

# Bone marrow edema of the ankle and foot: overuse injuries and beyond

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# Bone marrow edema - differential diagnosis

**Overuse injuries**

**Avascular necrosis**

**Insufficiency fractures**

**Complex regional pain  
syndrome (CRPS)**

**Regional migratory  
osteoporosis (RMO)**

**Infection**

**Neoplasms**

**Major trauma**

**Degenerative/  
Inflammatory  
arthropathy**

**Impingement**

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- Definition - pathophysiology of BME
- Causes of BME
- Imaging
- Conclusions

# Microscopic - imaging features

Imaging Modality of Choice

MRI



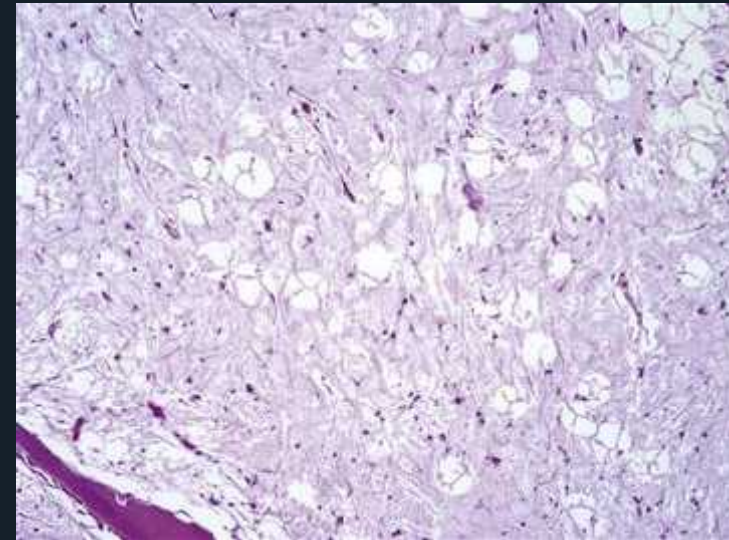
T1



T1 + Gd

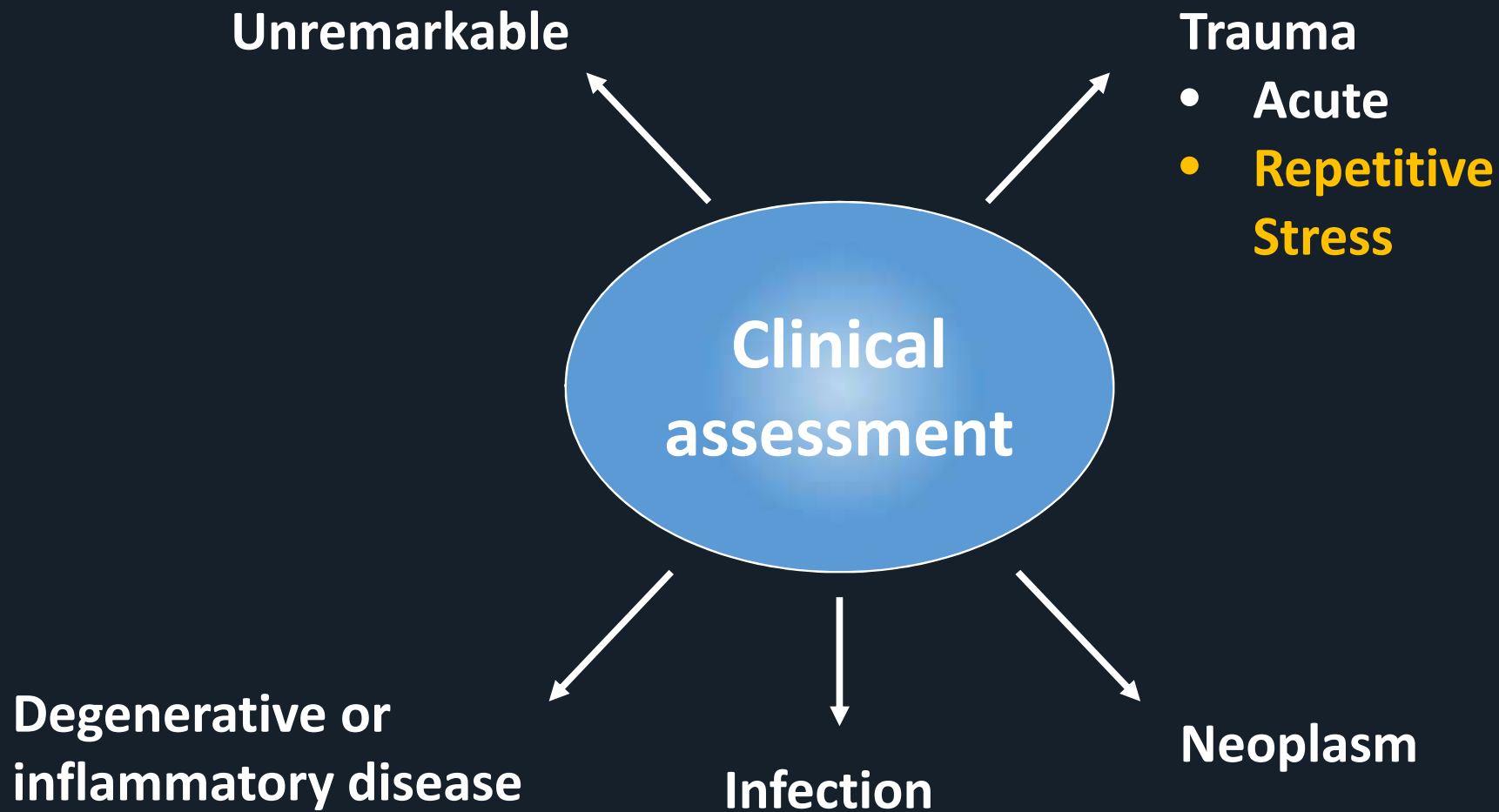


STIR,  
Pd / T2 FS



**Histopathologic features:**

- Eosinophilic material **(Liquid)** inbetween fat cells
- Engorged vessels
- Lipid vacuoles



