

Post-Operative Complications of Total Hip Arthroplasty

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Background

- In 2010, the U.S. prevalence of total hip arthroplasty (THA) was estimated to be 0.83% or 2.5 million individuals.¹
- 270,000 primary THA performed yearly.²
- With an aging population this number is expected to increase significantly over the next few decades.
- Average cost for re-admission following THA is roughly \$36,000.³

THA Post-operative complications

- Infection
- Osteolysis
- Pseudotumor
- Aseptic loosening
- Periprosthetic fracture
- Dislocation
- Leg length discrepancy
- Heterotopic ossification

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Case

- 68 year-old female status post left total hip arthroplasty in 2012.
- Uncomplicated post-operative course to date.
- Normal routine radiographs of her left hip and pelvis last year.
- Continued mild left hip/groin pain for the past year.
- No known trauma or signs/symptoms of infection.

What Imaging Studies Should Be Ordered?

Date of origin: 1998
Last review date: 2015

American College of Radiology ACR Appropriateness Criteria®

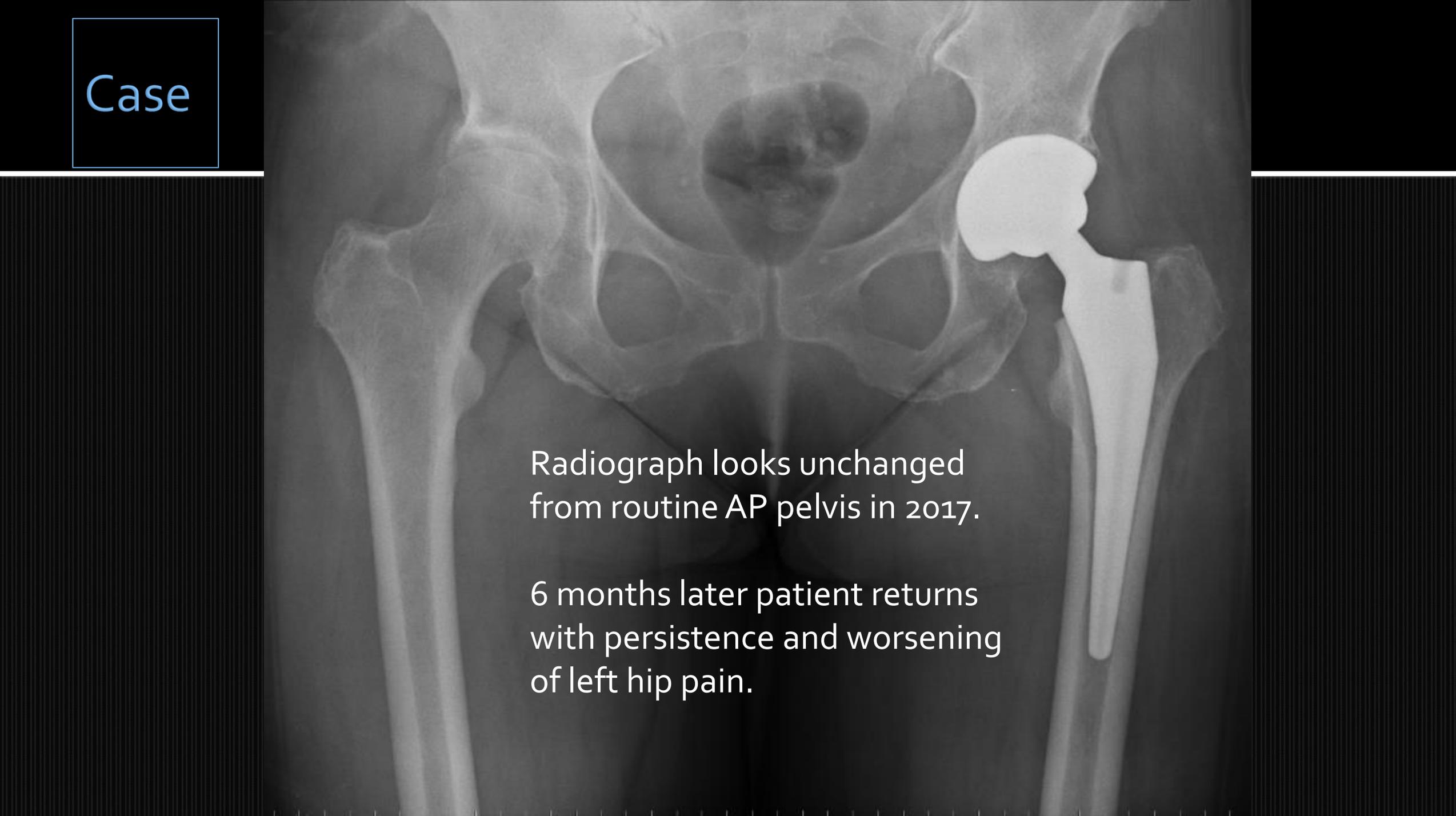
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Clinical Condition: Imaging After Total Hip Arthroplasty

Variant 1: Follow-up of the asymptomatic patient with a total hip arthroplasty.

