

Osteomyelitis: Always a Diagnostic Puzzle

Osteomyelitis

Always a Diagnostic Puzzle

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Osteomyelitis: Put the Pieces Together

HISTORY
✓ Clinical
✓ Surgical

RADIOGRAPHS
✓ Recent

CT
✓ Chronic

MRI
✓ Active

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Osteomyelitis: Topics

Definitions

- Active
- Chronic

Mechanisms

- Hematogenous
- Direct spread

Imaging

- Radiographs
- MRI

Bone Model

Cortex →

→ Marrow

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Osteomyelitis: Definitions

“Osteomyelitis” comes from Greek:

- *osteon* = bone
- *myelos* = marrow
- *itis* = inflammation

“Inflammation of bone marrow”
Infection of bone marrow

☺ **High Sensitivity**
☹ **Low Specificity**
Marrow inflammation from infection looks like inflammation from any other cause

MRI
✓ Marrow

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Osteomyelitis: Definitions

Active Osteomyelitis
vs
Chronic Osteomyelitis

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Osteomyelitis: Definitions

Active Osteomyelitis

- “Aggressive”
- Resembles Tumor
 - ✓ Cortex Destruction
 - ✓ Periosteal Reaction

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Osteomyelitis: Always a Diagnostic Puzzle

Active Osteomyelitis 16yoM distal fibula pain 3w after inversion injury

➤ "Aggressive"
 ✓ Cortex Destruction
 ✓ Periosteal Reaction

HISTORY
 Clinical Followup

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Osteomyelitis: Definitions

Chronic Osteomyelitis

➤ "Non-Aggressive"
 ➤ Resembles Callus

3 Characteristics:

- ✓ **Involucrum**: "wrap" → Thick periosteum around infected bone
- ✓ **Sequestrum**: "set apart" → Piece of dead, infected, bone
- ✓ **Cloaca**: "sewer" → Opening in cortex through which pus can escape

RADIOGRAPHS
 Active ≠ Chronic

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Active vs Chronic Osteomyelitis

Active Osteomyelitis **RADIOGRAPHS** **Chronic Osteomyelitis**
 Active ≠ Chronic

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Active Osteomyelitis 16yoM distal fibula pain 3w after inversion injury

"Aggressive"
 ✓ Cortex Destruction
 ✓ Periosteal Reaction

Active Osteomyelitis

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Chronic Osteomyelitis 19yoM fibula pain 2.5years later...

RADIOGRAPHS
 Active ≠ Chronic

2.5 years →

Chronic Osteomyelitis

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Chronic Osteomyelitis 19yoM fibula pain 2.5years later...

