Giant cell tumors (GCTs) account for 4%–5% of all primary bone tumors, and radiography shows radiolucent expansile, eccentric lesions at the end of long bones. Twelve patients with primary GCTs of the bone were studied. In some cases, the complex anatomy and extent of the lesion could not be clearly depicted on conventional radiography, thus, computed tomography, magnetic resonance imaging, and digital subtraction angiography were helpful. The clinical course, radiographic findings, and differential diagnoses were discussed.

Key words: Bone, neoplasm; Bone, CT; MRI; DSA
Three patients received digital subtraction angiography (Siemens Angiostar).

**RESULTS**

The 12 cases of primary giant cell tumors of the bone occurred in the following sites: 3 were located in the distal femur, 2 were located in the sacrum, 1 each was located in the proximal tibia, humerus, distal tibia, ulna, radius, skull base, and 1st metatarsal. Radiological features revealed that 5 were radiolucent expansile lesions, 3 were soft tissue masses with radiolucent expansile lesions, 3 were pathologic fractures, 1 was radiolucent...

<table>
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<th>Case</th>
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<th>Sex</th>
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<th>Radiographic appearance</th>
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**Figure 1.** Giant cell tumor in the distal radius of a 31-year-old woman. **a.** Anteroposterior and lateral radiographs showing an expansile radiolucent lesion in the distal radius (arrows). **b.** Tumor showed moderate inhomogeneous enhancement on CT with contrast medium infusion (arrow) and cortical breakthrough in the distal radius. **c.** Coronal T1WI (TR: 450 ms, TE: 25 ms) with contrast infusion demonstrate heterogeneous enhancement of the tumor (arrows) and thinning bone cortex in the distal radius.
with a soft tissue mass, and 1 was a radiolucent eccentric lesion. The location and radiographic features of the 12 giant cell tumors were shown in table 1.

All tumors were proven to be GCTs by histology from surgical specimens of biopsy or curettage, and only 1 tumor showed malignant behavior.

DISCUSSION

Giant cell tumors (GCTs) of the bone comprise 4%-5% of primary bone tumors. Of these tumors, 70% to 90% are located at the epiphysis of long bones, while the remaining 10% to 30% are found in the sacrum, patella, vertebrae, tarsal, metacarpal, metatarsal bones, and skull. There is a female predominance, and the age at presentation is usually between 20 and 50 years. The tumors are rare in patients under 16 or over 70 years of age [1-3].

Jaffe stated that GCTs may be classified into grades I, II, or III based on the atypism of the stroma cells. Grade I represents normal mature...
Figure 4. Giant cell tumor in the right temporal region of a 58-year-old man who had right facial palsy for 3 years and vertigo for 1 month. **a.** Anteroposterior view of the skull showing suspicious bony erosion of the cranial base on the right side (arrow), but the mastoid air cells were preserved. **b.** HRCT of temporal bones with bone window setting coronal view shows a soft tissue tumor involving the right middle cranium and infratemporal fossa (arrowheads). **c.** Axial T1WI (525/15) with contrast infusion showing heterogeneous enhancement of the tumor which involves the right middle cranial fossa as well as the infratemporal fossa. The multiseptated cystic component is noted at the anterior aspect of this tumor (white arrow).

Figure 5. Giant cell tumor in the right 1st metatarsal of a 25-year-old woman. **a.** Anteroposterior and oblique radiographs showing a soft tissue mass with expansile radiolucent lesion and bony cortex destruction in the right 1st metatarsal (arrows). **b.** Tumor showing inhomogeneous enhancement on CT with contrast infusion (arrows) and irregular erosion of the cortex and abnormal soft tissue outside the bone in the right 1st metatarsal.
stroma cells. Grade II contains moderately atypical cells, and grade III has pronounced atypism, indicating a frankly malignant neoplasm [2].

GCTs grow insidiously and are likely to attain a large size before clinical symptoms occur. Dull aching pain may be the early complaint. A pathologic fracture may be the initial finding (10%). As the tumor grows, it encroaches on joints resulting in restricted and painful motion, and its mass usually becomes large enough to be palpated, eliciting local tenderness [1, 2, 3, 4].

