Arthritis. A radiographic pictorial review.

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Authors: L. Resende, A. Bordini, T. Baraviera, D. B. D. A. L. Baptista, D. L. Ferreira; São Paulo/BR
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Learning objectives

To review imaging patterns of the different types of arthritis and to help establishing differential diagnosis among them based on radiographies.
Background

Arthritis etiologies can be very diverse. They can be categorized into erosive, productive, mixed and depositional disease. Among each category there are several diagnosis with many different treatments and prognosis. When the arthritis process is well established in a particular patient, it usually achieves a typical appearance, which allows imaging diagnosis.

1- Erosive arthritis

The main etiologies of erosive arthritis are: rheumatoid arthritis, erosive osteoarthritis and juvenile idiopathic arthritis. Rheumatoid arthritis is a chronic progressive systemic inflammatory immunologically mediated disease with unknown etiology in which joints are primary target. It affects more women than men, mainly in the fourth and fifth decades of life and affects 1% of worldwide population. It can involve both, the axial and the appendicular skeleton. The axial involvement in general involves C1-C2 and presents itself as an atlantoaxial subluxation or impaction while the appendicular involvement is very diverse and can affect the shoulders, elbows, wrist, hands, hips, knees, ankles and feet.

Erosive osteoarthritis is a form of osteoarthritis in which there is an additional erosive/inflammatory component. It affects mainly women (F:M 12:1), typically after the menopause and has a predilection for the hands, involving the distal and proximal interphalangeal joints and the first carpometacarpal joint.

Juvenile idiopathic arthritis also called juvenile rheumatoid arthritis affects children who are 16 years old or less. It usually presents itself as a polyarthritis or oligoarthritis, during more than 6 weeks and the diagnosis is done after excluding other forms of juvenile arthritis.

2- Productive arthritis

Productive arthritis also called bone-forming arthritis is the damage of the joint in which the main characteristic is bone formation in the absence of erosion. Bone formation can appear as osteophytes, bone sclerosis or ligament ossification. Although radiographic findings are crucial to establish the diagnosis, other information such as age, gender and specific joint involvement also play an important role. There are three main examples of this group of arthritis: Osteoarthritis (OA), Diffuse idiopathic skeletal hyperostosis (DISH) and Ossification of posterior longitudinal ligament (OPLL).
OA is a degenerative joint disease with multifactorial risk factors (genetics, repetitive trauma, occupation, etc.) that clinically presents with joint pain and later loss of function. The most common joints affected by OA are knee, hip, spine, distal interphalangeal and first carpometacarpal joints. As a degenerative process, it affects people in the fourth and fifth decades. Radiographic findings vary depending on the disease stage. Initial disease can be spotted by discrete bone sclerosis or formation of marginal osteophytes and joint space narrowing. More advanced stages show prominent osteophytes, bone sclerosis, subchondral cysts and important joint space narrowing. Hip and knee usually have asymmetric involvement and present preferential joint space narrowing in the areas that receive more body weight, such as medial compartment of knee and superior aspect of hip joint. Bone density is commonly normal in osteoarthritis regarding age and gender references. Spine involvement will be seen as osteophytes in the anterior and lateral margin of the spine, more prominently on the right side associated to reduction of intervertebral spaces and changes in the spine curvature and alignment.

DISH, also called Forestier disease, is the bone formation with ossification of the anterior and lateral ligaments and tendons of the spine. This disease affects usually thoracic and cervical spine. The spine hyperostosis is seen on the right aspect of the spine and this is probably related to mechanical factors due to aorta proximity that inhibits ossification on the left side. In DISH the intervertebral space and discs are often normal when compared to people at the same age and gender. Clinically the patient may face spine stiffness and pain and reduction of movement range.

OPLL can be found in association with DISH (40-50% of the cases) and other diseases but can also be found as an isolated finding. In severe cases it can cause myelopathy leading to peripheral neurological symptoms.

3- Mixed arthritis

This group has a mixed pattern disease, productive and erosive, known as spondyloarthropathies. The pattern of involvement is related to enthesitis and has association with HLA B27. Reactive arthritis, ankylosing spondylitis, psoriatic arthritis and enteropathic arthritis are examples of this group.

