Original Article

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Radiology Section

Radiological Differences in Chondroblastoma of Tubular and Non-Tubular Bones

SUJATA PATNAIK, JYOTSNARANI YARLAGADDA, K SHASHANK REDDY, SHANTIVEER UPPIN, RAMMURTI SUSARLA

ABSTRACT

Introduction: Chondroblastomas are rare bone tumours accounting for only 1% all primary bone tumours. Epiphysis of long bones are most commonly affected, where as the flat bones, short tubular bones and apophysis of long bones are comparatively less commonly affected.

Aim: This study is aimed at finding out radiological differences when the tumour arises in tubular and non-tubular bones.

Materials and Methods: This retrospective study was conducted in the Department of Radiology, Nizam's Institute of Medical Sciences, Hyderabad, India. All histologically confirmed cases of chondroblastoma were analysed with respect to their imaging findings.

Results: Of the total 22 cases (including 13 females) that could be included in our study over seven years, 17 had lesions in long bones. Youngest was eight years old and the oldest was 40-year-old female. Four cases were associated with Anuerysmal Bone Cyst (ABC) and one case was associated with Giant Cell Tumour (GCT). Femur was the most common site (n=7) followed by tibia (n=7) and humerus (n=3). There were one each of calcaneum, talus, mandible, maxilla and iliac bone involvement. Epiphyseal lesions were seen 10 out of 17 tubular bones. Epiphyseal lesion extending to metaphysis were observed in seven. Typical site, geographic lucent lesion, matrix calcification and sclerotic rim were observed in 10 cases of long tubular bone and diagnosis was straight forward. Sclerotic rim, matrix calcification, periosteal reaction, coarse trabeculations and pathological fractures are common in lesions of long tubular bones. Soft tissue component is common in flat bone lesions. Tarsal bone lesions are most often associated with GCT/ABC and joint effusions.

Conclusion: Chondroblastoma is more common in tubular bone and mostly around knee. About half of them show characteristic imaging features. Flat bone lesions are rare, show soft tissue component and appear aggressive. Tarsal bone lesions are mostly associated with GCT/ABC and joint effusion. Lack of calcification in non-tubular bones is characteristic and adds to the difficulty in diagnosing the tumour.

Keywords: Aneurysmal bone cyst, Chondrosarcoma, Giant-cell tumour

INTRODUCTION

Chondroblastoma (otherwise known as cartilage containing giant cell tumour or Codman's tumour) was first described as a variant of giant cell tumour by Kolodney in 1927; and a year later it was named as calcifying giant cell tumour by Ewings [1]. In 1931 Codman termed these tumours as chondroblastic giant cell tumours and finally the term 'Benign Chondroblastoma' was introduced in 1942 [1]. Chondroblastoma accounts for 1% of primary bone neoplasms occurring 2nd decade with age ranging from 8 to 50 years. Males are more affected than females with a ratio of 2:1 [2]. Pathologically they are derived from primitive cartilage cells. Polyhydral chondroblasts, multinucleated giant cells along with nodules of pink amorphous material and chicken wire calcification (pericellular deposition of calcium) is virtually diagnostic on histology. Long bones are the most common site. Epiphysis of proximal femur, distal femur, proximal tibia, and proximal humerus are common sites. Apophysis of long bones, flat bone, short tubular bones of hand and feet are less common sites [3]. The objective of the study was to report the distinctive imaging characteristic lesions of non-long tubular bones as compared to changes in typical long tubular bones.

MATERIALS AND METHODS

This study was conducted in the Department of Radiology, Nizam's Institute of Medical Sciences, Hyderabad, India. It was a retrospective cross sectional analysis of 22 consecutive histopathologically proven patients of chondroblastomas over last seven years (2009 to 2016). Radiographs and all cross sectional images (either CT or MRI) were analysed. Various radiological features in terms of site, size, border, sclerosis, calcification, trabeculation, cortical disruption, periosteal

reaction, soft tissue component, oedema both soft tissue and marrow were studied. Association of other pathologies like ABC, GCT were also noted. The cases operated or treated earlier were not included in the study. The cases with non-diagnostic histopathology were excluded from the analysis. Critical analysis was made to observe any difference in imaging characteristics of long tubular bone lesions from lesions in other sites. The design, conduct and write-up of the study were notified to the Institutional Ethical Committee.

RESULTS

Study patients were 22 which included 13 females and 9 males. Youngest was eight years old and the oldest was 40-years-old female. Four cases were associated with ABC and one case was associated with GCT. Femur was the most common site (n=7) and tibia (n=7) and humerus (n=3). There were one each of calcaneum, talus, mandible, maxilla and iliac bone involvement. Involvement around knee was seen in 50% (n=11) and upper end of tibia was the most common site (n=7). Epiphyseal lesions were seen 10 out of 17 tubular bones (In 2 cases apophysis was the site of involvement). Epiphyseal lesion extending to metaphysis were observed in seven. Typical site, geographic lucent lesion, matrix calcification and sclerotic rim were observed in 10 cases of long tubular bone and diagnosis was straight forward. Imaging findings of all cases are tabulated in [Table/Fig-1].

