Overview of this Presentation

- Why Bone Tumors are Intimidating
- Describing Bone Tumors
  1) Patient’s Age
  2) “Aggressive”
     - Zone of Transition
     - Periosteal Reaction
  3) Matrix
  4) Location

Building the Bone Tumor Chart

Why Bone Tumors are Intimidating

- Bone Tumors are Rare

- Bone Tumors: Many Types

Bone Tumors: Many Types

Orthopedic Radiology

Differential Diagnosis of Tumors and Tumor-Like Lesions of Bones and Joints

GREENSPAN: Orthrad 15:24

Bone Tumors

Bone Tumors: In 1 Simple Chart

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Bone Tumors: In 1 Simple Chart

**Why Bone Tumors are Intimidating**
- Bone Tumors are Rare 😞
  - Don’t see enough to be confident 😞
- Many types of Bone Tumors 😞
- Have Confusing (similar) Names
  - “Osteosarcoma” 😞
  - “Osteochondroma” 😞
- Occur in children 😞
  - Essentially only 2 😊 bone malignancies occur in children

**Bone Tumors: by Age**

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Osteosarcoma</th>
<th>Ewing Sarcoma</th>
<th>Everything else benign</th>
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<tr>
<td>&lt;20</td>
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**Overview of this Presentation**
- Why Bone Tumors are Intimidating
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  1) Patient’s Age
     - <20
       - Osteogenic Sarcoma
       - Ewing Sarcoma
       - Everything else benign
  2) >40
     - Multiple Myeloma, Metastases

**Overview of this Presentation**
- Why Bone Tumors are Intimidating
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     - <20
       - Osteogenic Sarcoma
       - Ewing Sarcoma
       - Everything else benign
     - 20-40
       - Could be anything
     - >40
       - Multiple Myeloma, Metastases
  2) “Aggressive” vs “Non-aggressive”
     - (NOT “Malignant” vs “Benign”)
Bone Tumors: In 1 Simple Chart

**Aggressive vs. Non-aggressive**

**Zone of Transition**

- Periosteal Reactions

**Grow Slowly**
- “Narrow”
- “Geographic”
- “Well Defined”
- Can Outline Lesion with Sharp Pencil
- Sclerotic Margins
- Grows VERY Slowly!

**Asymptomatic, incidental finding**

**Grow Rapidly**
- “Wide”
- “Permeative”
- “Ill Defined”
- “Moth Eaten”
- Cannot tell where Lesion ends and Normal Bone begins
Bone Tumors: In 1 Simple Chart

**Aggressive vs Non-aggressive**

**Zone of Transition**
- Grows Rapidly
  - “Wide”
  - “Permeative”
  - “Ill Defined”
  - “Moth Eaten”
- Cannot tell where Lesion ends and Normal Bone begins

**Aggressive vs Non-aggressive**

**Periosteal Reaction**
- Grows Rapidly
- “Too Complicated”
- Cannot tell where Lesion ends and Normal Bone begins

**Aggressive vs Non-aggressive**

**Simplifying Periosteal Reaction**
- Grows Slowly
  - “Solid”
  - Smooth
  - Continuous
- Looks like Healing Callus

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Bone Tumors: In 1 Simple Chart

**Aggressive vs Non-aggressive Simplifying Periosteal Reaction**

- **Grows Rapidly**
  - “Interrupted”
  - May grow so rapidly it doesn’t have time to ossify
  - (Unossified periosteum is not radiopaque)

**Grows Slowly**

- “Solid”
- Smooth
- Continuous
- Looks like Healing Callus

**Aggressive vs Non-aggressive Simplifying Periosteal Reaction**

- **Grows Rapidly**
  - “Interrupted”
  - Lamellated
  - Onionskin
  - Spiculated
  - Hair-on-end

- **Grows Slowly**
  - “Solid”
  - Smooth
  - Continuous
  - Looks like Healing Callus

**Simplifying Periosteal Reaction**

- **Aggressive**
  - Grows... ossifies...
- **Non-aggressive**
  - Grows... ossifies...

