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Role of MRI in Evaluation of Benign and Malignant Soft Tissue Tumours of Extremities

Dr.Vijayakumari[1], Dr.Srikanth Sagi[2]
1Professor & HOD Department of Radioloy OMC
[2]Consultant Radiologist
Corresponding author: Dr.Srikanth Sagi Consultant Radiologist

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I. Introduction

MR imaging has become established as an important cross-sectional imaging study for the evaluation of soft tissue tumours [1,2,3,4,5,6].Compared with ultrasonography and CT, MR imaging has proved superior in defining more accurately the extent of soft tissue tumor and the relationship of the tumor to surrounding structures, making MR imaging the study of choice in evaluating large or infiltrating soft tissue lesions. .Spin echo, fat-suppressed, and gradient echo sequences are the most commonly used sequences for evaluating soft tissue masses. The T1-weighted images (short TE, short TR) provide the best contrast between tumor and fatty tissue or bone marrow and are useful in depicting the presence of fat, myxoid component or hemorrhage within a lesion. The T2-weighted sequences (long TR, long TE) provide excellent contrast between tumor and adjacent soft tissues and are useful to show lesion homogeneity and margination; extension of tumor into adjacent soft tissue, muscle, bone, neurovascular bundle, or joint; and also the presence of peritumoral edema .This paper reviews the current techniques of performing MR imaging in the evaluation of soft tissue tumors and the MR imaging findings of the common soft tissue tumours with the exclusion of venous malformations, haemangiomas, arteriovenous malformations, non neoplastic soft tissue masses, soft tissue tumours not involving extremities.

II. Aims And Objectives

1. To evaluate the role of MR imaging in characterization of soft tissue tumors of extremities.
2.To correlate MRI findings with histopathological findings.

III. Materials And Methods

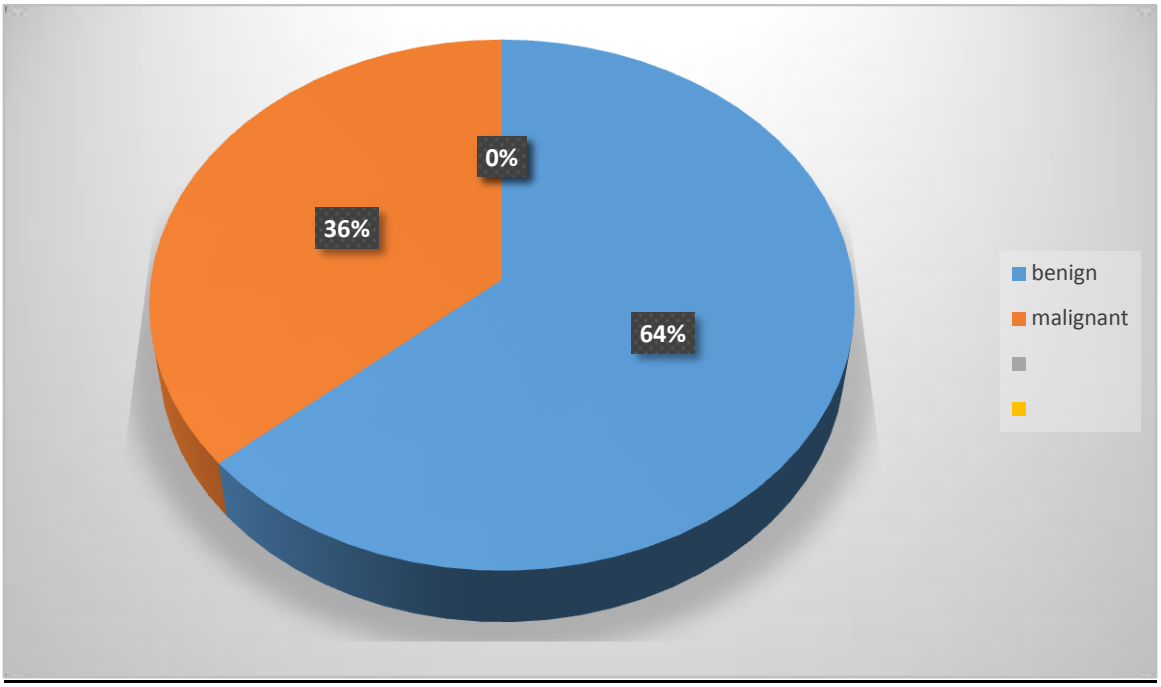
Our study was a prospective study in the department of Radiology & Imageology. We studied 33 patients who were clinically suspected to have soft tissue tumor involving the extremities. The study period was between January 2018 to May 2019. The patients included age from 5 years to 80 years. All the 33 patients underwent MRI examination. Of these only 21 patients underwent surgery. In 12 patients surgery was not done due to benign etiology & inoperability of lesions. The final diagnosis was confirmed on guided or open biopsy/FNAC & characteristic imaging findings. We excluded venous malformations, hemangiomas, arteriovenous malformations, non neoplastic soft tissue masses, soft tissue tumours not involving extremities.