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

# Questions

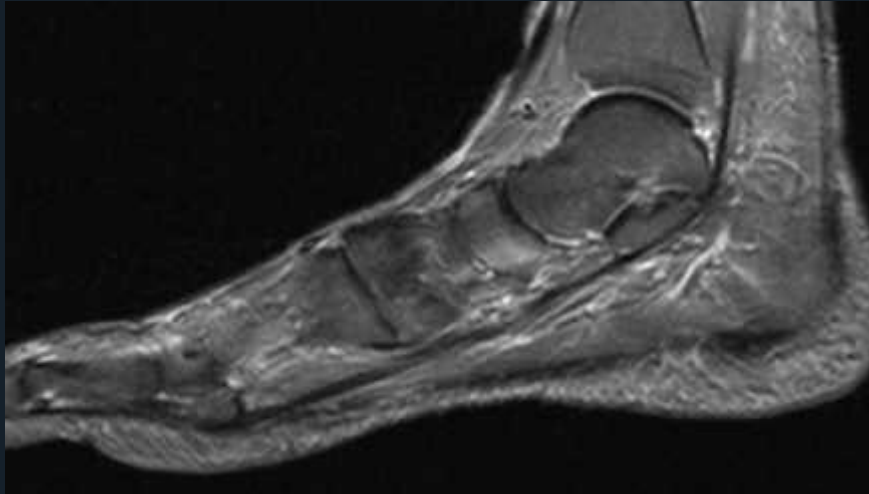
- Location?
- Multifocal?
- Acute or insidious onset of pain?

# Overuse injuries

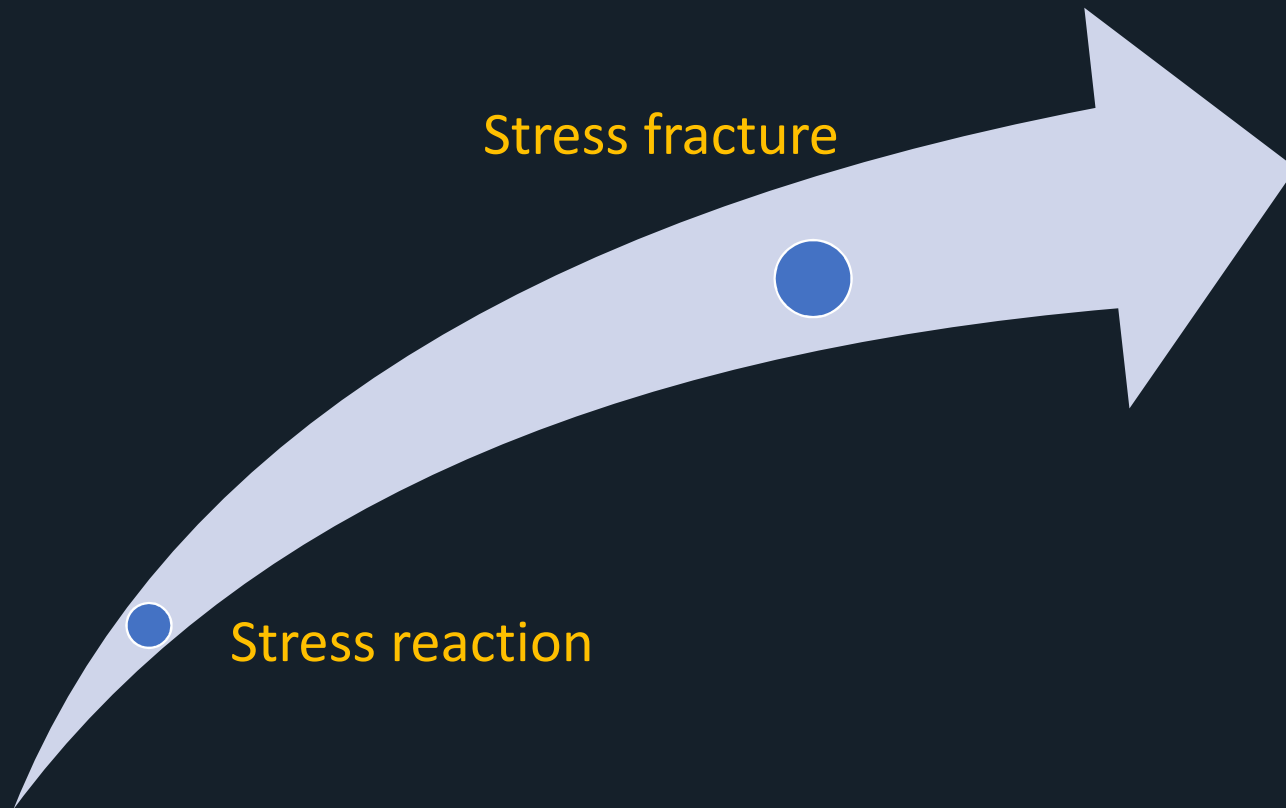
- ✓ Repeated minor trauma - **not enough** to cause tears/fractures
- ✓ Stress reactions - fractures
- ✓ Tendinopathies



