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Radiodiagnosis

Utility of Magnetic Resonance Imaging in the Assessment of Primary Bone Tumors

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Abstract **Original Research Article**

***Background*:** These radiographic features, coupled with clinical information, help to define whether the lesion is neoplastic or non-neoplastic, primary or metastatic, and will help to direct the subsequent work-up further. MRI is the best modality to assess the focal extent and local staging. ***Aims and Objectives*:** To assess the Utility of magnetic resonance imaging in assessing primary bone tumors. ***Materials and Methods*:** Present cross-sectional study was performed on 50 patients undergoing magnetic resonance imaging with clinical suspicion of primary bone tumors at the Department of Radiodiagnosis. A detailed socio-demographic, in addition to routine MR pulse sequences, was recorded. ***Results*:** In our study, 31 cases (62 %) had a wide zone of transition, in which 25 cases were benign, and the remaining 6 cases were malignant, while 19 cases (38 %) had an arrow zone of transition and all 19 cases (38%) were malignant. This difference was found to be statistically significant. ($\chi 2$ value = 30.645 , p value= 0.0001. Sixteen patients (32%) were in the age group of 11-20 years of age. The majority of the primary bone tumors (72%) were observed in the appendicular skeleton; the most commonly involved bones were the femur, tibia, and humerus in 19, 8, and 5 cases, respectively. ***Conclusion*:** MR imaging is an excellent modality to delineate the extent of the tumor, and soft tissue involvement, localize the lesion, and determine its aggressiveness. The findings of this population study are consistent with other studies in this field. So we have sufficient evidence to conclude that MRI is highly accurate in diagnosing bone tumors.
Keywords: Magnetic resonance imaging, utility & bone tumors.

INTRODUCTION

Primary bone tumors are rare malignant tumors arising from bone derived from primitive mesenchymal cells. Cross- sectional imaging has improved the ability to characterize tumors, and differential diagnosis of primary bone tumors remains based on their radiographic appearances [1]. Radiographs provide critical information regarding location margin, matrix mineralization, cortical involvement, and periosteal reaction [2]. X-ray offers much more information than any other imaging modality in studying bone lesions and the differential diagnosis of skeletal tumors and tumor-like lesions. The imaging features that help to make the diagnosis of a bone tumor or tumor-like lesion include patterns of bone destruction, margins of the lesion, its internal characteristics, type of host bone response (medullary or periosteal), location, site, and position of the lesion in the skeletal system and the individual bone, soft tissue involvement, and single or multiple lesions.

These radiographic features, coupled with clinical information, help to define whether the lesion is neoplastic or non-neoplastic, primary or metastatic, and will help to direct the subsequent work-up further. Magnetic Resonance Imaging (MRI) is maximally sensitive to the presence of musculoskeletal soft-tissue lesions and provides an exquisite definition of their features. Categorizing the many distinct attributes of the lesions is the key to differentiating benign from malignant processes [2].

The architectural details with the location and pattern of growth, the specific MR signal characteristics, and contrast enhancement patterns combining all these observations will produce the most limited differential diagnosis possible. Although there are few pathognomonic findings for benign and malignant lesions in diagnostic imaging, a high degree of confidence or statistical likelihood can be achieved using MR imaging [3].

MRI is the best modality to assess the focal extent and local staging [4]. This is particularly true regarding the invasion of muscle, neurovascular structures, and adjacent fat planes and the degree of marrow involvement.

MRI is superior to looking for soft tissue changes with necrotic, hemorrhagic, sclerotic, and intra-articular extension, which may be missed on radiographs and CT [5]. MRI is the best technique to detect skip lesions which are small metastasis separated from the primary tumor by healthy tissue, often missed by other imaging means [6]. In the follow-up, MRI is the best method to detect tumor persistence and assess the response to therapy [7]. A biopsy is the gold standard procedure for diagnosis. Whenever a bony lesion is suspected, clinic-radiological and pathologic correlation is essential to make an accurate diagnosis and improve patient care.

Material and Method

The present cross-sectional study was conducted in the Department of Radiodiagnosis, Sri Aurobindo Medical College & Post Graduate institute, Indore, after approval from the institutional research & ethical committee from 1st April 2021- 30th September 2022. A total of 50 patients were included in our study.

In our institute, we get, on average, 3-4 cases per month of bone tumors for which an MRI is being done. Therefore, we will achieve our sample size of 50 patients in 14 months.

Patients undergoing magnetic resonance imaging with clinical suspicion of primary bone tumors within the study duration were included. In contrast, patients not giving consent, in whom MRI is contraindicated, secondary bone metastasis, and patient on a life support system were excluded.

