Benign Bone Forming Tumors

James C. Wittig, MD
Orthopedic Oncologist
Sarcoma Surgeon
www.TumorSurgery.org
Osseous Lesions of Bone

Benign
- Enostosis and related conditions
- Osteoma
- Osteoid Osteoma
- Osteoblastoma

Malignant
- Osteosarcoma
  - Intramedullary
    - Conventional
      - Osteoblastic
      - Fibroblastic
      - Chondroblastic
    - Telangiectatic
    - Small Cell
    - Low Grade Intraosseous
  - Juxtacortical
    - Parosteal
    - Periosteal
    - High grade surface
  - Intracortical
Osseous Lesions of Bone

- **Definition:** Characterized by the presence or production of bone and/or osteoid

- **Radiographically:** Mineralization
Benign Osseous Lesions of Bone

• **Enostosis (Bone Island)**
  - Solitary foci, spot or island of dense compact bone within the medullary cavity (within cancellous bone)
  - Considered a hamartoma or developmental abnormality
  - Usually found incidentally
  - Patient is usually asymptomatic
  - Rare in children
Enostosis

- **Anatomic Sites:**
  - Any site
  - Most Common
    - Ribs
    - Spine
    - Pelvis
Enostosis

- **Radiology**
  - Round to oval dense osteoblastic area within the intramedullary canal usually with thorny, radiating spicules at margin that blend with surrounding trabeculae but are well defined
  - May be attached to inner cortex
  - 0.2 to 2 cm
  - Often epiphyseal or metaphyseal
  - Bone scan: Normal to mild increase in activity which helps differentiate an enostosis from a sclerotic bone metastasis
Enostosis

• **Radiology:**
  - May slowly increase or decrease in size
  - Up to 25% increase in diameter over 6 months

• **Differential Dx:**
  - Osteoblastic Metastasis
  - Osteoma
  - Osteoid Osteoma
  - Low Grade Osteosarcoma

• Bone scan is best test to differentiate

• Follow up: 1, 3, 6, 12 mos; Biopsy if grows too rapidly
Enostosis

• Pathology:
  • Intramedullary
  • Normal appearing **compact, lamellar (cortical) bone** with haversian canals within medullary bone
  • Thornlike projections at margins blend with surrounding trabeculae creating an irregular margin
  • **Haversian canals** with osteoblasts and osteoclasts (Howship’s lacunae)
    • Features of active bone deposition and remodeling
  • Increased activity on bone scan reflects increased bone turnover
Microscopic Pathology: Enostosis
Microscopic Pathology: Enostosis
Microscopic Pathology: Enostosis

Thorny Projections
Microscopic Pathology: Enostosis
Giant Enostosis (Giant Bone Island)

- Greater than 2-3cm in size
- Pelvis is most common site
- Most likely to demonstrate increased activity on bone scan (25-30% show mild increased uptake vs osteoblastic metastasis or sclerosing osteosarcoma that show intense uptake)
- Osteoblastic met and sclerosing osteosarcoma show entrapped host lamellar bone on pathology
Osteoma

- Rare, slow growing benign tumor or hamartoma composed of mature osseous tissue (compact lamellar bone)
- Protruding mass of dense periosteal intramembranous bone on surface of host bone
- Abnormally dense, but normal bone formed in the periosteum on the surface of bone

**Distribution:**
- Cranium, sinuses and mandible are most common
- Long bones—rare
Osteoma

- **Clinical:**
  - 4\textsuperscript{th} to 5\textsuperscript{th} decades
  - Usually asymptomatic
  - Sinus lesions may lead to sinusitis or can grow into cranial vault (found in 0.42\% of sinus radiographs)
  - Orbital lesions—exophthalmos, diplopia, displacement of globe
  - May be associated with Gardner’s syndrome
    - Familial Polyposis Coli
    - Refer to a Gastroenterologist for colonoscopy
Osteoma

• **Radiology:**
  - **XR:** Sharply defined, smooth, homogeneous bone protruding from the surface of a bone
  - Usually remain unchanged on serial studies
  - Usually diagnosed incidentally on radiographs
Osteoma
Osteoma
Osteoma of Calvarium
Osteoma