**S,C 15yoM**

- 3w post Fx, ORIF = very early callus
- 8w post Fx, ORIF = more mature callus

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Bone Tumors: In 1 Simple Chart

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- Why Bone Tumors are Intimidating
- Describing Bone Tumors
  1) Patient’s Age
  2) “Aggressive” vs “Non-aggressive”
     - Zone of Transition
     - Periosteal Reaction
     - Cortical Destruction

Aggressive vs Non-aggressive
- Cortical Destruction
  - Cortex Absent = Aggressive
  - Cortex Intact = Non-aggressive

2 Cases: Aggressive lesions distal fibula
- Benign? Malignant?
- Can’t tell with radiographs...
- Thus we use the term “Aggressive”

Active Osteomyelitis
- Aggressive vs Non-aggressive

Two YEARS later → Active Osteomyelitis
Chronic Osteo.
Bone Tumors: In 1 Simple Chart

Bone Matrix: 4 Types

- **Chondroid**
  - "rings & arcs"
  - Calcified Uterine Fibroid
- **Osseous**
  - "cloud-like" "amorphous"
  - Myositis Ossificans
- **Fibrous**
  - "Ground Glass"
  - Enchondroma
- **None**
  - Purely Lytic
  - Not necessarily cystic
  - Multiple Myeloma

Calcified Uterine Fibroid

Myositis Ossificans

Enchondroma

Calcified Uterine Fibroid

Osteogenic Sarcoma

Myositis Ossificans

Fibrous Dysplasia

Fibrous Dysplasia

Multiple Myeloma

Multiple Myeloma

Intraosseous Lipoma

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Overview of this Presentation

- Why Bone Tumors are Intimidating
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  1) Patient’s Age
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  4) Location
     - Which bone? Some tumors have propensity for certain bones
     - Which part of the bone? MANY tumors characteristically occur at the:
       - Epiphysis / Metaphysis / Diaphysis

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Osteogenic Sarcoma

- Pt Age: 10-20 years (when growth spurt occurs)
- Location: Metaphyseal (where growth occurs)
  - Distal Femur
  - Proximal Tibia (where most growth occurs)
- Matrix: Osseous
  - “osteo-genic”: makes bone
  - Need to eval for “skip mets”
  - MR entire length of bone

Osteogenic Sarcoma

- MRI is useful for staging the extent of the tumor...
- Radiographs show us what we need to know to diagnose type of tumor:
  - Skeletally immature
  - Aggressive lesion
  - Wide zone of trans.
  - Sunburst periost.
  - Osseous matrix
  - Metaphyseal

Osteogenic Sarcoma

- Sometimes osteosarc is growing SO quickly it doesn’t have time to form an osseous matrix
  - Patient presents with hair-on-end periosteal reaction
  - After 2 months of chemotherapy tumor growth has slowed enough to form osseous matrix
Ewing Sarcoma

Pt Age: 5-25 years
Tumor of Bone Marrow
Location: Diaphyseal Flat Bones
Matrix: Permeative
➢Cortical Destruction
➢Aggressive Periosteal Reaction
Soft Tissue Extension
>> Bone Extent

Ewing Sarcoma common in pelvis

Air in colon
Air in colon?

Ewing Sarcoma common in pelvis

Things can hide in the pelvis
3 months later...

Ewing Sarcoma

T2 Soft Tissue Extension >> Bone Extent

T2

H,M 13yoF

T1

Ewing Sarcoma

Soft Tissue Extension

H,M 13yoF

Ewing Sarcoma common in pelvis

Things can hide in the pelvis

Unlike in the extremities where radiographs are key, the usefulness of radiographs in the pelvis is limited.

In the pelvis, cross-sectional imaging is crucial, preferably with MRI.

Age Agressive Non-aggressive Lytic Non-aggressive Blastic

<20 Osteosarcoma Ewing Sarcoma Osteomyelitis (Active) Mets (NB <5yo)

Osteomyelitis resembles Tumor! Whenever doing a bone biopsy, ALWAYS send samples for BOTH surgical pathology AND microbiology culture!