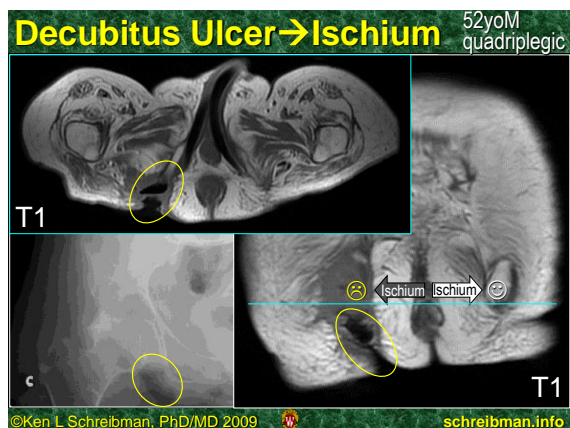
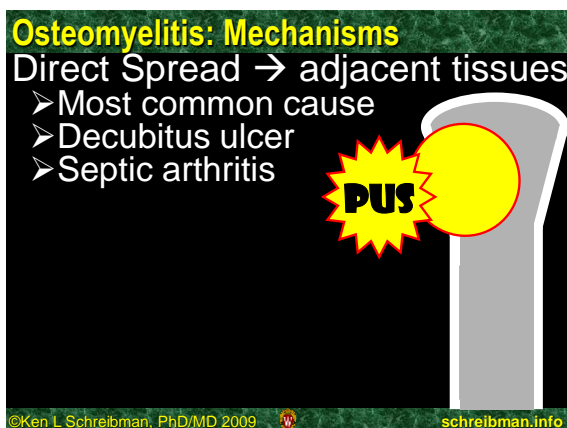
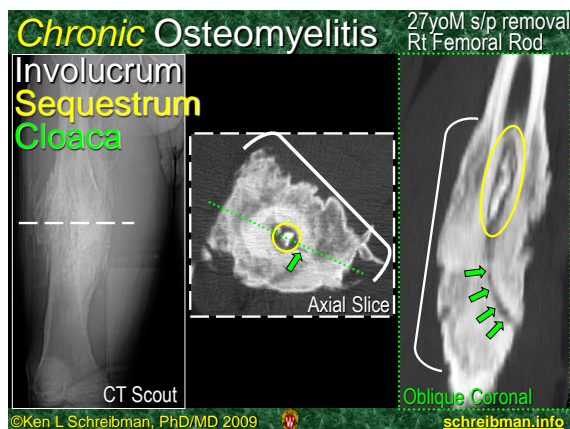
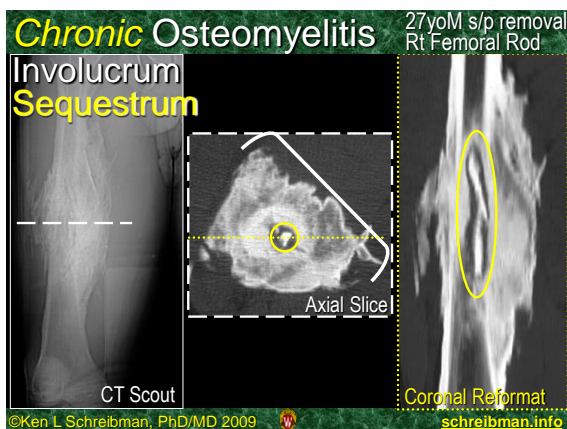
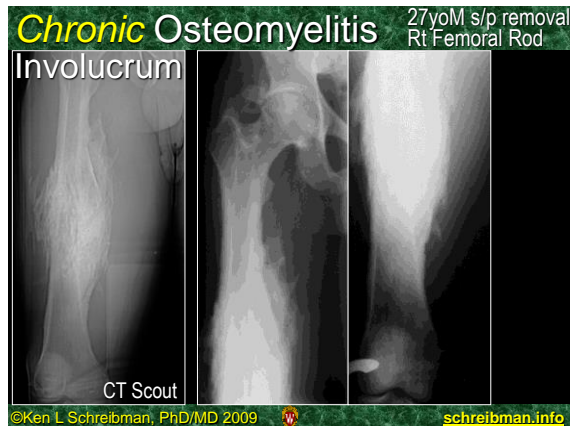
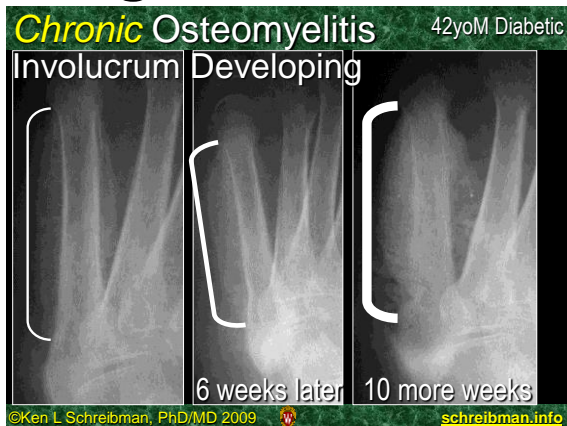
CT

- Involucrum**
- Sequestrum**
- Cloaca**

Chronic Osteomyelitis

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Osteomyelitis: Always a Diagnostic Puzzle



Osteomyelitis: Always a Diagnostic Puzzle

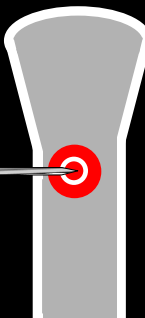
Osteomyelitis: Mechanisms

Direct Spread → adjacent tissues

- Most common cause
- Decubitus ulcer
- Septic arthritis

Puncture into bone

- Stepped on nail
- External fixator
- Ring sequestrum

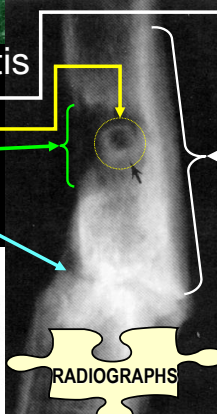


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Ring Sequestrum

Chronic Osteomyelitis

- ✓ Involucrum
- ✓ Sequestrum
- ✓ Cloaca
- ✓ Poor Union



APPLIED RADIOLOGY, October 1997

Radiological Case of the Month

Pamela J. Lund, M.D.