- Pathology:
  - Nodules of dense, mature, lamellar (cortical) bone surrounding Haversian Canals (same as enostosis)
  - The bone is very orderly and mature
  - The bone is organized into lamellae
  - The cells are uniform and have small nuclei
  - No nuclear pleomorphism
  - No Mitoses
Gross Pathology: Osteoma
Microscopic Pathology: Osteoma
Microscopic Pathology: Osteoma
Microscopic Pathology: Osteoma

Haversian Canals
Polarized Light Demonstrating Lamellar Arrangement
Microscopic Pathology: Osteoma
Differential Diagnosis of Osteoma

- The following chart demonstrates the radiological and pathological differential diagnosis of an osteoma.
Differential of an Osteoma
Relationship of Lesions to Cortex of Bone: How to Differentiate

Parosteal Osteosarcoma
Sessile Osteochondroma
Periosteal Osteoblastoma
Ossified Parosteal Lipoma
Myositis Ossificans
Melorheostosis
Parosteal Osteosarcoma
CT Scan of Parosteal Osteosarcoma

- A cleft (arrow) can often be identified at the periphery of the tumor between the tumor and underlying cortex.
- There is no cleft associated with an osteoma.
Parosteal Osteosarcoma

- The cortex is usually intact with a parosteal osteosarcoma unless it has grown through the cortex and invaded the medullary canal (this would indicate a more aggressive parosteal osteosarcoma). The cortex is also intact with an osteoma.
CT Scan Parosteal Osteosarcoma

Cleft
Osteochondroma

- Cartilaginous tumor
- Calcifications in a ring and arc manner
- It grows from a piece of the growth plate that branches off and grows outward instead of longitudinally
- Corticomedullary continuity
- Notice that there is no cortex between the osteochondroma and underlying bone; the medullary cavities are continuous
Myositis Ossificans
Myositis Ossificans

• Myositis ossificans occurs from an injury
• It can form directly in a muscle or form closely applied to the surface of a bone
Myositis Ossificans

- Zonal Phenomenon: The periphery of the lesion matures and the central portion of the lesion appears to form a medullary canal that contains fat and marrow.
  - Myositis ossificans goes through a maturation phase.
  - Initially it may show minimal ossification and mineralization
  - Usually after 6-12 weeks, the amount of mineralization increases. As the process matures, a zonal phenomenon occurs.
Melorheostosis

- **Definition:** Rare sclerosing bone disorder that is symptomatic and usually becomes manifest after early childhood; “Candle Wax Drippings”
- Localized, diffuse thickening of cortical bone; wax dripping down the side of a candle
- Sometimes initial signs appear in adult patients
- Equal sex distribution
- No inheritance pattern
Melorheostosis

• **Clinical Manifestations:**
  • Asymmetric; Usually a single limb involved
  • Lower extremity > Upper extremity

• **Signs/Symptoms**
  • Pain and swelling of joints
  • Decreased ROM
  • Joint contractures; tendon and ligament shortening
  • Soft tissue involvement and juxtaarticular masses
  • Growth disturbances that can lead to scoliosis, joint contracture, and foot deformity
  • Scleroderma like skin lesions over affected bones
Melorheostosis

- **Radiology:**
  - Osseous excrescenses often exuberant and lobulated along bone surface (Periphrally located cortical hyperostosis)
  - Wavy, sclerotic bone contour
  - Endosteal involvement (rare) may encroach on marrow space
  - Soft tissue masses: Soft tissue ossification and calcification---ankylosis
  - Bone scan: Intense activity
  - MR: Bone and soft tissue lesions demonstrate low signal on all pulse sequences
Melorheostosis

Thickened and enlarged cortical bone with prominent haversian canals
Melorheostosis

• **Associations:**
  
  - Linear scleroderma
  - Osteopoikilosis
  - Osteopathia striata
  - Neurofibromatosis
  - Tuberous sclerosis
  - Hemangiomas
  - In the axial skeleton, can be accompanied by overlying fibrolipomas in adjacent areas including the spinal canal and retroperitoneum
Parosteal Lipoma

- A parosteal lipoma consists of an exostosis protruding from the surface of a bone that is surrounded by a benign fatty tumor.
- There is no corticomedullary continuity between the exostosis and underlying bone.
Osteoid Osteoma
• Osteoid Osteoma is a benign osteoblastic (bone forming) tumor that is usually less than 2cm in size.