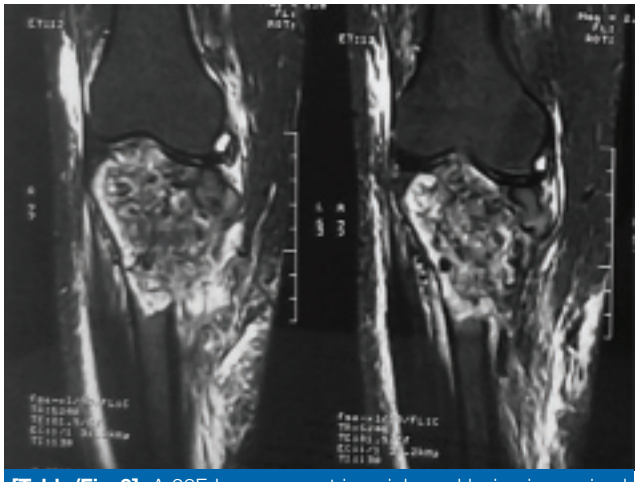
Sclerotic rim, matrix calcification, periosteal reaction, pathological fractures are common in lesions of long tubular bones. Calcification is less common in non- tubular bones. Sclerotic rim and joint effusion are observed in tarsal bones and soft tissue component in flat bone lesions. Another significant finding was coarse trabulations in tubular bones and thin trabeculation in tarsal bones. Diagnostic dilemmas were encountered in six cases of tubular long bones and in all cases of non- tubular long bones, as depicted in [Table/Fig-2-13].

Imaging features	Long bones (n=17)	Flat bones (n=3)	Short bones (n=2)	Remarks
Ill-defined margins	6	2		
Expansion of bone	15	3	2	
Extensive sclerosis	3			
No sclerosis	3	1	1	
Calcification	13	1	0	
Periosteal reaction	4			All long tubular bones
Pathological fracture	3			All long tubular bones
Soft tissue component or oedema	4	2		Both flat bones showed soft tissue component
Joint effusion	6	1	2	Both tarsal lesions were associated with joint effusion
Fluid –fluid level	2		2	Lesions were associated with ABC
Association with other lesions	3		2	

[Table/Fig-1]: Depicting the imaging features of the study cases.

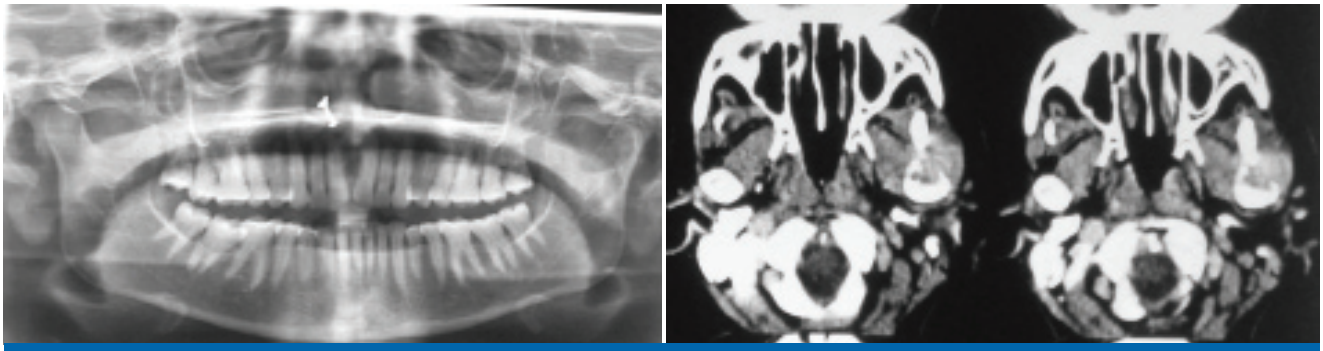
S. No.	Site (TB/ NTB)	Radio-logical diagnosis	Final HPE	Remarks
1.	TB	GCT [Table/Fig-3]	CB	No sclerotic rim/ calcification
2.	NTB	Chondro-sarcoma/ GCT [Table/Fig-4]	CB	Age, margin, large soft tissue
3.	TB	GCT [Table/Fig-5]	CB	No sclerotic rim/ calcification
4.	TB	Chondro-sarcoma [Table/Fig-6]	CB	Margin, extensive soft tissue
5.	TB	GCT [Table/Fig-7]	CB and ABC	No sclerotic rim/ calcification. Presence of trabeculae
6.	TB	Chondro-sarcoma [Table/Fig-8]	CB and GCT	Extensive expansion and calcification
7.	NTB	GCT/ABC [Table/Fig-9]	CB and ABC	No sclerotic rim/ calcification, Presence of trabeculae
8.	TB	GCT [Table/Fig-10]	CB and ABC	No sclerotic rim/ calcification and fluid-fluid level
9.	NTB	GCT [Table/Fig-11]	CB and ABC	No sclerotic rim/ calcification and fluid-fluid level
10.	NTB	Chondro-sarcoma [Table/Fig-12]	CB	Site, margin, expansion, soft tissue component
11.	NTB	Odontogenic Keratocyst [Table/Fig-13]	CB	Expansile lytic lesion, ill-defined margin

