

Non-traumatic bone marrow edema of the knee

Michail Klontzas, MD, DIC, PhD

Department of Medical Imaging, University of Crete

 @Klonmich

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- Definition - pathophysiology of BME
- Bone marrow edema syndromes
- Diagnostic dilemmas - nomenclature
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Bone marrow edema - differential diagnosis

Transient osteoporosis
(TO) - SIF

Regional migratory
osteoporosis (RMO)



Self-limited

Avascular necrosis
Complex regional pain
syndrome (CRPS)
Infection
Neoplasms
Degenerative/
Inflammatory
arthropathy



Non-reversible
without treatment

Bone marrow edema syndrome

- Transient osteoporosis - SIF (**acute**)
- Regional migratory osteoporosis (**acute**)
- Complex regional pain syndrome (**chronic**)

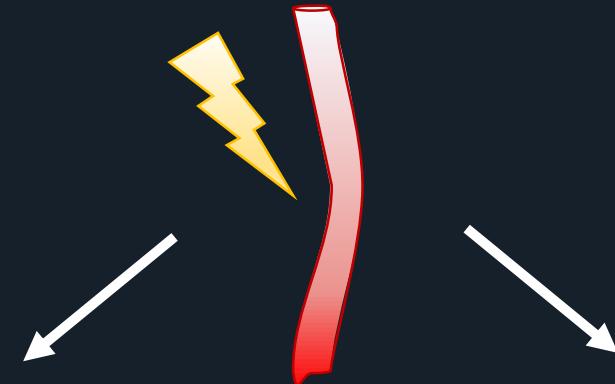
Hoffman S et al. Orthop Clin N Am 2004

- Bone demineralization (**transient**)
- Ill-defined pathogenesis
 - Hyperemia leading to demineralization
 - Neurogenic compression
 - Ischemia of vessels supplying nerve roots

Curtiss & Kincaid J Bone Joint Surg Am 1959

Rosen RA, Radiology 1970
Curtiss & Kincaid J Bone Joint Surg Am 1959

Microvascular damage



Direct
(e.g. trauma,
neoplasm)

Indirect
(e.g. high
intravascular
pressure, venous
congestion)

Microscopic - imaging features

Imaging Modality of Choice

MRI



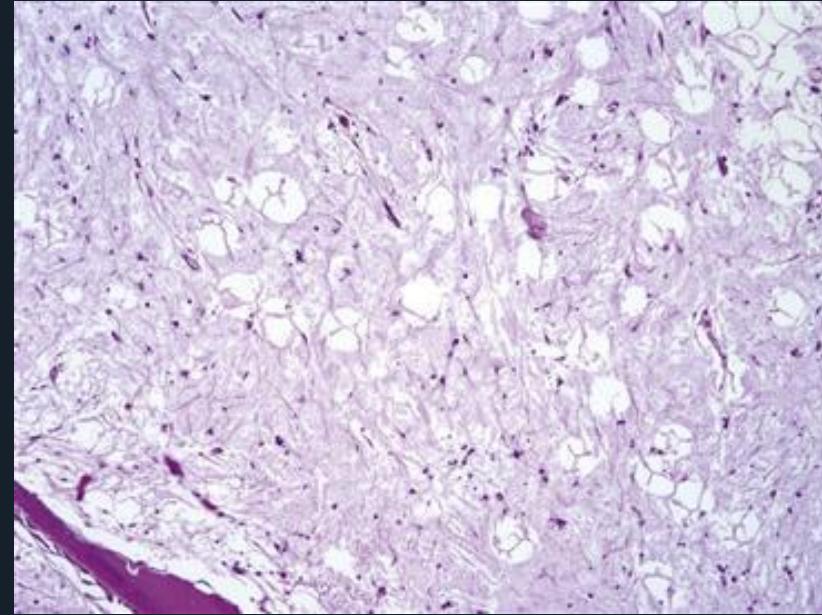
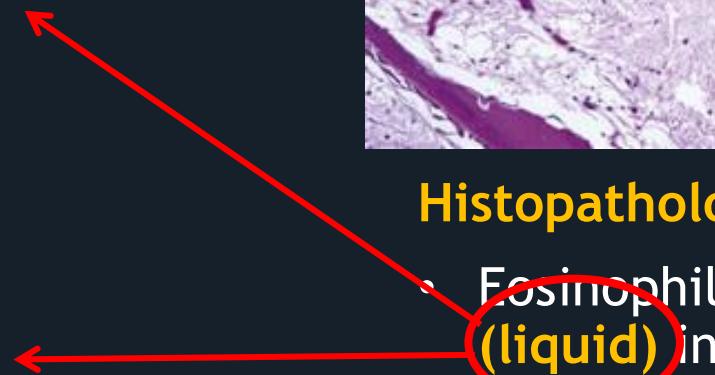
T1



