Benign cartilage tumors

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Abstract

Benign cartilage lesions can be divided into those that differentiate towards fetal type cartilage (chondroblastoma and chondromyxoid fibroma) and those that differentiate towards mature hyaline type cartilage (osteochondroma, chondroma). Nora lesion is a reactive periostitis that mimics osteochondroma and is discussed with this group of lesions. This article reviews their clinical, radiological and pathological features along with the main differential diagnoses. It also briefly reviews multiple osteochondromas, multiple enchondromas and Maffucci syndrome.

Keywords bizarre parosteal osteochondromatous proliferation; cartilage; chondroblastoma; chondroma; chondromyxoid fibroma; diaphyseal aclasis; enchondromatosis; EXT1; FGF 23; IDH1/IDH2; Maffucci syndrome; Ollier disease; osteochondroma

Cartilage tumors can be divided into those that differentiate towards *fetal type* cartilage, and those that differentiate towards more *mature hyaline type* cartilage (Table 1). The former are intraosseous lesions most often seen in children and young adults. The latter may be lytic or, if mineralized, show a characteristic stippled or popcorn pattern of matrix on x-rays and are seen in adults either on the surface of or within bone. Generally speaking, in keeping with their benign nature, both types of tumors show a fairly good circumscription on x-rays with a relatively narrow zone of transition. Often, the lesions show some sclerosis of the margins.

Tumors of fetal type cartilage

Chondroblastoma

General and clinical features: chondroblastoma typically arises in the epiphyses and apophyses of skeletally immature patients although several cases of older patients and unusual locations have been reported. Most tumors arise in long tubular bones; but have also been described in short bones, flat bones, vertebrae and the craniofacial skeleton. The patients may present with pain or mass effects such as tinnitus in the case of temporal bone tumors. Rare patients have presented with oncogenic osteomalacia,[1] and conversely the presence of a phosphatonin (FGF 23) that is often seen in tumors that produce osteomalacia has been reported in chondroblastoma.[2]

Radiological features: radiographically, the lesions are lytic, epiphyseal, small (generally less than 5 cm) and sharply demarcated, often have a sclerotic rim (Figure 1). There is generally no expansion of bone or periosteal reaction (except in large lesions arising in flat bones). Mineralized matrix or a secondary cystic change may be seen in a few cases. MRI shows a relatively low T2 signal compared to other cartilage lesions along with the presence of surrounding bone marrow edema.

Pathology: microscopically, the characteristic cell is the chondroblast. It is a uniform epithelioid cell with an oval nucleus showing a prominent groove (Figure 2). Additionally, variable numbers of osteoclasts may be present along with a background chondroid matrix. A network of fine pericellular "chicken wire" calcification may be seen (Figure 3). A few typical mitoses are acceptable. Focal hemosiderin deposition or calcification can also be present. Secondary aneurysmal bone cyst formation is common. These secondary cysts lack the characteristic translocations involving the *USP6* gene that are seen in primary aneurysmal bone cysts.[3] The chondroblasts generally express S-100 protein and vimentin.

Biology and behavior: chondroblastomas are benign tumors. Marginal or intralesional procedures (curettage and/or cryotherapy) followed by cement or bone grafting is generally successful.

A few benign chondroblastomas have metastasized.[4–12,15] The metastases in these patients have generally responded well to excision although fatal cases have been reported.[13,14] It is hypothesized that rather than representing a true metastasis, the tumor may have got passively carried to the lung by "falling into" the adjacent peritumoral veins. Rare cases have produced skin or soft-tissue metastases.[16,17] Mutations in *H3F3B*, a gene encoding histone related protein, have been described in some chondroblastomas. Interestingly, a gene encoding a related histone protein, *H3F3A* is mutated in the stromal cells of giant cell tumor of bone.[18]

Differential diagnosis: radiographically the tumor must be differentiated from other epiphyseal lesions such as giant cell tumor of bone and clear cell chondrosarcoma. Histologically, the main differential is with clear cell chondrosarcoma, a tumor in which the chondrocytes have a clear halo like space along with a sprinkling of giant cells and foci of metaplastic bone. The differential may sometimes include chondromyxoid fibroma. However since some chondroblastomas show features intermediate between these two tumors this distinction is less important.

Practice points

- Chondroblastomas are benign and treated with intralesional or marginal procedures such as curettage.
- Some chondroblastomas have metastasized, but the metastases have generally been amenable to treatment.
- Secondary changes include aneurysmal bone cyst formation are common.

