Wrist and Hand

- Erosions
  - Earliest bone pattern is loss of cortical distinctness, followed by dot-dash pattern of cortex loss
  - Marginal erosions tend to start in marginal "bare areas" not covered by cartilage
  - Direct subchondral erosions follow
  - Late aggressive disease: pencil-in-cup appearance in phalanges
- While considered purely erosive and nonproductive, may show ulnar styloid capping and ankylosis of intertarsal or intercarpal joints
- Malalignment due to ligament/tendon disruption

Diagnostic Checklist

- Earliest RA may be monostotic or asymmetric
  - » Must differentiate from septic arthritis
- Use sites of focal soft tissue swelling to guide you to subtle bone findings on radiography
- Assess for cortex indistinctness and dot-dash pattern for earliest radiographic signs of erosion

Location

- Symmetry of disease is classic
  - Early in disease, may be unilateral/asymmetric
- Proximal distribution
  - MCP or PIP
  - Distal radioulnar joint (DRUJ), ulnar styloid
  - Radiocarpal (RC) joint
  - Intercarpal joints
    - » Early findings better appreciated on MR than radiography
- DIPs not involved until end stage

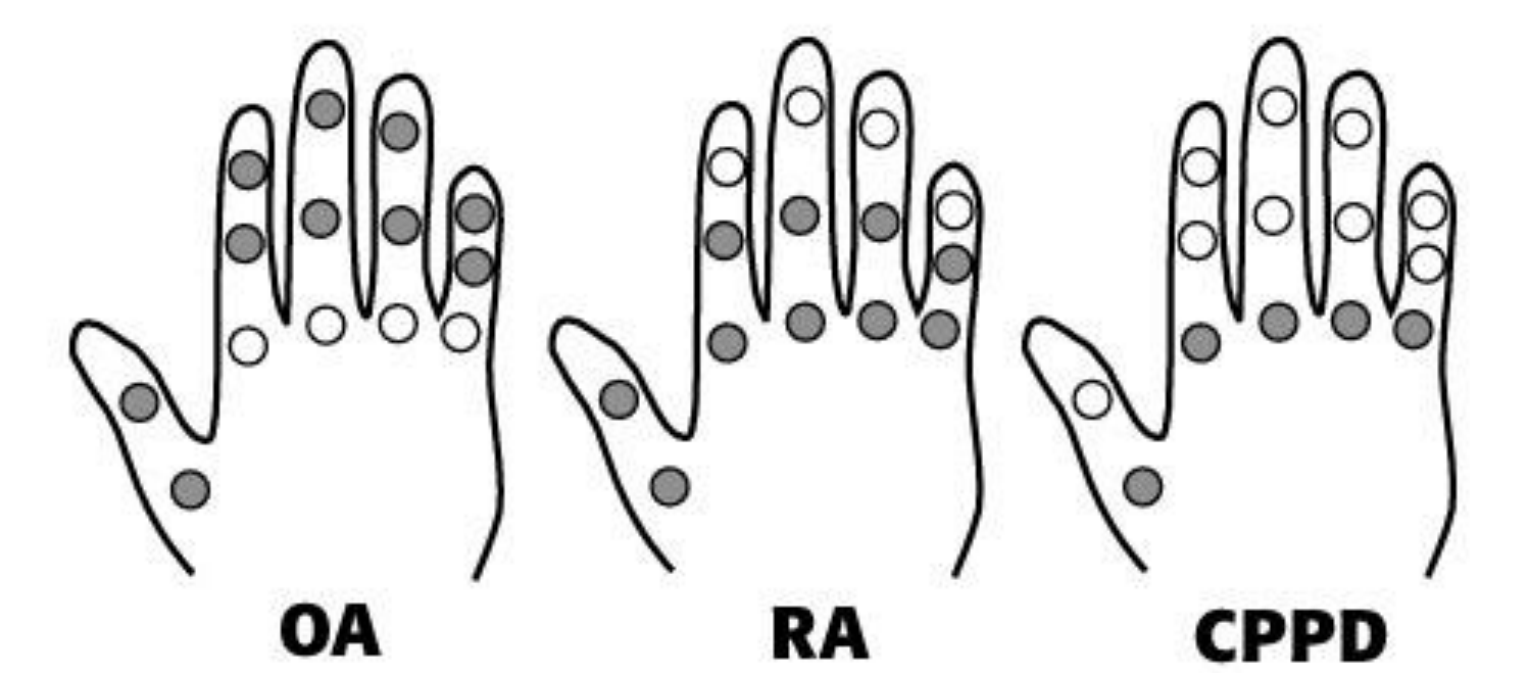
Imaging

- Hand and foot have earliest involvement; may be subtle
- Focal soft tissue swelling may be clue to underlying bone involvement
  - Especially about MCP, PIP, ulnar styloid
- Osteoporosis
  - Early: periarticular
  - Later: diffuse
- Erosions
  - Loss of cortical distinctness, followed by dot-dash pattern of cortex loss
  - Marginal erosions tend to start in portion of bone that is within capsule but not covered by cartilage ("bare area")
    - Base of phalanges, margins of metacarpal heads
    - Ulnar and radial styloid processes