T1 + Gd



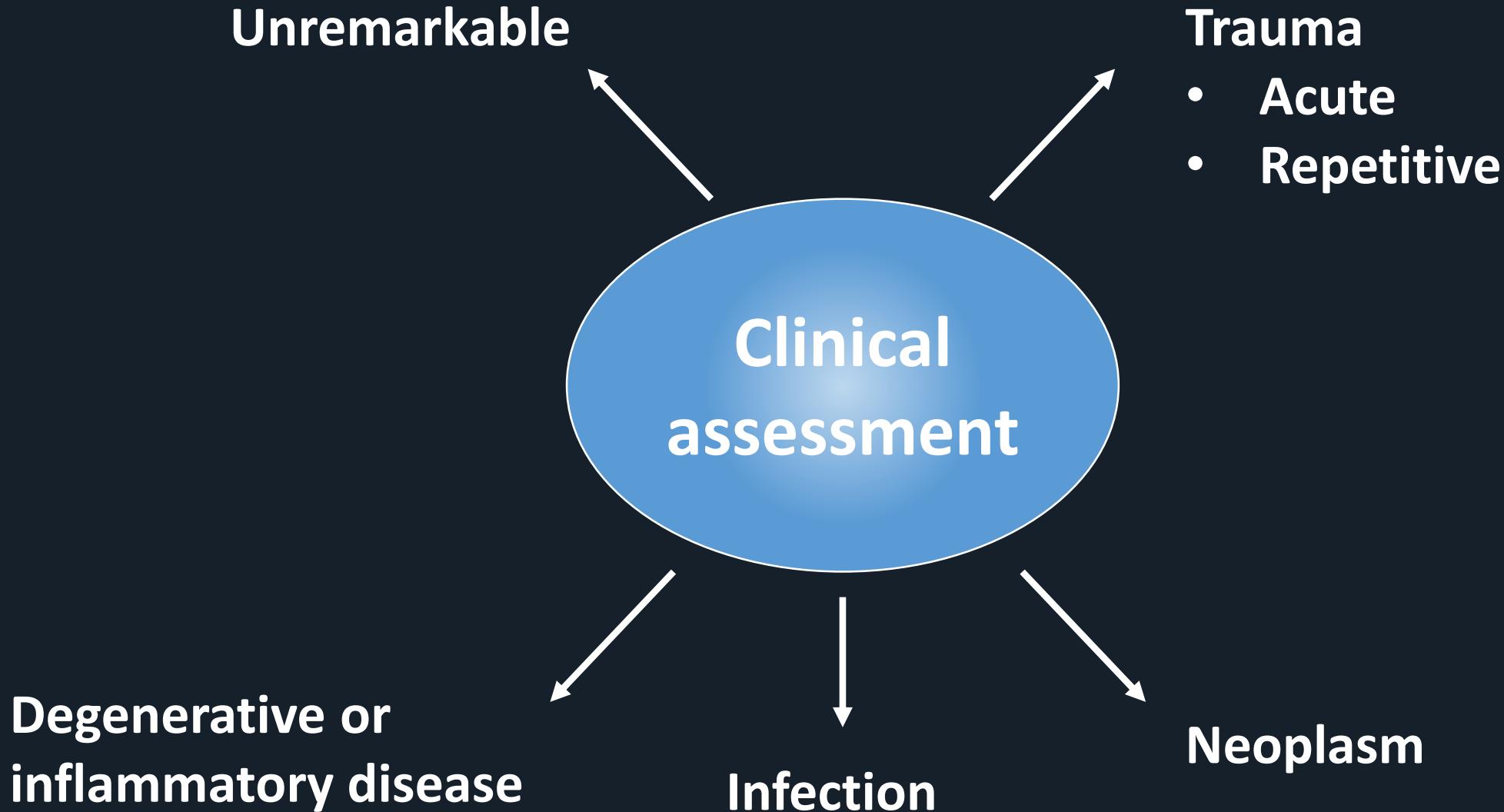
STIR,
Pd / T2 FS



Histopathologic features:

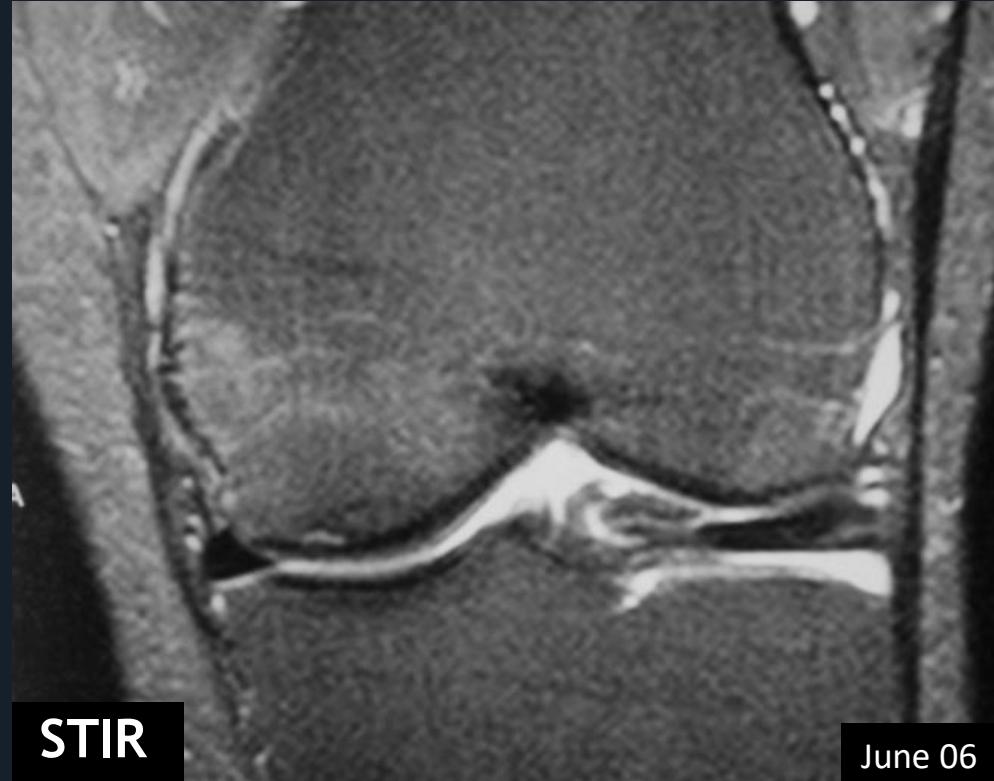
Eosinophilic material
(liquid) in-between fat cells

