IN THE NAME GOD

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Osteoarthritis Imagining (lower exterimity)

Spring 1404

Introduction :

In osteoarthritis research, **imaging** plays an **important** role in clinical trials and epidemiological observational studies.

Radiography remain the primary imaging modality for defining inclusion/exclusion criteria as well as an outcome measure in OA clinical trials, despite known limitations for visualization of OA features .

Three main imaging modalities utilized for osteoarthritis (OA) imaging are conventional **radiography, MRI and ultrasound.**

Diagnosing Osteoarthritis

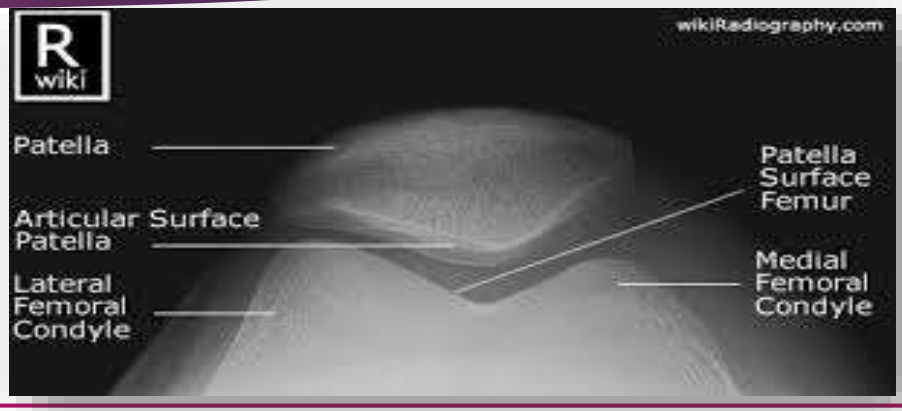
Diagnosis of OA is primarily based on a thorough **clinical examination** of the joint, and **imaging** has always been important in detecting joint damage. Radiography has so far played an **important role** in the diagnostic process even though it is limited to the assessment of osseous structures. Additionally, patients with **symptomatic** OA show **radiographic changes** in only about **half** of the cases. **Earlier stages** and potentially **reversible** changes of the joint can be detected by magnetic resonance imaging (**MRI**) which allows to assess soft tissues such as cartilage, synovia, menisci, and the surrounding muscles and ligaments . However, so far **MRI** only plays a **minor role** in the **primary** diagnosis of OA in clinical routine, even though its **sensitivity** to detect structural changes in the joint has been confirmed in research settings .


Ankle series
AP
Mortise
Lateral
Cases courtesy of Andrew Murphy & Dr Ian Bickle, rID: 37950, 48079

Radiography, which is still the most commonly used imaging technique for OA, is usually acquired in **two planes**, i.e., the lateral and anterior-posterior view. It is widely available and inexpensive.

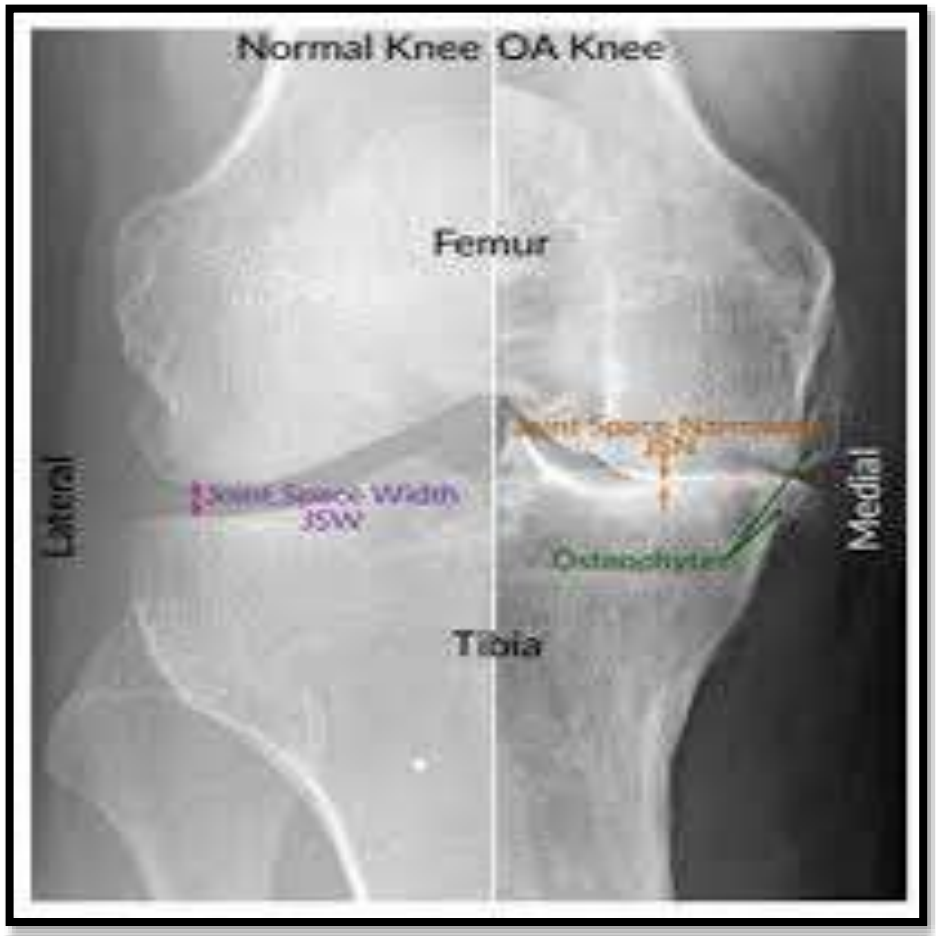
In addition, **weight-bearing** images can be obtained .

Depending on the clinical facility and the clinical patient history, additional views, such as the **patella view** or the **Rosenberg view**, can be obtained to evaluate specific regions of the joint.