Osteomyelitis: Mechanisms

Direct Spread → adjacent tissues

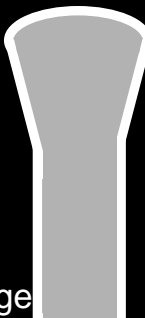
- Most common cause
- Decubitus ulcer
- Septic arthritis

Puncture into bone

- Stepped on nail
- External fixator
- Ring sequestrum

Hematogenous

- Site related to patient age



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Hematogenous Osteomyelitis

Site related to patient age

Epiphysis

Physis

Metaphysis

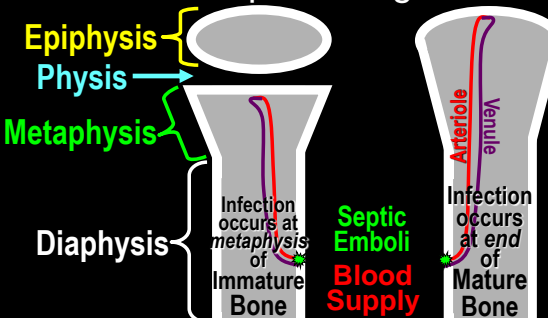
Diaphysis

Infection occurs at metaphysis of Immature Bone

Septic Emboli

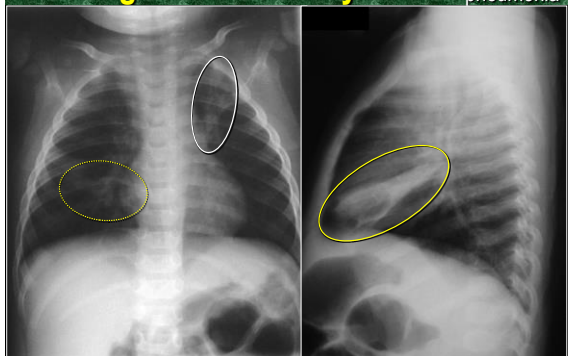
Blood Supply

Infection occurs at end of Mature Bone



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Hematogenous Osteomyelitis 1yoM strep pneumonia



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Hematogenous Osteomyelitis 1yoM strep pneumonia

3 months later



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Osteomyelitis: Imaging

Many Imaging Options:

- Radiographs
- CT
- MR
- US
- Nuc Med

What to order when?



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Osteomyelitis: What to Order When


➤ Radiographs.....**ALWAYS!**

- ✓ May show evidence of active infection
 - ❖ Bone destruction, periosteal reaction
- ✓ May show evidence of chronic infection
 - ❖ Involucrum
- ✓ Screen for metal
 - ❖ Orthopedic hardware, foreign bodies
- ✓ Unexpected findings
 - ❖ Fractures, gas in soft tissues
- ✓ Delineate current anatomy
 - ❖ Surgical resections, neuropathic deformity

RADIOGRAPHS NEED TO BE RECENT

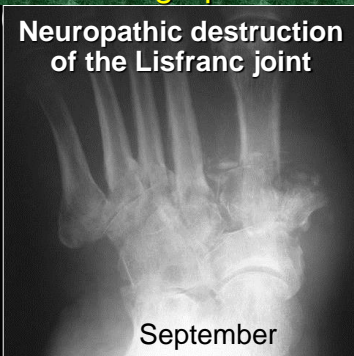
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Need for Recent Radiographs Example



Normal Lisfranc joint

June



Neuropathic destruction of the Lisfranc joint

September

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Osteomyelitis: What to Order When

➤ Radiographs.....**ALWAYS!**

➤ CT.....**Chronic Cases**

- ✓ CT best for calcified structures
 - ❖ Involucrum
 - ❖ Sequestrum
 - ❖ Cloaca
- ✓ CT of the extremities is insensitive for:
 - ❖ Bone marrow pathology
 - ❖ Soft tissue pathology