Radiologic Procedure	Rating	Comments	RRL*
X-ray hip	9		☼☼☼
CT hip without IV contrast	1	This procedure can be considered in late follow-up.	☼☼☼
CT hip with IV contrast	1		☼☼☼
CT hip without and with IV contrast	1		☼☼☼
MRI hip without IV contrast	1		○
MRI hip without and with IV contrast	1		○
Tc-99m bone scan hip	1		☼☼☼
US hip	1	This procedure can be used as a screening test for metal-on-metal prostheses.	○
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

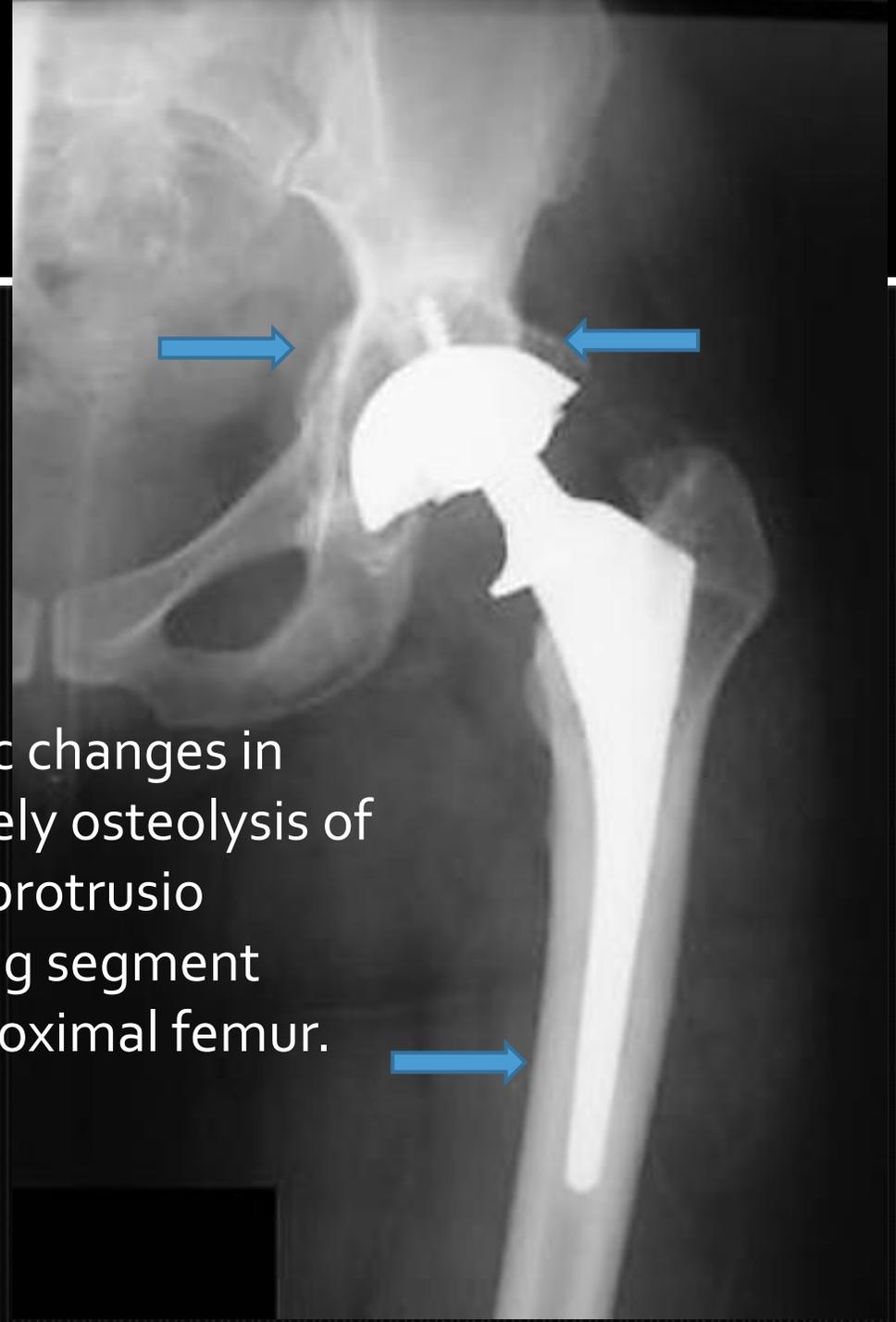
Case



Radiograph looks unchanged
from routine AP pelvis in 2017.

6 months later patient returns
with persistence and worsening
of left hip pain.

Case



Note radiographic changes in the interval, namely osteolysis of the acetabulum, protrusio acetabuli, and long segment sclerosis of the proximal femur.