• It consists of a central vascularized nidus that represents the neoplastic tissue. The nidus is surrounded by normal reactive bone.

• Usually a single lesion that is very painful. The nidus microscopically resembles the same type of tissue as an osteoblastoma.
Clinical Presentation

• **Signs/Symptoms:** Progressive pain that is significantly relieved by aspirin or an NSAID (very rarely, less than 1%, may be painless)
  - The pain is often the worst at night
  - Unmyelinated nerve fibers have been demonstrated in osteoid osteomas
  - Osteoid Osteomas produce high levels of PGE2 (this may be the reason why aspirin works at relieving pain, by inhibiting PGE2 production)
  - Tumors next to growth plates may increase growth and cause skeletal asymmetry
  - Epiphyseal lesions may cause a joint effusion and clinical picture similar to rheumatoid arthritis
  - Vertebral lesions may cause a scoliosis due to muscle spasm

• **Prevalence:**
  - 3% of all bone tumors
  - Males more commonly affected than females ~ 3:1
Clinical Presentation

- **Age:** Most common in second decade of life
  - 75%-80% of patients < 25 years
  - Rarely over 30 years

- **Sites:** Femoral neck most common but can occur in any bone and any site within a bone (metaphyseal, diaphyseal, epiphyseal; cortical, medullary and periosteal)
  - 50% occur in long bones of lower extremities
  - Most osteoid osteomas are intracortical in origin but can also occur in the medullary canal or subperiosteal
Radiographic Presentation

**Plain X-Rays:**
- Lucent nidus (well defined) surrounded by a zone of marked sclerosis
  - Nidus may be a few millimeters to 2 cm in diameter
- Central zone of density within center of nidus due to mineralization of osteoid/ossification
- Periosteal reaction is solid and continuous, rarely lamellated and often appears as cortical thickening
- Cortical and subperiosteal osteoid osteomas usually more reactive sclerosis than medullary tumors
- Intracapsular osteoid osteomas are difficult to identify because there is no periosteum in the intracapsular region and hence a periosteal reaction does not occur.
Radiographic Presentation

- **CT Scan:** Well defined nidus with a smooth peripheral margin; +/- mineralization (CT more sensitive than XR and MRI for detecting mineralization); CT is better for detecting nidus in presence of exuberant sclerosis.
Radiographic Presentation

• **Bone Scan:**
  - **Double Density Sign:** Hot within the nidus and less intense accumulation peripherally within the sclerotic bone

• **MRI:**
  - MRI should be performed with gadolinium. The nidus should enhance with gadolinium
  - Marrow and soft tissue edema is extensive that it may be difficult to visualize the nidus and may mimic a malignant tumor such as Ewing’s sarcoma or osteomyelitis. CT is more useful for detecting the nidus if there is extensive edema
  - MRI is good for detecting synovitis and joint effusion with intraarticular osteoid osteomas
Plain X-ray: Osteoid Osteoma

- **Cortical Thickening**
- **Nidus**
Plain X-Ray: Osteoid Osteoma

- Radiolucent Nidus (arrow)
- Surrounding Sclerosis
- Benign Periosteal Reaction causing Cortical Thickening

Wittig Orthopedic Oncology
CT Scan: Osteoid Osteoma

Mineralization in Nidus Detected on CT

Cortical Thickening
CT Reformatted Image: Osteoid Osteoma

Punctate Mineralization in Nidus
MRI: Osteoid Osteoma

Nidus
Plain X-ray: Osteoid Osteoma of Femur
CT Scan: Osteoid Osteoma of Femur

Radiolucent Nidus with Central Mineralization, Reactive Bone and Thickened Cortex
Xray: Intramedullary Osteoid Osteoma of Proximal Femur

- Radiolucent nidus
- Mild reactive sclerosis around lesion
- Intramedullary lesions are associated with less reactive bone than intracortical lesions that usually demonstrate intense reactive sclerosis
X-ray: Osteoid Osteoma of Distal Humerus Olecranon Fossa

Radiolucent Nidus with Mineralization and Surrounding Sclerosis
Osteoid Osteoma of Distal Humerus: CT Shows Nidus with Extensive Mineralization
X-Ray: Osteoid Osteoma of Tibia