All the MRI examinations are done with 1.5 T SignaHdxt GE MRI Scanner and Achieva Philips 1.5 T 32 channel MRI scanner. All the scans are done in supine position using a surface coil with size of the coil dependent on the size and location of the lesion. Axial T1,T2, STIR,T2 sagittal & coronal STIR are performed. For optimal signal-to-noise ratio and spatial resolution, MR imaging examinations are performed with the smallest coil that fits tightly around the body part being studied while covering the entire lesion. Images are obtained with 3- to 10-mm collimation; a 1- to 2-mm interspace gap to reduce cross-talk between consecutive sections; one to two acquisitions; a 192 X 256 matrix (or 256 X 256 if more detail is desired); and the smallest field of view possible. Thinner slices (3 to 5 mm) are preferred for the evaluation of small lesions and through areas of maximum interest, whereas thicker slices (6 to 10 mm) are used for a general survey of larger lesions or an entire extremity.

IV. Observation & Results

TABLE 1: STT BASED ON HISTOPATHOLOGY

Benign soft tissue tumor	Malignant soft tissue tumor	Total
21	12	33



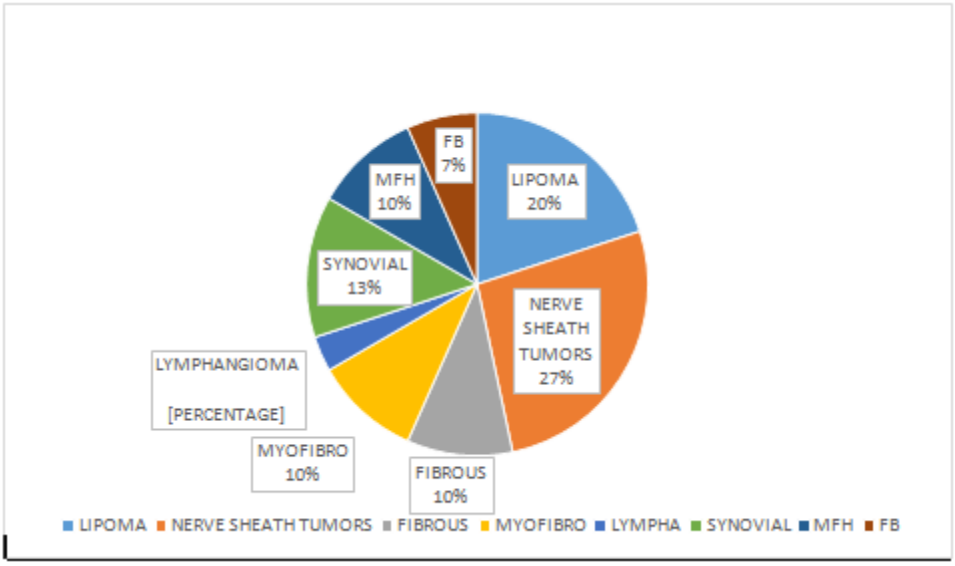


TABLE 2: NUMBER OF DIFFERENT STT BASED ON HISTOPATHOLOGY

Soft tissue tumor	Number of cases
Nerve sheath tumor	8
lipoma	6
Benign myofibroblastic proliferation	3
Fibromatosis	3
Lymphangioma	1
Synovial sarcoma	4
Malignant fibrous histiocytoma	3
Well differentiated liposarcoma	3
Fibrosarcoma	**2**
Total	**33**