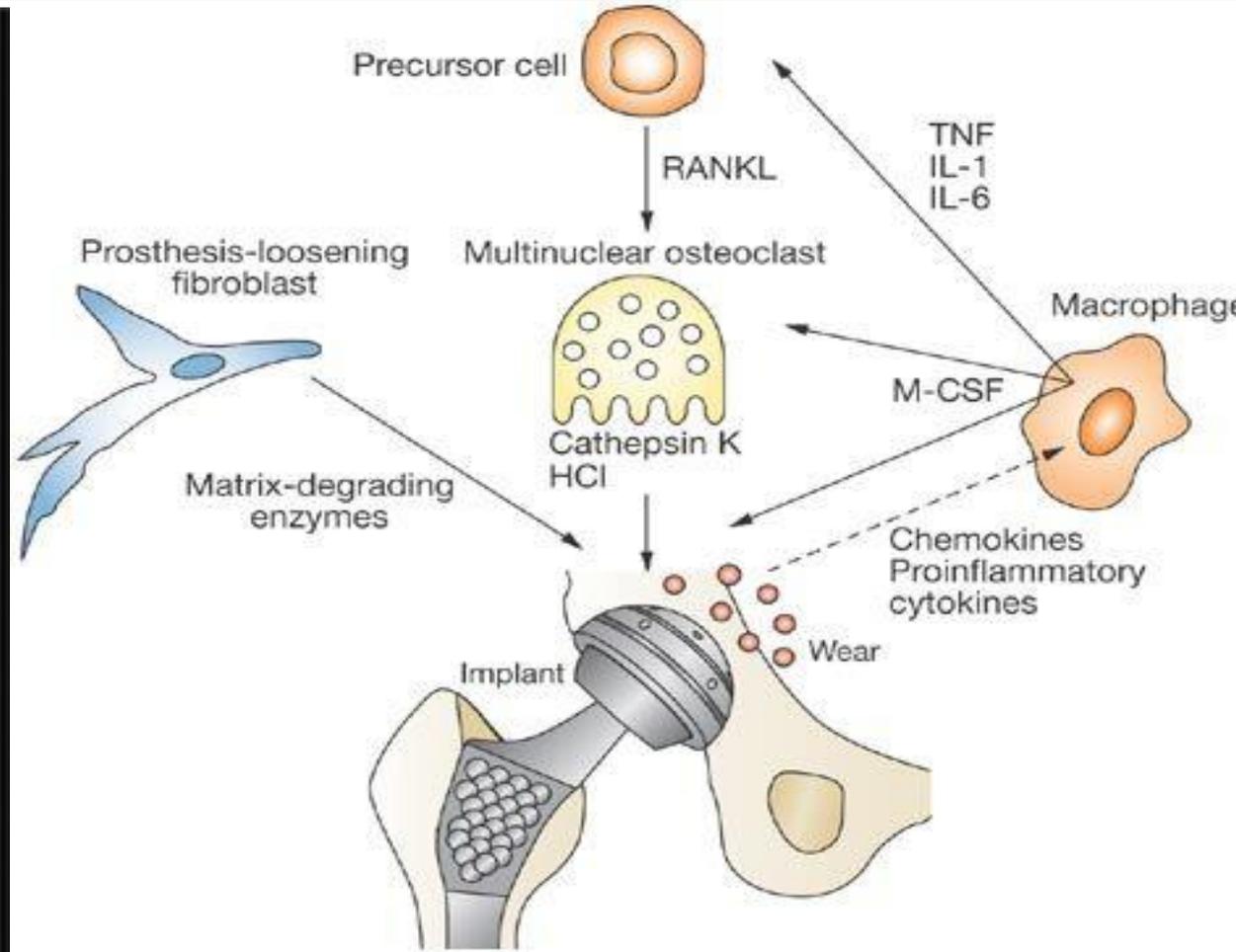
Osteolysis

- Bone is resorbed secondary to the body's response to foreign debris.⁴
- Often asymptomatic, but can cause progress to cause pain due to aseptic loosening or reactive synovitis.⁵
- Incidence ranges from 17-63% of THA patients by 10 years post-op with polyethylene implants.⁶
- Most common cause of implant failure leading to revision surgery.⁶

Pathogenesis

- Physical and chemical wear on artificial joint produces particles to form, leading to an inflammatory response.⁶
 - Termed “particle disease”.
- Inflammatory response involves macrophages, fibroblasts, lymphocytes, and osteoclasts.
- Causes bone breakdown via 3 mechanisms:⁶
 - Exaggerated inflammation induced by activated macrophages and osteoclasts
 - Disruption of periprosthetic bone formation
 - Disruption of bone regeneration
- Type and severity of immune response dependent on particle size, number, and composition.⁶

Pathogenesis



Drees, P et al. Mechanisms of Disease: molecular insights into aseptic loosening of orthopedic implants. *Nature Clinical Practice Rheumatology* : 2007; 3 (165-171).

Radiologic Evaluation⁸

- Radiographs
 - Good initial screening test and useful for tracking progression.
 - Well demarcated, osteolytic lesions around the bone-implant interface.
 - May involved acetabulum or femur.
 - Sensitivity 57%, Specificity 93%
- CT
 - Useful as a supplement to radiographs and in indeterminate cases.
 - Improved sensitivity and characterization of lesion.
 - Must use metal artifact reduction protocol for best results.
- MRI
 - Requires protocol changes and new sequences.
 - Used when concerned for a lesion with soft tissue extension.

ACR Appropriateness Criteria: Heterotopic Bone

Variant 10:

