

## Benign Bone Tumors

Tumor	Location	Age	Male : Female	Morphology			Notes
				Macroscopic	Histology	Radiology	
Osteoma	most commonly in the head and neck	Middle age		solitary, slowly growing, hard, exophytic masses on a bone surface	composed of a mixture of woven and lamellar bone.		<ul style="list-style-type: none"> <li>Multiple lesions are a feature of Gardner syndrome</li> <li>not locally aggressive and do not undergo malignant transformation.</li> </ul>
Osteoid Osteoma	Around the knee	teenage years and 20s	2:1	round-to-oval masses of hemorrhagic, gritty-appearing tan tissue. A rim of sclerotic bone is present at the edge of both types of tumors.	composed of interlacing trabeculae of woven bone surrounded by osteoblasts. The intervening stroma is loose, vascular connective tissue containing variable numbers of giant cells.	Nidus < 1.5 cm	<ul style="list-style-type: none"> <li>Treatment: local excision</li> <li>Malignant transformation is rare unless the lesion is treated with irradiation.</li> <li>Aspirin relieve osteoid osteoma pain but not osteoblastomas</li> </ul>
Osteoblastoma	Vertebra					Nidus > 1.5 cm	
Osteochondroma	only in bones of endochondral origin arising at the metaphysis near the growth plate of long tubular bones, especially about the knee	late adolescence and early adulthood	3:1	Exostosis		Exostosis	<ul style="list-style-type: none"> <li>Cause: Inactivation of both copies of the <b>EXT1</b> or <b>EXT2</b> genes through mutation</li> <li>rarely progress to chondrosarcoma</li> </ul>
Giant Cell Tumor	arise in the epiphysis and involve the metaphysis of long bones around the knee.	20s to 40s		GCTs are large and red-brown, and often show cystic degeneration	composed of uniform oval mononuclear cells and scattered osteoclast-type giant cells containing 100 or more nuclei. Mitotic figures are typically frequent. Necrosis, hemorrhage, and reactive bone	Soup like	<ul style="list-style-type: none"> <li>relatively common benign but locally aggressive bone tumor</li> <li>2% spread to the lungs as localized lesions that are</li> </ul>

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					formation also are commonly present.		cured by local excision
Enchondroma	the short tubular bones of the hands and feet.	Between 20 and 50 years			they are well circumscribed and composed of hyaline cartilage containing cytologically benign chondrocytes		<ul style="list-style-type: none"> <li>rarely undergo malignant</li> </ul>
Fibrous dysplasia	In descending order of frequency, ribs, femur, tibia, jawbones, calvariae, and humerus are most commonly affected...	during the second and third decades	no gender predilection	fibrous dysplasia is characterized by well-circumscribed, intramedullary lesions of varying sizes; large masses expand and distort the bone. Lesional tissue is tan-white and gritty-appearing;	it exhibits curved trabeculae of woven bone (mimicking Chinese characters), without osteoblastic rimming, surrounded by a moderately cellular fibroblastic proliferation		Mutations of the GNAS gene, are responsible

#### More Notes:

- Osteoid osteoma showing randomly oriented trabeculae of woven bone rimmed by prominent osteoblasts. The intertrabecular spaces are filled by vascular loose connective tissue.
- Chondroma:
  - When they arise within the medulla, they are termed enchondromas; when on the bone surface, they are called juxtacortical chondromas
  - Ollier disease is characterized by multiple chondromas preferentially involving one side of the body.
  - Maffucci syndrome is characterized by multiple chondromas associated with soft tissue spindle cell hemangiomas.
- Fibrous dysplasia manifests with one of three clinical patterns:
  - (1) involvement of a single bone (monostotic); accounts for 70% of cases;
  - (2) involvement of multiple bones (polyostotic);
  - (3) polyostotic disease, associated with café au lait skin pigmentations and endocrine abnormalities, especially precocious puberty (McCune-Albright syndrome).

## Malignant tumors of bone

Tumor	Location	Age	Male : Female	Morphology		Notes
				Macroscopically	Microscopically	
Osteosarcoma	the metaphyseal region of the long bones of the extremities, with almost 60% occurring about the knee	Osteosarcomas occur in all age groups, but about 75% of patients are younger than 20 years of age, with a second peak occurring in elderly persons	1.6 : 1	Macroscopically. Mass involving the upper end of the tibia. The tan-white tumor fills most of the medullary cavity of the metaphysis and proximal diaphysis. It has infiltrated through the cortex, lifted the periosteum, and formed soft tissue masses on both sides of the bone.	Tumor cells vary in size and shape and frequently have large hyperchromatic nuclei; bizarre tumor giant cells are common, as are mitotic figures. <b>The production of coarse and lacelike mineralized or unmineralized bone (osteoid) by malignant cells is essential for diagnosis of osteosarcoma</b>	<ul style="list-style-type: none"> <li>• After myeloma and lymphoma, osteosarcoma is the most common primary malignant tumor of bone</li> <li>• Vascular invasion is common, as is spontaneous tumor necrosis</li> <li>• Several mutations are closely associated with the development of osteosarcoma. In particular, RB gene mutations</li> </ul>
Secondary osteosarcomas		older adults most commonly in the setting of Paget disease or previous radiation exposure.				Despite aggressive behavior, standard treatment with chemotherapy and limb salvage therapy currently yields long-term survivals of 60% to 70%.
Chondrosarcoma		40 or older	2:1		Tumor grade is determined by cellularity, degree of cytologic atypia, and mitotic activity	

