Chondroblastoma of the distal femoral metaphysis
A case report with emphasis on imaging findings and differential diagnosis
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Abstract
Chondroblastoma is a rare benign tumor, consisting of tissue resembling foetal cartilage, and arising in the epiphyses, or apophyses of long tubular bone. However, chondroblastoma of the cortex of the long bone metaphysis is extremely rare. A 15-year-old girl presented a 10-month history of intermittent knee pain and without mobility limitation. X-ray, computed tomography (CT), and magnetic resonance imaging (MRI) showed a slightly expansile lytic lesion involving the metaphyseal cortex of the left distal femur. During histological examination, typical features of chondroblastoma were observed. Chondroblastoma was definitely and histologically diagnosed. Surgical procedures included intralesional tumor curettage and allograft bone implantation. The patient was discharged without any complications 1 week after surgery and there was no recurrence during a 10-month follow-up.

This report describes a case of chondroblastoma in the metaphyseal cortex of the distal femur and serves as a reminder of the atypical anatomic location of chondroblastoma. Patients in an appropriate age group with typical imaging features may be diagnosed with chondroblastoma despite its rare location.

Abbreviations: CT = computed tomography, MRI = magnetic resonance imaging.

Keywords: chondroblastoma, magnetic resonance imaging, tomography, tumor, X-ray computed tomography

1. Introduction
Chondroblastoma is a rare type of benign cartilage tumor that accounts for approximately, 1% of all bone tumors, and affects mostly children, and young adults in the second, and third decades of life. It is classically, located in the medullary cavity of long bone epiphyses, and apophyses, and it is rarely, found in the cortex of the long bone metaphysis. We describe a chondroblastoma in the cortex of the distal femur metaphysis, and emphasize imaging findings, and differential diagnosis. Due to the retrospective nature of the study, informed consent from patients and ethics committee approval were waived.

2. Case report
A 15-year-old girl visited our hospital with a 10-month history of intermittent knee pain and without mobility limitation. Her past medical history was unremarkable. Physical examination revealed that the lower end of the shaft of her left femur was swollen with tenderness. No signs of infection were observed, and laboratory data were within normal limits. The radiographs revealed an ovoid radiolucency with sclerotic margins in the metaphyseal cortex of her distal left femur (Fig. 1). Computed tomography (CT) showed a 4 × 3 × 2 cm intracortical lesion that split the medial cortex and was surrounded by an eccentrically thickened cortical bone with a local cortical breach. The lesion was well defined, with internal stippled calcifications and without an apparent periosteal reaction (Figs. 2 and 3). In magnetic resonance imaging (MRI), the intracortical lesion exhibited low signal intensity on T1WI, and a mixed signal intensity on T2WI, and was peripherally, surrounded by a hypointense rim on T1WI, and T2WI. A soft tissue thickening medial to the lesion was also observed. Perilesional marrow, and soft tissue edema was found in the fat-suppressed T2WI, and a small amount of effusion was detected in the joint cavity of the left knee. In contrast-enhanced MRI, the lesions showed markedly, inhomogeneous enhancement, and the surrounding bone, and adjacent soft tissue showed a mild enhancement (Figs. 4 and 5). Intralesional chondroma was preoperatively diagnosed based on clinical and radiographic findings.

The biopsy procedures were performed preoperatively and it was diagnosed as chondroblastoma. Operative procedures were chosen generally, according to biopsy results, and the extent of bone involvement. The intralesional curettage, and artificial bone grafting were performed, and intraoperative findings revealed intracortical expansive bone destruction in the distal femoral metaphysis. Subsequent histopathological examination of the surgical specimen showed that the tumor was composed of a mixture mononuclear cells, multinucleated giant cells, cartilage-like matrix, chicken-wire calcification, and small foci of bone tissue. Immunohistochemistry indicated the positivity for S100
protein. (Fig. 6). The final pathologic diagnosis was chondroblastoma. The patient survived the operation, and recovered uneventfully, was discharged after 9 days. The patient had no evidence of recurrence or metastasis 10 months after the operation.

Figure 1. Lateral X-ray reveals the localized bone destruction of distal metaphysis of the left femur (white arrow) with internal matrix mineralization and marginal sclerosis.

Figure 2. CT reveals the oval bone destruction of the medial-distal left femoral metaphysis (white arrow) with internally stippled calcification, marginal sclerosis, and local cortical breach. CT = computed tomography.

Figure 3. Coronary reconstruction CT images show the local cortical thickening, and lytic bone destruction of medial-distal left femoral metaphysis (white arrow) with internally, stippled calcification, and marginal sclerosis. CT = computed tomography.