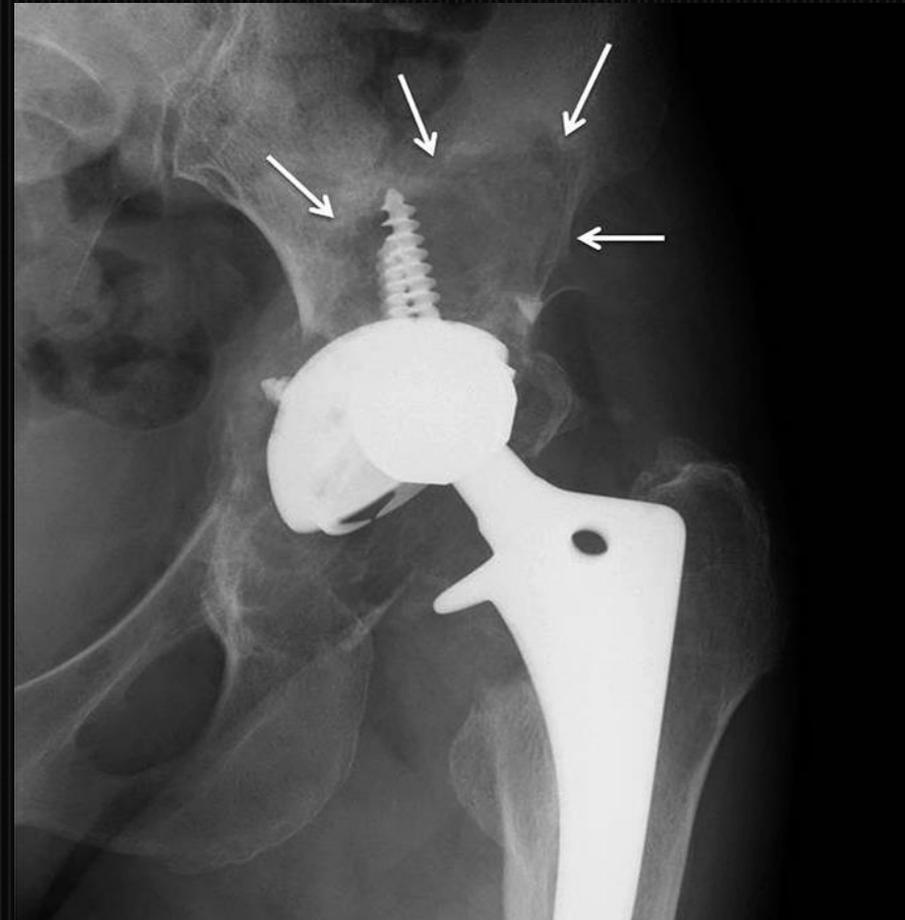
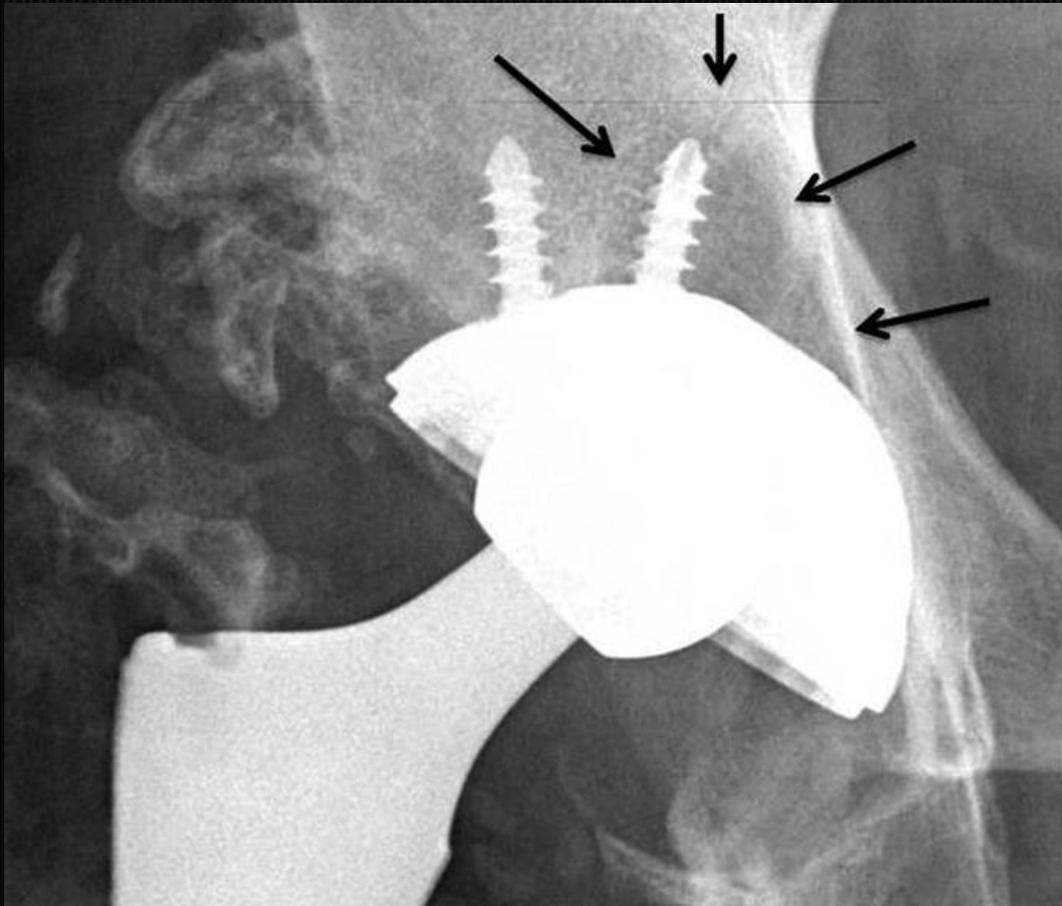
Total hip arthroplasty, evaluate heterotopic bone.

Radiologic Procedure	Rating	Comments	RRL*
X-ray hip	9		☼☼☼
CT hip without IV contrast	7	This procedure is <u>complementary to radiography</u> when additional detail is needed.	☼☼☼
Tc-99m bone scan hip	5	The panel noted this procedure is not often currently used for evaluating heterotopic bone.	☼☼☼
MRI hip without IV contrast	5	This procedure may be appropriate but there was disagreement among panel members on the appropriateness rating as defined by the panel's median rating. <u>Neurovascular structures</u> may be delineated.	0
US hip	4		0
CT hip with IV contrast	1		☼☼☼
CT hip without and with IV contrast	1		☼☼☼
MRI hip without and with IV contrast	1		0