- Engorged vessels
- Lipid vacuoles



Vassalou, Spanakis, Tsifountoudis, Karantanas.
Semin Musculoskeletal Radiol 2019

Subchondral Insufficiency Fracture of the Knee



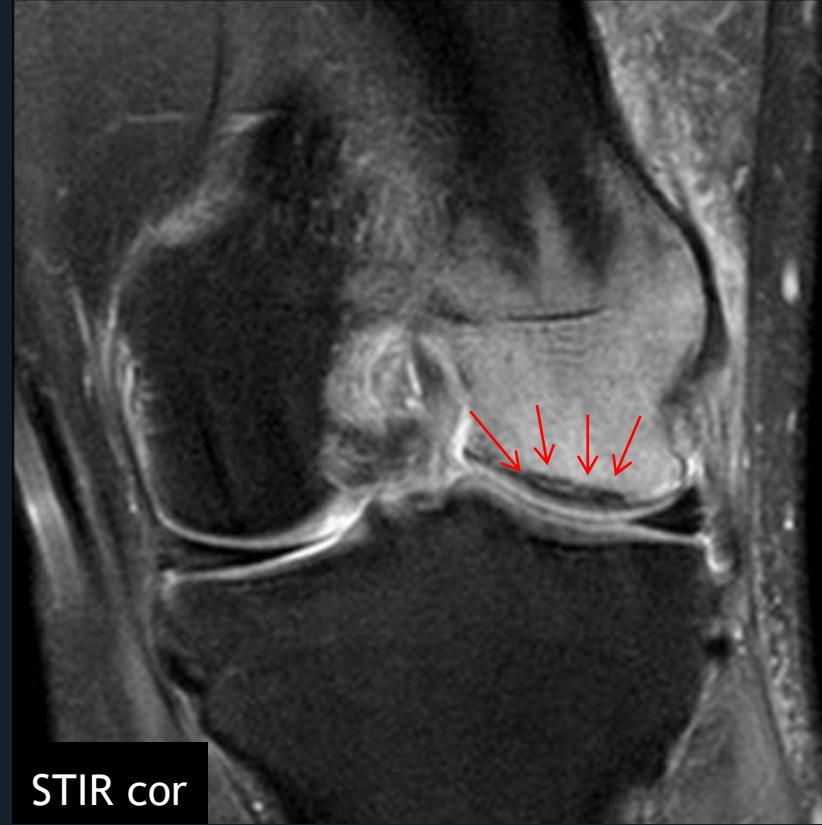
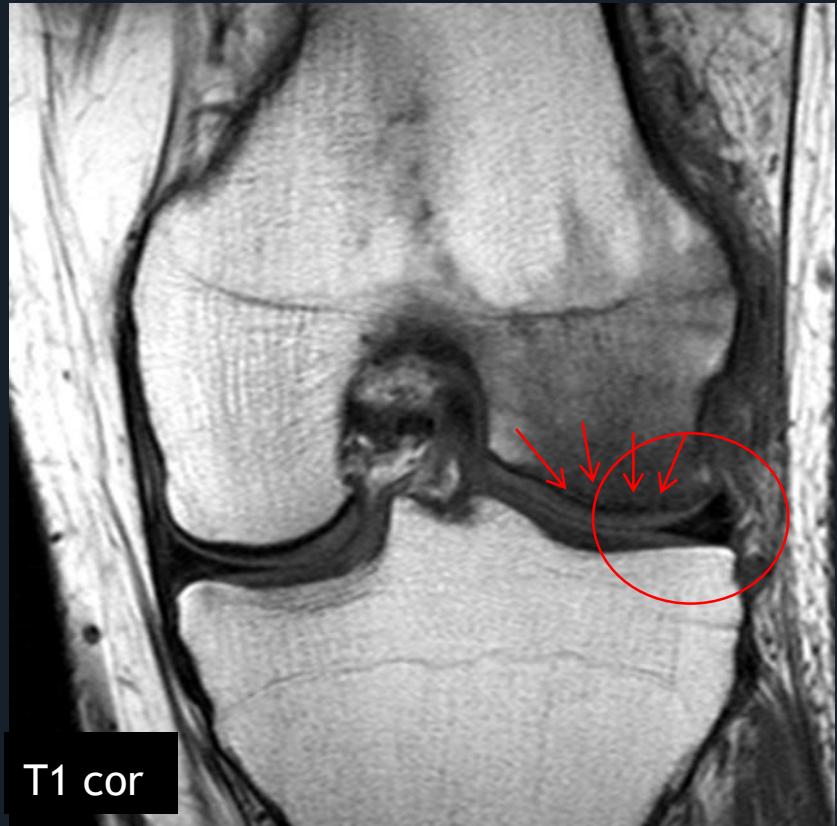
Subchondral Insufficiency Fracture of the Knee

