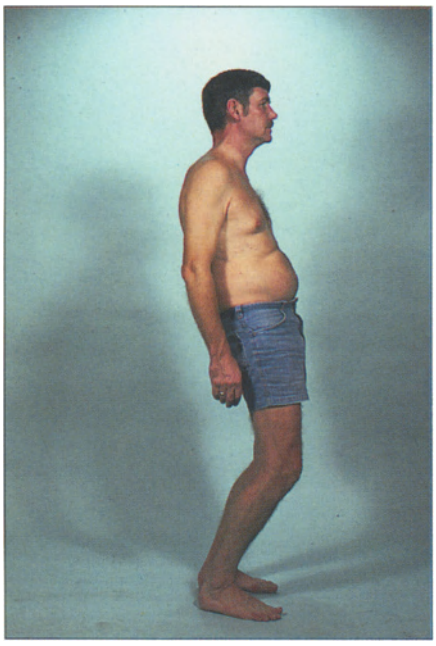

Figure 7.12 *Severely restricted lumbar spinal extension with compensatory flexion of the knees*

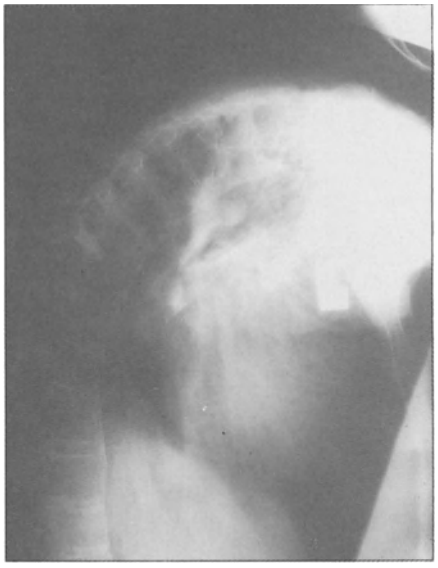

Figure 7.14 *Severe thoracic kyphosis with osteopaenia and bony ankylosis*

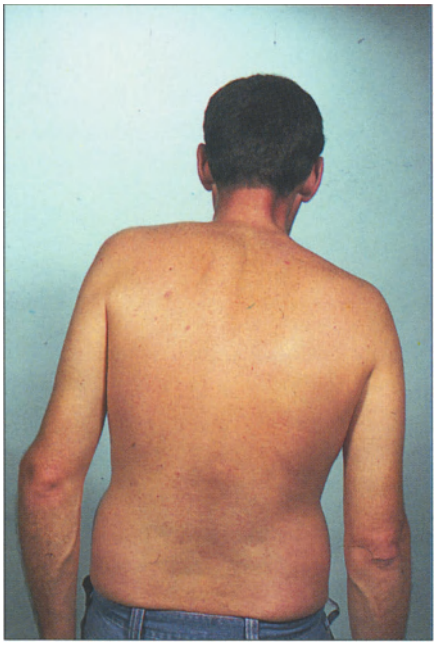

Figure 7.13 *Severely restricted lateral flexion to the right*

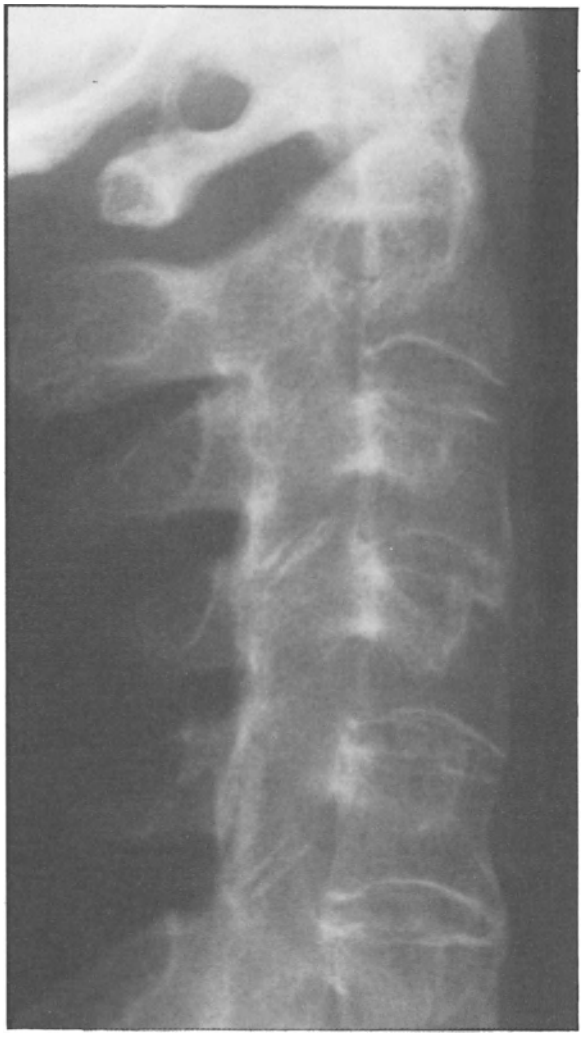

Figure 7.15 *Straightening of the cervical spine, osteopaenia, syndesmophyte formation, ligamentous calcification and apophyseal joint fusion*

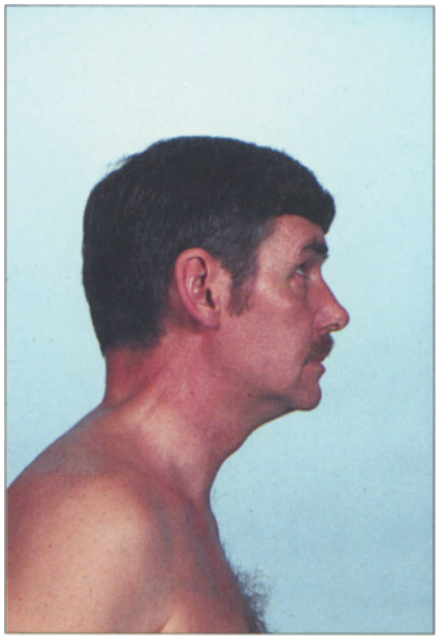

Figure 7.16 *Severely restricted cervical spinal extension*

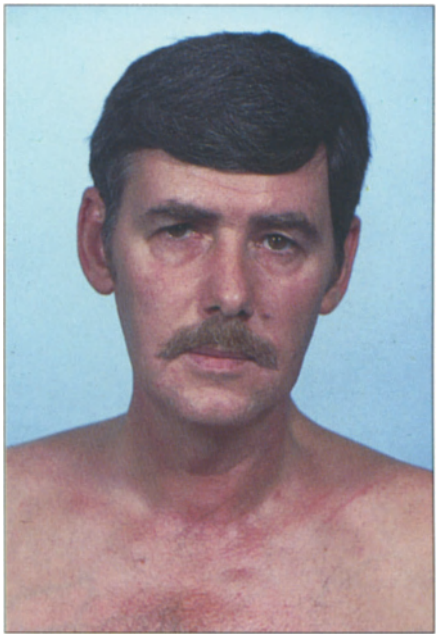

Figure 7.17 *Severely restricted lateral flexion to the left*

been reported. Spinal mobility is often severely restricted in flexion, extension (Figure 7.16), lateral flexion (Figure 7.17) and lateral rotation. Patients may have difficulty driving a car, and those with significant atlantoaxial subluxation may be at increased risk of severe neurologic injury or death if involved in a motor vehicle accident.

Twenty percent of patients initially present with a peripheral arthritis, and 35% may experience it at some time during their illness. The large joints of the lower extremity, particularly the hips and knees, are target joints for ankylosing spondylitis, although the large joints of the upper extremity, and on occasion the small joints, may also be involved (Figure 1.5). Radiographs of involved joints may show evidence of soft tissue swelling, erosion, proliferative new bone formation and fibrous or bony ankylosis (Figure 7.18). It is of note that following total hip joint replacement, hypertrophic new bone formation and occasionally recurrent ankylosis may occur. The combination of knee and hip flexion contractures, straightening of the lumbar spine, thoracic kyphosis and straightening or kyphosis of the cervical spine results in the typical question-mark deformity of advanced ankylosing spondylitis (Figure 7.19).

In addition to spinal and peripheral articular abnormalities, ankylosing spondylitis may also result in enthesitis which is manifest clinically by pain and tenderness, and radiographically by the formation of whisker-like hyperostoses particularly along the inferior ramus of the ischium and pubis, the superior iliac crests, the greater trochanter of the femur, the insertions of the sacrospinous and and sacrotuberous ligaments and at the insertions of the Achilles tendon and plantar fascia (Figure 7.20). Inflammatory heel spurs tend to be exuberant and fluffy in appearance and require differentiating from idiopathic spurs which are smaller and harder (Figure 7.21). Ankylosing spondylitis may be a purely musculoskeletal disorder, or be complicated by acute iritis (25%), apical pulmonary fibrosis, amyloidosis, aortic regurgitation, cardiomegaly, cardiac conduction defects, lumbosacral disc syndromes, spinal fracture, atlantoaxial subluxation or the cauda equina syndrome.

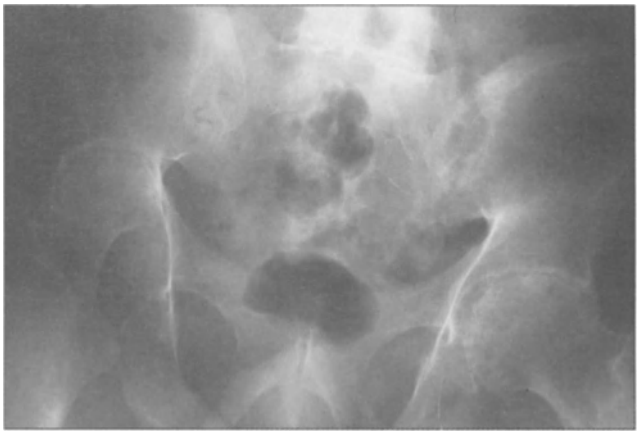

Figure 7.18 *Erosion and joint space narrowing of the hip joints in advanced ankylosing spondylitis*

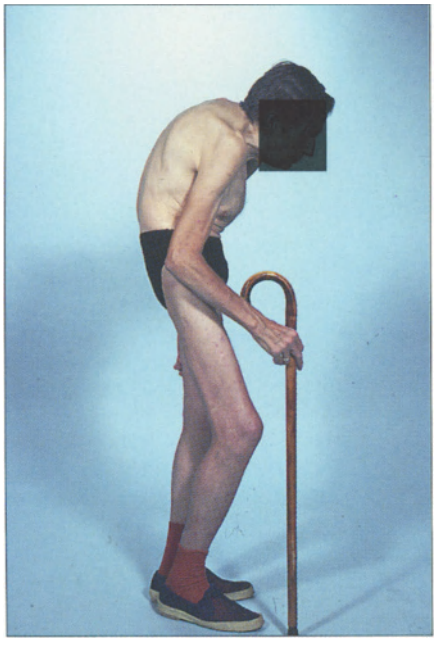

Figure 7.19 *Question-mark deformity with flexion of the knee and hip, straightening of the lumbar spine and marked thoracic kyphosis (see Figure 7.14). (Courtesy of Update Publications)*

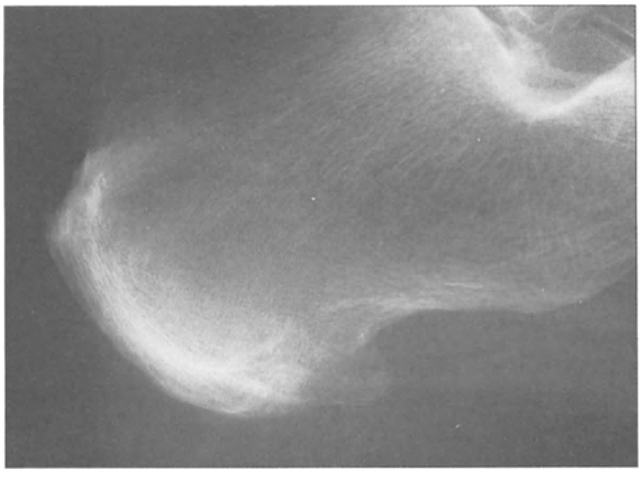

Figure 7.20 *Spur formation due to enthesitis at the plantar fascia insertion*

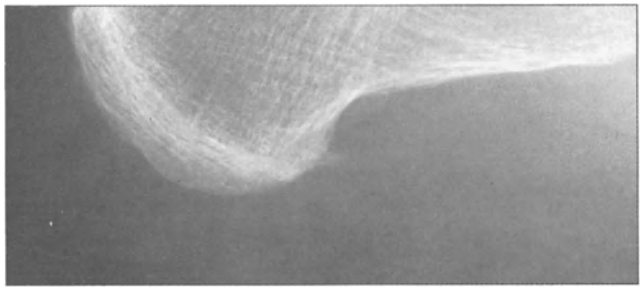

Figure 7.21 *Small, hard, well-defined, non-inflammatory bony spur*

Psoriatic arthritis

Psoriatic arthritis occurs in 5–8% of the psoriatic population, i.e. approximately 0.1% of the general population. It occurs with similar frequency in males and females, and most commonly presents between 36–45 years of age. Forty percent of patients with axial skeletal disease and 16% with peripheral joint involvement are HLA-B27 positive. Other histocompatibility antigens associated with psoriatic arthritis are HLA-B13, B17 and in particular B38.

Usually preceding the arthropathy, psoriatic skin and nail changes may also occur synchronously with (7% and 26% respectively) or follow (26% and 41% respectively) the development of arthritis. Nail changes characterized by multifocal deep, irregular pitting (Figure 7.22), ridging and onycholysis (Figure 7.23), occur in 85% of psoriatics with arthritis and 31% without. The cutaneous lesions of psoriasis frequently occur on the elbows (Figure 7.24), knees, scalp (Figure 7.25) and trunk. It is essential to perform a careful examination of the scalp, umbilicus and natal cleft in patients with articular signs suggesting a spondyloarthropathy but in whom psoriatic skin lesions are not immediately obvious. Pustular psoriasis may develop on the palms and soles (Figure 7.26), and is both clinically and histologically indistinguishable from the rash of keratodermia blenorrhagica seen in patients with Reiter's syndrome. In most patients with psoriatic arthritis, activity in the skin and joints is asynchronous and there is no unequivocal evidence that treating the skin lesions results in improvement of the arthritis.

Psoriatic arthritis has been categorized into five broad subgroups:

(1) *Predominant distal interphalangeal joint involvement.* Involvement of the DIP joints is more common in males than females and is frequently associated with psoriatic nail dystrophy (Figure 7.27). The differential diagnosis is between psoriatic arthritis, classical osteoarthritis and erosive osteoarthritis. Radiographs of affected psoriatic joints frequently show evidence of an erosive and often destructive arthropathy (Figure 7.28). Severe disease results in the middle phalanx being whittled away, the base of the terminal phalanx becoming flared and development of the 'pencil-in-cup' or 'fish-tail' deformity (Figure 7.29). Progressive polyarticular destruction of the proximal and distal interphalangeal joints ultimately results in arthritis mutilans. In addition to these destructive articular changes, digits may also undergo shortening as the result of erosion of the tufts of the terminal phalanges (acro-osteolysis).

(2) *Arthritis mutilans.* Severe deforming polyarthritis is not peculiar to psoriatic arthritis but is typical of severe forms of this disorder, and results in the opera glass hand (*doigt en lorgnette*) deformity.

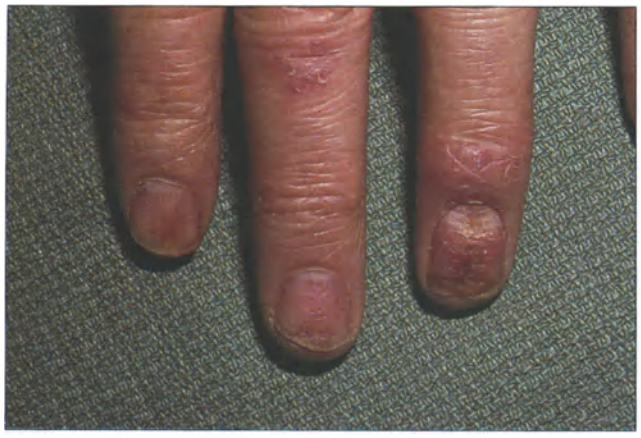

Figure 7.22 *Multifocal, deep, irregular pitting and transverse ridging in psoriatic nail dystrophy*

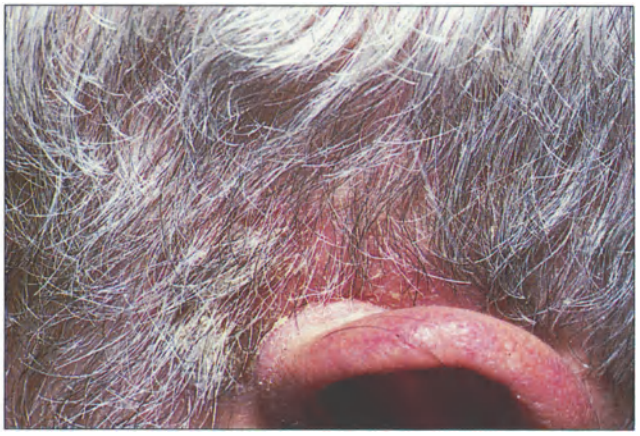

Figure 7.25 *Psoriatic lesions in the scalp, umbilicus and natal cleft may easily be missed without careful examination*

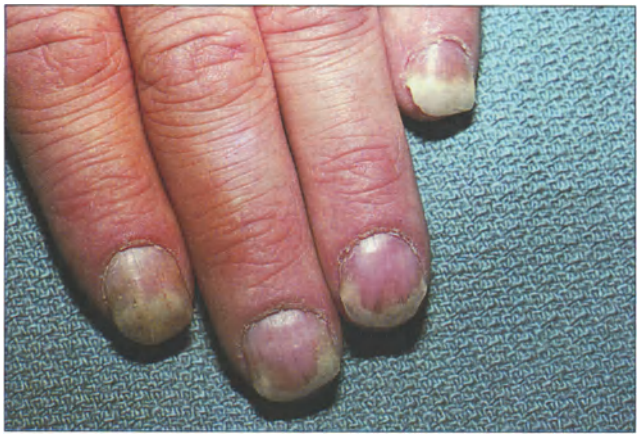

Figure 7.23 *Marked onycholysis in psoriatic nail dystrophy*

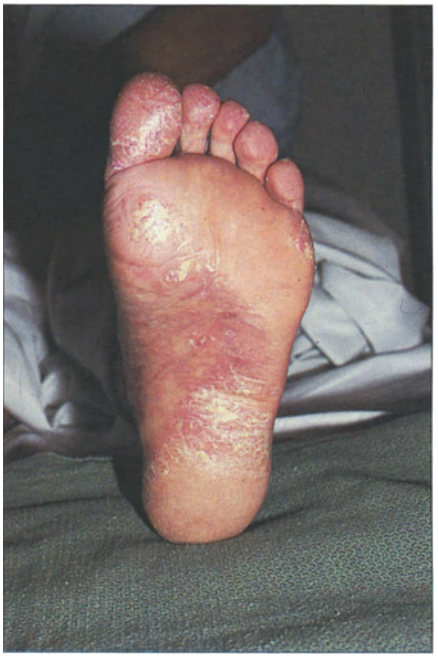

Figure 7.26 *Pustular psoriasis on the sole of the left foot*

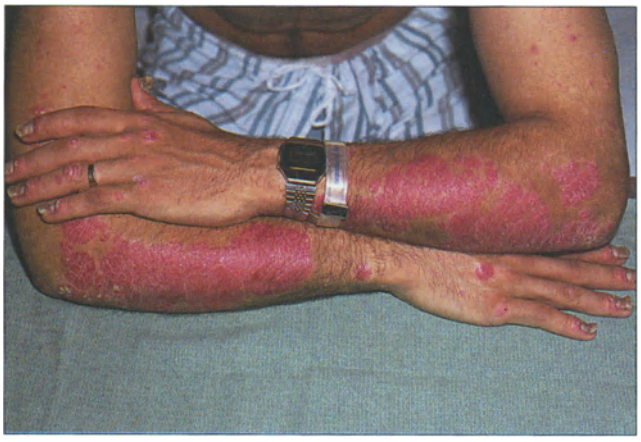

Figure 7.24 *Typical lesions of psoriatic arthritis*

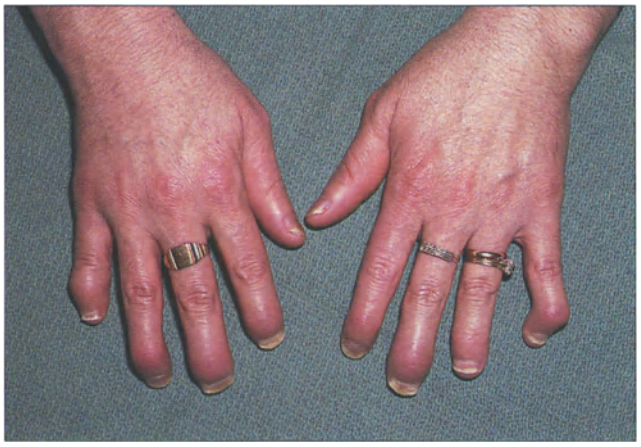

Figure 7.27 *Pure distal interphalangeal joint involvement in psoriatic arthritis*

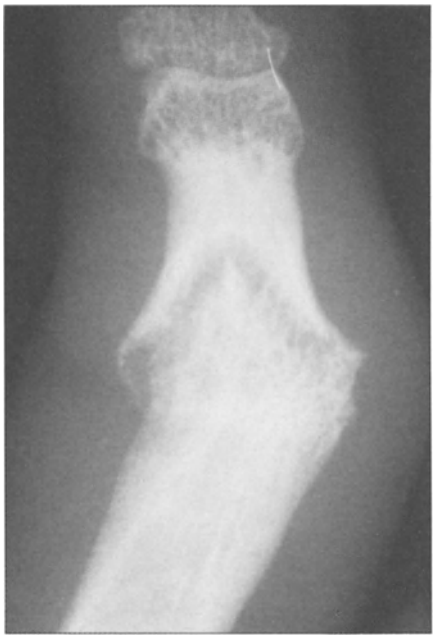

Figure 7.29 *'Pencil-in-cup' deformity in PIP joint*

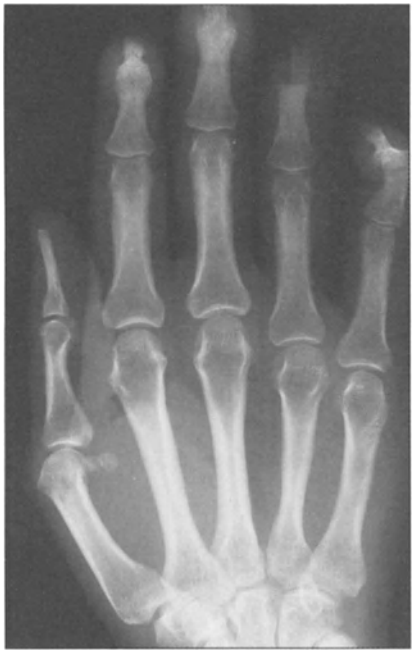

Figure 7.28 *Joint space narrowing and deformity in the DIP joints of patient shown in Figure 7.27*

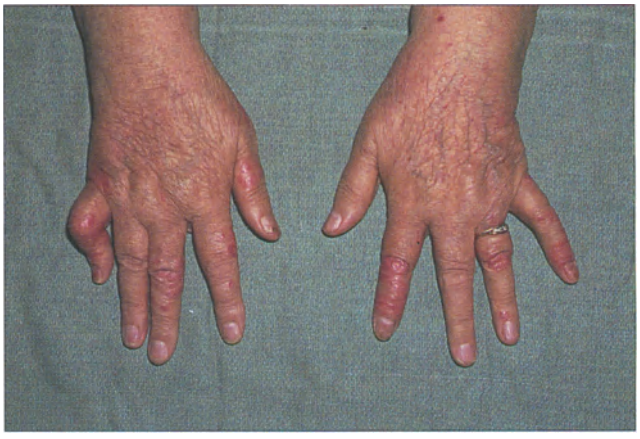

Figure 7.30 *Rheumatoid-like variant of psoriatic arthritis showing swan neck deformity in the right fifth digit and symmetrical involvement of the MCP joints*

(3) *Rheumatoid-like polyarthritis.* In patients with the symmetrical polyarticular form of the disease, pure psoriatic arthritis cannot always be clearly differentiated from rheumatoid arthritis (Figure 7.30). However, the presence of psoriatic skin and nail lesions, seronegativity for IgM rheumatoid factor, involvement of the DIP joints and radiographic features of psoriatic arthropathy allow most patients to be categorized correctly. In contrast to rheumatoid arthritis, psoriatic arthritis involves fewer joints, is asymmetrical, shows a tendency to ankylosis, a relative paucity of erosions (Figure 7.31) and may spare the MCP and MTP joints. Furthermore, in the interphalangeal joints, erosion is often accompanied radiographically by hypertrophic changes. Dactylitis (Figure 7.32) in a toe or finger produces swelling which resembles a cocktail sausage (i.e. a sausage digit) and is an extremely valuable sign in differential diagnosis.

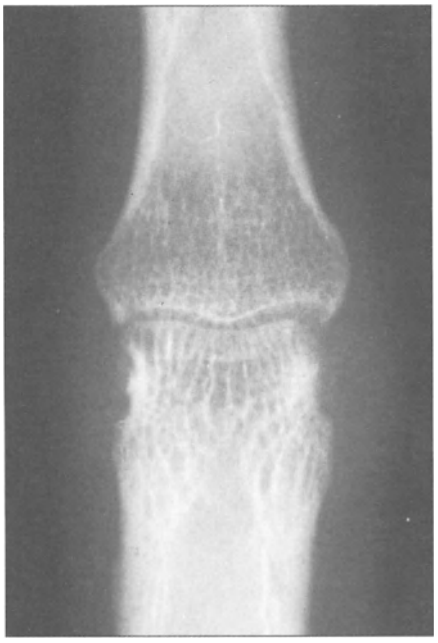

Figure 7.31 *Marginal erosion in the interphalangeal joint*

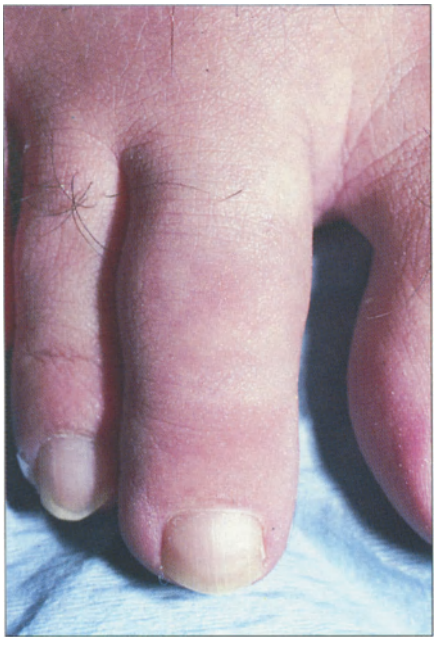

Figure 7.32 *Dactylitis of the right second toe. Note diffuse sausage-like swelling*

(4) *Oligoarthritis (or monoarthritis).* The oligoarticular form of psoriatic arthritis may involve large and small joints in an asymmetric fashion. On occasion it may have a gout-like presentation involving the great toe. In these cases diagnosis may be confounded by a concomitant elevation of the serum uric acid which results from extensive skin involvement.

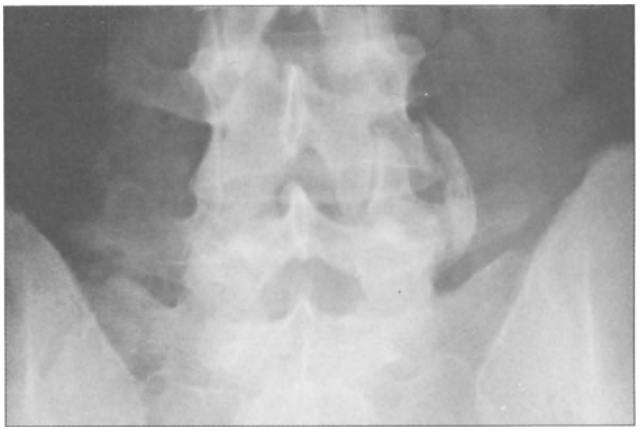

Figure 7.33 *Asymmetrical non-marginal syndesmophyte formation in psoriatic spondylitis. (Courtesy of Update Publications)*

(5) *Spondylitis.* Sacroiliitis and spondylitis occur in 21–40% of patients, and in some resemble idiopathic ankylosing spondylitis. Males are more commonly affected than females in this HLA-B27 related subgroup. Radiographically sacroiliitis is often unilateral or asymmetric in distribution. Syndesmophytes are few in number, may occur in the absence of sacroiliac disease and are non-marginal in their location (Figure 7.33). Fusion due to paravertebral ossification may occur in the thoracic region of the spine, while apophyseal joint sclerosis and narrowing, anterior ligament calcification and syndesmophyte formation may develop in the cervical spine. In contrast to ankylosing spondylitis, the bamboo spine is rare in psoriatic spondylitis.