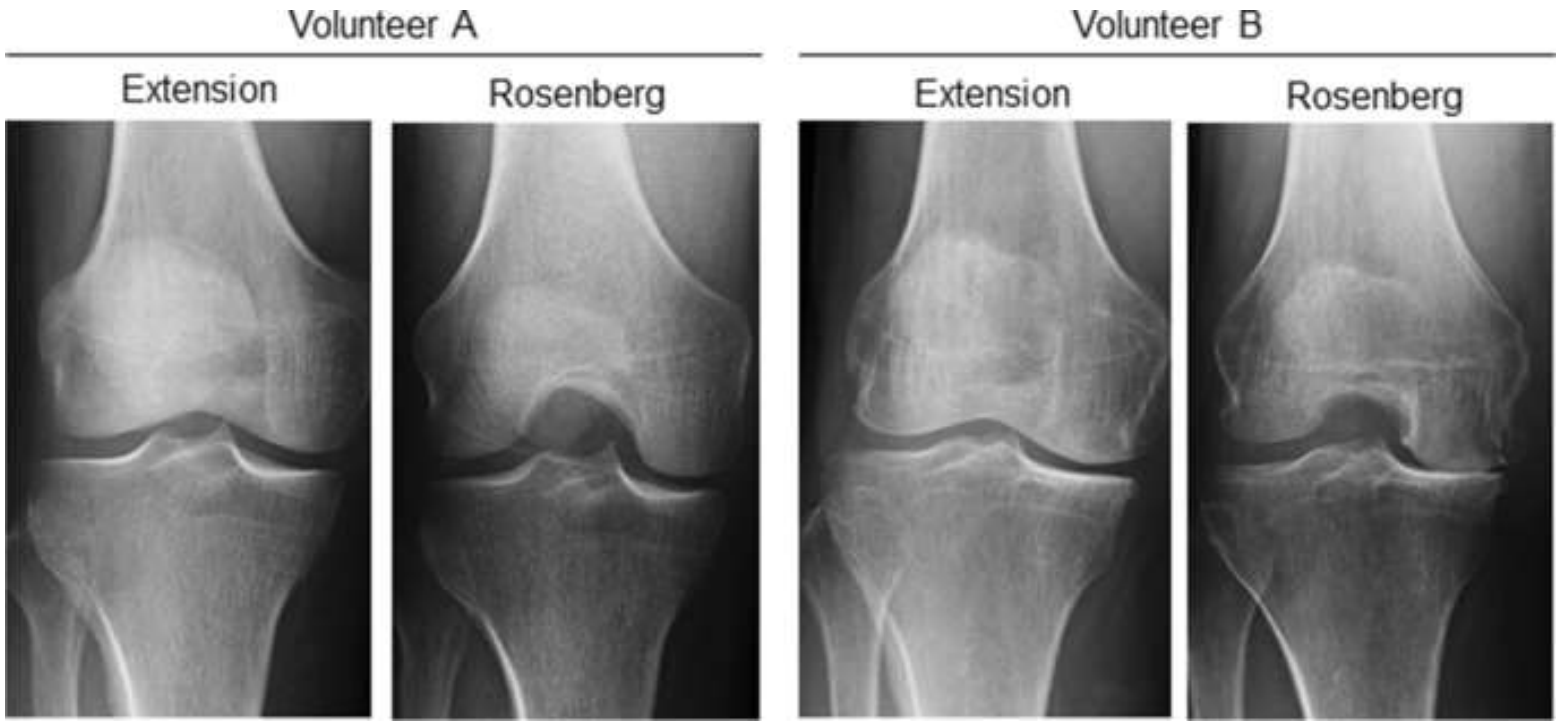
OA grading on plain radiographs is based on the assessment of osseous tissues while cartilage thickness can only be evaluated indirectly as a measure of JSW .

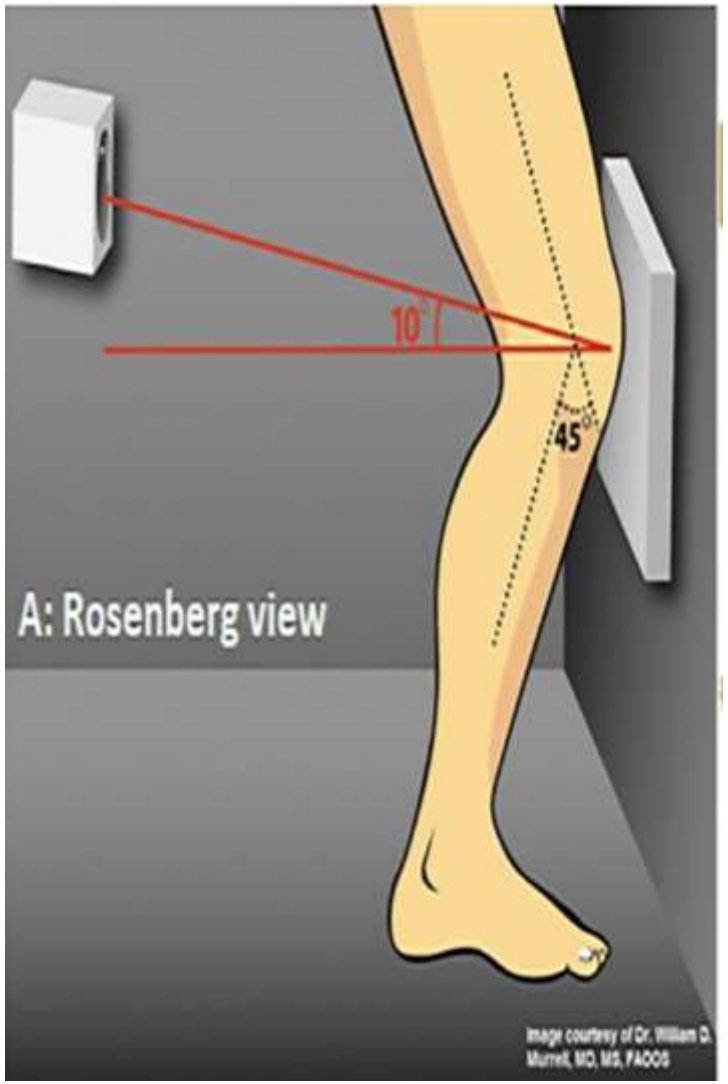
However, MRI studies have shown that joint space narrowing (JSN) is not solely dependent on loss of cartilage thickness but can rather be considered as a composite of meniscal damage, meniscal extrusion, and cartilage damage .



Patellofemoral joint osteoarthritis in the skyline view.

The patellofemoral joints are degenerated, and the space between the patellofemoral joints is narrow .


Volunteer A
Extension
Rosenberg
Volunteer B
Extension
Rosenberg


10°
45°
A: Rosenberg view
Image courtesy of Dr. William D. Murrell, MD, MS, FAOOS

