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Tibial Osteomyelitis: Diagnostic MRI Imaging and Pathogenesis

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Learning Objectives

- Clinical presentation and physical exam findings of osteomyelitis
- Classical findings in plain film and MRI
- Pathophysiology and common microorganisms of osteomyelitis



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Our patient: History

- 82 F presents to the ED with worsening **knee pain**
- Fall 2 months ago -> progressing R knee pain -> difficulty ambulating
- **Nursing home resident**, walks with a walker at baseline
- PMH: dementia, DVT, a fib, HTN, UC s/p ileostomy
- Soc: No smoking or drugs, occasional EtOH
- Temp: **99.4**, BP: 112/61, HR: 83, RR: 18, O2%: 96% RA
- PE: **Erythema and warmth** in right knee, painful to palpation, **fluctuance**, old **cuts** around posterior fossa



Our Patient: Lab findings

- WBC: 5.7
- Cr: 0.6
- INR: 2.3
- CRP: 65.5
- ESR: 105
- Cultures pending



Our Patient: Brief Summary

- R knee pain
- Nursing home resident
- T: 99.4
- History of fall + cuts around knee
- Erythema and warmth
- Fluctuance
- Increased ESR, CRP



Our Patient: Differential Diagnosis

- High:
 - Osteomyelitis
 - Septic Arthritis
 - Cellulitis
 - Tumor
- Low
 - Reactive Bone Marrow Edema
 - Trauma
 - DJD
 - Gout



Learning Objectives

- ✓ Clinical presentation and physical exam findings of osteomyelitis
- Classical findings in plain film and MRI
- Pathophysiology of and common microorganisms osteomyelitis



Choice of imaging

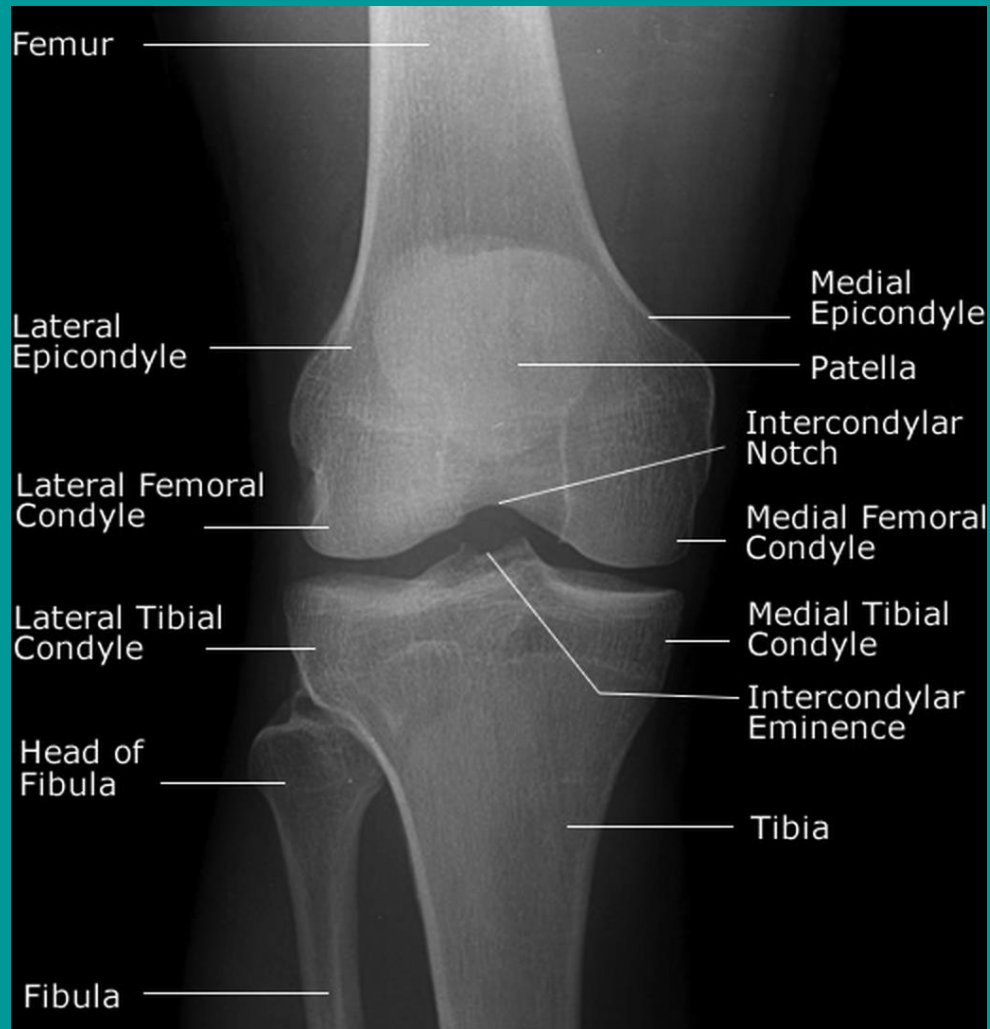
- Plain Film Sensitivity: 43-75%, Specificity: 75-83%
- CT Scan Sensitivity: 67%, Specificity: 50%
- MRI Sensitivity: 82-100%, Specificity: 75-96%
- Ultrasound TBD
- Bone Scintigraphy
 Sensitivity: 60%, Specificity: 80%



