The hand X-ray in rheumatology

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X-ray of the hands is the most valuable imaging modality in rheumatology. Joint disease may be identified by individual features such as joint space narrowing, erosions, new bone formation, subluxation and deformity, which may be diagnostic. In diseases such as rheumatoid arthritis presence of erosions on hand X-ray give a valuable measure of disease progression and response to therapy.

Since the discovery of X-rays by Roentgen plain film radiology has grown in importance. The hand X-ray is a revealing diagnostic tool: indeed the first radiograph ever taken was of a hand. It is the X-ray most frequently requested by rheumatologists, highlighting the emphasis which is placed on radiology of the hand and also how important, in terms of symptoms, the hand is to patients with rheumatic complaints.

Although no clinician would rely entirely on radiology for a diagnosis, faced with the uncertainty of, for example, a patient with swollen painful interphalangeal joints, the differentiation between erosive and non-erosive diseases can be quite rewarding. This may influence the management of the patient.

The presence of erosions in an apparently well patient with rheumatoid arthritis (RA) may help influence the clinician's decision to treat with disease-modifying drugs. Conversely, the absence of erosions and joint destruction reassures both doctor and patient. Furthermore clinicians have been known to fall into the trap of mistaking a subgroup of osteoarthritis (OA) characterized by erosive changes (erosive OA) for RA. The hand X-ray also acts as a permanent historical record of the patient's illness.

In exceptional circumstances experts can assess disease activity and/or pronounce confident diagnoses using this inexpensive investigation. Unfortunately most people require further, more expensive investigations to be able to make a firm diagnosis. In one study, consultant radiologists and rheumatologists were shown to have poor concordance on diagnosis of various common rheumatic conditions with the hand X-ray (Kassimos et al, 1994). With this caveat aside, the hand X-ray is still a useful window into rheumatic disease and familiarity with it is extremely rewarding.

The hand X-ray should be viewed on a well-lit X-ray box in the posteroanterior view. A proper examination will include the wrists and the distal radio-ulnar joints. The hands should have been placed flat against the film. The joint spaces are about 1 mm and increase from distal to proximal joints. The soft tissue shadow should be easily visible. With increasing age interphalangeal joint periarticular calcified oscines (in essence, osteophytes) may appear.

The common differential diagnoses in rheumatology requiring hand X-rays are:

- OA: grading, features, subtypes: osteophytosis, erosive, inflammatory
- RA: typical patterns, stages
- Psoriatic arthritis: typical changes, features
- Crystal arthritis: gout, pyrophosphate arthropathy.

OSTEOARTHRITIS

OA is the commonest arthritis. Up to 35% of hand X-rays in patients over 60 years of age will have changes of OA (Cushnaghan and Dieppe, 1992) and at least 10% of these will have symptoms. The main features of OA are osteophytes, sclerosis and joint space narrowing but other features like cysts and collapse may be seen (*Figures 1* and *2*).

Figure 1 shows classic hypertrophic OA. The involvement is at the distal interphalangeal joints (DIPJs) and proximal interphalangeal joints (PIPJs). There may be involvement of the thumb bases. Classically osteophytosis with subchondral sclerosis and joint space narrowing is seen. Soft tissue swelling represents Heberden's nodes clinically. Heberden's nodes were first described by Sir William Heberden (1710–1801), and were first called Heberden's nodes by Sir William Osler. The main peculiarity is the pattern of distribution.

The first carpometacarpal joint is frequently affected (*Figure 2*). There may be squaring of

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the thumb base with point tenderness. The digit may be rotated in slight flexion and adduction. There is frequently an association with carpal tunnel syndrome. Rest, expert splintage and intra-articular corticosteroids can be extremely helpful. Also involved are DIPJ of the index, thumb, middle, ring and little fingers and then the PIPJ of the fingers (Wood, 1977; Plato and Norris, 1979). Apart from the thumb, OA in the metacarpophalangeal joints (MCPJ) in the fingers is uncommon.