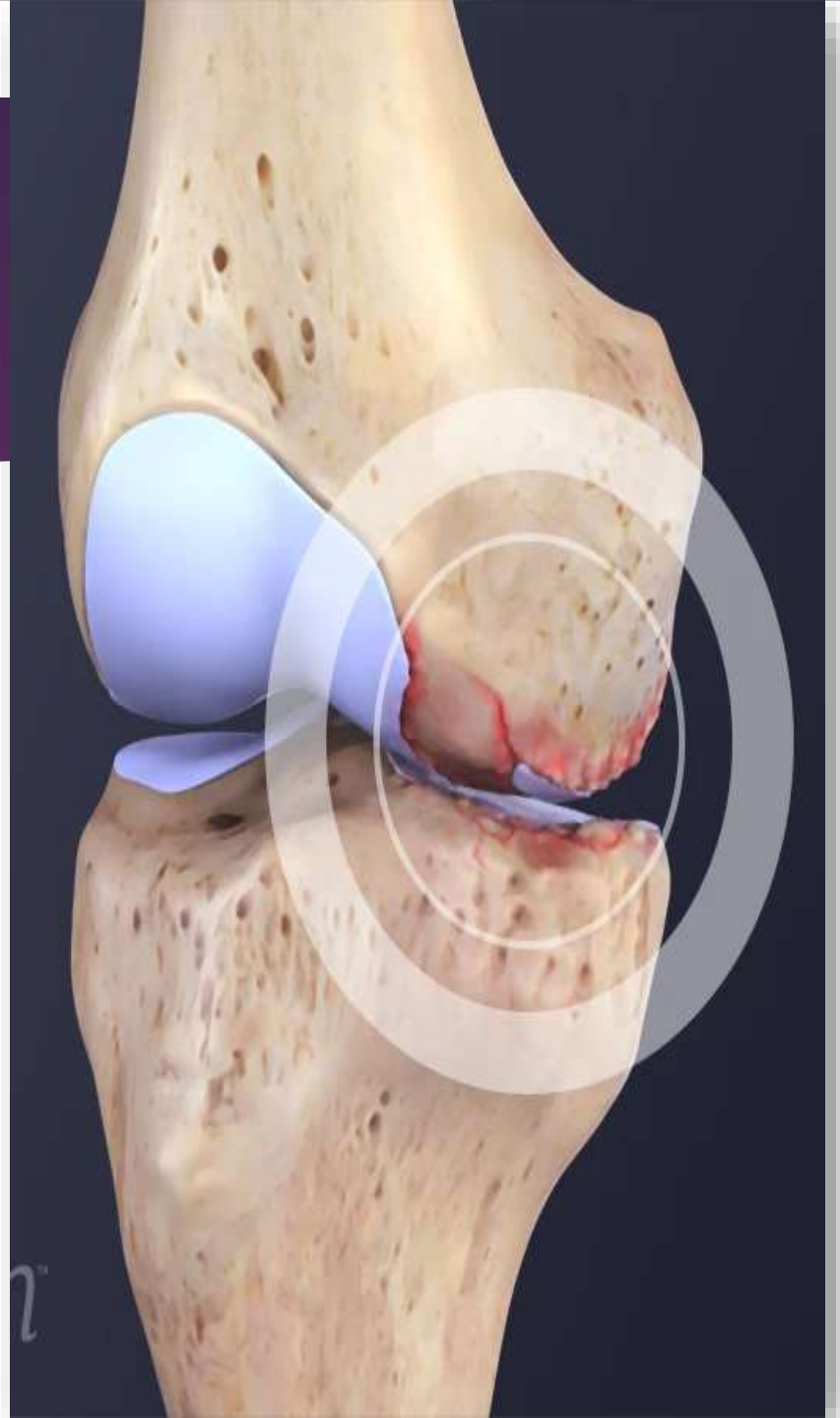
- **Osteoarthritis (OA)** is a prevalent and debilitating disease that affects a large population worldwide. With an estimated 240 million individuals suffering from symptomatic OA globally, it is clear that OA represents a significant health concern.
- In the United States alone, it is estimated that 10% of the population will develop symptomatic knee OA before they reach the age of 60 years .

- Global estimates from the Global Burden of Diseases, Injuries and Risk Factors Study show that **knee OA cases have increased by 9.3%, and hip OA cases have increased by 8.2% since 1990**, highlighting the need for improved diagnostic and therapeutic strategies

- The Osteoarthritis Research Society International **(OARSI)** defines OA as a molecular derangement, followed by anatomic and physiological derangements that can result in illness. As a result, there is a need to reconsider imaging protocols for OA. Over the past few decades, musculoskeletal imaging has undergone significant advancements, providing new opportunities for improved diagnosis and characterization of OA [.
- **Modern musculoskeletal imaging** can help visualize various tissues and provide pathophysiological information beyond anatomic details.

First Step

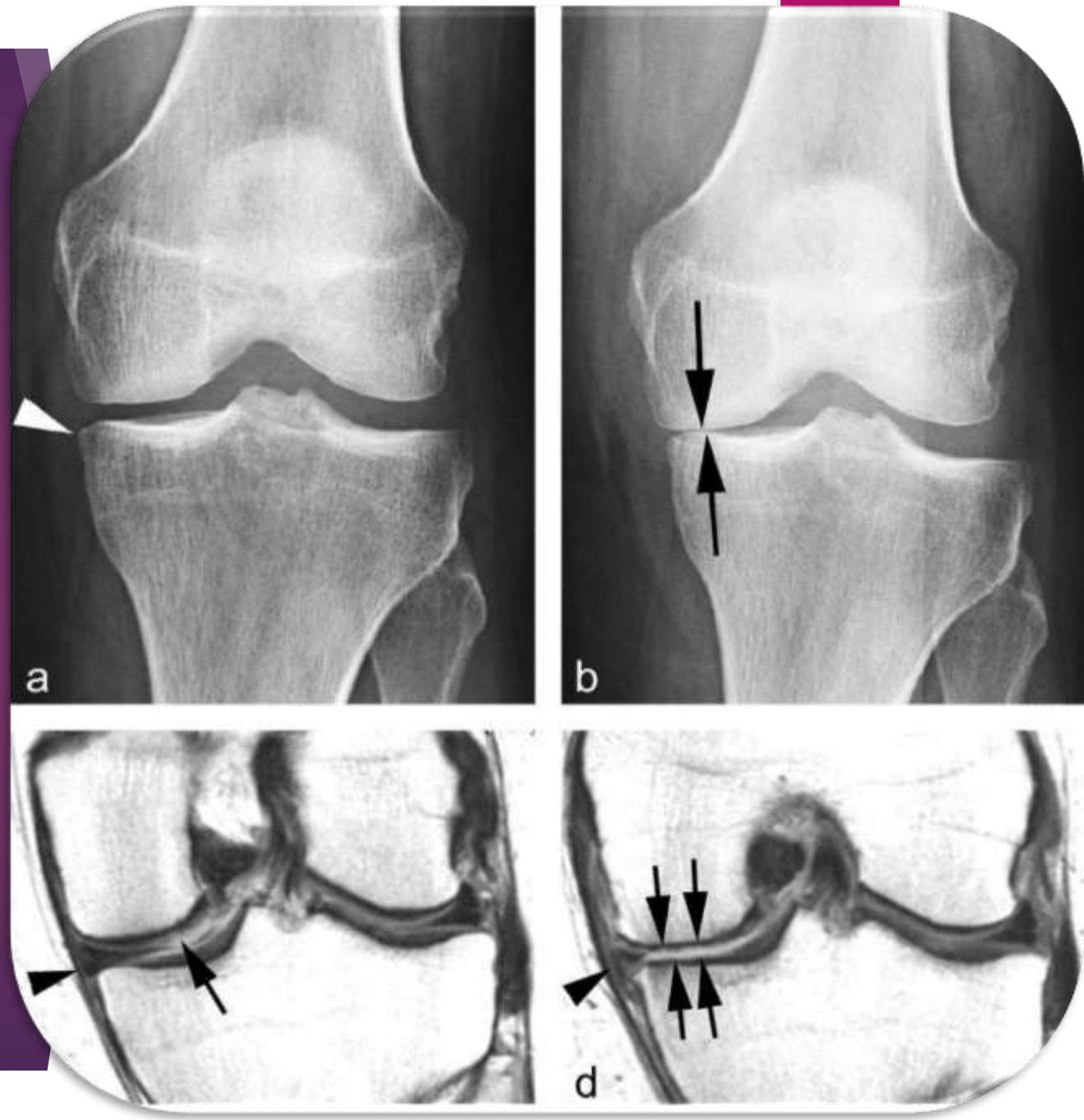
- the use of imaging in the routine clinical management of patients with OA, essentially **stating radiography** is the primary imaging modality and additional imaging such as MRI and ultrasound should only be used in **atypical cases** or patients showing rapid progression of symptoms.
- It has been recognized that OA can be classified to various phenotypes. While radiography **alone** may be sufficient for a **simple** phenotypical classification of foot OA (**isolated first metatarsophalangeal joint OA and polyarticular OA**), other more sophisticated classification needs more **advanced** imaging techniques. *e.g.* adequate assessment of "pain" phenotype or inflammatory phenotype require contrast-enhanced MRI and/or ultrasound imaging since **synovial inflammation** **cannot** be directly visualized by **radiography**.