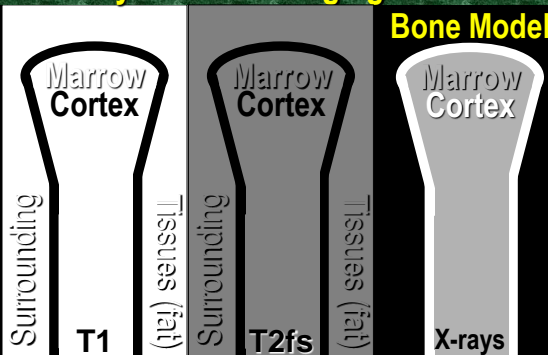
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Osteomyelitis: What to Order When

- Radiographs.....**ALWAYS!**
- CT.....**Chronic Cases**
- MRI.....**Active Cases**
 - ✓ Shows extent of soft tissue edema
 - ✓ Excellent for demonstrating abscesses and other drainable fluid collections
 - ✓ Sensitive for bone marrow pathology
 - ❖ Can be *overly* sensitive at expense of specificity
 - ❖ Infected bone marrow resembles marrow edema due to other causes

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Osteomyelitis: MR Imaging



The diagram shows three cross-sections of a bone model. The first is labeled 'T1' and shows 'Marrow' as dark and 'Cortex' as light. The second is labeled 'T2fs' and shows 'Marrow' as light and 'Cortex' as dark. The third is labeled 'X-rays' and shows 'Marrow' as dark and 'Cortex' as light. Labels 'Surrounding Tissues (fat)' are on the sides.

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Osteomyelitis: MR Imaging

1 T1
2 (STIR) T2fs
3 T1fs+Gd

Path=Fluid

- 1 T1=Dark
- 2 T2=Bright
- 3 T1fs+Gd

Enhancement

- ✓ Inflamed
- Uniform
- ✓ Abscess
- Wall
- ✓ Cyst
- Not

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Osteomyelitis: MR Imaging

1 T1
2 (STIR) T2fs
3 T1fs+Gd

Enhancement

- ✓ Inflamed
- Uniform
- ✓ Abscess
- Wall
- ✓ Cyst
- Not

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Osteomyelitis: MR Imaging

Detection of the non-enhancing pus pocket (abscess) is crucial

- Presence of soft tissue abscess proves the edema in underlying bone marrow is osteomyelitis.
- Site for aspiration for culture.
- If IV Gd doesn't get into abscess, IV antibiotics won't get in either, abscess may require drainage.

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Osteomyelitis: MR Imaging 63yoM Diabetic with heel ulcer

Intact cortex
Minimal Marrow Edema
IR
T1
T1fs IVGd

✓ Enhancing cellulitis
✓ No non-enhancing abscess pocket

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Osteomyelitis: MR Imaging 63yoM Diabetic 2 weeks later...