Subtle Cortical Thickening and Sclerosis
X-Ray: Osteoid Osteoma of Tibia

Subtle Sclerosis
Difficult to see nidus on X-ray
Bone Scan: Osteoid Osteoma of Tibia
Bone Scan: Osteoid Osteoma of Tibia
CT Scan: Osteoid Osteoma of Tibia
CT Scan: Osteoid Osteoma of Tibia
Extensive Sclerosis Obliterated the Canal of the Right Tibia
X-ray: Osteoid Osteoma of Left Acetabulum (Not Detectable on Plain X-ray)
Bone Scan: Osteoid Osteoma of Left Acetabulum
CT Scan: Osteoid Osteoma of Left Acetabulum
(The nidus is a few millimeters)
MRI of Osteoid Osteoma of Acetabulum
(Nidus not Clearly Visualized)
There is Extensive Surrounding Edema
Gross Pathology

- The nidus is distinct oval/round and reddish from vascularity
- It is well circumscribed and easily separated from surrounding bone
- The nidus is usually less than 1 cm but may be up to 2 cm
- The nidus may have a variable consistency depending on the extent of mineralization
  - Friable, soft and granular to densely sclerotic
Gross Pathology: Osteoid Osteoma

Nidus Surrounded by Reactive Cortical Bone
Gross Pathology: Osteoid Osteoma Nidus

- The nidus is reddish due to its vascularity
- It may be friable, granular and gritty
Gross Pathology: Osteoid Osteoma
Microscopic Pathology

- Vascularized fibrovascular stroma and trabeculae of immature woven bone
- Nidus is sharply demarcated from surrounding reactive bone and there is an abrupt zone of transition between normal bone and the osteoid osteoma. There is no permeation of the lesion through the surrounding reactive trabeculae of bone
- The trabeculae are uniformly lined by plump, uniform, active osteoblasts ("Osteoblastic Rimming")
- Osteoclasts may be prominent
- Mature nidus consists of more heavily calcified trabeculae of woven bone and osteoid
- No abnormal mitoses
Nidus is Sharply Demarcated from Surrounding Reactive Bone
Microscopic Pathology: Osteoid Osteoma

- Interlacing trabeculae of woven (immature) bone and osteoid (Arrows)
- Bone is lined by plump, uniform, regularly arranged osteoblasts (Osteoblastic Rimming)
- No mitotic figures
- No pleomorphism
- The intervening stroma is very well vascularized
Microscopic Pathology: Osteoid Osteoma Nidus
Low Power View
Microscopic Pathology: Osteoid Osteoma
Osteoid Osteoma
Intermediate Power

Osteoblasts line up around the trabeculae.
Osteoid Osteoma High Power

- Osteoblasts are plump and regularly arranged around and line the woven bone trabeculae. This is referred to as “Osteoblastic Rimming”
- There are no mitoses and minimal pleomorphism
Differential Diagnosis: Osteoid Osteoma

• **Differential DX of Cortical Osteoid Osteoma**
  - Brodie’s Abscess
  - Stress Fracture
  - Eosinophilic Granuloma
  - Intracortical Hemangioma
  - Bone Island
  - Intracortical Osteosarcoma
  - Ewing’s Sarcoma
Osteoid Osteoma

• Differential Diagnosis of Intraarticular lesions
  • Rheumatoid arthritis
  • JRA
  • Tuberculous arthritis
  • Nonspecific synovitis
  • Septic arthritis
  • Osteoblastoma (especially the spine)
Bone Island (Enostosis)

Brodie Abscess

Stress Fracture

Intracortical Osteosarcoma

Medullary Osteoid Osteoma

Medullary Osteoid Osteoma with Sclerotic Center

Cortical Bone Abscess

Cortical Osteoid Osteoma

Cortical Bone Abscess
Brodie’s Abscess
Bone Abscess
Bone Abscess

Sinus Tract
Brodie’s Abscess
Brodie’s Abscess
Brodie’s Abscess

Draining Sinus Tract from Bone
Stress Fracture
Bone Island
Bone Island Pathology

- Pathology is same as an osteoma except a bone island occurs within the medullary canal and not on the surface of the bone
- Mature, dense, cortical, compact bone arranged in a lamellar manner around haversian canals
- Sits within medullary canal
Bone Island

• The periphery of a bone island extends outward as spicules that blend in with surrounding trabeculae