- **Kellgren and Lawrence (KL) grading**
- (Grade 0 = normal
- Grade **1** = presence of equivocal osteophyte;
- Grade **2** = presence of definite osteophyte without joint space narrowing
- Grade **3** = presence of joint space narrowing
- Grade **4** = complete loss of joint space, "bone on bone" appearance.

(**a**)Baseline posterioranterior radiograph of the left knee shows small medial tibial osteophyte **(arrow head)** but no additional signs of osteoarthritis. No joint space narrowing is apparent. (**b**) Follow-up radiograph 2 years later shows marked progression of radiographic osteoarthritis with **near bone-on-bone appearance of the medial tibiofemoral joint space** (arrows). (**c**) Baseline coronal intermediate-weighted MRI shows discrete superficial **focal** cartilage **defect** at the weight-bearing medial femur (**arrow**).

All three factors contribute to joint space **narrowing** on radiograph, *i.e.* cartilage **loss**, **meniscal** morphologic **damage** and meniscal **extrusion**.



OA Stages (Kellgren and Lawrence, 1957)—(**a**) Grade **0**: Physiological joint. (**b**) Grade **I**: Subtle JSN in the medial compartment with osteophytic lipping. (**c**) Grade **II**: Definite JSN in the medial compartment. (**d**) Grade **III**: Definite JSN in the medial compartment and sclerosis of the subchondral bone. (**e**) Grade **IV**: JSN with a bone-on-bone phenomenon and deformity of the medial tibial plateau as well as the medial femoral condyle.

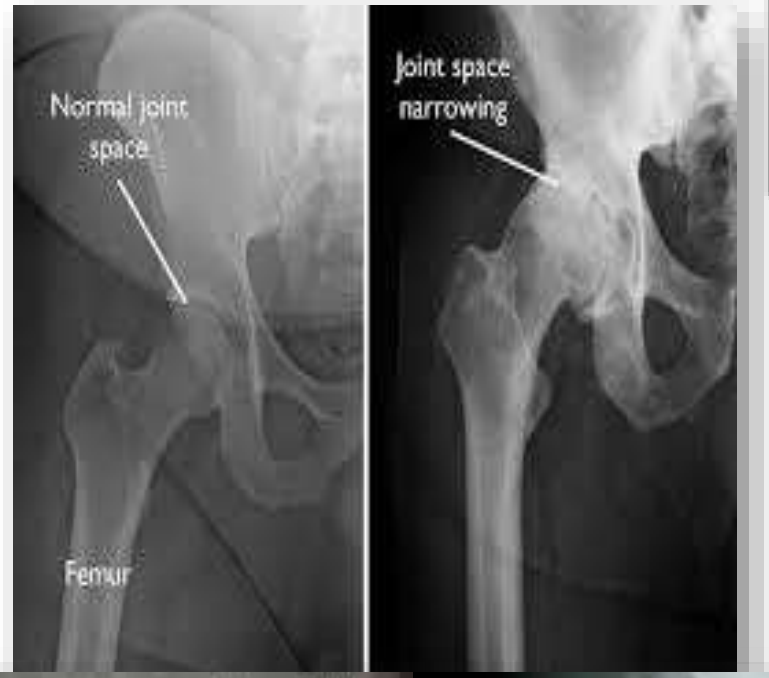
STAGE OF KNEE OSTEOARTHRITIS

- In **non-gout patients** with knee OA, **high** serum **urate** levels predicted **progression** of joint space narrowing over 24 months [baseline serum uric acid levels distinguished progressors (joint space loss >0.2 mm)

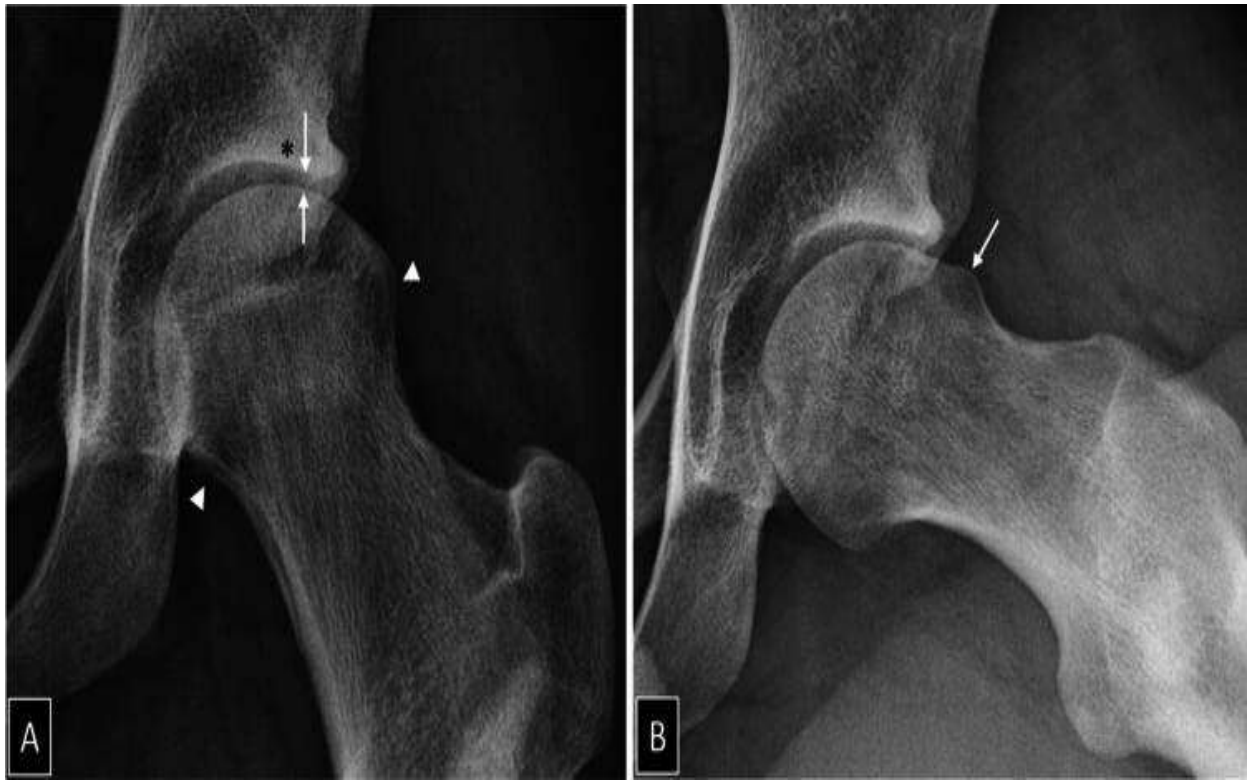
  - **Synovitis in OA** can be assessed using **MRI with or without intravenous gadolinium.** MRI signal changes within Hoffa's fat pad ("Hoffa synovitis") and the presence of effusion ("effusion-synovitis") are two **indirect** markers of synovitis in knee OA. Hoffa synovitis is strongly associated with knee pain.