Choice of imaging

- Plain Film
- CT Scan
- MRI
- Ultrasound
- Bone Scintigraphy

Normal Anatomy of the Knee





Our Patient: Plain Radiograph



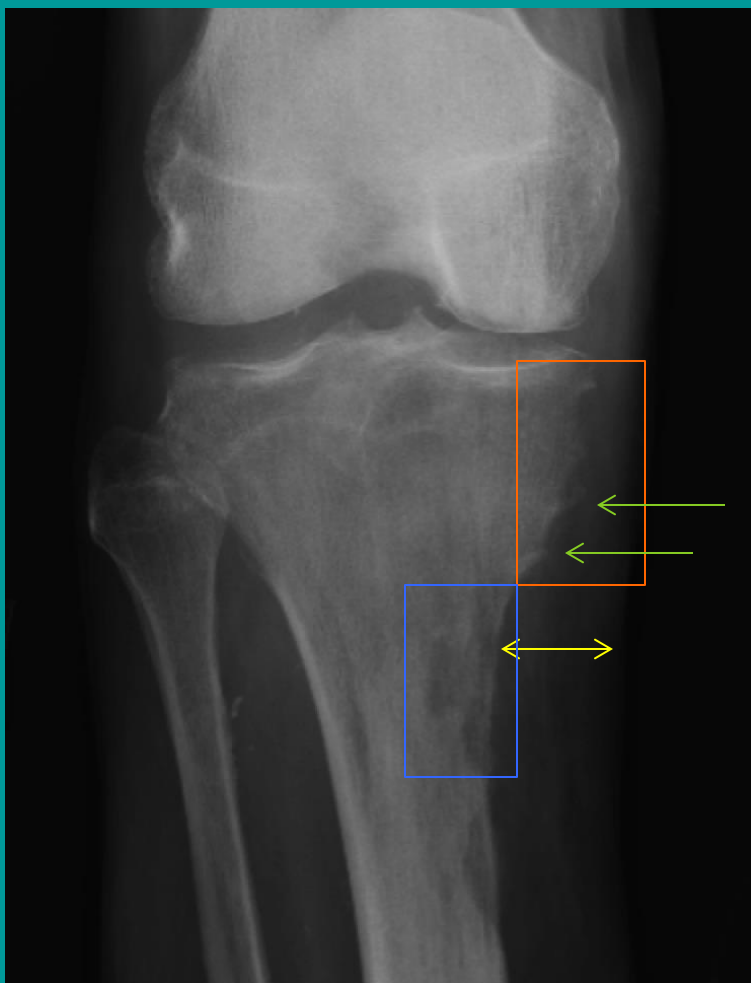
AP



Cross Table Lateral



Our Patient: Radiograph Highlights



Radiographic Findings:

