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# The role of Magnetic Resonance Imaging in the evaluation of primary malignant bone tumors

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**Conflicts of Interest:** Nil

Abstract:

Background: Radiographs are the primary method of screening for bone tumors. When a lesion is indeterminate or shows signs of aggressiveness, MRI is indicated for further characterization. It can extend the diagnostic evaluation by demonstrating components such as cartilage, vascular tissue, fat, liquid, and hemosiderin. Thus, MRI can help by narrowing the differential diagnosis. Faint lytic /sclerotic bone lesions can be difficult to visualize using only radiographs. MRI is superior to other imaging modalities in detecting the degree of intramedullary extension and invasion of adjacent physical plates, joints, muscle compartments, and neurovascular bundles.

The purpose of this study is to evaluate the role of MRI in cases of primary malignant bone tumors and to determine the MRI characteristics of different primary malignant bone tumors.

**Materials and methods:**We prospectively evaluated forty patients of suspected primary malignant skeletal neoplasms for period of 12 months (1st October 2020 to 30th September 2021). who are aged between 10-80 years with 1.5 Tesla SEIMENS MRI machine using required protocol and sequences. There were 21 males and 19 females. In all patients, data on history, clinical examination and clinical diagnosis was obtained.

Results In our study, we tried to prospectively analyze the accuracy of MRI. We studied 40 of primary malignant bone tumours. 14 Osteosarcomas,9 Ewing's

sarcomas, 5 Chondrosarcomas, 8 Giant cell tumors, 2 chordomas and 2 multiple myelomas. There were 21 males and 19 females. The common clinical symptoms were pain in the region of tumour and swelling. All the patients were investigated with plain radiographs and MRI and were confirmed with gross surgical and histopathological findings.

**Conclusion:**MRI is the preferred modality to image musculoskeletal tumours and should be obtained after radiographic evaluation. The multi planar imaging capability of MRI helps delineation of tumour and its extent in bone and soft tissues with high contrast resolution. MRI is excellent modality for determining the extent of the tumour within the medullary canal and in showing the extent of extra-osseous soft tissue involvement.

**Keywords:** Osteosarcoma, Ewing's sarcoma, Chondrosarcoma, Giant cell tumor, chordoma, multiple myeloma, bone tumors, magnetic resonance imaging

## Introduction

Radiographs are the primary method of screening for bone tumours.When a lesion is indeterminate or shows signs of aggressiveness, MRI is indicated for further characterization. It can extend the diagnostic evaluation in demonstrating components such as cartilage, vascular tissue, fat, liquid and hemosiderin. Thus, MRI can help by narrowing the differential diagnosis.

Faint lytic /sclerotic bone lesions can be difficult to visualise using only radiographs. MRI is superior to the other imaging modalities in detecting the degree of intramedullary extension and invasion of adjacent physical plates, joints, muscle compartments and neurovascular bundles.

The purpose of this study is to evaluate the role of MRI in cases of primary malignant bone tumors and to determine the MRI characteristics of different primary malignant bone tumours[1].

## Aims and objectives

The purpose of the study is to evaluate the role of MRI in primary malignant bone tumors and to determine the MRI characteristics of different primary malignant bone tumors and to correlate and compare the imaging findings with surgical and gross pathological findings.

## Materials and methods

We prospectively evaluated forty patients of suspected primary malignant skeletal neoplasms for period of 12 months starting from August 2020 to September 2021 who are aged between 10-80 years with 1.5 Tesla SEIMENS MRI machine using required protocol and sequences. There were 21 males and 19 females. In all patients, data on history, clinical examination and clinical diagnosis was obtained

### Source of data

Patients referred from outpatient department of tertiary care center with history of suspicion of primary malignant skeletal neoplasms

### Selection criteria

### Inclusion criteria

Patients referred with suspected primary malignant skeletal neoplasms.

### Exclusion criteria

- All patients who did not give consent to be a part of the study.
- Patients with benign skeletal neoplasms
- Degenerative arthritis, infection, and any previous surgery to the knee

## Result

In our study, we tried to prospectively analyze the accuracy of MRI. We studied 40 primary malignant bone tumors. 14 Osteosarcomas, 9 Ewing's sarcomas, 5

Chondrosarcomas, 8 Giant cell tumors, 2 chordomas and 2 multiple myelomas.

