Gordon Bae, MS III
Gillian Lieberman, MD

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Tibial Osteomyelitis: Diagnostic MRI Imaging and Pathogenesis

Gordon H. Bae, Harvard Medical School, Year III
Gillian Lieberman, MD

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Gillian Lieberman, MD

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

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Our Patient: Lab findings

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

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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

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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%

Pineda *et al*. 2009

Choice of imaging

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

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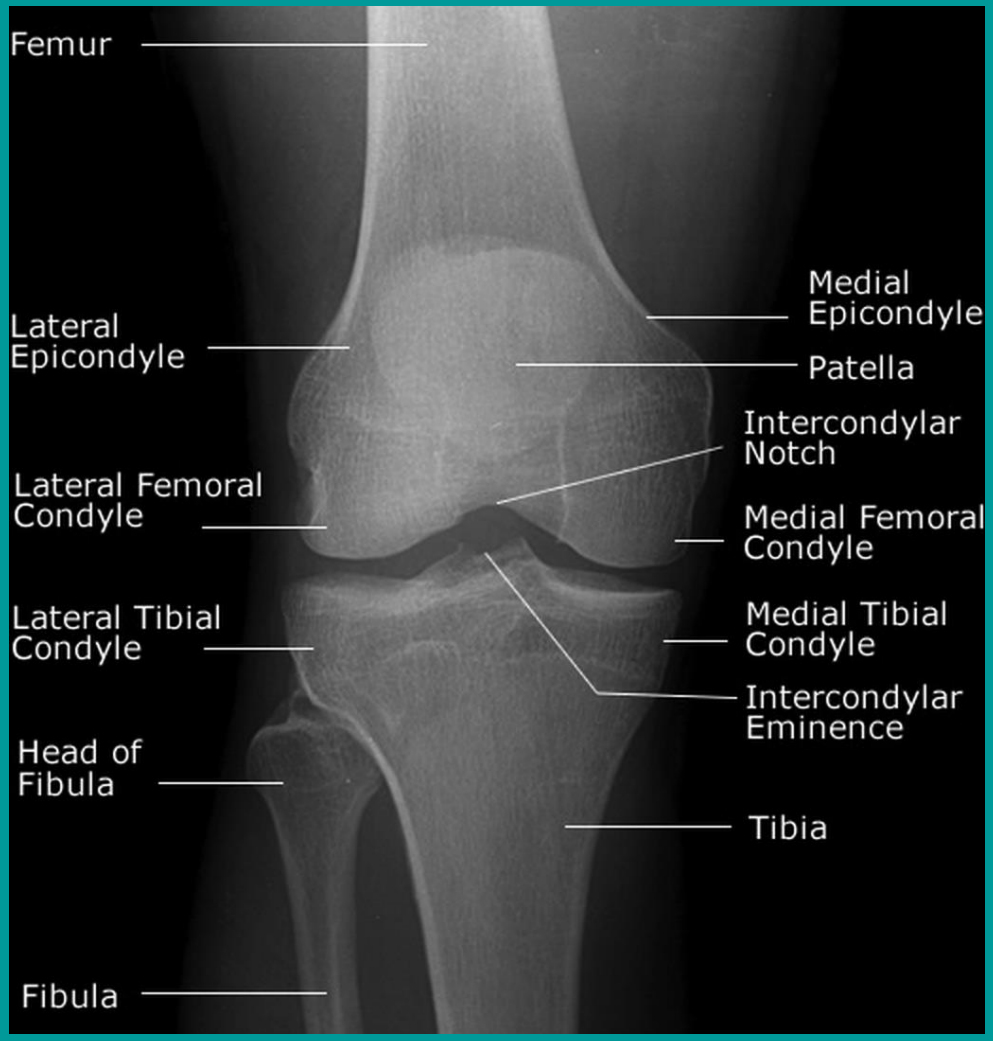
Normal Anatomy of the Knee



Wikiradiography; http://www.wikiradiography.net/page/Knee+(non+trauma)+Radiographic+Anatomy; Date accessed: November 16, 2014

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Our Patient: Plain Radiograph