# Stress reaction - navicular



# Metatarsal stress reaction - progression to fracture



# 56F - trekking

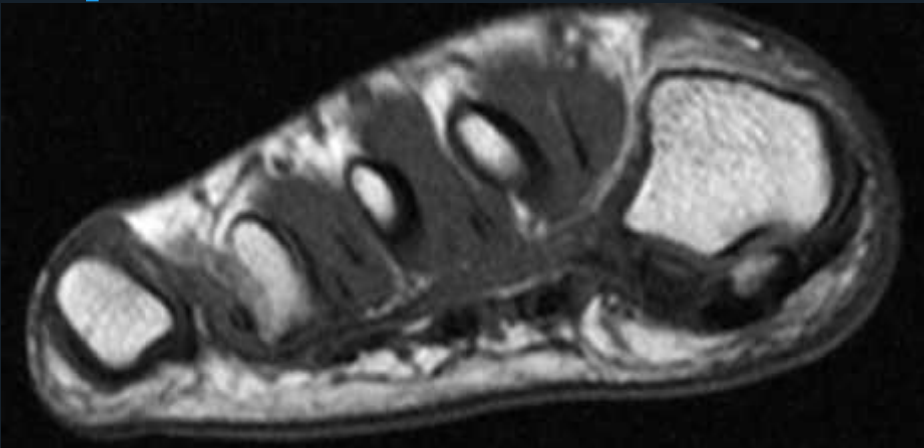
3w pain



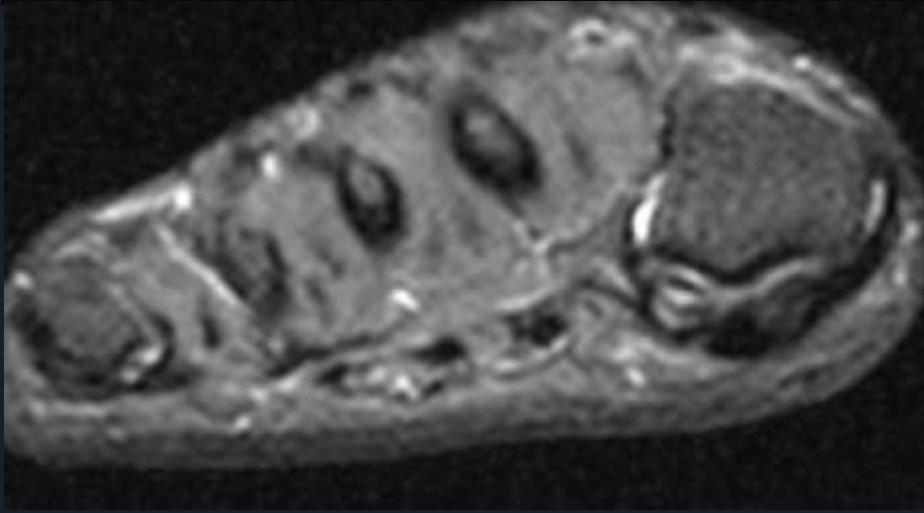
6w later



# 27 y/o military recruit - pain over 2 months



Sesamoid stress fx

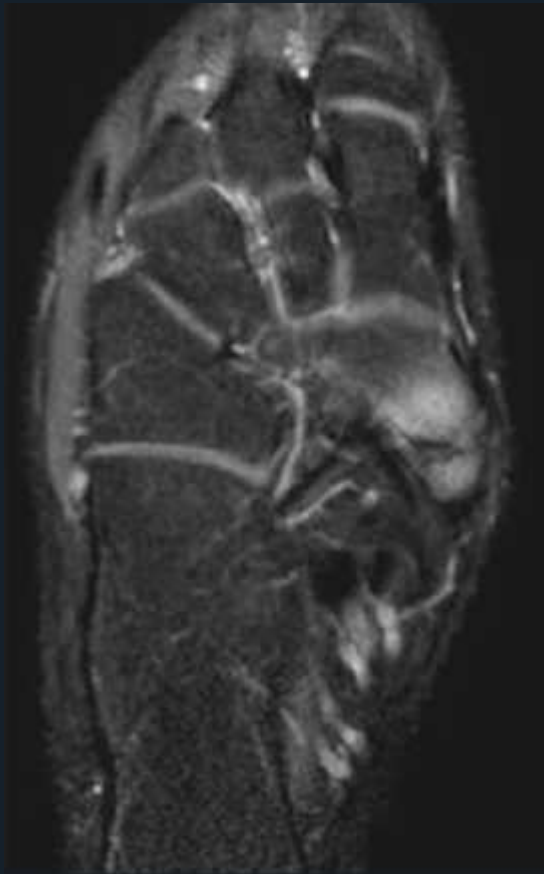


Pseudarthrosis

# Haglund's deformity



Szaro, Geijer, Solidakis, Insights Imaging 2020

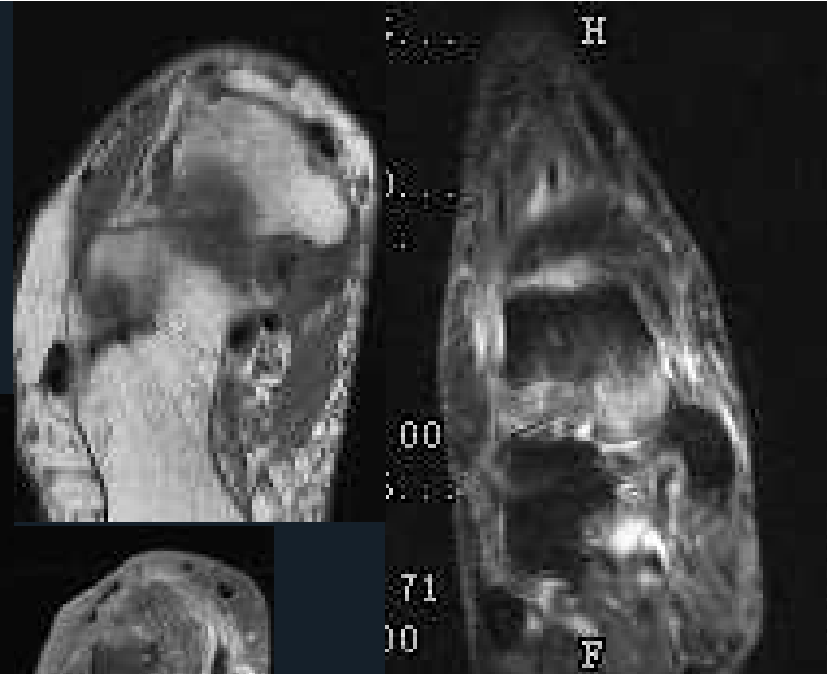