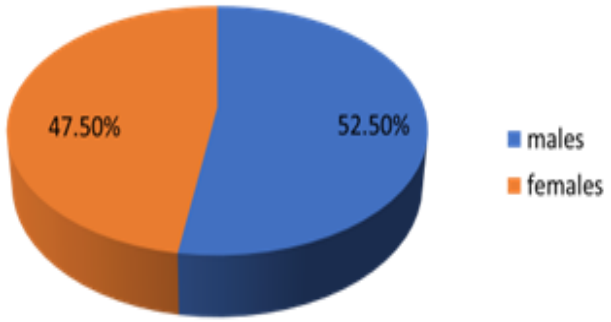


Figure 1: Distribution of tumors among males and females.

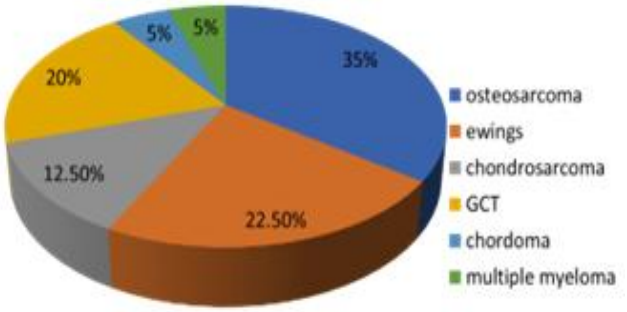


Figure 2: Incidence of bone tumors.

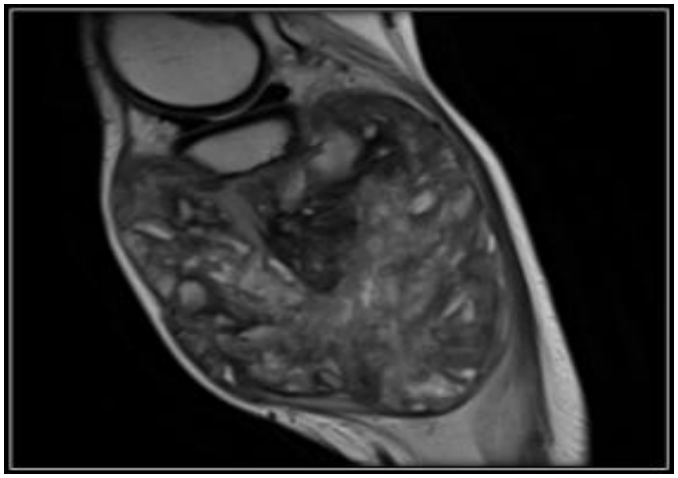

Figure 3: T1 weighted image showing large relatively defined multilobulated lesion with heterogeneous signal with hypointense osteid matrix

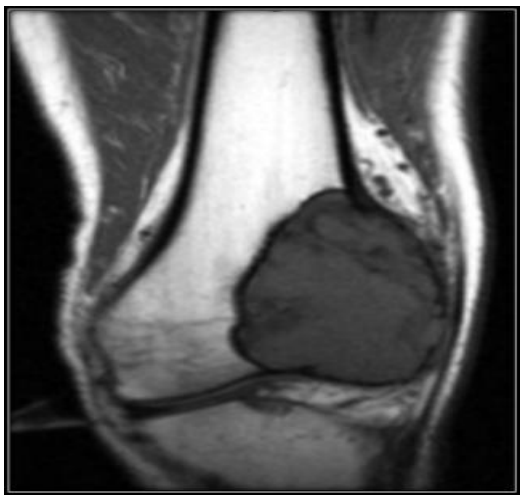

Figure 4: T1 weighted coronal MR image reveals the expansile hypointense lesion in the subarticular location of distal femur.