- Cortical destruction/erosion
- Periosteal reaction
- Soft tissue swelling
- Ill defined area of lucency

Plain Radiograph: AP View



Our Patient: Differential Diagnosis

- High:
 - Osteomyelitis
 - ~~Septic Arthritis~~
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 - Tumor
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 - Gout

Next Step in Imaging

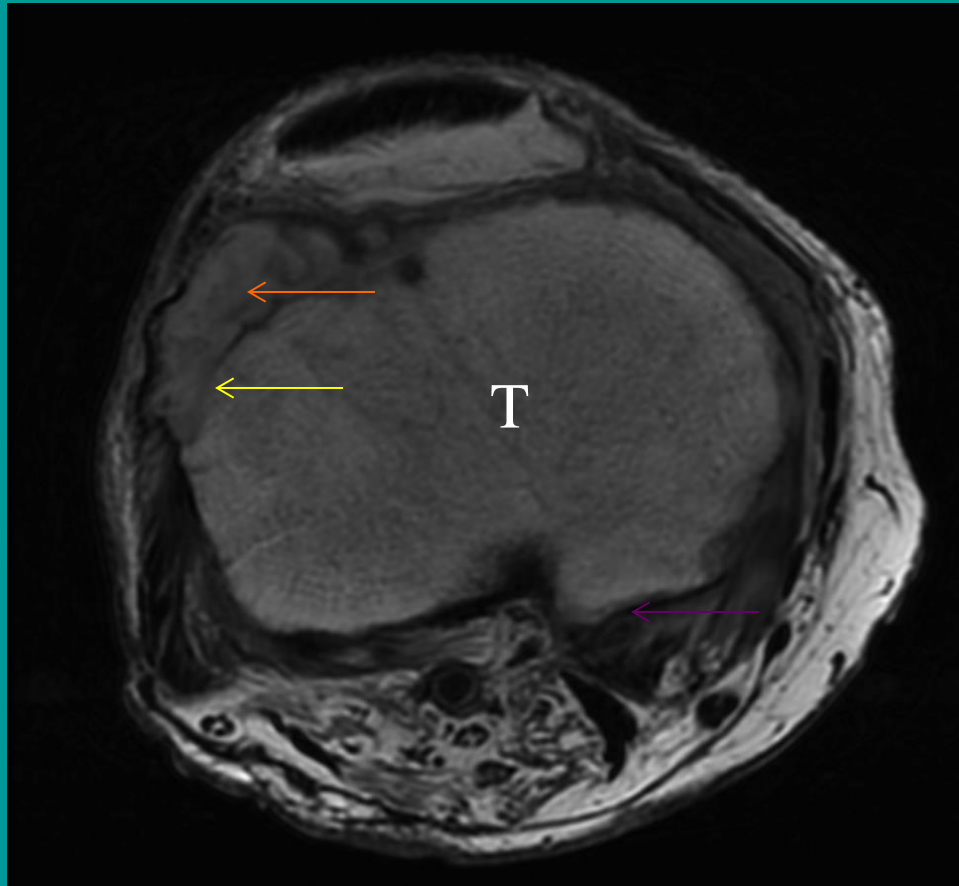
MRI

Interpreting a T2 C- MRI

Object	Color
Air	Dark
Edema (fluid)	Light
Blood	Dark
Bone (cortex)	Dark
Bone (marrow)	Light
Fat	Light



Our Patient: T2 MRI Findings



Radiographic Findings:

- Tissue enhancement
- Cortical destruction
- Normal Cortex

Axial T2 C- MRI

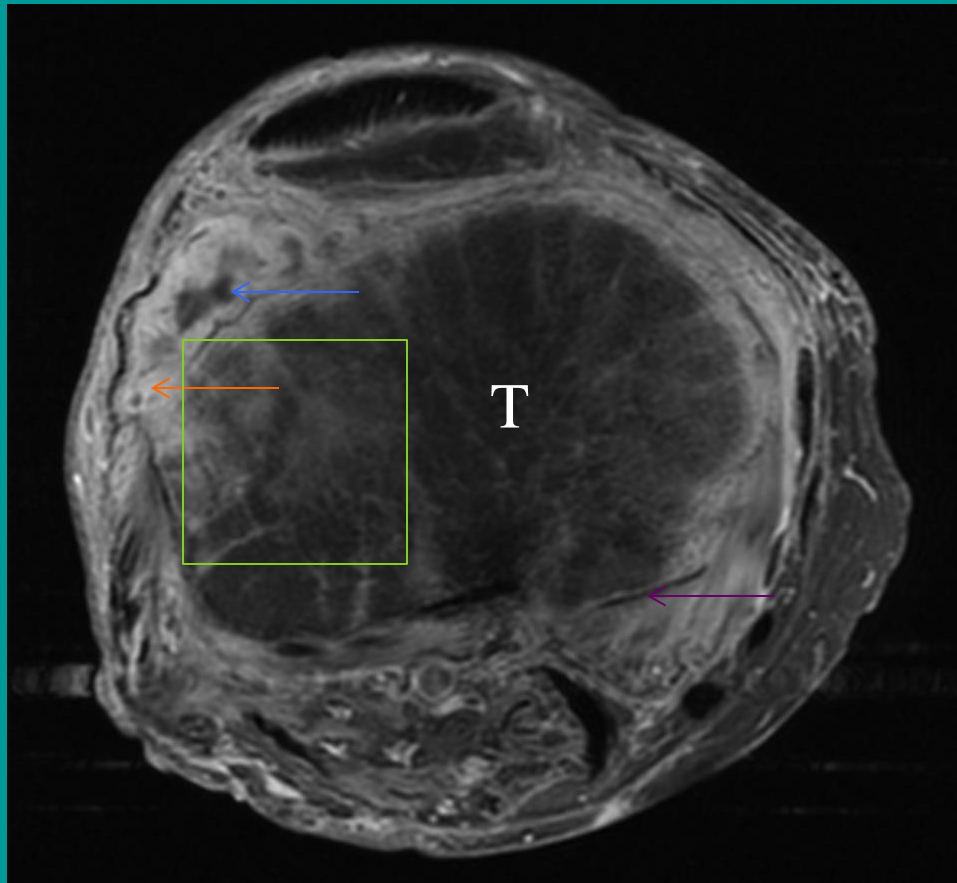


Interpreting a T1 FS C+ MRI

Object	Color
Air	Dark
Edema (fluid)	Dark
Blood	Light
Bone (cortex)	Dark
Bone (marrow)	Dark
Fat	Dark



Our Patient: T1 MRI Findings



Radiographic Findings:

- Non-enhancing fluid with thick rim enhancement
- Tissue enhancement
- Increased signal intensity in bone
- Normal Cortex