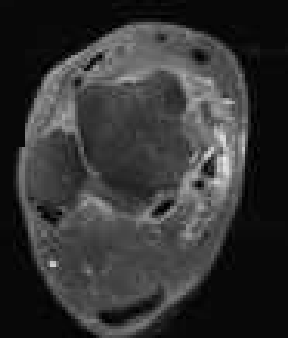
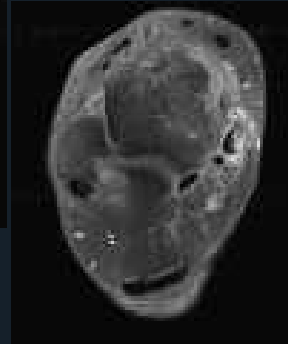
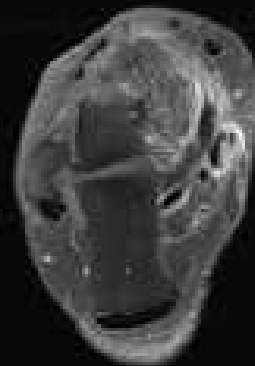
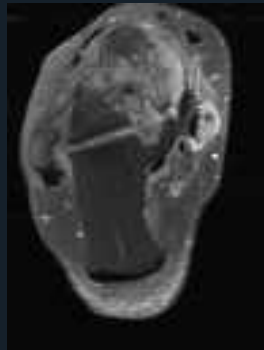
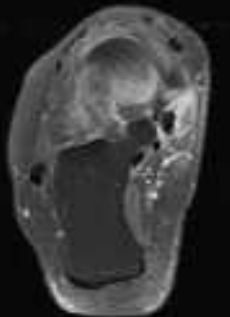
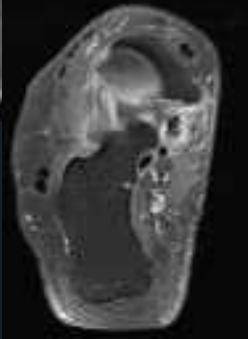
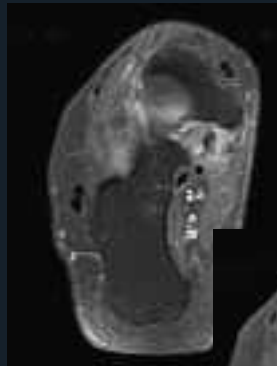


Painful os naviculare type II

# PTT dysfunction

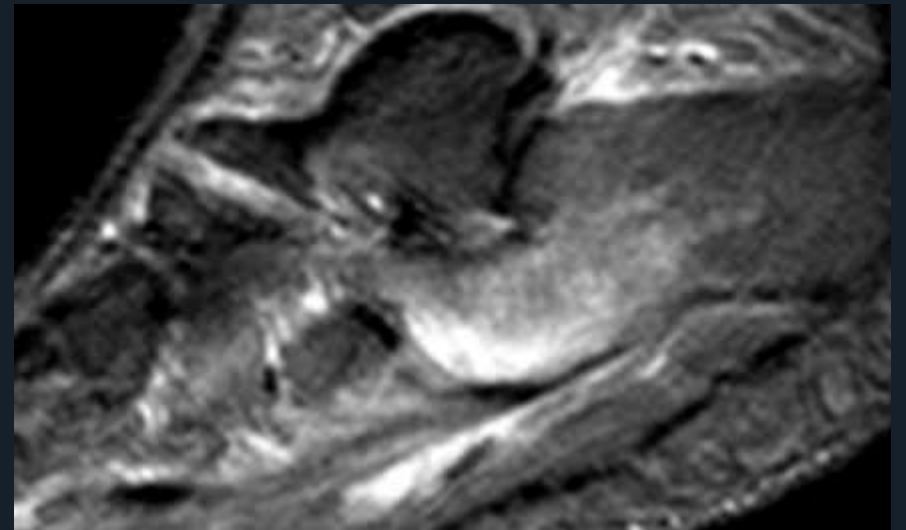
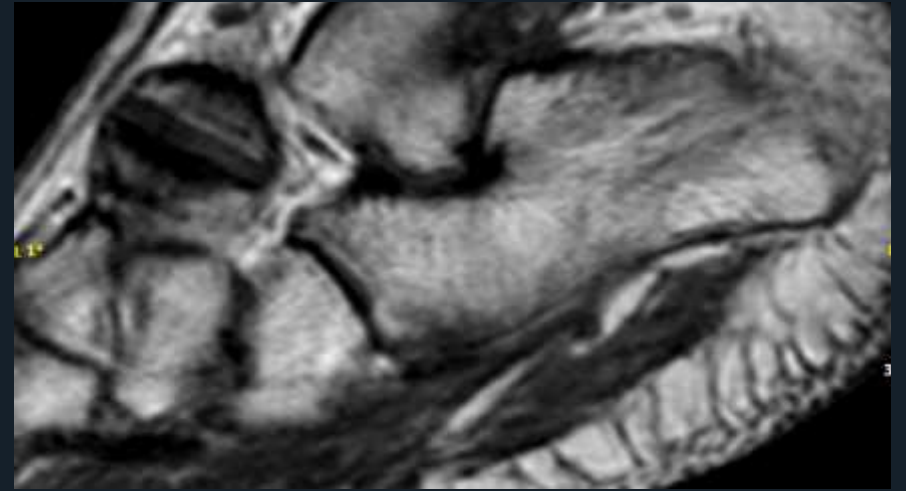
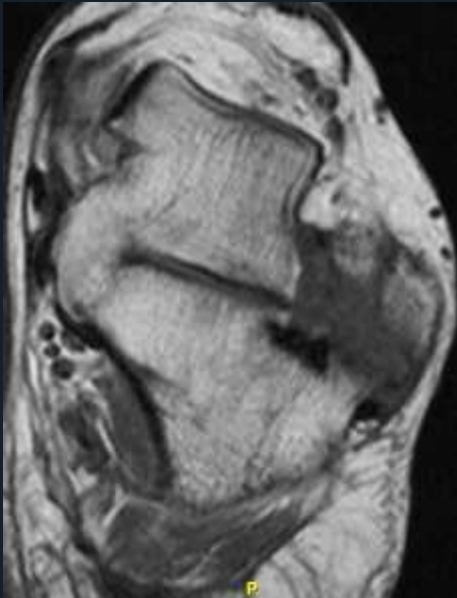
*pain 4m*