Different phases of OA may be differentiated clinically and radiologically. Soft tissue swelling is probably the earliest change on X-ray in cases where inflammation is a feature but this may be barely perceptible to the patient and most will not present at the early stages of the disease. The osteophyte is a 'bone' of contention. It begins with an ossification centre (ossicle) usually adjacent to the joint. The actual chondroblastic mass will be larger and radiolucent until all of it ossifies.

Figure 1. Hypertrophic osteoarthritis.

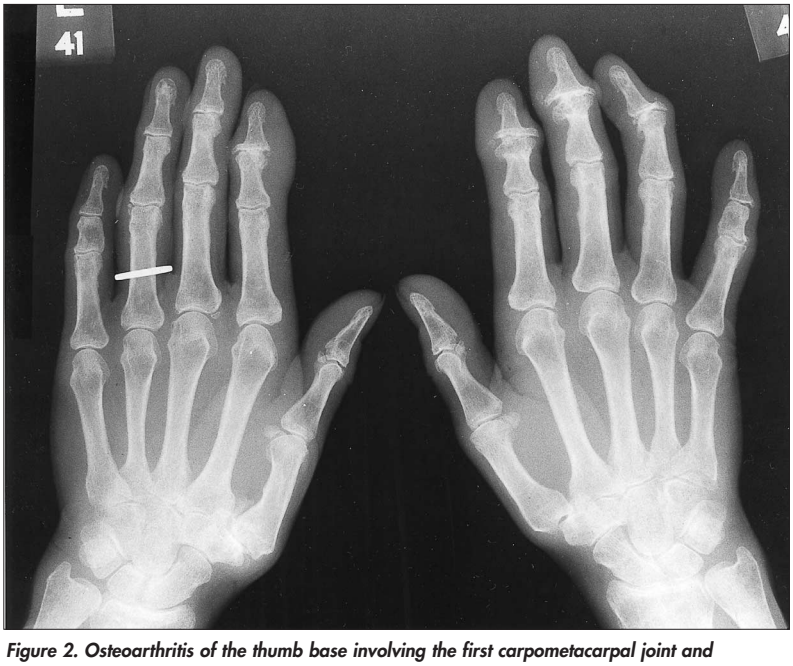
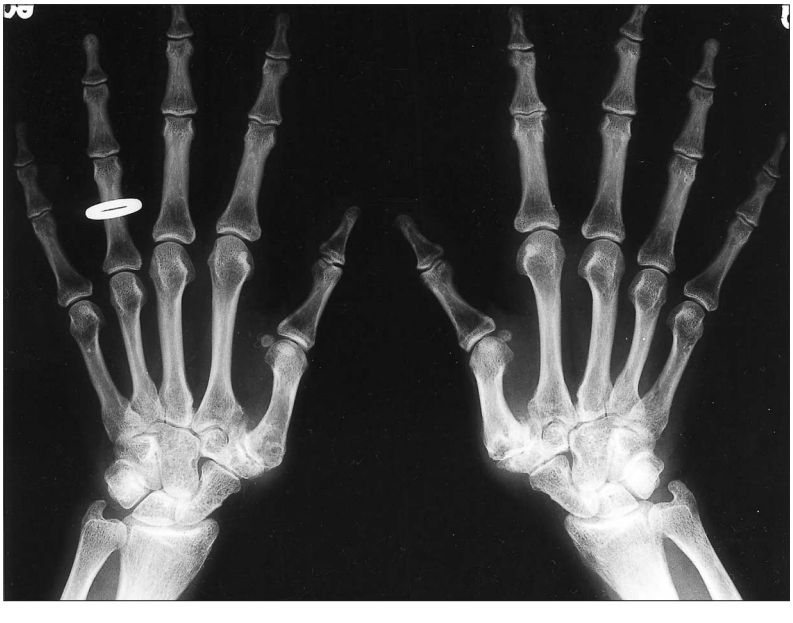


Figure 2. Osteoarthritis of the thumb base involving the first carpometacarpal joint and scaphotrapezial joint.



