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MRI Evaluation Of Musculoskeletal Tumours In Correlation With Conventional Radiography

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Abstract
Introduction: *Since the beginning of the twentieth century, there has been enormous progress in the diagnosis and therapy of musculoskeletal tumors, leading to substantial improvements in overall prognosis and patient survival. This progress has resulted largely from the development of an integrated, multidisciplinary approach to musculoskeletal tumors and from advances in multiple medical specialities, perhaps most notably in the new medical imaging speciality, radiology.*
Materials and Methods: *MR imaging was performed on a 1.5T MRI system. Patient's position was determined by the area of abnormality. Body or surface coils were used according to the site of involvement. The smallest local coil that adequately covers the anatomic area was used for imaging. The closest joint was included in the field of view in at least one plane to provide a landmark for surgical localisation. The region of abnormality was positioned as close to the centre of the coil as possible. Prior to imaging the region of interest, a large field of view localiser using an increased diameter surface coil or body coil was used to accurately determine the proximal and distal extension of a large lesion, wherever required. Slice thickness was 2mm.*
Results: *The present study was carried out on 40 patients of musculoskeletal tumors suspected clinically and/or on plain radiography. All the cases in the study attended outpatient or were inpatients at ASRAMS. Patients were examined radiologically and findings were recorded as per proforma attached, in all cases. In all patients, plain radiographs were done first followed by MRI (T1W, T2W, STIR, sequences were used to obtain images in coronal, sagittal and axial planes). FNAC/Biopsy/Histopathological findings were recorded where ever possible.*
Conclusion: *Magnetic Resonance Imaging is the mode of choice for evaluation of musculoskeletal tumours. It is highly specific & sensitive in diagnosing musculoskeletal tumours. Its combination with conventional radiograph leads to better analysis & accuracy. It gives added information of surrounding tissues including joints & neurovascular bundle. In the final analysis a combination of Radiography & MRI evaluation gives accurate & all round information regarding the musculoskeletal tumours, increasing the sensitivity & specificity to a much higher extent than if done independently.*
Key Words: *MRI, STIR, FNAC, Biopsy*

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I. Introduction

Since the beginning of the twentieth century, there has been enormous progress in the diagnosis and therapy of musculoskeletal tumors, leading to substantial improvements in overall prognosis and patient survival. This progress has resulted largely from the development of an integrated, multidisciplinary approach to musculoskeletal tumors and from advances in multiple medical specialities, perhaps most notably in the new medical imaging speciality, radiology.

Medical imaging revolutionized both diagnostic and therapeutic approaches in musculoskeletal oncology by providing accurate information about the tissue composition and the anatomic relationships of musculoskeletal tumors that is used in tumor detection, staging, therapeutic monitoring, and post therapy surveillance.

Throughout the history of musculoskeletal tumor imaging, numerous luminaries in radiology, pathology, and surgery have made contributions that allowed the field to flourish. This multidisciplinary approach was institutionalized in 1972 with the formation of the International Skeletal Society, the concept for

which was developed by three renowned musculoskeletal radiologists: Harold G. Jacobson, Ronald O. Murray, and Jack Edeiken.

Radiographs provide critical information regarding lesion location, margin, matrix, mineralisation, cortical involvement and adjacent periosteal reaction [2]. Radiography offers more information than any other imaging modality in the study of bone lesions & remains the cornerstone for the differential diagnosis of skeletal tumours and tumour like lesion, or at least narrow the diagnostic possibilities, include patterns of bone destruction, lesion margins, internal characteristics of the lesion, type of host bone response, location, site and position of the lesion, the skeletal nature. The radiographic features coupled with clinical information helps define whether the lesion is neoplastic or non neoplastic, primary or metastatic and will help further in directing the subsequent work up.

Nuclear magnetic resonance was discovered independently by Felix Bloch and Edward Purcell in 1946, but its medical application, MR imaging, was not apparent until the 1970s when Raymond Damadian demonstrated that different tissue types most notably normal tissue and cancer possess different relaxation times and Paul Lauterbur produced the first MR image.

Particular emphasis is on those soft tissue and bone diagnoses that may be confidently made or suggested by MRI and lesions that are frequently encountered as incidental findings on examinations obtained for unrelated reasons. The use of MRI in differentiating benign from malignant soft tissue lesions, follow-up evaluation for differentiation of recurrent tumors from postoperative or radiation change, and response to therapy are also covered. Imaging evaluation for diagnosis and staging should be done before biopsy.

Biopsy is the definitive diagnostic procedure and should be carried out only after the appropriate diagnostic and staging tests. Whenever a bone lesion is suspected, clinico-radiological and pathologic correlation is essential to make a more accurate diagnosis and improve patient care [8].

II. Aims And Objectives

1. To determine the role of MRI in prospective evaluation of patients with clinical suspicion of musculoskeletal tumours.
2. Relevance of MRI in correlation with conventional Radiography as an investigative modality in musculoskeletal tumours.
3. To correlate the findings of MRI with final diagnosis by histopathological results.

III. Materials And Methods

Place of study: Department Of Radiodiagnosis, Alluri Sitaramaraju Academy Of Medical Sciences, Eluru.
Period of study: August 2013 to August 2015
Sample size: 40 cases
Equipment: SIEMENS 1.5 T OPEN MRI SYSTEM
Study design: This is a prospective, diagnostic study
Study population: Patients of all age groups & both sexes.

Inclusion criteria

1. All patients presenting with localized swelling.
2. Histopathology/FNAC a mandatory criteria as proof for final diagnosis.

Exclusion criteria

1. Patients with generalized oedema.
2. Patients presenting with recurrence of a primary lesion.
3. Patients in whom MRI was contraindicated eg: With pacemakers, metallic implants.
4. Undiagnosed suspected cases of primary musculoskeletal tumors which were diagnosed as metastasis or inflammatory/infective aetiology on histopathological examination were excluded from the study.