- **Cartilage damage** is one of central components of OA disease process. Partial-thickness and full-thickness focal cartilage defects seem to contribute equally to development of new cartilage damage in knee OA

- **Hip osteoarthritis (OA)** is a highly prevalent and disabling disorder that affects elderly but also young patients with a high socio-economic burden .
- In patients with clinically suspected hip OA, medical imaging contributes to confirm the diagnosis and rule out alternative diagnoses by demonstrating **cartilage lesions and associated structural changes** .
- For decades, conventional **radiography** (CR) has been used to support the clinical diagnosis of hip OA.
- Over the years, magnetic resonance imaging (**MRI**) emerged as a powerful imaging modality to detect **cartilage** lesions and structural changes of the hip joint.

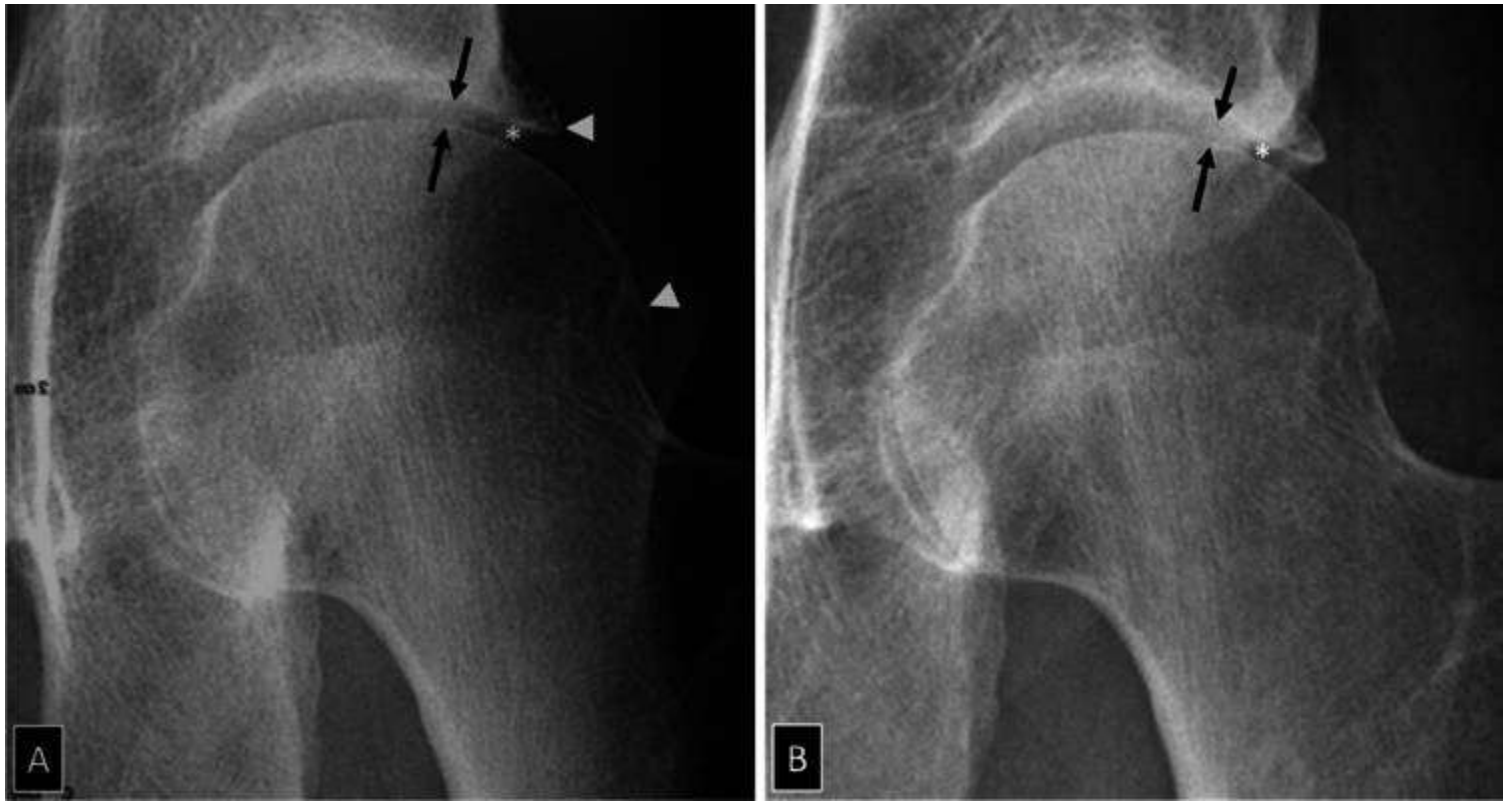


- **Hip OA** can be classified according to its etiology, time of onset, severity, and clinical course.
- In **primary** hip OA, cartilage degradation can either be idiopathic or develop in association with dynamic conflict between the articular surfaces, the FAI syndrome.
- In **secondary** hip OA, joint degradation results from preexisting conditions including developmental hip dysplasia, growth-associated disorders, fracture, femoral head osteonecrosis and inflammatory or metabolic synovial disorders .
- Early-onset and late-onset disease develop either before or after 50 years of age .