AP

Cross Table Lateral

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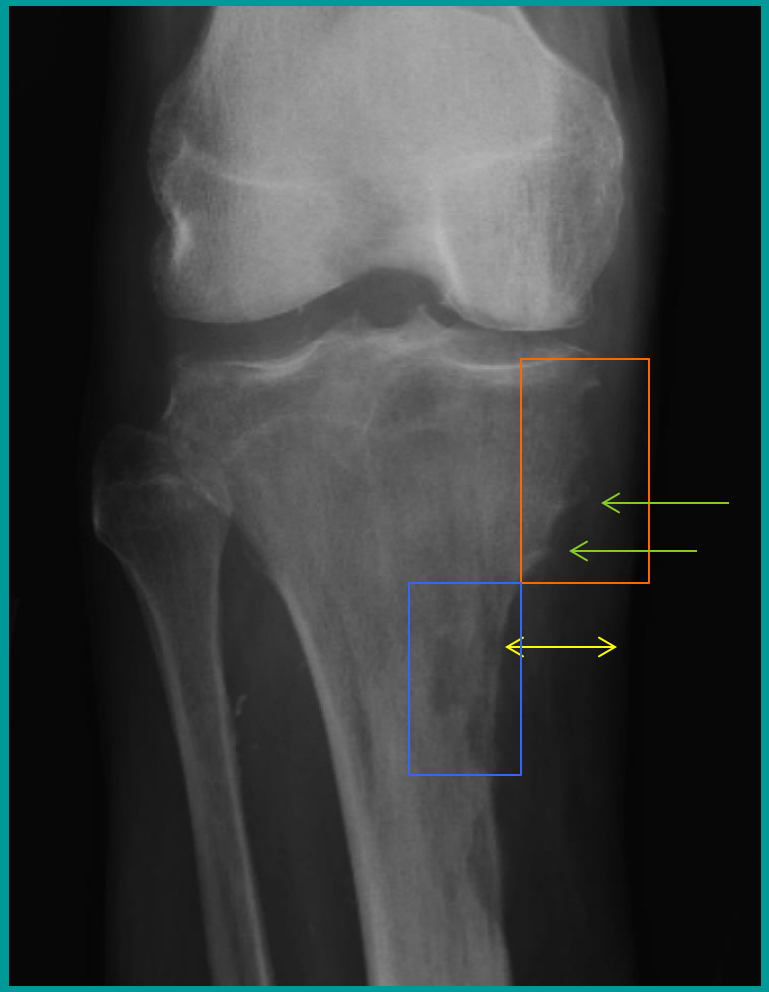
Our Patient: Radiograph Highlights



Plain Radiograph: AP View

Radiographic Findings:

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

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Our Patient: Differential Diagnosis

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

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Next Step in Imaging

MRI

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Interpreting a T2 C- MRI

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

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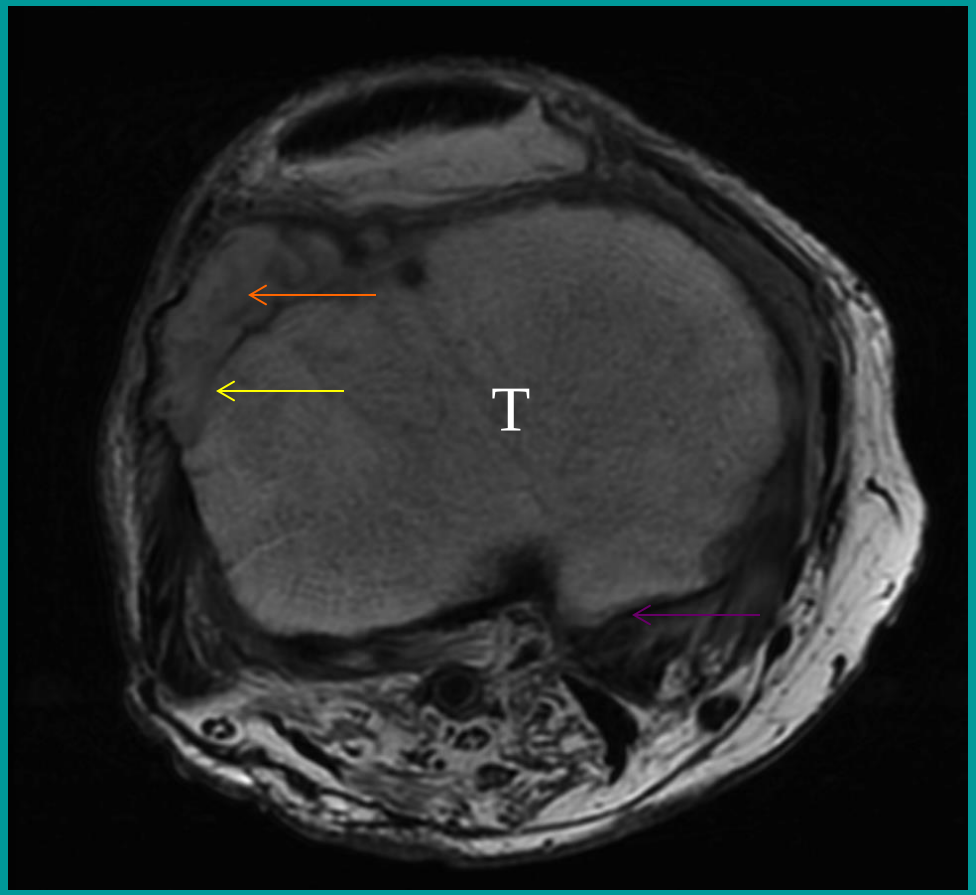
Our Patient: T2 MRI Findings