Ideally, osteophytosis should not be used as the sole criteria for OA as it may simply represent an age-related phenomena. It may also be seen in 'bone-forming' diseases such as diffuse idiopathic skeletal hyperostosis (Rogers et al, 1993). The presence of lateral osteophytes in the DIPJs on X-ray correlates with the presence of Heberden's nodes (Lim et al, 1993). In the case of thumb base pain it is relevant to the clinician whether carpometacarpal joint disease is accompanied by scaphotrapezial joint OA as well, as the surgical procedure if contemplated will be different (Eaton and Glickel, 1987).

At the the interphalangeal joints a recognized subset is erosive OA. This is characterized by articular surface collapse, ankylosis and erosions of the joint surfaces resulting in a classic 'gull's wing' appearance. Clinically this does not seem to be a special grouping, the radiological features simply represent a severe end point of idiopathic interphalangeal OA. However, some researchers suggest that this is a distinct form called inflammatory OA (Cobby et al, 1990). Inflammatory episodes that accompany OA changes in the joints may show soft tissue swelling as in RA. Rheumatoid factor has a 20–30% positivity rate in the elderly, regardless of whether they have RA, which may cause diagnostic confusion. If classic OA changes are present with absence of periarticular erosions and sparing of the wrist and MCPJs then the diagnosis of inflammatory OA is easier.

RHEUMATOID ARTHRITIS

The different clinical stages of RA are well demonstrated by hand radiography. The earliest changes occur in the hands (MCPJ and carpal bones) and there is a strong correlation between destructive changes in the hands and the changes in other joints (Sharp et al, 1991). The hand (and foot) X-ray is the most simple radiographic tool for monitoring disease activity and assessing treatment efficacy. It is not the most sensitive method but it provides at least an historical record of changes. By the first year 25% of erosions would have occurred, by the second year 75% and by the third year most of all erosions would have occurred (Brook and Corbett, 1977).

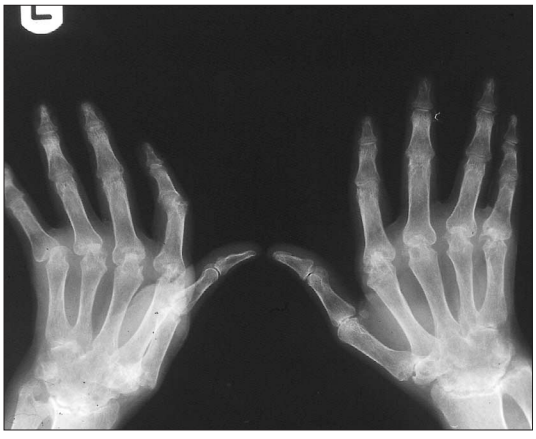


Figure 3. Erosive rheumatoid arthritis. Synovitis at second and third proximal interphalangeal joint with early erosions, soft tissue swelling and juxta-articular osteopenia. Note sparing of the distal interphalangeal joint and symmetrical involvement.