20-40 “Do Not Touch” lesions

>40

Cortical Desmoid: Do Not Touch!

They all present like this:
➢ Athletic teenager
➢ Just a little periosteal reaction
   ✓ MED/AL posterior femoral condyle
   Tug lesion: Reductor longus insertion
   Medial gastrocnemius origin

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Bone Tumors: In 1 Simple Chart

**Cortical Desmoid: Do Not Touch!**

- Cross-sectional imaging doesn't really help
- Just a little periosteal reaction
- MEDIAL posterior femoral condyle
- Tug lesion: Adductor longus insertion
- Medial gastrocnemius origin

**Lymphoma**

- Tumor of bone marrow
- Can be lytic or blastic
- Resembles Ewing

**Why Age is Important**

- Location: Diaphyseal
- Soft tissue extension
- Age: < 20
  - Ewing Sarcoma
- Age: 20-40
  - Lymphoma
- Age: > 40
  - Metastases
  - Multiple Myeloma

**Chondrosarcoma**

- Cartilage malignancy
- Matrix: Chondroid
- Location: Ends of bones
  - Pelvis
  - Soft tissues

**New Cancer Cases, USA, 2009**

- Lymphoma = 74,490
- Lymphoma is 29x more common than all Bone Tumors combined
- Bone Tumors = 2,570 (0.17%)
Chondrosarcoma
Cartilage malignancy
Matrix: Chondroid
- Normal cartilage has no blood supply
  - Injured cartilage doesn’t regrow
- Chondrosarcoma: poor blood supply
  - Shows very little Gd enhancement
  - Doesn’t respond to chemotherapy
- Treatment: Complete tumor resection
Bone Tumors:
In 1 Simple Chart

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Fibrosarcoma
Malignant Fibroblastic Cells
Malignant Fibrous Histiocytoma (MFH)
Pt Age: > 20
May involve the bones
✓ Secondarily
✓ Primarily

Osteogenic Sarcoma
Pt Age: 10-20 years
Location: Metaphyseal
Matrix: Osseous
4 Subtypes:
1) Conventional
2) Telangiectatic Surface Osteosarcomas
3) PERIosteal
4) PARosteal

Osteogenic Sarcoma
1) Conventional
Pt Age: 10-20 years
Location: Metaphyseal
Matrix: Osseous
2) Telangiectatic
Highly vascular/bloody
Very aggressive
Nearly purely lytic
Usually present after pathologic fracture
→ Diffuse metastases

MRI is useful for staging the extent of the tumor...
Bone Tumors: In 1 Simple Chart

**Osteogenic Sarcoma**

Surface Osteosarcoma
Pt Age: 20-30 years
Good prognosis if marrow not involved, can resect tumor.
If spreads to marrow, conventional OS.

3) **PERiosteal**
Looks like aggressive periosteal reaction
Location: Long bones

[Image: Aggressive Periosteal Reaction]

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**Osteogenic Sarcoma**

Surface Osteosarcoma
Pt Age: 20-30 years
Good prognosis if marrow not involved, can resect tumor.
If spreads to marrow, conventional OS.

4) **PARosteal**

Pt Age: 20-30 years
Location: Back of Femoral Condyles
Arise from cortex, grow outward
Do NOT contain normal marrow (As opposed to osteochondroma)

[Image: CT]

©2004 Radiological Society of North America

**Periosteal Osteosarcoma**

Aggressive Periosteal Reaction

[Image: Aggressive Periosteal Reaction]


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## Bone Tumors: In 1 Simple Chart

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### Adamantinoma

- **VERY RARE**
- 0.1% Primary Bone Tumors
- Pt Age: 30-50
- Matrix: *Permeative*
- Location: TIBIA (90%)
  - Diaphyseal
  - Anterior Cortex
  - Soft Tissue Mass: Likely Malignant