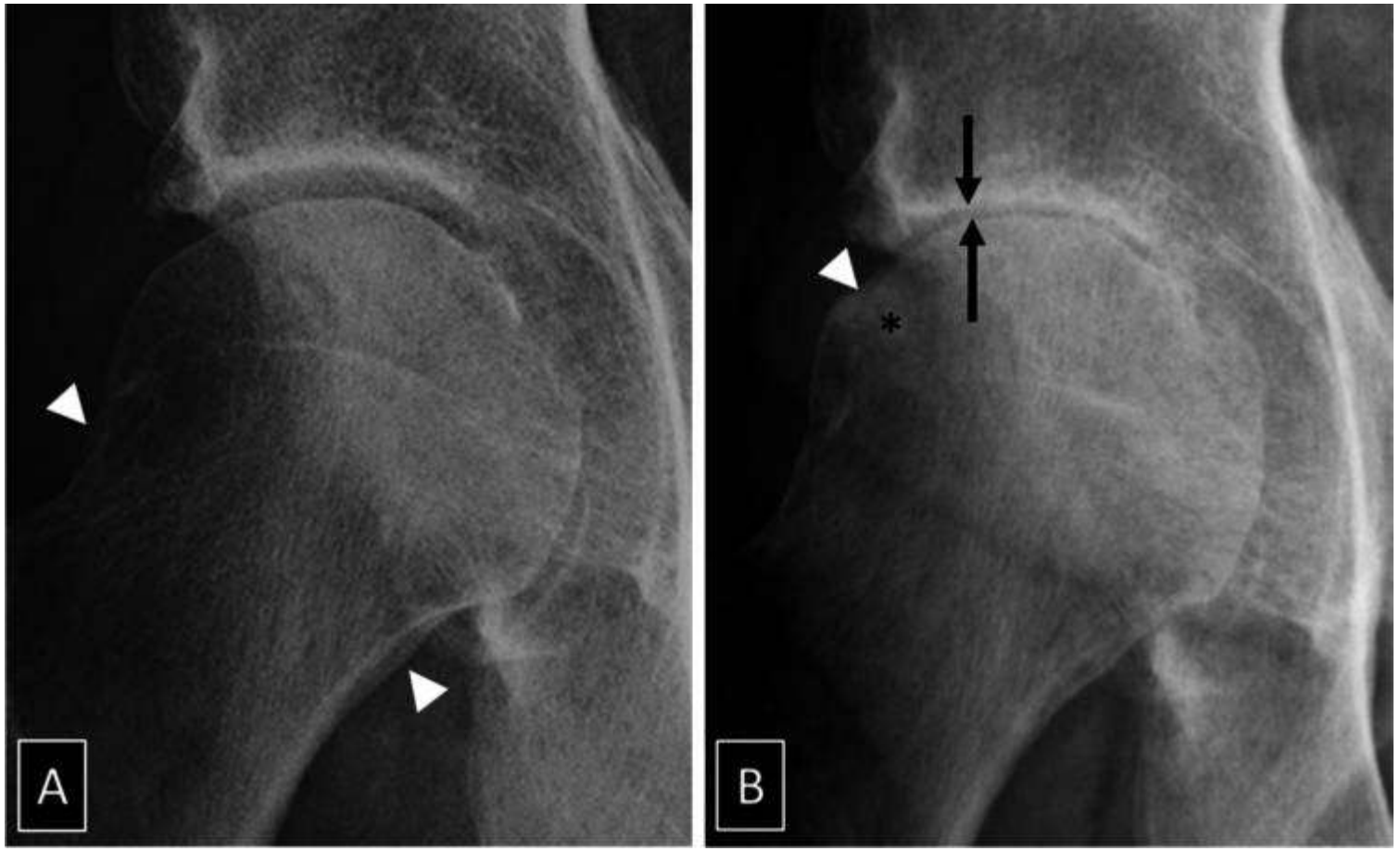
A 21-year-old man with moderate left hip pain and osteoarthritis secondary to femoro-acetabular impingement.
A AP radiograph demonstrates lateral joint space narrowing (arrows), subchondral sclerosis of the acetabular roof (asterisk) and femoral head osteophytes (arrowheads). **B** The 45° Dunn lateral view demonstrates Cam deformity at the head-neck junction (arrow)

Secondary hip osteoarthritis.
A AP radiograph of the left hip in an 8-year-old boy with Legg-Calvé-Perthes disease showing **sclerosis** of the femoral head **epiphysis** (asterisk) and **cystic** changes of the metaphysis (arrow). **B** Follow-up AP radiograph of the same patient at the age of 23 years showing secondary osteoarthritis with **abnormal femoral head contours, articular incongruity, and joint space narrowing**

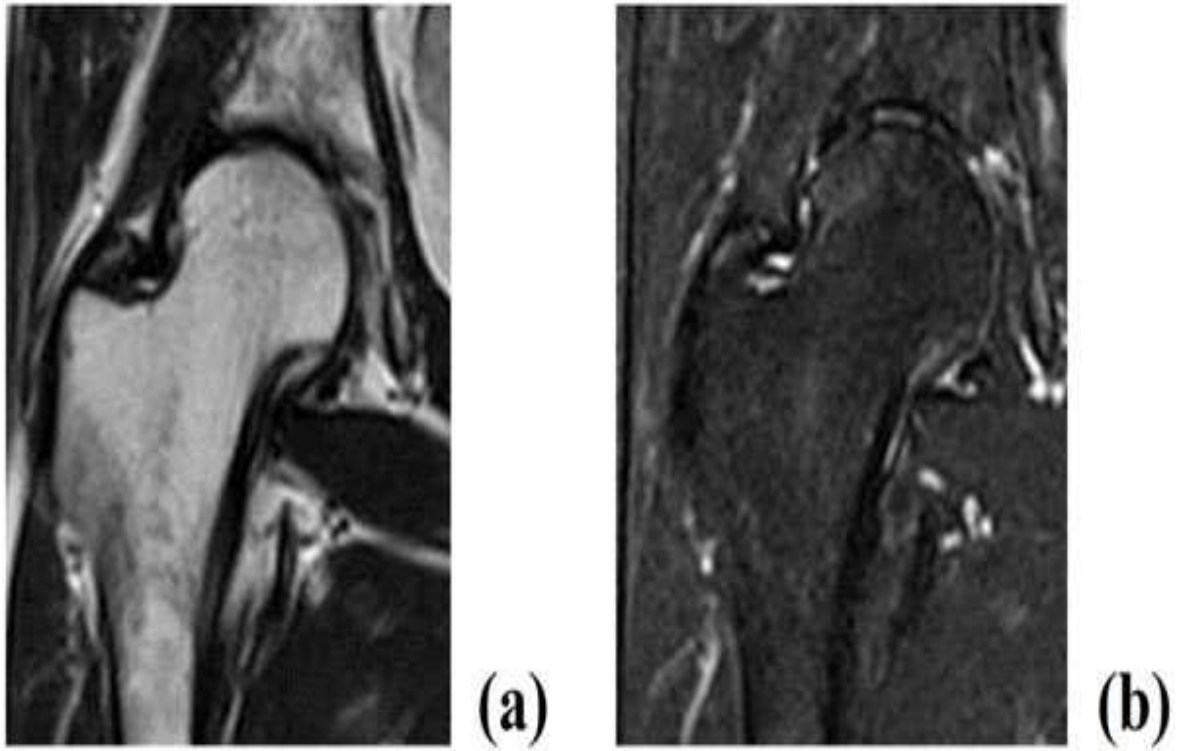


Non-evolutive osteoarthritis of the left hip in a 62-year-old man with limited range of motion but no hip pain.

