

Definition

► Epidemiology

Affects 2% of the population • Peak incidence (diagnosis) in 4th and 5th decades • Women affected 3–4 times more often than men • Increased familial incidence • Up to 70% of patients have HLA antigen DR4.

► Etiology, pathophysiology, pathogenesis

Chronic inflammatory disease • Predilection for synovial membrane • With disease progression, osseous destruction of affected joints • Etiology is complex and incompletely understood • Cellular immune reaction to an as yet unidentified antigen • Synovium is the primary target organ of various immunological cascades, responding with inflammatory proliferative changes (pannus) • Secondary destruction of the capsule–ligament complex, cartilage, and bone.

Imaging Signs

► Modality of choice

Radiography • MRI.

► Radiographic findings

No radiologically identifiable skeletal changes in early disease • Often bilateral, symmetrical, and usually polyarticular pattern of involvement • Sites of predilection: phalangeal finger and toe joints as well as wrists • Findings divided into three groups based on Dohlmann:

- Soft-tissue swelling • Joint effusion • Synovitis
- Collateral phenomenon in rheumatoid arthritis: band-like areas of juxta-articular osteoporosis
- Direct signs: joint space widening (mainly due to joint effusion) • Symmetrical narrowing of joint space is an indirect sign of joint destruction (especially marked between carpal bones) • Erosions, sites of predilection: hand (MCP joints II–V, PIP, carpal bones, ulnar styloid process), foot (MTP joints II–V, IPJ) • Early visualization of disrupted subchondral bone end plate • Subchondral cysts • Ulnar deviation of the fingers • Buttonhole deformity and swan-neck deformity of the fingers • Ankylosis as end-stage finding.

In cervical spine involvement, stepladder deformity, atlantoaxial dislocation, and pseudobasilar invagination.

► MRI findings

Symmetrical pattern of involvement is characteristic (see radiographic findings; DD: degenerative changes, psoriatic arthritis, gout) • Detection of synovitis on contrast-enhanced images enables early diagnosis, estimate of disease activity, and early medication, if possible before onset of bone destruction • Signal alterations analogous to those of bone marrow edema (especially on fat-saturated T2-weighted sequences) that have no corresponding findings in conventional radiographs represent pre-erosive changes, still potentially reversible • Tendon sheath inflammation seen as increased signal intensity on T2-weighted images • Direct imaging of cartilage destruction • Dynamic contrast-enhanced sequences with rapid imaging time (less than 10 seconds per data set) appear to reflect

Fig. 2.4 Long-standing rheumatoid arthritis. Radiograph of both hands. Generalized osteopenia. Symmetrical pattern affecting the carpus, MCP joints, and (slight) involvement of the PIP joints. Complete joint destruction at some sites, but only joint narrowing at others. Secondary degenerative changes. Decreased carpal height on the left side and ulnar translocation of the carpus.

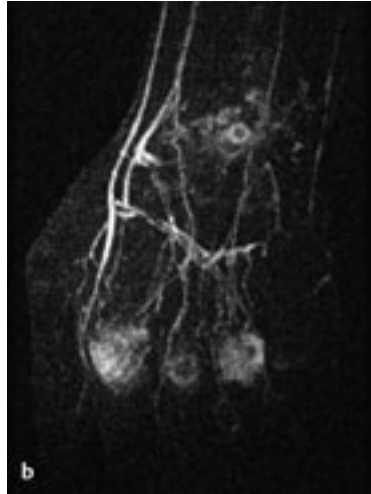


Fig. 2.5 a, b Rheumatoid arthritis. MRI.

- a** Fat-saturated T1-weighted SE sequence after administration of contrast material. Synovial enhancement in the carpus as well as radiocarpal and distal radioulnar joint. Involvement of scapholunate ligament and osseous erosion of the scaphoid.
- b** Dynamic, contrast-enhanced MIP in another patient. Early arterial contrast enhancement around MCP joints II-IV and wrist joints, indicative of florid inflammation.