MRI Protocol/Sequences

The study was done on a Siemens 1.5 T MAGNETOM ® Symphony® with Tim technology MR Machine. Routine MR Pulse sequences include;

- Axial T1W1 600/17(TR/TE), 3.5mm slice thickness, flip angle 150, gap 0.5mm,
- Sagittal T1WI 691/9.9(TR/TE), 4mm slice thickness, flip angle 150, gap 0.5mm,
- Axial T2WI 8170/66(TR/TE), 4mm slice thickness, flip angle 150, gap 0.5mm,
- Saggital T2W1 5420/82(TR/TE), 3 mm slice thickness, flip angle 150, gap 0.5mm,
- Axial STIR 3000/23(TR/TE), 4mm slice thickness, flip angle 150, gap 0.5mm,
- Coronal STIR 3580/56(TR/TE), 4mm slice thickness, flip angle 150, gap 0.5mm.

The findings were recorded on pre-structured proforma for the study. All the data analysis was performed using IBM SPSS ver. 25 software. Descriptive statistics were carried out to identify the characteristics of the collected data. All the data were expressed as a proportion. The chi-Square test was used to compare the proportion and obtain the significance level. A p-value of <0.05 is considered significant.

Results

Table 1: Distribution of cases as per their age

Age Group (in years)	Frequency	Percentage
00-10	7	14%
11-20	16	32%
21-30	12	24%
31-40	2	4%
41-50	4	08%
51-60	6	12%
61-70	3	6%
Total	**50**	**100%**

In our study, 50 patients were included with a range (of 08-67) years with a mean of 28.04 ± 17.662 years. Maximum [16 (32%)] patients were present in the 11-20 years age group, while only 2 (4%) were present in the 31-40 years age group.

Table 2: Distribution of cases as per the clinical features of patients

Clinical features	Frequency	Percentage
Pain	11	22%
Swelling	2	04%
Pain and Swelling	27	54%
Incidental	10	20%
Total	**50**	**1005**

The most common presenting symptom was pain and swelling over the affected region [n=27 (54%)]; only pain was present in 11 (22%), while only swelling was present in 2 (4%), and the remaining 10 (20%) patients had no complaints.

Table 3: Distribution of Pathologies as per their site of involvement in Long Bone Lesions

Site	Frequency	Percentage
EM	6	16.66 %
M	10	27.77%
MD	12	33.33%
D	5	13.88%
EMD	3	8.33%
Total	**36**	**100%**

Out of 36 cases of long bone involvement, most bone tumors were observed in the meta-diaphyseal region, comprising 12 cases (25.6 %). The second most common site was metaphyseal (10 cases), and the third most common site was epiphysio- metaphyseal site (6 cases).

Table 4: Distribution of lesions as per their zone of transition of bone lesion

Zone of Transition	Imaging Diagnosis			Chi-square, p-value
	Benign	**Malignant**	**Total**	30.645, 0.0001
Narrow	25 (50)	6 (12)	31(62)	
Wide	0 (0)	19 (38)	19 (38)	
Total	**25 (50)**	**25 (50)**	**50 (100)**	

In our study, 31 cases (62%) had a wide zone of transition, in which 25 cases were benign and the remaining 6 cases were malignant, while 19 cases (38 %) had an arrow zone of transition, and all 19 cases (38%) were malignant. This difference was found to be statistically significant ($\chi 2$ value = 30.645, p value= 0.0001).

Figure 1: Osteosarcoma of tibia: MRI T2 WI coronal image reveals an expansive lytic lesion in the metaphyseo-diaphyseal region of the upper third of right tibia (anterolateral aspect) with significant spiculated/ sunburst periosteal reaction and Codman's triangle formation

