Clues by Appearance of Lesion
Patterns of Bone Destruction

- Geographic
- Moth-eaten
- Permeative
<table>
<thead>
<tr>
<th>Geographic Bone Destruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Destructive lesion with sharply defined border</td>
</tr>
<tr>
<td>● Implies a less-aggressive, more slow-growing, benign process</td>
</tr>
<tr>
<td>● Narrow transition zone</td>
</tr>
</tbody>
</table>
Patterns of Bone Destruction

- Geographic
- Moth-eaten
- Permeative

Non-ossifying fibroma
<table>
<thead>
<tr>
<th>Geographic Lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>- Non-ossifying fibroma</td>
</tr>
<tr>
<td>- Chondromyxoid fibroma</td>
</tr>
<tr>
<td>- Eosinophilic granuloma</td>
</tr>
</tbody>
</table>
Moth-eaten Appearance

- Areas of destruction with ragged borders
- Implies more rapid growth
  - Probably a malignancy
Patterns of Bone Destruction

- Geographic
- Moth-eaten
- Permeative

Multiple Myeloma
### Moth-eaten Appearance

#### Examples

- Myeloma
- Metastases
- Lymphoma
- Ewing’s sarcoma
Permeative Pattern

- Ill-defined lesion with multiple “worm-holes”
- Spreads through marrow space
- Wide transition zone
- Implies an aggressive malignancy
  - Round-cell lesions
Patterns of Bone Destruction

- Geographic
- Moth-eaten
- Permeative

Leukemia
Permeative Pattern
Round cell lesions

- Lymphoma, leukemia
- Ewing’s Sarcoma
- Myeloma
- Osteomyelitis
- Neuroblastoma
Patterns of Destruction

- Geographic
- Moth-eaten
- Permeative

Less malignant  More malignant
Periosteal Reactions

- Benign
  - None
  - Solid
- More aggressive or malignant
  - Lamellated or onion-skinning
  - Sunburst
  - Codman’s triangle
Periosteal Reactions

- **Benign**
  - None
  - Solid

- **Aggressive/malignant**
  - Onion-skinning
  - Sunburst
  - Codman’s triangle

Non-ossifying fibroma
Periosteal Reactions

- **Benign**
  - None
  - Solid

- **Aggressive/malignant**
  - Onion-skinning
  - Sunburst
  - Codman’s triangle

Chronic osteomyelitis
Periosteal Reactions

- **Benign**
  - None
  - Solid

- **Aggressive/malignant**
  - Onion-skinning
  - Sunburst
  - Codman’s triangle

Ewing’s sarcoma
Periosteal Reactions

- **Benign**
  - None
  - Solid

- **Aggressive/malignant**
  - Onion-skinning
  - Sunburst
  - Codman’s triangle
Periosteal Reactions

- **Benign**
  - None
  - Solid

- **Aggressive/malignant**
  - Onion-skinning
  - Sunburst
  - Codman’s triangle

- Ewing’s-Codman’s triangle
Periosteal Reactions

- Solid
- Lamellated
- Sunburst
- Codman’s

Less malignant → More malignant
Tumor Matrix

- Osteoblastic
  - Fluffy, cotton-like or cloud-like densities
    - Osteosarcoma

- Cartilaginous
  - Comma-shaped, punctate, annular, popcorn-like
    - Enchondroma, chondrosarcoma, chondromyxoid fibroma
Tumor matrix

- Osteoblastic
- Cartilaginous

Osteosarcoma
Tumor matrix

- Osteoblastic
- Cartilaginous

Chondrosarcoma
<table>
<thead>
<tr>
<th>Expansile Lesions of Bone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Multiple myeloma</td>
</tr>
<tr>
<td>2. Mets</td>
</tr>
<tr>
<td>3. Aneurysmal bone cyst</td>
</tr>
<tr>
<td>4. Fibrous dysplasia</td>
</tr>
<tr>
<td>5. Brown tumor</td>
</tr>
<tr>
<td>6. Enchondroma</td>
</tr>
<tr>
<td>7. Lymphoma</td>
</tr>
</tbody>
</table>
Expansile lesions

- Multiple myeloma
- Mets
- Aneurysmal bone cyst
- Fibrous dysplasia
- Brown tumor
- Enchondroma
- Lymphoma

Multiple Myeloma
Expansile lesions

- Multiple myeloma
- Mets
- Aneurysmal bone cyst
- Fibrous dysplasia
- Brown tumor
- Enchondroma
- Lymphoma

Renal Cell Carcinoma
Expansile lesions

- Multiple myeloma
- Mets
- Aneurysmal bone cyst
- Fibrous dysplasia
- Brown tumor
- Enchondroma
- Lymphoma

Aneurysmal Bone Cyst
Expansile lesions

- Multiple myeloma
- Mets
- Aneurysmal bone cyst
- Fibrous dysplasia
- Brown tumor
- Enchondroma
- Lymphoma
Expansile lesions