  - Direct subchondral erosions as disease progresses
  - Late severe destruction of osseous structures
    - May give pencil-in-cup appearance in phalanges
    - May destroy distal ulna or proximal carpal row

Imaging

- Cartilage destruction
  - Cartilage thinning and narrowing of joint are uniform
- Subchondral cysts frequent finding in RA but nonspecific
- Ulnar styloid may show capping: only site of productive change in RA beyond intercarpal or intertarsal joint ankylosis that may develop
- Malalignment due to ligament/tendon disruption
  - Carpus
    - » Ulnar translocation: carpals subluxate ulnarly at RC joint
    - » Volar subluxation of carpus on radius
    - » Scapholunate dissociation
    - » Volar or dorsal intercalated segmental instability (VISI or DISI)
  - Digits
    - » Ulnar deviation at MCPs
    - » Volar subluxation of MCPs
    - » Hitchhiker's thumb (flexion MCP, hyperextension interphalangeal joint)
    - » Boutonnière (hyperflexion PIP, hyperextension DIP) and swan-neck (hyperextension PIP, hyperflexion DIP) deformities

Patterns



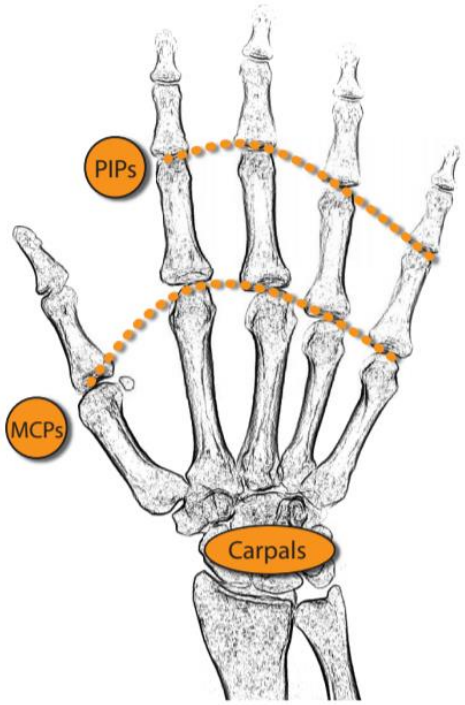
- PA graphic of a PIP joint depicts progressive destruction of the joint:
- (A) is normal with intact cortex, cartilage, bone density, and capsule;

- (B) shows early disease with only synovitis and effusion;
- (C) shows juxtaarticular osteopenia with cortex becoming indistinct, the dot-dash pattern;
- (D) shows thinning of cartilage and marginal erosions (white curved arrow) in the portion of bone that is intracapsular but not protected by cartilage;
- (E) shows progression of osteopenia and subchondral erosions extending through cartilage defects;
- (F) shows arthritis mutilans with pencil-in-cup deformity seen in end-stage disease.