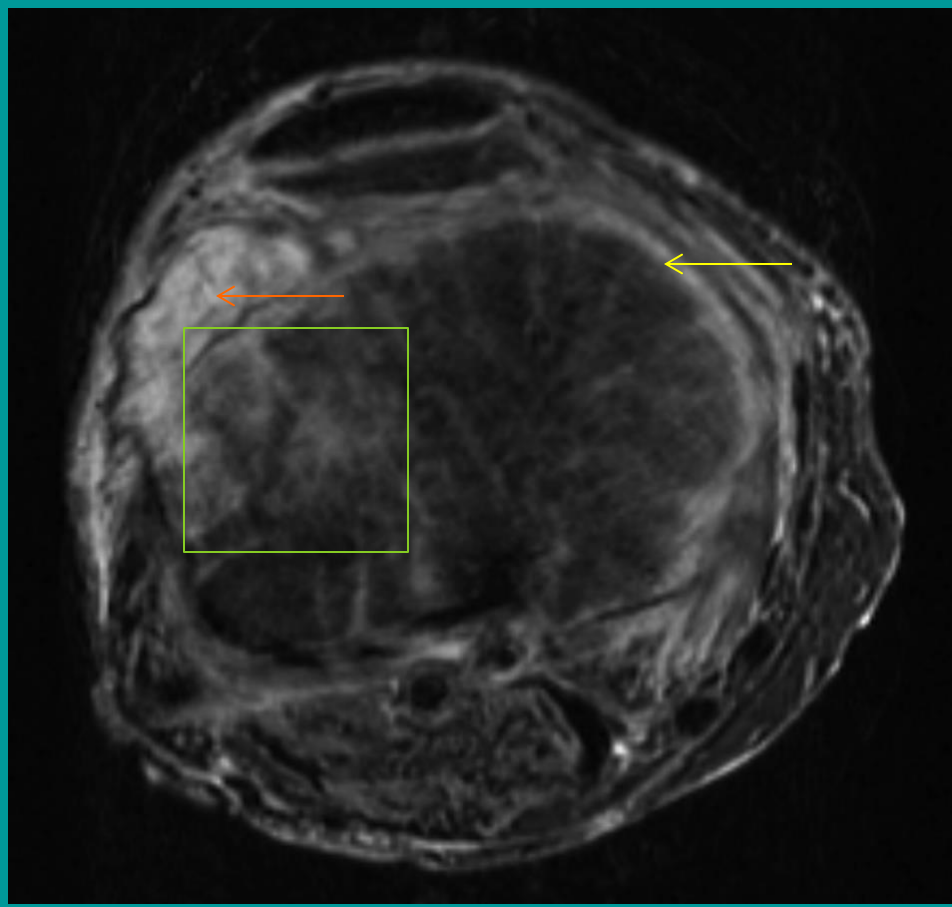
Axial T1 FS C- MRI

Interpreting STIR MRI

Object	Color
Air	Dark
Edema (fluid)	Light
Blood	Dark
Bone (cortex)	Dark
Bone (marrow)	Dark
Fat	Dark



Our Patient: STIR MRI Findings



Radiographic Findings:

- Fluid collection
- Periosteal edema
- Edema

Axial STIR MRI



Our Patient: Review of Radiological Findings

- Plain Film
 - Cortical destruction
 - Periosteal reaction
 - Soft tissue swelling
 - Areas of lucency
- MRI
 - Abscess (loculated)
 - Cortical erosion
 - Periosteal edema
 - Bone marrow edema



Our Patient: Next Steps?

- Tissue biopsy
- Bacterial cultures
- Debridement
- Bone biopsy to rule out tumor



Our Patient: CT S/P Debridement



Axial CT

Radiographic Findings:

- Evacuated Bone

Physical Findings in Surgery:

- Pockets of necrotic tissue
- Scalloped areas of proximal tibia



Our Patient: Pathology Results

- Bone:
 - Acute inflammation
 - Granulation tissue
- Blood culture:
 - Negative
- Tissue culture:
 - *Pseudomonas aeruginosa*



Our Patient: Differential Diagnosis

- High:
 - Osteomyelitis
 - ~~Septic Arthritis~~
 - ~~Cellulitis~~
 - ~~Tumor~~
- Low
 - ~~Reactive Bone Marrow Edema~~
 - ~~Trauma~~
 - ~~DJD~~
 - ~~Gout~~

Our Patient: Outcome

- Managed with antibiotics (IV cefepime BID for 6 weeks)
- Recovery: able to ambulate with a walker + improvement in strength
- No recurrence as of 2 months