Extra-articular manifestations of this disorder include enthesitis, conjunctivitis (19.6%), iritis (7.1%), keratoconjunctivitis sicca (2.7%) and episcleritis (1.8%).

Reiter's syndrome

While the aetiology of Reiter's syndrome remains unknown, its occurrence following dysenteric illness and sexual promiscuity suggests an infectious aetiology. To date, however, it has not been possible to account for all patients with a single causal agent. Reiter's syndrome has been reported following an epidemic of *Shigella flexneri* dysentery, and has also been observed following infection with *Shigella dysenteriae,* Salmonella, Campylobacter and Yersinia organisms. Mycoplasma and Chlamydia have been detected in several post-coital cases but have not been isolated in the majority of patients. The arthritis of Reiter's syndrome is considered to be reactive, since cultures of synovial fluid fail to grow any organisms including those of the primary infection.

The incidence and prevalence of Reiter's syndrome are difficult to assess due to (1) difficulty in diagnosis, (2) the absence of certain disease accompaniments in incomplete forms of the disease, (3) the geographic mobility of affected individuals and (4) the reluctance to report symptoms in cases of venereally-related disease. Moreover, in female patients, both urethritis and cervicitis may be asymptomatic. Thus the condition is almost certainly underdiagnosed (particularly in females) and may in some instances be misdiagnosed. Nevertheless, it appears to be more common in males than females and current estimates place the incidence of Reiter's syndrome at 1.5% in patients with Shigella infection and between 1 to 3% in patients with non-specific urethritis. The risk of Reiter's syndrome developing in HLA-B27-positive individuals with Shigella infection is 25% and with non-specific urethritis is 20%. Eighty percent of Caucasians with Reiter's syndrome are positive for HLA-B27. The disease is uncommon in children because of an apparent resistance to post-dysenteric forms of the disease and a lack of venereal contact.

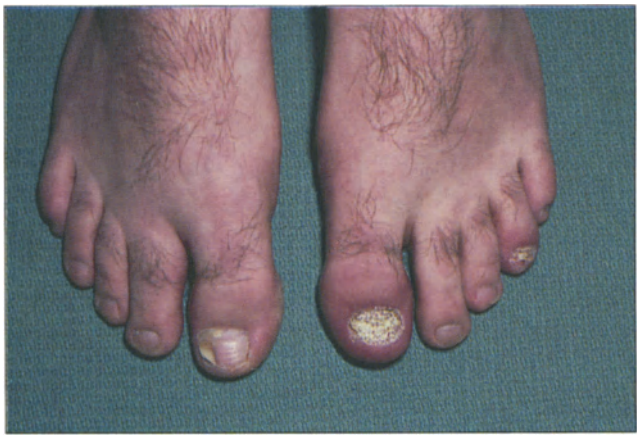

Figure 7.34 *Nail dystrophy and a dactylitis of the second right toe in Reiter's syndrome*

Reiter's syndrome is a triad of conjunctivitis, non-specific urethritis and arthritis. When these three features coexist the diagnosis is straightforward. However, it should be noted that (1) the components of the triad may be temporally separated, i.e. not exist concurrently and (2) incomplete forms of the disorder (particularly urethritis and arthritis without conjunctivitis) are quite common. In this latter situation differentiation from gonococcal arthritis is of paramount importance. Conjunctivitis may be absent in 40% of cases of Reiter's syndrome, and may be either transient or forgotten by the patient. Similarly, urethritis may be mild, transient and go unreported. Fever and leukocytosis may occasionally accompany other features of the disorder and suggest the presence of an infection.

The large weight bearing joints of the lower extremity, particularly the knees and ankles, are the target joints for Reiter's syndrome (Figure 1.6). However, the large joints of the upper extremity as well as the small joints may also be involved. Swelling in the toes may be due to either arthritis of the interphalangeal joints or alternatively to dactylitis (Figure 7.34). Arthritis is usually asymmetric, oligoarticular and commonly follows the earlier features of urethritis, conjunctivitis or diarrhoea by 1–3 weeks. Synovial analysis reveals a sterile turbid yellow fluid, having an elevated white cell count. In early disease, radiographs show only evidence of soft tissue swelling, while in more advanced disease periarticular osteoporosis, bony erosion and on occasion ankylosis may be present.

Spinal involvement tends to occur in patients who have longstanding or recurrent disease. Back pain may be due to sacroiliitis, spondylitis, or insertional tendonitis and displays features typical of an inflammatory disorder. Whilst sacroiliitis is often unilateral or asymmetrical and tends to skip areas of the spine, some patients develop the typical picture of ankylosing spondylitis. Enthesitis may result in pain and spur formation at the Achilles tendon and plantar fascia insertions, while involvement of the intercostal muscle insertions results in a pleuritic type of chest pain.

A mucoid or mucopurulent urethral discharge denotes the presence of urethritis, while tenderness and enlargement of the prostate gland are indicative of prostatitis. In some patients, it may be necessary to perform prostatic massage to demonstrate the presence of a discharge. Haemorrhagic cystitis is infrequent but results in pyuria, and micro- or macroscopic haematuria. Cystoscopic findings in patients with haemorrhagic cystitis include oedema, superficial ulceration and pinpoint haemorrhage of the bladder wall.

The conjunctivitis of Reiter's syndrome is usually mild and bilateral, and should be differentiated from iritis which tends to be painful, unilateral and occurs in approximately 20–50% of patients.

The tongue (Figure 7.35), oral mucosa (Figure 7.36), penis, nails and skin should be carefully examined for evidence of mucocutaneous lesions. This is particularly true in the case of the tongue and oral mucosa since superficial ulceration may be asymptomatic (*cf* Behçet's disease) and otherwise remain undetected. Circinate balanitis results in painless superficial erosion of the glans penis and may be present in up to 50% of patients (Figure 7.37). Nail abnormalities consist of a raised erythematous edge to the nail fold, subungal keratosis and a severe dystrophy which occasionally results in nail loss (Figure 7.38). Keratodermia blenorrhagica most usually occurs on the soles of the feet (Figure 7.39), and is clinically and histologically indistinguishable from pustular psoriasis.

Reiter's syndrome may occasionally be complicated by hydronephrosis, keratitis, optic neuritis, retinitis, pericarditis, valvulitis, peripheral neuritis, pleurisy, pneumonitis, purpura, amyloid or thrombophlebitis.

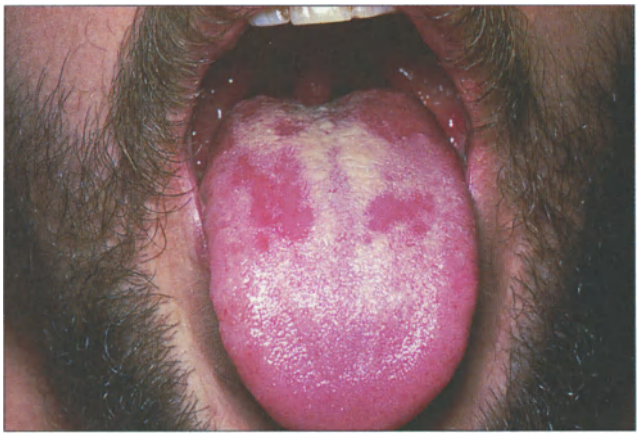

Figure 7.35 *Superficial ulceration of the tongue*

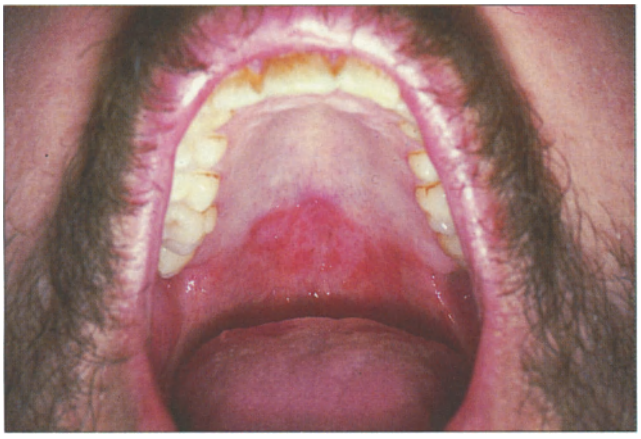

Figure 7.36 *Superficial ulceration of the palate*

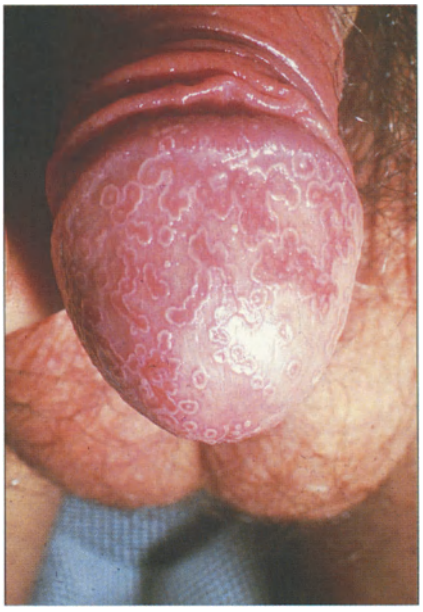

Figure 7.37 *Circinate balanitis in Reiter's syndrome (Courtesy of Dr W. W. Buchanan)*

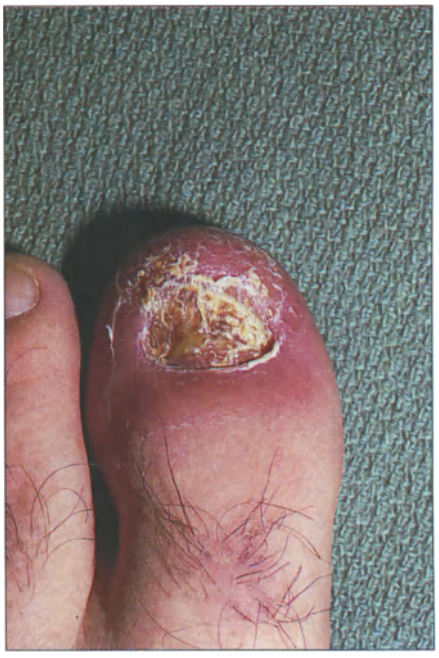

Figure 7.38 *Severe nail dystrophy in Reiter's syndrome showing subungal lakes of pus and periungal erythema*

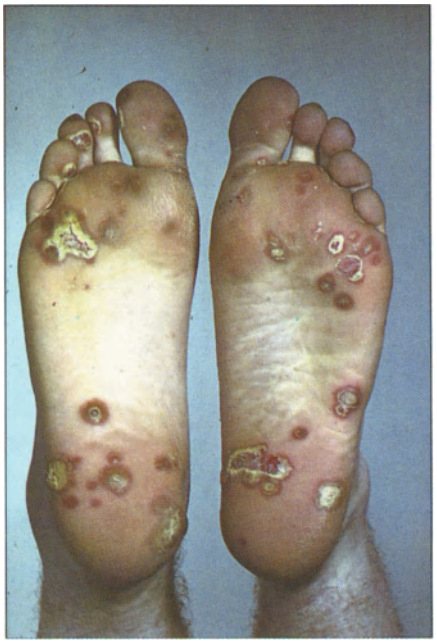

Figure 7.39 *Typical appearance of keratodermia blenorrhagica*

Enteropathic arthropathies

The spondyloarthropathies associated with Crohn's disease, ulcerative colitis and Whipple's disease are known collectively as the enteropathic arthropathies.

Crohn's disease (regional enteritis)

Peripheral arthritis occurs in 20% of patients with Crohn's disease, males and females being equally affected. The arthritis is oligoarticular, usually affects the knees and ankles and follows the onset of bowel symptoms by a variable period of time (Figure 7.40). Arthritis is typically episodic, attacks frequently lasting less than 4 weeks and paralleling variations in the activity of the enteritis. Even with prolonged attacks of arthritis most patients recover with little or no permanent disability. Ankylosing spondylitis has been reported in 4% of patients with Crohn's disease. Approximately 55% of spondylitic patients with Crohn's disease are HLA-27-positive. In contrast to the peripheral arthropathy, spondylitic disease may precede the onset of bowel symptoms, or may be asymptomatic. It does not parallel the enteritis in its activity and is frequently indistinguishable from idiopathic ankylosing spondylitis.

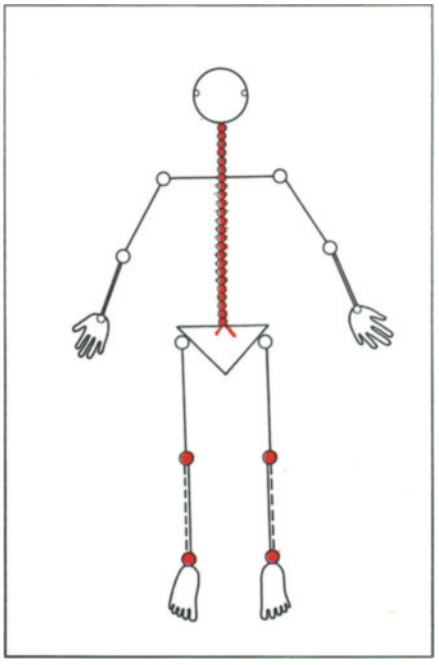

Figure 7.40 *Crohn's disease – distribution of target joints*

Ulcerative colitis

Peripheral arthritis occurs in 10% of patients with ulcerative colitis, males and females being equally affected. The arthropathy is oligoarticular and commonly affects the knees and ankles with shortlived (less than 4 weeks) self-limited attacks of inflammation (Figure 7.41). As with Crohn's disease the large joints of the upper extremity may be affected, albeit less frequently. Inflammatory activity of the colitis and peripheral arthritis often parallel one another, and even with prolonged inflammation most patients recover with little or no permanent damage. Ankylosing spondylitis occurs in approximately 4% of patients and is indistinguishable from the idiopathic form. HLA-B27-positivity has been reported in 73% of spondylitic patients with ulcerative colitis. Spondylitic disease may precede the onset of colitis, or be asymptomatic and does not parallel the colitis in activity. Total colectomy appears to have no significant effect on the course of the spondylitis.

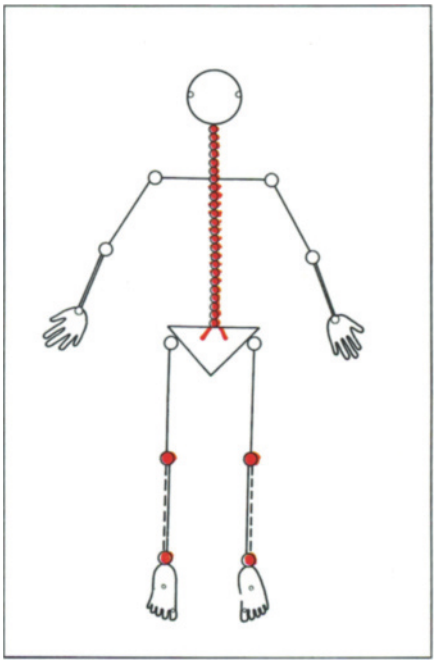

Figure 7.41 *Ulcerative colitis – distribution of target joints*

Whipple's disease

Whipple's disease principally affects males, and appears to be the result of infection in that (1) bacteria have been noted in PAS-positive macrophages and (2) the disease is responsive to antibiotic therapy. Arthralgia or arthritis develop in more than 50% of patients and characteristically precede other features of the disease (diarrhoea, weight loss, abdominal pain) by substantial periods of time. The arthropathy tends to involve the ankles, knees, elbows, shoulders and fingers in a recurrent oligo- or polyarticular pattern. Prolonged periods of complete remission are punctuated by short attacks of arthritis lasting hours or days. It is of interest that the arthritis may remit with the onset of bowel symptoms. HLA-B27 positivity is thought to be increased in patients with this disorder, ankylosing spondylitis having been reported in six patients and radiographically abnormal sacroiliac joints in four others.

Chapter 8

Infectious Arthritis

Several types of viral, bacterial and fungal infection may result in arthritis. Since this chapter concerns principally those types of infection in which the offending organism can be detected within the synovial cavity, viral arthritis has not been reviewed although the common causes are shown in Table 8.1. Infectious arthritis may occur *de novo,* or complicate either an established arthritis or a major (joint replacement) or minor (joint aspiration) surgical procedure. Joint sepsis is a rheumatologic emergency and demands urgent attention, skilled management and specific therapy. Significant morbidity and mortality are associated with delayed, inappropriate and suboptimal therapy.

Bacterial arthritis

Bacterial arthritis in adults usually results from haematogenous spread of organisms from a distant focus, rather than by direct invasion from a juxta-articular site of infection. Septic arthritis may be caused by a variety of organisms which differ in their propensity to infect joints (Table 8.2). It is convenient for clinical purposes to subdivide bacterial arthritis into five distinct subgroups:

(1) Gonococcal arthritis
(2) Non-gonococcal arthritis
(3) Septic arthritis in childhood
(4) Septic discitis
(5) Tuberculous arthritis and spondylitis.

Gonococcal arthritis

This frequent cause of septic arthritis (particularly in North America) occurs in 1–3% of patients infected with *Neisseria gonorrhoeae.* In some geographic locations, it is the commonest cause of infectious arthritis in the 16–40-year-old age group. Gonorrhoea is at least as common in females as it is in males. Affected females, however, may pursue a more benign course, and in some cases act as an asymptomatic reservoir of infection. Haematogenous spread may occur from primary foci in the urethra, vagina, pharynx and rectum.

Pregnant and menstruating females are particularly at risk of dissemination from vaginal foci. Arthritis and dermatitis are the most usual complications of such dissemination, endocarditis, meningitis, myocarditis and perihepatitis occurring less frequently. Fever, chills and a mild leukocytosis may accompany other features of gonococcaemia. The most usual presentation is that of a migratory polyarthritis which eventually localizes in one or more joints usually the knees and wrists. Tenosynovitis of the dorsum of the hands, wrists and feet or

Table 8.1 ***Viral causes of arthritis***

Rubella (infection or vaccination)	Chikungunya
Hepatitis B	O'nyong nyong
Mumps	Epidemic polyarthritis of Australia
Varicella	Lyme arthritis (probably viral)
Echovirus	Erythema infectiosum (probably viral)
Adenovirus	
Infectious mononucleosis	
Smallpox (no new cases expected)	

Table 8.2 ***Bacterial causes of arthritis.***

Neisseria gonorrhoeae	– commonest in age group 16–40 y
Staphylococcus aureus	– commonest in age group 2–16 y and greater than 40 y
Haemophilus influenzae	– commonest in age group 6 months–2 y
Pseudomonas aeruginosa	
Escherichia coli	
Proteus mirabilis	
Seratia marcescens	
Klebsiella pneumoniae	
Salmonella species	
Neisseria meningitidis	
Bacteroides fragilis	
Mycobacterium tuberculosis	

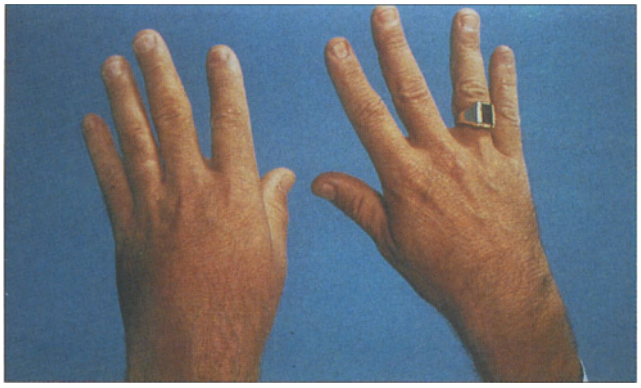

Figure 8.1 *Gonococcal tenosynovitis of the extensor tendons of the left wrist. (Courtesy of Update Publications and Dr J. Bertouch)*

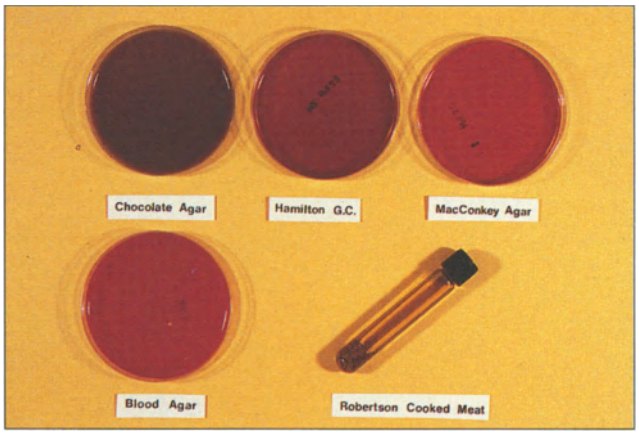

Figure 8.4 *Specific culture media are necessary to facilitate the growth of certain organisms (Chocolate agar — Neisseria and Haemophilus; Hamilton GC – Neisseria, MacConkey agar — Gram negatives especially coliforms; blood agar — Gram positives; Robertson cooked meat — fastidious organisms and anaerobes)*

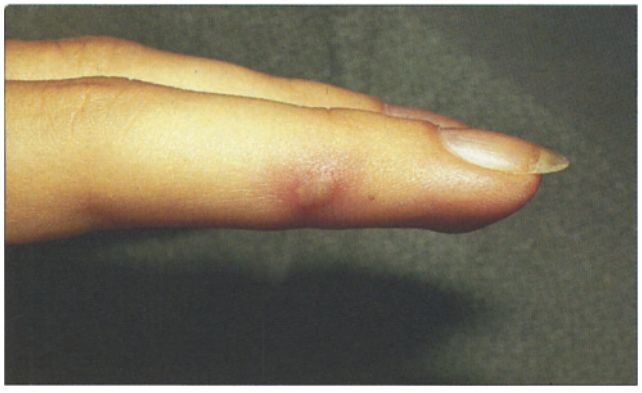

Figure 8.2 *Gonococcaemia, showing typical vesicopustular lesion on erythematous base (Courtesy of Update Publications)*

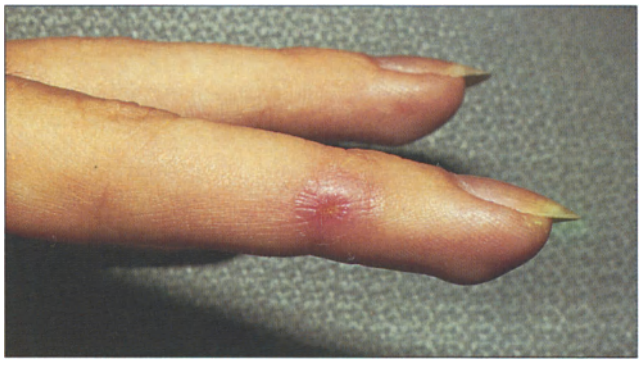

Figure 8.3 *Resolving stage of gonococcal dermatitis. (Courtesy of Update Publications)*

of the Achilles tendon occurs in 68% of patients (Figure 8.1), periarthritis being encountered less frequently. The characteristic skin lesions of disseminated gonococcal infection are vesicopustular and arise from an erythematous base (Figures 8.2, 8.3). Lesions are few in number, have a predeliction for the distal extremities and may on occasion appear haemorrhagic. Gonococcal lesions should be differentiated from those due to meningococcaemia, an infection which may also be complicated by arthritis (less than 10% of cases). An acute onset, migratory polyarticular configuration and associated tenosynovitis are all more suggestive of gonococcal than meningococcal infection.

Synovial fluid is typically inflammatory in nature with white cell counts of 35 000 to 60 000 cells/mm^3, 90% of which are polymorphonuclear leukocytes. Gram-negative intracellular diplococci may be observed on Gram staining and the organism detected on appropriate culture media, i.e. Chocolate agar (blood, skin or synovial fluid) or Hamilton GC (cervix, rectum, pharynx) (Figure 8.4). Even under ideal circumstances, however, synovial fluid cultures are positive in only 50% of cases and this underscores the importance of obtaining cultures from all potential primary foci.

Non-gonococcal arthritis

In addition to the intrinsic arthrotropicity of some bacteria, certain groups of patients are at greater risk of bacterial infection, particularly by Gram-negative bacilli. Patients on corticosteroid, cytotoxic and immunosuppressive drugs, intravenous drug abusers, patients with certain chronic diseases (malignancy, alcoholism, diabetes mellitus) and those with extra-articular infections are at increased risk, as are those with pre-existing joint disease (rheumatoid arthritis) and those who have

undergone articular surgery (replacement arthroplasty). In patients with established joint disease, intercurrent septic arthritis must be differentiated from an exacerbation of the primary articular disorder. Most patients with non-gonococcal bacterial arthritis have either altered immune resistance, or a regional joint abnormality or both. Finally, infection may follow simple joint aspiration, although this is exceedingly rare (1 in 5000 aspirations) provided a sterile technique is employed.

Irrespective of the type of organism, dissemination may result in bacteria becoming preferentially localized in the interstitial space of the synovium. The release of exotoxins, endotoxins, chemotactic factors and other phlogistic molecules results in polymorph activation and the release of proteolytic enzymes into the synovial fluid. These enzymes (e.g. collagenases, elastases, cathepsins) degrade collagen and proteoglycan, cause synovial proliferation and chondrocyte death, and thereby result in destruction of the articular cartilage. As activated polymorphonuclear leukocytes make a major contribution to this destructive process, it is important to remove them by repeated joint aspiration or surgical drainage.

Bacterial arthritis is usually acute in onset, monoarticular and affects the weightbearing joints of the lower extremity (especially the knee). Oligo- and polyarticular configurations occur less frequently and may involve the ankle, knee, hip, wrist, elbow and shoulder, or rarely the small joints of the upper or lower extremity. Pain, tenderness, swelling, increased temperature, decreased range of movement and erythema characterize the acutely infected joint (Figure 8.5). A modest fever ($<38°C$) and malaise are common, chills being infrequent and rigors rare. The peripheral white blood cell count is frequently elevated, but it should be noted that in immunosuppressed and debilitated patients there may be few specific signs of infection. In particular, the temperature and white cell count may be entirely normal. On rare occasions, a polyarticular distribution may suggest a diagnosis such as rheumatoid arthritis or calcium pyrophosphate deposition disease rather than bacterial arthritis.

In septic arthritis, the synovial fluid appears frankly purulent (Figure 8.6), white cell counts often being in the range of 50 000–100 000 cells/mm^3, 90% or more being polymorphonuclear leukocytes. The fluid typically shows a poor mucin clot, low viscosity and a glucose level which is less than 50% of a simultaneously obtained fasting serum glucose. *Staphylococcus aureus* is the most commonly isolated organism (Table 8.2) although cultures should be plated to detect other potential pathogens (Figure 8.4). Radiographs taken early in the course of the disease may be normal, or show evidence of soft tissue swelling, or in the case of an established arthropathy (e.g. rheumatoid arthritis) display features of the primary disorder. With persistent infection, however, juxta-articular bone becomes osteopaenic, the joint space rapidly diminishes due to chondrolysis and ultimately the subchondral bone is destroyed (Figure 8.7). Even patients who have been effectively treated, may develop secondary osteoarthritis after an intervening period of several years (Figure 8.8).