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### A) Aneurysmal Bone Cyst

- **Pt Age:** < 20
- **Matrix:** None (Cyst)
- **Location:** Metaphyseal, Posterior Spine, Hands, Pelvis
- **“AVM of Bone”**
  - **MRI:** fluid/fluid level
- **“Aneurysmal & Cystic”**

- **“Aneurysmal”**
  - Multi-septated
  - Looks like soap bubbles

- **“MRI”**
  - **T2 fluid/fluid level**

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B) Unicameral (Simple) Bone Cyst

Uni-cameral: Latin “one” - “chamber”
(in US we have bi-cameral legislature)

Pt Age: < 20
Matrix: None (True Cyst)
Location: Metaphyseal
>50% Proximal Humerus
20-30% Proximal Femur
50% - Incidental Finding
50% - Pathologic Fx
✓ “Fallen Fragment”

Fractures tend to heal after 3 months...
Fracture healed

Cysts tend to recur
6m later...
12m later...
18m later
Although UBCs arise from metaphysis...
end of bone grows away from cyst...
so cyst becomes diaphyseal

MRI shows cyst extent

Fallen Fragment
after 3 months
Bone Tumors:
In 1 Simple Chart

B) Unicameral (Simple) Bone Cyst

P,D 6yoM

Simple cyst with hemorrhage → fluid-fluid level

B) Unicameral (Simple) Bone Cyst

H,T 18yoM

C) Chondroblastoma

Pt Age: Skeletally immature

Location: Epiphyseal

Matrix: Chondroid
(No matrix if not calcified)

Benign…
Aggressive appearance!

- Periosteal Reaction
- Surrounding Edema
  - Bone Marrow
  - Soft Tissues

C) Chondroblastoma

T2fs

Surrounding Edema
- Bone Marrow
- Soft Tissues

C) Chondroblastoma

cartilage-sensitive sequence

Epiphyseal mass, skeletally immature
Aggressive appearance
- Edema in surrounding marrow & tissues

C) Chondroblastoma

B,Q 15yoM

Cartilage → unfused physis

Articular Cartilage
Bone Tumors: In 1 Simple Chart

**D) Fibrous Cortical Defect**

**Non-Ossifying Fibroma (NOF)**

*THE most common bone lesion*
- Occurs up to 40% ALL children (75% occur 10 – 20 years old)
- Regress after skeletal maturity
- Asymptomatic, incidental finding (e.g. on knee MR for ACL tear)

If >50% bone diameter → Fx

**Location:** Metaphysis

Femur & Tibia

**Radiographic appearance:**
- If asymptomatic, no further workup is needed
- Eccentric, sub-cortical
- Cortex thinned, expanded
- Sclerotic margin
- Scalloped
- Multi-loculated

**No aggressive characteristics**

**G,M 9yoF**

9yo → 11yo → 13yo

Healing Callus

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Bone Tumors: In 1 Simple Chart

E) Eosinophilic Granuloma

Non-neoplastic proliferation histiocytes
Langerhans Cell Histiocytosis

Pt Age: typically <12yo (can occur young adult)
➢ EG (aka Histiocytosis X)
➢ Hand-Schuller-Christian (>3yo)
➢ Triad: skull lesions, exophthalmos, DI
➢ Letterer-Siwe (<3yo, fatal)

Pain, swelling, fever, ↑ESR, eosinophilia
Diff.Dx: Osteomyelitis (Ewing, Lymph/Leuk)

Bone lesions may resolve spontaneously
Often get Dx Bx/curettage. Steroids?

E) Eosinophilic Granuloma

Pt Age: < 12
Matrix: None
Location: Bone Marrow
➢ Skull (most common site)
    ✓ Sharp
    ✓ Punched-out
    ✓ “Beveled Edge” due to uneven involvement of outer/inner table

W,J 2yoM

E) Eosinophilic Granuloma

Pt Age: < 12
Matrix: None
Location: Bone Marrow
➢ Skull (most common site)
➢ Spine
    ✓ vertebra plana
    Can regrow height with treatment!