[Table/Fig-2]: Details of cases with diagnostic dilemma; note the radiological diagnosis and HPE.
TB=tubular bone; NTB=non tubular bone; GCT= giant cell tumour; ABC –aneurysmal bone cyst CB=chondroblastoma

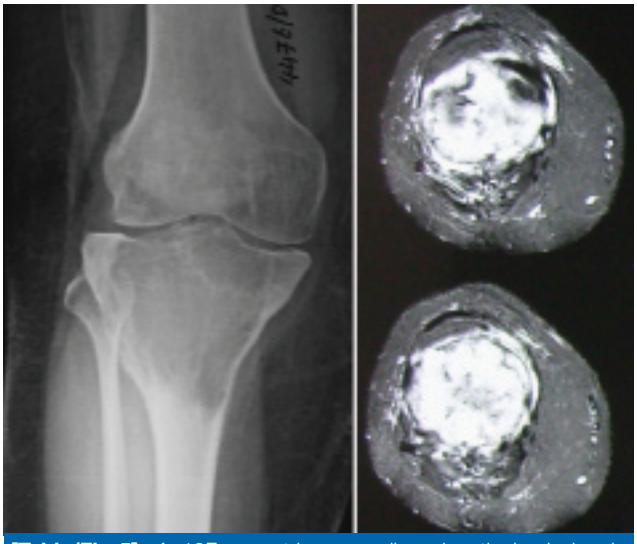


[Table/Fig-3]: A 23F-Large eccentric epiphyseal lesion in proximal tibia extending to metaphysis with multiple septations mimicking GCT.

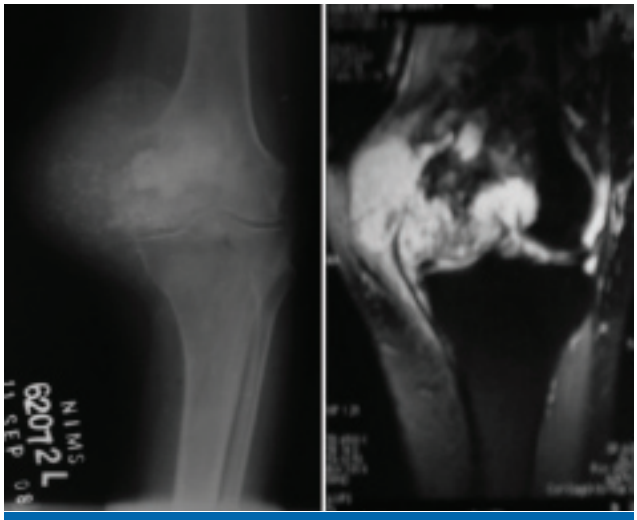
The radiological diagnosis mentioned below was representing the diagnosis made before any operative/biopsy procedure.



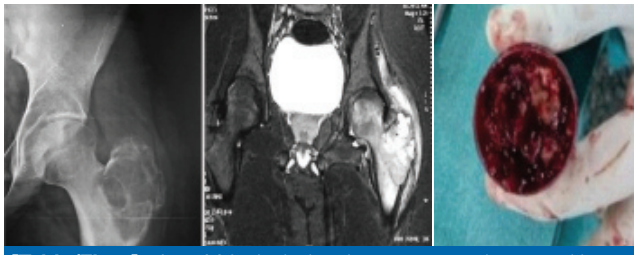
[Table/Fig-4]: A 40-year-old F-mandible is rare site of occurrence. Note the cortical destruction and calcification in an expansile lytic lesion of left mandibular condyle on axial CT scan.



[Table/Fig-5]: A 19F–eccentric expansile sub-articular lesion in upper end of tibia with no sclerotic margin. Axial T2W image showing extensive marrow and adjacent soft tissue edema.

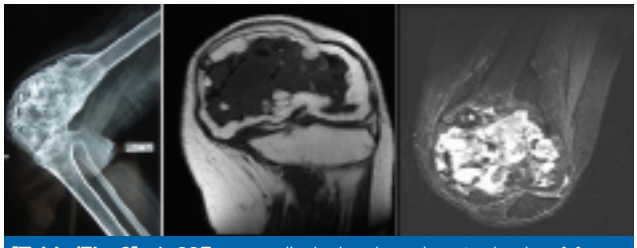


[Table/Fig-6]: A 35F-chondroblastoma of lower end of femur showing variable matrix mineralisation having ring/arc like calcification with large soft tissue component (d/d chondrosarcoma).