- Self-limited (transient) 
- Healing: ~ 12 months
- Plain films: -, (20% osteopenia in 4-8 weeks)
- Osteoporosis or osteopenia on DEXA (Klontzas et al. EJR 2015)

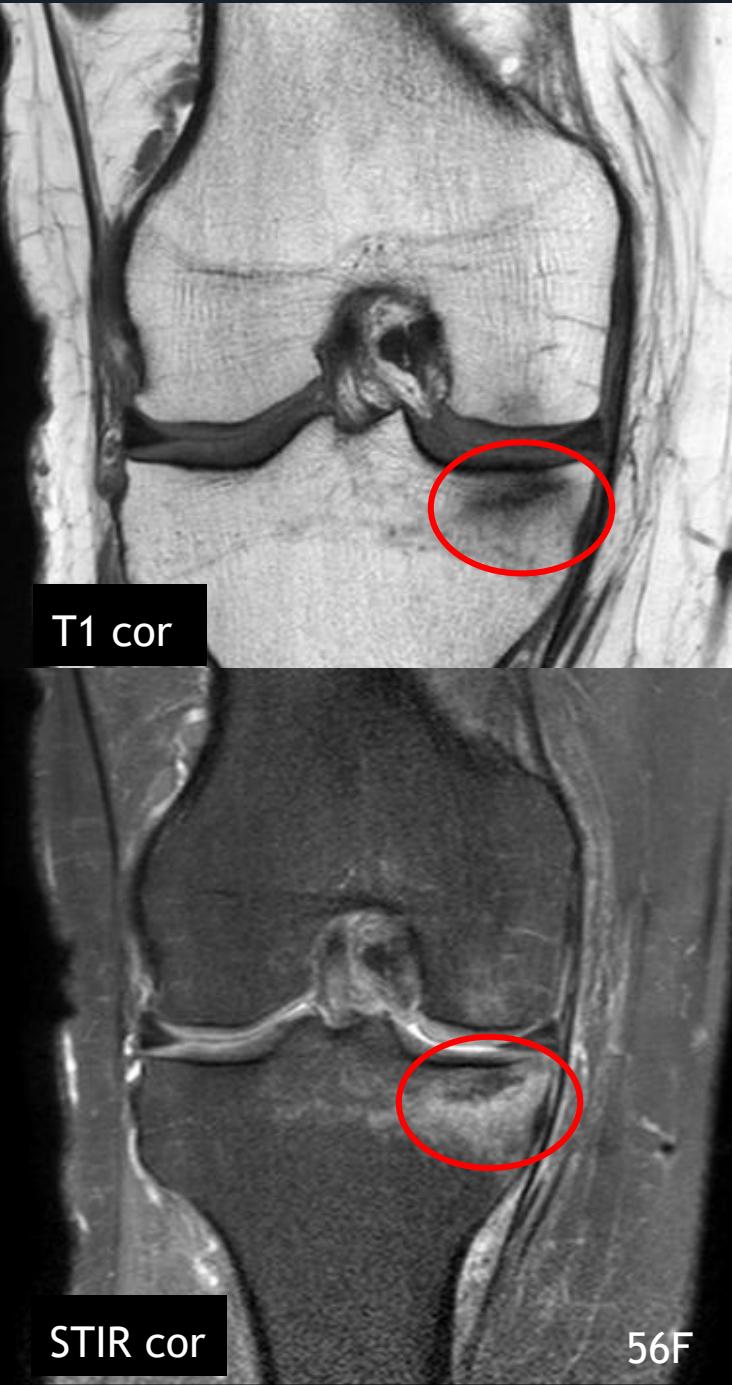
Subchondral insufficiency fractures of the knee

- Formerly known as “Spontaneous Osteonecrosis of the Knee”
 - SONK
- In reality – no necrosis initial stages – renamed SIF
- **The equivalent of transient osteoporosis of the hip**
(Yamamoto and Bullough, JBJS Am, 2000 & Kattapuram, EJR, 2008)
- >45 y/o patients
- No history of trauma
- Characterized by BME