Tendon degeneration  
*Maltracking*



Gd

- Osseous talocalcaneal coalition  
biomechanics?
- Stress fx

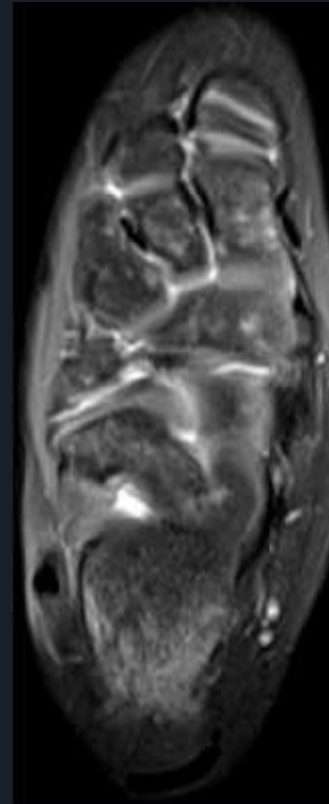




# 9 y/o pain over 9 months

- Chronic recurrent multifocal osteomyelitis
- Children - adolescents
- **Exclusion diagnosis**
  - No infection

**TAKE CARE OF NORMAL VARIANTS**



# Bone marrow edema syndrome

- Insufficiency fracture (**acute**)
- Regional migratory osteoporosis (**acute**)
- Complex regional pain syndrome (**chronic**)

*Hoffman S et al. Orthop Clin N Am 2004*

# Bone marrow edema syndrome

- 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



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

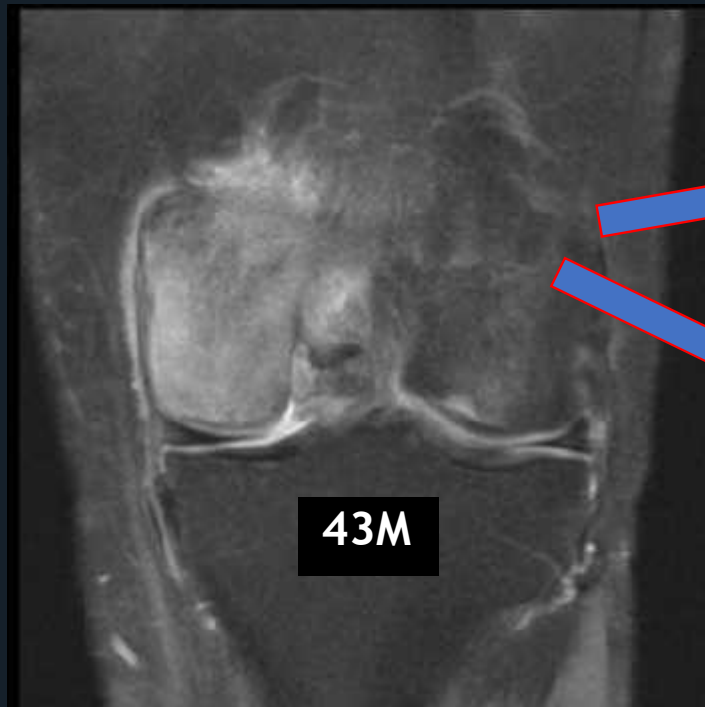
# Insufficiency fracture

- **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

# Regional Migratory Osteoporosis




2 mo



19.4% chance for migration

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

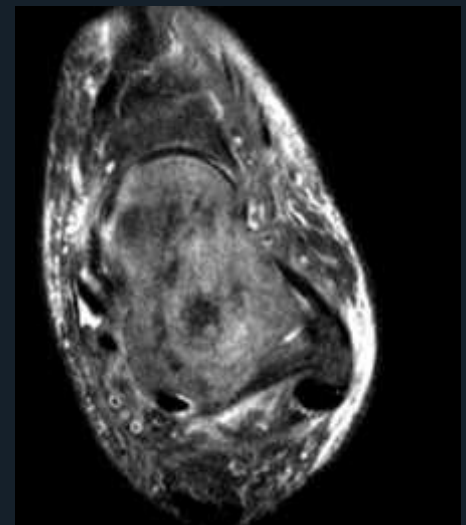
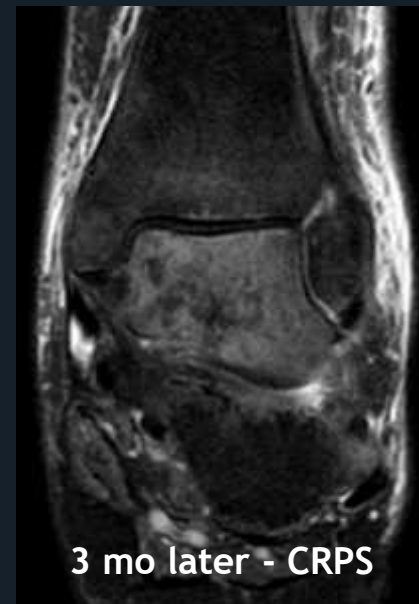
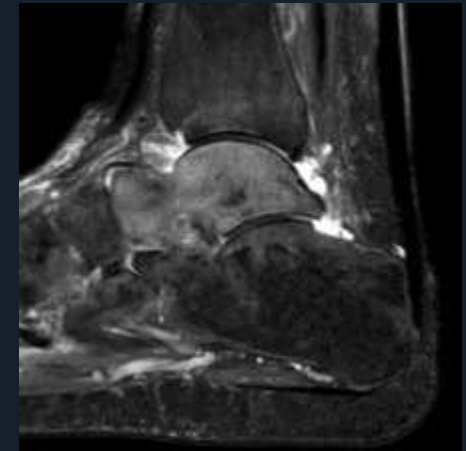
# Bone marrow edema syndrome