[Table/Fig-7]: A 13M-Lytic lesion in greater trochanter with no sclerotic rim and multiple trabeculae appearing as soap bubble appearance mimicking GCT and on histopathology turned out to be chondroblastoma with ABC.

Though the lesions were in typical site in long tubular bone, because of ill-defined border, lack of calcification confused with GCT (n=4), large soft tissue component with calcification and cortical disruption are thought of chondrosarcoma.

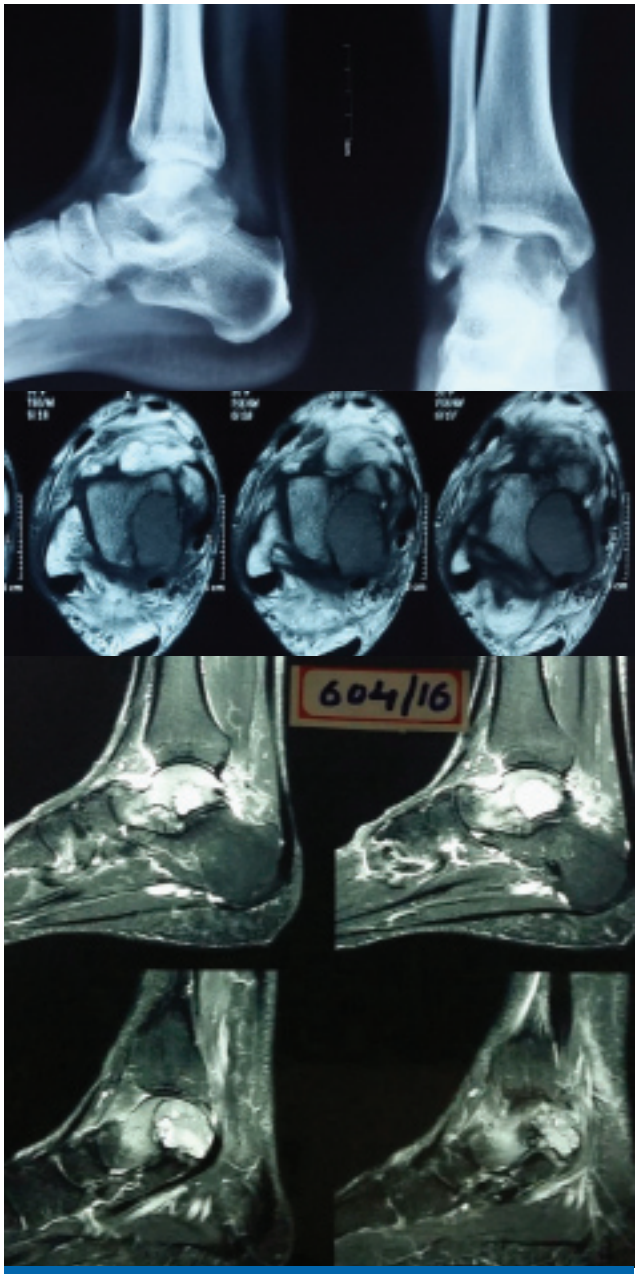


[Table/Fig-8]: A 23F-expansile lesion in epi-metaphysis of femur with pathological fracture and multiple matrix calcification in lateral radiograph and on MRI T1 STIR images shows the calcific foci as T1, STIR hypointense mimicking chondrosarcoma.

DISCUSSION

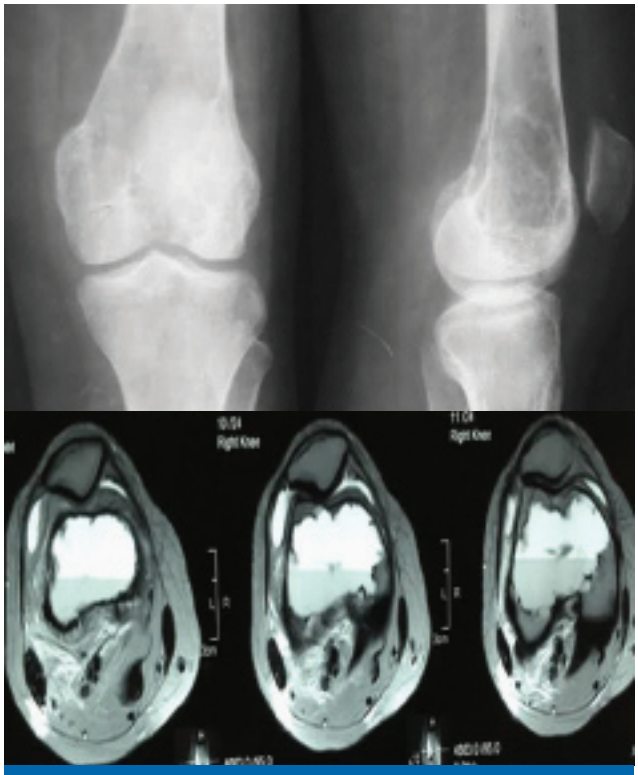
Retrospective analysis of 22 cases of chondroblastomas showed varied radiological features. Age ranged from 8 to 40 years with male predominance (13:9) in the present study similar to most of other studies. In a study of 31 cases by Jaovisidha S et al., concluded that an increase in age by one year reduced the risk of having tubular bone involvement by about 27% when compared with NTBs [4].