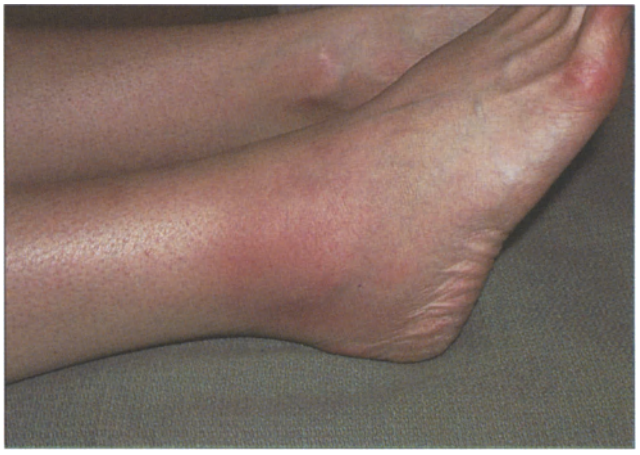

Figure 8.5 *Swelling and erythema in patient with staphylococcal arthritis of the ankle*

Figure 8.6 *Typical appearance of purulent synovial fluid* (staphylococcus aureus)

Septic arthritis in childhood

Bacterial arthritis in children commonly involves the hip and less frequently the knee or elbow. Males are more frequently affected than females, infection usually being a consequence of haematogenous spread from the middle ear, sinuses or skin. In contrast to sepsis in

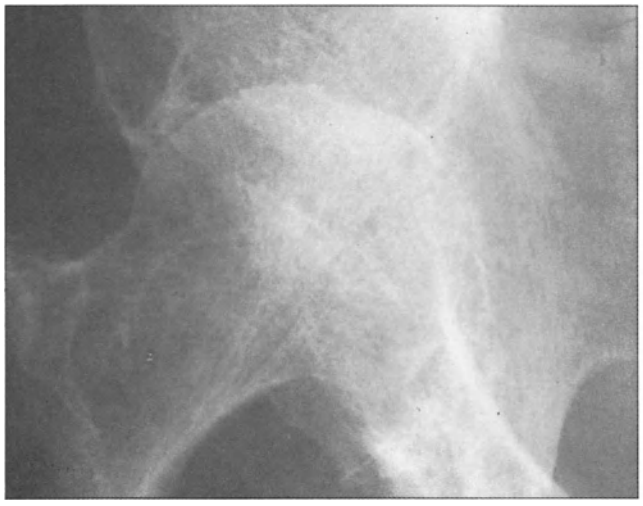

Figure 8.7 *Complete loss of joint space and irregularity of thhe femoral head in staphylococcal arthritis*

Figure 8.9 *Erosion of the vertebral end-plate in patient with* Proteus mirabilis *septic discitis*

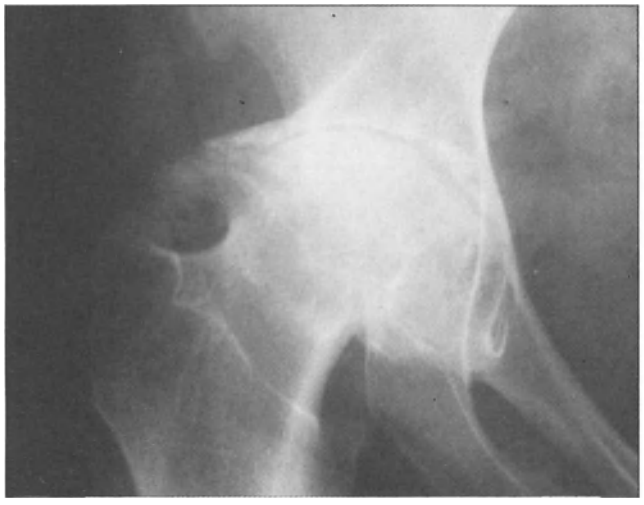

Figure 8.8 *Secondary osteoarthritis in patient with prior staphylococcal arthritis*

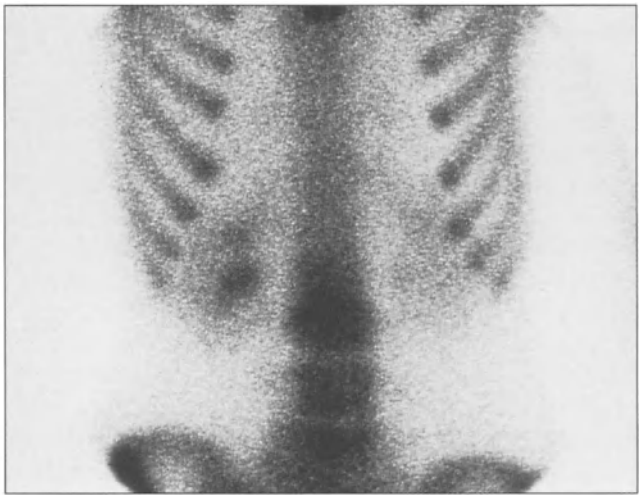

Figure 8.10 *Technetium scintiscan of septic discitis showing increased uptake at L2–3 intervertebral disc space. (Courtesy of Dr A. Driedger)*

adults, infection may spread directly from an osteomyelitic focus through the epiphyseal region and penetrate the joint space. Fever, malaise and joint pain are the characteristic presenting symptoms, although young children may be generally irritable or display a reluctance to move the affected limb. Infected joints are often extremely sensitive to even small degrees of movement, and in children with hip involvement the leg is frequently held abducted, flexed and externally rotated. *Haemophilus influenzae* is the commonest organism isolated in children between 6 months and 2 years of age, while *Staphylococcus aureus* predominates in the 2–16-year age group.

Septic discitis

Septic discitis is a distinct clinical entity in which the principal site of infection is in the intervertebral disc space. It is most commonly caused by *Staphylococcus aureus* or *Escherichia coli*. The clinical picture is frequently one of subacute back pain, tenderness over adjacent spinous processes and an elevation of the erythrocyte sedimentation rate. On occasion, however, there may be evidence of sciatic nerve root irritation, i.e. in those patients with discitis at the lumbar level. Diagnosis is often delayed by several weeks (particularly in patients with known degenerative disc disease), either because of a low index of suspicion or because of difficulty in discerning infection in a previously abnormal disc space. Irregularity and sclerosis of the vertebral end plate may be visible on plain radiographs, although the destructive nature of this disorder is often better appreciated on tomograms (Figure 8.9). Gallium scanning is a useful adjunct to tomography and may provide more specific information than that obtained by technetium scintiscanning (Figure 8.10). A localized area of

increased uptake of the radionucleotide may suggest a diagnosis of septic discitis prior to the development of florid radiographic abnormalities. Needle aspiration of the affected intervertebral disc, performed under fluoroscopic control, allows the diagnosis to be confirmed and provides infected material on which antibiotic sensitivities can be determined.

Tuberculous arthritis and spondylitis

Mycobacterium tuberculosis as well as atypical forms of tubercle bacilli (*M. kansasii, M. avium-intracellulare* etc.) may cause a chronic granulomatous arthritis. Since the introduction of pasteurized milk, *M. bovis* arthritis has become rare in the Western world. Approximately 1.3% of patients with tuberculosis develop musculoskeletal involvement, the axial and peripheral skeleton being equally affected. Less than 50% of patients show evidence of pulmonary tuberculosis, although almost all have a positive tuberculin skin test. The initial involvement of skeletal structures is usually due to haematogenous spread from a primary focus (although infection from a contiguous structure may occasionally occur). Following this initial infection, however, there may be direct spread from bone to joint or vice versa, or between adjacent levels of the spine.

Tuberculosis most frequently affects either the thoracolumbar spine or the hip joint. Monoarticular involvement of the knee, ankle or wrist occurs less frequently. The onset of symptoms is often insidious and the patient may complain of pain and disability for several months before the diagnosis is confirmed. Tuberculous arthritis of the hip most often occurs in middle-aged males and results in radiographic changes of osteopaenia, cartilage erosion and sequestration of subchondral bone. Since this process is focal, the joint space is often well preserved until late in the course of the disease (Figure 8.11). Tuberculous infection may result in sinus tract formation with drainage to the outer thigh (Figure 8.12) or an associated osteomyelitis. Synovial fluid from peripheral joints is usually turbid, the white cell count and protein content being elevated. Tubercle bacilli have been observed in 20% of acid-fast stains, 80% of synovial fluid cultures and 90% of synovial biopsies. Most atypical mycobacterial infections are diagnosed by synovial biopsy. In addition to causing articular disease, tuberculosis may also result in flexor or extensor tenosynovitis of the hand, dactylitis and tuberculous trochanteric bursitis.

Pott's disease (tuberculous spondylitis) most commonly involves the anterior borders of vertebrae and intervertebral discs of the thoracolumbar spine (Figure 8.13). Radiographically there is evidence of disc space narrowing, bone loss and osteopaenia, which in later stages of the disease may be associated with reactive new bone formation producing a mixed lytic-sclerotic appearance. In severe cases the vertebral body may eventually collapse resulting in a severe kyphotic angulation of the spine, i.e. a gibbous deformity (Figures 8.14 and 8.15). Paravertebral abscess formation may cause vertebral abnormalities at multiple spinal levels or destructive changes affecting the ribs. Cord compression and mycotic aortic aneurysm formation are the two most serious complications of this disorder.

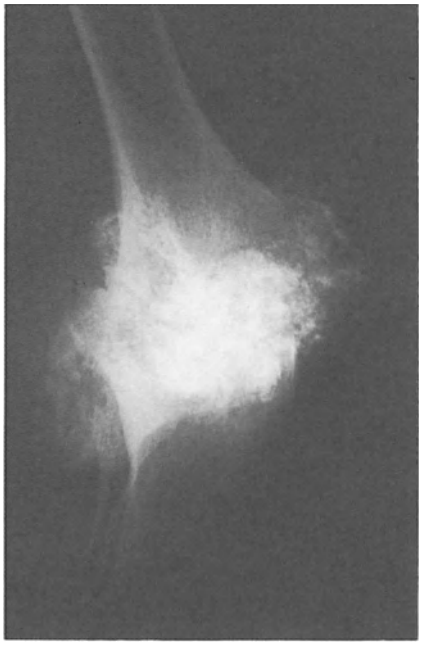

Figure 8.11 *Tuberculous arthritis of the knee showing complete obliteration of the joint space (By courtesy of Dr R. Haddad)*

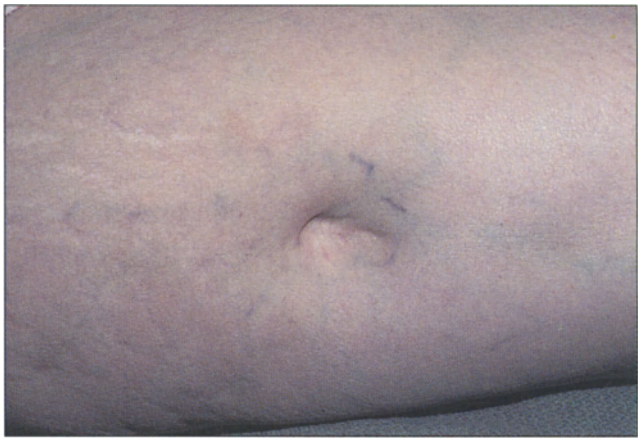

Figure 8.12 *Evidence of prior tuberculous disease with sinus tract communicating to the outer thigh*

Fungal arthritis

Arthritis and osteomyelitis are associated with several types of fungal infection. A chronic peripheral monoarthritis of insidious onset is most usual, although acute polyarticular forms may occur. The joint is usually

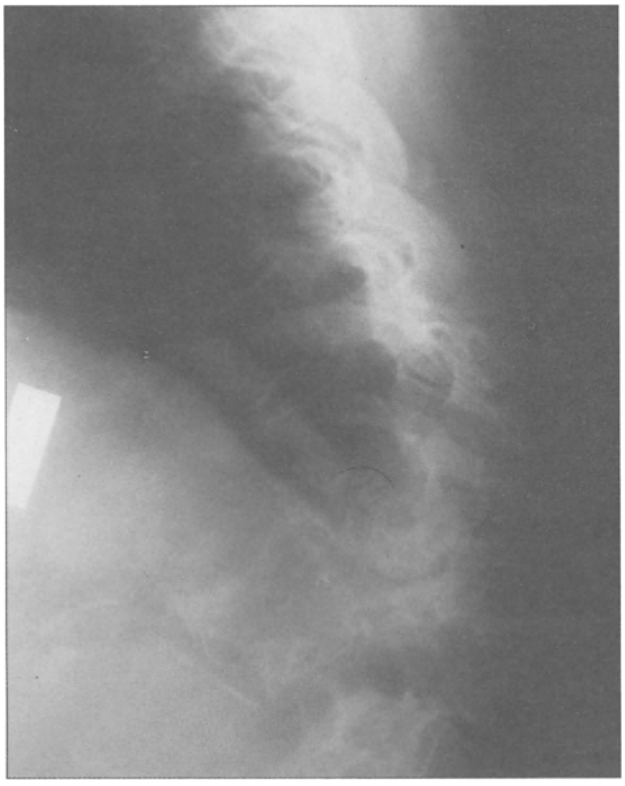

Figure 8.13 *Gibbous deformity in tuberculous spine. Note acute kyphotic angulation of the thoracolumbar junction due to vertebral body destruction*

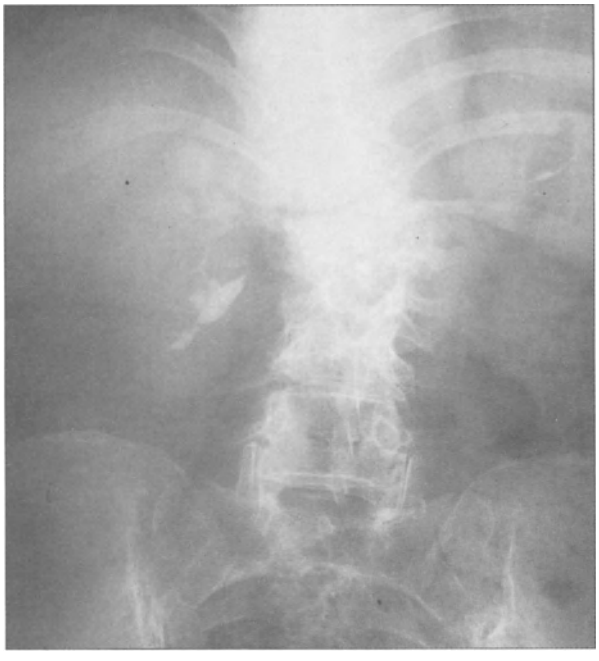

Figure 8.14 *Anteroposterior view of patient shown in Figure 8.13. Note scoliosis, loss of intervertebral disc spaces, compression of vertebrae and renal calcification secondary to tuberculous infection*

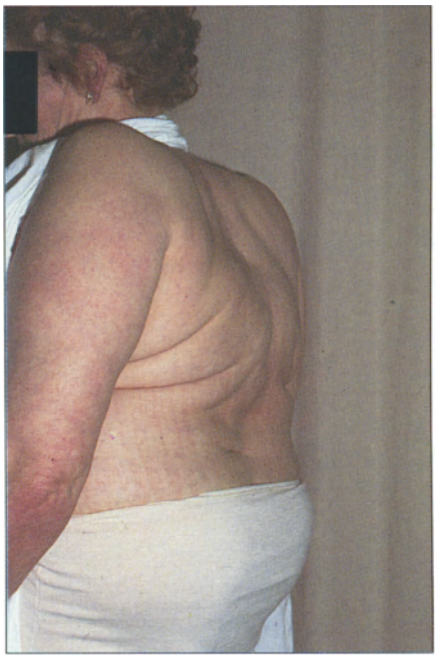

Figure 8.15 *Gibbous deformity in patient with tuberculous spondylitis. (Corresponding radiographs shown in Figures 8.13 and 8.14)*

infected from an adjacent bony focus, and less commonly by haematogenous spread from a more distant focus. The indolent course of the disease frequently delays diagnosis which in most instances is made on the results of serologic and skin testing, synovial fluid analysis and the examination of synovial biopsy material. In established disease, radiographs show evidence of a destructive process in which osteopaenia and joint space narrowing are associated with lytic lesions in subchondral bone.

Blastomyces dermatitidis

Blastomycosis is usually acquired by inhalation and results in pulmonary and cutaneous disease. Most infections are subclinical or mild, although skeletal involvement occurs in about 50% of patients with systemic manifestations. Arthritis may involve the knee or ankle, while osteomyelitis may occur in the axial skeleton, skull and long bones. Arthritis may be acute in onset but is more usually chronic in its evolution.

Cryptococcus neoformans

This rare cause of infectious arthritis, is usually acquired by inhalation of particles derived from avian faeces containing high concentrations of cryptococci. Dissemination from a pulmonary focus may occur to several organ systems. The commonest osteomyelitic sites are the skull, axial skeleton, ribs and long bones. Arthritis is usually chronic, monoarticular, involves the knee and is associated with an adjacent osteomyelitis.

Histoplasma capsulatum

H. capsulatum is also associated with avian faeces and commonly causes mild pulmonary symptoms. Skeletal involvement is rare, and while arthralgia and erythema nodosum may occur in acute histoplasmosis, arthritis is unusual.

Coccidioides immitis

Erythema nodosum and arthralgia may occur in the acute phase of this infection, which frequently causes upper respiratory symptoms. Dissemination is rare but may result in osteomyelitis and in arthritis in an adjacent knee, elbow or ankle.

Aspergillus fumigatus

Aspergillus fumigatus is a ubiquitous organism which may exist as either a commensal or a pathogen. Dissemination is usually confined to individuals with abnormal immune responsiveness, osteomyelitis being infrequent and arthritis rare.

Sporothrix schenckii

This aerobic fungus found in soil and vegetable matter, usually causes a cutaneous infection but may occasion ally result in tenosynovitis or a mono-, oligo- or polyarthritis having a predilection for the knee, ankle, wrist and elbow. The tibia is the most commonly affected bone in those patients who develop sporothrix osteomyelitis.

Candida species

While *Candida* spp. are ubiquitous in man, candida arthritis is restricted in general to patients who are immunosuppressed. Arthritis is rare, tends to affect the knee and may be either acute or chronic in its onset.

Actinomyces israelii

This commensal of the oropharynx is a Gram-positive anaerobic bacillus which has been misclassified as a fungus. Actinomycosis usually affects the facial bones and has a tendency to form abscesses and sinus tracts. Skeletal involvement by haematogenous spread is rare.

Chapter 9

Connective Tissue Diseases

The connective tissue disorders are a group of systemic rheumatic diseases characterized by a propensity for multisystem involvement early in the course of the disease, and arthropathies which tend to be mild, non-erosive and in general non-deforming. Systemic lupus erythematosus (SLE), progressive systemic sclerosis (PSS), the dermatomyositis–polymyositis complex (D–P complex), polyarteritis nodosa (PAN) and an overlap syndrome termed mixed connective tissue disease (MCTD) are the principal disease entities in this broad spectrum of disorders.

Systemic lupus erythematosus

Systemic lupus erythematosus (SLE) is more common in females than males (9:1) and occurs with a variable prevalence in different geographic areas. In Caucasian populations it affects approximately 1 in every 1000 women. The aetiology is unknown in the majority of patients, although in some it is related to drug ingestion (Table 9.1) or an underlying complement deficiency. It is thought in the remainder, that abnormal immune responsiveness, genetic predisposition or possibly viral infection may be of aetiologic importance. In particular a number of auto-antibodies to nuclear, nucleolar and cytoplasmic antigens have been found in the sera of patients with SLE (Table 9.2), and studies of the F_1 hybrid (NZB/NZW) mouse, have shown that female animals may spontaneously develop auto-antibodies to nuclear antigens and double-stranded DNA, and subsequently die of an immune complex mediated glomerulonephritis. The presence of viral antigens (especially type-C oncornavirus) in various tissues, and elevated antibody titres to rubella and measles viruses have suggested that viral infection may be of aetiologic importance in some patients. In respect to genetic factors, it should be noted that (1) SLE is more common in monozygotic than dizygotic twins, and in relatives of affected than non-affected individuals, (2) Negroes are more commonly affected than Caucasians and (3) HLA-A1, B8, B15 and B19 occur in increased frequency in SLE while HLA-A10 and B18 are associated with C2 deficiency, which is a recognized disease accompaniment in some patients. Environmental factors appear to play some role since (1) up to one-third of asymptomatic household relatives of patients with SLE, and research workers who handle lupus sera may be at risk of developing serologic abnormalities (lymphocytotoxic antibodies, anti-DNA and antinuclear antibodies), and (2) domestic dogs belonging to some individuals with SLE may show evidence of the disease. Finally, hormonal status may be of importance since (1) the disease

Table 9.1 ***Commonly prescribed drugs associated with the induction of systemic lupus erythematosus***

Definite association	*Probable association*
Hydralazine (Apresoline)	D-penicillamine
Procainamide (Pronestyl)	L-dopa
Isoniazid (Rimifon)	methyldopa (Aldomet)
Anti-convulsants	propylthiouracil
Chlorpromazine (Largactil)	antibiotics

Table 9.2 ***Classification of auto-antibodies to cellular components***

Nuclear	anti-DNA (single- or double-stranded*) antihistone* antinonhistone (Sm*, RNP*, SSB) anti-SSA* anti-RANA
Nucleolar	antinucleolar*
Cytoplasmic	anti-Ro* anti-La* antimicrosomal antimitochondrial antiribosomal RNP anti-RNA* (single-stranded or t-RNA)

*SLE-associated

predominantly affects females, (2) disease activity may increase in pregnancy and following therapeutic abortion, (3) SLE and Kleinfelter's syndrome have been reported to coexist and (4) manipulation of the hormonal status of the NZB/NZW F_1 hybrid mouse results in modification of disease expression.

Whatever its aetiology, SLE is thought to be an immune complex mediated disorder in which hyperactive B lymphocytes and hypoactive suppressor T lymphocytes lead to hypergammaglobulinaemia, autoantibody production, activation of the classic and alternate complement pathways and the deposition of circulating immune complexes in a variety of organ systems. The disease shows spontaneous fluctuation in its activity, but may be exacerbated by intercurrent infection, surgery, pregnancy, therapeutic abortion, drug ingestion (especially sulphonamides) and exposure to artificial ultraviolet light (disco-lupus) or natural sunlight.

The American Rheumatism Association (ARA) Criteria (Table 9.3) are used as a method of classifying SLE and were revised in 1982. Several changes in the original 1971 criteria have resulted in enhanced sensitivity (96%) and specificity (96%). Nevertheless some patients currently diagnosed as having lupus-like syndromes do not fulfil present criteria and remain a diagnostic dilemma. In addition to organ-specific features, active disease may be accompanied by constitutional symptoms such as low-grade fever, malaise, fatigue and weight loss.

Arthralgia or arthritis occurs in 86–100% of patients. The arthritis is usually symmetrical and commonly involves the proximal interphalangeal (Figure 9.1), metacarpophalangeal, knee, and wrist joints (Figure 1.7). Swan neck deformities (Figure 9.2) and ulnar deviation (Figure 9.3) may occur, but in contrast to rheumatoid arthritis, deformities are less frequent, less severe, reducible, and are rarely associated with bony erosion, cartilage loss or nodule formation (Figure 9.4). Synovial

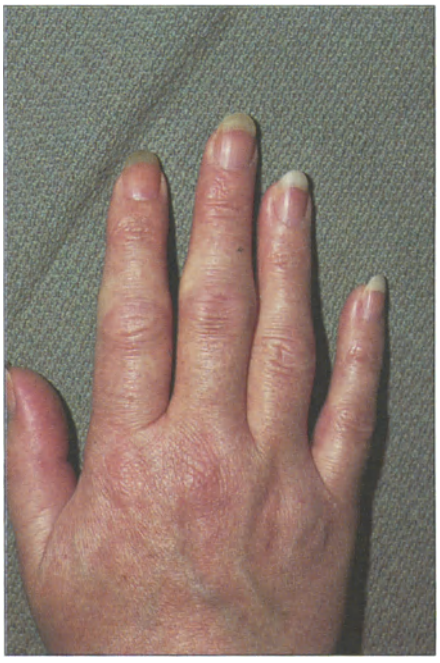

Figure 9.1 *Proximal interphalangeal joint swelling in early systemic lupus erythematosus*

Table 9.3 ***Summary of the ARA (1982) criteria for the classification of SLE****

Malar rash	
Discoid rash	
Photosensitivity	
Oral ulcers	
Arthritis	
Serositis	– Pleuritis or pericarditis
Renal disorder	– Persistent proteinuria (>3+) or cellular casts
Neurologic disorder	– Seizures or psychosis
Haematologic disorder	– Haemolytic anaemia or leukopenia or lymphopenia or thrombocytopenia
Immunologic disorder	– Positive LE cell preparation or anti-DNA or anti-Sm antibodies or chronic false positive serologic test for syphilis
Antinuclear antibody	– Abnormal titre of ANA

* SLE diagnosed on basis of four or more criteria.
For details see: *Arthritis and Rheumatism*, 1982: **25**, 1271–1277

Table 9.4 ***Major organ involvement in SLE***

Renal
Mild (focal) glomerulonephritis
Severe (diffuse) proliferative glomerulonephritis
Membranous lupus nephritis
Mesangial (minimal) lupus nephritis
Renal tubular acidosis

Neurological
Peripheral neuropathy
Psychosis
Seizures
Headaches
Cranial nerve abnormalities
Ocular abnormalities
Myelitis

Vascular
Raynaud's phenomenon
Digital gangrene, nailbed and nailfold haemorrhages
Thrombophlebitis

Gastrointestinal
Serositis
Anorexia, nausea, vomiting
Oral ulceration
Mesenteric arteritis – bowel infarction
Ascites
Pancreatitis
Hepatomegaly
Splenomegaly

Ocular
Conjunctivitis, keratoconjunctivitis sicca
Episcleritis
Retinal arteritis
Cytoid bodies

Cardiac
Pericarditis
Electrocardiogram abnormalities
Myocarditis
Endocarditis
Valvulitis (Libman Sachs verrucous endocarditis)

Haematological
Anaemia
Leukopaenia
Thrombocytopaenia
Circulating anticoagulants

Respiratory
Pleurisy
Nasal ulceration
Pneumonitis

Cutaneous
Discoid lupus
Alopecia
Photosensitivity
Vasculitis
Bullous lesions

Miscellaneous
Lymphadenopathy
Parotid enlargement
Xerostomia

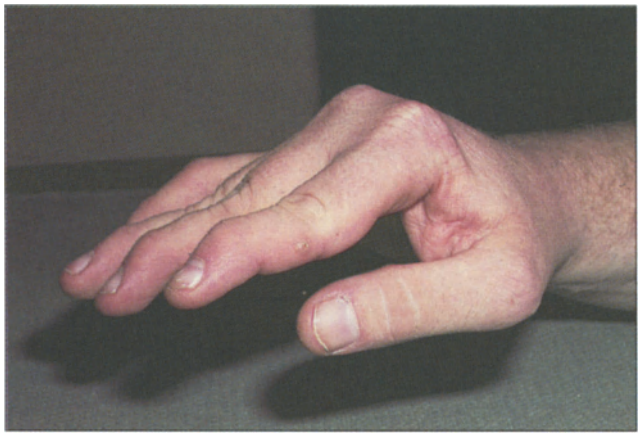

Figure 9.2 *Swan neck deformities in SLE*

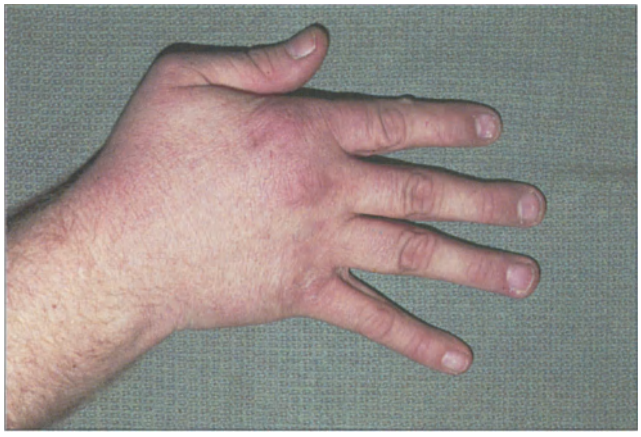

Figure 9.3 *Jaccoud-type of arthropathy in patient with SLE*

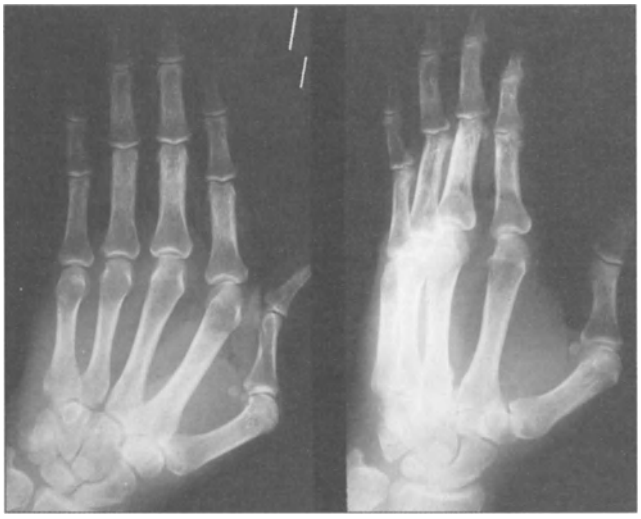

Figure 9.4 *Ulnar deviation in SLE – note absence of erosive changes and similarity to Jaccoud's arthropathy which may complicate rheumatic fever. (Radiograph of patient shown in Figure 9.3)*

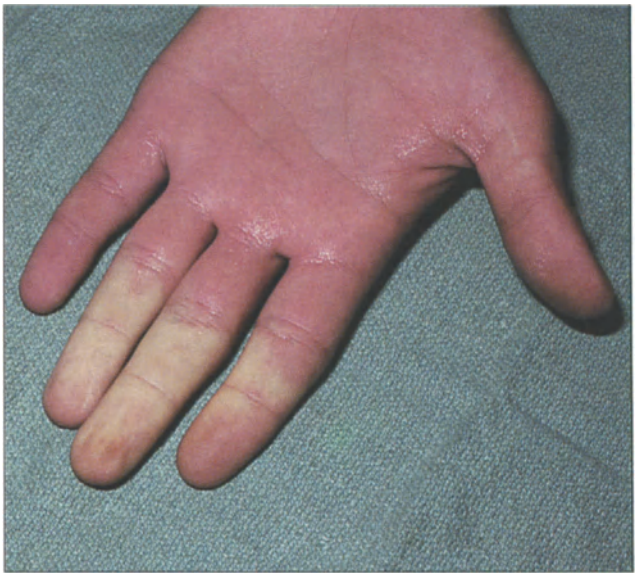

Figure 9.5 *Vasospastic changes induced by cold water immersion in patient with SLE*

fluid from affected joints shows a mildly elevated white cell count in which mononuclear cells predominate. Patients with SLE, particularly those on corticosteroid drugs, are also at increased risk of developing septic arthritis and osteonecrosis.