- Multiple myeloma
- Mets
- Aneurysmal bone cyst
- Fibrous dysplasia
- Brown tumor
- Enchondroma
- Lymphoma

Brown Tumor
Expansile lesions

- Multiple myeloma
- Mets
- Aneurysmal bone cyst
- Fibrous dysplasia
- Brown tumor
- Enchondroma
- Lymphoma
Exansile lesions

- Multiple myeloma
- Mets
- Aneurysmal bone cyst
- Fibrous dysplasia
- Brown tumor
- Enchondroma
- Lymphoma

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Clues by Location of Lesion
<table>
<thead>
<tr>
<th>Location</th>
<th>Tumors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>Enchondroma</td>
</tr>
<tr>
<td></td>
<td>GCT, osteosarcoma, chondromyxoid fibroma</td>
</tr>
<tr>
<td>Eccentric</td>
<td></td>
</tr>
<tr>
<td>Cortical</td>
<td>Non-ossifying fibroma, osteoid osteoma</td>
</tr>
<tr>
<td>Parosteal</td>
<td>Parosteal osteosarcoma, osteochondroma</td>
</tr>
</tbody>
</table>
Parosteal sarcoma
Osteochondroma

In The Transverse Plane

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In the Longitudinal Plane

- Epiphyseal
  - GCT, chondroblastoma

- Metaphyseal
  - Osteomyelitis, osteo- and chondrosarcoma

- Diaphyseal
  - Round cell lesions, ABC, enchondroma
Tumor Types
Characteristic Locations

- Simple bone cyst
  - Proximal humerus
- Chondroblastoma
  - Epiphyses
- Giant Cell tumor
  - Epiphyses
Characteristic locations

- Simple bone cyst
  - Proximal humerus
- Chondroblastoma
  - Epiphyses
- Giant Cell tumor
  - Epiphyses
Characteristic locations

- Simple bone cyst
  - Proximal humerus
- Chondroblastoma
  - Epiphyses
- Giant Cell tumor
  - Epiphyses
Characteristic locations

- Simple bone cyst
  - Proximal humerus
- Chondroblastoma
  - Epiphyses
- Giant Cell tumor
  - Epiphyses
Tumor Types
Characteristic Locations

- **Adamantinoma**
  - Tibia

- **Chordoma**
  - Sacrum, clivus

- **Osteoblastoma**
  - Spine, posterior
Characteristic locations

- Adamantinoma
  - Tibia
- Chordoma
  - Sacrum, clivus
- Osteoblastoma
  - Spine, posterior
Characteristic locations

- Adamantinoma
  - Tibia
- Chordoma
  - Sacrum, clivus
- Osteoblastoma
  - Spine, posterior
Characteristic locations

- Adamantinoma
  - Tibia
- Chordoma
  - Sacrum, clivus
- Osteoblastoma
  - Spine, posterior
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<th>Characteristic Locations</th>
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<tr>
<td>Parosteal sarcoma</td>
<td>Distal femur</td>
</tr>
<tr>
<td>Periosteal sarcoma</td>
<td>Tibia</td>
</tr>
</tbody>
</table>
Characteristic locations

- Parosteal sarcoma
  - Distal femur
- Periosteal sarcoma
  - Tibia
Characteristic locations

- Parosteal sarcoma
  - Distal femur
- Periosteal sarcoma
  - Tibia
Characteristic Tumors
By Body Site
Pelvic Lesions

- Chondrosarcoma
- Solitary plasmacytoma
- Chordoma
Pelvic lesions

- Chondrosarcoma
- Solitary plasmacytoma
- Chordoma
Pelvic lesions

- Chondrosarcoma
- Solitary plasmacytoma
- Chordoma

Plasmacytoma
Pelvic lesions

- Chondrosarcoma
- Solitary plasmacytoma
- Chordoma
Expansile Rib Lesions

- Plasmacytoma
- Metastases
- Chondrosarcoma
- Eosinophilic granuloma
- Neurofibromatosis
- Fibrous dysplasia
Expansile rib lesions

- Plasmacytoma
- Metastases
- Chondrosarcoma
- Eosinophilic granuloma
- Neurofibromatosis
- Fibrous dysplasia
Expansile rib lesions

- Plasmacytoma
- Metastases
- Chondrosarcoma
- Eosinophilic granuloma
- Neurofibromatosis
- Fibrous dysplasia

Thyroid Carcinoma
Expansile rib lesions

- Plasmyctoma
- Metastases
- Chondrosarcoma
- Eosinophilic granuloma
- Neurofibromatosis
- Fibrous dysplasia
Expansile rib lesions

- Plasmacytoma
- Metastases
- Chondrosarcoma
- Eosinophilic granuloma
- Neurofibromatosis
- Fibrous dysplasia
Expansile rib lesions

- Plasmacytoma
- Metastases
- Chondrosarcoma
- Eosinophilic granuloma
- Neurofibromatosis
- Fibrous dysplasia
Expansile rib lesions