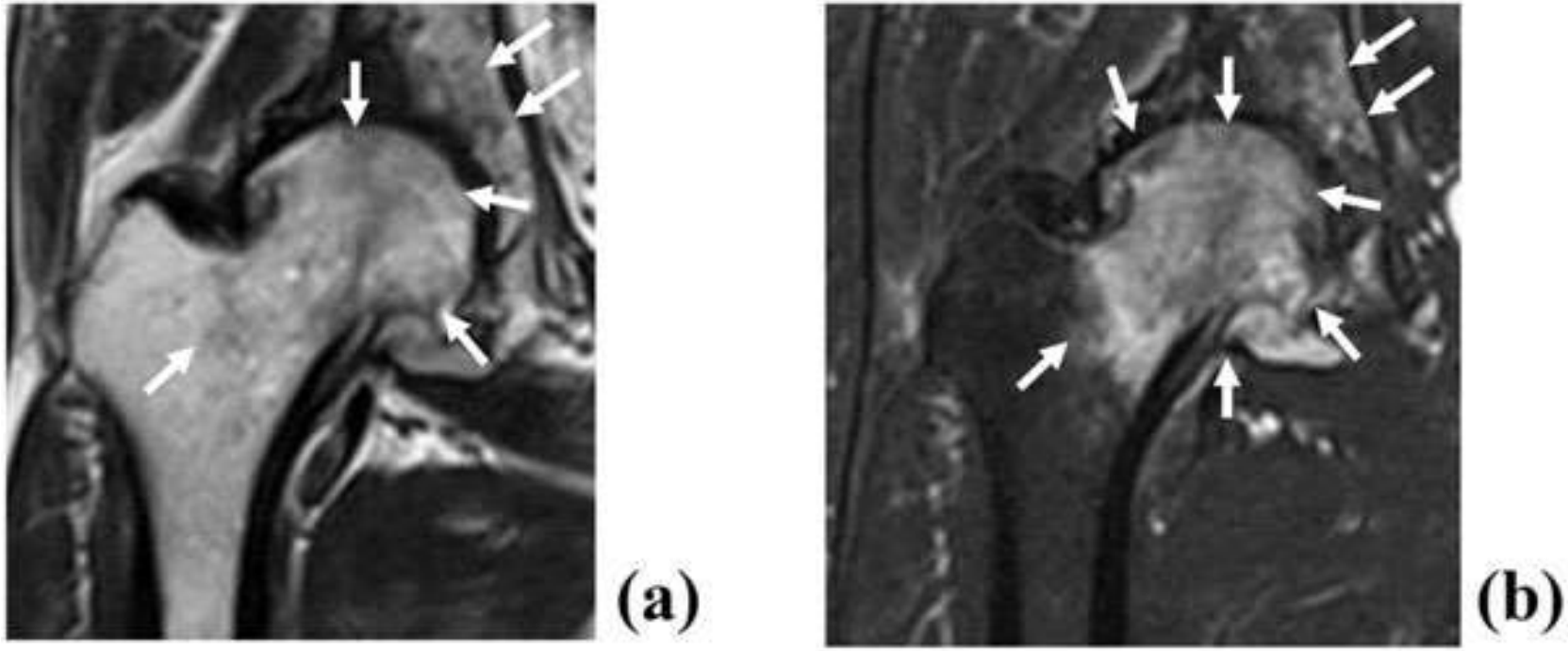
A AP radiograph of the left hip demonstrates **lateral joint space narrowing** (arrows) and **marginal osteophytes** (arrowheads). **B** Follow-up radiograph after 10 years demonstrates **no significant change** in joint space narrowing. Outcome prediction on radiographs is unreliable. Note that the area underneath the osteophyte (asterisk) **does not correspond to the articular joint space .**



65-year-old man with rapidly **destructive osteoarthritis.**
A AP radiograph of the right hip obtained at onset of symptoms shows **early osteophytes (arrowheads)** but **no joint space narrowing.**
B AP radiograph obtained 3 months later shows **complete joint space narrowing (arrows**) with deformity of the femoral head (arrowhead) and **subchondral sclerosis (asterisk).**



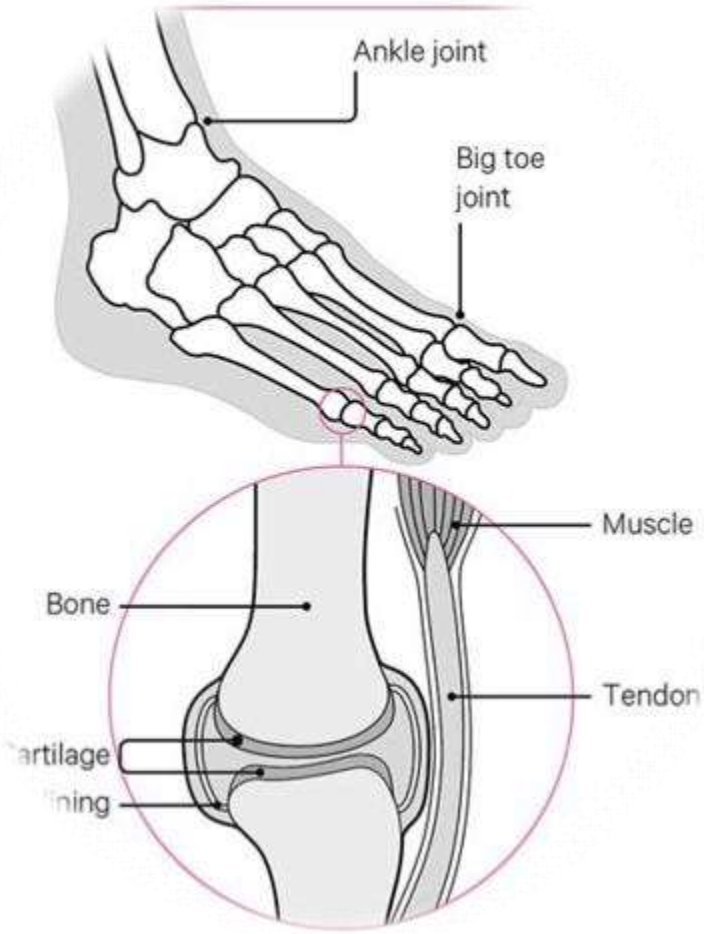
MRI showing no signal changes in right hip joints. Note that there was almost no joint pain when MRI was performed. No signal change by T1-weighted image (a) and T2-STIR (b) was seen in the right hip joint.



- MRI showing **high signal change** in the entire femoral head and acetabulum.
- Broad low intensity signal by T1-weighted image (**a**) and high intensity by T2-STIR (arrows) (**b**) in the right femoral head and acetabulum.
- Note that there was continuous joint pain when MRI was performed.

- **Osteoarthritis** is the most common type of arthritis. It mostly affects the hands, knees, hips and spine, but it can happen in **any joint** in the body, including the feet and ankles

- A joint is a part of the body where two or more bones meet. Your ankle joint is where the tibia and fibula bones in your leg join up with your foot. There are **33 joints in the foot**, but the big toe is the one that is **most commonly** affected by osteoarthritis.



- Osteoarthritis can affect **anyone at any age**, but it's most common in people **over 45.** It affects more **women than men**.
- The risk of developing osteoarthritis is commonly linked to:

•being overweight or obese

•your genetics, or if you have a family member with osteoarthritis

•having a condition that affects the joints, such as **rheumatoid arthritis** **or** **gout**.