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

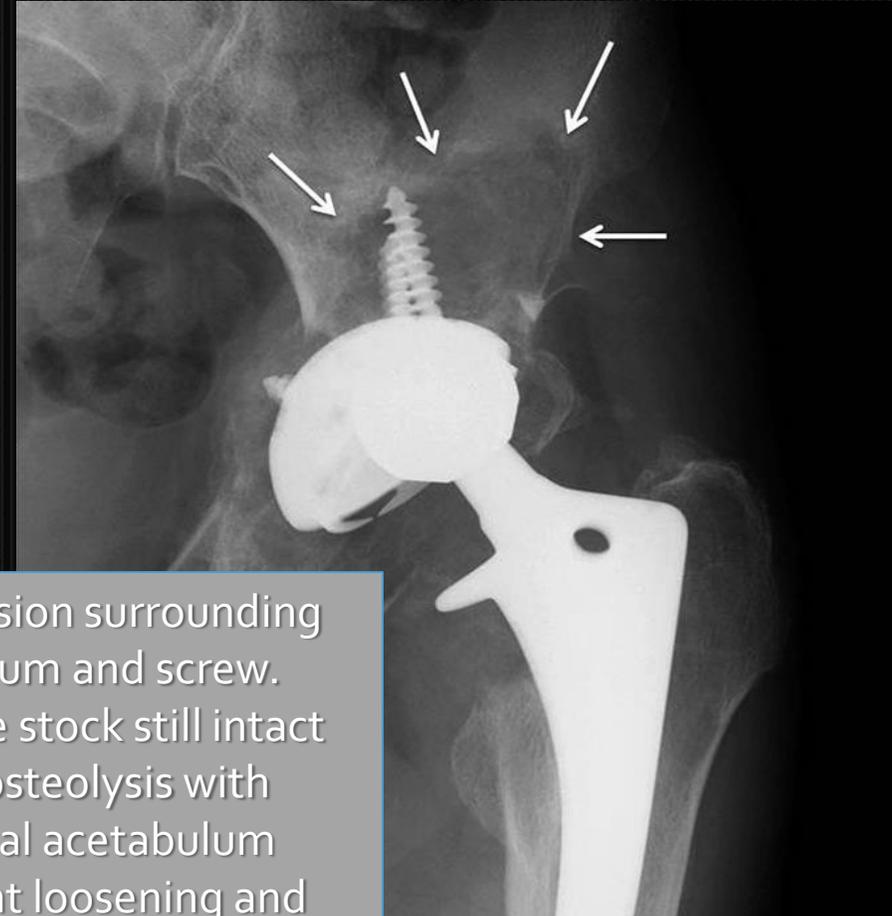
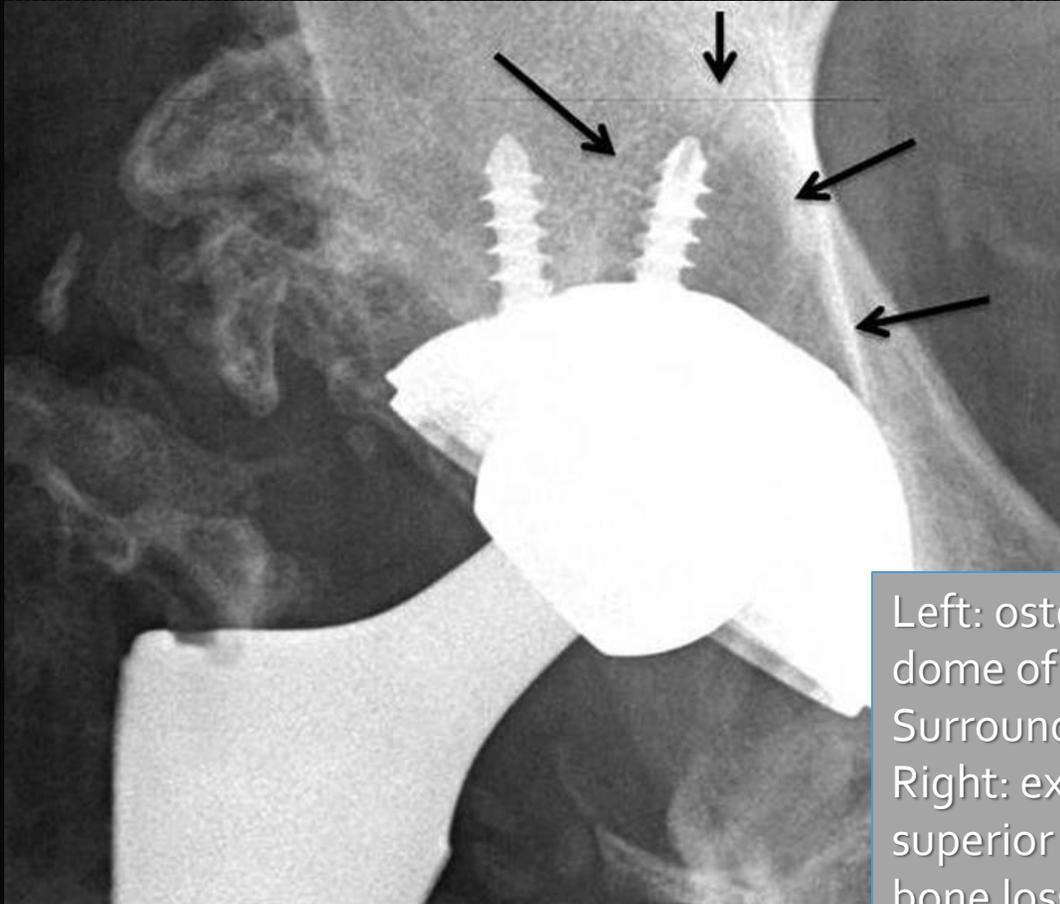
***Relative Radiation Level**

Radiographs – acetabular involvement



-Ries MD, Link TM. Monitoring and Risk of Progression of Osteolysis After Total Hip Arthroplasty. *The Journal of Bone and Joint Surgery American volume*. 2012;94(22):2097-2105.

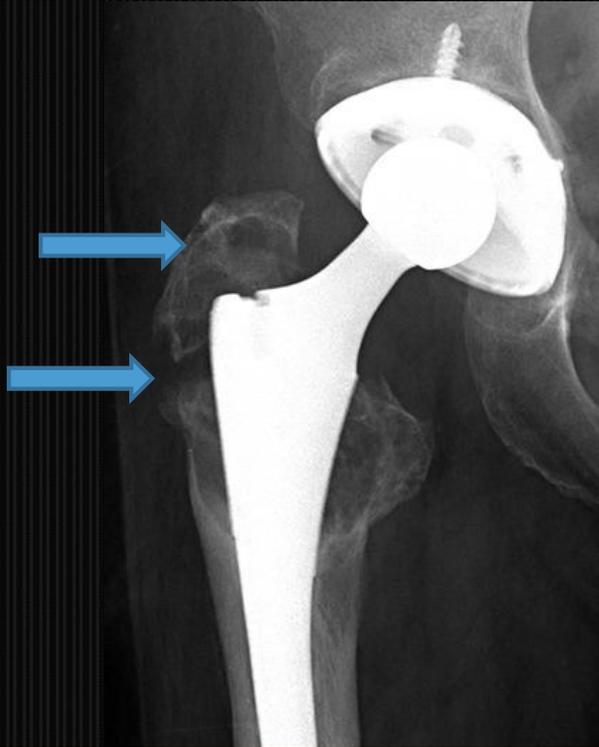
Radiographs – acetabular involvement



Left: osteolytic lesion surrounding dome of acetabulum and screw. Surrounding bone stock still intact
Right: extensive osteolysis with superior segmental acetabulum bone loss. Implant loosening and superior migration of acetabular component. Possible dislocation