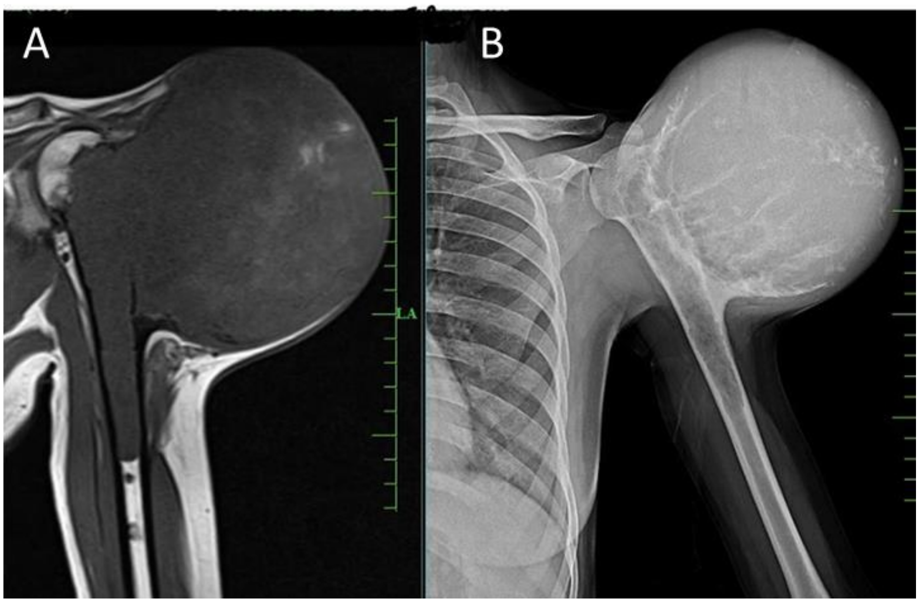

Figure 2:Osteosarcoma of humerus: MRI T1W (Fig A) and x ray shoulder (Fig B) images reveals lytic destruction in the upper 1/3rd shaft of the humerus, associated with large exophytic heterogeneously enhancing soft tissue component, sunburst periosteal reaction extending in the subcutaneous compartment. Diffuse heterogeneous marrow signals/extension of the disease involving upper and mid humeral shaft

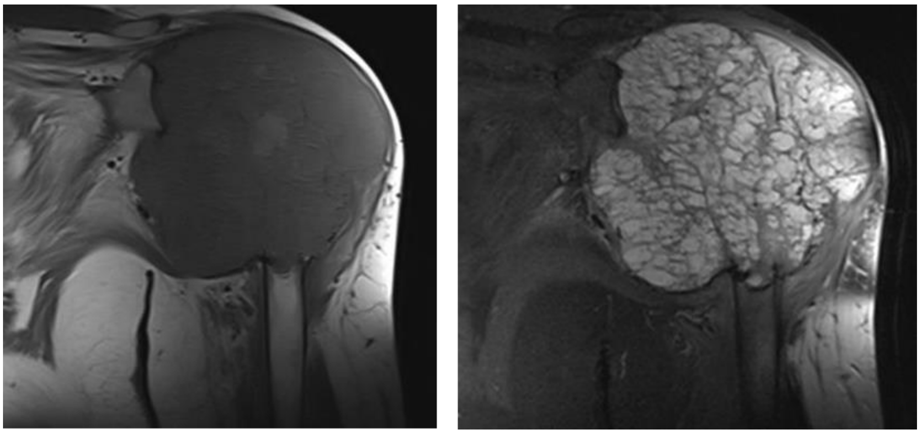

Figure 3: Giant cell tumor: MRI T1W coronal and T2 FSI images reveals large multiloculated cystic lesion in the proximal left humerus with narrow zone of transition. The locules of the lesion show multiple fluid filled levels. It is hypointense on T1WI and hyperintense on T2WI

DISCUSSION

In our study group, most patients were in the age group of 11 -20 years, comprising 32 % of cases, followed by 21-30 years (24%). Lesions were more common in males (66%) than in females (34 %). This was consistent with the studies done by Obalum, D. C. *et al.,* [8].

In our study group, the most common presenting symptom was pain and swelling over affected region n=27 (54%); only pain was present in 11(22%) while only swelling was present in 2(4%) and the remaining 10(20%) patients had no complaints. Our study is in concordance with the study by Nitishkumar, D. Y. *et al.,* [9].

In our study group, Most of the lesions involved the appendicular skeleton (n=36). The femur was the most common among the appendicular skeleton, followed by the tibia. The most common site was meta-diaphyseal in 12 cases (25.6%), followed by metaphyseal in 10 cases. Similar findings were seen in the study by Onikul, *et al.,* [10].

In our study group, 28 cases (56 %) were lytic lesions. Of these 28 cases, 25 were purely lytic, and 3 were lytic destructive. Our study is in concordance with Mulligan, M. E. *et al.,* [11] who retrospectively reviewed two hundred thirty-seven pathologically proven cases of primary lymphoma of bone. Long bones were involved more often than flat bones (71% versus 22%). Common appearances were a lytic (70%) or mixed-density (28%) lesion [12].

In our study, 32 cases (64%) had well-defined margins, of which 25 were benign and 7 (14 %) were malignant lesions. Eight cases (16 %) had irregular borders, and 10 (20%) cases had ill-defined borders, all of which were malignant. Our study is per Ragsdale, B. D. *et al.*, [13].