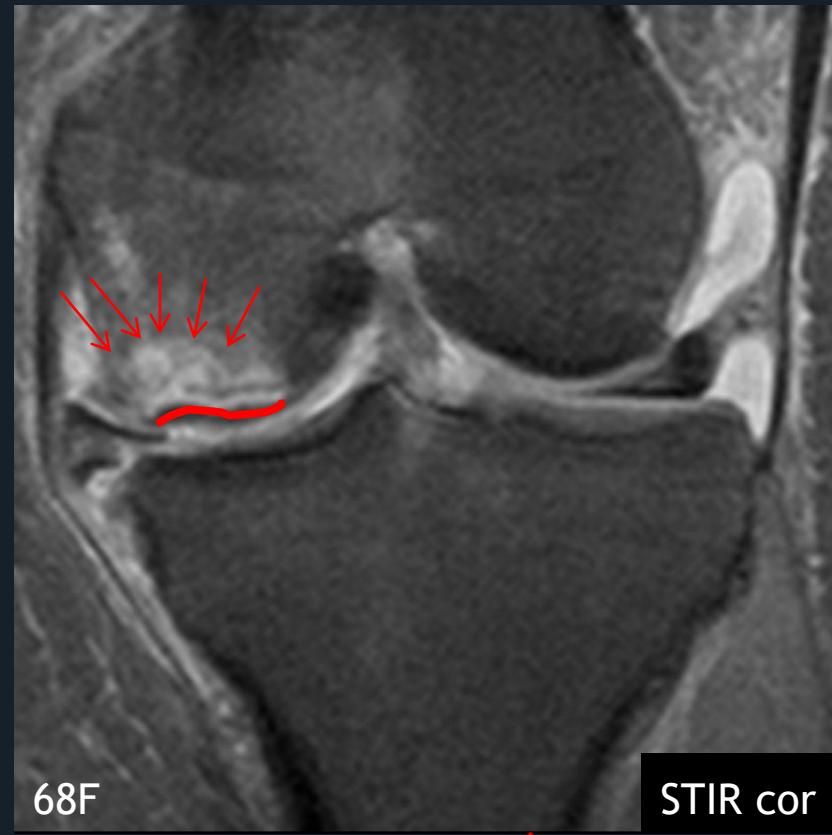
Subchondral Insufficiency Fracture of the Knee



34M (osteoporosis secondary to vitD deficiency)



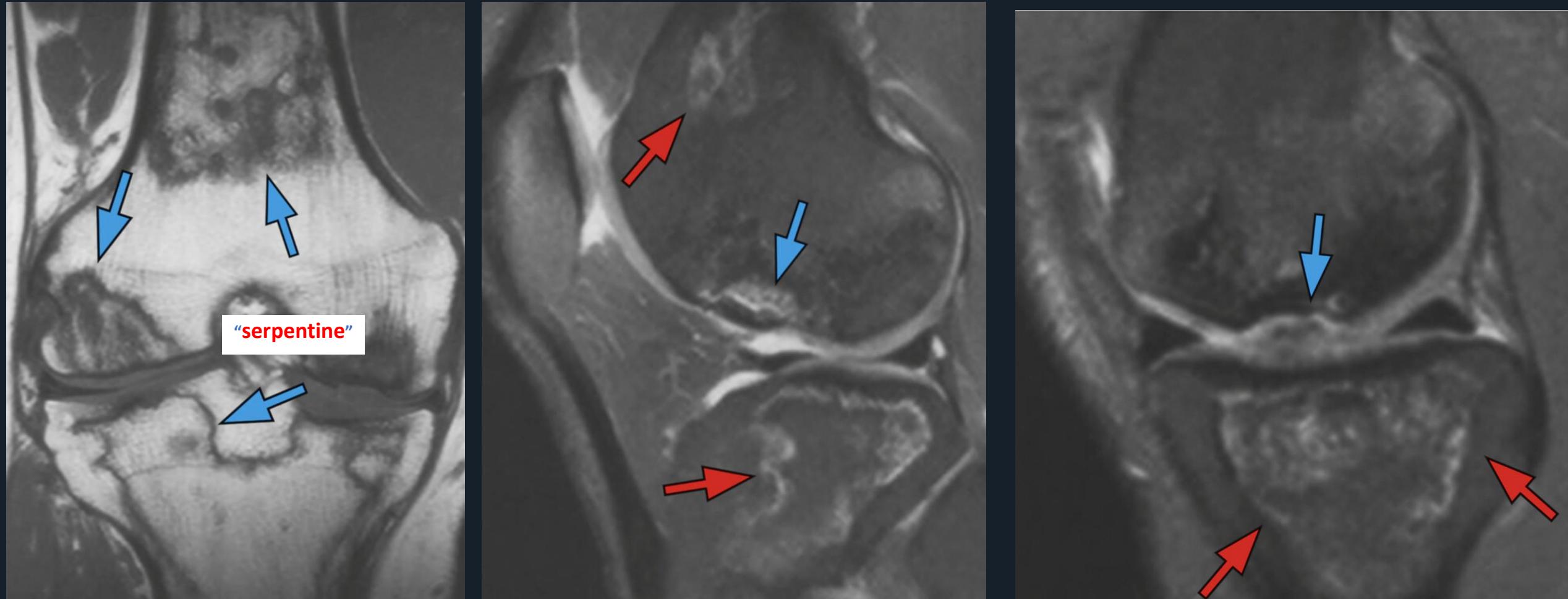
SIF



Worse prognosis



Osteonecrosis



32M (corticosteroids - leukemia)



Stress fx

AVN or TOH? A longstanding diagnostic dilemma

- It has been suggested that TOH is a precursor of AVN
(Trevisan, Clin Rheumatol 2002 & vande Bergh, Radiology, 1999)
- Most patients with TOH get a referral for signs of AVN
(Balakrishnan A et al. Can J Surg, 2003)

However...