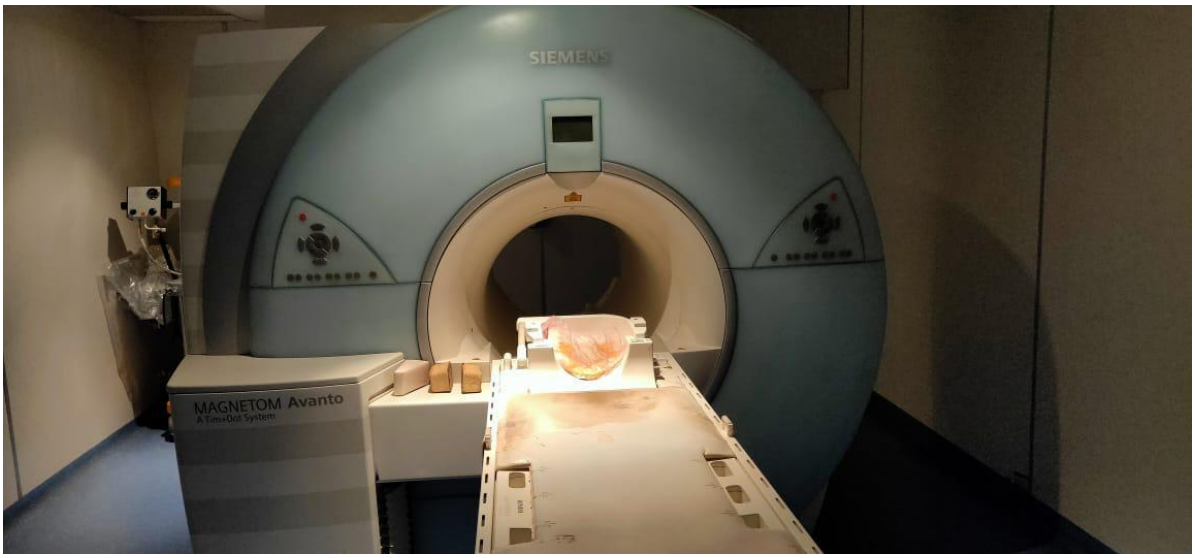
Recommended protocol for MR imaging:

MR imaging was performed on a 1.5T MRI system. Patient's position was determined by the area of abnormality. Body or surface coils were used according to the site of involvement. The smallest local coil that adequately covers the anatomic area was used for imaging. The closest joint was included in the field of view in at least one plane to provide a landmark for surgical localisation.

The region of abnormality was positioned as close to the centre of the coil as possible. Prior to imaging the region of interest, a large field of view localiser using an increased diameter surface coil or body coil was used to accurately determine the proximal and distal extension of a large lesion, wherever required. Slice thickness was 2mm.

T1-weighted images were obtained in coronal and sagittal plane.T2-weighted images were obtained in axial and sagittal planes. These were supplemented by STIR sequences in sagittal plane. Wherever required, a second plane of imaging included STIR sequence in coronal and T2W-GRE in axial planes.

SIEMENS MRI MACHINE



IV. Results

The present study was carried out on 40 patients of musculoskeletal tumors suspected clinically and/or on plain radiography. All the cases in the study attended outpatient or were inpatients at ASRAMS. Patients were examined radiologically and findings were recorded as per proforma attached, in all cases. In all patients, plain radiographs were done first followed by MRI (T1W, T2W, STIR, sequences were used to obtain images in coronal, sagittal and axial planes). FNAC/Biopsy/Histopathological findings were recorded where ever possible.

AGE DISTRIBUTION:

Patients of all age groups were included in the study. The youngest patient was 6 year old and the oldest was 75 years old. Maximum number of patients were in the age group 11-30 years.

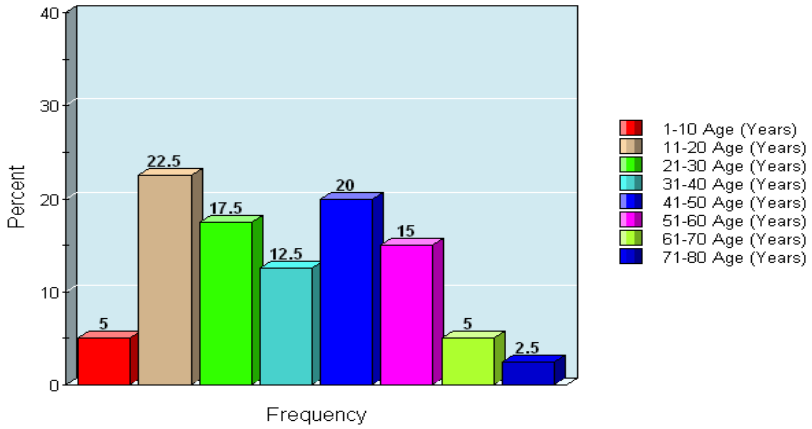
Age distribution of the patients is shown in Table -1

.

Table 1: AGE INCIDENCE (N=40)

Age (Years)	Frequency	Percent
1-10	**2**	**5**
11-20	**9**	**22.5**
21-30	**7**	**17.5**
31-40	**5**	**12.5**
41-50	**8**	**20**
51-60	**6**	**15**
61-70	**2**	**5**
71-80	**1**	**2.5**
Total	**40**	**100**

AGE INCIDENCE



SEX DISTRIBUTION

Out of 40 patients, 22 (55%) were males and 18 (45%) were females. Sixth decade was the commonest age group in males and second and fifth decade was commonest age group in females for musculoskeletal tumors. Sex distribution of the patients is shown in Table 2.

Table 2: SEX INCIDENCE (N=40)

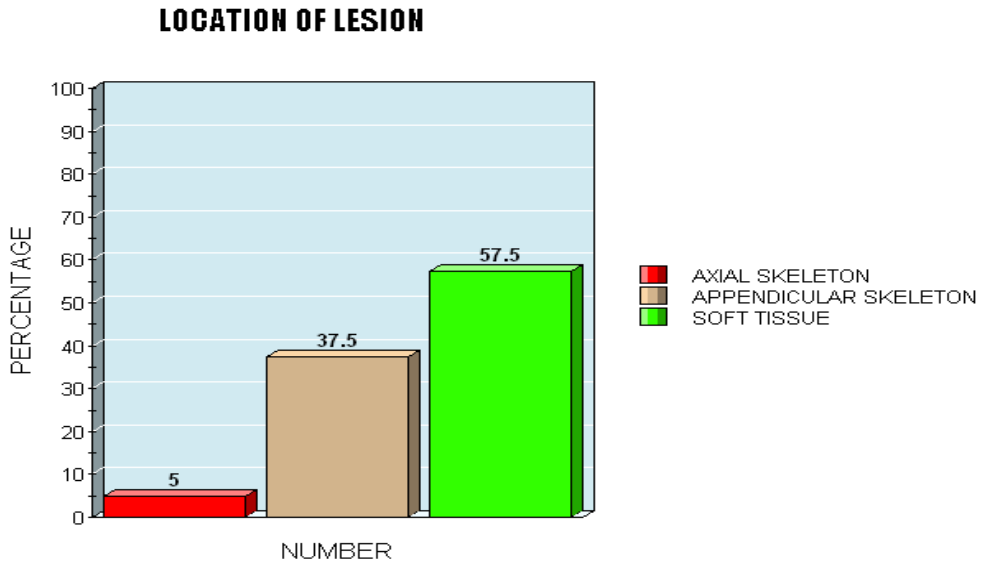
Age (Years)	Male	Female
1-10	2	0
11-20	4	5
21-30	4	3
31-40	1	4
41-50	3	5
51-60	5	1
61-70	2	0
71-80	1	0
Total	22	18