Raynaud's phenomenon is a vasospastic response usually induced by cold exposure. It is characterized by a triphasic colour change (pallor–cyanosis–suffusion) affecting the fingers (and sometimes the toes), which is associated, during the ischaemic phase, with digital pain or paraesthesia (Figure 9.5). Raynaud's phenomenon is often asymmetrical, affects some but not all digits and is associated with multisystem pathology. It should be differentiated from the related, but benign condition known as Raynaud's disease, which principally affects young women, is not associated with involvement of other systems and results in a symmetrical non-progressive vasospastic abnormality.

Although malar erythema (Figure 9.6), discoid lupus (Figure 9.7) and photosensitivity (Figure 9.8) are considered diagnostic criteria for SLE (Table 9.3), numerous other skin rashes have also been reported (e.g. livedo reticularis, lupus profundus, bullous dermatitis, urticaria). Cutaneous vasculitis may be manifest as areas of periungal infarction or splinter haemorrhage, or result in palpable purpura, particularly in the lower extremities (Figure 9.9). Such lesions may occur in isolation, or herald more severe disease in both skin and viscera. The

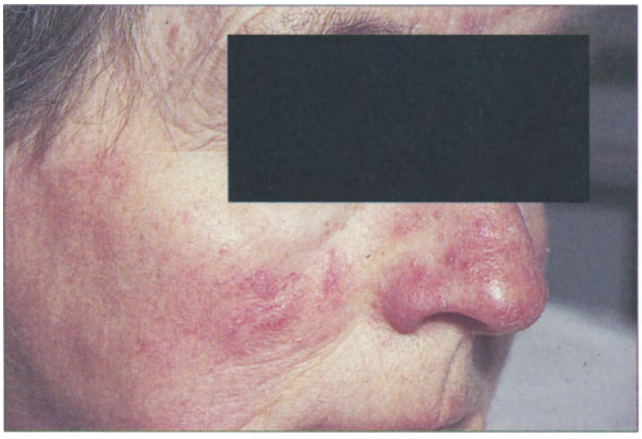

Figure 9.6 *Butterfly rash of SLE. (Courtesy of Update Publications and Dr W. W. Buchanan)*

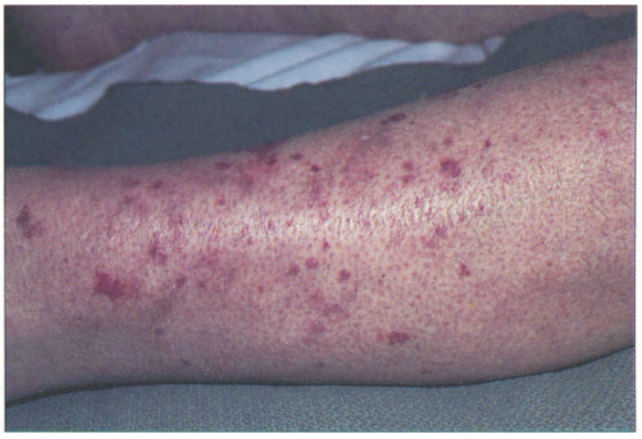

Figure 9.9 *Palpable purpura in the lower extremity due to lupus vasculitis*

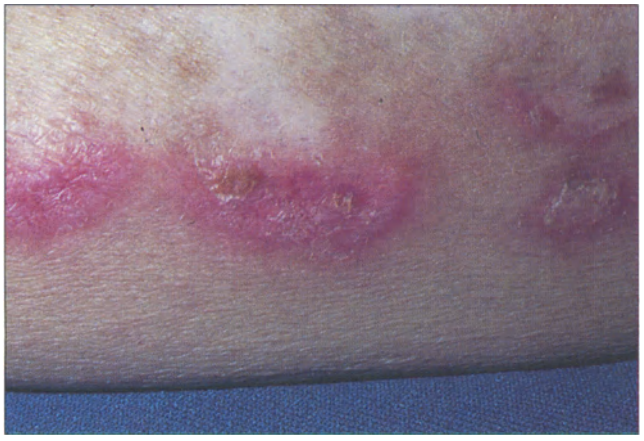

Figure 9.7 *Lesions of discoid lupus showing erythema, induration and early scarring. (Courtesy of Dr P. Kenny)*

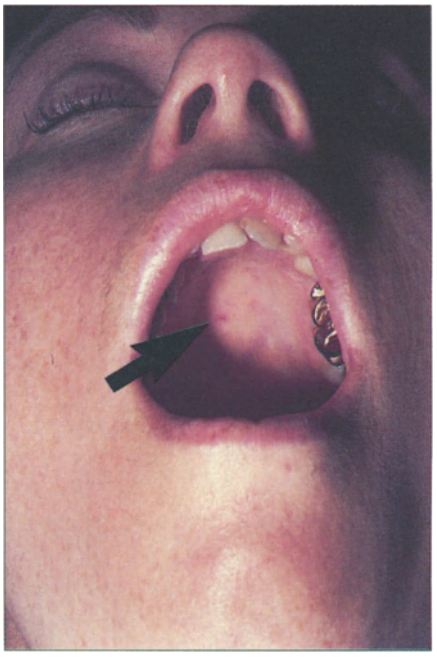

Figure 9.10 *Superficial mucosal ulcer on the hard palate (arrow)*

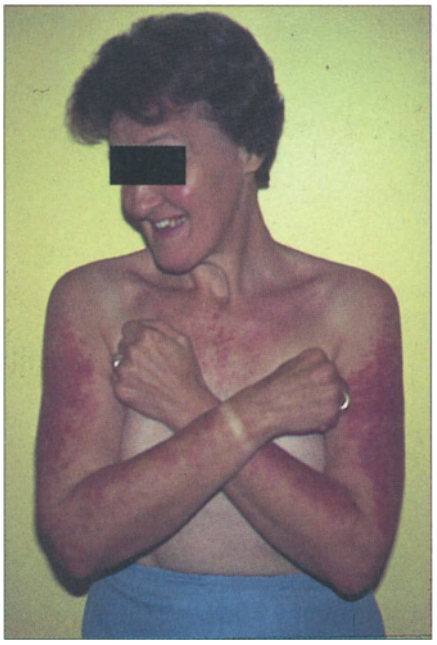

Figure 9.8 *Photosensitivity reaction in SLE. Note erythema of light-exposed areas. (Courtesy of Dr P. Kenny)*

nailfold capillaries may be abnormal in SLE, and there is an increased incidence of periungal warts. ANA-negative patients with SLE frequently present with a skin rash, and 60% have anti-Ro antibodies in their serum. Aphthous ulcers are detectable in approximately 20% of patients. They tend to be superficial, painless and occur on the hard palate (Figure 9.10).

Myalgia and myositis due to lupus occur in 30% of patients and require differentiating from myopathies due to antimalarial and corticosteroid medications.

Major organ involvement, particularly of the kidney or central nervous system is of serious prognostic significance. Renal involvement is usually recognized by the appearance of proteinuria, an increase in the cellular content of the urinary sediment or the presence of casts (Figure 9.11). Of the five major subgroups of nephropathy, diffuse proliferative glomerulonephritis carries the worst prognosis (Table 9.4). While the clinician may elect to simply observe patients with mild proteinuria, those with high degrees of proteinuria, or an increase in the cellular content of the urine, or whose sediment contains casts, usually require a renal biopsy for diagnostic, as well as prognostic purposes.

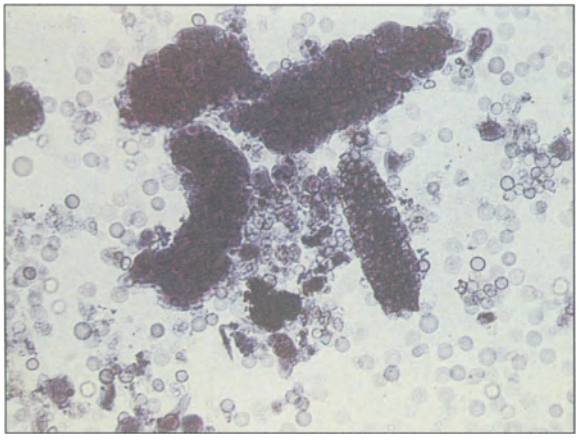

Figure 9.11 *Active urinary sediment showing increased cellular content and red cell casts. (Courtesy of Dr W. Clark)*

Psychosis, seizures, headaches and cranial nerve abnormalities are the most frequent neurologic symptoms which occur, although lesions may develop in almost any area of the cerebral hemisphere, brainstem or spinal cord (Figure 9.12). Lupus psychosis should be differentiated from psychosis related to corticosteroid therapy, this being largely a matter of clinical judgement. Unfortunately there are no good diagnostic tests for lupus cerebritis at the present time, and the physician has to rely on his clinical assessment with minimal information from radiographic and scintigraphic procedures and the results of spinal fluid analysis.

Pulmonary involvement most often results in the development of a pleural effusion, less frequently in pneumonitis and rarely in the appearance of the shrinking lung syndrome in which there is a severe reduction in lung volume and poor diaphragmatic movement (Figure 9.13). In respect to cardiac involvement, pericarditis is more common than myocarditis, endocarditis or valvulitis. Serositis, however, is not restricted to the pleural and pericardial cavities and may also occur within the abdomen, resulting in the formation of ascitic fluid. Mesenteric arteritis, pancreatitis and hepatosplenomegaly are less frequent intra-abdominal complications of SLE.

A number of haematologic abnormalities including anaemia, leukopaenia and thrombocytopaenia are associated with active disease. The LE cell phenomenon is one of the ARA diagnostic criteria for SLE, and results

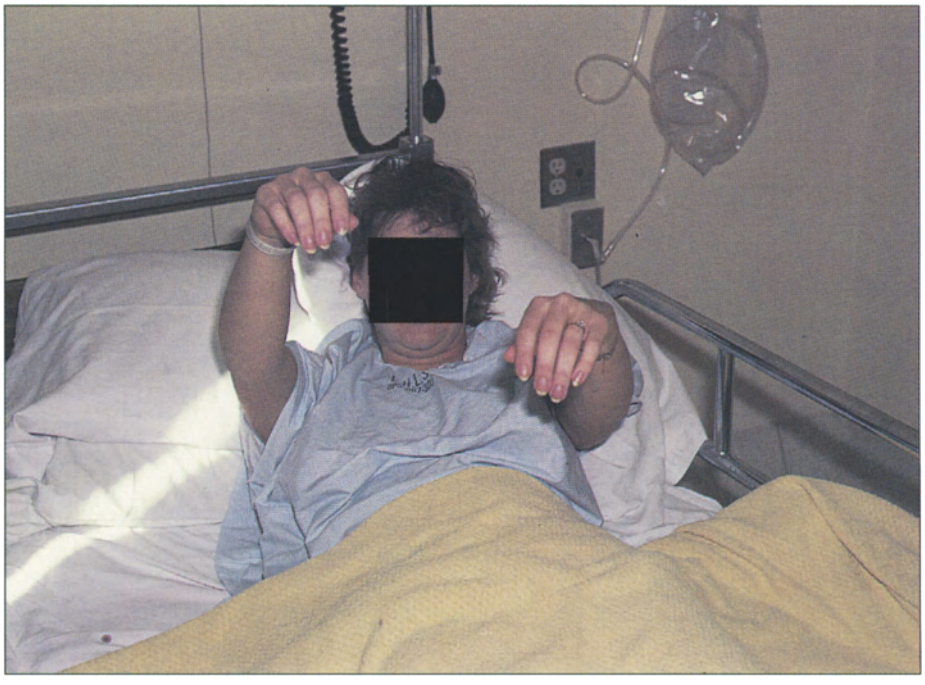

Figure 9.12 *Lupus cerebritis – Right hemispheric disturbance producing weakness of left arm and leg*

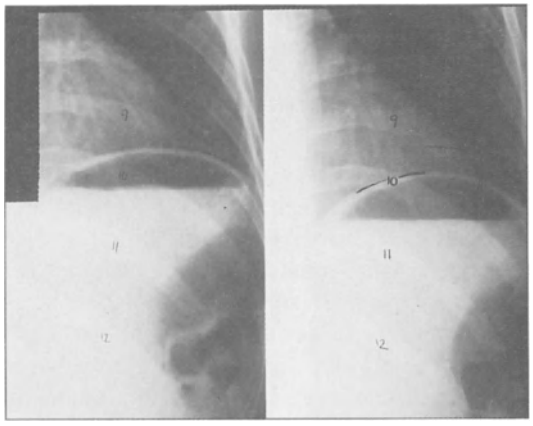

Figure 9.13 *Lupus lung showing severely reduced diaphragmatic movement (left = expiration, right = inspiration). Lung volumes were markedly reduced (Courtesy of Dr R. McFadden)*

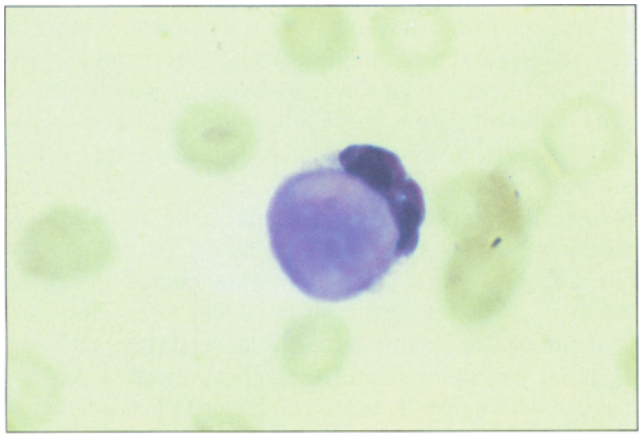

Figure 9.14 *LE cell phenomenon. Note displacement of PMN nucleus by large quantity of phagocytosed nuclear material. (Courtesy of Update Publications)*

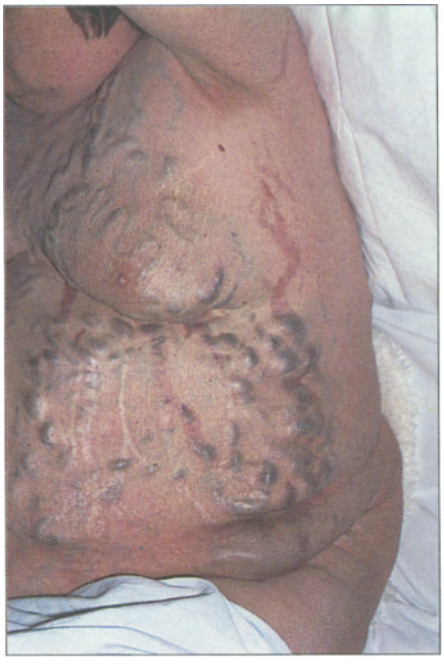

Figure 9.15 *Dilated superficial veins secondary to widespread intra-abdominal thrombosis in patient with a lupus-like syndrome*

from the ingestion of altered nuclear material by a phagocytic cell (Figure 9.14). Some patients with lupus develop circulating anticoagulants in their blood, but in spite of this haematologic abnormality are usually asymptomatic. Venous thrombosis is an extremely rare complication of SLE and some other lupus-like syndromes (Figure 9.15).

Ocular examination may reveal the presence of conjunctivitis, xerophthalmia, episcleritis, retinal arteritis or on occasion the presence of retinal exudates (cytoid bodies). A number of other manifestations of this disease are listed in Table 9.4.

Progressive systemic sclerosis

Progressive systemic sclerosis (PSS; scleroderma) is a multisystem disease of unknown aetiology. It is currently thought that a component of the patient's serum may inflict a cytotoxic injury on endothelial cells. There is a subsequent increase in vascular permeability, myointimal migration of smooth muscle cells with oedema and inflammation of end organs. Fibrosis results from the synthesis of increased amounts of collagen in involved organs. Proliferative arterial lesions, vasomotor instability and microvascular insufficiency develop and may activate the renin–angiotensin system. PSS requires differentiating from its several variants as well as from conditions associated with, or resembling, its cutaneous features (Table 9.5).

Table 9.5 ***Classification of sclerodermatous disease***

Generalized scleroderma
Progressive systemic sclerosis
CREST syndrome
Localized scleroderma
Linear scleroderma
Morphoea
Scleroderma-associated disorders
Mixed connective tissue disease
Sclerodermatomyositis
Scleromyxoedema
Sclerolupus
Primary biliary cirrhosis
Sjögren's syndrome
Werner's syndrome
Phenylketonuria
Carcinoid syndrome
Bronchoalveolar carcinoma
Scleroderma-like syndromes
Eosinophilic fascitis
Vinyl chloride acro-osteolysis
Scleroderma
Porphyria
Amyloidosis
Graft-versus-host reaction

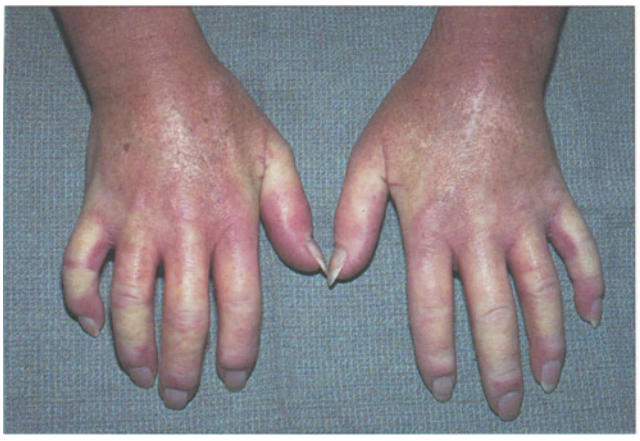

Figure 9.16 *Sclerodactyly. Note flexion contracture, loss of skin creases and tight waxy appearance of skin*

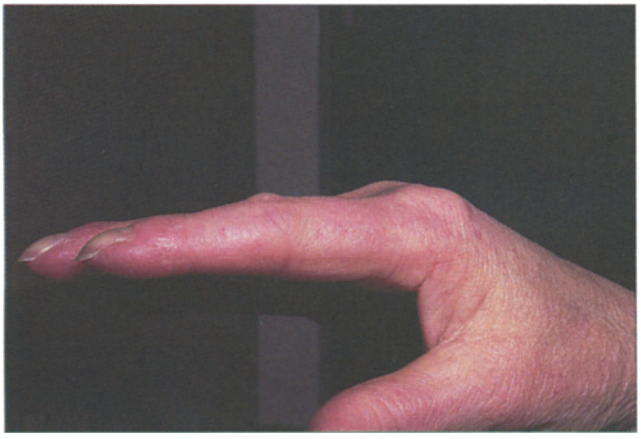

Figure 9.17 *Typical changes of scleroderma showing beaking of the nails and pulp atrophy*

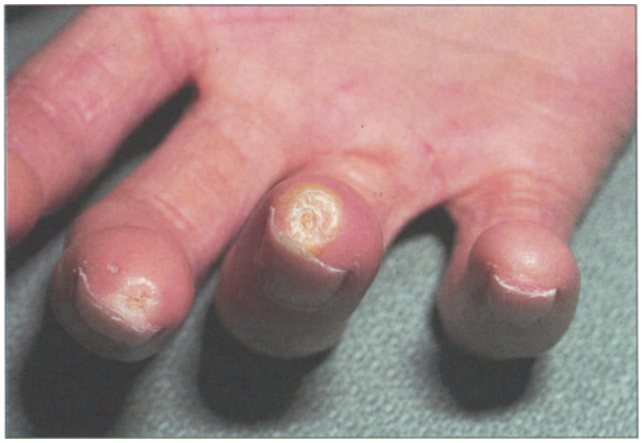

Figure 9.18 *Scarring of fingertip due to healed digital ulcer*

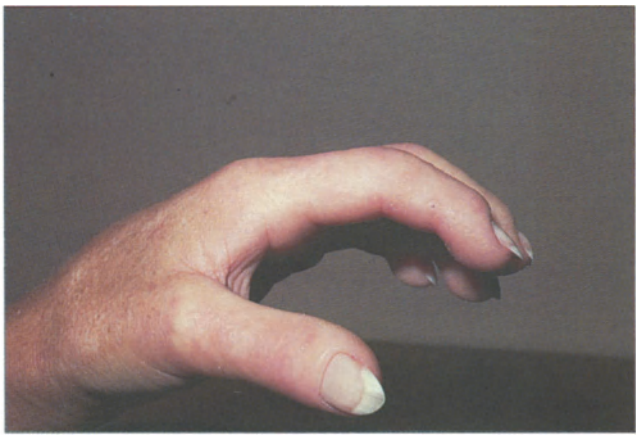

Figure 9.19 *Claw hand of advanced scleroderma*

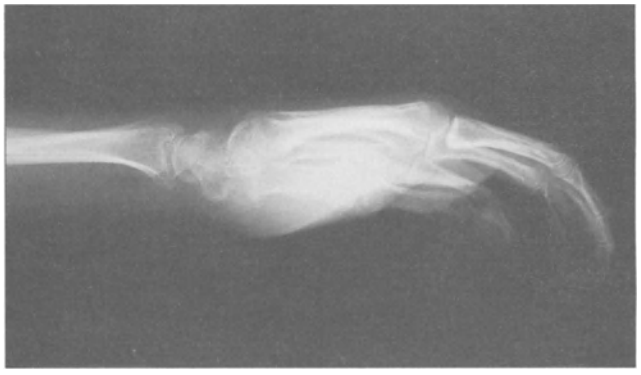

Figure 9.20 *Radiographic appearance of claw hand. Restriction in movement is due to skin and not to articular disease*

Clinical features

The predominant musculoskeletal limitation imposed by this disorder relates to tightness and loss of elasticity in periarticular skin. True synovitis is unusual and in the few affected patients, tends to subside as skin changes develop. The acral areas, particularly in the upper extremity, are oedematous in early disease. Later, however, the digits show loss of hair and skin creases and eventually the characteristic tight, waxy, inflexible, tapered appearance of advanced scleroderma (Figure 9.16). Terminal tuft erosion, loss of soft tissue and *beaking* of the nails are features of established disease (Figure 9.17). Small, hard, pale patches which represent healed digital ulcers are not infrequent on the tips of the fingers (Figure 9.18) . In the most advanced cases, the hand assumes a clawed configuration with severe restriction in range of movement and extreme disability (Figures 9.19, 9.20). Scleroderma has a propensity to spread proximally involving the upper and lower extremities, face and trunk. Patients in whom skin

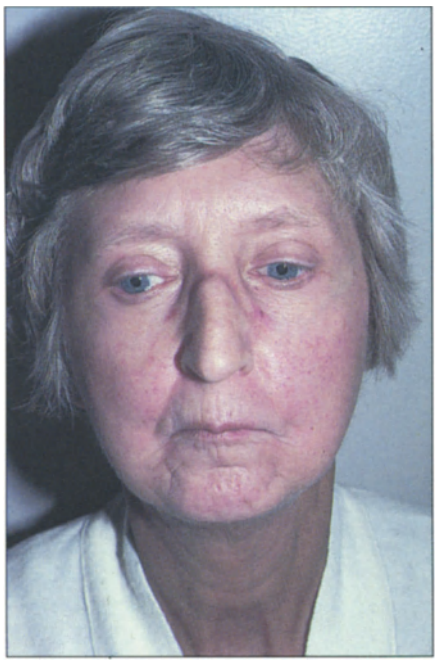

Figure 9.21 *Tightness of skin around the nose and puckering of skin around the mouth typical of scleroderma*

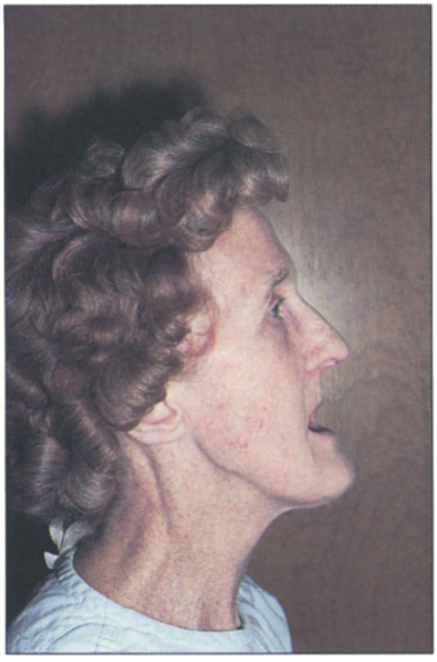

Figure 9.22 *Restricted incisor gap in adentulous patient with scleroderma*

changes are confined to areas distal to the metacarpophalangeal joints are considered to have a more favourable prognosis. Involvement of the face results in skin around the nose becoming tight and waxy (Figure 9.21). Puckering develops around the mouth and the incisor gap (Figure 2.16), a measure of ability to open the mouth, becomes restricted (Figure 9.22).

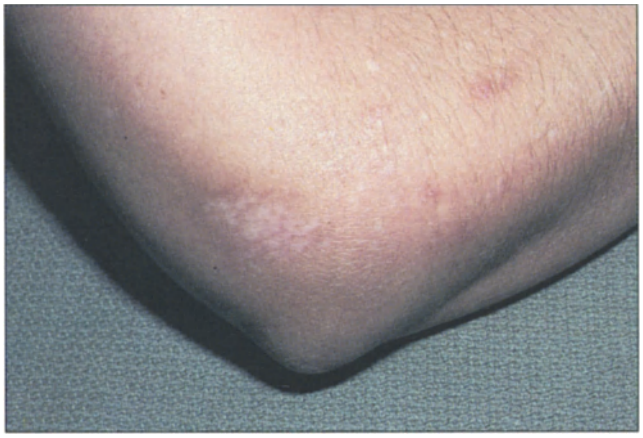

Figure 9.23 *Hypo- and hyperpigmented areas around the elbow*

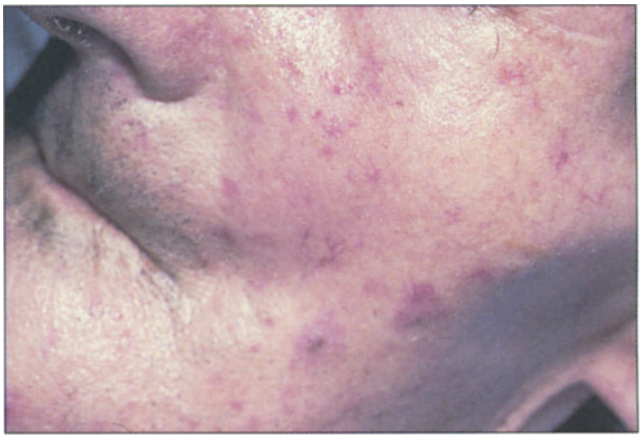

Figure 9.24 *Typical appearance of telangiectasia in scleroderma*

Raynaud's phenomenon occurs in 90% of patients with PSS. It shows seasonal variation in its frequency and severity and is worst during the winter months for obvious reasons. Hyper- and hypopigmentation of the skin (Figure 9.23) as well as telangiectasia (Figure 9.24) are common cutaneous accompaniments and may develop on the face and trunk as well as on the arms and legs.

Renal involvement is the most frequent cause of death, up to 30% of patients having clinical evidence of some degree of renal disease on careful screening, and up to 80% having histologic abnormalities at post mortem. Hypertension, proteinuria and microangiopathic haemolytic anaemia are all indicative of renal involvement, the acute onset of hypertension being of serious prognostic importance.