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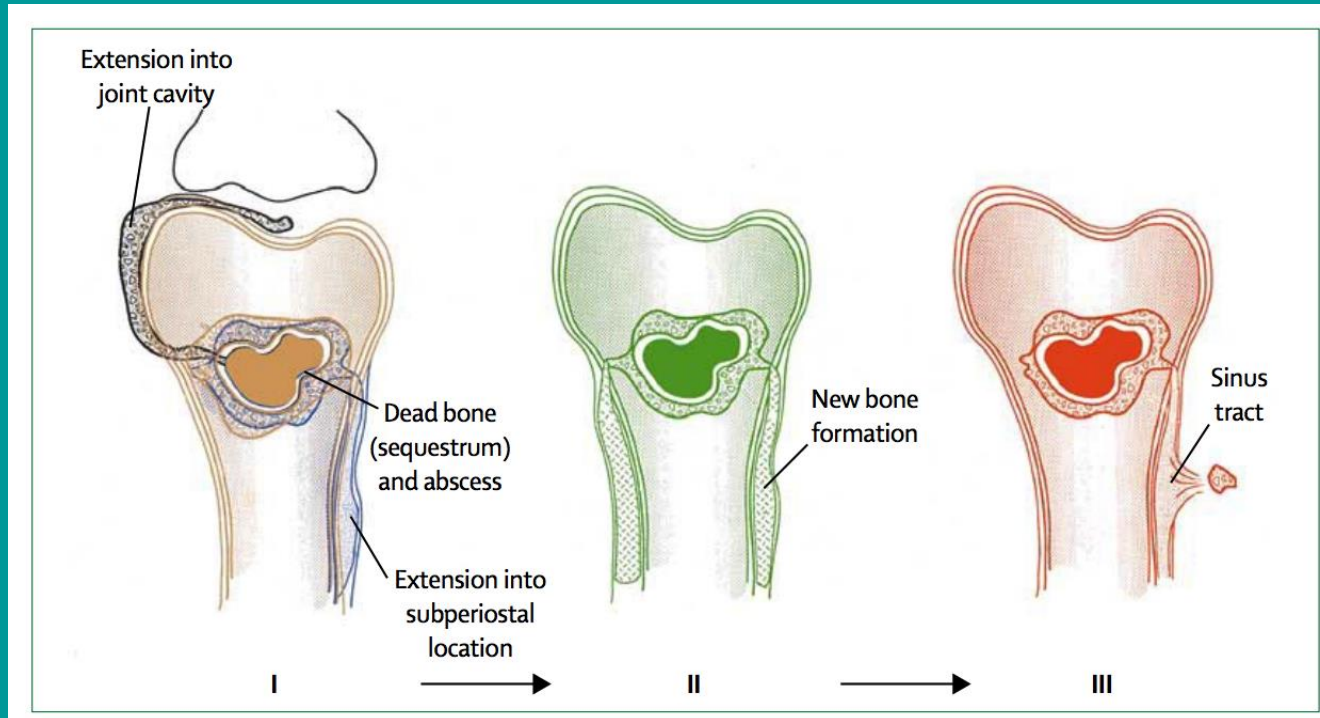


Osteomyelitis: Initiation

- Hematogenous seeding
 - Children/elderly patients
- Contiguous spread
 - Trauma, surgery, prosthetics
- Vascular insufficiency
 - Diabetics, vascular insufficiency



Osteomyelitis: Pathogenesis



1. Infection

Lew DP and Waldvogel FA. Osteomyelitis. Lancet. 2004; 364(9431):369.