Axial T2 C- MRI

Radiographic Findings:

- Tissue enhancement
- Cortical destruction
- Normal Cortex

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Interpreting a T1 FS C+ MRI

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

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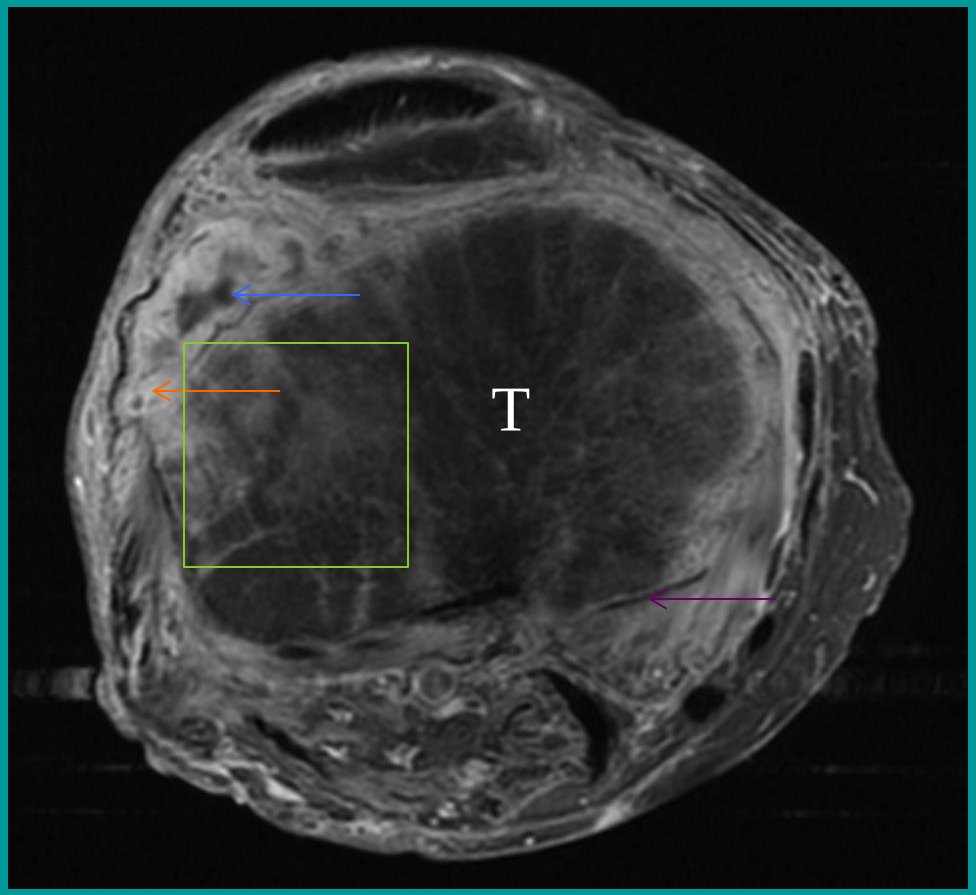
Our Patient: T1 MRI Findings



Axial T1 FS C- MRI

Radiographic Findings:

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

Interpreting STIR MRI

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

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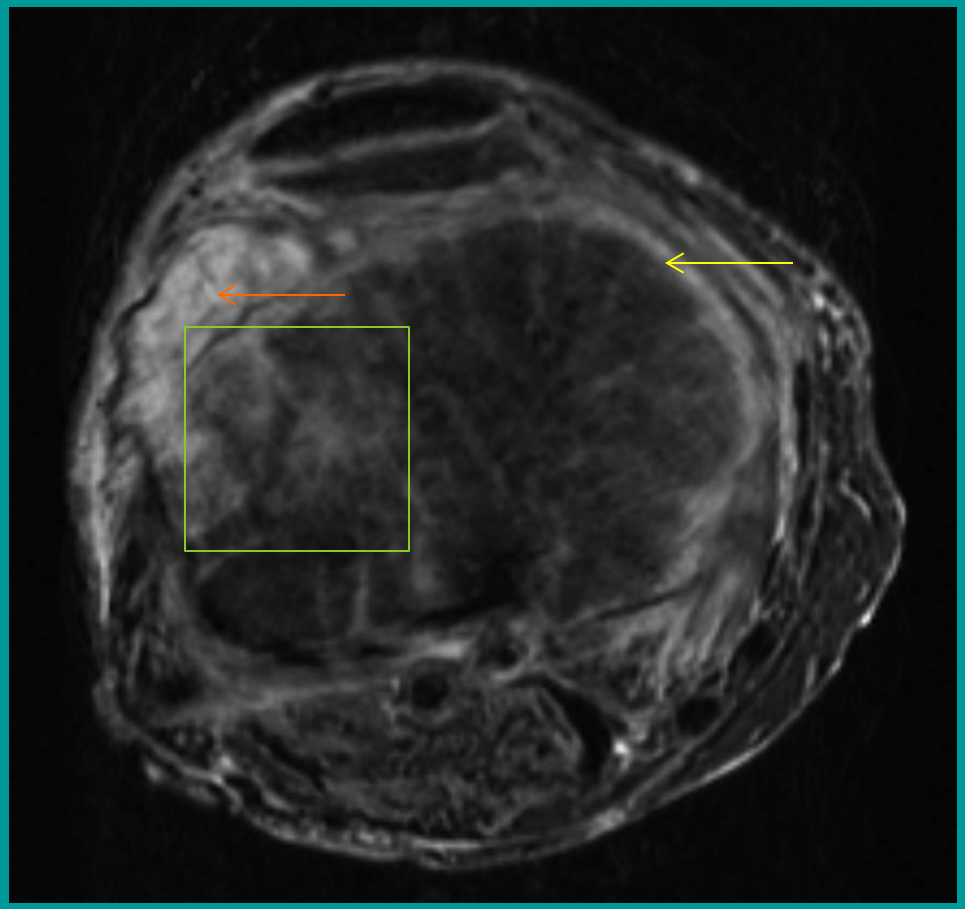
Our Patient: STIR MRI Findings



Axial STIR MRI

Radiographic Findings:

- Fluid collection
- Periosteal edema
- Edema

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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

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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

Learning Objectives

- ✓Clinical presentation and physical exam findings of osteomyelitis
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Osteomyelitis: Initiation

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

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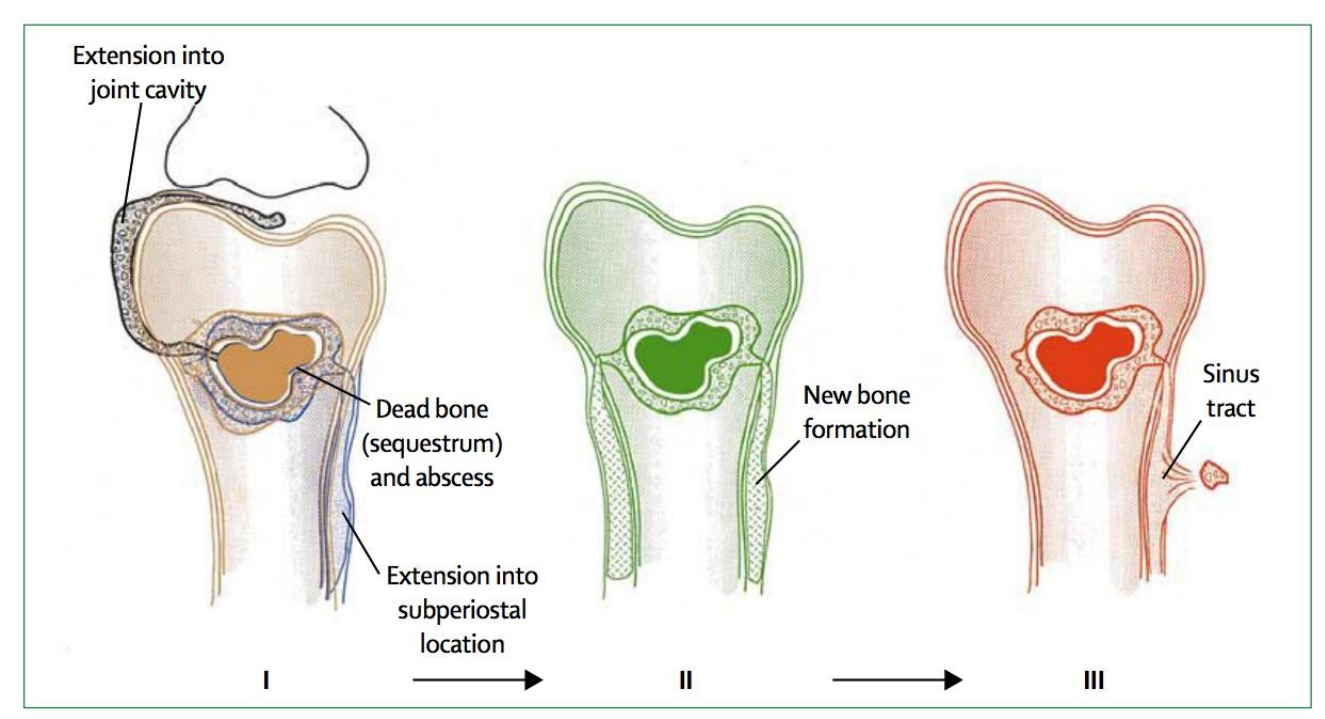
Osteomyelitis: Pathogenesis