The most common site is epiphysis of long bones (70%), distal and proximal femur, proximal tibia and proximal humerus [Table/Fig-14].

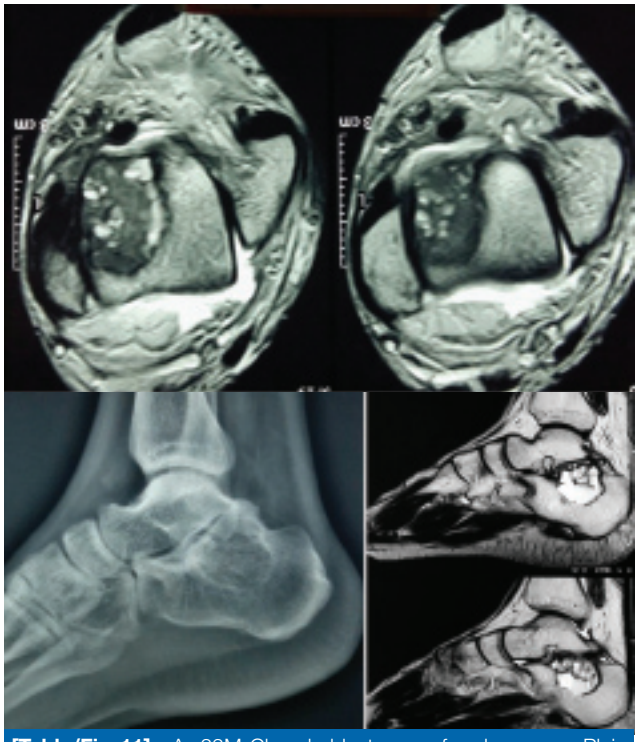


[Table/Fig-9]: A 24M-Chondroblastoma of talus mimicking GCT. Well defined lytic lesion with sclerotic rim on plain radiograph. Lesion appear hypo on T1W images and hyper on T2W image with hypointense septae within it. There is adjacent marrow edema appreciated on MRI.

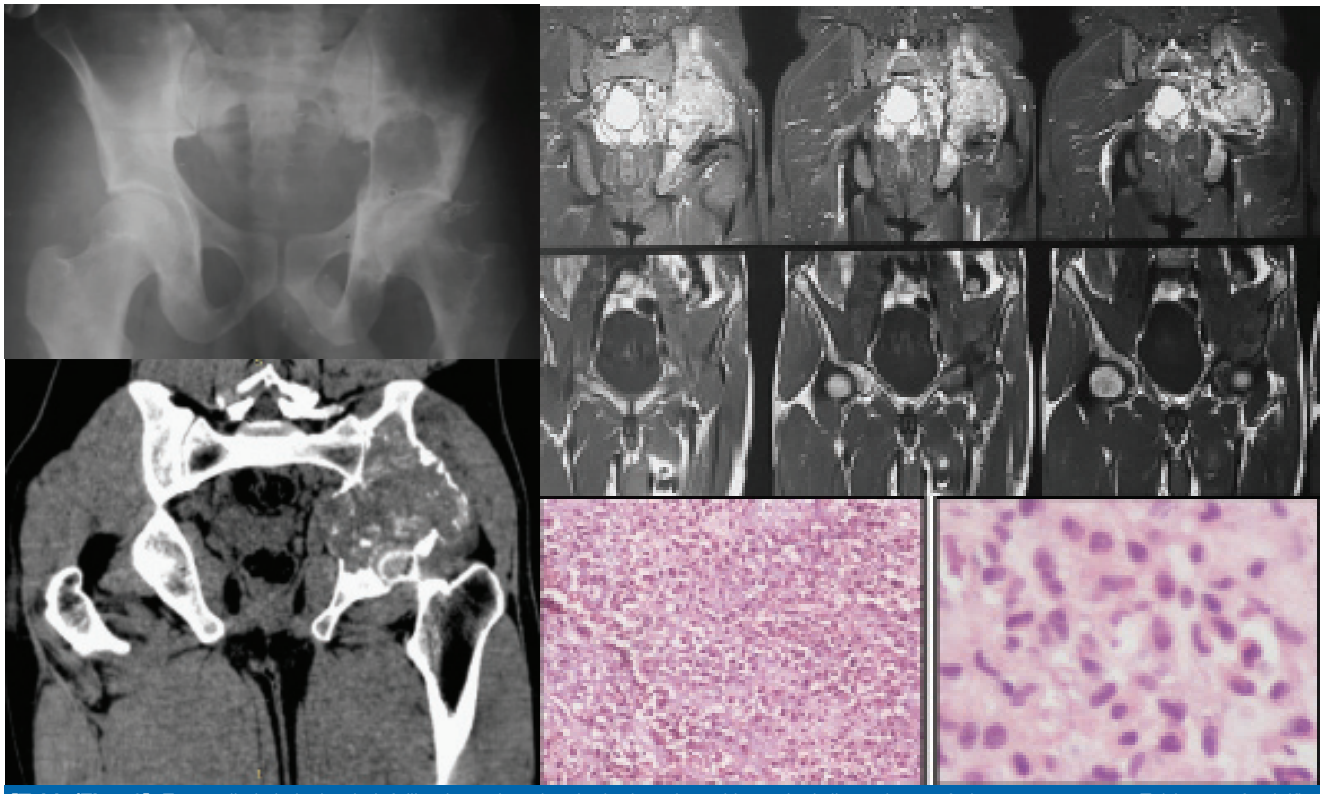
Para acetabular area of innominate bone, ribs, skull, mandible, maxilla, vertebra, scapula, patella, and sternum are rare sites. Unusual but classic sites are talus, calcaneus and patella [Table/Fig-9,11] [3]. In craniofacial region temporal bone is commonly affected [5]. In our study involvement around knee was seen in 52% (n=11) and upper end of tibia was most common site as described in many studies. NTB sites were three in flat and two in tarsal bones. Posterior aspect of calcaneum at talo-calcaneal articulation is the most common site of calcaneal