2. Inflammation

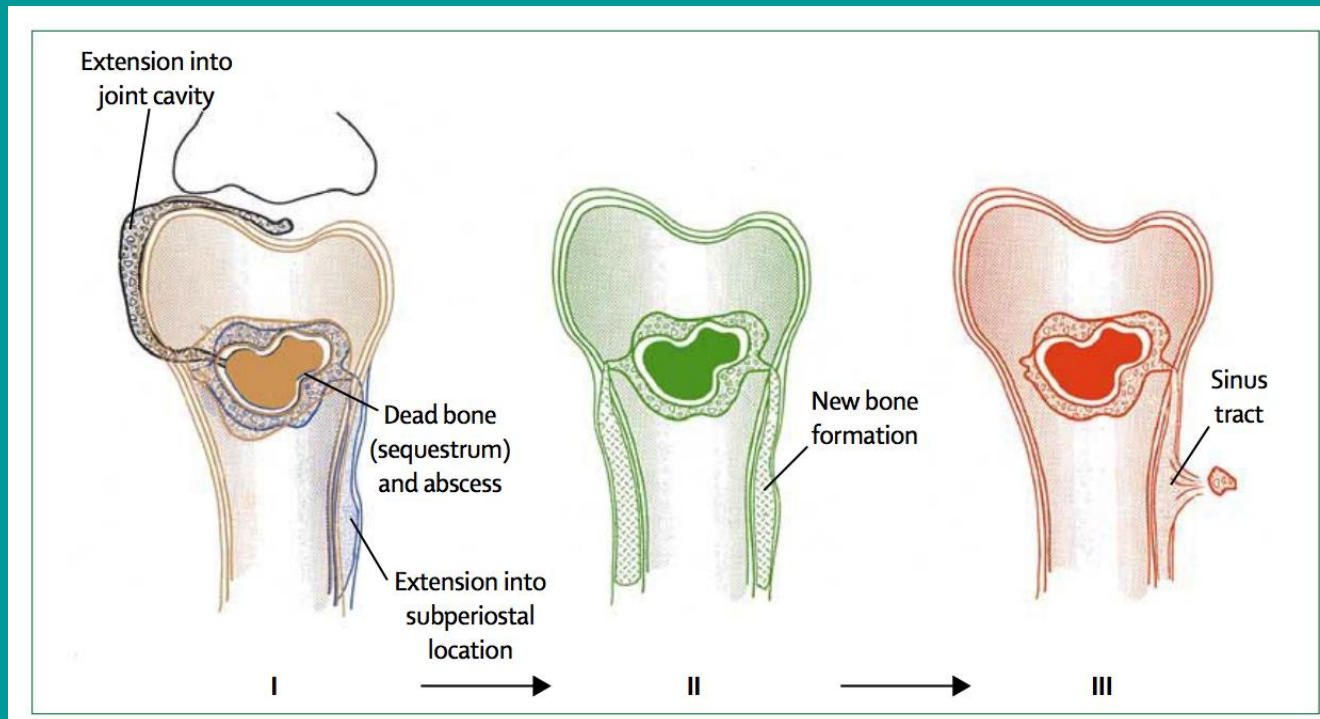
1. Reactive hyperameia -> osteoclastic activity

2. Destruction of soft tissue -> decreased vascular supply to bone

3. Extension into cortex



Osteomyelitis: Pathogenesis



Lew DP and Waldvogel FA. Osteomyelitis. *Lancet*. 2004; 364(9431):369.

4. Areas of dead bone (sequestra)
5. New bone formation at periphery
6. Sinus tract formation



Osteomyelitis: Differentiating Acute vs. Chronic

- Acute
 - Several days to weeks
 - Acute inflammation
- Chronic
 - Weeks to years
 - Low-grade inflammation
 - Presence of dead bone (sequestrum)
 - Sinus tracts
 - Relapses



Osteomyelitis: Common Organisms

Organism	Association
S. Aureus	Most frequent; adhesins
S. Epidermis	Foreign bodies
P. Aeruginosa	Puncture wound
Anaerobes	Fist to tooth; diabetic ulcer
Salmonella	Sickle cell disease
Pasteurella	Bites
M. Tuberculosis	Endemic area
Fungal	Immunocompromised



Summary

- Clinical presentation and physical exam findings of osteomyelitis
 - R knee pain
 - Nursing home resident
 - T: 99.4
 - History of fall + cuts around knee
 - Erythema and warmth
 - Fluctuance
 - Increased ESR, CRP
- Classical findings in plain film and MRI
 - Plain Film
 - Cortical destruction
 - Periosteal reaction
 - Soft tissue swelling
 - Areas of lucency
 - MRI
 - Abscess (loculated)
 - Cortical erosion
 - Periosteal edema
 - Bone marrow edema
- Pathophysiology and common microorganisms of osteomyelitis
 - 3 mechanisms of infection
 - Acute vs. chronic
 - Common microorganisms and associations



References

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