LOCATION OF LESION

Appendicular skeleton was involved in 15 patients (37.5%). Axial skeleton was involved in 2 patients (5%) and soft tissue in 23 patients (57.5%) as shown in Table -3.

Table 3: LOCATION OF LESION (N=40)

TUMOR LOCATION		NUMBER	PERCENTAGE
BONE	AXIAL SKELETON	2	5
	APPENDICULAR SKELETON	15	37.5
SOFT TISSUE		23	57.5



DEMOGRAPHIC PROFILE

The demographic profile of the patients revealed pain and swelling to be the most common presenting symptoms. The age range and sex ratio of various tumors are shown in table 4.

TABLE 4: DEMOGRAPHIC PROFILE

DIAGNOSIS	AGE (Years)	SEX RATIO (M:F)	COMMONEST SYMPTOM
OSTEOSARCOMA(5)	51-55	2:3	SWELLING
GCT(4)	23-47	1:3	SWELLING
OSTEOCHONDROMA(3)	6-17	2:1	SWELLING
ABC(2)	16-27	1:1	PAIN
LIPOSARCOMA(3)	50-75	2:1	SWELLING, PAIN
CHONDROSARCOMA(1)	45	0:1	SWELLING, PAIN
MYXOMA(2)	31-49	1:1	SWELLING, PAIN
SYNOVIAL SARCOMA(2)	17-40	0:2	SWELLING
MALIGNANT FIBROUS HISTIOCYTOMA(4)	51-55	3:1	SWELLING
NEUROFIBROMA(2)	45	1:1	SWELLING
DERMOID(1)	70	1:0	PAIN
LIPOMA(1)	49	0:1	PAIN
HAEMATOMA(1)	50	0:1	PAIN
FIBROMA(1)	30	1:0	SWELLING, PAIN
SIMPLE BONE CYST(1)	19	1:0	PAIN
FIBROUS CORTICAL DEFECT(1)	7	1:0	PAIN
HAEMANGIOMA(1)	52	1:0	PAIN
SPINA VENTOSA(1)	21	1:0	PAIN,SWELLING
MALIGNANT PHERIPHERAL NERVE SHEATH TUMOUR(1)	51	1:0	SWELLING
AV MALFORMATION(1)	26	0:1	SWELLING
JUGULAR VEIN THROMBOSIS(1)	40	0:1	SWELLING

OSTEOID OSTEOMA(1)	12	1:0	PAIN,SWELLING

NATURE OF LESION

Twenty two patients (55%) had benign musculoskeletal tumors and 18 patients (45%) had malignant musculoskeletal tumors. Nature of lesion is shown in Table-5

.

TABLE 5: NATURE OF LESION

NATURE OF LESION	FREQUENCY	PERCENTAGE
BENIGN	22	55
MALIGNANT	18	45

ZONE OF TRANSITION:

"Narrow", if it is so well defined that it can be drawn with a fine-point pen. "Wide", if it is imperceptible and can not be drawn at all. Eight patients had narrow zone of transition and 4 patients had wide zone of transition on Radiographs whereas on MRI, 3 patients had narrow zone of transition and 8 patients had wide zone of transition as shown in Table-6.

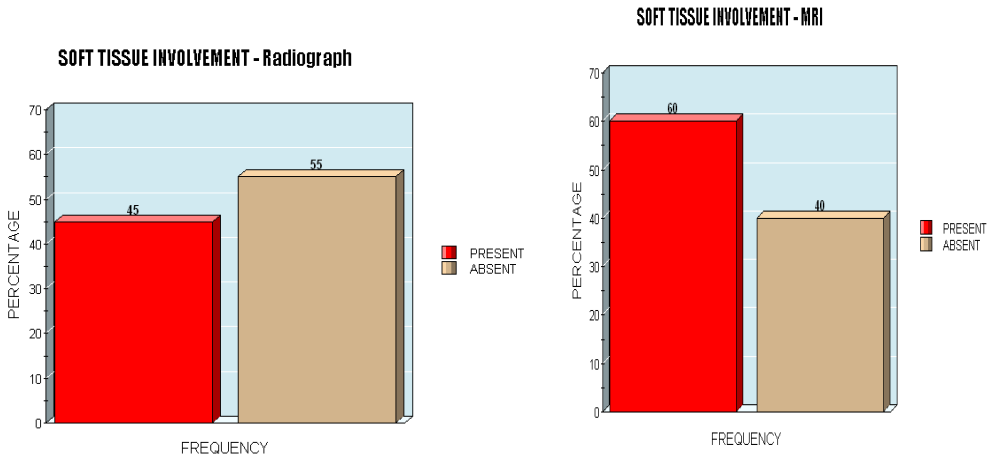
Zone of transition	Radiograph	MRI
NARROW	8	3
WIDE	4	8

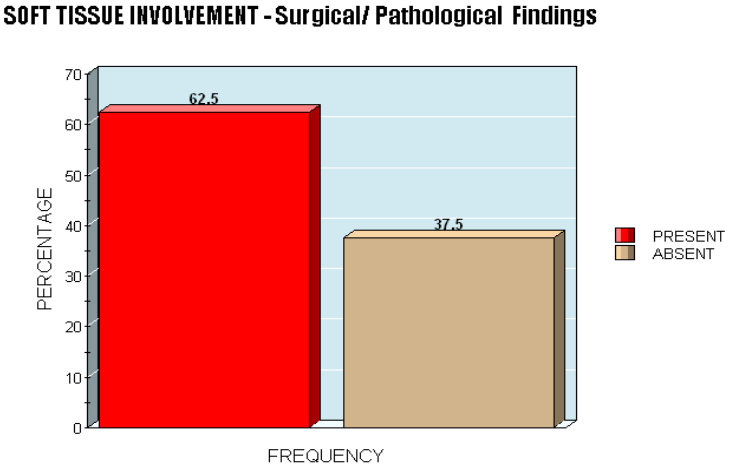
SOFT TISSUE INVOLVEMENT

Soft tissue involvement was depicted in 18 patients on radiographs (45%) whereas MRI demonstrated soft tissue involvement in 24 patients (60%) and surgery demonstrated soft tissue involvement in 25 patients (62.5%). Soft tissue involvement is shown in Table-7.