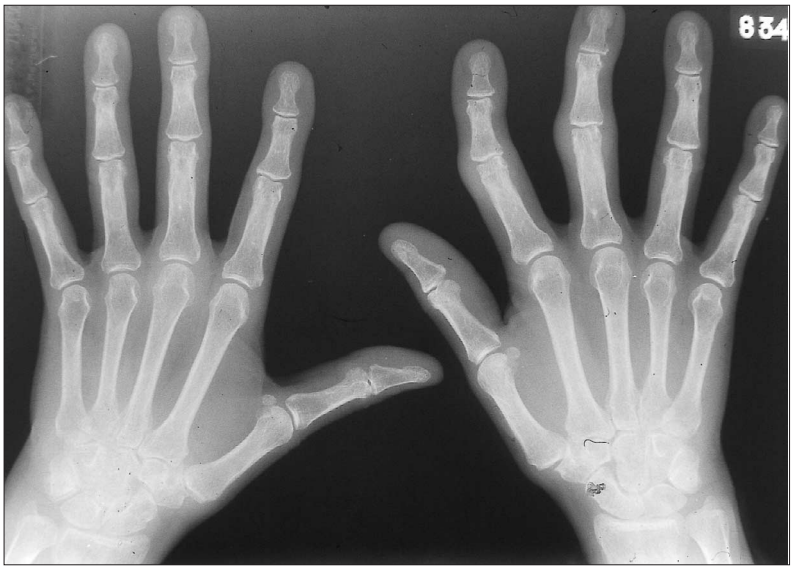


Figure 4. Aggressive erosive rheumatoid arthritis. There is soft tissue swelling, joint space narrowing and marginal erosions in the proximal interphalangeal joints and metacarpophalangeal joints (MCPJs) and the right wrist. Subluxation at the MCPJs (ulnar deviation) is evident.

Figures 3 and *4* represent different stages in the rheumatoid process. The typical early changes include juxta-articular osteoporosis and soft tissue swelling. As cartilage and bone are destroyed, juxta-articular erosions appear. Erosive disease correlates with high rheumatoid factor titres in particular immunoglobulin (Ig) G, an insidious polyarticular onset, HLA DR4 and a persistently high C reactive protein (Dawes et al, 1986).

Later stages of RA include ulnar deviation (through the destruction of ligamental and muscular structures, resulting in subluxation or luxation of the MCPJs), swan neck and boutonnière deformities and Z deformities of the thumb. The wrists are frequently affected and can go through the same stages but with the addition of bony ankylosis, a fairly common result of persistent active disease. Erosion and destruction of the ulnar styloid is common. It is commonly believed that the DIPJ is spared in RA but in about 20% of cases of RA DIPJs are affected.

The important point about erosions on the hand X-ray is that they reflect disease at other joint sites and are predictive of widespread erosive arthropathy and of potentially dangerous scenarios, i.e. cervical disease with C1–C2 subluxation (Kramer et al, 1991). The presence of erosions early in the disease is one indication to intervene with more aggressive disease-modifying agents.

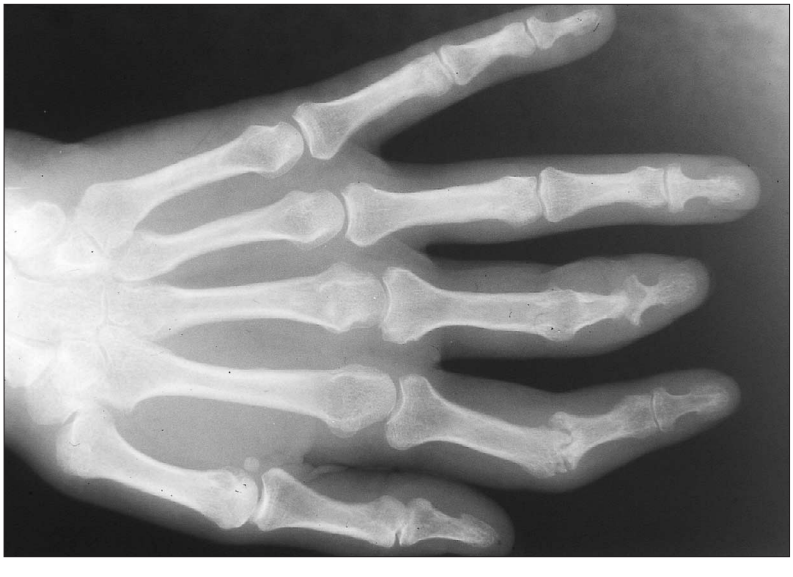
PSORIATIC ARTHRITIS

Of the five types of disease patterns seen in psoriasis, three can be recognized in the hands:

1. The classic asymmetrical hand arthritis affecting the DIPJs with sausage digits (*Figure 5*). Changes include increased bony reaction. Associations with this type of arthropathy are HLA B27 (25–30%), nail pitting and psoriasis
2. The rheumatoid-type hand distribution (seronegative)
3. Arthritis mutilans with severe joint destruction and osteolysis.