- No progression to AVN of 155 patients with TOH
(Klontzas et al. EJR, 2015)
- No histological necrosis in cases with TOH
(Yamamoto, Skeletal Radiol, 1999)

Transient osteoporosis or avascular necrosis?

- Different **history** - acute onset of pain
- **Articular collapse**
 - in TOH = unsuccessful weightbearing
- Subchondral fractures in TOH **DO NOT** mean progression to AVN

*Korompilias et al. Skeletal Radiol 2009
Fujioka M et al. Magn Reson Imaging 2001
Kubo et al. Magn Reson Imaging 1997
Klontzas et al. Hip Int 2017*

Transient osteoporosis or avascular necrosis?

In AVN

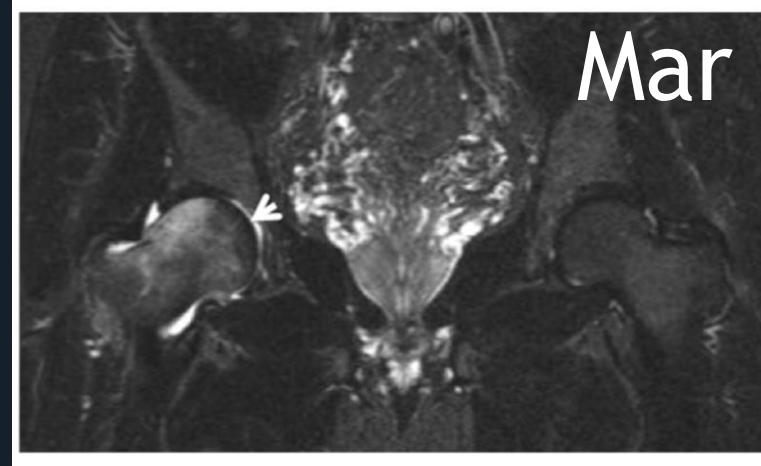
- Bilateral 70-90% - younger patient
- BME = **advanced AVN OR fibular graft failure**
- **BME is never found before band patterns**
- ARCO stage IV - BME = early stage osteoarthritis

*Korompilias et al. Skeletal Radiol 2009
Fujioka M et al. Magn Reson Imaging 2001
Kubo et al. Magn Reson Imaging 1997
Klontzas et al. Hip Int 2017*