-Ries MD, Link TM. Monitoring and Risk of Progression of Osteolysis After Total Hip Arthroplasty. *Journal of Bone and Joint Surgery American volume*. 2012;94(22):2097-2105.

Radiographs – femoral involvement



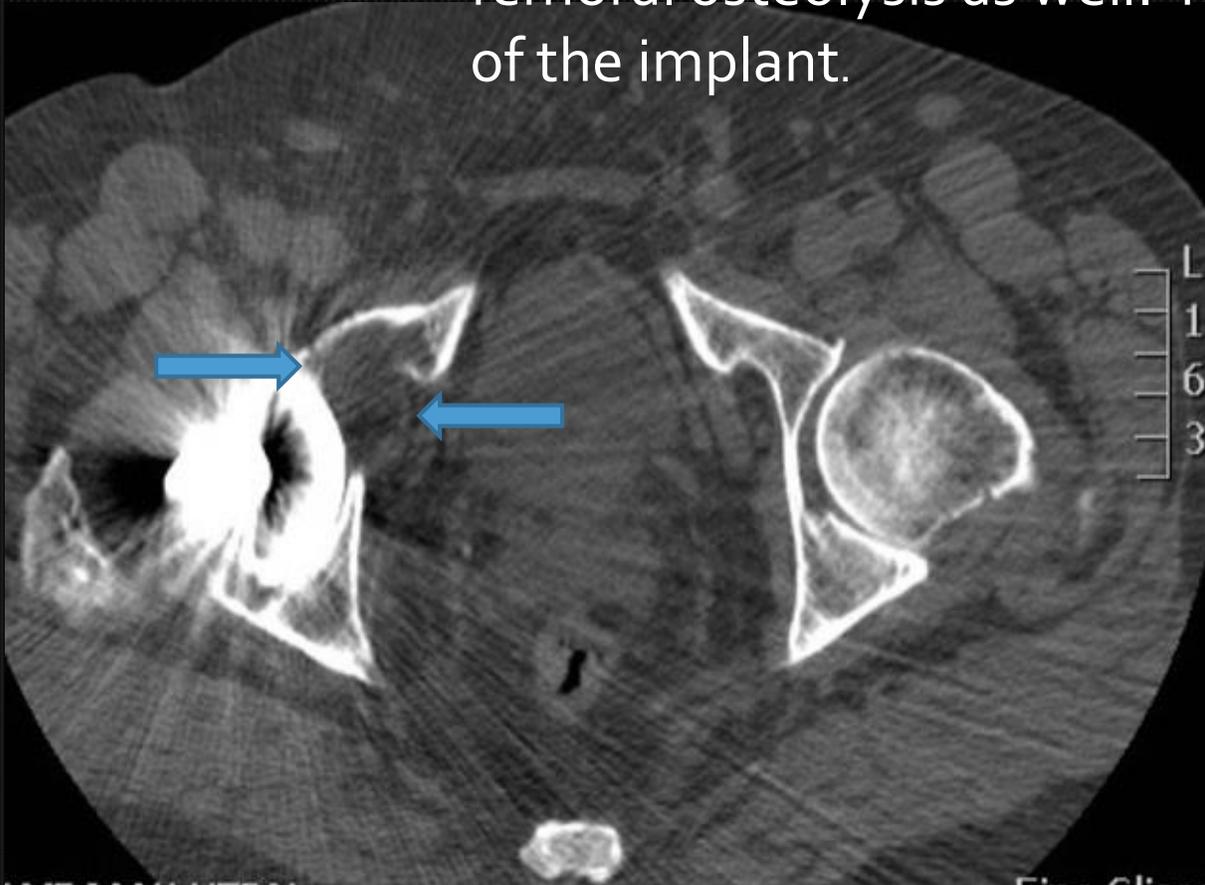
Osteolysis involving the greater trochanter, leading to a fracture

- Often involves the greater trochanter or weight bearing surface of the calcar.
- Can expand to reach distal femoral component.
- May cause periprosthetic fractures.

CT

2 dif pts Left: Axial CT. Lysis of inner cortex of the acetabulum. Some soft tissue extension. ~~No concern for malignancy or infection based on history.~~

Right: Coronal CT. Osteolysis of acetabular component, femoral osteolysis as well. Fracture through the cement of the implant.



Treatment⁵

- Definitive treatment is surgical.
- Indications for revision arthroplasty:
 - Pathologic fracture
 - Symptomatic with extensive osteolysis on imaging

Prevention

- Two double blind randomized control trials suggest using highly cross-linked polyethylene liners significantly lower rates of implant wear.^{9,10}
 - Need longer follow-up data.
- Role of oral bisphosphonate therapy is controversial.
 - One population based study found lower rates of revision arthroplasty among patients who had received prior bisphosphonates.¹¹
 - Not statistically significant.
- Role for routine monitoring⁸
 - Initial radiograph 5 years post-op.
 - Radiographs every 2-3 years, more frequently if high risk.
 - Serial radiographs to follow a known lesion.