Radiograph and CT findings	*MRI findings*
Marginal erosions, which first occur at the intracapsular articular margins in the "bare area." The bare area is a region of exposed bone just within the joint capsule that is not covered by thick cartilage. **Soft-tissue swelling**. **Diffuse, symmetric joint space narrowing**. **Periarticular osteopenia**. **Joint subluxations**.	**Marginal erosions,** which are fluid signal intensity and enhance. **Synovitis,** with thickened and early enhancing synovium. **Subchondral edema**, due to inflammatory and reactive changes. **Joint subluxations**.

Rheumatoid arthritis in the hand and wrist

- The hands are commonly affected in patients with RA.
- Typical joints involved are the MCPs, PIPs, and the carpal articulations. The DIPs are usually spared.
- The earliest radiographic changes of RA are soft-tissue swelling and periarticular osteopenia, reflecting synovitis and hyperemia.
- Erosions occur early in disease, typically of the radial aspects of the second and third metacarpal heads, the radial and ulnar aspects of the bases of the proximal phalanges, and the ulnar styloid.
- Joint subluxations are present in more advanced disease, which typically are not reducible and lead to several common deformities, including:
  - *Boutonnière* deformity (PIP flexion and DIP hyperextension).
  - *Swan neck* deformity (PIP hyperextension and DIP flexion).
  - Ulnar subluxation of the fingers at the MCPs.



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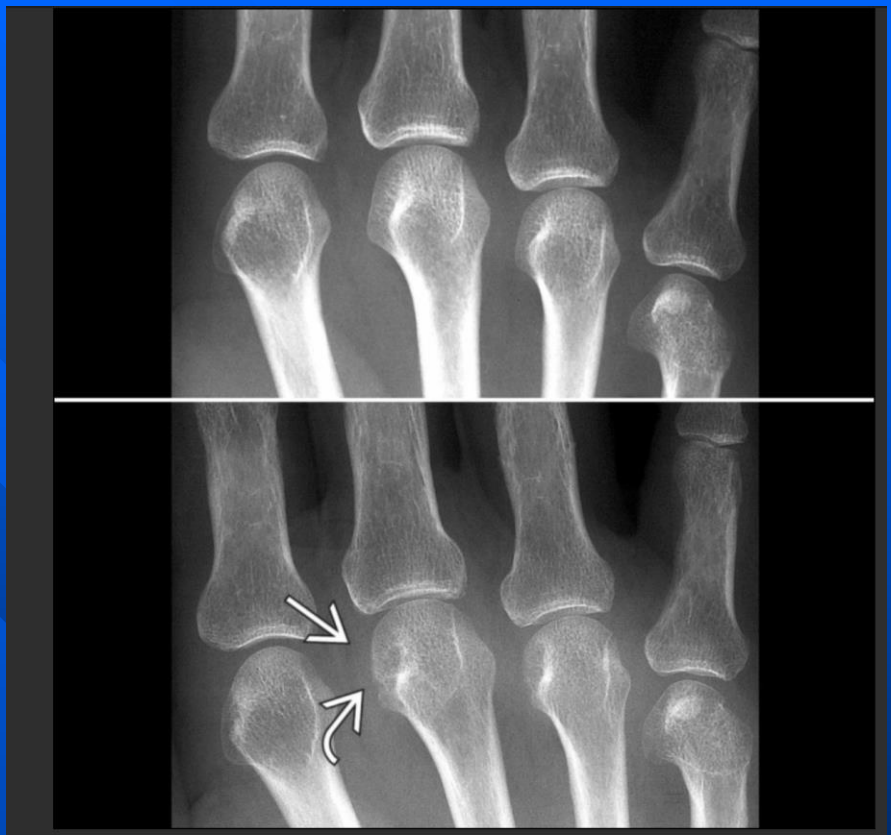
PA view in a 67-year-old man with RA and stiffness and swelling in the hand shows early findings of RA, including periarticular soft tissue swelling, consistent with synovitis →, and a marginal erosion in the region of the "bare area" ⇨.



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Normal PA view (top) in a 50-year-old man with RA is shown. Image obtained 2 years later (bottom) shows osteopenia, indistinctness of subchondral cortex of metacarpal head →, marginal erosion ↗, and joint space narrowing (JSN). Cortex indistinctness is also noted at 3rd and 4th metacarpals.