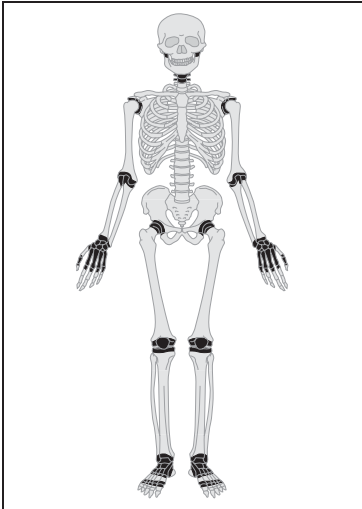


Fig. 2.6 Pattern of involvement in rheumatoid arthritis.

disease activity in terms of inflammatory changes involving the synovial membranes.

▶ **Nuclear medicine**

Three-phase bone scan • Overview of pattern of involvement • May provide evidence of disease when radiographic findings are negative.

▶ **Ultrasound findings**

Pannus (synovial proliferation, hyperechoic) • Joint effusion • Depiction of tendon sheaths (potential for targeted injection of antiphlogistic drugs) • Baker cysts • Tendon ruptures • Power Doppler imaging: perfusion assessment (synovial hyperemia as indicator of disease activity).

Clinical Aspects

▶ **Typical presentation**

Nonspecific generalized symptoms • Painfully swollen joints with limited mobility (Gaenslen sign: pain on pressure) • Rheumatoid nodules • In later stages, severe malalignment, subluxation, and fibrous ankylosis • Periods of exacerbation and remission are typical • Rarely, severe generalized signs of disease, fever, or extra-articular involvement occur.

▶ **Treatment options**

- Active and passive physical therapy (thermotherapy, cryotherapy, exercise therapy, massage therapy, physiotherapy).
- Medication (NSAIDs, glucocorticoids, disease-modifying drugs, and biologics, which are agents that interfere directly in the process of immunomodulation).

- Radiation synovectomy, synovectomy.
- Reconstructive surgery and prosthetic joint replacement.

▶ **Course and prognosis**

Unfavorable prognosis: polyarticular involvement, high rheumatoid factor titer, high CRP levels, high ESR • In one-third of patients, joint changes lead to disability after a few years • Life expectancy may be decreased by complications (e.g., secondary AA [reactive systemic] amyloidosis with nephrotic syndrome and possible renal insufficiency).

▶ **What does the clinician want to know?**

Stage and location • Treatment monitoring (does joint destruction cease or continue to progress with treatment?).

Differential Diagnosis

<i>Psoriasis</i>	<ul style="list-style-type: none"> - Involvement of SI joint and entire spinal column - Enthesitis - Asymmetrical joint involvement more common - Coexisting proliferative and erosive changes
<i>Reiter syndrome</i>	<ul style="list-style-type: none"> - Asymmetrical oligoarthritis, especially of the lower extremities - Patient history: intestinal/urogenital infection - Usually unilateral SI joint involvement
<i>Polyarthrosis/polyarthritis of the fingers</i>	<ul style="list-style-type: none"> - Distal interphalangeal joints usually more severely affected than proximal; MCP joints not affected - No erosions except in erosive form of disease ("seagull sign")
<i>Collagenosis</i>	<ul style="list-style-type: none"> - Usually marked malalignment of wrist and finger joints, but no bony destruction

Tips and Pitfalls

Mistaking rheumatoid arthritis for one of the differential diagnoses.

Selected References

- Keen HI, Brown AK, Wakefield RJ, Conaghan PG. MRI and musculoskeletal ultrasonography as diagnostic tools in early arthritis. *Rheum Dis Clin North Am* 2005; 31(4): 699-714
- Sommer OJ, Kladosek A, Weiler V, et al. Rheumatoid arthritis: a practical guide to state-of-the-art imaging, image interpretation, and clinical implications. *Radiographics* 2005; 25(2): 381-398

Definition

▶ Epidemiology

4–5% of all fractures • Predominantly occur in older patients.