R,D 5yoM

E) Eosinophilic Granuloma

Pt Age: < 12
Matrix: None
Location: Bone Marrow
➢ Skull (most common site)
➢ Spine
➢ Pelvis
    ✓ supra-acetabulum
➢ Long bones (Femur)
    ✓ diaphysis

W,J 2yoM

E) Eosinophilic Granuloma

Pt Age: < 12
Matrix: None
Location: Bone Marrow
➢ Skull (most common site)
➢ Spine
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W,J 2yoM

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<td></td>
<td>...Mets Surface OS Adamantinoma</td>
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<td></td>
<td>Osteomyelitis (Active)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>2°Osteosarc (&gt;60)</td>
<td>CDC</td>
<td></td>
</tr>
</tbody>
</table>
Bone Tumors: In 1 Simple Chart

**F) Fibrous Dysplasia**
- **Pt Age:** <30 years
- **Location:** Any bone
- **Matrix:** Ground Glass
  - Monostotic (one bone)
    - Usually asymptomatic
  - Polyostotic (many bones)
    - Presents at younger age
    - Usually symptomatic
    - Syndromes
      - McCune– Albright syndrome

**McCune–Albright syndrome**
- **Triad**
  - Polyostotic Fibrous Dysplasia
    - Unilateral
  - Endocrine Abnormalities
    - Precocious puberty in girls
  - café au lait spots
    - "coast of Maine"

**AGGRESSIVE vs. NON-aggressive**

<table>
<thead>
<tr>
<th>age</th>
<th>AGGRESSIVE</th>
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<td>D</td>
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<td>E</td>
<td>G</td>
</tr>
<tr>
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<td>...Mets</td>
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<td>E</td>
</tr>
<tr>
<td></td>
<td>Surface OS</td>
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<td>F</td>
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**Bone Tumors: In 1 Simple Chart**

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</table>

**Giant Cell Tumor**

- Pt Age: Skeletally Mature
- (as opposed to Chondroblastoma)
- THE most common bone tumor in young adults 20-40yo

**Location:** Subarticular
- Arise from Metaphysis
- Extend across fused Growth Plate

**Matrix:** Purely Lytic
- Narrow Zone of Transition
- **NO SCLEROTIC MARGIN**

**V,R 21yoM**
- Benign
- Locally Aggressive

**B,J 25yoM**
- Solid & Cystic components
- Histologically, similarities GCT ↔ ABC

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### Bone Tumors: In 1 Simple Chart

**Why Age is Important**

<table>
<thead>
<tr>
<th>Location: Subarticular</th>
<th>Matrix: Purely Lytic</th>
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<tbody>
<tr>
<td>Age: &lt; 20 (skeletally immature)</td>
<td>Chondroblastoma</td>
</tr>
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<td>Age: 20-40 (skeletally mature)</td>
<td>Giant Cell Tumor</td>
</tr>
<tr>
<td>Age: &gt; 40</td>
<td>Metastases Multiple Myeloma</td>
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</table>

### Herniation Pit of the Femoral Neck

aka “Pitt’s Pit”

Michael Pitt, et.al. AJR 1982 vol 138, 6, p 1115-1121

- Round lucency
- Thin sclerotic rim
- Proximal Superior
- Anterior

Incidental finding \( \frac{1}{3} \) patients
Mechanical, not neoplastic

![Herniation Pit of the Femoral Neck](chart)

### Lytic Lesion: Distal Phalanx

- Enchondroma
  - Lytic: phalanges
  - Pathologic Fx
- Glomus Tumor
  - Nail bed ➔ Dorsal
- Epidermoid Inclusion Cyst
  - Puncture ➔ Volar
- Giant Cell Tumor
  - Tendon Sheath (Localized PVNS)
- Felon
  - (Fingertip infection)
- Sarcoidosis
- Gout
- Metastases
  - Lung

![Lytic Lesion: Distal Phalanx](chart)
**Enchondroma**
Benign rests of hyaline cartilage
- Common
  - Often discovered incidentally
  - Typically asymptomatic
  - 50% small tubular bones
- Mostly lytic
  - Pathologic Fracture