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Classification and radiological features of benign cartilage tumors

Type of cartilage	Location		Radiology	
	Intraosseous	Surface	Purely lytic	Lytic or stippled (popcorn)
Fetal	• Chondroblastoma • Chondromyxoid fibroma		• Chondroblastoma • Chondromyxoid fibroma	
Mature	• Enchondroma	• Osteochondroma • Nora lesion • Periosteal chondroma		• Enchondroma • Periosteal chondroma • Nora lesion

Table 1

Chondromyxoid fibroma

General and clinical features: chondromyxoid fibroma is a rare tumor that usually occurs in the second or third decades. It most often occurs in the long tubular bones where it is metaphyseal. Chondromyxoid fibroma can also arise in the flat bones as well as the short tubular bones of the hands and feet. Rarely, it can present as a surface lesion.[19–25] Similar to chondroblastomas the paraneoplastic syndrome of oncogenic osteomalacia has been associated with chondromyxoid fibroma[1,26,27] and FGF 23 has been identified on some tumors.[2]

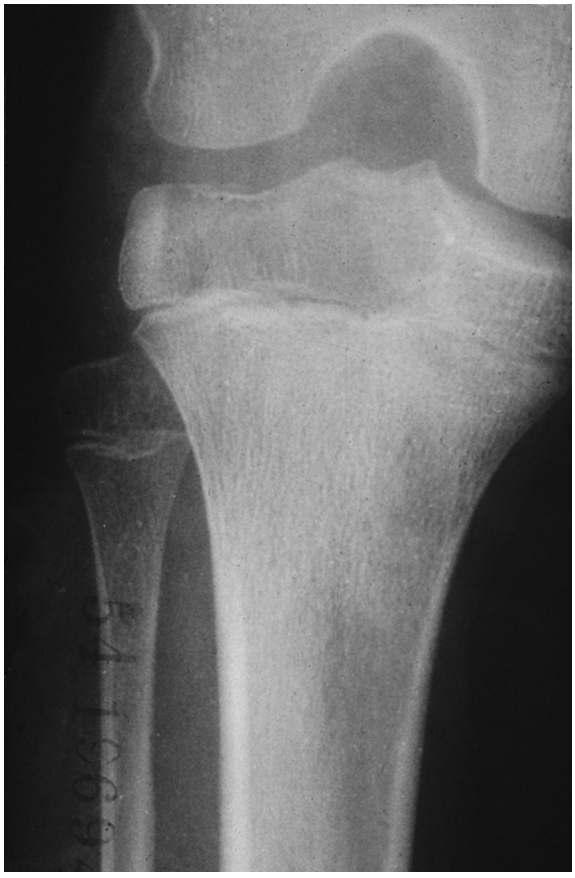

Figure 1 Chondroblastoma. The X-ray shows a lytic lesion of the proximal mid and lateral portions of the tibial epiphysis. The lesion is very sharply demarcated with a slightly sclerotic rim. There is no expansion of the bone, nor is there a periosteal reaction.

Radiological features: radiographically, the tumors are metaphyseal, eccentric and sharply delineated (Figure 4). In the small bones of the hands and feet there may be bony expansion that can be associated with focal cortical breakthrough and extension into soft-tissue. The presence of calcified matrix is most unusual on plain films, but may occasionally be seen on CT scans.

Pathology: microscopically the tumor is composed of spindle shaped cells, growing in a lobular fashion. It is well demarcated, and there is no evidence of an infiltrative growth pattern. The spindle shaped cells are embedded within an abundant extracellular myxoid or chondroid matrix. The lobules are classically hypocellular centrally with a condensation or hypercellularity of cells at the periphery of the lobules (Figure 5). Some cases show areas that merge into foci that are similar to chondroblastoma. Chondrocyte atypia or significant mitotic activity are all absent. Osteoclast like giant cells may be present and there may be a secondary aneurysmal bone cyst like areas.

Biology and behavior: the tumor is benign and metastases have not been reported.

Differential diagnosis: Some tumors show features that blend microscopically with chondroblastoma, especially in flat bones. Since both are benign lesions and this feature is well recognized,

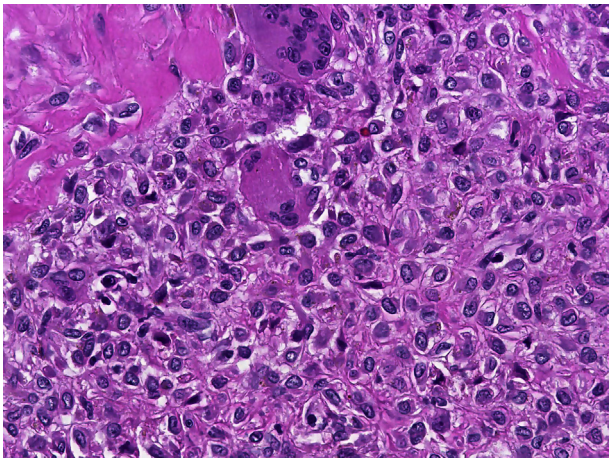

Figure 2 Chondroblastoma (microscopic). The picture shows several chondroblasts in a chondroid matrix. The nuclei are slightly elongated or oval and a prominent groove can be seen in some of these cells.