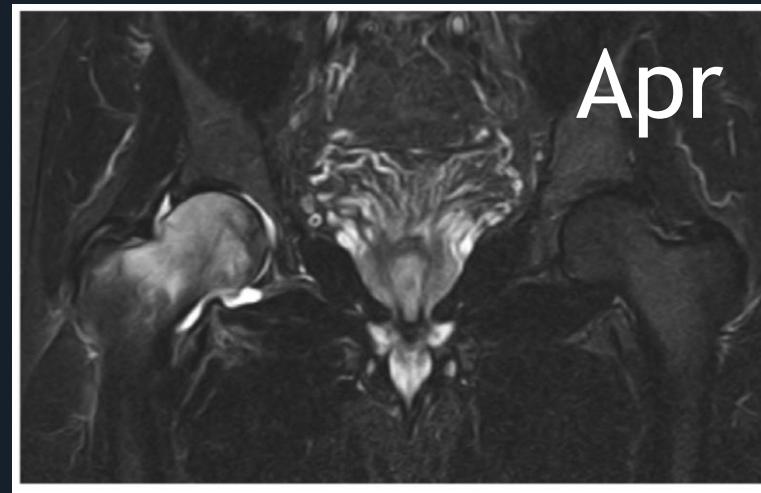
57-year-old male - knee pain



Nov

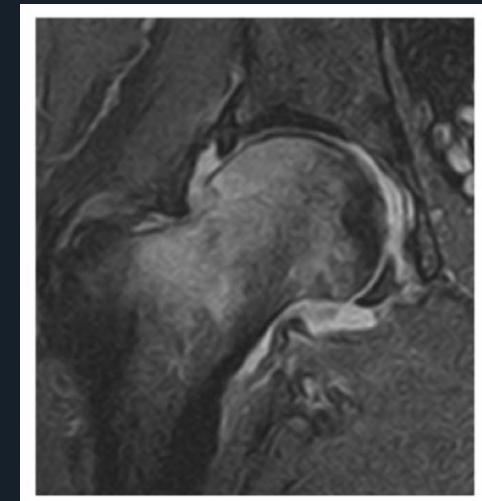


Mar



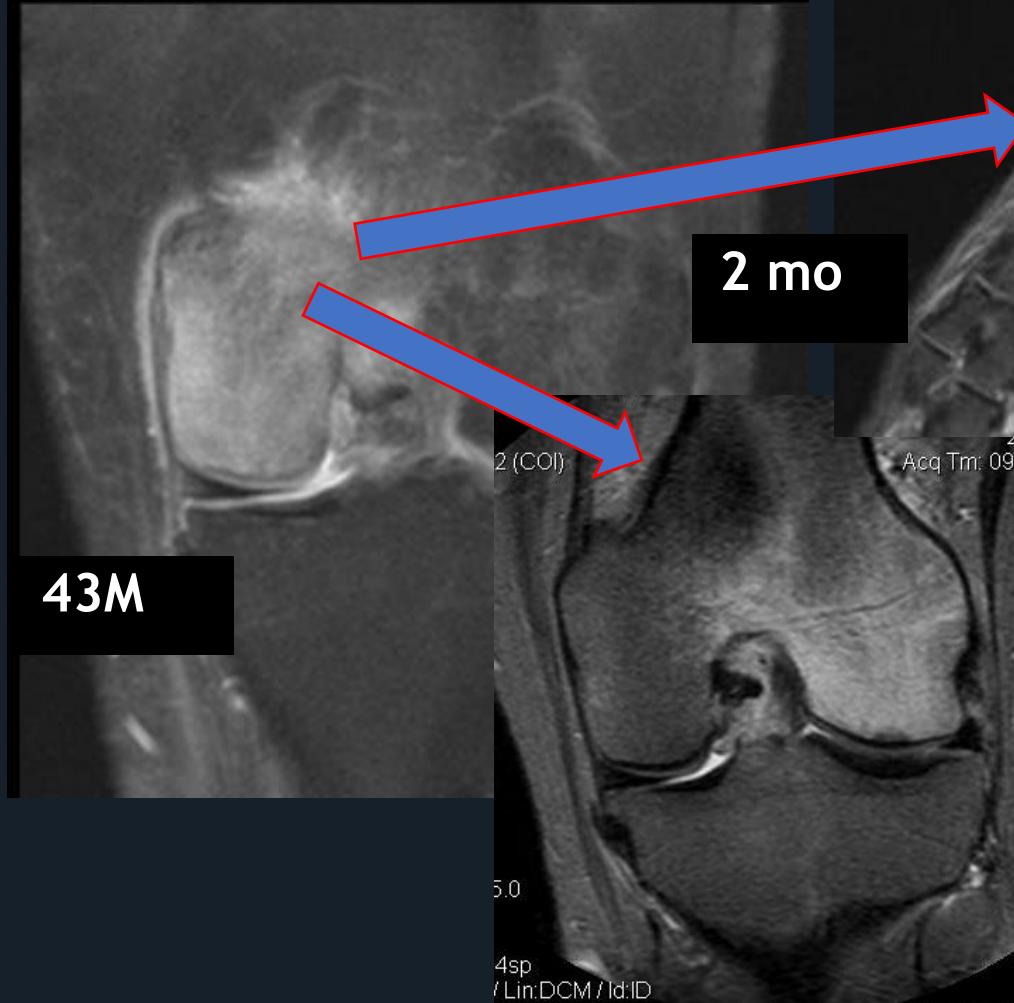
Apr

Regional
Migratory
Osteoporosis



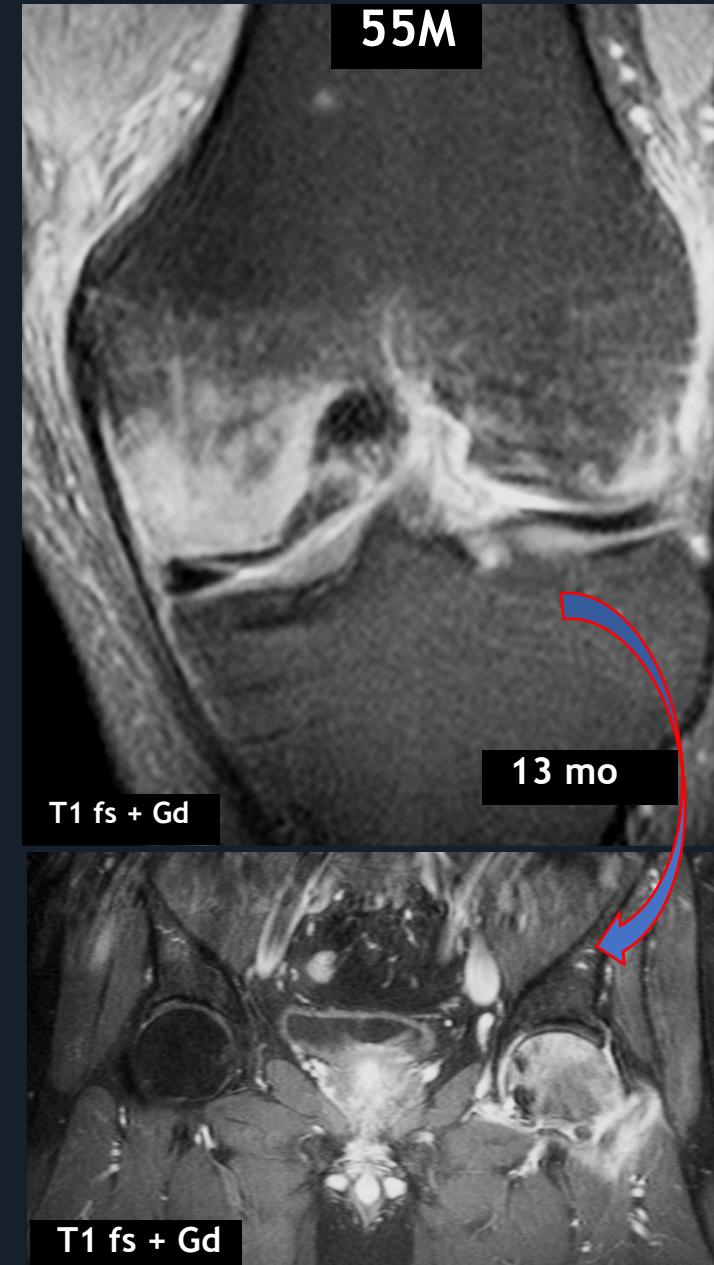
Klontzas, Vassalou, Zibis, Bintoudi, Karantanas. MR imaging of transient osteoporosis of the hip: An update on 155 hip joints, EJR (2015) 84:431-436