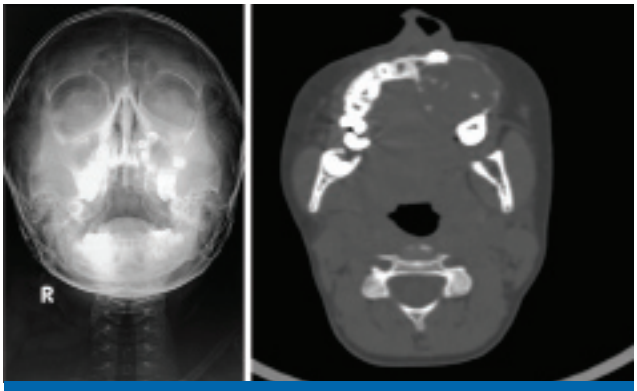
[Table/Fig-10]: A 21F-Chondroblastoma of lower end of femur appearing as lytic lesion in plain radiograph and showing fluid level on T2W axial MR images mimicking GCT with ABC. There is also minimal joint effusion.



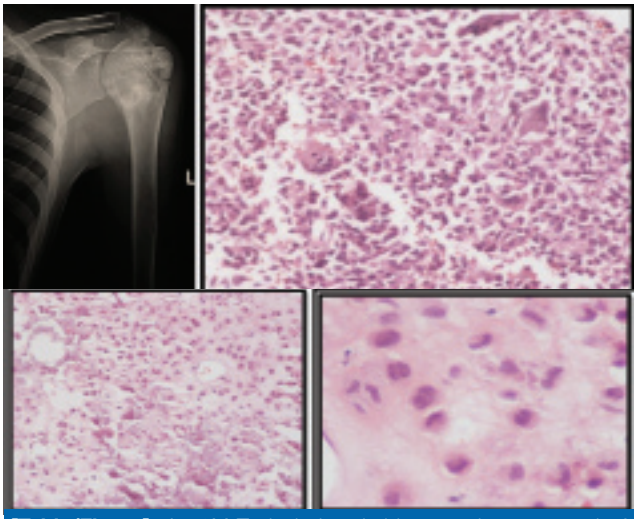
[Table/Fig-11]: A 23M-Chondroblastoma of calcaneum. Plain radiograph shows well-defined lytic lesion with internal trabeculation mimicking GCT. Axial, sagittal T2W images depict the septations.



[Table/Fig-12]: Expansile lytic lesion in left iliac bone in subarticular location with cortical disruption, soft tissue component. Evidence of calcific foci in the lesion on CT scan; B - pericellular chicken wire calcification, 100x, H&E.C- round to oval nuclei with nuclear groves and indentations, 400x, H&E.



[Table/Fig-13]: A 9F-Expansile lytic lesion in left maxilla as shown in radiograph and CT scan depicts well defined lytic lesion with thin imperceptible margin and displaced teeth mistaken for odontogenic keratocyst and HPE proven to be chondroblastoma.