- Plasmacytoma
- Metastases
- Chondrosarcoma
- Eosinophilic granuloma
- Neurofibromatosis
- Fibrous dysplasia
Lesions of the Spine

- Osteoblastoma
  - Expansile, with punctate densities within
- Chordoma
- ABC
- Metastatic disease
Spine lesions

- Osteoblastoma
- Chordoma
- ABC
- Metastatic disease
Spine lesions

- Osteoblastoma
- Chordoma
- ABC
- Metastatic disease

Chordoma
Spine lesions

- Osteoblastoma
- Chordoma
- ABC
- Metastatic disease

Aneurysmal bone cyst
Spine lesions

- Osteoblastoma
- Chordoma
- ABC
- Metastatic disease

Metastatic Breast Carcinoma
Sclerotic Cortical Lesions

- Osteoid osteoma
- Brodie’s abscess
- Stress fracture
Sclerotic cortical lesions

- Osteoid osteoma
- Brodie’s abscess
- Stress fracture
Sclerotic cortical lesions

- Osteoid osteoma
- Brodie’s abscess
- Stress fracture
Sclerotic cortical lesions

- Osteoid osteoma
- Brodie’s abscess
- Stress fracture

Healing Stress Fracture
Sclerotic Cortical Lesions

- Osteoid Osteoma
- Brodie’s abscess
- Healing Stress Fracture
## Lytic Lesions in Children

- Eosinophilic granuloma
- Neuroblastoma
- Leukemia
Lytic Lesions in Children

- Eosinophilic granuloma
- Neuroblastoma
- Leukemia

Eosinophilic granuloma
Lytic Lesions in Children

- Eosinophilic granuloma
- Neuroblastoma
- Leukemia

Neuroblastoma
Lytic Lesions in Children

- Eosinophilic granuloma
- Neuroblastoma
- Leukemia
Lytic Lesions in Adults

- Metastatic lesions
  - Lung
  - Renal
  - Thyroid
- Multiple myeloma
- Primary bone tumor
Lytic Lesions in Adults

- Mets
- Myeloma
- Primary bone tumor

Met from Thyroid Carcinoma
Lytic Lesions in Adults

- Mets
- Myeloma
- Primary bone tumor

Multiple myeloma
Lytic Lesions in Adults

- Mets
- Myeloma
- Primary bone tumor

Chondrosarcoma
Blastic Lesions in Children

- Medulloblastoma
- Lymphoma
Blastic Lesions in Children

- Medulloblastoma
- Lymphoma

Medulloblastoma
Blastic Lesions in Children

- Medulloblastoma
- Lymphoma
Blastic Lesions in Adults

- Metastatic disease
  - Breast – female
  - Prostate – male
- Lymphoma
- Paget’s disease
- Etcetera-mastocytosis, fluorosis
Blastic Lesions in Adults

- Mets
- Lymphoma
- Paget’s

Prostate Mets
Blastic Lesions in Adults

- Mets
- Lymphoma
- Paget’s
Blastic Lesions in Adults

- Mets
- Lymphoma
- Paget’s

Lymphoma
Blastic Lesions in Adults

- Mets
- Lymphoma
- Paget’s

Paget’s of Spine
Other Clues
Benign Lesions
Without Sclerotic Boarders

- Giant Cell tumor
- Brown tumor
- Osteolytic phase of Paget’s Disease
Benign Lesions without Sclerotic Borders

- Giant cell tumor
- Brown tumor
- Osteolytic Paget’s
Benign Lesions without Sclerotic Borders

- Giant cell tumor
- Brown tumor
- Osteolytic Paget’s
Benign Lesions without Sclerotic Borders

- Giant cell tumor
- Brown tumor
- Osteolytic Paget’s
Soft Tissue Extension

- Usually implies malignancy
  - More likely to form discrete soft tissue mass
- Benign conditions with soft tissue extension
  - Osteomyelitis
    - Usually infiltration of fat
Osteosarcoma
Multiple Lesions

- More often benign
- Malignancies with multiple lesions
  - Metastatic disease
  - Multiple myeloma
  - Lymphoma
  - Ewing’s sarcoma (rarely)
  - Osteosarcoma (rarely)
Multiple lesions

- Metastatic
- Multiple myeloma
- Lymphoma

Mets from Ca of Prostate
Multiple lesions

- Metastatic
- Multiple myeloma
- Lymphoma

Multiple Myeloma
Multiple lesions

- Metastatic
- Multiple myeloma
- Lymphoma

Lymphoma
Multiple lesions

- Metastatic
- Multiple myeloma
- Lymphoma
- Osteosarcomatosis
Benign vs. Malignant

Benign Lesion
- well defined, sclerotic border
- lack of soft tissue mass
- solid periosteal reaction
- geographic bone destruction

Malignant Lesion
- interrupted periosteal reaction
- moth-eaten or permeative bone destruction
- soft tissue mass
- wide zone of transition

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The End