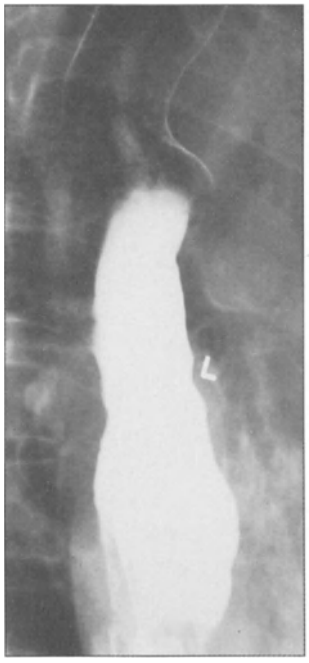

Figure 9.25 *Hypomotility and dilatation of the oesophagus*

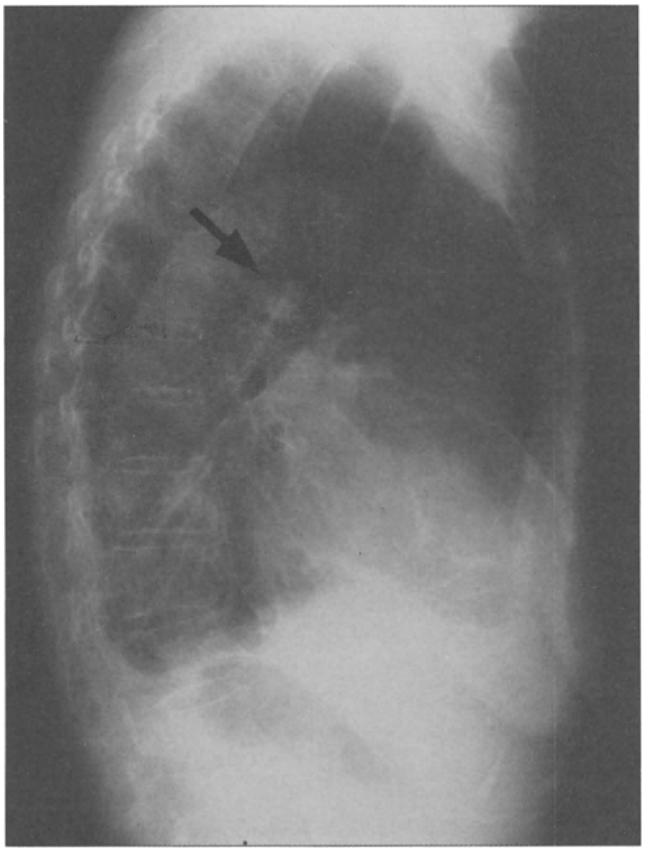

Figure 9.26 *Air-fluid level (arrow) in oesophagus due to stricture formation and hypomotility*

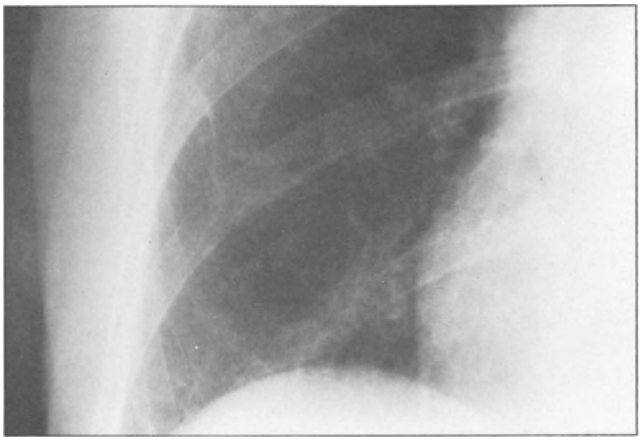

Figure 9.27 *Dense reticular fibrosis at the lung base typical of scleroderma*

Scleroderma affects both the upper and lower gastrointestinal tract. The oesophagus is involved in 90% of patients of whom approximately half are symptomatic. Hypomotility (Figure 9.25) may be accompanied by reflux oesophagitis, a hiatus hernia and in late stage disease by stricture formation (Figure 9.26). While the diagnosis of oesophageal disease may be made on contrast radiography, oesophageal manometry is more sensitive in detecting early disturbances in motility. Small bowel involvement also results in hypomotility, and occasionally in a malabsorption syndrome secondary to overgrowth of the bowel flora. Large bowel involvement is characterized by hypomotility, constipation and the development of asymptomatic, wide-mouthed diverticulae.

Pulmonary involvement may result in pleural disease (but rarely effusion), pulmonary hypertension and diffuse interstitial pulmonary fibrosis (honeycomb lung) (Figure 9.27). Pulmonary function tests, (particularly the diffusing capacity), become deranged well in advance of any radiographic evidence of disease. While early changes may respond to corticosteroid therapy, fibrotic disease is not amenable to any specific treatment.

The heart may be affected by systemic or pulmonary hypertension, by inflammation and fibrosis of the pericardium and less frequently by myocardial fibrosis or microvascular disease. The combination of cardiomegaly and bilateral basal pulmonary fibrosis frequently indicates a diagnosis of PSS. The central nervous system is not involved in scleroderma although fibrosis may occasionally result in nerve entrapment particularly of the trigeminal nerve.

The CREST syndrome (Figures 9.28, 9.29) is a variant of scleroderma in which involvement is limited to calcinosis (C), Raynaud's phenomenon (R), oesophageal disease (E), sclerodactyly (S) and telangiectasia (T).

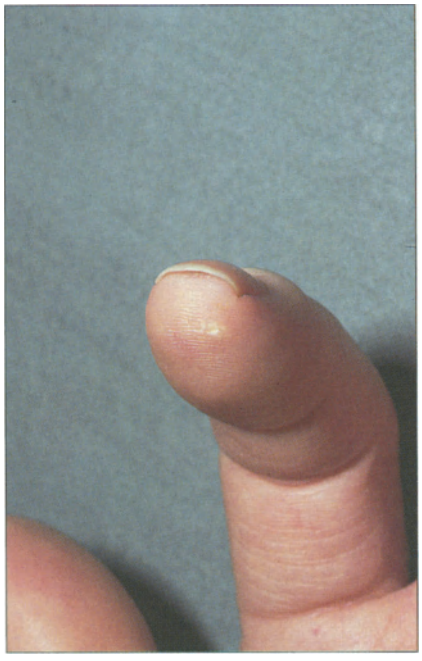

Figure 9.28 *Calcinosis in patient with CREST syndrome*

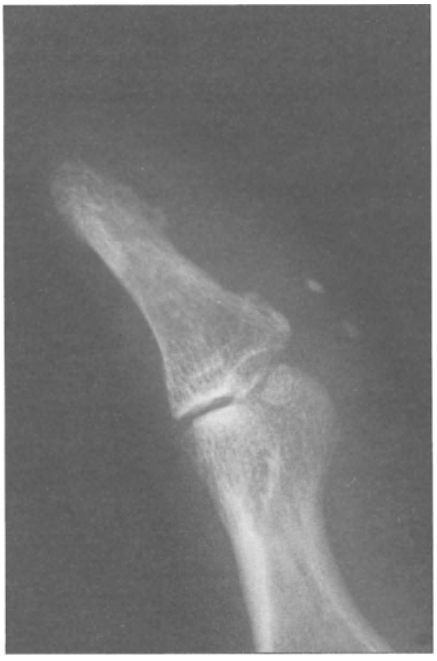

Figure 9.29 *Radiographic evidence of calcinosis in soft tissue of digit*

Another variant termed eosinophilic fascitis affects young males and often onsets after heavy physical exercise. The skin is indurated but in contrast to PSS, the fingers and hands are relatively spared and the viscera unaffected. Eosinophilia and hypergammaglobulinaemia are commonly associated with histopathologic abnormalities in the subcutaneous fat and fascia.

Dermatomyositis–polymyositis complex

The dermatomyositis–polymyositis complex (D–P complex) is subdivided into five categories (Table 9.6). The aetiology of these disorders is unknown, although abnormalities in humoral and cellular immune responsiveness support an autoimmune hypothesis. In particular, (1) lymphocytes from patients with the D–P complex show enhanced transformation when exposed to skeletal muscle antigens, (2) macrophage migration inhibition is increased and (3) peripheral lymphocytes are cytotoxic to fetal myoblasts. It seems probable that cellular factors are more important in the aetiology of this disease than humoral factors. Viruses have not yet been isolated from patients with D–P complex, although the discovery of virus-like particles and elevated viral antibody titres has suggested a viral aetiology in at least some patients. In the case of malignancy, tumour antigens may be the primary aetiologic factor, although it is possible that both the D–P complex and the malignancy arise from a common aetiology. The occurrence of vasculitis in one paediatric subgroup of the disease has suggested a microvascular aetiology in affected children.

Table 9.6 ***Classification of the dermatomyositis–polymyositis complex***

Group 1 – Primary idiopathic polymyositis
Group 2 – Primary idiopathic dermatomyositis
Group 3 – Dermatomyositis associated with malignancy
Group 4 – Childhood dermatomyositis or polymyositis
Group 5 – Dermatomyositis or polymyositis associated with collagen vascular disease

Primary idiopathic polymyositis

This subgroup of the disease is more common in females than males (2:1) and onsets at a mean age of 50 years. Fatigue and malaise are associated with the insidious onset of muscle weakness which affects the proximal and distal muscle groups as well as the axial skeleton. Weakness is usually symmetrical, is best appreciated in the proximal muscles due to their greater bulk and more frequent involvement, and may be associated with some degree of muscle tenderness. Severe involvement of the limb and neck (flexor) muscles may render the patient unable to lift his arms, legs or head from the bed. Although the facial muscles are usually spared, involvement of the pharangeal musculature may produce a nasal voice, allow nasopharangeal regurgitation of food and fluids, and cause difficulty with chewing and deglutition. Diagnosis is made on the basis of clinical examination and the results of muscle enzyme determinations (elevated CPK, LDH, SGOT), electromyographic studies (insertional activity, polyphasic potentials, fibrillation, positive sharp wave activity and high frequency repetitive discharges) and muscle biopsy. Affected muscles show variation in fibre size and stage

of involvement (i.e. necrosis, atrophy, regeneration), Type II fibre atrophy and an inflammatory infiltrate in which lymphocytes predominate. The biopsy should be taken from a moderately affected muscle which has not previously been subject to electromyography. Both normal and profoundly affected muscles should also be avoided as biopsy sites.

Primary idiopathic dermatomyositis

The mean age of onset of this subset is 50 years, there being a slight female predominance. Muscle involvement is similar to that of primary idiopathic polymyositis but in contrast is associated with a skin rash which on occasion may be mild and transient and, therefore, overlooked. The characteristic cutaneous lesions occur on the extensor surfaces of the knuckles (Figure 9.30) as well as on the trunk, elbows and knees, the malar area, bridge of the nose and the eyelids. Flat plaques occurring on the dorsal surface of the knuckles are known as Gottron's papules. Skin lesions may show a violaceous (heliotrope) coloration or be erythematous but are characteristically non-pruritic. Rarely the skin may ulcerate or calcinosis may develop (Figure 9.31).

Dermatomyositis associated with malignancy

It is currently estimated that 2–3% of patients with polymyositis and 15–20% of patients with dermatomyositis have an underlying malignancy. Males over 40 years of age who develop dermatomyositis are especially at risk. Solid tumours of the gastrointestinal tract, breast and genitourinary tract are the most frequent malignancies encountered. Patients in this subgroup may be relatively resistant to treatment of their myositis and show a tendency to relapse following an initial response. The myositis may however improve with effective treatment of the underlying malignancy.

Dermatomyositis (or polymyositis) of childhood

Two types of dermatomyositis are recognized in children (Figures 9.32, 9.33, 9.34). The Banker type is rapid in its progression, demonstrates prominent vasculitic features and has a poor prognosis. In contrast the Brunstring type resembles adult dermatomyositis, is slow in its evolution, devoid of vasculitic accompaniments, shows marked calcinosis and has a favourable prognosis.

Dermatomyositis (or polymyositis) associated with collagen vascular disease

The D–P complex may overlap with PSS, SLE, PAN, RA and Sjögren's syndrome. Females are more commonly affected than males (9:1) and, the myositis varies considerably in its severity.

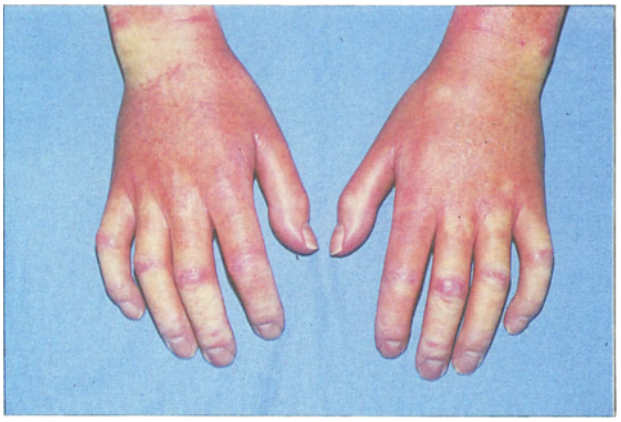

Figure 9.30 *Typical appearance of dermatomyositis. Note plaque-like lesions (Gottron's papules) over the PIP joints. (Courtesy of Update Publications)*

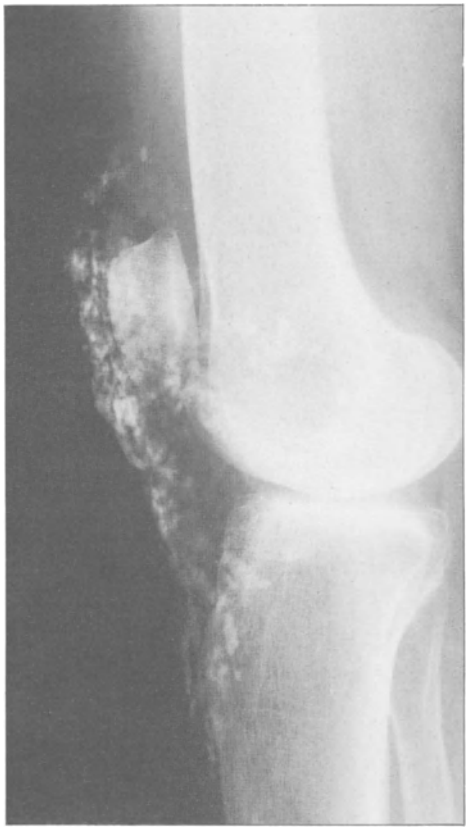

Figure 9.31 *Subcutaneous calcification in patient with dermatomyositis*

Polyarteritis nodosa

The systemic vasculitides are a group of multisystem disorders characterized by inflammation in blood vessels. They are generally classified according to tissue histology, clinical features and the size of vessel involved (Table 9.7). This review is confined to polyarteritis nodosa, a disease which is rare and occurs with a prevalence of 0.7 per 100 000 population. The aetiology is unknown but the disease may result from exposure to a variety of antigens. PAN has been observed in association with hepatitis B infections, acute otitis media,

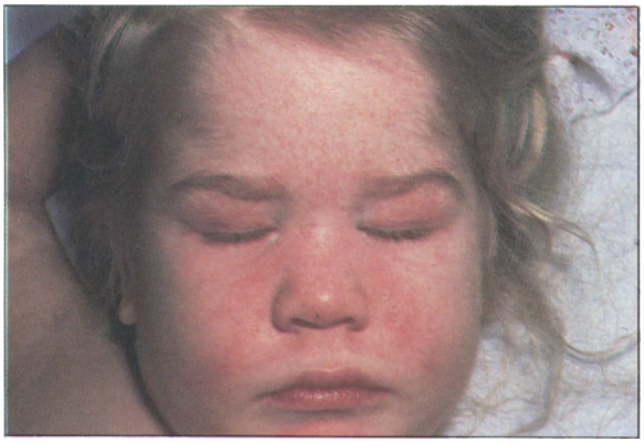

Figure 9.32 *Dermatomyositis of childhood – note facial rash and violaceous (heliotrope) discoloration of the eyelids*

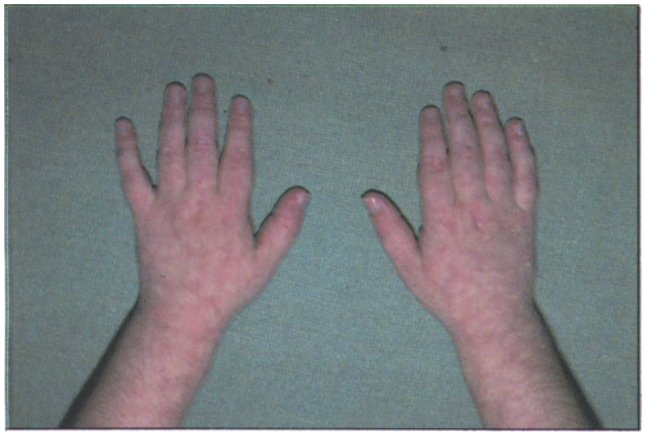

Figure 9.33 *Extensive livedo reticularis in Banker type of childhood dermatomyositis. (Courtesy of Dr J. Boone)*

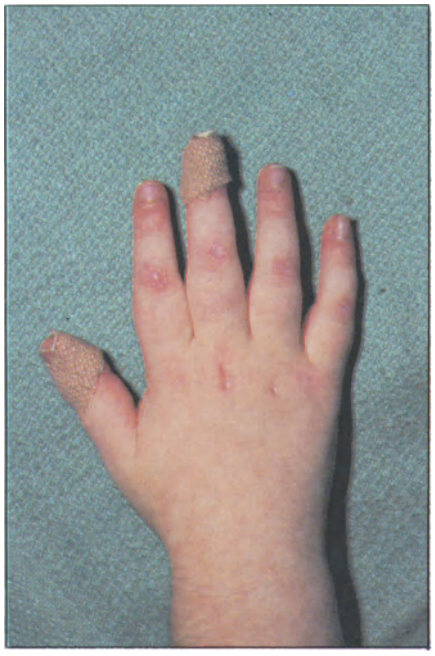

Figure 9.34 *Close up of hand shown in Figure 9.33. Note Gottron's papules*

Table 9.7 ***Classification of the systemic vasculitides***

Takayasu's arteritis
Giant cell arteritis
Polyarteritis nodosa
Churg–Strauss vasculitis
Wegener's granulomatosis
Leukocytoclastic vasculitis
Infective vasculitis

intravenous drug abuse, C2 and α-l-antitrypsin deficiencies and in patients with coexisting carcinoma. Typically the vasculitis affects predominantly medium-sized arteries and some small muscular vessels, causing multifocal necrotizing inflammation which extends from the intima to the adventitia. Thrombosis and narrowing, or alternately nodose dilation and aneurysm formation, may develop in affected vessels. Histologic involvement of the kidney occurs in 70% of patients and of the liver and bowel in 50%.

Clinical features

The presentation of PAN is highly variable, and ranges from a rather subtle pyrexia of unknown origin to dramatic derangements in specific organ systems. This high degree of variability together with a lack of useful serologic markers often makes the diagnosis of PAN difficult.

Seventy percent of patients experience arthralgia or arthritis, the large joints of the lower extremity being most often involved. Articular involvement is characteristically non-erosive, non-deforming and self-limiting. Livedo reticularis (Figure 9.35), cutaneous ulcers, petechiae and digital ischaemia (Figure 9.36) are the commonest cutaneous lesions. Cutaneous ulceration usually occurs in the lower extremity, is frequently slow to resolve even with effective treatment, and may recur in the same or adjacent areas (Figure 9.37).

Renal involvement results in proteinuria, an active urinary sediment and occasionally in hypertension (Figure 9.38). Peripheral neuropathy occurs in over 50% of cases and in some it is the presenting complaint. Mononeuropathy (e.g. foot drop or wrist drop) is often rapid in onset and may affect peripheral nerves in the upper or lower extremities. In general, sensory deficits tend to precede motor abnormalities. Involvement of more than one such peripheral nerve is termed mononeuritis multiplex. Central neurological involvement is rare in PAN but when present may result in seizures or paresis.

Diffuse pulmonary infiltration and obstructive lung disease may occur in PAN but are more characteristic of Churg–Strauss vasculitis. Cardiac disease is rare, and is usually due to either coronary insufficiency or systemic hypertension.

Intra-abdominal vasculitis results in abdominal pain and may be the result of mesenteric infarction of the large or small bowel, or vasculitis involving the appendix or gallbladder. Less common manifestations are

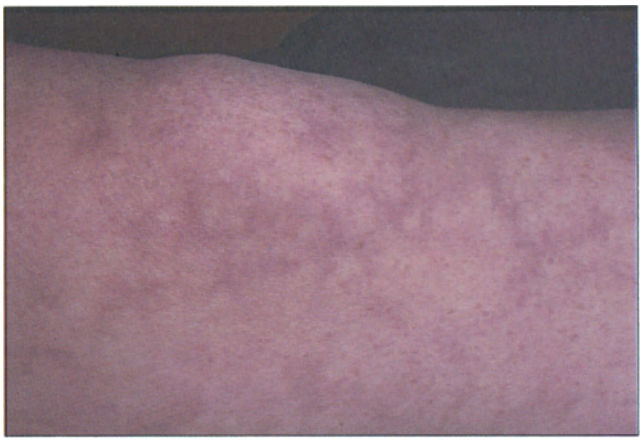

Figure 9.35 *Typical lesion of livedo reticularis*

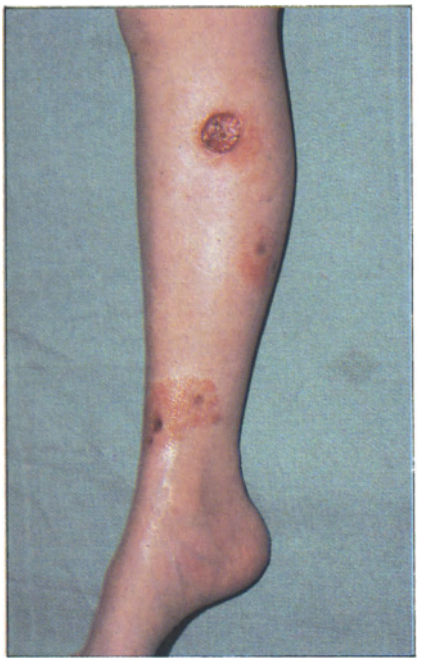

Figure 9.37 *Multiple vasculitic ulcers due to polyarteritis nodosa*

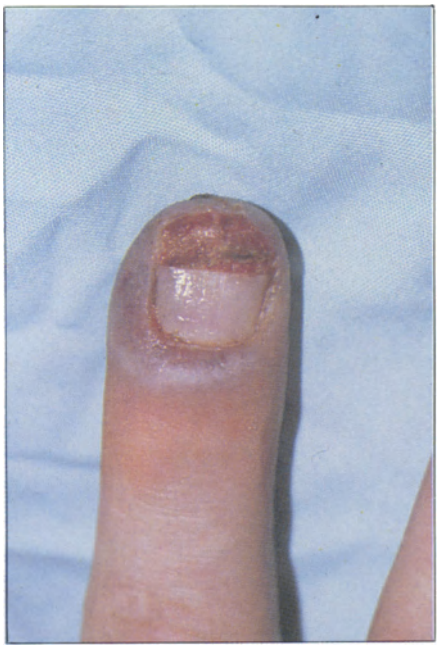

Figure 9.36 *Digital necrosis secondary to polyarteritis nodosa. (Courtesy of Update Publications)*

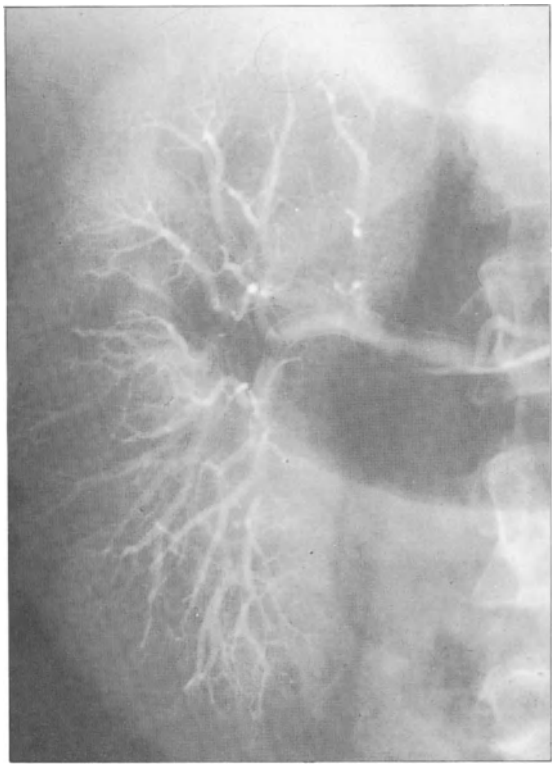

Figure 9.38 *Aneurysmal dilatation of medium-sized arterioles in patient with polyarteritis nodosa. (Courtesy of Update Publications)*

those of scleritis, retinopathy, retinal detachment, peripheral vascular disease and testicular pain.

The diagnosis of PAN is dependent on detecting a medium vessel necrotizing vasculitis on a tissue biopsy sample, or on recognizing luminal irregularities and aneurysm formation on mesenteric, hepatic or renal angiograms (Figure 9.38).

Mixed connective tissue disease

Mixed Connective Tissue Disease (MCTD) is an overlap syndrome in which more than one type of connective tissue disorder coexists (usually PSS and D–P complex).

Three criteria are necessary for the diagnosis of MCTD:

(1) Definite clinical or laboratory evidence for the existence of more than one disease entity;
(2) A high antinuclear antibody (ANA) titre in a speckled pattern;
(3) A high antiribonuclear protein antibody (anti-RNP) titre.

The titres of both the ANA and anti-RNP antibodies are important, since low titres may be found in other connective tissue diseases, particularly SLE. RNP is one, of at least two, components of the extractable nuclear antigen (ENA). Antibodies to Sm, the other component of the ENA, are confined to patients with SLE and while highly specific for the disease (100%) they have a low sensitivity (20%). It should be noted that LE cells and anti-DNA antibodies are infrequent in MCTD.

MCTD onsets at a mean age of 37 years and is more common in females than males (4:1). The prevalence is not clearly defined but appears less than that of SLE. Symptoms and signs evolve slowly and the condition may be misdiagnosed (i.e. considered a single connective tissue disorder) unless a high-titre speckled ANA leads to determination of the anti-RNP status. Any or all of the manifestations of the component conditions may coexist, although it is generally felt that renal involvement is infrequent and with few exceptions the disease carries a favourable prognosis. Even in patients with multisystem involvement a satisfactory response to treatment is often achieved.

Chapter 10

Miscellaneous Conditions

While previous chapters describe the major classes of rheumatic disorders, there are numerous other diseases, which come to attention by virtue of their musculoskeletal associations.

Behçet's syndrome

Behçet's syndrome is a multisystem disorder characterized by a triad of recurrent oral (Figure 10.1) and genital (Figure 10.2) ulceration and relapsing iritis. It is more common in males than females. Penile, scrotal and oral ulcers are usually painful while vulval and vaginal ulcers are often painless and may remain undetected. Other important manifestations of this disorder are: skin lesions including pyoderma (Figure 10.3), erythema nodosum and superficial thrombophlebitis, iridocyclitis, arthralgia and less frequently mono- or oligoarthritis typically involving large joints, intestinal ulceration, epididymitis, obliterative venous and arterial disease

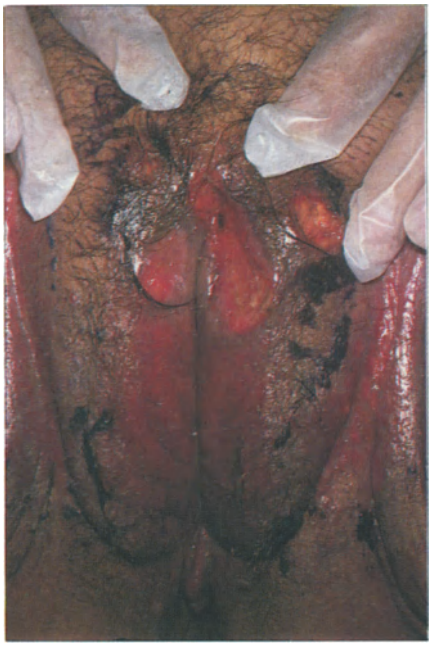

Figure 10.2 *Behçet's disease – punched out genital ulcers may occur on the scrotum, glans penis, vulva, vagina or cervix. (Courtesy of Dr G. Dilworth)*

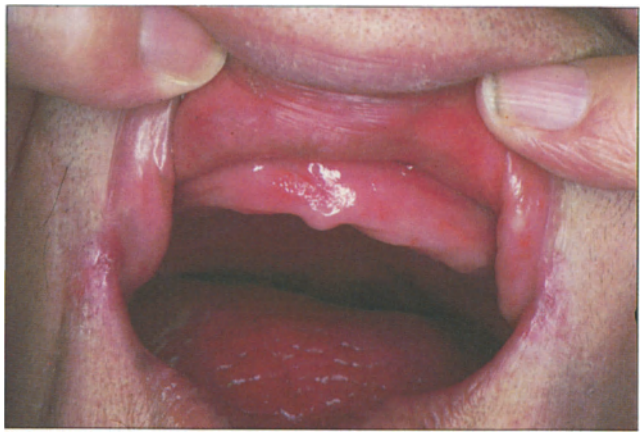

Figure 10.1 *Behçet's disease – oral ulcers are small, oval-shaped and sharply defined. They may occur on the labial, buccal, gingival or lingual mucous membranes. (Courtesy of Dr G. Dilworth)*

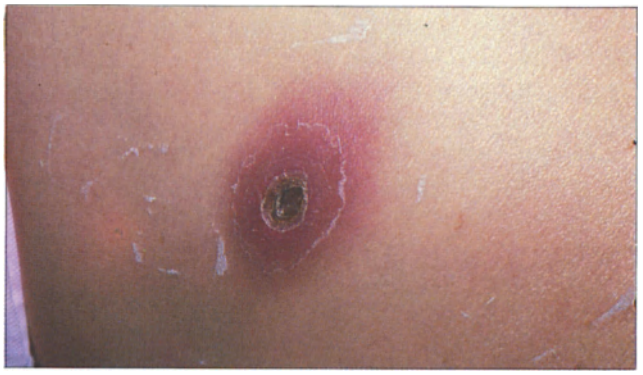

Figure 10.3 *Pyoderma due to Behçet's disease. This lesion may also be induced by a sterile puncture of the skin (pinprick sign). (Courtesy of Dr G. Dilworth)*

and neuropsychiatric symptoms. Skin lesions are particularly common and may be induced by a needle puncture of the skin (pinprick sign). The arthritis is insidious in onset, variable in its severity and duration, intermittent in nature and usually affects the knee.