- Self-limited (transient) 
- Healing: ~ 12 months
- Plain films: -, (20% osteopenia in 4-8 weeks)
- **Osteoporosis or osteopenia on DEXA**

(Klontzas et al. EJN 2015)

# 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



# Clinical diagnosis

- Budapest Criteria



All of the following criteria must be met:

- Continuing pain that is disproportionate to the inciting event
- 1 sign in 2 or more of the categories below
- 1 symptom in 3 or more of the categories below
- No other diagnosis can better explain the signs and symptoms

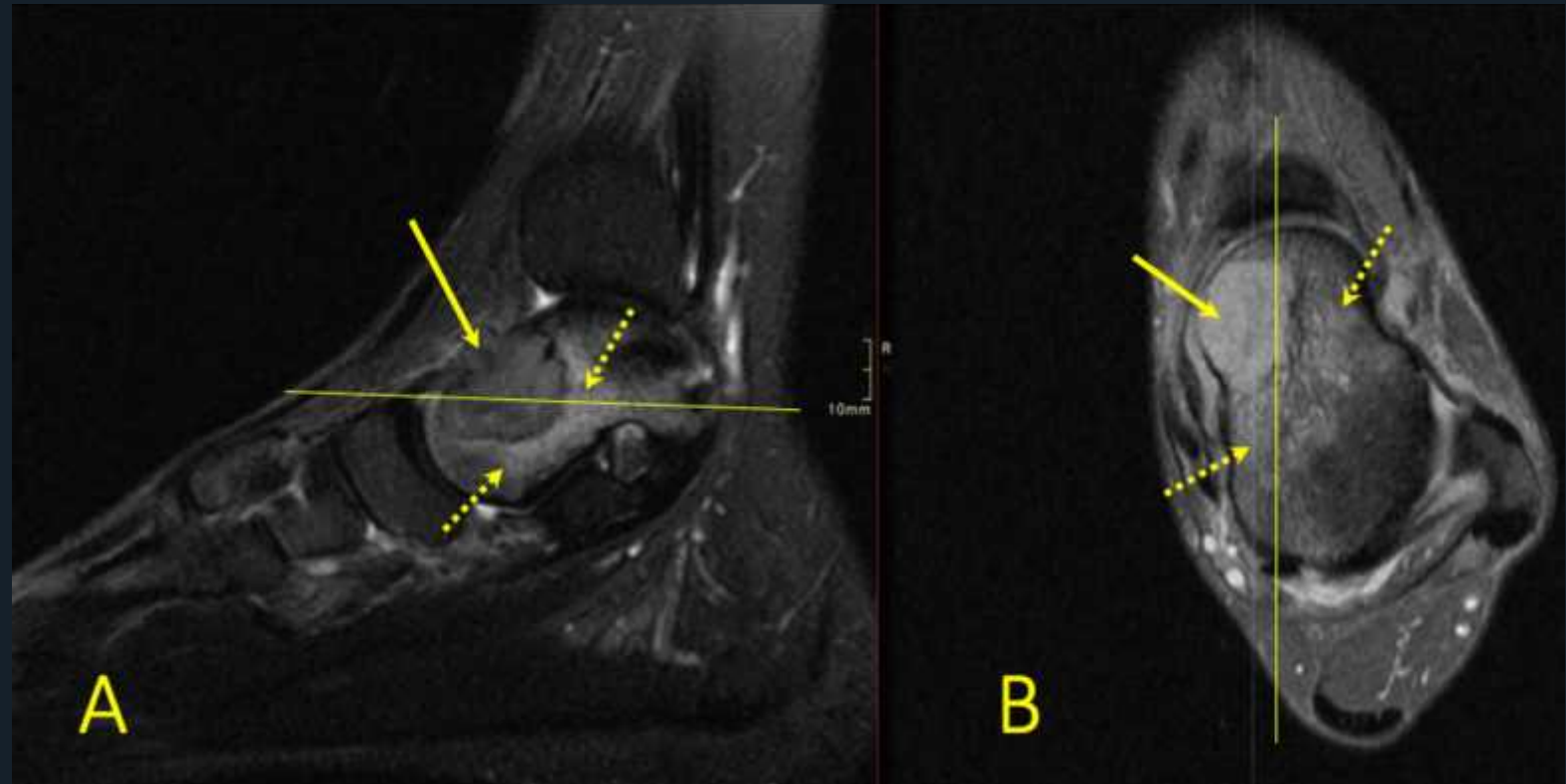
Category	Signs/Symptoms
<b>Sensory</b>	Allodynia (pain to light touch or temperature sensation and/or deep somatic pressure and/or joint movement) and/or hyperalgesia (to pinprick)
<b>Vasomotor</b>	Temperature asymmetry and/or skin color changes and/or skin color asymmetry
<b>Sudomotor/Edema</b>	Edema and/or sweating changes and/or sweating asymmetry
<b>Motor/Trophic</b>	Decreased range of motion and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin)

50% of CRPS - no BME  
 ???????????????