TABLE -7: SOFT TISSUE INVOLVEMENT

Soft tissue involvement	Radiograph		MRI		Surgical/ Pathological Findings	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
PRESENT	18	45	24	60	25	62.5
ABSENT	22	55	16	40	15	37.5
TOTAL	40	100	40	100	40	100



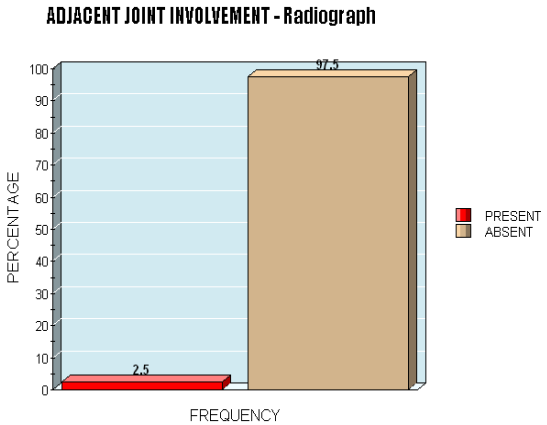


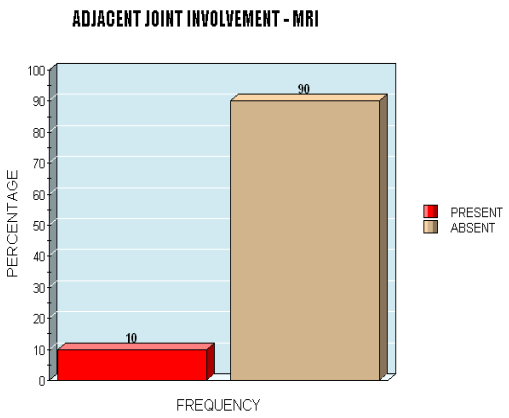
ADJACENT JOINT INVOLVEMENT

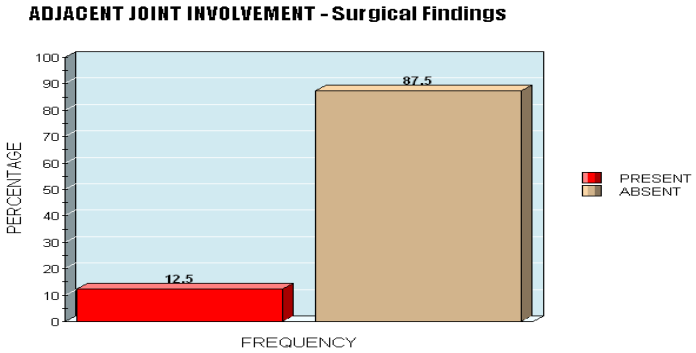
Radiographs showed adjacent joint involvement in 1 patient (2.5%). MRI demonstrated adjacent joint involvement in 4 patients (10%) and surgery demonstrated adjacent joint involvement in 5 patients (12.5%).

TABLE -8: ADJACENT JOINT INVOLVEMENT

Adjacent joint involvement	Radiograph		MRI		Surgical Findings	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
PRESENT	1	2.5%	4	10%	5	12.5%
ABSENT	39	97.5%	36	90%	35	87.5%
TOTAL	40	100%	50	100%	40	100%