Radiographically, GCTs appear as solitary radiolucent or expansile radiolucent lesions without bony sclerosis or periosteal reaction (Figs. 1a, 3a, 4a, 5a). There may be little periosteal reaction and faint trabeculation. Pathologic fractures are even present with radiolucent lesions (Fig. 2).

The tumor begins as an eccentric lesion but may progress to involve the entire bone. It arises in the epiphysis and secondarily involves metaphysis of the long bone.

Multicentric GCT of the bone is uncommon and most frequently occurs because of direct extension of the tumor to contiguous bone, either directly or across a synovial which differs from a solitary lesion [2].

Sacral GCT is uncommon and represents 3%-7% of all primary GCTs of bone. Pain is common, and neurologic deficit is a frequently associated finding. Plain radiography reveals an expansile lytic lesion without calcification which is associated with a presacral soft tissue mass (Fig. 3a).

GCT in the cranial bone is rare and represents 1% of all primary GCTs of bone. The most commonly involved sites are the sphenoid bones, followed by the temporal bone (Fig. 4a). Other sites include the occipital, frontal, and parietal bones. Clinical symptoms vary widely, depending on tumor size, location, and involvement of intracranial neurovascular structures [4-6].

GCT is rarely encountered in metatarsal bone. Pain is the most common presenting symptom, and a palpable mass is a frequently associated finding. Plain radiography shows a radiolucent expansile lesion without calcification (Fig. 5a). In small bones such as a metacarpal, ulna, fibula, or metatarsal, GCTs reveal expansile and ballooning radiographic findings [1, 3].

CT of GCT reveals the integrity of the cortex, and the presence and extent of any soft tissue component and can assess the extent of intraosseous involvement (Fig. 1b, 3b, 4b, 5b). A CT scan provides the most complete and accurate anatomic evaluation including the tumor’s relationship to major vessels and nerves. Contrast enhancement contributes to good vessel opacification and striking tumor enhancement. However, some CT scans are difficult to interpret with respect to cortical penetration and soft tissue invasion [1, 7].

MRI with its multiplanar capability reveals excellent soft tissue contrast and has contributed to its effectiveness in evaluating bone tumors (Fig. 1c, 4c). MRI is useful in determining the extent of marrow and cortical bone thinning or destruction, joint involvement, and soft tissue extension.

MRI is the best modality for demonstrating tissue homogeneity. GCTs produce low to intermediate signals on T1-weighted spin echo images and intermediate to high signals on T2-weighted images with homogeneous or inhomogeneous enhancement after intravenous administration of Gd-DTPA on T1-weighted images. These findings are nonspecific, depending on the amount of coexistent hemorrhage, necrosis, or cystic content [1, 8].

Angiography was performed in 3 of our 12 cases and showed hypervascular tumor staining and venous pooling of contrast material (Fig. 3c). One case showed hypovascularity with a faint tumor stain. Transcatheter arterial embolization using Gelfoam was performed and was successful in a preoperative GCT of the sacrum in 1 of our
Prando et al. reported that 90% of GCTs are hypervascular, and 10% are hypovascular or avascular. Although its features are non-specific, angiography has an important role in the preoperative evaluation of GCT, as it accurately depicts the intraosseous extent of the tumor and defines the extraosseous extent in 89% of patients [2, 9].

Differential diagnoses with GCT include aneurysmal bone cyst, chondroblastoma, enchondroma, osteogenisarcoma, hemangioma, fibrous dysplasia, non-mineralized osteoblastoma, “brown tumor” of hyperparathyroidism, and other fibro-osseous lesions [1, 2, 3, 6]. Aneurysmal bone cysts have an irregular “soap bubble” appearance. Ninety percent of lesions occur in patients under 20 years of age with preferred sites at the metaphysis of long bones.