THA Post-operative complications

- Infection
- **Osteolysis**
- **Pseudotumor**
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- Dislocation
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Pseudotumor²

- Most commonly arise from wear from metal-on-metal (MOM) bearings.
 - Designed to reduce wear, increase stability, and improve range of motion compare to traditional metal on polyethylene (MOP) bearings.
- “Non-neoplastic and non-infectious cystic or solid mass associated with a hip arthroplasty.”
 - Form as a reaction to metal.
- Prevalence: 1-39% following MOM THA
- Usually asymptomatic.
 - Can cause pain, paresthesia, antalgic gait, or palpable mass.
- Uncommon cause of revision arthroplasty.
 - 1.7 – 5.6%

Pathogenesis²

- Metal debris is formed via mechanical wear, corrosion, and fretting.
- Metal ions cause perivascular lymphocytic inflammation with some macrophages.
- Tissue necrosis and fibrin deposition occur.

Imaging²

- Radiographs have poor sensitivity.
- CT is less sensitive for MRI and used for patients with extensive metal artifact on MRI or who cannot tolerate MRI.
- MRI is most sensitive.
 - Metal artifact is a problem, requires metal artifact reduction sequences.
 - Variable appearance to lesions, range from thin walled cysts to solid masses but generally non-enhancing. Usually see synovial thickening, surrounding fluid, and scattered debris.
- Ultrasound is useful to characterize initial lesion.
- Arthrography – can be useful in differentiating peri-articular masses.

ACR Appropriateness Criteria: Pseudotumor

Variant 6:

Evaluating patients with a painful primary metal-on-metal total hip arthroplasty or surface replacement: evaluate for aseptic lymphocyte-dominated vasculitis-associated lesion.

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Radiologic Procedure	Rating	Comments	RRL*
MRI hip without IV contrast	8		O
US hip	6		O
X-ray hip	5	This procedure may be appropriate but there was disagreement among panel members on the appropriateness rating as defined by the panel's median rating.	☹☹☹
MRI hip without and with IV contrast	5	Gadolinium contrast is usually not needed but may define areas of necrosis.	O
Aspiration hip	5	This procedure can detect metallosis.	Varies
CT hip without IV contrast	3		☹☹☹
CT hip with IV contrast	3		☹☹☹
CT hip without and with IV contrast	1		☹☹☹
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

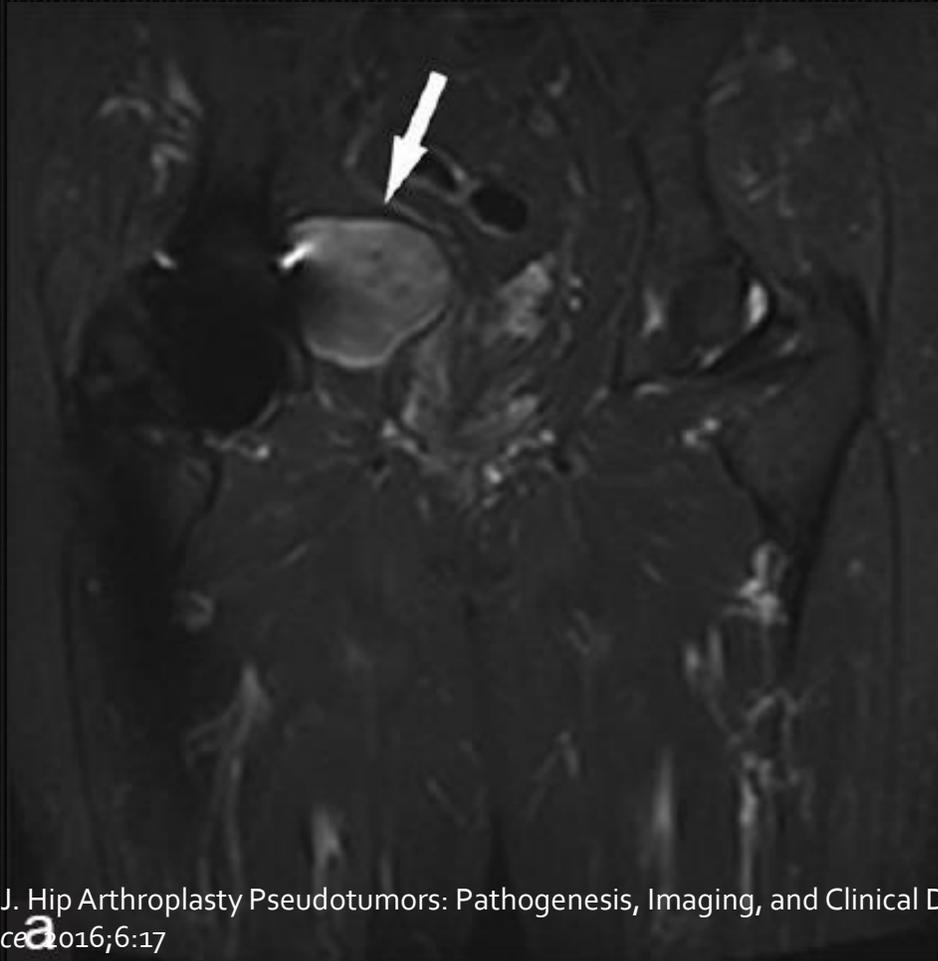
MRI classification²

- Three types:
 - Type I: thin walled cyst (<3 mm)
 - Type II: thick walled cyst (>3 mm)
 - Type III: predominantly solid mass
- Symptom severity and revision arthroplasty rates increase from Type I to Type III.

MRI

MR T2 image: Heterogeneously bright T2 mass on coronal section abutting the medial wall of the acetabulum.