The other two patterns – the sacroiliitis/ankylosing spondylitis and the large joint oligoarthritis patterns – tend to spare the hands. The classic changes seen in psoriasis which may help differentiate from RA are the presence of early ankylosis, relative lack of osteoporosis, osteolysis, pencil-in-cup deformi-

Figure 5. Psoriatic arthritis: typical pattern with distal interphalangeal joint involvement.



ties, bony formation (periostitis) and its pattern of distribution. The wrists, as in RA, can be affected. The MCPJs of the fingers and the thumb carpometacarpal joint are usually spared. Often all joints in a single finger can be affected: this, together with involvement of tendons, results in the classic dactylitis or 'sausage' finger. In the authors' experience differentiating psoriatic arthritis from other arthritis on hand X-rays can be very difficult (Kassimos et al, 1994).

GOUT

Gouty tophi are obvious and should not pose diagnostic difficulty. The tophaceous masses cause erosions which are typically adjacent to joints (juxta-articular) by pressure effects. *Figure 6* shows gout with soft tissue swelling and erosion at the interphalangeal joint. The appearance is said to be like that of a mouse-bitten cheese with a distinct overhanging edge. The cause of the erosion is probably the result of pressure from the tophus. As urate crystals are not radio-opaque, tophi show only as soft tissue swelling. Occasionally the tophi are calcified.

Tophaceous gout is one of the indications for hypouricaemic therapy. Any joint can be affected but usually it is the interphalangeal joints. Gout may be difficult to diagnose radiologically when there are no tophi. A classic story in an obese middle age man with likely risk factors, high alcohol intake and/or diuretics with a high uric acid level should clinch the diagnosis. A controversial diagnosis is gout in the presence of RA which is a radiological curiosity. It is said that the number of reported cases can be counted on the fingers of the hand (Rizzoli et al, 1980; Atoljian and Fernandez-Madrid, 1981). It cannot be diagnosed confidently without the demonstration of urate crystals. The reasons for this rarity remain speculative but range from the protective effect of IgM rheumatoid factor to the inability of RA joints to mount an inflammatory response during urate crystallization (Atoljian and Fernandez-Madrid, 1981; Bywaters, 1986).

Figure 6. Gout.

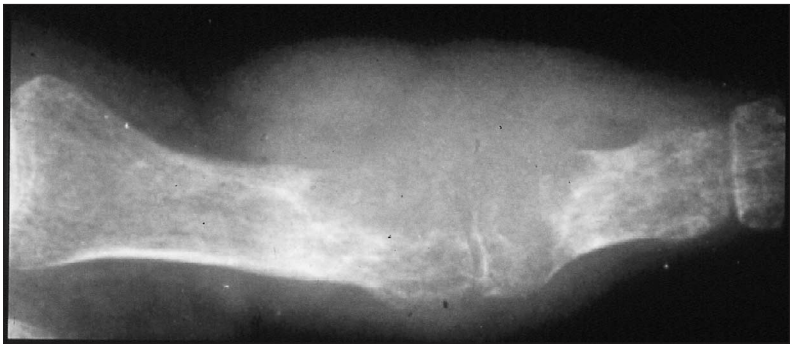
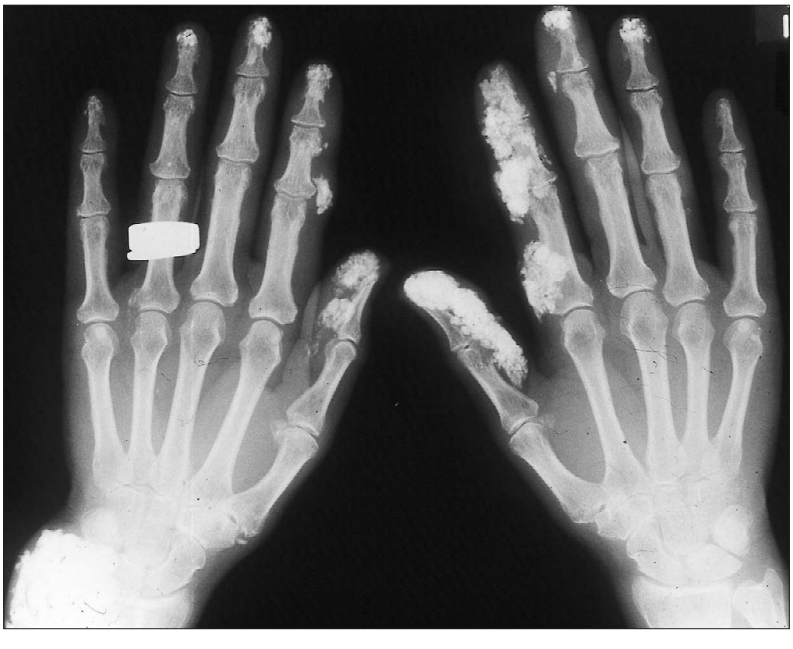