Osteoid osteoma: In our study, 4 cases (8%) were of osteoid osteoma. In all our cases, lesions were hypointense on T1 and hyperintense on T2/STIR and showed enhancement. MR and adjacent synovial thickening and joint effusion were also seen. Our study is in concordance with a study done by Goswam, P. & Pendse *et al.*, [14].

The limitations of the present study are the cross-sectional nature and small size, so the current study results cannot be applied to the whole population. There is a need for large randomized clinical trials to provide more strength to present study findings.

Conclusion

Most primary bone tumors were observed in the appendicular skeleton; the most commonly involved bones were the femur, tibia, and humerus. MR imaging is an excellent modality to delineate the extent of the tumor, and soft tissue involvement, localize the lesion and determine its aggressiveness. The findings of this population study are consistent with other studies in this field. So we have sufficient evidence to conclude that MRI is highly accurate in diagnosing bone tumors.

References

1. Bloem, J. L., Bluemm, R. G., Taminiau, A. H., Van Oosterom, A. T., Stolk, J., & Doornbos, J. (1987). Magnetic resonance imaging of primary malignant bone tumors. *Radiographics*, *7*(3), 425-445.
2. Baweja, S., Arora, R., Singh, S., Sharma, A., Narang, P., Ghuman, S., ... & Puri, S. (2006). Evaluation of bone tumors with magnetic resonance imaging and correlation with surgical and gross pathological findings. *Indian Journal of Radiology and Imaging*, *16*(4), 611-8.
3. Weatherall, P. T. (1995). Benign and malignant masses: MR imaging differentiation. *Magnetic resonance imaging clinics of North America*, *3*(4), 669-694.
4. Maximilian, F. R. (1996). MRI in diagnosis and staging of bone tumors. *AJR*, 132, 567-576.
5. Holland, B. R., & Freyschmidt, J. (1988). Magnetic resonance tomographic results in bone changes associated with sclerosis. *Rofo: Fortschritte auf dem Gebiete der Rontgenstrahlen und der Nuklearmedizin*, *149*(5), 513-521.
6. Schima, W., Amann, G., Stiglbauer, R., Windhager, R., Kramer, J., Nicolakis, M., ... & Imhof, H. (1994). Preoperative staging of osteosarcoma: efficacy of MR imaging in detecting joint involvement. *AJR. American journal of roentgenology*, *163*(5), 1171-1175.
7. Balzarini, L., Sicilia, A., Ceglia, E., JD, T. T., Trecate, G., & Musumeci, R. (1996). Magnetic resonance in primary bone tumors: a review of 10 years of activities. *La Radiologia Medica*, *91*(4), 344-347.
8. Berquist, T. H. (1993). Magnetic resonance imaging of primary skeletal neoplasms. *Radiologic Clinics of North America*, *31*(2), 411-424.
9. Chand, P., Reddy, G. As with Kumar P3, 1Assistant Professor, Department of Radiology, 2Senior Resident, Department of Radiology, 3Assistant Professor, Department of Radiology. Narayana Medical and College Hospital.
10. Kroon, H. M., Bloem, J. L., Holscher, H. C., van derWoode, H. J., Reijnierse, M., & Taminiau, A. H. M. (1994). MR imaging of edema accompanying benign and malignant bone tumors. *Skeletal Radiol.*, 23(2), 261-269.
11. Wortler, K., Blasius, S., Hillmann, A., Marx, C., Brinkschmidt, C., & Heindel, W. (2000). MR morphology of primary aneurysmal bone cysts?: a retrospective analysis of 38 cases. *Rofo.*, 172(7), 591-6.
12. del Carmen Baena-Ocampo, L., Ramirez-Perez, E., Linares-Gonzalez, L. M., & Delgado-Chavez, R. (2009). Epidemiology of bone tumors in Mexico City: retrospective clinicopathologic study of 566 patients at a referral institution. *Annals of diagnostic pathology*, *13*(1), 16-21.
13. Wörtler, K., Blasius, S., Hillmann, A., Marx, C., Brinkschmidt, C., & Heindel, W. (2000). MR morphology of primary aneurysmal bone cysts: a retrospective analysis of 38 cases. *Rofo: Fortschritte auf dem Gebiete der Rontgenstrahlen und der Nuklearmedizin*, *172*(7), 591-596.
14. Suhil, A., Choh, N., & Choh, A. (2009). Multiple enchondromatosis (Ollier disease). *Ann Saudi Med*, 29(1), 65-67.