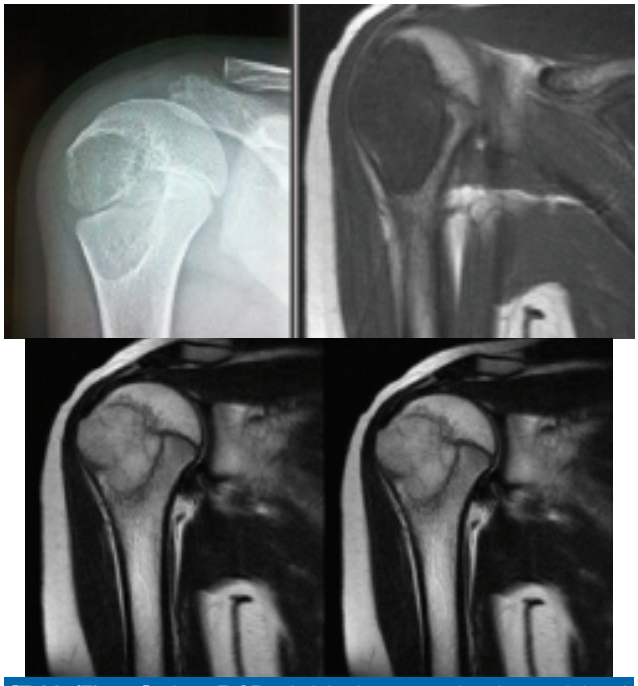


[Table/Fig-14]: A 18M-Typical chondroblastoma in upper end of humerus appearing as eccentric expansile lytic lesion with sclerotic rim and internal calcification. -B- sheets of mononuclear cells and randomly distributed and osteoclast type giant cells,40x H&E. C- calcification and eosinophilic cartilage,100x H&E; D- nuclear grooves and indentations, 400x H&E.

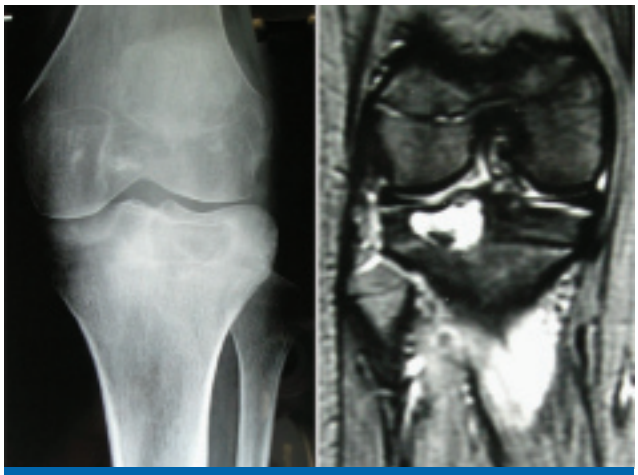
involvement as observed by us. It is speculated that tumours at talo-calcaneal articulation may be from cartilage rest from articular cartilage. Typically, chondroblastoma is a slow growing tumour in epiphysis and is eccentric expansile round or oval or geographic lucent lesion with complete/partial, focal sclerotic rim [Table/Fig-15] [6].

About 80% of tumour are 1-4 cm but may be as big as 8 cm. When small lesion is mostly confined to epiphysis and when large it extends to metaphysis [Table/Fig-16].

Lesion is homogenously lucent in 40% and in 60% there may be mottled appearance. Opacities are due to septae and calcification are best seen in CT. Calcifications are ring or arc like. Close differentials are GCT, ABC, and histiocytosis. Because of lack of sclerotic rim, lack of calcification four of



[Table/Fig-15]: A 14F-CB of right humerus showing peripheral rim of low signal on both T1W and T2W images and pathological fracture.



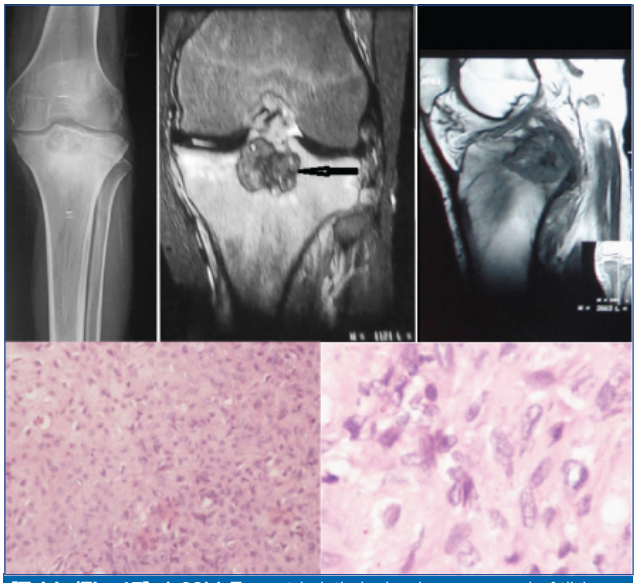
[Table/Fig-16]: A 16F-Sub articular, eccentric, minimally expansile lytic lesion in upper end of tibia with sclerotic border on radiograph and foci of T2/STIR hypointensity s/o calcification noted within the tumor matrix see on MRI.

tubular the bone lesions, both the lesions in tarsal bones and one iliac bone lesion were misdiagnosed as GCT. When large, the lesion can cause scalloping, cortical break and periosteal reaction. Epiphysis is intra articular and has no periosteum. Hence, periosteal reaction is seen along the diaphysis in about 50% of cases in literature. Periosteal reaction was observed in 5/17 (29.4%) of our cases [Table/Fig-7].

CT depicts the matrix mineralisation, soft tissue extension, cortex erosion and fluid-fluid level [Table/Fig-10].