**Glomus Tumor**
Benign vascular tumor (neuromyoarterial apparatus)
- Subungual, erodes bone
  - Dorsal cortex distal phalanx
- Age: 30 – 50 (3x>)
- Triad
  - Sensitivity to cold
  - Localized tenderness
  - Severe intermittent pain

**Epidermoid Inclusion Cyst**
Implantation of epidermal elements
- Amputation
- Puncture (seamstress)
  - Volar cortex distal phalanx

**Gout**
M.B 78yoM
## Bone Tumors: In 1 Simple Chart

### Bone Tumors: In 1 Simple Chart

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### POEMS syndrome
- Polyneuropathy
- Organomegaly
- Endocrinopathy
- Monoclonal gammapathy
- Skin abnormalities
  - Sclerotic bone lesions
    - Medial Clavicle
    - Pelvis

### Paget’s Disease
- Becoming less common
- Three Phases
  - Lytic: Wedge with sharp borders
    - “Blade of grass”, “Candle flame”
  - Mixed: Bone destruction & formation
  - Blastic: Cortical/Trabecular thickening

### Ivory Vertebra
- Lymphoma
- Paget
- Blastic Met
- Breast
- Prostate
- Treated Met
- Chronic Osteo (Sarcoi) rare
- (Sclerotic Bone Lesion)
Bone Tumors: In 1 Simple Chart

### Enchondroma
Benign rests of hyaline cartilage
- **Common**
  - Often discovered incidentally
- **Typically asymptomatic**
  - can be painful (40%)
  - Pathologic Fracture
- **50% long tubular bones**
- Metaphyseal
- **Chondroid matrix**

### Chondrosarcoma
Malignant tumor of cartilage
- Pelvis
- Ends of bones
- **Presents with PAIN!**
  - 99% Painful
  - 40% Enchondromas
- Low Grade difficult to differentiate from benign
  - Radiologist
  - Pathologist
- 30% - Low Grade

Histopathology
1: Low Grade
2: Intermediate
3: High Grade

- Cellularity: **markedly** increased
- Nuclei Size: **markedly** increased

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Bone Tumors: In 1 Simple Chart

**Chondrosarcoma**

- **Histopathology**
  - 1: Low Grade
  - 2: Intermediate
  - 3: High Grade
- **Cellularity:** markedly increased
- **Nuclei Size:** markedly increased

**Enchondroma**

- **Histopathology**
  - 0.5: Borderline
  - 1: Low Grade
  - 2: Intermediate
  - 3: High Grade
- **Histologically:** resembles enchondroma
- **Radiologically:** aggressive

---

**How do you distinguish between them?**

Very difficult, sometimes you can’t 😞

- **Clues:**
  - Some Enchon Hot on BS
  - All Chondrosarc Hot on BS
  - 40% Enchon Painful
  - All Chondrosarc Painful (never incidental)

**Pt was very happy with outcome!**

- She’s now pain free
- She’s doesn’t have cancer

---

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## Bone Tumors: In 1 Simple Chart

### Osteoid Osteoma (Osteoblastoma)

**Pt Age:** < 30

- **Presents with PAIN!**
  - 98% Painful
  - Night pain, Rx NSAID

**Matrix:** Lucent Nidus

**Location:**

- **Diaphyseal**
  - Surrounding Sclerosis
  - Intra-capsular
  - No Sclerosis
  - Posterior Elements (OB)
  - Painful Scoliosis

### Radiographs

- **Cortical thickening**

### Bone Scan

- **Hot all 3 phases**

### CT:

- **Gold Standard for OO**

- **Diagnosis**
  - Lucent Nidus
  - Central Dot Calcium

- **Rx**
  - CT Guided RF Ablation
Osteoblastoma (= Osteoid Osteoma)

Term osteoblastoma used for:
- Larger lesions (\( > \approx 1\text{cm} \))
- Lesion in spine posterior elements
  - Painful scoliosis
    (Typically scoliosis is painless)