# 28 y/o male - 3 months pain

- GCT

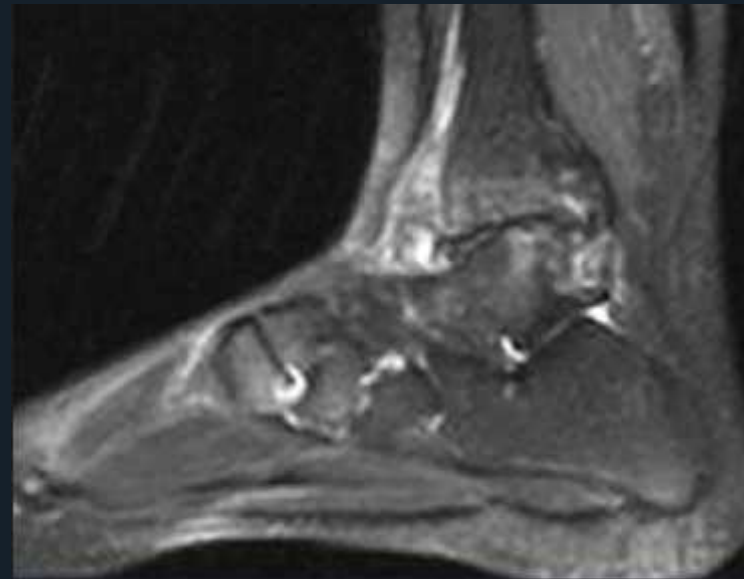


# Arthropathies

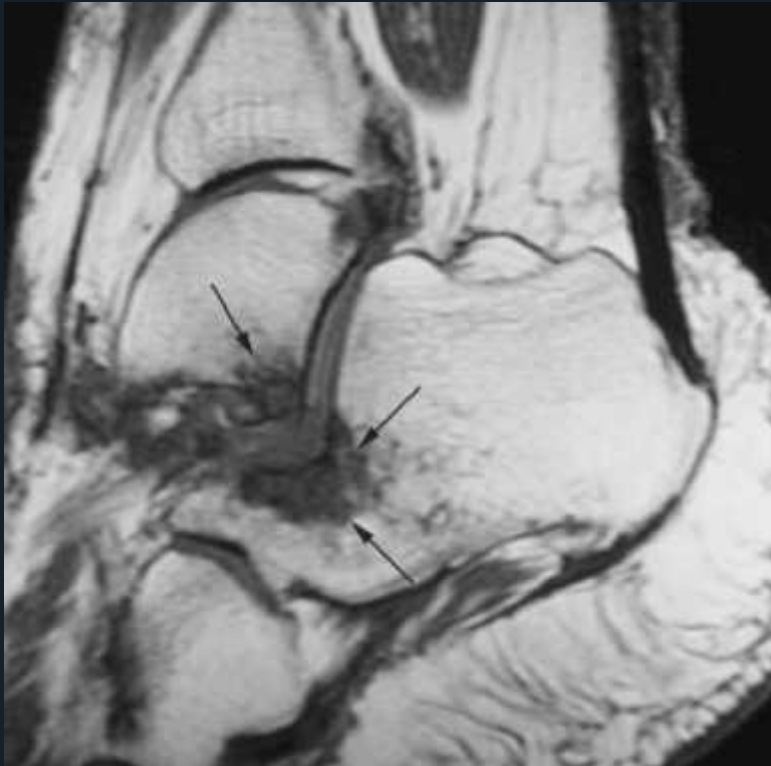
- ✓ Osteoarthritis
- ✓ Rheumatoid arthritis
- ✓ Gout
- ✓ Psoriatic arthritis
- ✓ Neuropathic
- .....

## OA - 24F

- Post-traumatic
- Early onset
- Tri-malleolar fracture



# Rheumatoid arthritis



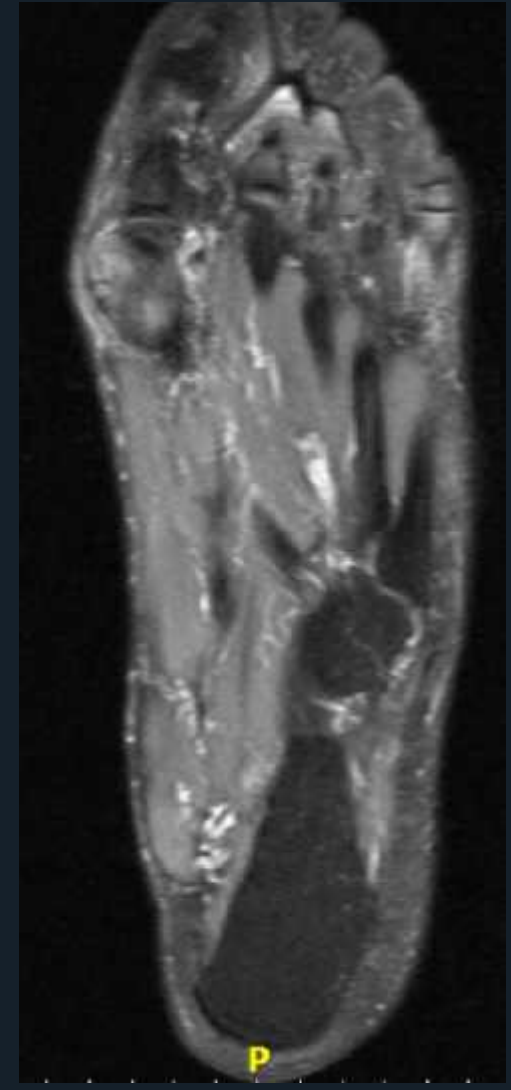
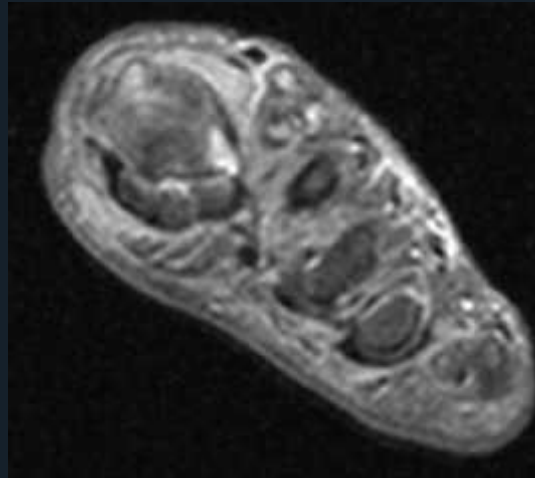
## Sinus tarsi syndrome in RA