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				Macroscopically	Microscopically	
<p><b>Ewing Sarcoma and Primitive Neuroectodermal Tumor</b></p> <p>(They share certain molecular features, however; PNETs demonstrate clear neural differentiation, whereas Ewing sarcomas are undifferentiated)</p>		<p>Most patients are 10 to 15 years of age, and 80% are younger than 20 years</p>	<p>Boys are affected slightly more frequently than girls</p>	<p>Ewing sarcoma/PNET arises in the medullary cavity and invades the cortex and periosteum to produce a soft tan white tumor mass, frequently with hemorrhage and necrosis</p>	<p>: t is composed of sheets of uniform small, round cells that are slightly larger than lymphocytes; The presence of Homer-Wright rosettes (tumor cells circled about a central fibrillary space) indicates neural differentiation</p>	<ul style="list-style-type: none"> <li>• Ewing sarcoma accounts for 6% to 10% of primary malignant bone tumors</li> <li>• At a practical level, these translocations are of diagnostic importance, as approximately 95% of tumors have t(11;22) or t(21;22).</li> </ul>

### Variants of Chondrosarcomas

- ✓ **Conventional chondrosarcoma, the most common variant.** It is composed of malignant hyaline and myxoid cartilage.
- ✓ **Myxoid chondrosarcomas.** Low-grade tumors may be difficult to distinguish from enchondroma. Higher-grade lesions contain pleomorphic chondrocytes with frequent mitotic figures.
- ✓ Approximately 10% of patients with conventional lowgrade chondrosarcomas have a second high-grade poorly differentiated component (**dedifferentiated chondrosarcomas**)
- ✓ **Clear cell chondrosarcomas.**
- ✓ **Mesenchymal chondrosarcomas.**

### Metastatic Disease:

- ✓ *Metastatic tumors are the most common malignant tumors involving bone.* Pathways of spread include:
  - (1) Direct extension.
  - (2) Lymphatic or hematogenous dissemination.
  - (3) Intraspinal seeding.
- ✓ In adults more than 75% of skeletal metastases originate from cancers of the prostate, breast, kidney, and lung.
- ✓ In children, neuroblastoma, Wilms tumor, osteosarcoma, Ewing sarcoma, and rhabdomyosarcoma are the common sources of bony metastases.
- ✓ The radiologic appearance of metastases can be purely lytic, purely blastic, or both. In lytic lesions (e.g., with kidney and lung tumors and melanoma), however; metastatic tumors that elicit an osteoblastic response (e.g., prostate adenocarcinoma).

## Clinical Features:

### 1. Osteosarcoma Clinical Features:

- Osteosarcomas typically manifest as painful enlarging masses, although a pathologic fracture can be the first sign.
- Radiographic imaging usually shows a large, destructive, mixed lytic and blastic mass with indistinct infiltrating margins. A triangular shadow on the x-ray film between the cortex and raised periosteum (*Codman triangle*) is characteristic of osteosarcomas.
- Osteosarcomas typically spread hematogenously.

### 2. Chondrosarcomas Clinical Features:

- Chondrosarcomas commonly arise in the pelvis, shoulder, and ribs; in contrast with enchondromas, chondrosarcomas rarely involve the distal extremities.
- They typically manifest as painful, progressively enlarging masses.
- There is also a direct correlation between grade and biologic behavior of the tumor.
- Fortunately, most conventional chondrosarcomas are indolent and low-grade, with a 5-year survival rate of 80% to 90% (versus 43% for grade 3 tumors); grade 1 tumors rarely metastasize, whereas 70% of the grade 3 tumors disseminate.
- Chondrosarcomas metastasize hematogenously, preferentially to the lungs and skeleton.
- Conventional chondrosarcomas are treated with wide surgical excision.
- Chemotherapy is added for the mesenchymal and dedifferentiated Variants.

### 3. Ewing Sarcoma and Primitive Neuroectodermal Tumor Clinical Features:

- Ewing sarcoma/PNET typically manifests as a painful enlarging mass in the diaphysis of long tubular bones (especially the femur) and the pelvic flat bones.
- There is a characteristic periosteal reaction with deposition of bone in an onion-skin pattern.
- Treatment includes chemotherapy and surgical excision with or without irradiation.
- The 5-year survival rate is currently 75% for patients presenting with localized tumors.