Osteoblastoma

CT: ✨ Gold Standard
- Diagnosis
  - Lucent Nidus
  - Central Dot Calcium

S,T 16yoM

Bone Scan
(Sagittal)

(S,T 16yoM)

S,T 16yoM
### Bone Tumors: In 1 Simple Chart

**Non-Aggressive Lytic**
- Osteosarcoma
- Ewing Sarcoma
- Chondrosarcoma

**Non-Aggressive Blastic**
- Osteoblastoma
- Chordoma
- Epidermoid Cyst

**Blastic**
- Osteomyelitis (Active)
- Paget's Disease
- Multiple Myeloma

**Lytic**
- Paget's Disease
- Metastases

### Osteochondroma

- Most Common Benign Neoplasm of Bone
- "Exostosis"
  - Pedunculated (stalk)
  - Sessile (flat)
- Cartilage Cap
  - Seen only on MR
- Point away from joint
- Continuity with underlying bone
  - Cortex continuous with cortex
  - Marrow continuous with marrow

### Osteosarcoma

- Most Common Benign Neoplasm of Bone
- Ewing Sarcoma
- Chondrosarcoma
- Fibrosarcoma/MFH
- Surface OS
- Adamantinoma
- Mets/Mult Myeloma

### Osteomyelitis

- Active
- Chronic

### Other Tumors

- Adamantinoma
- Ewing Sarcoma
- Osteosarcoma
- Osteomyelitis (Active)
- Mets (NB <5yo)
- Cortical Desmoid ("DNT")
- Lymphoma
- Chondrosarcoma
- Fibrosarcoma/MFH
- Paget's Disease
- Multiple Myeloma

---

**Bone Tumor Models**

- "Exostosis"
- "Pitts Pit"
- "Ivory Vertebra";
- Lymphoma, Paget, Met

---

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**Osteochondroma**

Most Common Benign Neoplasm of Bone

- **“Exostosis”**
  - Pedunculated (stalk)
  - Sessile (flat)
- Cartilage Cap
  - seen only on MR
- Point away from joint
- Continuity with underlying bone
  - Cortex continuous with cortex
  - Marrow continuous with marrow

**Osteochondroma**

Malignant Transformation to Chondrosarcoma

- Solitary: 1%
- Multiple Hereditary Exostoses (MHE): 10-30%
- Signs of malignant transformation:
  - Growth of lesion after skeletal maturity (can grow during childhood)
  - Cartilage cap > 1cm (can be 2-3cm during childhood)

**Osteochondroma**

KJ 11yoM

- CT: Tissue Window
- CT: Bone Window

Malignant Transformation to Chondrosarcoma

- Chondroid matrix
- Aggressive appearance
- Funny shaped femurs
- MHE?

**Osteochondroma**

Malignant Transformation to Chondrosarcoma

- Hot on BS c/w Chondrosarcoma

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Bone Tumors: In 1 Simple Chart

**Osteochondroma**

Most Common Benign Neoplasm of Bone
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Can cause mechanical problems

**Osteochondroma**

Can cause mechanical problems

**Osteochondroma**

Can cause mechanical problems

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**Osteochondroma**

Can cause mechanical problems

**Osteochondroma vs PARosteal Osteosarcoma**

- Cortex continuous with cortex
- Marrow continuous with marrow
- Cartilage Cap

**Osteosarcoma**

Non-aggressive

- Lytic
- Agressive

**Osteosarcoma**

Non-aggressive

- Blastic

**Osteosarcoma**

Non-aggressive

- Enchondroma
- Chondroblastoma
- Chondromyxoid Fibroma
- Osteoblastoma
- Osteoid Osteoma
- Osteoblastoma
- Osteochondroma

**Osteosarcoma**

Non-aggressive

- Paget's
- Bone Infarct
- Enchondroma
- Stress Fracture
- Osteomyelitis (Chronic)
- Metastases
- Mets/MM

**Osteosarcoma**

Non-aggressive

- Metastases
- Paget's
- Bone Infarct
- Osteosarcoma
- Ewing Sarcoma
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