Formerly known as "Reiter syndrome", term not used anymore, reactive arthritis present itself by the classic triad: arthritis, urethritis (cervicitis) and conjunctivitis. A disease of sexually active people, aged between 15-60 years old, it can be triggered by gastrointestinal or genitourinary infection, and generate 15% of disabling arthritis. Nonspecific findings are weight loss, fever and rash. The joint pattern is an enthesitis associated with erosion and asymmetric impairment, mainly in extremities of lower limbs like calcaneus, toes, knees and ankles. Bone density usually is normal. In axial bones we can find bilateral sacroiliitis, often asymmetric and paravertebral ossification.
Ankylosing spondylitis affects mainly the axial skeleton and proximal appendicular joints. Observed more in young men, between 15-30 years old, produces arthritis with erosion, fusion and diffuse osteopenia. It is classically known as a symmetric and bilateral sacroiliitis, with joint fusion and progressive ascending spinal involvement, forming longitudinal syndesmophytes, with a final chronic appearance called "bamboo spine". In peripheral disease, injuries involve usually hips and shoulders with same pattern.

Psoriatic arthritis has an egalitarian distribution among genders, usually emerges after the skin lesions, and is present in about of 20% of patients with psoriasis. It has a classic pattern with preservation of bone density, asymmetric and monoarticular erosion and periostitis, mainly in distal joints like feet and hands, with the aspect of "sausage digit". Other finding that suggests psoriasis arthritis is "pencil in the cup" one, but we can also see subluxated joints and mutilating lesions in late stages (acro-osteolysis). Psoriatic arthritis can reach sacroiliac joints, spine, knees, ankles and shoulders.

4- Arthritis due to biochemical disorders or depositional disease

Arthritis due to biochemical disorders or depositional disease is a group of pathologies related to deposition of different kinds of crystals or substances in or around the joints (monosodium urate crystals, pyrophosphate, hydroxyapatite, calcium oxalate, iron, copper or fibrillar protein aggregates in amyloidosis). Among the different kinds of depositional arthritis, gout is the most prevalent.

Gout is a crystal arthropathy due to deposition of monosodium urate crystals in and around the joints. It typically occurs in patients above 40 years and there is a strong male predilection (20:1). About 22% of men with a serum uric acid greater than 9 mg/dL develop gout over a 5-year period. Podagra is the first manifestation in 50% of gout cases, and may be present in 90% of patients during the course of the disease. Clinical findings, elevated serum uric acid and plain radiographs play an important role in the diagnosis of the disease. Erosions with overhanging edges in plain radiographs are generally considered pathognomonic for gout. Other findings include: joint effusion (earliest sign); maintenance of the joint space; absence of periarticular osteopenia; location outside the joint capsule; sclerotic (cookie-cutter, punched-out) borders; asymmetric distribution among the joints, with a strong predilection for distal joints, especially in the lower extremities; tophi (pathognomonic); periarticular soft tissue swelling due to crystal deposition in tophi around the joints. The soft tissue swelling may be hyperdense due to the crystals, and the tophi can calcify.
Findings and procedure details

In figure 1 we observe a patient with rheumatoid arthritis involving the elbow. We can observe the right elbow with erosion in the joint mainly in the trochlea.

In figure 2 there is a hand/wrist radiography of patients with rheumatoid arthritis (RA). On the left we can observe wrist involvement, with erosion, ulnar deviation and ankylosis. In the middle, a patient with severe RA, we can find the wrist involvement but also erosion of the metacarpophalangeal and interphalangeal proximal joints. Note the sparing of the distal interphalangeal joint. On the right, we can observe the boutonniere and swan neck deformities.

In figure 3, two female patients with erosive osteoarthritis (EA). On the left we can observe a low grade disease, with ulnar deviation, incipient rhizarthrosis and seagull erosions of the distal interphalangeal joints (IFJ). On the right a patient with severe EA with accentuation of the finds described before, but including the involvement of the proximal IFJ.

In figure 4 a seven years old female patient with idiopathic juvenile arthritis. In the hands there is an ankylosis of carpocarpal joints and erosion of carpo-ulnar and carpometacarpal joints. Note also a mild erosion of the interphalangeal proximal joint of the third right finger. We can observer in the feet films also ankylosis of the intertarsal and tarsometatarsal joints, mainly on the right.

In figure 5, knee radiographies of a male patient with severe osteoarthritis. Notean important joint space narrowing predominantly on medial compartment of the knee. Bone sclerosis are also more noticeable in the medial compartment. Marginal osteophytes is also seen. There is also a fracture in the medial plateau of the right tibia. Note chondrocalcinosis, best seen on lateral view of the left knee.