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PA radiograph in a young adult with joint pain is normal with the exception of soft tissue swelling at a single joint, the 3rd PIP →. This merits a closer look at this joint.

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Coned-down radiograph of the abnormal PIP in the same patient more clearly shows the soft tissue swelling around the joint. In addition, there is a marginal erosion of the head of the proximal phalanx and base of the middle phalanx →. In the hand, the earliest erosions may be found in either the PIP or the MCP.

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Classic findings of RA are shown, including osteoporosis, ulnar deviation at the MCPs →, ulnar translocation at the radiocarpal joint ⇨, erosions at the MCPs and ulnar styloid ⇩, and pancarpal, MCP, and PIP JSN.

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PA radiograph in a middle-aged man with joint pain shows only soft tissue swelling → near the ulnar styloid. This should raise the question of early RA.

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PA view in a patient with early RA shows mild ulnar translocation of the carpus. Note that > 1/2 of the lunate overlies the ulna. There are erosions at the triquetrum and base of the 5th metacarpal and soft tissue swelling at the ulnar styloid.

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Longstanding RA with advanced erosive disease presented with development of pencil-in-cup deformities. This deformity is more common in psoriatic arthritis but can also be present in RA.

Rheumatoid arthritis

Multiple erosions and marked joint space narrowing are noted in a pancarpal distribution

Rheumatoid arthritis

Boutonniere deformity -arises from hyperextension of the distal interphalangeal joint, while the proximal interphalangeal joint is flexed

Rheumatoid arthritis

"swan neck deformity" Specifically, the deformity arises from hyperextension of the proximal interphalangeal joint, while the distal interphalangeal joint is flexed.

RA

Rheumatoid arthritis in the spine

- The cervical spine is involved in up to 70% of patients. Involvement is increased with more severe and long-standing disease.
- The general pattern of rheumatoid arthritis in the cervical spine includes subluxation at multiple levels, osteopenia, and erosions of the odontoid, facet joints, vertebral endplates, and spinous processes. Unlike osteoarthritis, there is no bone production.
- A characteristic finding of rheumatoid arthritis is **atlantoaxial (C1–C2) subluxation**. Atlantoaxial subluxation may occur in multiple directions, including anterior (most common), posterior, vertical (atlantoaxial impaction), rotatory, and lateral.
- **Anterior atlantoaxial subluxation** is caused by inflammation and resultant laxity of the transverse ligament, which normally functions to stabilize the atlantoaxial joint.

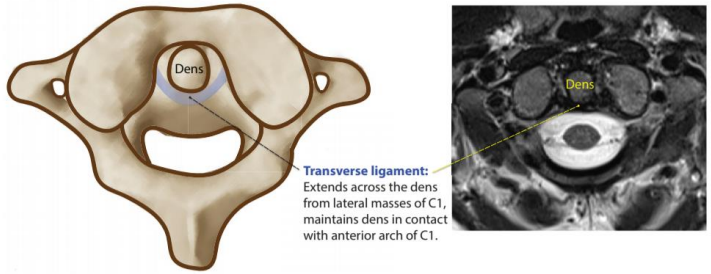


Illustration and T2-weighted axial MRI demonstrating the transverse ligament, which stabilizes the atlantoaxial (C1–C2) articulation between the dens (C2) and C1.

Anterior atlantoaxial subluxation may not be apparent if flexion radiographs are not obtained.

Anterior atlantoaxial subluxation is present if the atlanto-dental interval (ADI) is >2.5 mm (>5 mm in children). The atlanto-dental interval is the distance between the anterior aspect of the dens and the posterior aspect of the anterior ring of C1.

Lateral radiograph of the cervical spine in extension demonstrates the atlanto-dental interval (calipers) measuring less than 2.5 mm.

Lateral radiograph of the same patient in flexion demonstrates marked widening of the atlanto-dental interval (calipers), indicating atlanto-axial instability.