Dupuytren's contracture

Dupuytren's contracture is more common in males than females (6:1). It is associated with ageing, epilepsy, pulmonary tuberculosis, diabetes mellitus, chronic alcoholism, possibly with barbiturate administration, and in some cases affects multiple members of a single family. The condition is usually bilateral and involves, in decreasing order of frequency, the ring, little, middle and index fingers. Puckering of the palmar skin may be associated with nodule formation and flexion contracture of affected digits (Figure 10.4). These contractures, unlike those of congenital and spastic aetiology, cannot be reduced when the wrist is fully flexed. Dupuytren's contracture may be associated with knuckle pads (Figure 10.5), plantar fibromatosis and Peyronie's disease.

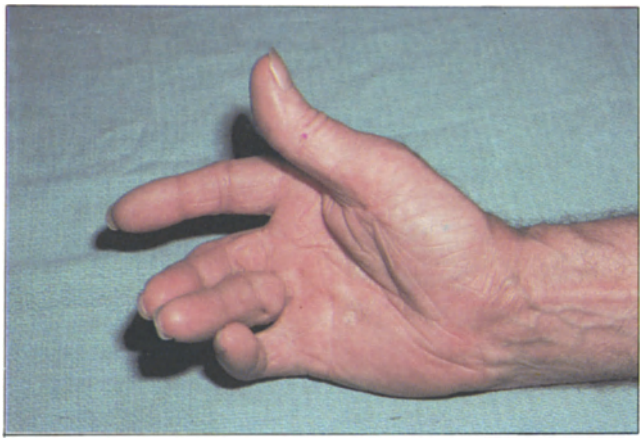

Figure 10.4 *Dupuytren's contracture showing puckering of palmar skin, fascial band extending from proximal palm to proximal interphalangeal joint and flexion contracture of fourth digit. Similar abnormalities are present in adjacent digits*

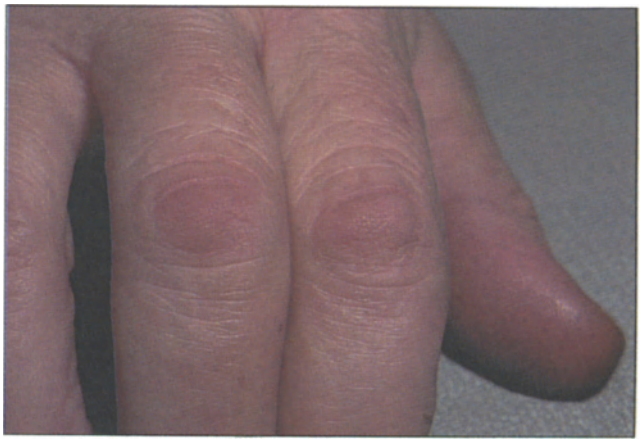

Figure 10.5 *Knuckle pads over second and third proximal interphalangeal joints*

Haemophilic arthritis

Haemarthrosis has been described in all forms of haemophilia (with the exception of factor V deficiency), and occurs in 80–90% of affected individuals. The synovial cavity is the commonest site for repeated major haemorrhage, although prolonged and excessive bleeding may occur from the gastrointestinal and genitourinary tracts, or following relatively minor trauma. The majority of patients experience their first haemarthrosis between ages 1 and 5 years. After age 10 years, the frequency of recurrent bleeding tends to decline. The knee, ankle and elbow are the most frequently affected joints although the shoulder, hip, knee, ankle and finger are not exempt. Monoarticular involvement is most usual, and repeated haemorrhage often occurs in the same joint. In the acute attack, the joint is painful, tender, warm, swollen and severely restricted in its movement (Figures 10.6, 10.7). With recurrent bleeding, flexion contractures may develop particularly in the knees and elbows (Figure 10.8). Soft tissue swelling may be the only radiographic abnormality in early disease, but with repeated haemarthrosis the characteristic appearance of secondary osteoarthritis develops, i.e. irregularity and joint space narrowing, with osteophytosis, sclerosis and bone cysts (Figure 10.9). Flattening of the inferior portion of the patella (squared-off patella) is considered highly characteristic of advanced haemophilic arthropathy. On occasion a pseudotumour of bone may develop (Figure 10.10) or intraosseous bleeding may result in osteonecrosis.

Henoch–Schonlein purpura

Although primarily a disease of childhood, Henoch–Schonlein purpura may affect individuals of any age group. It often follows an upper respiratory tract infection and most frequently occurs in the springtime. The principal clinical features are: (1) palpable purpura secondary to cutaneous vasculitis, (2) a transient arthritis usually affecting the ankles and knees, (3) abdominal pain which may be severe and occasionally associated

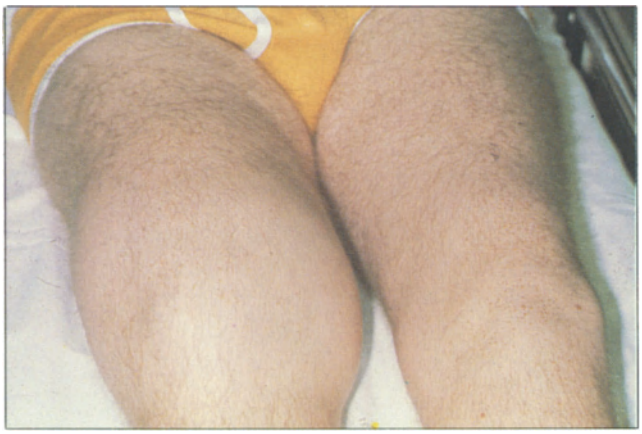

Figure 10.6 *Acute haemarthrosis of the knee. (Courtesy of Dr M. Inwood)*

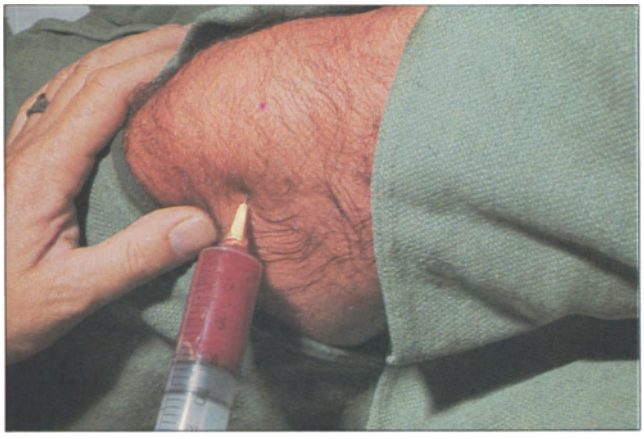

Figure 10.7 *Haemorrhagic synovial aspirate from haemophilic knee. (Courtesy of Dr M. Inwood)*

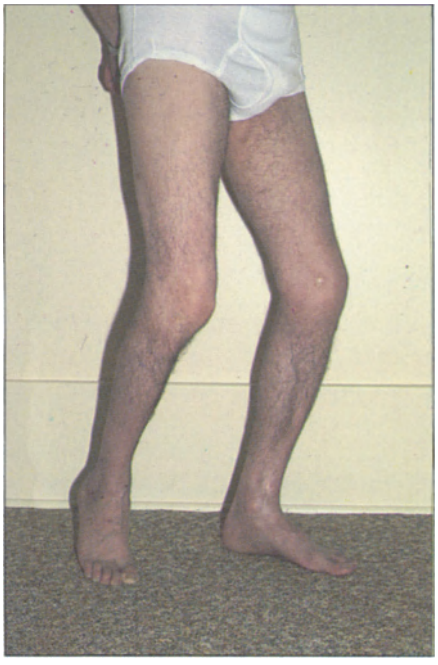

Figure 10.8 *Flexion contracture of both knees due to haemophilic arthritis*

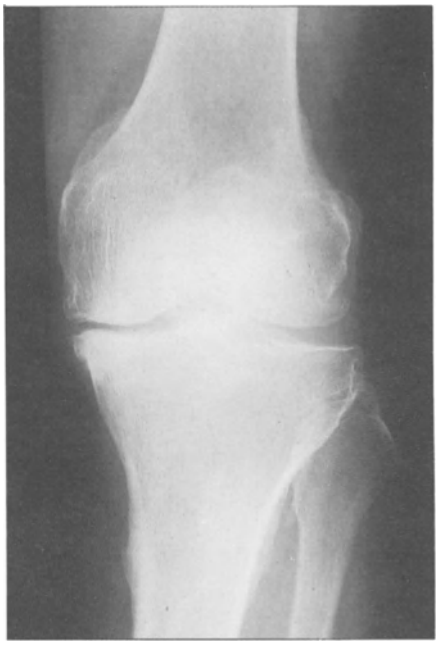

Figure 10.9 *Osteoarthritis secondary to recurrent haemarthroses. (Courtesy of Dr M. Inwood)*

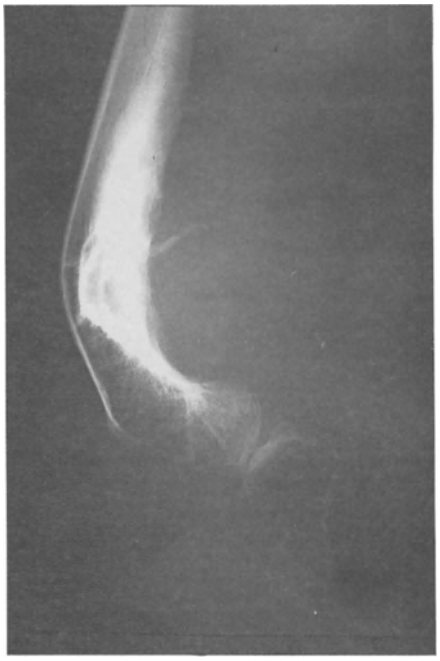

Figure 10.10 *Pseudotumour of bone due to haemophilia. (Courtesty of Dr M. Inwood)*

with an intestinal haemorrhage, intussusception or protein-losing enteropathy, (4) glomerulonephritis and (5) oedema which frequently affects the distal lower extremity but may also involve the hands and periorbital areas. The characteristic purpuric skin rash is most prominent over the extensor surfaces of the distal upper and lower extremities and over the buttocks (Figure 10.11). The lesions are palpable and may coalesce resulting in small areas of skin infarction (Figure 10.12).

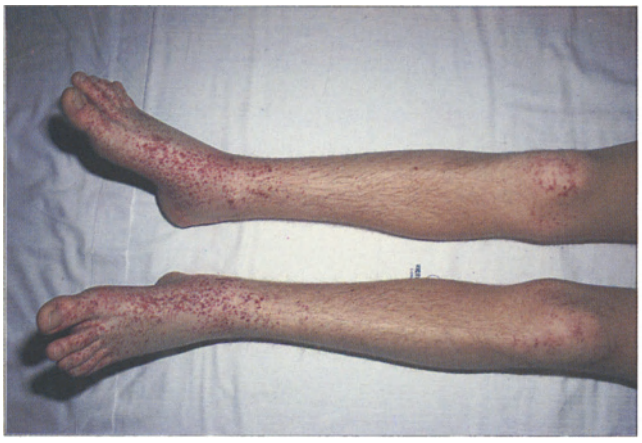

Figure 10.11 *Henoch–Schonlein purpura*

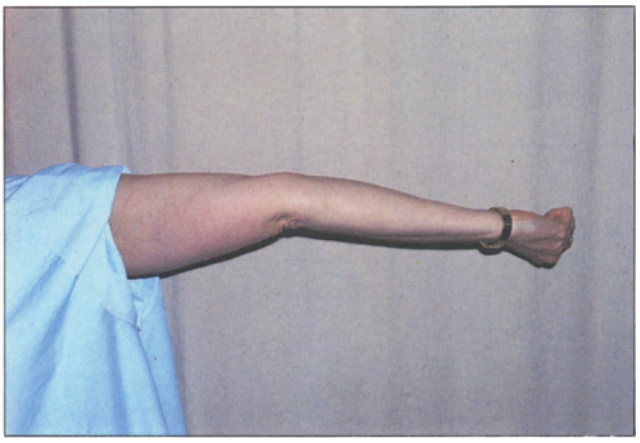

Figure 10.13 *Hyperextension of the elbow*

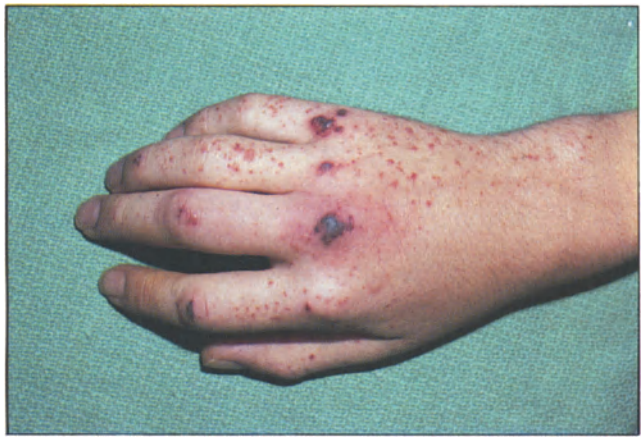

Figure 10.12 *Henoch–Schonlein purpura – coalescence of vasculitic lesions resulting in necrosis*

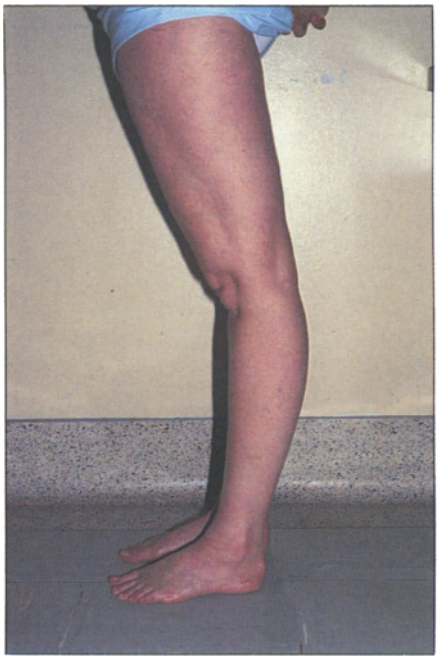

Figure 10.14 *Genu recurvatum*

Hypermobility syndrome

Hypermobility is due to undue laxity of articular and periarticular structures. It is recognized by finding three of the following:

(1) Hyperextension (greater than 10°) at the elbow (Figure 10.13)
(2) Genu recurvatum (Figure 10.14)
(3) Passive apposition of thumb to forearm (Figure 10.15)
(4) Fingers parallel to the forearm on passively extending the wrist
(5) Foot dorsiflexion to more than 45° (Figure 10.16).

Patients may also demonstrate hypermobility in other areas, and in particular may be able to hyperextend their fingers to at least 90°, or touch the palms of their hands flat on the floor while the knees are extended (Figure 10.17). Owing to an excessive range of movement and joint laxity, hypermobile patients may be at increased risk of developing degenerative arthritis in later life.

Patients with benign hypermobility syndromes should be differentiated from those in whom hypermobility is secondary to a more generalized disorder, e.g. Ehlers–Danlos syndrome, pseudoxanthoma elasticum, osteogenesis imperfecta etc.

Pseudoxanthoma elasticum is a disorder of elastic tissue which may be inherited by either autosomal dominant or autosomal recessive mechanisms. Joint hypermobility may be associated with cutaneous, ocular or vascular abnormalities. Yellowish, slightly raised papules (pseudoxanthoma) develop on the side of the neck (Figure 10.18), and in flexural areas (Figure 10.19, 10.20), and impart an appearance similar to that of

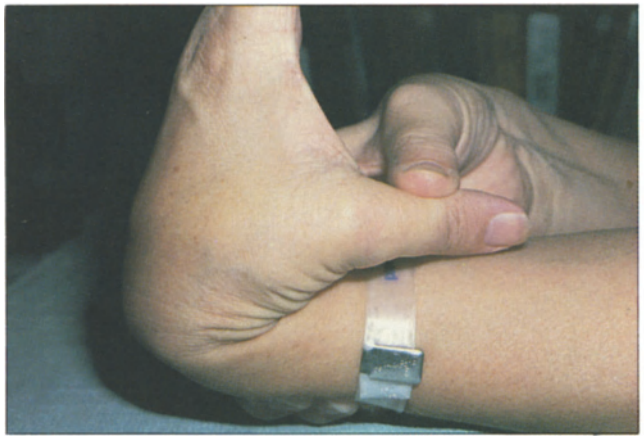

Figure 10.15 *Hypermobility of the wrist*

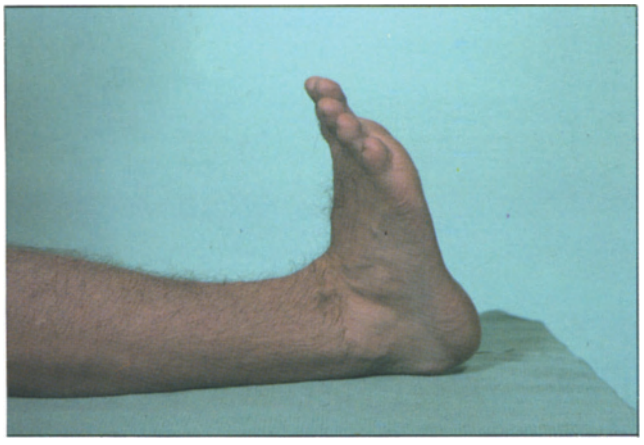

Figure 10.16 *Ankle dorsiflexion in hypermobile patient*

Figure 10.17 *Hypermobility of the spine and hips*

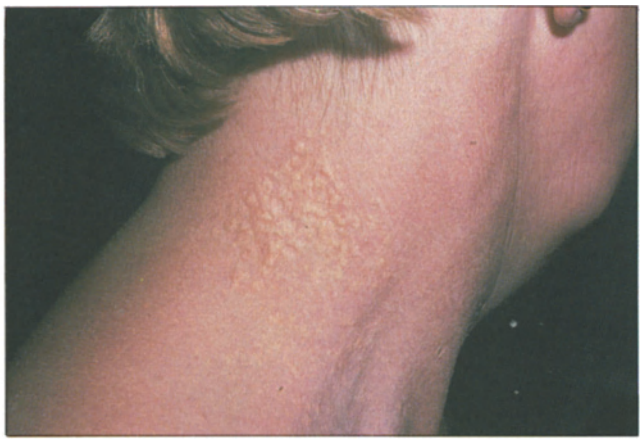

Figure 10.18 *Chicken skin appearance of pseudoxanthoma elasticum*

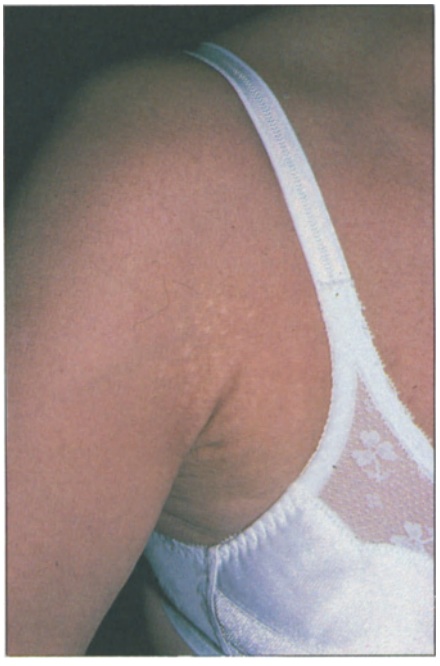

Figure 10.19 *Flexural lesion of pseudoxanthoma elasticum*

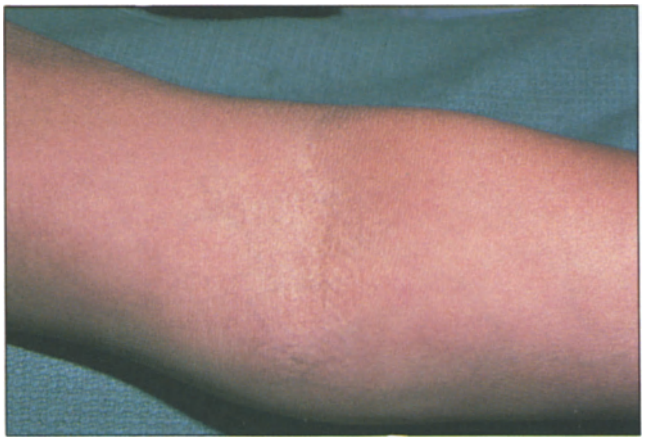

Figure 10.20 *Pseudoxanthoma elasticum – such lesions may appear in inguinal, popliteal and periumbilical locations*

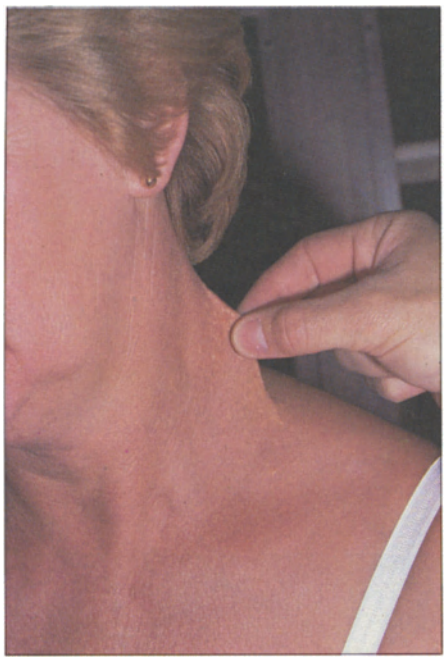

Figure 10.21 *Pseudoxanthoma elasticum – note hyperextensible skin and pseudoxanthomatous skin lesions*

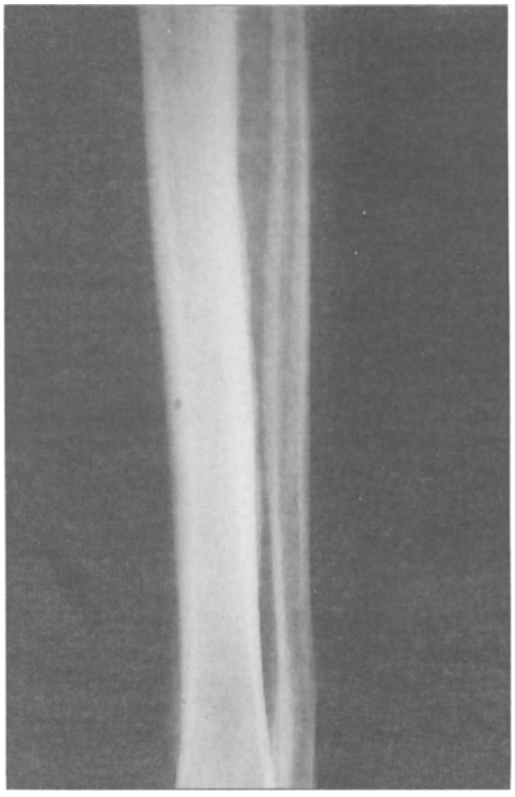

Figure 10.22 *Subperiosteal new bone formation in hypertrophic osteoarthropathy secondary to a bronchogenic carcinoma. (Courtesy of Dr R. Haddad)*

chicken skin. The skin is often hyperextensible (Figure 10.21), and there may be evidence of pathology in other organ systems, e.g. angioid streaks in the retina, choroiditis, retinal haemorrhage, vascular disease (peripheral, cardiac, mesenteric or cerebral), hypertension and gastrointestinal or uterine bleeding.

Hypertrophic osteoarthropathy

This condition is most usually secondary to either an underlying intrathoracic neoplasm (bronchogenic carcinoma or pleural tumour) or intrathoracic sepsis (lung abscess, bronchiectasis or empyema). Less commonly it is associated with pneumoconiosis, pulmonary tuberculosis, cystic fibrosis or mediastinal lymphoma. Rarely it is inherited and on occasion it is idiopathic. Musculoskeletal examination often shows evidence of finger clubbing which coexists with arthralgia or arthritis involving the wrists, elbows, metacarpophalangeal joints, knees or ankles. Pain may be experienced in the long bones (particularly on dependency of the affected limb), and may be associated with mild bony tenderness. Radiographs show symmetrical linear subperiosteal new bone formation, particularly in the distal diaphyseal regions of the long bones of the legs and forearms and occasionally in the phalanges (Figures 10.22, 10.23). Progress of the osteoarthropathy tends to be rapid in cases of intrathoracic neoplasm but more gradual in patients with intrathoracic sepsis.

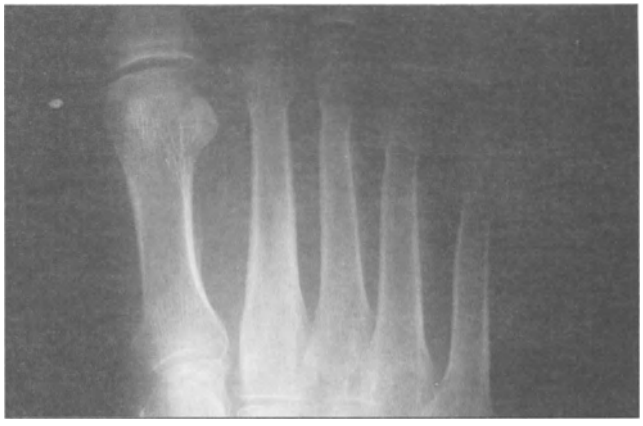

Figure 10.23 *Subperiosteal new bone formation in hypertrophic osteoarthropathy secondary to bronchogenic carcinoma. (Courtesy of Dr R. Haddad)*

Metabolic disorders

The discussion which follows is confined to the principal musculoskeletal features of several important metabolic disorders. The reader is referred to standard texts for comprehensive descriptions of a more general nature.

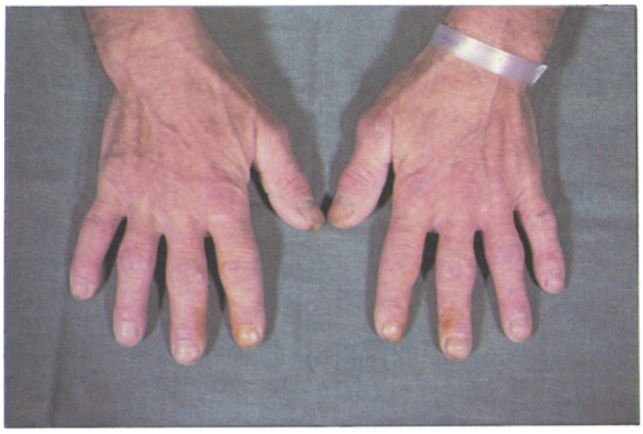

Figure 10.24 *Typical spade-like hands of acromegaly. (Courtesy of Dr M. W. Edmonds)*

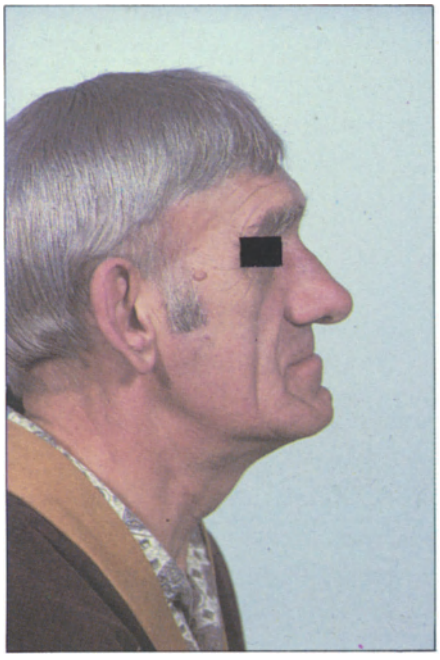

Figure 10.25 *Prominence of supraorbital ridge and nose in patient with acromegaly. (Courtesy of Dr M. W. Edmonds)*

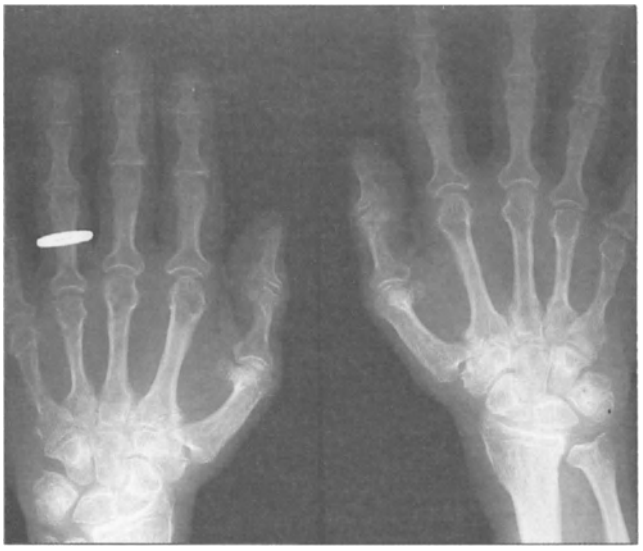

Figure 10.26 *Soft tissue prominence, arrowhead changes of distal phalanges in acromegaly. (Courtesy of Dr R. Haddad)*

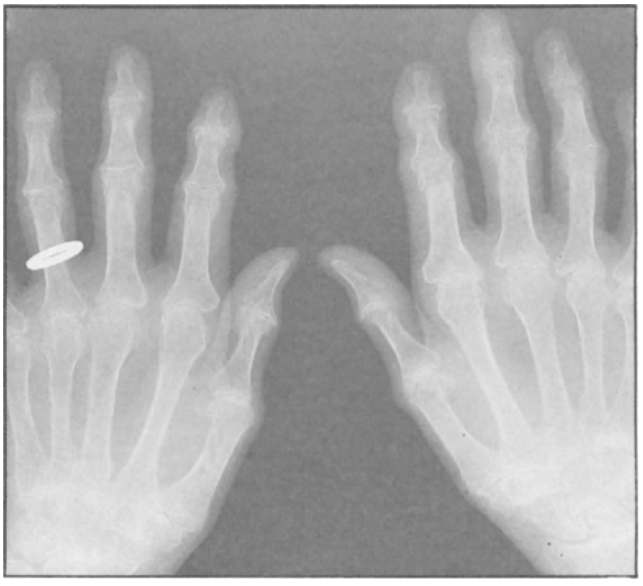

Figure 10.27 *Degenerative disease of MCP, PIP and DIP joints in patient with haemochromatosis*

Acromegaly

Excessive growth hormone production results in hyperplasia and proliferation of articular and periarticular tissues. The hands assume a spade-like configuration (Figure 10.24) and may show evidence of carpal tunnel compression. Rings are difficult to remove, and glove, shoe and hat sizes often increase. Coarsening of facial features often occurs slowly and may be quite subtle (Figure 10.25). For this reason prior photographs may be useful in detecting early changes. Radiographs of affected joints show widening of the joint space, bony enlargement with periosteal remodelling, secondary degenerative changes, calcification in tendons and at capsule insertions and, occasionally, chondrocalcinosis (Figure 10.26).