Regional Migratory Osteoporosis



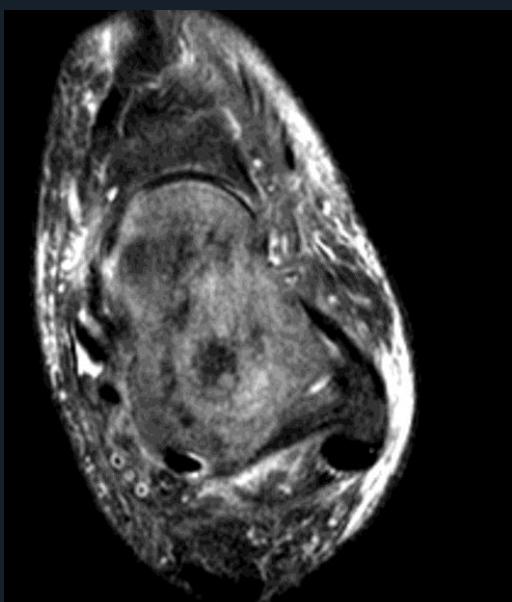
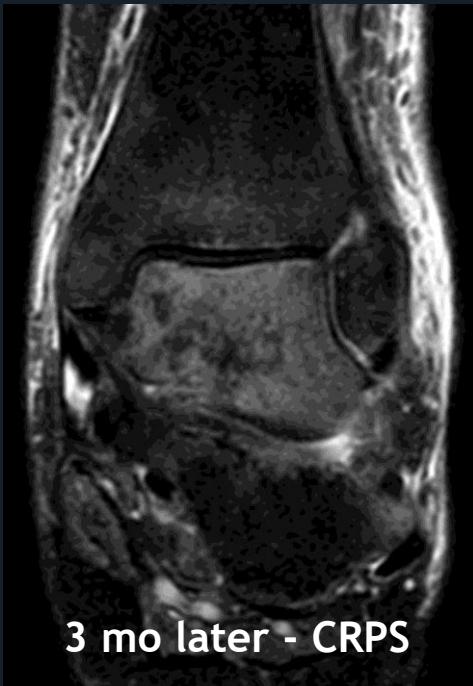
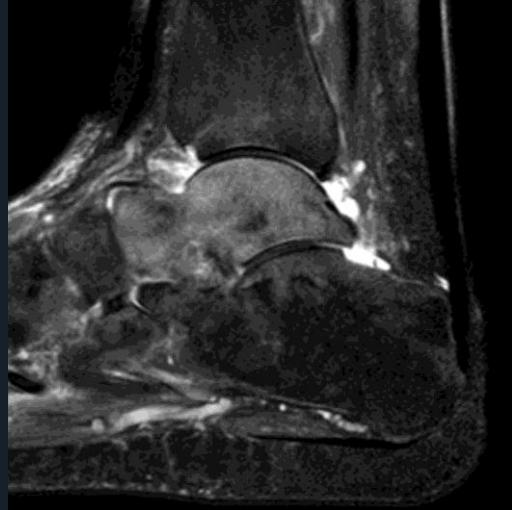
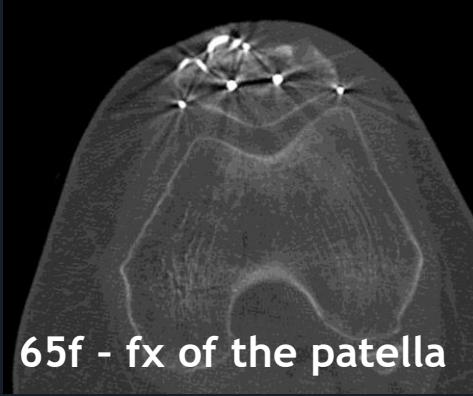
19.4% chance
for migration

Klontzas, Vassalou, Zibis, Bintoudi,
Karantanas. EJR (2015) 84:431-436



Complex regional pain syndrome

- Several names
 - Reflex sympathetic dystrophy
 - Algodystrophy
 - Sudeck syndrome
- Sustained sympathetic activity
- Excessive pain
- Usually following trauma & immobilization
- Chronic - Not self-limiting
- Soft tissue edema



Conclusions

- BME is non-specific
- Modality of Choice: **MRI**



T1



T1 + Gd



STIR,
Pd / T2 FS

History

Diagnosis

- SIFK does not progress to AVN
- Correct diagnosis = great impact on patient management



Thank you!!!