- 5% of non-flat feet
- 75% of flat feet

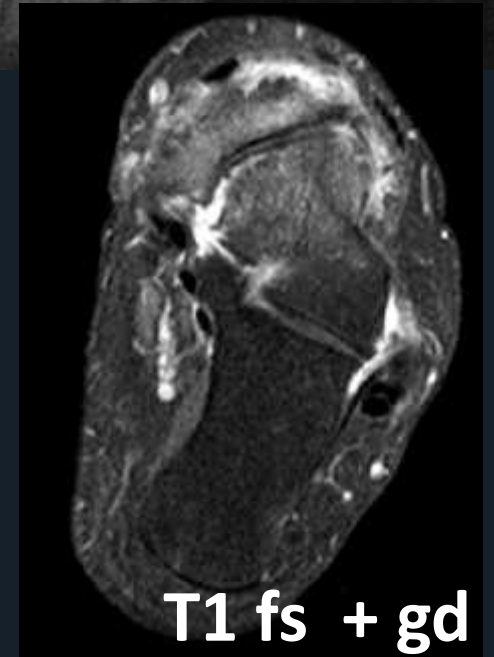
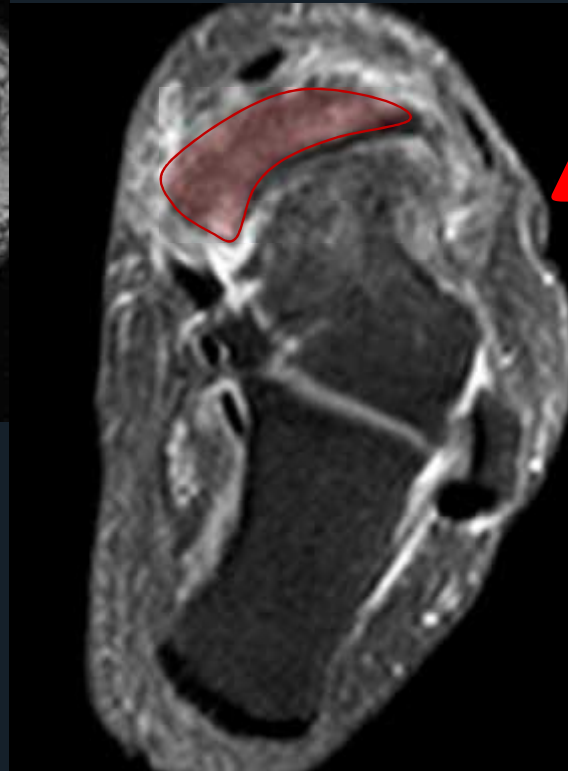
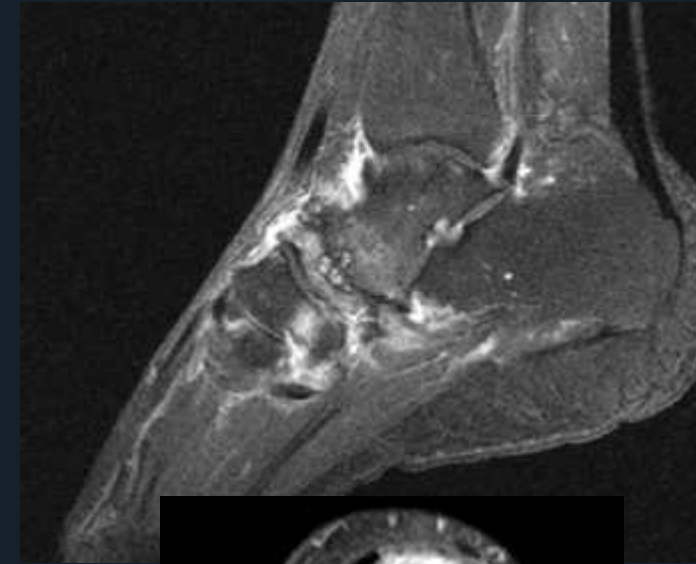
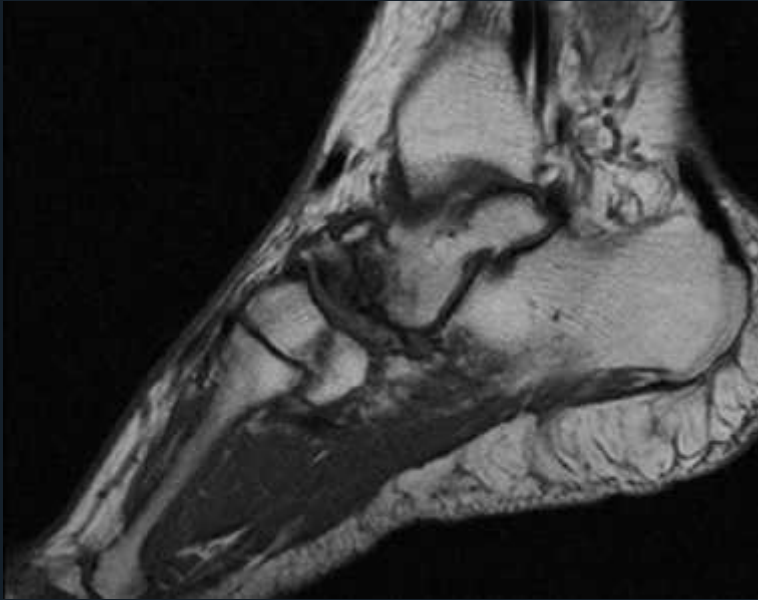
# 50 y/o male

- Acute pain
- Inflamed 1<sup>st</sup> MTP joint

GOUT



60F Insidious onset of pain  
- midfoot (no trauma)



T1 fs + gd

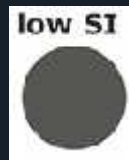
**Mueller Weiss syndrome**

Navicular osteonecrosis

40-60 y/o F

# Conclusions

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



T1



T1 + Gd



STIR,  
Pd / T2 FS

History

Diagnosis



A scenic view of a coastline with rocky cliffs and a deep blue sea under a blue sky with light clouds. The text "Thank you!!!" is overlaid in the center.

**Thank you!!!**