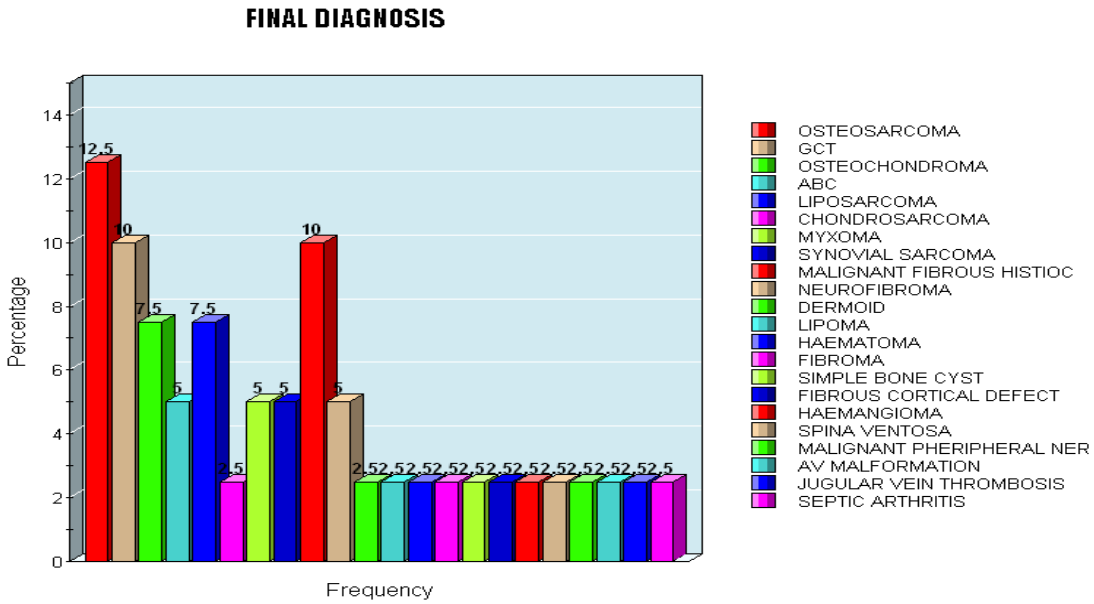






FINAL DIAGNOSIS

DIAGNOSIS	Frequency	Percent
OSTEOSARCOMA(5)	5	12.5%
GCT(4)	4	10%
OSTEOCHONDROMA(3)	3	7.5%
ABC(2)	2	5%
LIPOSARCOMA(3)	3	7.5%
CHONDROSARCOMA(1)	1	2.5%
MYXOMA(2)	2	5%
SYNOVIAL SARCOMA(2)	2	5%
MALIGNANT FIBROUS HISTIOCYTOMA(4)	4	10%
NEUROFIBROMA(2)	2	5%
DERMOID(1)	1	2.5%
LIPOMA(1)	1	2.5%
HAEMATOMA(1)	1	2.5%
FIBROMA(1)	1	2.5%
SIMPLE BONE CYST(1)	1	2.5%
FIBROUS CORTICAL DEFECT(1)	1	2.5%
HAEMANGIOMA(1)	1	2.5%
SPINA VENTOSA(1)	1	2.5%
MALIGNANT PHERIPHERAL NERVE SHEATH TUMOUR(1)	1	2.5%
AV MALFORMATION(1)	1	2.5%
JUGULAR VEIN THROMBOSIS(1)	1	2.5%
SEPTIC ARTHRITIS(1)	1	2.5%
TOTAL	**40**	**100%**



TUMOR CHARACTERIZATION BY INTENSITY PATTERNS:

Musculoskeletal tumors were characterized by their intensity pattern to allow a specific diagnosis in certain situations. Tumor characterization by intensity pattern is shown in Table-1

TABLE-10: TUMOR CHARACTERIZATION BY INTENSITY PATTERNS

TUMOR ORIGIN	T1W	T2W
OSTEOCHONDROMA	Low intensity(cartilage cap)	High intensity
MALIGNANT FIBROUS HISTIOCYTOMA	Heterogenously Hypointense	Hetrogenously hypointense
HEMANGIOMA	Hyperintense	Hyperintense
GCT	Low intensity	Intermediate intensity
CHONDROSARCOMA	Low intensity	Intermediate to high intensity
MALIGNANT SOFT TISSUE TUMOR	Hypo to isointense with central high intensity hemorrhage	Predominantly hyperintense with high intensity hemorrhage and necrosis
LIPOMA	Fat intensity on all sequences	Fat intensity on all sequences
MYXOMA	Low intensity	Homogenous high intensity

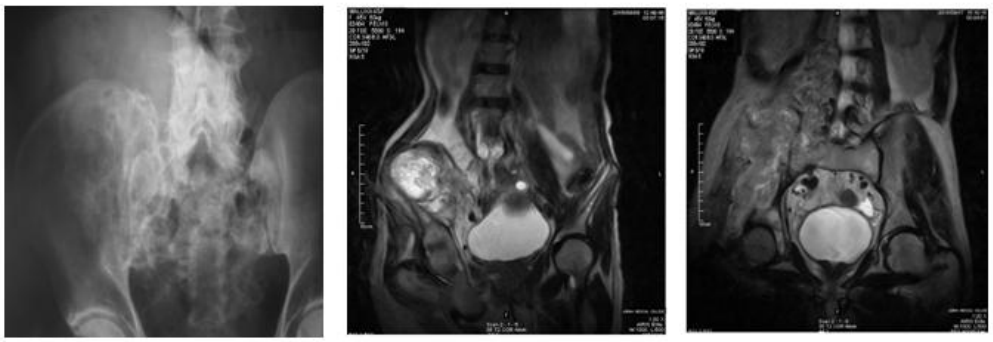
MRI CHARACTERISTICS

Musculoskeletal tumors were characterized by their signal intensity pattern and homogeneity.
MR characteristics of various musculoskeletal tumors is shown in Table-11

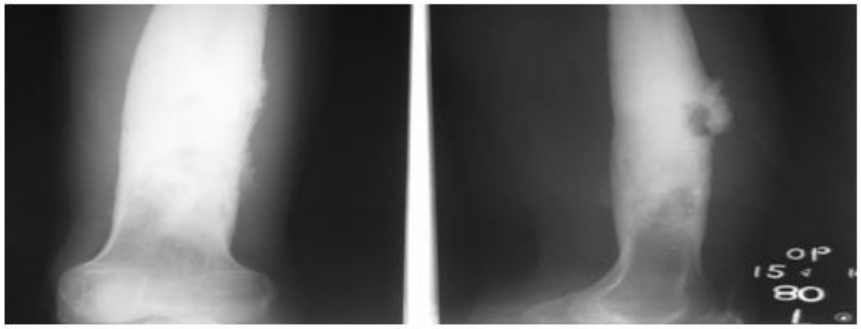
TABLE-11: MRI Characteristics

MR Characteristics	T1W	T2W
Signal intensity		
➢ Greater than that of fat	0	0
➢ Equal to that of fat	0	11
➢ Between that of fat and muscle	6	19
➢ Equal to that of muscle	27	12
➢ Less than that of muscle	7	0
➢ Complex	10	8
Homogeneity		
➢ Homogeneous	2	11
➢ Mild inhomogeneity	10	12
➢ Moderate inhomogeneity	28	19
➢ Complex	10	8

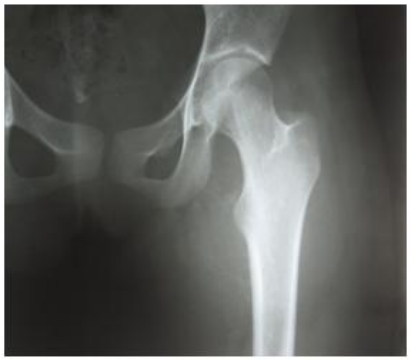
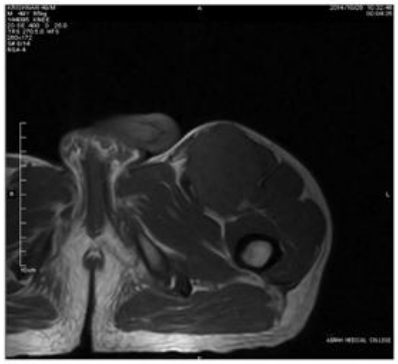
CHONDROSARCOMA