• CT scan can often demonstrate these spicules
Pathology of a Bone Island
Osteoid osteomas exhibit limited growth potential and grow to a certain size (rarely grow greater than 1 cm) and then stop growing. Some tumors may spontaneously regress. Osteoid osteomas that occur next to joints or intra-articularly may cause the adjacent synovium to become thickened. There may be chronic inflammatory cell infiltrates with lymphofollicular features in the synovium that can be mistaken for rheumatoid arthritis. Long standing intraarticular tumors can lead to a true arthritis.
Treatment

- CT guided percutaneous radiofrequency ablation (RF Ablation).
  - 90% successful and there are minimal risk
- Some patients may require open surgical excision or “Burr Down Resection” of the osteoid osteoma
  - Mostly for recurrent tumors
- Lesions not accessible surgically or with RF ablation may be treated with chronic NSAIDS
  - Problems with gastritis and renal failure
  - Sometimes spontaneously regress or burn but there are patients who have had osteoid osteomas for years
Osteoblastoma
General Information

• Benign osteoblastic neoplasm with aggressive growth pattern (considered a benign aggressive tumor)
  • Histologically it is similar to osteoid osteoma but is a larger size and grows progressively
• Consists of well vascularized connective tissue stroma with interconnecting trabeculae of osteoid and immature woven bone
• Constitute about 1% of excised primary bone tumors
• Osteosarcoma is 20x more common and osteoid osteoma is 4x more common than osteoblastoma
• There is a more aggressive form of osteoblastoma in which recurrences are more common. These tumors have a higher rate of recurrence.
Clinical Presentation

**Signs/Symptoms:** Pain is the most common presenting symptom
- Pain is usually less severe and less pronounced at night and may or may not be relieved by aspirin compared to an osteoid osteoma.
- Spinal lesions may be accompanied by muscle spasms, scoliosis and neurological manifestation

**Prevalence:** Males: Females 2-3:1

**Age:**
- 80% of patients are between 10 and 30 years old

**Sites:**
- Spine (40% of cases; usually posterior elements)
- Long Bones (30%)
  - Most arise from diaphysis or metaphysis
  - Epiphyseal lesions are rare but may occur more often in the tubular bones of the hands or feet
Radiographic Presentation

• **Plain X-rays:**
  - Geographic, circumscribed lesion usually around 5cm in size.
  - Expansion of bone, cortical thinning and cortical breakthrough. A soft tissue mass may accompany this lesion but the soft tissue component is usually contained by the periosteum.
  - The periosteum remains intact around the soft tissue component. CT scan useful to detect the subtle calcification (Egg Shell Rim of Calcification) associated with an intact periosteal reaction.
  - The lesion may be entirely radiolucent but usually shows some degree of mineralization. (CT useful for subtle mineralization)
  - Usually less surrounding sclerosis than an osteoid osteoma.
Radiographic Presentation

- **Bone Scan**: Increased uptake at the site of the lesion
- **CT Scan**: More useful for detecting mineralization and evaluating extent of bone destruction than plain X-ray
- **MRI**: Useful in determining extent
  - There is often extensive *edema* around the tumor in the surrounding bone and soft tissues that can lead to a misdiagnosis of a malignant tumor.
Plain X-Ray: Osteoblastoma

- Geographic Pattern of Bone Destruction
- Eccentric
- Sclerotic Margin
- Buttressing, Benign Appearing Periosteal Reaction (Cortical Thickening/Bony Expansion)
- No clear mineralization on X-ray
Plain X-ray: Osteoblastoma of Proximal Humerus
Plain X-Ray: Osteoblastoma of Distal Femur

- Geographic Well Circumscribed Lesion
- Mineralization
- Intact Periosteal Reaction
- Continuous Periosteal Reaction
MRI: T1 Weighted Image of Osteoblastoma of Distal Femur

- Geographic Well Circumscribed Lesion
- Intermediate Signal on T1
MRI: T2 Weighted of Osteoblastoma of Distal Femur

- Geographic Lesion
- High signal on T2 with punctate low signal areas consistent with mineralization (Arrows)
- There is extensive edema around the lesion (high signal in medullary canal)
MRI: T2 Coronal MRI of Osteoblastoma of Distal Femur

Geographic Lesion with Narrow Zone of Transition between Tumor and Surrounding Bone