Haemochromatosis

Haemochromatosis is characterized by a combination of hepatomegaly, cirrhosis, slate-grey pigmentation of the skin, diabetes mellitus, heart failure and arthropathy. In respect of the arthropathy, patients may develop chondrocalcinosis (30–60%) or a degenerative arthritis principally affecting the hands, knees and hips. The second and third metacarpophalangeal joints are the most commonly affected peripheral joints, radiographs showing evidence of joint space narrowing and irregularity, bone cysts, subchondral sclerosis and bony proliferation (Figure 10.27). The onset of articular and extra-articular features is often temporally related, although occasionally the arthropathy may precede other features of the disorder.

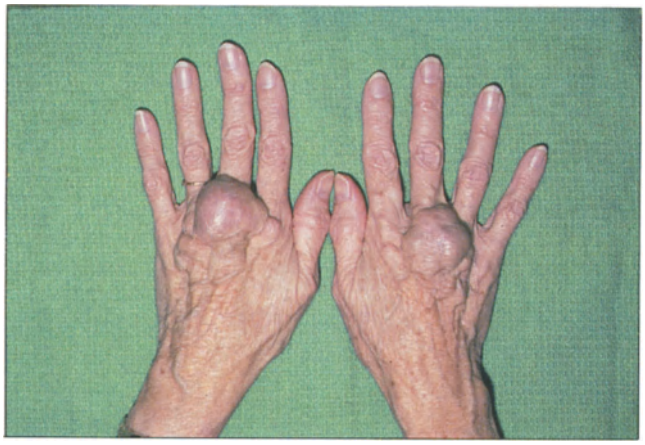

Figure 10.28 *Symmetrical tuberous xanthomata*

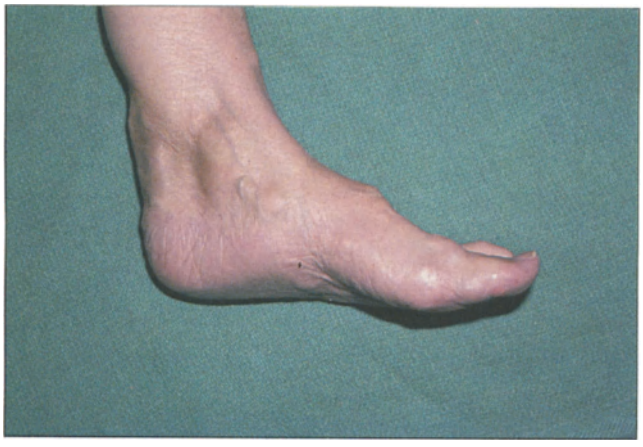

Figure 10.29 *Xanthomata adjacent to Achilles tendon, anterior tibia, mid tarsal area and medial longitudinal arch*

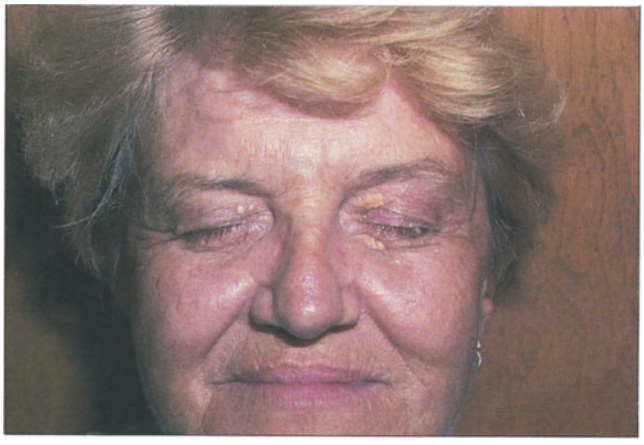

Figure 10.30 *Xanthelasma in patient with hypercholesterolaemia*

Hyperlipoproteinaemic arthropathy

Musculoskeletal syndromes have been described in patients with several types of hyperlipoproteinaemia (Types IIa, IV and V) (Figures 10.28, 10.29). The tuberous, cutaneous and periosteal xanthomata, xanthelasmata (Figure 10.30), corneal arcus and premature atherosclerosis which characterize Type IIa familial hypercholesterolaemia may be associated with tenosynovitis, Achilles tendonitis and polyarthritis. Joint symptoms are typically migratory, self-limited, affect large peripheral joints and vary in severity from mild arthralgia to frank synovitis. Type IV hyperlipoproteinaemia is associated with a bilateral but asymmetric oligoarthritis involving the large and small joints of the hands and feet. Symptoms vary in severity between arthralgia and moderate arthritis and tend to be intermittent and self-limited. Radiographs may show evidence of periarticular osteopaenia, which may in some patients, be associated with cystic lesions in the metaphyses.

Metabolic bone disease

Osteoporosis, osteomalacia, hyperparathyroidism and Paget's disease are the major types of metabolic bone disease. They are differentiated by their varying clinical, biochemical and radiographic characteristics.

Osteoporosis is often asymptomatic but may cause bone pain (particularly in the axial skeleton), which in the case of vertebral collapse is acute in its onset. Radiographs show evidence of decreased bone density, loss of vertebral height (due to compression fracture) and biconcavity of vertebral bodies due to disc pressure (i.e. cod fish vertebrae, Figure 10.31).

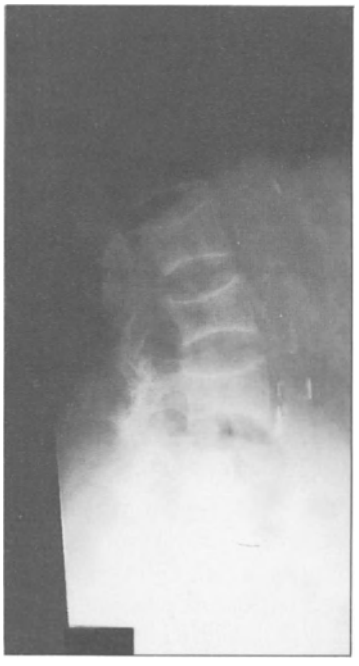

Figure 10.31 *Cod fish vertebrae in osteoporosis. (Courtesy of Dr R. Haddad)*

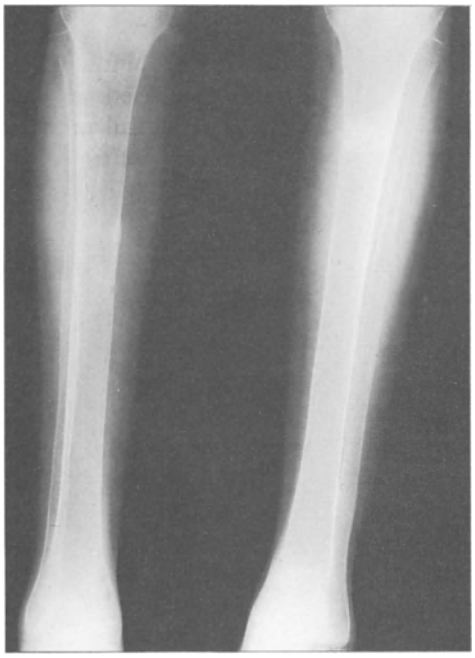

Figure 10.32 *Pseudofractures of left and right tibia in osteomalacia. (Courtesy of Dr R. Haddad)*

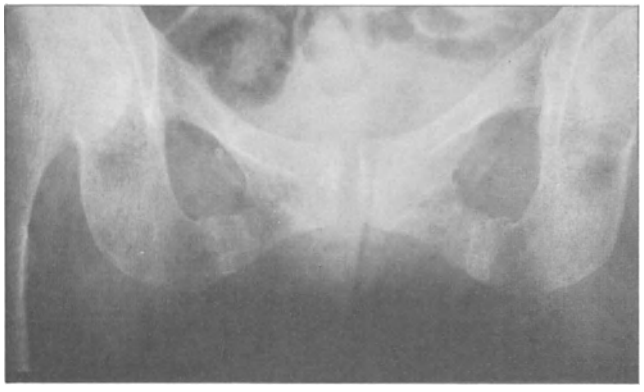

Figure 10.33 *Pseudofractures of ischium in osteomalacia. (Courtesy of Dr R. Haddad)*

In contrast to the normal biochemical profile of patients with osteoporosis, those with osteomalacia display reductions of serum calcium and phosphate and elevation of the alkaline phosphatase. Patients with osteomalacia may be asymptomatic or complain of bone pain and tenderness. They may experience compression fractures of the spine or symmetric pseudofractures particularly in the lateral margins of the scapula, ribs, femoral necks, pubic rami and ischial bones (Figures 10.32 and 10.33). True pathologic fractures may occur in the femoral neck. Rickets is the paediatric equivalent of osteomalacia and is characterized by bowing of the long bones, periarticular swelling, and swelling of the costochondral junctions (rickety rosary). Radiographs show metaphyseal cupping and epiphyseal plate expansion (Figure 10.34) and bowing of the long bones.

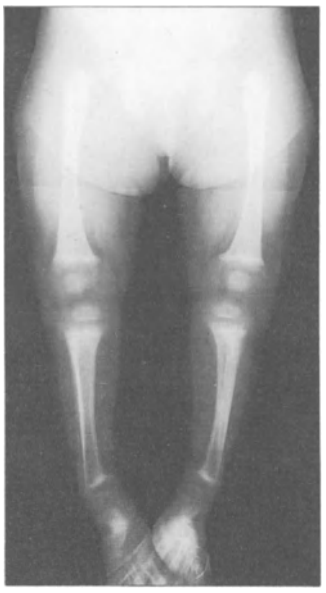

Figure 10.34 *Metaphyseal cupping, epiphyseal plate expansion and bowing in rickets. (Courtesy of Dr R. Haddad)*

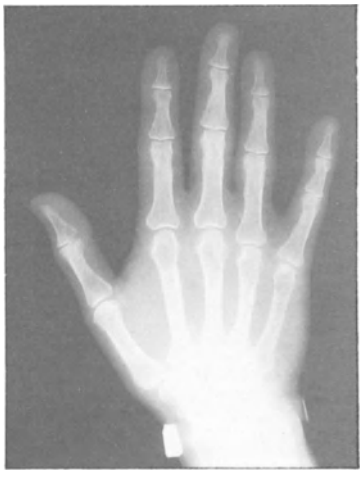

Figure 10.35 *Subperiosteal bone resorption of the phalanges. Similar changes may occur in other locations including the outer third of the clavicle. (Courtesy of Dr R. Haddad)*

Hyperparathyroidism

This disorder may be primary, secondary or tertiary in type. Elevation of the serum calcium and alkaline phosphatase and reduction of the serum phosphate is the typical biochemical profile of primary hyperparathyroidism. Diffuse pain in the extremities, bone tenderness and back pain are the most frequent musculoskeletal symptoms. Compression fractures, Schmorl's nodes, cod fish vertebrae, kyphosis and bowing of long bones may occur in advanced disease. However, the most characteristic radiographic features are (1) subperiosteal bone resorption (Figure 10.35),

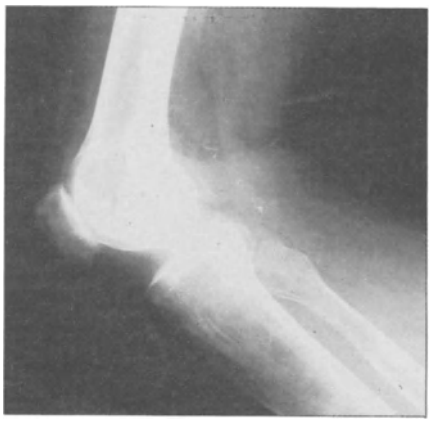

Figure 10.36 *Brown tumour in tibia of patient with primary hyperparathyroidism. (Courtesy of Dr R. Haddad)*

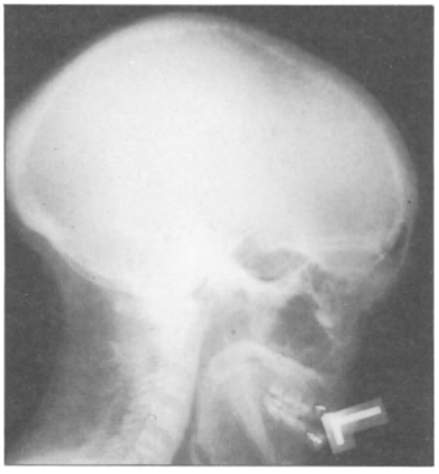

Figure 10.37 *'Salt and pepper' skull in patient with primary hyperparathyroidism. (Courtesy of Dr R. Haddad)*

(2) Brown tumours and single or multiple bone cysts (Figure 10.36) and (3) the 'salt and pepper' appearance of the skull (Figure 10.37). Calcium pyrophosphate deposition disease is a recognized complication of primary hyperparathyroidism. (See Chapter 6.)

Paget's disease

Paget's disease results in a substantial elevation of alkaline phosphatase, while serum calcium and phosphate levels remain normal. This disease is frequently asymptomatic, tends to affect males more than females and onsets usually in late middle life. Pain is typically deep and aching in quality and in the late stage of disease may be associated with bowing of the long bones (especially the tibia and femur), bossing of the skull, thoracic kyphosis or pathologic fracture (Figures 10.38, 10.39). Radiographically there is a mottled increase in bone density, coarsening of the trabeculation and thickening and bowing of the diaphysis (Figure 10.40). Technetium scintigraphy is of value in assessing the extent of disease, since uptake of the radionuclide is increased in affected bones (Figure 10.41). Osteogenic sarcoma, deafness and high-output cardiac failure are potential complications of this disorder.

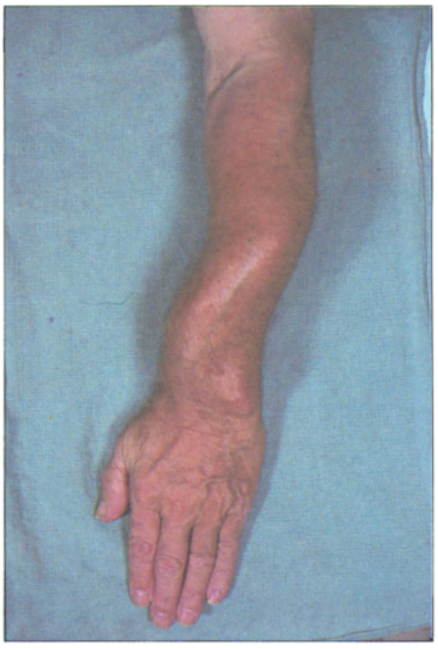

Figure 10.38 *Corkscrewing of forearm due to Paget's disease. (Courtesy of Dr M. W. Edmonds)*

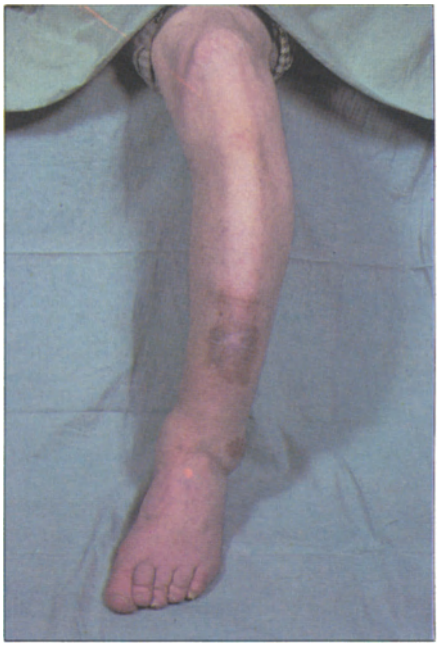

Figure 10.39 *Bowing of the left tibia in Paget's disease. (Courtesy of Dr M. W. Edmonds)*

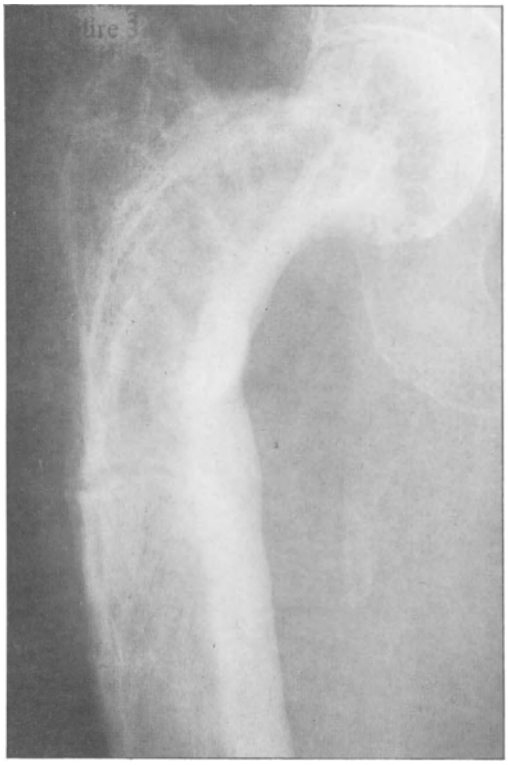

Figure 10.40 *Coarsening of trabeculae, diaphyseal thickening and partial fracture through femoral shaft*

Ochronosis

Ochronosis is an extremely rare disorder, inherited by a single autosomal recessive gene, in which there is an inability to oxidize homogentistic acid. This metabolic abnormality results in the accumulation of homogentistic acid, which appears in the urine and on prolonged standing produces a brownish-black discoloration (alkaptonuria). Homogentistic acid may be detected in the urine using either sodium hydroxide or Benedict's reagent (Figure 10.42). In the fourth and fifth decades a slate-blue discoloration develops in the cartilage of the ear and nose (Figure 10.43), the external auditory canal

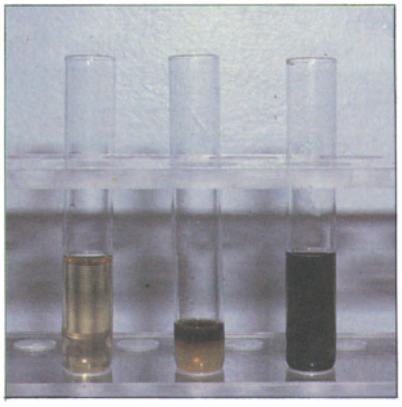

Figure 10.42 *Diagnostic urine tests for ochronosis' – Freshly voided urine (left). Expanding brown meniscal ring following addition of sodium hydroxide (centre). Black discoloration following treatment with Benedict's solution (right)*

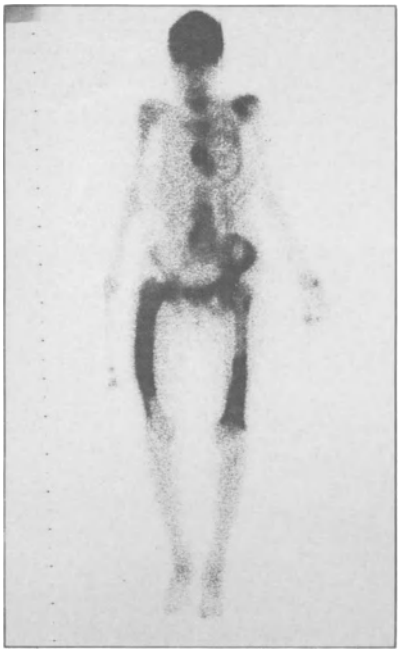

Figure 10.41 *Multifocal areas of increased uptake of technetium in patient with Paget's disease*

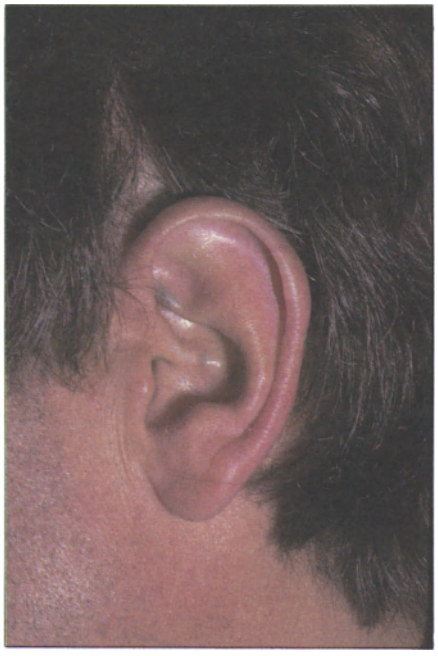

Figure 10.43 *Ochronosis – slate-blue pigmentation of the auricle (crura antihelicis and concha) (Courtesy of Dr B. Hanna)*

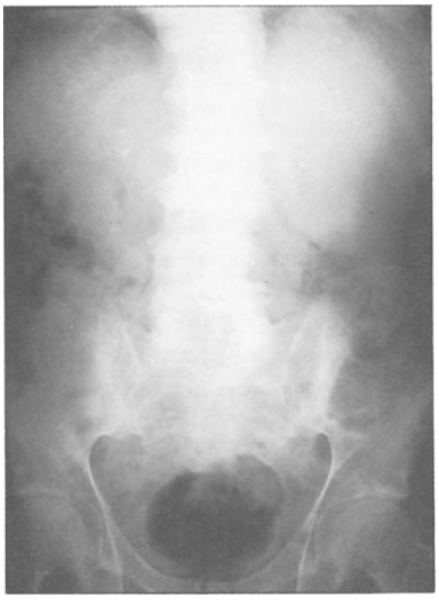

Figure 10.44 *Ochronosis – Wafer-like disc calcification and degenerative disease of lumbar spine. (Courtesy of Dr R. Haddad)*

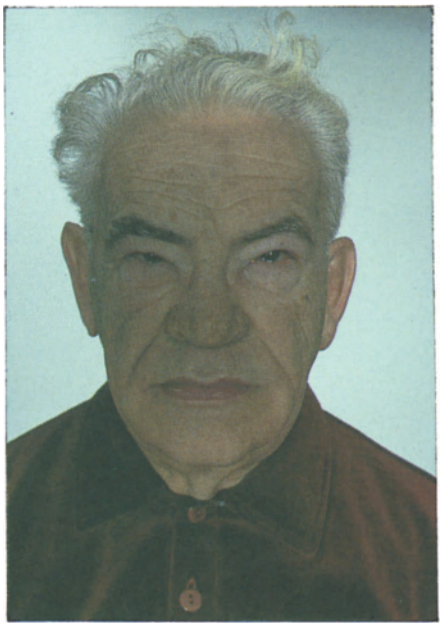

Figure 10.45 *Typical hypothyroid facies. (Courtesy of Dr M. W. Edmonds)*

and sclera. Deposition of pigment in articular cartilage, results in degenerative changes in the spine and peripheral joints. Characteristically the intervertebral discs show evidence of wafer-like calcification (Figure 10.44).

Thyroid disorders

Hypothyroidism may result in a subtle and rather generalized discomfort in both muscles and joints. While abnormal facial features, weight gain, tiredness and cold intolerance may suggest the diagnosis (Figure 10.45), the presence of non-inflammatory viscous effusions in the knees or detection of chondrocalcinosis may initiate a search for the disorder. In contrast hyperthyroidism may be associated with thyroid acropachy, finger clubbing, periosteal proliferation, soft tissue swelling and pretibial myxoedema (Figure 10.46).