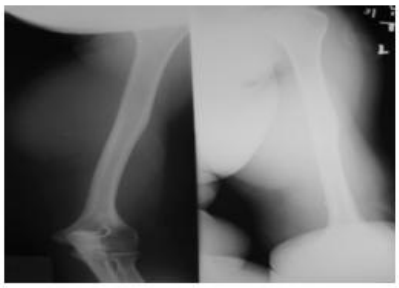
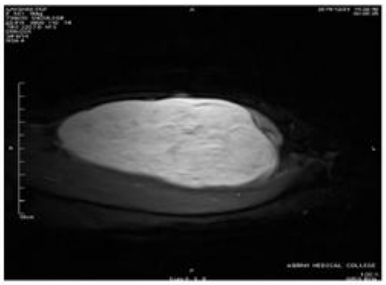
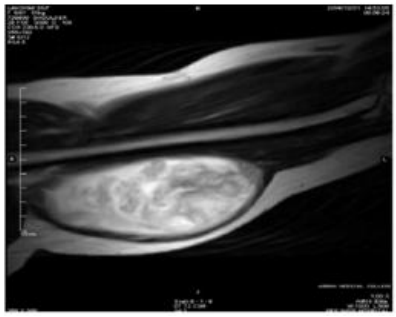
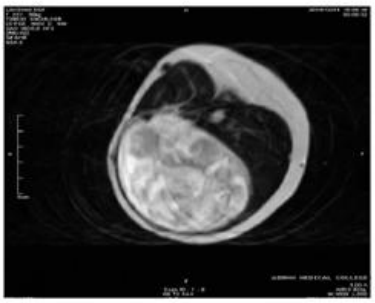
OSTEOSARCOMA



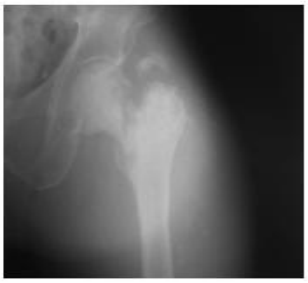
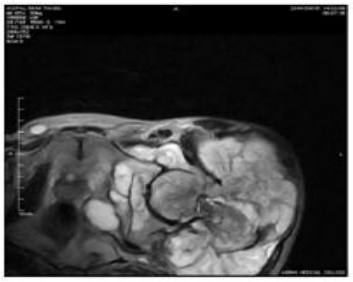
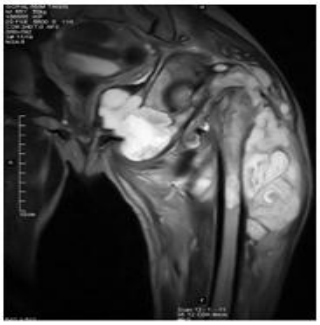
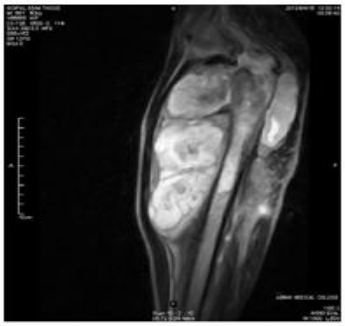
MYXOMA