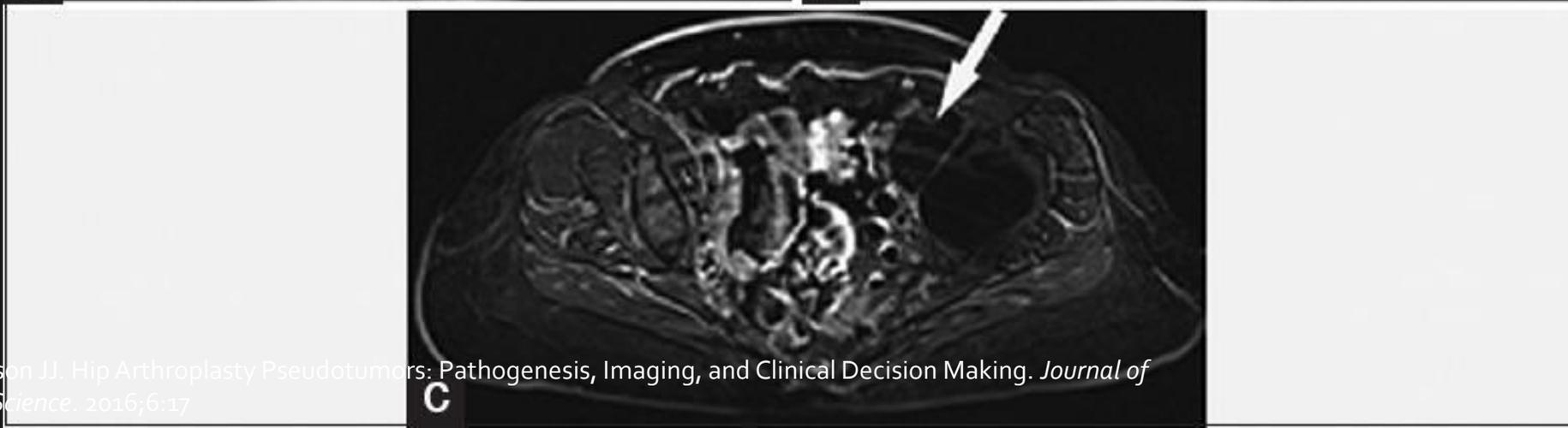
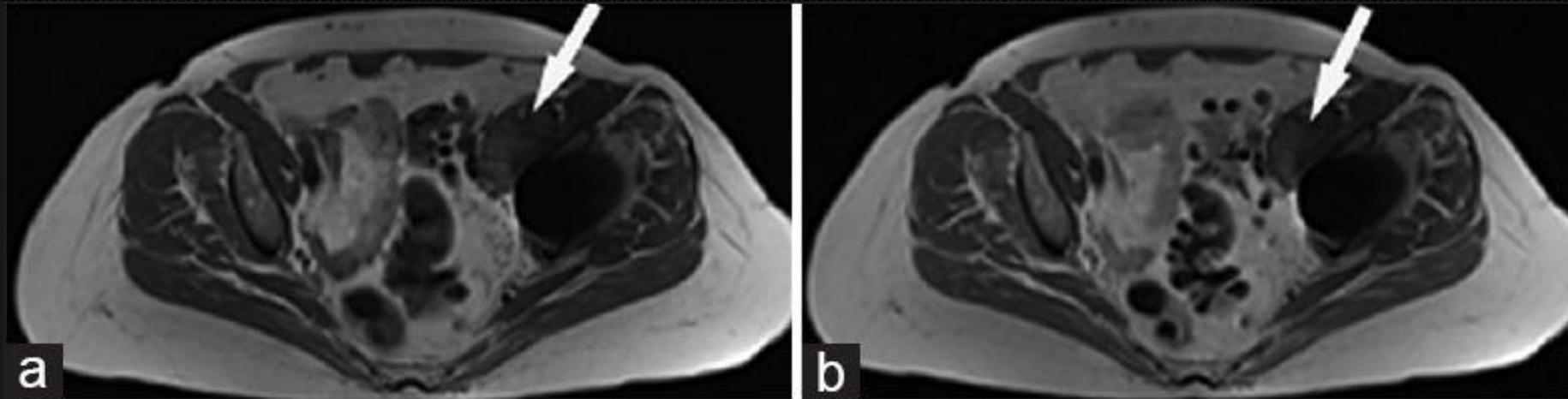
Hip Arthrogram: Fluoroscopic arthrogram confirming that the mass communicates with the hip joint and is likely associated with the arthroplasty, not of malignant origin



MRI

Axial T1 showing a left sided periacetabular mass, hyperintense to skeletal muscle, no contrast enhancement of mass (figs a and b)

Axial subtraction sequence showing no contrast enhancement (fig c)



Treatment considerations²

- Surgery vs. surveillance
- Poor outcomes are relatively common with surgery.¹²
 - 50% incidence of major complication with revision arthroplasty when compared to 14% for other indications.
 - 1/3 of patients will receive another revision surgery.
- Indications:
 - Severe pain and dysfunction
 - Large pseudotumors
 - Elevated serum metal levels with associated symptoms.
 - Serums metal ion levels >20 microgram/L with or without symptoms.
 - Concern for systemic effects of metal ions.

Summary

- Total hip arthroplasty is one of the most common orthopaedic procedures, complications are not uncommon.
- Osteolysis is resorption of bone secondary to inflammation due to particle debris from wear of the implant.
 - Radiographs best initial test, cross sectional imaging to further characterize.
 - Characteristic lytic lesions along the bone-implant interface.
- Pseudotumors are cystic or solid lesions associated with hip arthroplasty that are caused by a reaction to metal debris, usually from metal-on-metal bearings.
 - MRI is best imaging modality with variable appearance of lesions.
 - Solid lesions have the worst prognosis.
 - Surgery is associated with poor outcomes.

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