Chondroblastomas have a subtle benign appearance with a periosteal reaction and contain a punctate mineralized matrix. They are often located in the epiphysis. Enchondromas rarely extend to the subarticular end of the affected bone, and their preferred location is at the metaphysis or diametaphyseal region. There are 3 forms of this lesion: 1) pedunculated, 2) sessile, and 3) calcified; it has an irregular cauliflower or coat hanger exostosis appearance on radiographs. A “ground-glass” radiological appearance favors fibrous dysplasia. Osteogenic sarcomas occasionally appear as an osteolytic lesion on radiographs and may be associated with soft tissue masses, sometimes mimicking a GCT, depending on the amount of osteoblastic and osteolytic activity. Osteoblastomas are common in vertebral arches and in tubular bones. Lesions are eccentrically located in the metaphysis or shaft, and the epiphysis is not involved. The characteristic radiographic feature is a well-circumscribed, expansile lesion which may be surrounded by a fine calcified margin [1, 6].

In our patients, serum alkaline phosphatase and calcium levels were normal, excluding a diagnosis of “brown” tumor of hyperparathyroidism. Enchondromatosis, polystotic fibrous dysplasia, metastasis, and “brown” tumors of hyperparathyroidism are multiple lesions, but GCT is rarely multiple. Clinical laboratory data and specific radiologic findings can be helpful in the differential diagnosis [1, 6].

GCT is a potentially malignant, aggressive lesion and 30% to 60% recur after curettage. Treatment modalities include curettage, packing with bone graft and cement, excision, resection, amputation, and radiotherapy [1, 2, 10]. Nearly all our cases were treated with curettage and bone allografts with occasional use of cement fixation. Only 1 patient received cryotherapy and radiotherapy.

On histology, GCT shows a predominance of large multinucleated giant cells, dispersed in spindle-shaped stroma cells. However, multinucleated giant cells may be found in neoplastic and non-neoplastic bone lesions; so a correct pathological diagnosis is difficult [1-3, 6]. The histological differential diagnosis includes aneurysmal bone cysts, chondroblastomas, and fibrous dysplasia [1].

In conclusion, although conventional radiography can show the characteristics of GCTs, some atypical lesions can be missed. CT, MRI, and DSA are more sensitive than conventional radiography in demonstrating intraosseous and extraosseous components. A combination of these imaging modalities is helpful in the preoperative assessment and postoperative follow-up.

REFERENCES
8. Herman SD, Mesgarzadeh M, Bonakdorpour A, Dalinka MK. The role of magnetic resonance imaging in giant cell tumor of bone. Skelet Radiol 1987; 16: 635-643
骨骼巨細胞瘤

陳良光薛誠道蔡裕豐陳旭漪彭惠玲
吳金球姚敏思賴善鳴

新光吳火獅紀念醫院放射診斷科
元培科學技術學院

骨巨細胞瘤佔 % - % 之所有原發性骨骼腫瘤，其初期發生是良性，極少惡性，但經過刮除術後有 % 呈復發且 % 會轉移至肺部。

其發生年齡由 至 歲，少許低於 歲和高於 歲，女性多於男性。於臨床上其會產生極痛，腫塊和病理性骨折，另外，如侵犯至關節會造成行動受到限制和痛覺。

其最常侵犯部位為長骨近端和端，並有少許侵犯短骨，髋骨，椎骨，頭骨，踝骨等。於常規放射線攝影所顯示為擴張骨性病灶，有時破壞皮質而侵入鄰近之軟組織。另外會有病理性骨折，但很少有骨膜反應或鈣化。

新光吳火獅紀念醫院由 年 至 年共收集了 例疑似巨細胞瘤，年齡由 歲至 歲，平均年齡為 歲； 例女 例男。這些病患都接受常規放射線攝影，其中 例接受電腦斷層攝影， 例接受磁共振造影， 例接受數位消像血管攝影，並且經過開刀和病理組織診斷為骨巨細胞瘤。因此我們將其放射線上之變化提出討論，並提供給大家參考指導。

關鍵詞：骨，腫瘤；電腦斷層攝影；磁共振造影；數位消像血管攝影