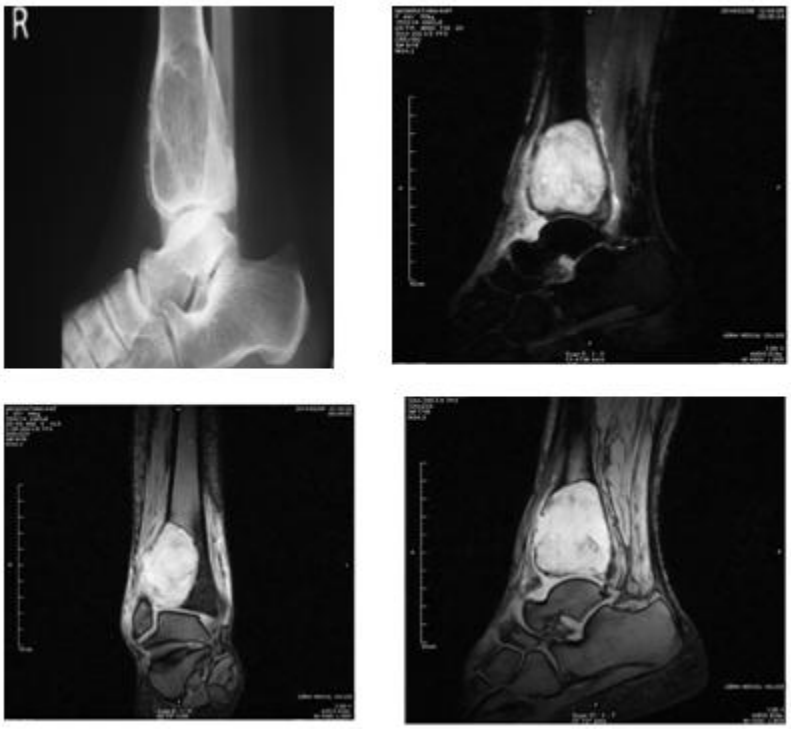
MFH

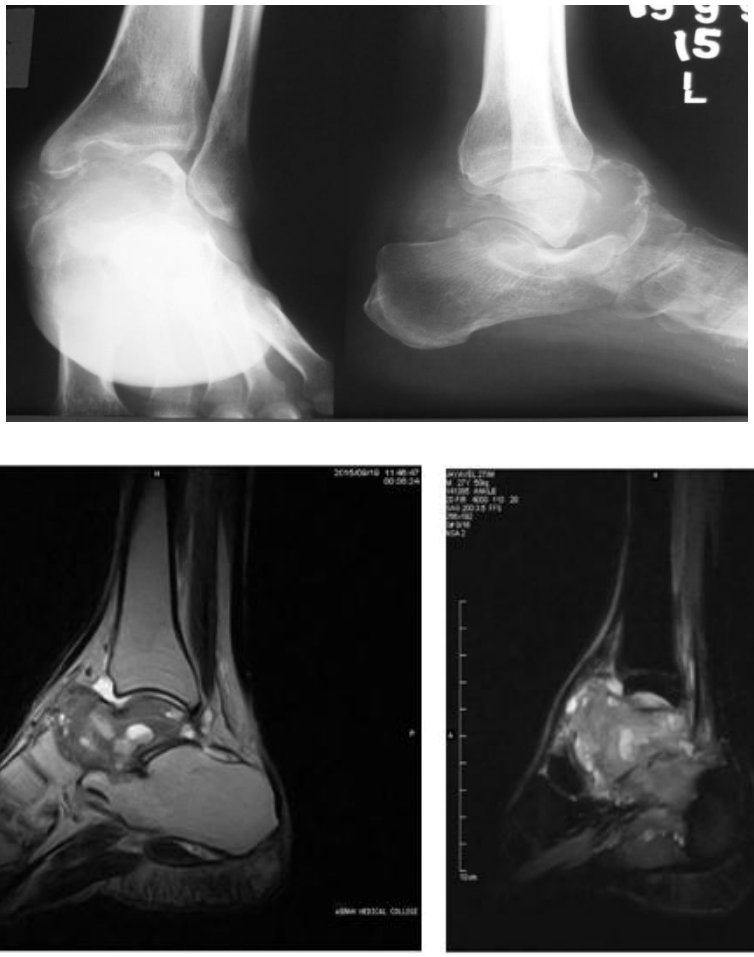
LIPOSARCOMA

GCT



ABC



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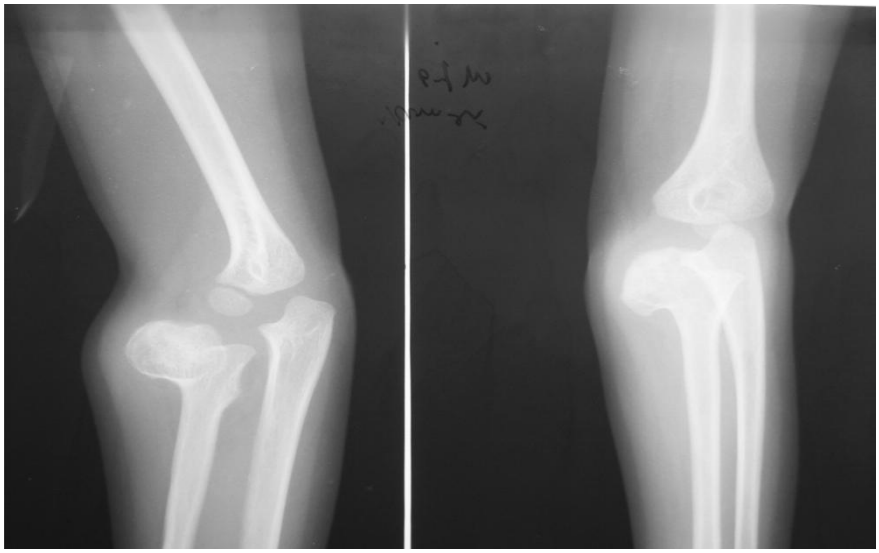

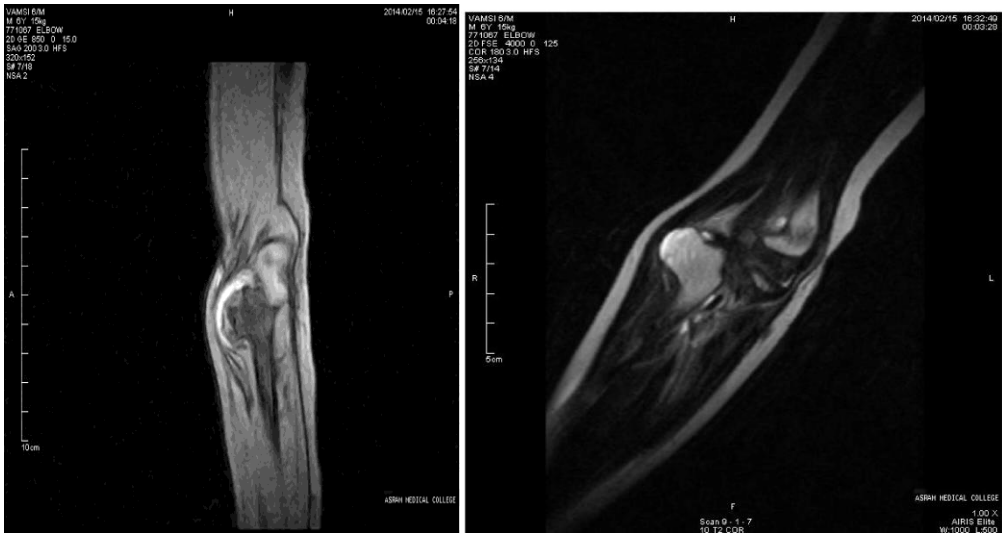

V. Discussion

The present study was undertaken to evaluate musculoskeletal tumors by Magnetic Resonance Imaging (MRI) and to correlate findings of MRI with histopathological/surgical findings.

A total of forty patients with musculoskeletal mass lesions suspected clinically and/or on plain radiography were evaluated. All patients underwent plain radiography and MR imaging. Thirty six out of forty patients had histopathological/biopsy/FNAC/surgical findings for correlation. Five patients however were not operated upon for varied reasons (1 – AV malformation, 1 - simple bone cyst, 1 – hemangioma,1-Jugular vein thrombosis).

Specific types of tumors affect certain age groups and anatomic sites. For instance, most osteosarcomas occur during adolescence and about half of them arise in the metaphysis around the knee, either in distal femur or proximal tibia. These are the sites of greatest skeletal growth activity. In contrast, chondrosarcomas tend to develop during mid to late adulthood and frequently involve the trunk limb girdles and proximal long bones. Giant cell tumors almost always arise in the epiphysis of long bones. Thus the location of a tumor provides important diagnostic information.

The demographic profile in the present study is discussed as under:

A. AGE INCIDENCE

Patients of all age groups were included in the study (from 6 years - 75 years). Maximum number of patients were in the age group of 11-30 years (16 patients - (48%).

B. SEX INCIDENCE: 22 males (56%) and 18 females (44%) were included in the study.

C. INCIDENCE OF CLINICAL FEATURES: In our study the commonest presentation was swelling followed by pain.

D. NATURE OF LESION: In our series there were 22 (56%) benign lesions, 18 (44%) malignant lesions.

INCIDENCE OF MUSCULOSKELETAL TUMORS: The most common malignant tumor of bone is metastatic carcinoma. Primary malignant tumors are listed according to WHO classification. The frequency of the tumor types is estimated from the extensive experience with 8542 bone tumors at the Mayo Clinic for more than 40 years. Marrow tumors (Multiple myeloma and lymphoma) comprised 3401 (40%) cases and most were diagnosed by marrow aspiration. Of the remaining 5141 (60%) primary non marrow bone tumors, 3113 (61%) were malignant and 2078 (39%) were benign. The malignant tumors consisted of 1330 (43%) of osteosarcoma, 732 (23%) malignant cartilage tumors, 402 (13%) Ewing sarcoma cases, 262 (8%) chordomas, 207 (7%) fibrosarcomas and 187 (6%) miscellaneous tumors. The benign lesions consisted of 1090 (52%) benign cartilage tumors and 142 (13%) miscellaneous tumor types.[50]

In our study also, osteosarcoma was the most frequent malignant primary bone tumor (5 cases-16% of total cases). However instead of benign chondroid lesions, Giant cell tumor was the most common benign primary bone tumor in our series of 40 patients (4 patients -8% of all cases). This may be because most of the patients with GCT came for further imaging and surgical intervention.

