Errors in Orthopedic Oncology

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Oncology Errors

- Detection/Observer (~80%)
- Interpretation (~20%)
- Communication
- Recommendation
- Biopsy


Interpretation Error Causes

- Lack of experience
- Lack of knowledge
- Lack of confidence
- History bias
- Alliterative bias
- Atypical presentation

Interpretation Errors Leading to Orthopedic Referral

- Paucity of systematic review
- Up to 1/3rd of referrals are unnecessary
- Unnecessary/suboptimal imaging is common
  - More unnecessary imaging is performed for benign lesions than malignant


Interpretation Errors Leading to Orthopedic Referral

<table>
<thead>
<tr>
<th>Entity</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft tissue trauma</td>
<td>14</td>
</tr>
<tr>
<td>Arthritis</td>
<td>12</td>
</tr>
<tr>
<td>NOF</td>
<td>11</td>
</tr>
<tr>
<td>Muscle inflammation/infection</td>
<td>10</td>
</tr>
<tr>
<td>Osteonecrosis</td>
<td>09</td>
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<tr>
<td>Stress fracture</td>
<td>08</td>
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<tr>
<td>Synovial recess/bursae</td>
<td>08</td>
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<tr>
<td>Cysts and ganglia</td>
<td>08</td>
</tr>
<tr>
<td>Normal red marrow</td>
<td>06</td>
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<tr>
<td>Paget disease</td>
<td>05</td>
</tr>
</tbody>
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History: Knee Pain
**Trauma**

**Stress/Insufficiency Fracture**

- Common cause of diagnostic uncertainty
- Common sites of diagnostic uncertainty*
  - Pelvis, Tibia, Hip
- MRI
  - T1 – linear low signal
  - T2 – marrow edema +/- linear low signal
- CT is most helpful study*


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**15 year old male referred for biopsy of presumed Ewing tumor.**

The parents and patient are in the department waiting for a CT biopsy. You review the following images prior to the biopsy.

**Typical MRI Findings**

- Linear low signal on T1 and T2 images
- Surrounding edema
Stress Fracture

- Findings
  - Marrow replacement > muscle on T1 images
  - Marrow fat preserved on CT
  - Increased signal in anterior cortex
  - Increased porosity of anterior cortex on CT

Learning Point!!

1. Avoid alliterative bias
2. Use T1 for specificity
3. Edema is higher in signal than muscle on T1
4. Tumor replaces fat on T1 images

Findings
- Vertical Sclerosis sacrum
- Left pubic fx
- Vertical Bands of low signal and edema
- Anterior fx too
Learning Point!!

- Insufficiency fx – Linear sclerosis
- Path fracture – Bone destruction

Learning Point!!

1. Always review plain film with MR
2. CT preferred for cortical abnormality

Learning Point!!

Do not use Sports Protocol for evaluation of possible marrow lesion.
54 year old woman on steroids for RA with sudden onset of severe medial knee pain. Past hx of Enbrel tx.

48 days later

Subchondral Cyst

• **Findings**
  - JSN and phytes
  - Lucent lesion with sclerotic margin
  - Rim on ↑ T1 signal
  - Rim on T2 images
  - Smoothly enhancing rim

**Arthropathy**

**Bone Lesions and Soft Tissue Masses**

• Arthropathies can mimic neoplasm
• Subchondral lucency
  - Subchondral cyst – OA and RA
• Cortical or intramedullary lesion
  - HADD
  - Gout
• Juxtaarticular mass
  - Synovial cyst or bursa
  - Gout
Subchondral Geode-OA

- Usually associated with joint space narrowing
- Narrow zone of transition or sclerotic margin
- May contain nitrogen gas
- MR –
  - Heterogeneous high T2 signal
  - Rim enhancement
  - No or minimal adjacent marrow edema
- Large cysts – large joints


Subchondral Geode-RA

- Usually associated with joint space narrowing
- Narrow zone of transition or sclerotic margin
- MR –
  - Heterogeneous high T2 signal
  - Rim enhancement
  - No or minimal adjacent marrow edema
  - Synovitis in joint
- Joints – knee, hip, shoulder, elbow

Learning Point!!

Should at least consider arthropathy in differential diagnosis of a juxtaarticular lucent bone lesion.

OA with Synovial Cyst

Findings:
1. JSN with phytes
2. Complex fluid collection contiguous with joint
Juxtaarticular Cyst

• Tend to arise from large joints
• Can be large
• May be heterogeneous on MR
• May be confused with myxoid neoplasm

Interpretation Errors
Solutions

• Organized
  – Pattern approach to differential diagnosis
• Diligent
  – Do not interpret MR without plain films
  – Call clinician and discuss case
  – Review differential diagnosis book
  – Discuss case with a colleague
  – Improve knowledge
• Vigilant
  – Understand own weaknesses and strengths

Interpretation Errors
Solutions – Organized

Same approach to each and every case

Systemic – multiple bones
Trauma - linear
Arthropathy – centered on joint
Tumor – lytic or sclerotic lesion
Infection – lytic or sclerotic lesion
Congenital – funky looking bones

Summary

• Organized approach is critical
• Understand most common referral errors
• Show cases to colleagues/ talk to clinician
• Do not interpret MR images without PF
• Use T1 images for specificity
• Juxtaarticular lesion – think about arthropathy
• Follow-up on every referral case!!