- **Hallux rigidus**

If osteoarthritis in the feet is left **untreated**, cartilage can wear away completely. This might cause the bones of your foot to **join together**.

When this happens in the big toe, it's known as **hallux rigidus**.

This can make it more **difficult to move** your big toe and you may have trouble walking. Sometimes bony growths may appear on the top of your toe.

Bunions

Hallux rigidus and **osteoarthritis** in your big toe can cause this toe to lean towards your other toes. When this happens, it's called a ***bunion or hallux valgus***.
A bony lump can then form on the side of your big toe. Sometimes you might have red or swollen skin over it, and it can also cause hard skin. You might feel unsteady while standing and walking

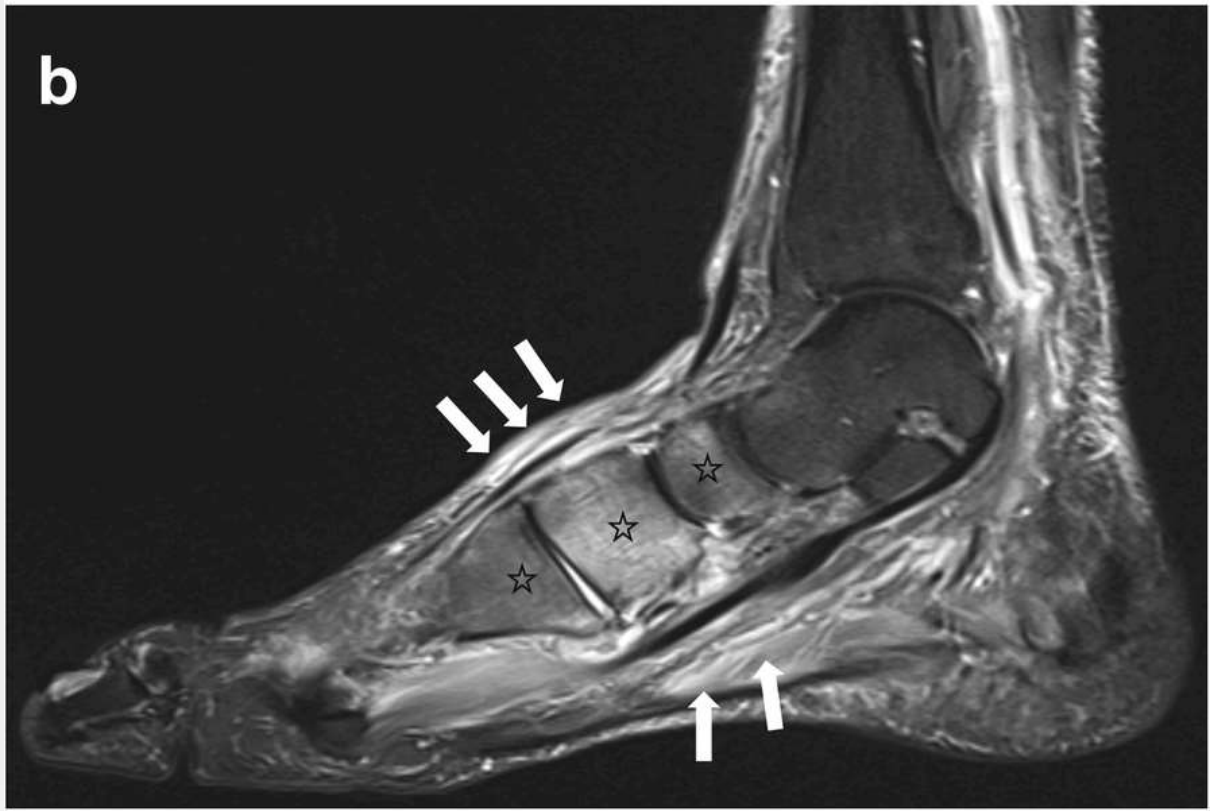
Corns and calluses

Corns and calluses can form on your feet in areas where they're exposed to pressure, or the skin is repeatedly rubbed. This might be because of uncomfortable shoes. Corns are small, hard lumps of skin, and calluses are patches of thicker skin that feel rough.

Corns and calluses can sometimes be caused by other problems with your feet, such as bunions.

Charcot joint

- **Charcot joint**, as Charcot neuropathic osteoarthropathy is seen in the lower extremity and is characterized by bone and joint **fragmentation** of the foot and ankle in individuals with various peripheral neuropathies. **Diabetes, neuropathy, trauma, and metabolic abnormalities** of the bone result in an acute localized inflammatory condition. The inflammatory response can permanently disrupt the bony architecture of the foot resulting in abnormal plantar pressures that are at **risk for ulceration, osteomyelitis, and amputation.**
- Charcot is a debilitating condition affecting the lower extremity of patients with established peripheral neuropathy caused by many complicated etiologies; however, **diabetic neuropathy has become the most common etiology**. Other etiologies include **spinal cord injury, poliomyelitis, leprosy, syphilis, syringomyelia, or chronic alcoholism.**



Stage 0 Pre-Charcot/Prodromal

•Clinically: red, hot, swollen foot. No deformity.
•Radiographically: no changes yet are seen. **Normal radiograph**

Stage I Development/Destruction

•Clinically: Erythema, foot edema, elevated temperature, no pain
•Radiographically: Boney **debris** at joints, **fragmentation** of **subchondral** bone, joint **subluxation**, and/or **fracture-dislocation**

Stage II Coalescence

•Clinically: Decreased signs of inflammation
•Radiographically: **Worsening of stage 1 features**. Absorption of boney debris with new bone formation. Coalescence of **large fragments with sclerosis** of bone ends. Some increased stability

Stage III Consolidation

•Clinically: **Resolution** of inflammation. Changes in overall foot architecture due to underlying final bony **remodeling** that can lead to new pressure points which are at **risk of ulceration**
•Radiographically: **Remodeling of affected bones and joints**

References:

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Imaging of osteoarthritis—recent research developments and future perspective

Daichi Hayashi [1,2,1,2,88], Frank W Roemer [1,3,1,3], Ali Guermazi [1]

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Abstract

In osteoarthritis research, imaging plays an important role in clinical trials and epidemiological observational studies. In this narrative review article, we will des
recent developments in imaging of osteoarthritis in the research arena, mainly foc
literature evidence published within the past 3 years (2014–2017). We will prima

Review · Best Pract Res Clin Rheumatol. 2023 Jun;37(2):101866. doi: 10.1016/j.berh.2023.101866. Epub 2023 Aug 31.

The role of imaging in osteoarthritis

Eun Hae Park [1], Jan Fritz [2]

Affiliations + expand

PMID: 37659890 DOI: 10.1016/j.berh.2023.101866

Abstract

Osteoarthritis is a complex whole-organ disorde
derangement. Advances in imaging techniques
osteoarthritis and functional changes. Radiograp
tomography (CT), and ultrasonography are com
and limitations in evaluating osteoarthritis. Radi
osseous features, while MRI provides detailed in
edema, synovitis, and soft tissue abnormalities.

Osteoarthritis and Cartilage

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Osteoarthritis year in review 2022: imaging

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