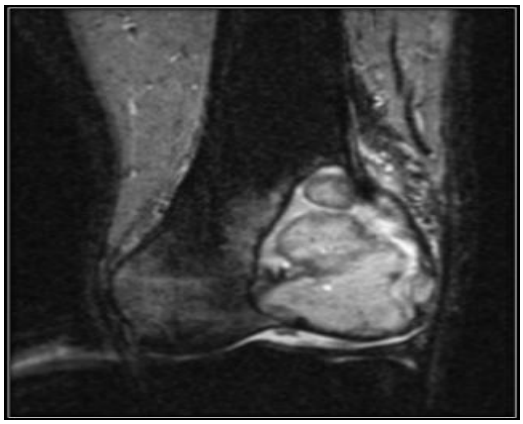

Figure 5: T1FS reveals the heterointense lesion

Figure 6: Coronal T1 weighted image showing hypointense lesion noted arising from the medial meta epiphyseal region of the distal femur

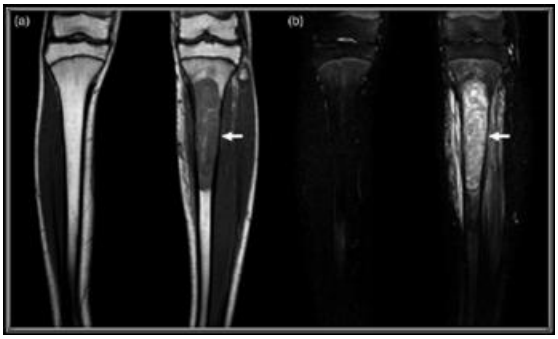

Figure 7:15 year old boy with Ewing sarcoma of the left tibia. Coronal T1 W and coronal FS T2W images showing lesion the lesion in proximal tibia.

31 cases were operated and 9 cases were not operated due to distant metastasis. Of the total 40 cases, cortical breach was detected on MRI in 33(82.5%) cases and absent in 7(17.5%) cases.

Out of the 31 cases operated, cortical involvement seen in 27 cases and absent in 4 cases. Thus sensitivity and specificity of MRI in detecting cortical involvement were 96.2% and 100% respectively. It is best demonstrated on T1W imaging

Marrow involvement is seen in all cases on MRI and confirmed by surgical &pathological findings. The extent of marrow involvement was best shown by T1W images, STIR coronal or sagittal sequences.

Extraosseous soft tissue involvement was seen in 34(85%) cases out of 40 cases.

Extra osseous involvement was best shown by T2wted images. MRI showed neurovascular bundle involvement in 4 (10%) cases. On MRI, joint involvement was seen in 13(32.5%) cases and not seen in 27 (67.5%) cases. The presence or absence of joint involvement is particularly important in preoperative evaluation of tumour extent which will subsequently decide the appropriate surgical procedure (intra or extra articular resection).

**Discussion**

Baweja S et al.[2] studied 20 patients with long bone osteosarcoma and found that STIR images significantly overestimated tumour length while no significant differences were found between measurements taken at pathological examination and those taken on T1 weighted images, concluding that T1 weighted images must be used for assessing intramedullary tumour extent. The overestimation of tumour length on STIR images was attributed to edema associated with the bone tumour.

Rita Golfieri et al. examined 68 MRI studies in primary bone tumours and discovered that STIR images are as good as the T1 spin echo sequence in assessing intramedullary extent[3].

Iagaru A et al.[4] studied 95 patients with osteosarcoma and concluded that T1 weighted images and post contrast T1 weighted images were ideal for assessing joint invasion and demonstrated a sensitivity of 100% for joint invasion using T1 weighted images; however, the specificity was only 63%, and thus MRI significantly over staged the disease due to a high proportion of false positives.

Messerschmitt PJet al.[5] studied 34 patients with osteosarcoma and discovered that MRI had 100% sensitivity, 70% specificity, and 86.4% positive predictive value in assessing joint invasion.

**Conclusion**

MRI is the preferred modality to image musculoskeletal tumours and should be obtained after radiographic evaluation. The multi planar imaging capability of MRI helps delineation of tumour and its extent in bone and soft tissues with high contrast resolution. MRI is excellent modality for determining the extent of the tumour within the medullary canal and in showing the

extent of extra-osseous soft tissue involvementT1 weighted images give information regarding intra medullary extent and T2 weighted images, the soft tissue extent. MRI is very sensitive in detecting cortical involvement but less sensitive in detecting the periosteal reaction, tumour osteoid and calcification when compared to plain radiography. Both T1 and T2 weighted images are equally sensitive in detecting the cortical break. Joint involvement, neurovascular involvement is detected on MRI. Axial T2 weighted images are the best for the evaluation of Joint and Neurovascular involvement.

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