Figure 6 shows a patient with a late stage OA of the hip. Significant joint space narrowing, bone sclerosis of the femoral head and acetabulum and acetabular osteophytes can be found. Also an acetabular protrusion happened due to advanced osteoarthritis.

Figures 7 and 8. A patient with diffuse idiopathic skeletal hyperostosis (DISH) involving cervical and thoracic spine. In the cervical spine we can see ossification of anterior aspect of the spine with relative preservation of intervertebral disc spaces. In the thoracic spine we see flowing ossification of anterior and right lateral margins of spine that continues through more than four vertebral bodies.
Figure 9. Patient with psoriasis and sacroiliac involvement. In this case we find a bilateral and asymmetric sacroiliitis. Note a normal bone density, typical of either psoriatic or chronic reactive spondyloarthropathy.

Figure 10. Patient with aggressive lesions in hands with erosive and productive patterns. We can observe a normal bone density associated to diffuse soft tissue swelling ("sausage digit"), "Pencil-in-cup" deformities (second right digit and fourth left digit) and ankylosis (interphalangeal joints of right hand, second and fifth digits).

Figure 11. Ankylosing spondylitis involvements stages. On the left a patient with initial impairment of ankylosing spondylitis showing a bilateral and symmetric sacroiliitis associated to a normal bone density. In the middle, a patient with mild disease characterized by vertical syndesmophytes and concomitant bilateral ankylosis of the sacroiliac. On the right, a representative case of "bamboo spine", showing evident vertical syndesmophytes and column fusion associated with a diffuse osteoporosis.

Figure 12, two patients with gout. On the left we can see punched-out lytic bone lesion, more evident in the proximal phalanx of the 5th finger of the left hand and maintenance of the joint space and; associated joint effusion. On the right, punched-out lytic bone lesion in the 2o, 3o and 5o fingers of the left hand in the 3o and 5o of the left hand. Note also in the 5o finger of the right hand, a pathological boxer´s fracture in pre-existing punched-out lytic bone lesion.

In figure 13 a patient with multiple punched-out lytic bone lesions in the feet. Note also in the ankle, periarticular soft tissue swelling due to crystal deposition in tophi around the joints is common; the soft tissue swelling may be hyperdense due to the crystals.

Figure 14. Patient with late stage of gout disease showing bilateral calcified giant tophi in the elbow (usually a sign of associated renal disease).
Fig. 1: Rheumatoid arthritis involving the right elbow.

Fig. 2: Rheumatoid arthritis (RA) involving wrists and hands. On the left we can observe wrist involvement, with erosion, ulnar deviation and ankylosis. In the middle, a patient with severe RA, we can find the wrist involvement but also erosion of the metacarpophalangeal and interphalangeal proximal joints. On the right, we can observe the boutonniere and swan neck deformities.
Fig. 2: Rheumatoid arthritis involving wrists and hands.

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Fig. 3: Erosive osteoarthritis.

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Fig. 4: Idiopathic juvenile arthritis.

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Fig. 5: Osteoarthritis.
Fig. 6: Osteoarthritis of the hip.

Fig 6. Late stage osteoarthritis of the hip. Significant joint space narrowing, bone sclerosis of the femoral head and acetabulum and acetabular osteophytes can be found. Also an acetabular protrusion happened due to advanced osteoarthritis.

Fig 8. Patient with diffuse idiopathic skeletal hyperostosis (DISH) involving thoracic spine. Wiflowing ossification of anterior and right lateral margins of spine that continues through more than four vertebral bodies.
Fig. 8: Diffuse idiopathic skeletal hyperostosis (DISH) involving cervical and thoracic spine.

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Fig. 7: Diffuse idiopathic skeletal hyperostosis (DISH) involving cervical spine.

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Fig. 9: Psoriasis and sacroiliac impairment.

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Fig. 10: Aggressive lesions in hands with erosive and productive patterns.
**Fig. 11:** Akylosing spondylitis involvements stages.

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**Fig. 12:** Gout pattern.

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![Gout pattern](image1)

**Fig. 13:** Gout in the feet.

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![Gout in the feet](image2)
**Fig. 14:** Late stage of gout disease.

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Conclusion

We reviewed the radiographic patterns of diverse arthritis lesions. Radiographies have been neglected since the emergence of new methods such as CT and MRI. However, it still plays an important role establishing different diagnosis between arthritis process. Radiologists should be able to recognize the arthritis patterns in radiographies once its image features usually are enough to establish a precise diagnosis.
References