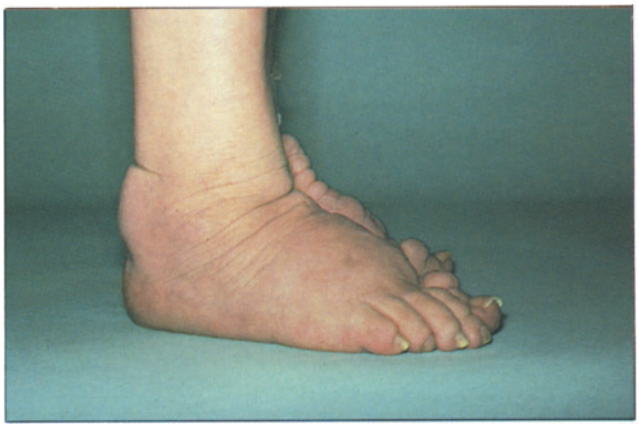

Figure 10.46 *Pretibial myxoedema – Note characteristic induration and prominence of soft tissues. (Courtesy of Dr M. W. Edmonds)*

Multicentric reticulohistiocytosis

Multicentric reticulohistiocytosis (MRH) is an extremely rare disorder which occurs more often in females than males (3:1). In 60% of cases, a symmetric polyarthritis involving the interphalangeal joints of the fingers (or less frequently the large joints of the upper and lower extremity), is the presenting symptom and may by virtue of its distribution suggest a diagnosis of rheumatoid arthritis. However, the coexistence of characteristic reddish-brown or copper coloured skin nodules allows MRH to be readily differentiated (Figure 10.47). Multiple facial and paranasal nodules give the facial skin a cobblestone or sometimes leonine appearance (Figure 10.48). Nodules characteristically involve the dorsum of the fingers and the nailfolds (Figure 10.49), the face, ears and chest, as well as mucosal surfaces of the

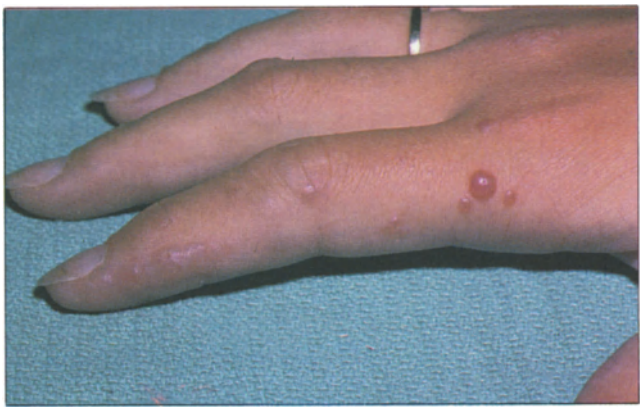

Figure 10.47 *Reddish-brown skin nodules of multicentric reticulohistiocytosis*

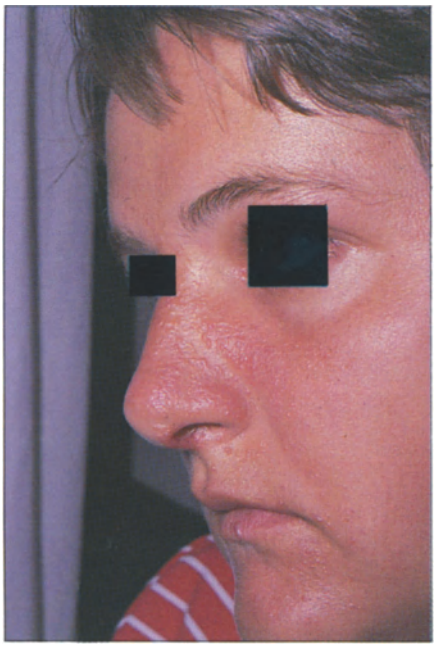

Figure 10.48 *Cobblestone appearance of multiple paranasal nodules. Note involvement of the lower lip*

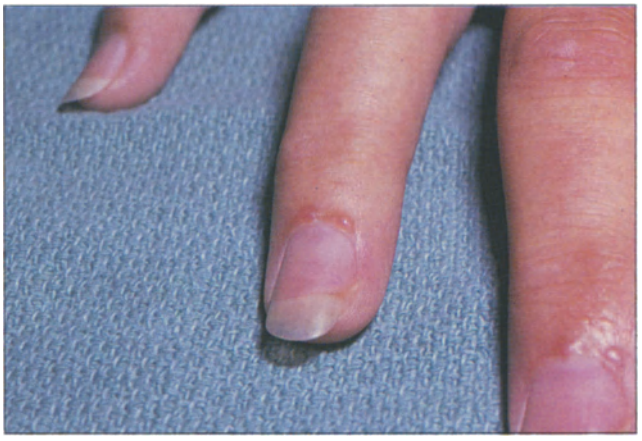

Figure 10.49 *Characteristic periungal nodules of multicentric reticulohistiocytosis*

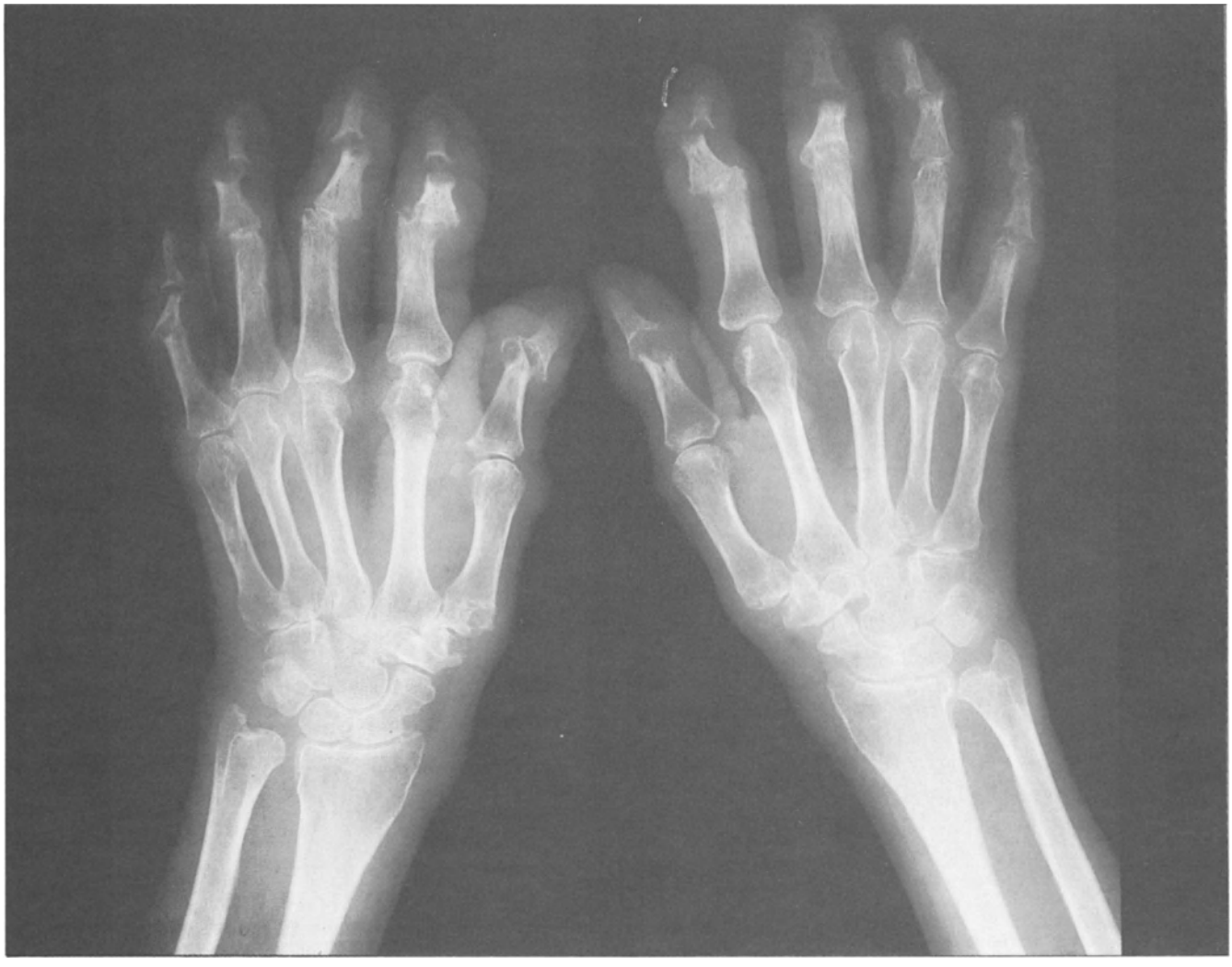

Figure 10.50 *Arthritis mutilans due to multicentric reticulohistiocytosis (Courtesy of Dr T. Munro). Note severe destructive changes in the interphalangeal joints*

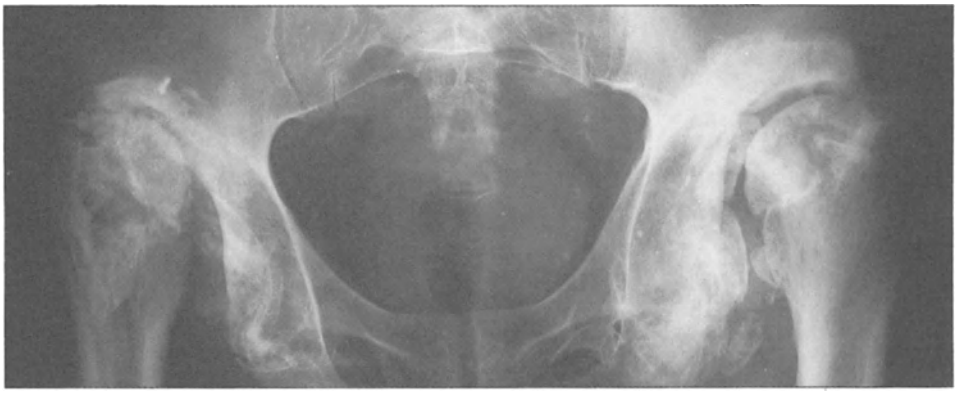

Figure 10.51 *Severe bony destruction and subluxation of left and right hips secondary to tabes dorsalis. (Courtesy of Dr R. Haddad)*

pharynx, gingiva, tongue, nasal septum and lips (Figure 10.48). In 40–50% of patients the arthritis progresses, and may in some produce the picture of arthritis mutilans (Figure 10.50).

Neuropathic arthritis

Neuropathic arthropathies occur, by definition, in patients with underlying neurologic diseases which diminish pain perception and proprioceptive function. Tabes dorsalis, diabetes mellitus and syringomyelia are the commonest causes. Neuropathic arthritis typically affects the hips and knees in tabes dorsalis (Figure 10.51), the small joints of the feet in diabetes mellitus (Figure 10.52, 10.53) and the shoulders and elbows in syringomyelia. This form of arthritis is extremely destructive, results in gross disorganization of the joint, fragmentation of bone and cartilage and bizarre configurations of new bone formation. In spite of the severity of disease, affected joints are painless, or relatively so.

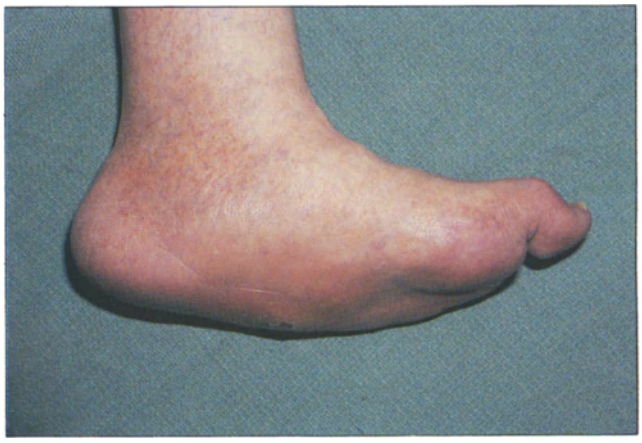

Figure 10.52 *Reversal of the medial longitudinal arch (rocker-bottom foot), expansion of the midfoot and plantar ulceration due to diabetic neuropathic arthritis*

Osteonecrosis

Avascular necrosis may be due to a variety of conditions including dysbarism, hypercortisolism, trauma, haemoglobinopathy, several haemopoetic disorders, diabetes mellitus, alcoholism, hyperlipoproteinaemias, pancreatitis and systemic lupus erythematosus. The femoral head is the most commonly affected area although site is partly dependent on aetiology, since in dysbaric osteonecrosis the lower end of the femur is the principal target area. In early disease radiographs are normal but scintiscans show evidence of a triangular shaped area of avascularity. With progression the corresponding area appears sclerotic, creating a so-called snow cap sign, the scintiscan by this time showing increased uptake. Spotty rarefaction, translucent cortical bands, collapse and sequestration of the articular cortex and secondary degenerative arthritis may occur in advanced stages of the disease (Figure 10.54).

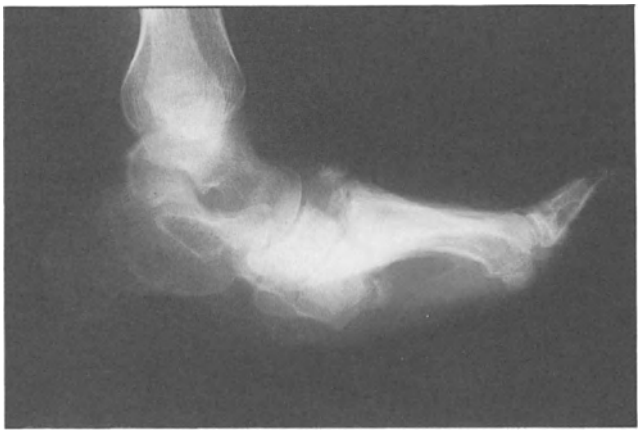

Figure 10.53 *Radiograph of patient shown in Figure 10.52. Note severe destructive changes and subluxation of midtarsal area resulting in the rocker-bottom foot and plantar ulceration*

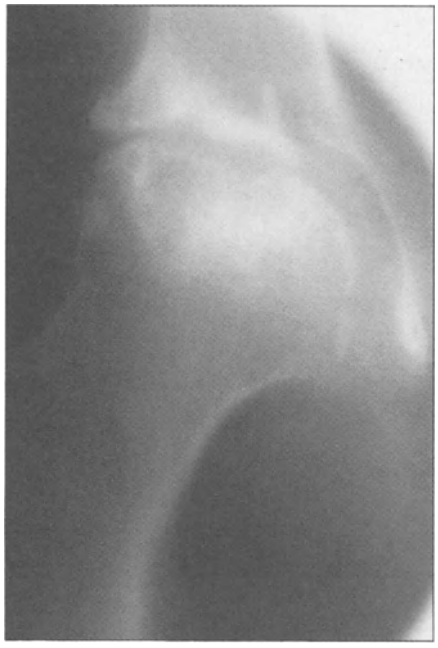

Figure 10.54 *Tomogram of advanced osteonecrosis of the femoral head showing sclerosis, rarefaction and cortical collapse*

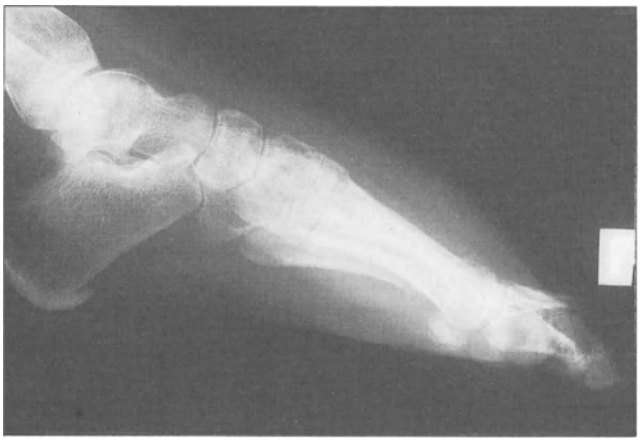

Figure 10.56 *Osteopaenia on radiograph of patient shown in Figure 10.55*

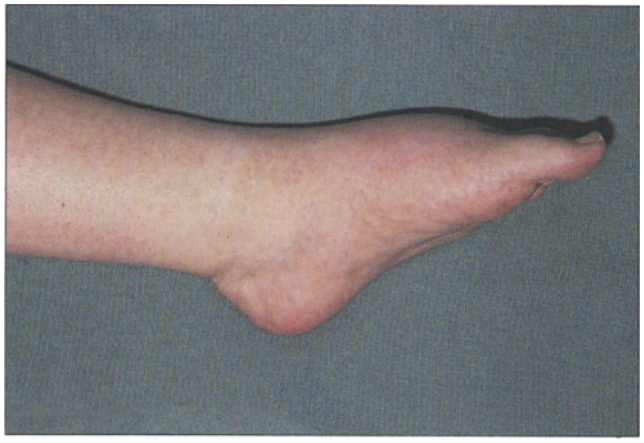

Figure 10.55 *Swelling in foot of patient with reflex sympathetic dystrophy*

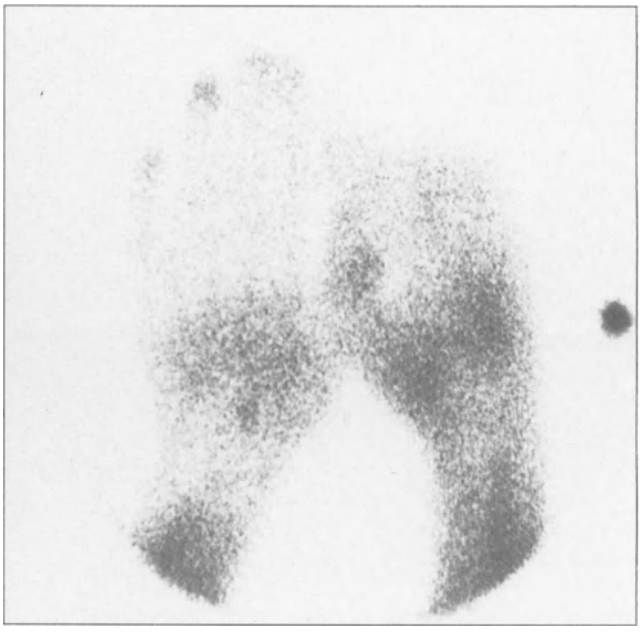

Figure 10.57 *Increased periarticular uptake in blood pool phase of technetium scintiscan of right hand of patient with reflex sympathetic dystrophy*

Reflex sympathetic dystrophy

Reflex sympathetic dystrophy may arise as the result of a large number of primary conditions including trauma, ischaemic heart disease, cervical spinal syndromes, spinal cord lesions, cerebral vascular accidents and degenerative or calcific lesions of the rotator cuff. However, in over a third of patients there is no identifiable underlying cause. The characteristic clinical features are those of pain and swelling in the distal extremity, trophic skin changes and signs and symptoms of vasomotor instability (Raynaud's phenomenon, pallor, suffusion or hyperhydrosis) (Figure 10.55). There may be an associated Dupuytren's contracture, or pain and limitation of movement in the ipsilateral shoulder (shoulder–hand syndrome). Radiographs may show evidence of patchy or mottled osteopaenia (Figure 10.56), while technetium scintiscans show increased periarticular uptake on the affected side and occasionally in a contralateral, asymptomatic extremity (Figure 10.57).

Sarcoidosis

Sarcoidosis is a multisystem disorder which principally involves the lung. Bilateral hilar lymphadenopathy is the characteristic radiographic lesion of early disease (Figure 10.58). This may eventually resolve but in some patients is replaced by a diffuse interstitial pattern. Erythema nodosum is a common accompaniment of early acute disease (Figure 10.59), although lupus pernio (Figure 10.60) and cutaneous sarcoid nodules may occasionally be encountered. Sarcoid arthropathy most often involves the ankle or knee in an oligoarticular pattern. Radiographs may show evidence of granulomatous deposits in bone, but joint destruction is infrequent, and articular structures usually appear normal (apart from soft tissue swelling). Hepatomegaly, hypercalcaemia, myopathy, central neurologic involvement and uveitis may complicate the more common respiratory, musculoskeletal and cutaneous features of the disease.

Wegener's granulomatosis

Wegener's granulomatosis is a necrotizing granulomatous vasculitis which has a predilection for affecting the respiratory tract. Thirty percent of patients experience sinus involvement, 26% pulmonary disease and 44% have both. Rhinorrhoea, sinusitis and nasal mucosal ulceration are the commonest presenting complaints. The chest radiograph in established disease may show evidence of multiple nodular opacities, some of which may cavitate (Figure 10.61). Interstitial lung disease, glomerulonephritis, arthritis, cutaneous vasculitis, myopathy and neurologic involvement may complicate this disorder which has a grave prognosis and requires specific treatment.

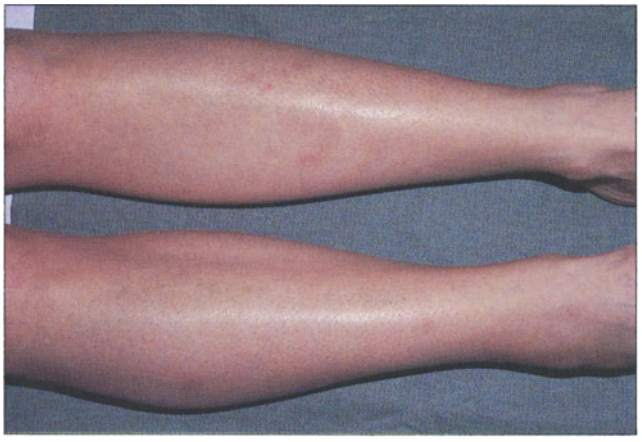

Figure 10.59 *Typical lesions of erythema nodosum on the lower extremity*

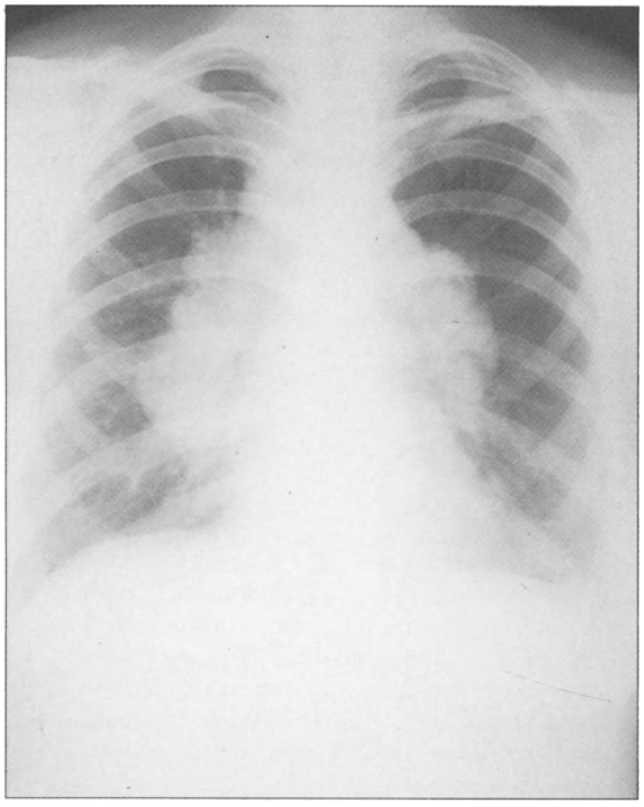

Figure 10.58 *Bilateral hilar lymphadenopathy in patient with sarcoidosis. (Courtesy of Dr M. Lefcoe)*

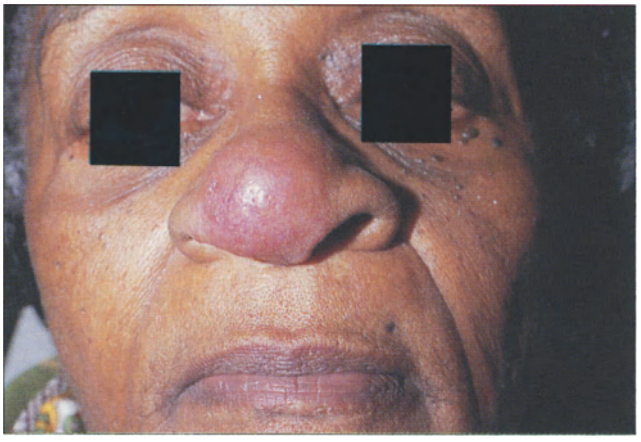

Figure 10.60 *Lupus pernio – a less familiar cutaneous accompaniment of sarcoidosis. (Courtesy of Dr P. Kenny)*

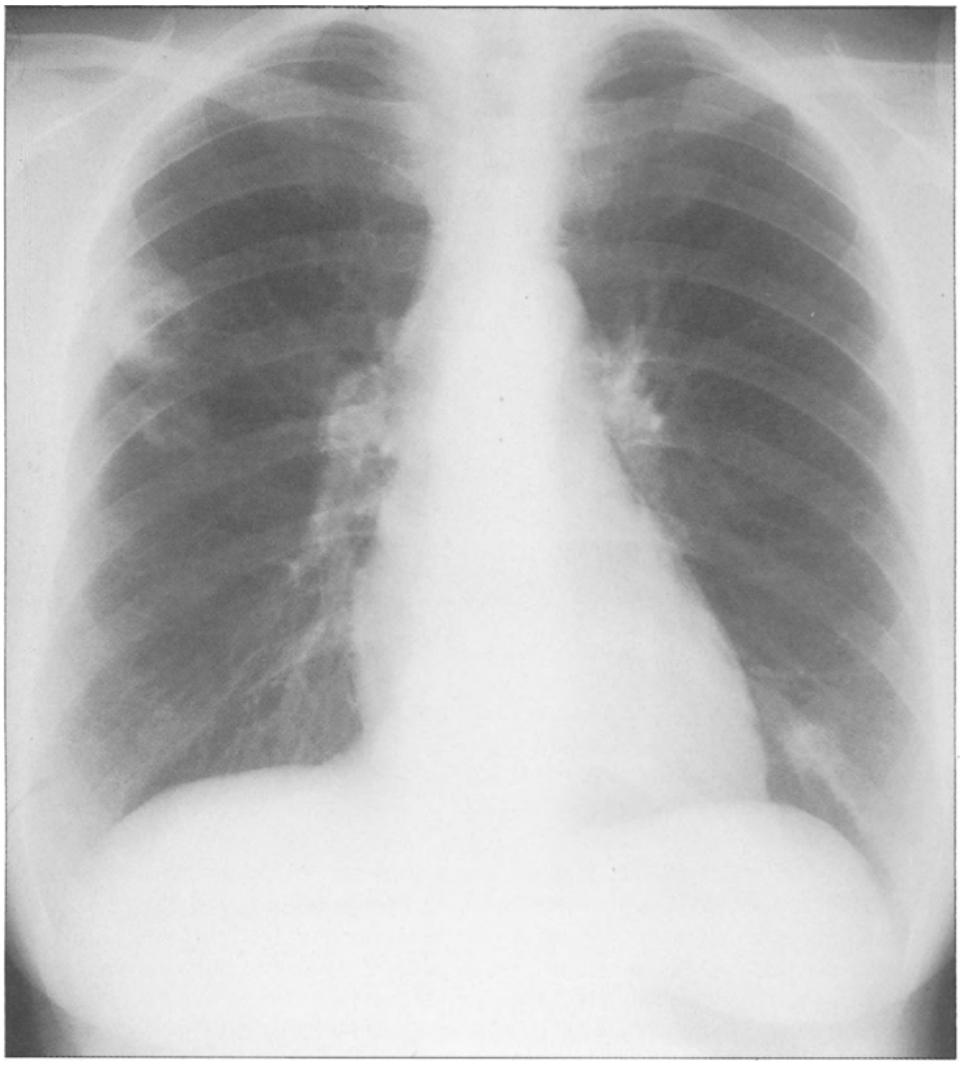

Figure 10.61 *Multiple pulmonary nodules due to Wegener's granulomatosis – note cavitation. (Courtesy of Dr M. Lefcoe)*

Giant Cell Arteritis

For several years it has been recognized that giant cell arteritis (syn: temporal arteritis, cranial arteritis) and polymyalgia rheumatica (PMR) are closely related disorders. Both conditions show a propensity to affect elderly individuals and result in marked elevation of the erythrocyte sedimentation rate. Stiffness and aching of the shoulder girdle, neck, upper arms and hip girdle are characteristic features of PMR. In addition some patients may experience a low grade fever, malaise, fatigue, arthralgia and occasionally arthritis.

Giant cell arteritis (GCA) may occur as a distinct entity or in association with some or all of the features of PMR described above. The arteritis of GCA is characteristically segmental and involves large and medium sized arteries. It may affect a variety of vessels but has a predilection for the superficial temporal, vertebral, ophthalmic and posterior ciliary arteries. Involvement of the superficial temporal artery results in localized pain (headache), linear erythema, swelling and tenderness, and renders the affected vessel pulseless (Figure 10.62). Arteritis of the ophthalmic and posterior ciliary vessels may result in visual symptoms including diplopia, ptosis and partial or complete blindness which may be transient or permanent. Other clinical features of GCA include intermittent claudication, jaw claudication, gangrene, hemiparesis, psychosis, peripheral neuropathy, acute hearing loss, brain stem ischaemia or infarction, myocardial infarction and congestive heart failure. Impending visual loss in a patient with GCA is a rheumatological emergency and demands the immediate introduction of corticosteroid therapy. Although corticosteroids alter the histopathological appearance of the subsequent arterial biopsy, in most instances the characteristic changes can be recognized for several days after the commencement of treatment. For this reason, and

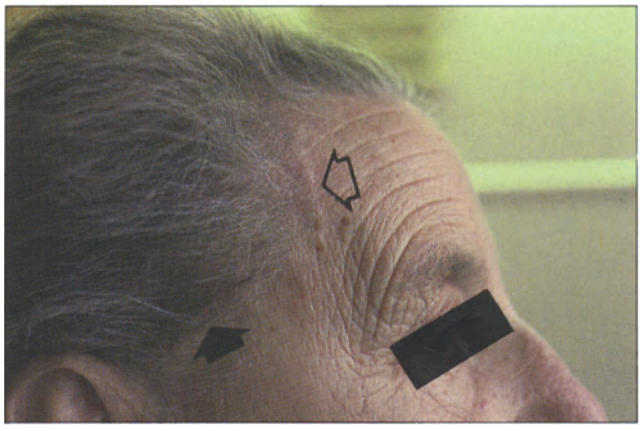

Figure 10.62 *Painful, tender, swollen, pulseless superficial temporal artery (open arrow) in elderly female with GCA. Diagnosis was confirmed by biopsy (closed arrow)*

given the prognostic implications of delayed treatment, corticosteroid therapy should be started before the biopsy is performed and the histological sections reviewed.

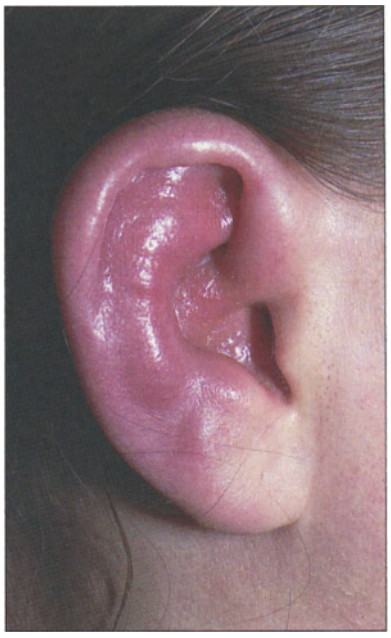

Figure 10.63 *External ear of young female with relapsing polychondritis. Note erythema and swelling of cartilaginous portion of the auricle with sparing of the lobule*

Relapsing Polychondritis

Relapsing polychondritis is a rare multisystem disorder characterized by recurrent attacks of inflammation involving cartilaginous and non-cartilaginous structures. It occurs equally in males and females, usually onsets during the middle years of life and is often fatal. The most frequent presentation (30%) is of acute pain, tenderness and violaceous, erythematous swelling involving the cartilaginous portion of one or both external ears (Figure 10.63). Attacks last for several days to several weeks, persistent or recurrent episodes resulting in the typical drooping ear deformity. Eighty-five percent of patients ultimately experience auricular inflammation, 66% nasal chondritis (which may ultimately result in a saddle nose deformity) and 68% a peripheral arthropathy which is usually episodic, asymmetric, non-deforming, non-erosive and involves both the large and small joints. Inflammation less frequently involves the parasternal articulations and rarely the sacroiliac joints. Other important manifestations of this disorder include scleritis, episcleritis, conjunctivitis, chorioretinitis, laryngotracheal-bronchial involvement, auditory and vestibular disturbances, systemic vasculitis, valvular insufficiency, aneurysm formation and a variety of cutaneous lesions. Prognostically the two most important lesions of relapsing polychondritis are (1) cartilaginous involvement of the larynx, trachea and bronchial rings which may result in structural collapse and severe narrowing or obstruction of the respiratory tract, and (2) aortic insufficiency. Although relapsing polychondritis usually arises *de novo,* in some cases the disease has been reported in association with one of a number of connective tissue disorders including RA, SLE, PSS, Behçet's disease, polymyalgia rheumatica, and the seronegative spondyloarthropathies.

INDEX