Soft Tissue Edema

Surrounding Edema
CT Scan of Distal Femur Osteoblastoma

Geographic Lesion

Punctate Mineralization
X-ray: Osteoblastoma of Distal Radius

- Geographic Lesion
- Well Circumscribed
- Mineralization may not be detectable on a plain radiograph
MRI: Osteoblastoma of Distal Radius
MRI: Osteoblastoma of Distal Radius
Plain X-Ray: Osteoblastoma of Sternum
CT Scan: Osteoblastoma of Sternum
Axial Section

Geographic Lesion
Well Circumscribed
Benign Periosteal Reaction
Internal Mineralization
CT Scan Osteoblastoma of Sternum
Coronal Section
CT Scan Osteoblastoma of Sternum
Sagittal Section
MRI: T1 Weighted Image Osteoblastoma of Sternum
MRI: T2 Weighted Image of Osteoblastoma of Sternum with Surrounding Edema
X-ray: Osteoblastoma of Proximal Phalanx

- Geographic Lesion
- Cortex Expansile
- Mineralization not always detected on x-ray
Osteoblastoma

• **Radiology of Spine Lesions:**
  - Well defined, expansile, geographic, osteolytic lesion that is partially or extensively calcified or ossified
  - Posterior elements alone (>60% of cases)
  - Posterior elements with extension into vertebral body (25%)
  - Vertebral body alone (15%)
  - More likely to contain ossification and a soft tissue mass
  - Sclerosis less likely than long bones
  - Scoliosis less characteristic than osteoid osteoma
Osteoblastoma of Spine

- Geographic Lesion
- Posterior Elements of Spine
- Bone is Expanded
- The lesion (soft tissue component) is surrounded by an “Egg Shell” rim of calcification indicating the periosteum is intact
- Mineralization present in lesion
Osteoblastoma of Spine
MRI: Osteoblastoma of Spine Posterior Elements

Osteoblastoma
MRI: Osteoblastoma of Spine Posterior Elements
CT Scan Osteoblastoma of Spine Posterior Elements
Osteoblastoma

• **Differential between Osteoid Osteoma and Osteoblastoma**

  • **Osteoblastoma**
    - Size: >1.5-2cm
    - Growth: Benign Aggressive Lesion: Continues to grow and destroy bone (osteoid osteoma has a limited growth potential--indolent)
  - Soft Tissue Mass with an Osteoblastoma
  - Scoliosis and classical pain symptoms absent with Osteoblastoma
  - Matrix is multifocal in an osteoblastoma and not central
Gross Pathology

• Indistinguishable from an osteoid osteoma except larger
• Nidus is well demarcated
  • Granular, friable, reddish hemorrhagic tissue
  • May bleed significantly when curetted
• Cortex is thinned, possibly destroyed
Microscopic Pathology

- Interlacing network of bone trabeculae in a loose fibrovascular stroma
  - Prominent vessels
- Osteoblasts are plump, active, scattered mitotic figures
- Osteoblasts line up around periphery of trabeculae (Osteoblastic Rimming)
- Soft tissue component usually surrounded by shell of reactive bone or periosteum (Egg Shell Rim of Calcification)
- No cartilage production (as opposed to osteosarcomas that may contain areas of cartilage)
Osteoblastoma
Osteoblastoma

Trabeculae of Woven Bone Lined by Osteoblasts

Fibrovascular Stroma
Osteoblastoma

Trabeculae of Woven Bone

Osteoblasts Line Trabeculae
Osteoblastoma

- Thickened Reactive Surrounding Bone
- Immature Trabeculae of Woven Bone Lined by Plump Osteoblasts
Osteoblastoma
Low Power View

Trabeculae of Immature Woven Bone Lined by Osteoblasts
Osteoblastoma
Low Power View
Osteoblastoma
Osteoblastoma
High Power View

Fibrovascular Stroma
Plump Osteoblasts
Line Trabeculae
Trabecula of Woven Bone
Osteoblastoma

- Trabeculae of Immature, Woven Bone
- Osteoblasts Line Trabeculae (Osteoblastic Rimming)
- Fibrovascular Stroma
Aggressive Osteoblastoma

• Aggressive osteoblastoma has much more aggressive local behavior than a conventional osteoblastoma. They have a higher chance for local recurrence after removal.