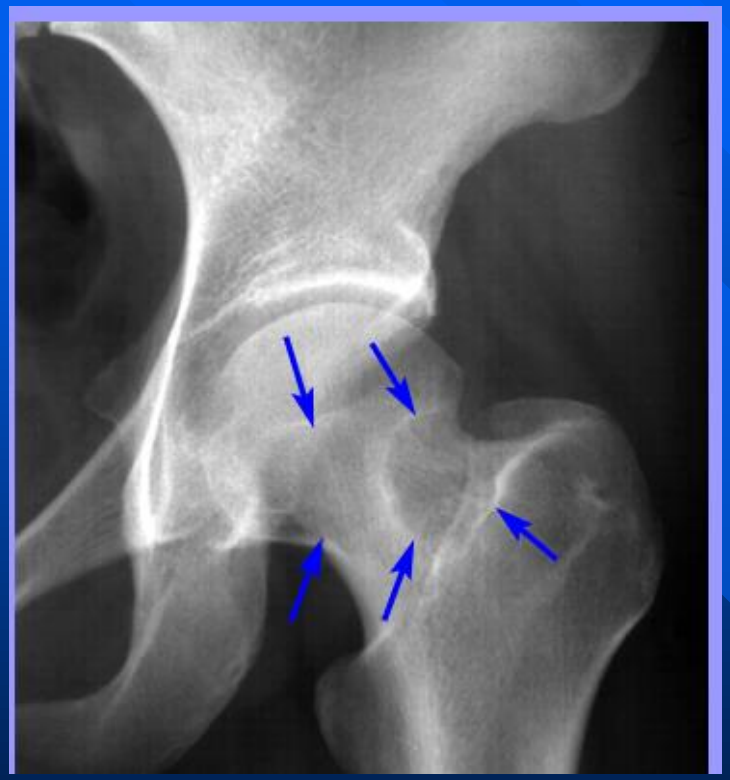
- **Vertical atlantoaxial subluxation** (also called atlantoaxial impaction) results from C1–C2 facet erosion and collapse, leading to protrusion of the odontoid through the foramen magnum. This may compress the midbrain.

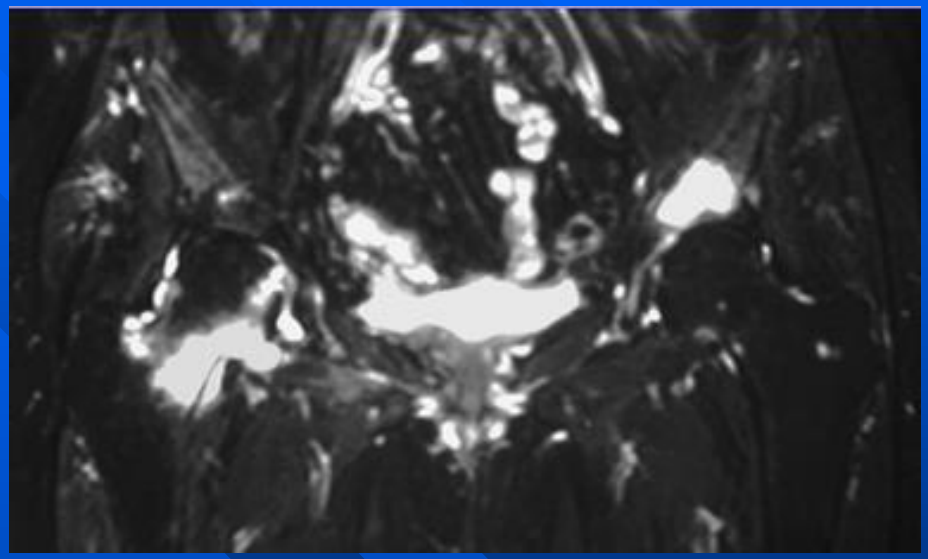
  Direct visualization of the odontoid is usually not possible on a lateral radiograph, but impaction may cause the anterior arch of C1 (normally in-line with the odontoid) to sink to the level of the body of C2.

- In the setting of RA, **posterior atlantoaxial subluxation** is usually due to odontoid erosion. It may also be caused by odontoid fracture.

Erosions

Turned out to be RA





Both Gout and RA can have High T2 periarticualr masses, can exclude other 2

DDX: RA, PVNS, Synovial chondromatosis, Gout