▶ Etiology, pathophysiology, pathogenesis

Trauma usually minimal • Fall onto an outstretched arm or direct blow to the lateral aspect of the humerus (often with osteoporosis) • In younger patients, more severe trauma is needed and displaced fractures or fracture-dislocations are more common.

Imaging Signs

▶ Modality of choice

Radiography • CT.

▶ Radiographic/CT findings

Radiograph of the shoulder joint in two planes (AP and transthoracic or Y-view)
 • Perhaps axial view to evaluate lesser tubercle • Modified Neer classification based on number of fragments and malalignment of four main segments (humeral head epiphysis, humerus metaphysis/diaphysis (surgical neck), and lesser and greater tubercles) • Displacement is diagnosed on the basis of 1 cm or more displacement or 45° angulation.

– Neer 1: nondisplaced fracture of one or more fragments.

Displaced fractures:

– Neer 2: fracture of the anatomical neck, two-fragment fracture, one displaced fragment.

– Neer 3: fracture of the surgical neck, two-fragment fracture, one displaced fragment.

– Neer 4: fracture of the greater tubercle, without or with additional fracture of the surgical neck or lesser tubercle; two- to four-fragment fracture, up to three displaced fragments possible.

– Neer 5: fracture of the lesser tubercle, two- to four-fragment fracture.

– Neer 6: fracture-dislocations.

AO classification scheme provides an alternative system.

▶ CT findings

Imaging of joint involvement, fragments, and displacement without superimpositions.

Clinical Aspects

▶ Typical presentation

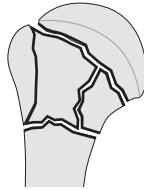
Pain • Swelling • Limited range of motion after fall onto arm. • Humeral head necrosis, especially in fractures with three or four fragments and in fractures involving the anatomic neck (13–34%) • Post-traumatic shoulder stiffness • Omarthritis • Rotator cuff tear • Nerve damage (axillary nerve) • Vascular injuries (axillary artery, 5% in displaced fractures).



Fig. 9.4 a–c Subcapital fracture of the humerus in a 65-year-old woman after falling onto her outstretched hand. **a** AP view and **b** Y-view of the shoulder. Subcapital fracture of the humerus with separation of a wedge-shaped fragment. Inferoposterior displacement of the humeral head (Neer III). The greater and lesser tubercles are intact. **c** Follow-up radiograph after reduction and plate fixation.

► Treatment options

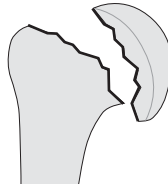
Goal: early mobilization given risk of capsule atrophy • Conservative treatment (Gilchrist bandage) for two-fragment fractures and nondisplaced or minimally displaced fractures • Surgery: plate fixation or fixed-angle proximal humerus nail, if needed with cerclage wiring of the tubercles (if displacement of greater tubercle exceeds 5 mm) • Endoprosthesis mainly in older patients with fractures involving four or more fragments and omarthritis.

Neer 1

Nondisplaced or
minimally displaced

Neer 2

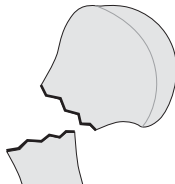
Anatomical
neck



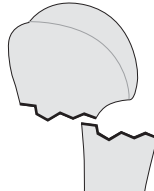
2-segment fracture

Neer 3

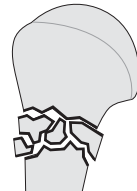
Surgical
neck



2-segment fracture
with axial displacement



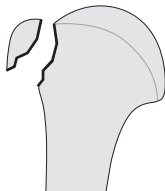
2-segment fracture
with lateral displacement



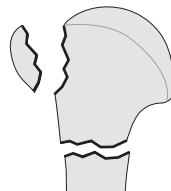
Comminuted
fracture

Neer 4

Greater
tubercle



2-segment fracture



3-segment fracture
(combined with
surgical neck fracture)



4-segment fracture
(combined with
surgical neck and
lesser tubercle fractures)

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