• There has been controversy about the true existence of this type of tumor and whether these tumors are actually low grade osteosarcomas.

• They have a similar appearance microscopically as a conventional osteoblastoma except the osteoblasts are twice as large and have an epithelioid quality with abundant eosinophilic cytoplasm (Epithelioid Osteoblasts).

• Aggressive osteoblastoma is a borderline lesion between osteoblastoma and osteosarcoma. It is not a precursor to osteosarcoma. It does not metastasize.
Aggressive Osteoblastoma

- Older age group than conventional osteoblastoma. Most patients are older than age 30.
- Affects a broad variety of bones.
- Usually larger than a conventional osteoblastoma and have been reported to be up to 8.5 cm in diameter.
- Most have a similar radiographic appearance as a conventional osteoblastoma and have well defined margins, variable amounts of mineralization and peritumoral sclerosis. They occasionally have radiographic characteristics consistent with malignancy.
Plain X-Ray: Aggressive Osteoblastoma of a Hand Metacarpal

Mineralization within tumor

Expansile large lesion with soft tissue component
Pathology of Aggressive Osteoblastoma

- Osteoblast cells are uniform
- Cells line trabeculae
- Trabeculae are usually more thickened than conventional osteoblastoma
- Osteoblasts are larger than normal osteoblasts and have an epithelioid shape (Epithelioid Osteoblasts)
Pathology of Aggressive Osteoblastoma
Epithelioid Osteoblasts
Aggressive Osteoblastoma

• Differential Diagnosis:
  • Osteoid Osteoma
  • Conventional Osteoblastoma
  • Osteosarcoma

• The differential between osteoid osteoma, conventional osteoblastoma and aggressive osteoblastoma is based on size and the presence of epithelioid osteoblasts. Can have epithelioid osteoblasts in osteoid osteoma and conventional osteoblastoma but they do not occur in cohesive sheets that fill intertrabecular spaces
Osteoblastoma

• Pathology:

• Differentiation from osteosarcoma
  
  • Osteoblastomas that are greater than 4 cm and that show prominent periosteal new bone formation may present problems in differentiation from osteosarcoma
  
  • May have foci of lace-like osteoid, high cellularity and more than a few scattered mitotic figures but these characteristics usually occur independently in an osteoblastoma vs all these atypical characteristics being present in an osteosarcoma
Osteoblastoma vs. Osteosarcoma
Osteosarcoma

- Lace-like Osteoid laid down in between cells
- No trabeculae
- Cells are crowded
- High degree of cellular pleomorphism
- Cells do not resemble osteoblasts
- High mitotic rate with atypical mitoses
Xray: Conventional Osteosarcoma of Distal Femur

- Classic radiographic example of a conventional osteosarcoma of the distal femur
- Distal Femur is most common site for a conventional osteosarcoma
- Permeative lesion with mixed lysis and sclerosis (sclerosis is calcified osteoid)
- Metaphyseal Origin
- There is a Codman’s triangle interrupted type of periosteal reaction
- Tumor extends into soft tissue and the soft tissue component is ossified
Xray: Osteosarcoma of Proximal Tibia

- Proximal tibia is second most common site for conventional osteosarcoma
- Permeative lesion with mixed lysis and sclerosis (ossification)
- Metaphyseal origin
- Soft tissue extension
- Hair on End periosteal reaction
Osteoblastoma

• **Natural History**

  • Benign, aggressive tumors
  
  • Propensity for local recurrence
  
  • Grow locally within the bone and destroy bone as they grow
  
  • Grow slowly and do not metastasize
Treatment

• Extremity Lesions:
  • Intralesional Curettage Resection and Cement Fixation vs. Bone Grafting
    • Local adjuvant may be considered such as cryosurgery to reduce the risk of local recurrence
  • En-bloc excision for massive tumors

• Spine lesions:
  • En-bloc resection (recurrence may be as high as 25%)
  • Radiotherapy may be recommended after inadequate removal particularly for spine lesions
  • Rarely—malignant transformation after radiation
Prognosis

• Majority of patients are cured by initial therapy
• Recurrences usually occur within 2 years from initial surgery from regrowth of microscopic cells
  • Recurrences after 2 years is very rare
• Recurrences in spine are more common and occur in approximately 25% of cases
Thank You