Figure 4. T2-FS FSE sequence shows a mixed long T2 signal mass (white arrow) with a low signal ring and peripheral edema.
3. Discussion

The incidence of metaphyseal or diaphyseal location in long bones accounts for only 2% of all chondroblastoma cases, and only 6 cases of metaphyseal/metadiaphyseal chondroblastoma of distal femur have been reported (Table 1).[2–8] Most chondroblastomas involve the medullary cavity, and rarely involve the cortex; furthermore, chondroblastomas originating within the cortex are rare.[9]

Chondroblastomas rarely occur in the long bone metaphyseal/metadiaphyseal cortex, and only 2 cases have been designated as a long bone metaphyseal/metadiaphyseal cortex lesion in studies published in English.[2,4] It may radiographically mimic other lesions and frequently manifest as a diagnostic dilemma. In this study, we described the classical imaging features of chondroblastoma in a typical site and discussed its imaging differential diagnosis from other primary bone tumors that appear in similar sites.

Classical chondroblastoma appears as a well-defined eccentric oval lytic lesion with internal mottled calcification and a peripheral sclerotic margin. Periosteal reaction is also common. MRI shows a lobulated low T1, and variable T2 signal lesion, with a peripheral thin hypointense rim corresponding to marginal sclerosis. In contrast-enhanced MRI, the lesions show lobular, marginal, and septal enhancement. Perilesional marrow edema, soft tissue edema, and synovitis have been found in some cases.

The recognition of the classic features of chondroblastomas on plain radiography, CT, and MRI may help radiologists correctly diagnose this condition despite its unusual location. The imaging and differential diagnosis of chondroblastoma in the metaphyseal cortex of the long bone include the lesions described below (Table 2).

Lesion size is a distinguishing feature between periosteal chondromas and periosteal chondrosarcomas; for example, the former are typically smaller than 3 cm, whereas the latter tend to be larger than 3 cm.[10] Radiographs revealed that periosteal chondromas are soft tissue lesions with cortical scalloping, underlying cortical sclerosis, and overhanging margins. Periosteal chondrosarcomas appear as a juxtapacortical soft tissue mass with chondroid matrix mineralization. In MRI, they appear as well-defined masses with a low to intermediate signal intensity on T1WI, and hyperintensity on T2WI with hypointense septa. A thin outer hypointense lining is noticeable on T2*W gradient-echo images. Peripheral and septal enhancement may be observed in enhanced MRI.[11]

Surface chondromyxoid fibroma is radiographically characterized by a lobulated, well-defined, expansive, and osteolytic

### Table 1

| Case            | Age (years)/gender | Location                               |
|-----------------|--------------------|----------------------------------------|
| Aditya et al.[1] 2011 | 14/F               | Left distal femoral metaphysis         |
| Znati et al.[2]  2007 | 15/M               | Left distal femoral metaphysis         |
| Hameed et al.[3] 2006 | 24/M               | Medial cortex of distal femoral metaphysis |
| McLeod et al.[4] 1973 | NS                 | Distal femoral metaphysis              |
| Dahlin et al.[5] 1972 | 14/F               | Distal femoral metaphysis              |
| Schajowicz et al.[6] 1970 | 13/F               | Left distal femoral metaphysis         |
| Kunkel et al.[7] 1956 | 15/M               | Right distal femoral metaphysis        |

NS: not specified.
lesion with intraloscalcic calcifications. In MRI, it appears as a lobulated hyperintense lesion on T2WI with hypointense septa and a peripheral rim.[12]

Osteoid ostema radiographically appears as an ovoid well-defined and expansive osteolytic lesion with a central mottled or striped density. A perilesional sclerotic rim of variable thickness is external to the bone.[15]

Radiographs show that an aneurysmal bone cyst (ABC) is a lobulated, expansive, and well-defined osteolytic lesion. CT may reveal cortical thinning, interrupted cortex, or periosteal reaction. ABC is hypointense on T1WI, and hyperintense on T2WI, with a hypointense rim, and internal septations. After gadolinium is administered, the septations and cyst walls may be enhanced. Fluid-fluid levels are suggestive of ABC but are non-specific. Adjacent soft tissue edema can also be observed.[14]

Parosteal osteosarcoma is radiographically described as a densely mineralized mass with irregular lobulations and attached to the underlying cortex by a broad base with a cleavage plane between the cortex and the tumor. In MRI, the tumor is hypointense on both T1WI, and T2WI because of dense osteoid components. Radiographs and CT reveal periosteal osteosarcoma as a lytic lesion with cortical erosion, and usually show a periperiosteal periosteal reaction that extends into the surface soft tissue component. This tumor is low in attenuation on CT and hypointense on T2WI due to the chondroid tissue. High-grade surface osteosarcoma often involves nearly, the entire circumference of the cortex, and likely, invades the underlying medullary cavity. Radiology findings indicate that the bulk of the lesion is external to the bone.[11-13]

4. Conclusion
Predilection age, predilection site, and imaging features are the major diagnostic criteria of chondroblastoma. Patients in an appropriate age group with typical imaging features, including presence of chondroid matrix, perilesional marrow, and soft tissue edema, marginal sclerosis, and periosteal reaction, may be diagnosed with chondroblastoma despite its rare location.

Author contributions
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