Calcification is noted in 20-50% of cases [Table/Fig-3,8,12][7]. The fluid- fluid level is due to association of secondary ABC which may be in 15% cases [8]. On contrast administration there is mild enhancement. Four out of 22 of our series were associated with secondary ABC and one had GCT. All the four cases (two in tarsal and two in long tubular bones) there was fluid-fluid level.

The characteristic signal intensity of chondroblastoma in MRI reflects cellular stroma which is low signal on T1W images and high or variable signal on T2W images [Table/Fig-17] [8]. T2W hypointensity represent abundant immature chondroid matrix, chondroblastic hyper cellularity, and hemosiderin. Lesion may contain fluid-fluid level and sometime lesion may be solid and show heterogeneous enhancement. There may be cystic component in the lesion. Periosteal reaction and marrow oedema are other features observed in MRI. Joint effusion is a feature in 30-50% cases, which we observed in 9/22(41%) cases [Table/Fig-10,11]. Both the cases of tarsal bone lesion and one case of iliac bone lesion had joint effusion.Tumor may penetrate the cortex and extend to adjacent soft tissue in small percentage of cases and some literature says it can occur in 10% [9,10]. Four cases had soft tissue component with calcification, were mis-diagnosed as chondrosarcoma; but HPE proven to be chondroblastoma. One was mandibular condyle lesion, two in distal femur and one Iliac bone lesion were confused aggressive GCT.



[Table/Fig-17]: A 23M-Eccentric lytic lesion in upper end of tibia on radiograph and MRI reveals extensive marrow edema surrounding the lesion and calcification appearing hypointense indicated by arrow.

Flat bone involvement is seen in older age group and is rare. Mandibular condyle is still rarer [8]. Usually these lesions are aggressive in appearance [11]. The only case of mandibular condyle (40F) had aggressive findings like expansion of bone, cortical disruption, enhancing soft tissue component, and calcific foci. Chondrosarcoma was working diagnosis and histopathology confirmed to be chondroblastoma [Table/Fig-4].

Although, chondroblastoma are benign, large size, joint effusion, soft tissue invasion, local recurrence, pulmonary metastases indicate aggressive nature. Flat bone lesions are more aggressive than the long bone lesions [12]. Due to hyperaemia, lesion may show avid uptake. Often it shows increased FDG uptake though it is a benign process [13]. Angiography is done as preoperative road map.

Prognosis of chondroblastoma is good. About 80-90% cases are successfully treated with curettage and graft. Radiofrequency ablation is other treatment option. Recurrence occurs in 14-18% within two years. All our cases were operated.Incidence of aggressive chondroblastoma is low and is <1%. According to Huvos and Marcove recurrence of chondroblastoma is 24% in three years and 100% when it is associated with ABC [13]. Signs of healing are cessation of symptoms, marked sclerosis surrounding lesion, centripetal calcification or ossification, obliteration of bone grafted or curetted or grafted area. Recurrence of lesion is suspected when there is increasing lucency with reappearance of symptoms. Recurrence is more common when chondroblastoma is associated with ABC. Metastasis is uncommon. It is common when there is recurrence and it metastasises to lung. Soft tissue/skin, bone and liver are other sites of metastases [14]. Lung metastasis may be non-progressive and can be treated with surgical resection or may be followed up conservatively.

LIMITATIONS

This is a retrospective analysis with only a limited number of cases included. Hence, the conclusions are only suggestive. Larger studies are recommended.

CONCLUSIONS

Chondroblastoma is more common in tubular bone and mostly around knee. About half of them are showing characteristics imaging features. Flat bone lesions are rare and show soft tissue component and appear aggressive. Tarsal bone lesions are mostly associated with GCT/ABC and joint effusion. Lack of calcification in non-tubular bones is characteristic and adds to the difficulty in diagnosing the tumour.

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AUTHOR(S):

1. Dr. Sujata Patnaik
2. Dr. Jyotsnarani Yarlagadda
3. Dr. K. Shashank Reddy
4. Dr. Shantiveer Uppin
5. Dr. Rammurti Susarla

PARTICULARS OF CONTRIBUTORS:

1. Additional Professor, Department of Radiology, Nizam's Institute of Medical Sciences, Hyderabad, Telangana, India.
2. Professor, Department of Radiology, Nizam's Institute of Medical Sciences, Hyderabad, Telangana, India.
3. DNB Student, Department of Radiology, Nizam's Institute of Medical Sciences, Hyderabad, Telangana, India.
4. Professor, Department of Pathology, Nizam's Institute of Medical Sciences, Hyderabad, Telangana, India.
5. Professor, Department of Radiology, Nizam's Institute of Medical Sciences, Hyderabad, Telangana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Sujata Patnaik,
404, Sai Kausalya Apt 1-2-384/1,
Gaganmahal Main Road,
Telangana, Hyderabad-500029, India.
E-mail: sujata_patnaik222@yahoo.co.in

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