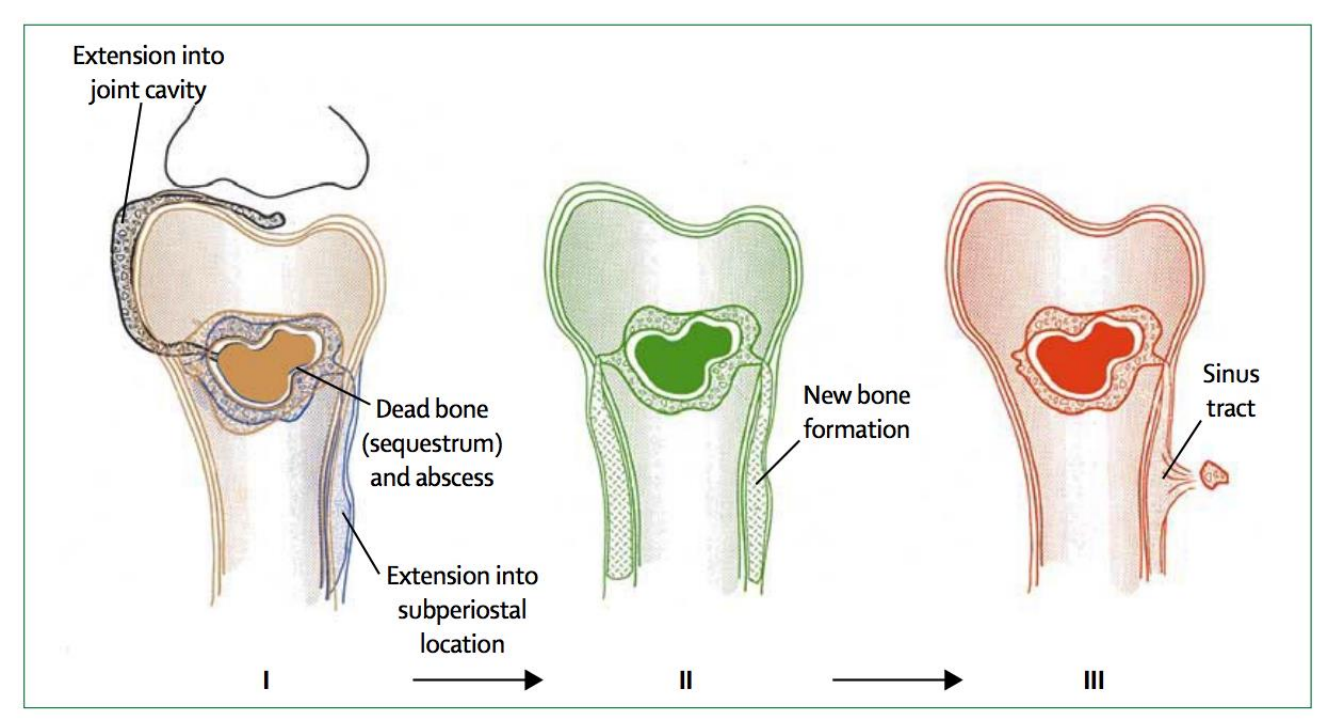


1. Infection

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

Lew and Waldvogel, 2004

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

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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

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Summary

- Clinical presentation and physical exam findings of osteomyelitis
  - R knee pain
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  - 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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