Figure 7. Scleroderma, showing subcutaneous calcification.



PSEUDO GOUT

This condition, also known as calcium pyrophosphate dihydrate disease, is often missed. The classic story of an elderly patient on a diuretic admitted because of an intercurrent infection developing acutely painful swollen knees and wrists should alert the clinician to the diagnosis.

X-rays of the hand may show soft tissue swelling and a thin line of chondrocalcinosis and in the wrists. This is usually present in between the distal ulnar border and the triangular ligament. With exclusion of sepsis, joint aspiration and a steroid injection will produce gratifying relief for the patient. Synovial fluid analysis can confirm the diagnosis by demonstrating positively birefringent rhomboid-shaped pyrophosphate crystals.

CALCIFICATION

Factors influencing extraskeletal calcification include:

- Abnormal matrix caused for example by trauma or scar. The body's attempt to repair with fibrosis provides a focus for macrophages to lay down calcium
- Abnormal calcium metabolism, e.g. hyperparathyroidism
- Raised phosphate ionic product.

Most cases of extraskeletal calcification are caused by a combination of all three. The most common substance is hydroxyapatite. The main causes of calcification on hand X-rays are:

- Ectopic calcification
- Scleroderma (*Figure 7*). This is often associated with Raynaud's syndrome (hands which turn pale, blue and then red in winter). Other clinical features include dysphagia and occasionally breathlessness. Antinuclear factor may be positive and anti-centromere antibodies are present in about 50% of limited disease. Anti-topoisomerase antibody (anti-Scl-70) may indicate more systemic involvement
- Dermatomyositis
- Chondromas
- Calcinosis cutis.

UNCOMMON DIAGNOSES

Jaccoud's arthritis is a fascinating condition seen in up to 10% of patients with systemic lupus erythematosus (SLE). Originally the term described deformities following immobility in rheumatic fever at the turn of the century. The gross deformities are not borne out by any obvious bony or joint destruction such as that seen in RA. It is thought to be primarily a problem of the tendons, ligaments and muscular structures. While it is said that erosions never occur in SLE, they may be seen and occur on the side of the joint deviation implying mechanical erosion by the tendons.

Other rarely conditions seen on a hand X-ray include septic arthritis (tuberculosis), sarcoidosis, Paget's disease, hypertrophic pulmonary osteoarthropathy, chondroma, acromegaly, haemochromatosis and Marfan's syndrome.

CONCLUSIONS

In an era of high technology and high cost imaging, the hand X-ray remains a cheap, efficient and non-invasive tool in the clinician's armamentarium. It can exclude worrying pathologies. It remains one of the most important diagnostic and prognosticating tool in rheumatology. HM

Conflict of interest: none.

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KEY POINTS

- Many forms of arthritis have characteristic X-ray appearances on hand X-rays.
- Key changes in rheumatoid arthritis are presence of erosions (which may be seen in feet as well as hands). Other early changes include juxta-articular osteoporosis and soft tissue swelling, with deformity occurring late.
- Osteoarthritis is characterized by cartilage loss (joint space narrowing), osteophyte and sclerosis.
- Psoriasis arthritis changes include periosteal new bone formation, erosions and ankylosis.
- Acute gout is likely to show only soft tissue swelling but chronic gout may be associated with typical hook-like erosions.