2 weeks earlier
Intact cortex
Cortical destruction
IR
T1fs IVGd

✓ More marrow edema
✓ More tissue edema
✓ Non-enhancing abscess pocket

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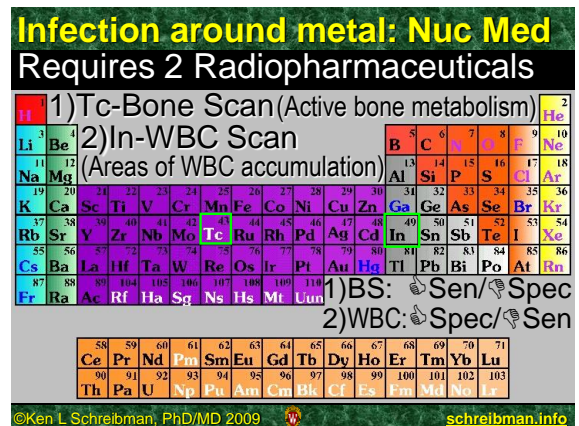
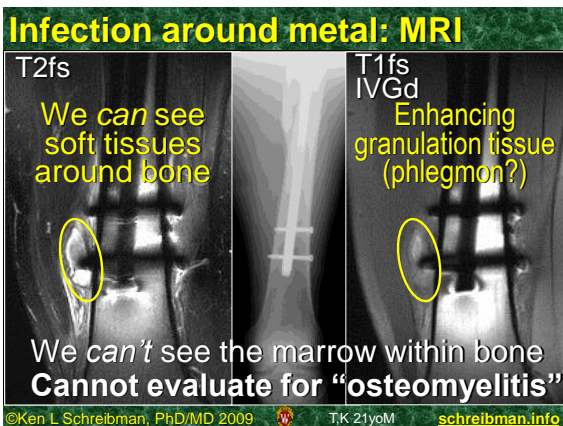
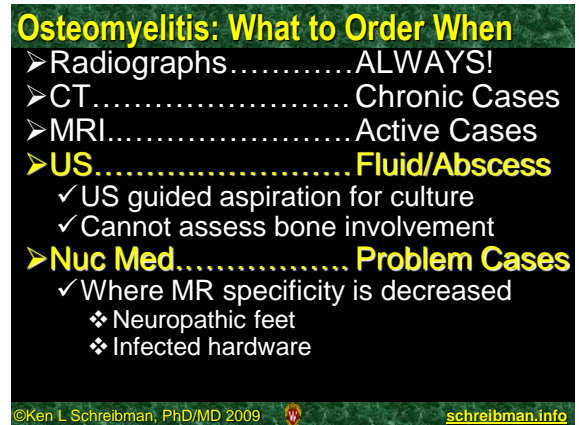
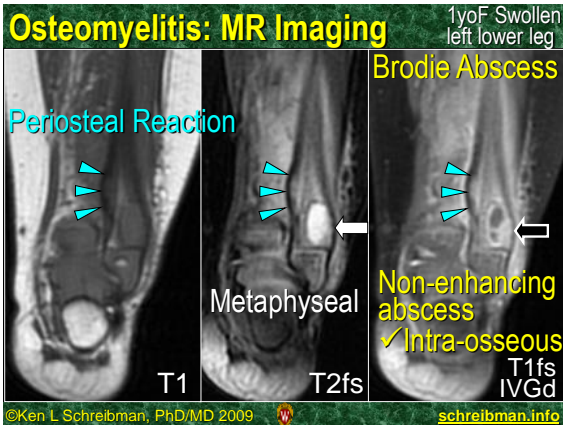
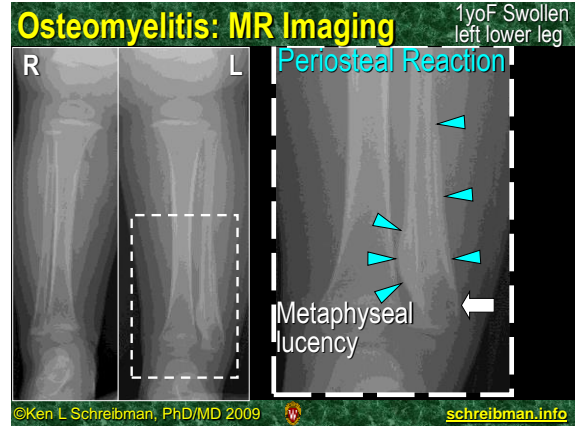
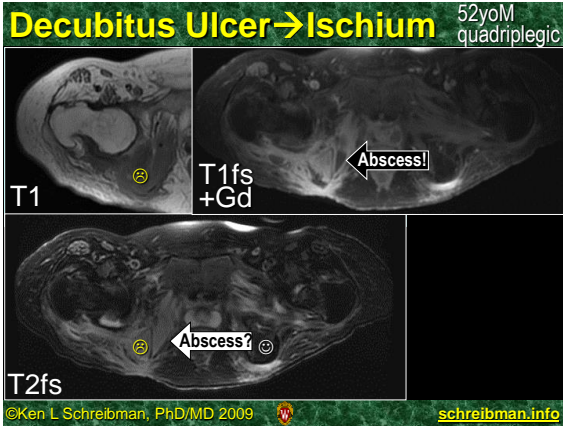
Osteomyelitis: MR Imaging 63yoM Diabetic 2 weeks later...

1 T1
2 IR
3 T1fs+Gd

Marrow edema
Abscess Pocket

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