Osteosarcoma: Out of Five cases of Osteosarcoma, femur was the most commonly involved bone. The age group varied from 51-55 years. They were seen predominantly in females (M: F =2:3).

- Radiographs showed mixed density metaphyseal lesion with wide zone of transition with soft tissue components, ossification and periosteal reaction (Sunray appearance and Codman's triangle).
- The lesions were heterogeneously hypointense on T1W and T2W images.
- MRI was better in delineating the adjacent joint involvement. There was soft tissue involvement in all cases (100%). Codman's type of periosteal reactions were seen in two patients, sunray type of periosteal reaction was seen in one patient. Cortical break was seen in all patients (100%). Adjacent joint involvement was present in two cases. On imaging diagnosis of osteosarcoma was made which was confirmed on biopsy.

Ellis et al[51] studied eight cases of well-differentiated, intramedullary osteosarcoma. They also found that the distal femur was the most frequent site.

Murphey et al[52] retrospectively reviewed 40 pathologically confirmed telangiectatic osteosarcoma lesions frequently affecting the femur, tibia and humerus. Radiographs showed geographic bone cysts, a wide zone of transition and matrix mineralization. MRI demonstrated high signal intensity on T2W images and both demonstrated hemorrhage, which simulated the appearance of aneurysmal bone cyst. Viable sarcomatous tissue surrounding hemorrhagic and/or necrotic region was best seen at contrast material enhanced CT and MR imaging with thick peripheral septal and nodular enhancement in all cases. Subtle matrix mineralization in this viable tissue was best seen at CT. An associated soft tissue mass was seen in 89% at MR imaging .Whereas, in present study an associated soft tissue mass was seen in 100% at MR imaging and the lesions were heterogeneously hypointense on T1W and T2W images because of extensive matrix mineralization and thick periosteal reactions.

GIANT CELL TUMOR

There were 4 cases of GCT in our study. They occurred in age group of 23-47 years. They presented with swelling. Male to female ratio was 1:3.

- Radiographs showed an eccentric expansile lytic extra articular lesion in meta-epiphysis of the bones.
- On MRI, the lesions were homogenously hypointense on T1W images. Varied appearances like heterogeneously hyperintense with fluid filled areas and necrotic areas were seen on T2W.
- MRI showed joint involvement in two cases (50%). Soft tissue involvement is seen in one case (25%).

The diagnosis was confirmed on histopathology

GCT are very rare in children under 15 years of age, [58,59] and are seen more commonly in girls. Radiographically, these tumors are solitary, well defined, eccentric lytic lesions usually located about the knee. They lack matrix calcification and have a non-sclerotic margin. Cortical thinning is common, but periosteal reaction is unusual.

GCT are located in the metaphysis and do not cross the open physis,[60] but may extend to the subchondral bone if the physis is closed. At MR imaging, GCT frequently demonstrates peripheral low signal on T1-weighted images and generalized hypointensity on T2-weighted images [61]. This T2-hypointensity may result from the tumor cellularity, or from recurrent hemorrhage within the lesion. In either case, it is a useful feature in characterizing this tumor.

VI. Conclusion

Magnetic Resonance Imaging is the mode of choice for evaluation of musculoskeletal tumours. It is highly specific & sensitive in diagnosing musculoskeletal tumours. Its combination with conventional radiograph leads to better analysis & accuracy. It gives added information of surrounding tissues including joints & neurovascular bundle. In the final analysis a combination of Radiography & MRI evaluation gives accurate & all round information regarding the musculoskeletal tumours, increasing the sensitivity & specificity to a much higher extent than if done independently.

References

[1]. S Bweja, R arora, s Singh, A Sharma, P Narang. Evaluation of bone tumours with Magnetic Resonance Imaging and corelation with surgical and pathological findings.IJRI 2006 ;16(4):611-618.
[2]. Karchevsky M, Babb JS, Schweitzer ME. Can diffusion- weighted imaging be used to differentiate benign from pathologic fractures.A meta-analysis. Skeletal Radiol 2008;37(9):791–5.
[3]. Herneth AM, Ringl H, Memarsadeghi M, et al. Diffusion weighted imaging in osteoradiology. Top Magn Reson Imaging 2007;18(3):203–12.
[4]. Hayashida Y, Yakushiji T, Awai K, et al. Monitoring therapeutic responses of primary bone tumors by diffusion-weighted image: initial results. Eur Radiol 2006;16:2637–43.
[5]. Baweja S, Arora R, Singh S, Sharma A, Narang P, Ghuman S, et al. Evaluation of Bone tumors with Magnetic Resonance Imaging and correlation with surgical and gross pathological findings. Ind J Radiol Imag. 2006; 16(4):611-18.
[6]. Baweja S, Arora R, Singh S, Sharma A, Narang P, Ghuman S, et al. Evaluation of Bone tumors with Magnetic Resonance Imaging and correlation with surgical and gross pathological findings. Ind J Radiol Imag. 2006; 16(4):611-18.
[7]. McCarville MB, Spunt SL, Skapek SX, et al. Synovial sarcoma in pediatric patients. AJR Am J Roentgenol 2002;179(3):797–801.
[8]. Woertler K. Benign bone tumors and tumor-like lesions: value of cross-sectional imaging. Eur Radiol 2003;13:1820–35.
[9]. .Mahnken AH, Nolte-Ernsting CCA, Wildberger JE, et al. Aneurysmal bone cyst: value of MR imaging and conventional radiography. Eur Radiol 2003;13: 1118–24.
[10]. Meyer JS, Hoffer FA, Barnes PD, et al. Biological classification of soft-tissue vascular anomalies: MRcorrelation. AJR Am J Roentgenol 1991;157(3):559–64.

Dr. Sunil Bonela, et. al. "MRI Evaluation Of Musculoskeletal Tumours In Correlation With Conventional Radiography." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(11), 2020, pp. 44-57.