TABLE 3: AGE DISTRIBUTION OF BENIGN & MALIGNANT STT

AGE GROUP	MALIGNANT	BENIGN
0-10	1	0
11-20	1	0
21-30	1	2
31-40	8	3
41-50	4	3
51-60	5	3
61-70	1	0
71-80	1	0
81-90	0	0

AGE DISTRIBUTION OF BENIGN& MALIGNANT STT

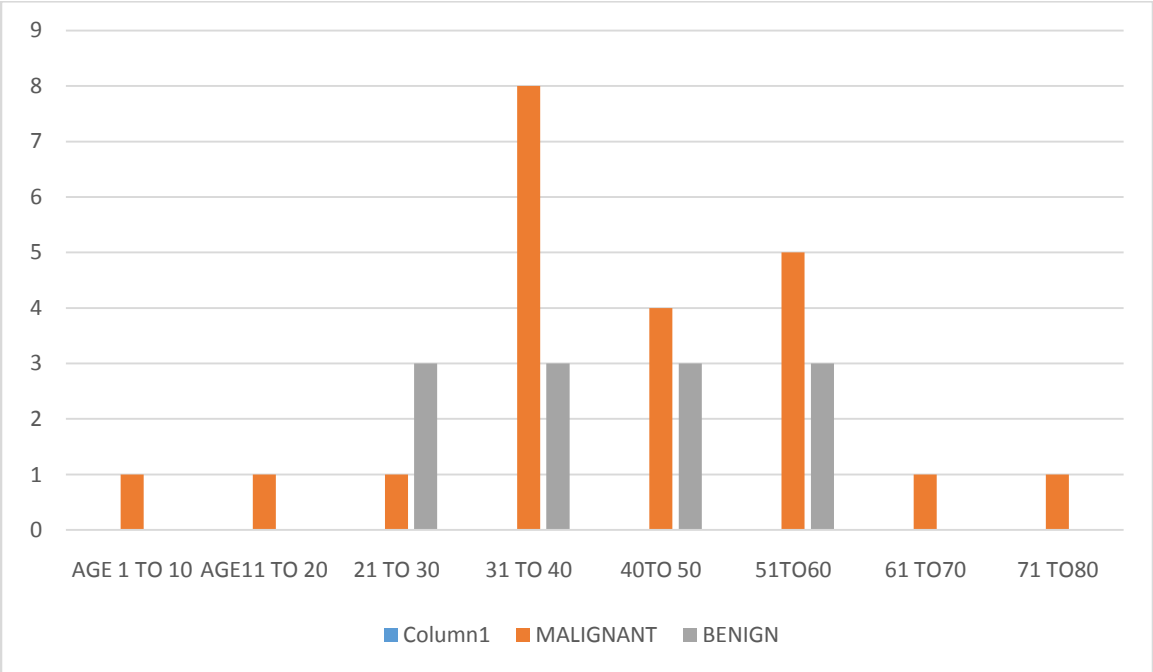


TABLE 4: GENDER DISTRIBUTION OF SOFT TISSUE TUMORS (STT)

Male	Female	Total
19	14	33

GENDER DISTRIBUTION OF STT

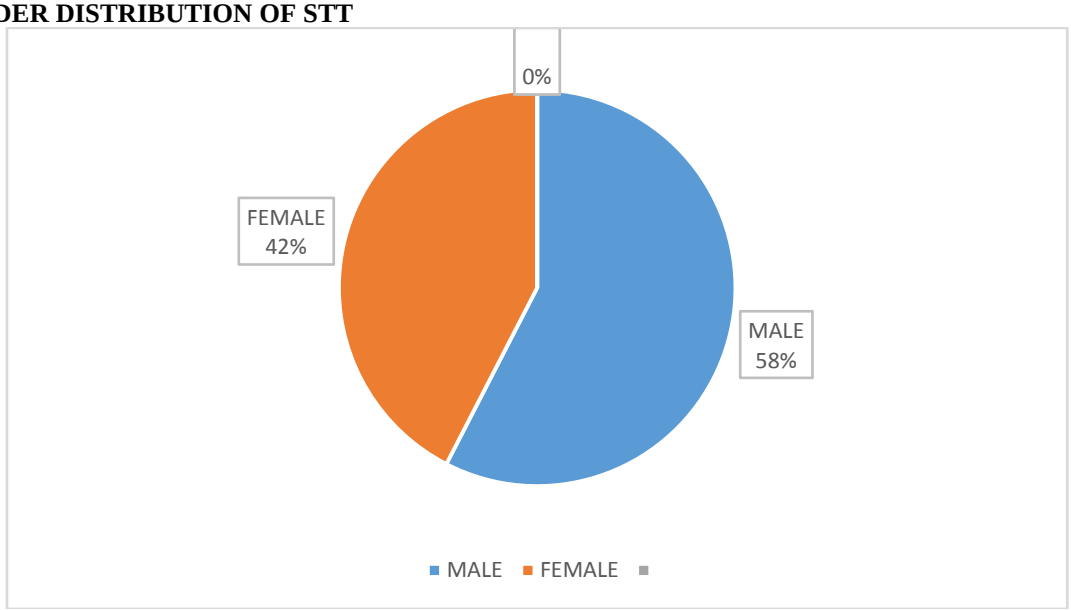


TABLE 5: DISTRIBUTION OF DIFFERENT STT IN MALE & FEMALE

Soft tissue tumor	M	F
Lipoma	4	2
Benign myofibroblastic proliferation	2	1
Fibromatosis	2	1
Nerve sheath tumor	5	3
Lymphangioma	1	0
Malignant fibrous histiocytoma	1	2
Synovial sarcoma	2	2
Fibrosarcoma	0	2
Well differentiated liposarcoma	2	1

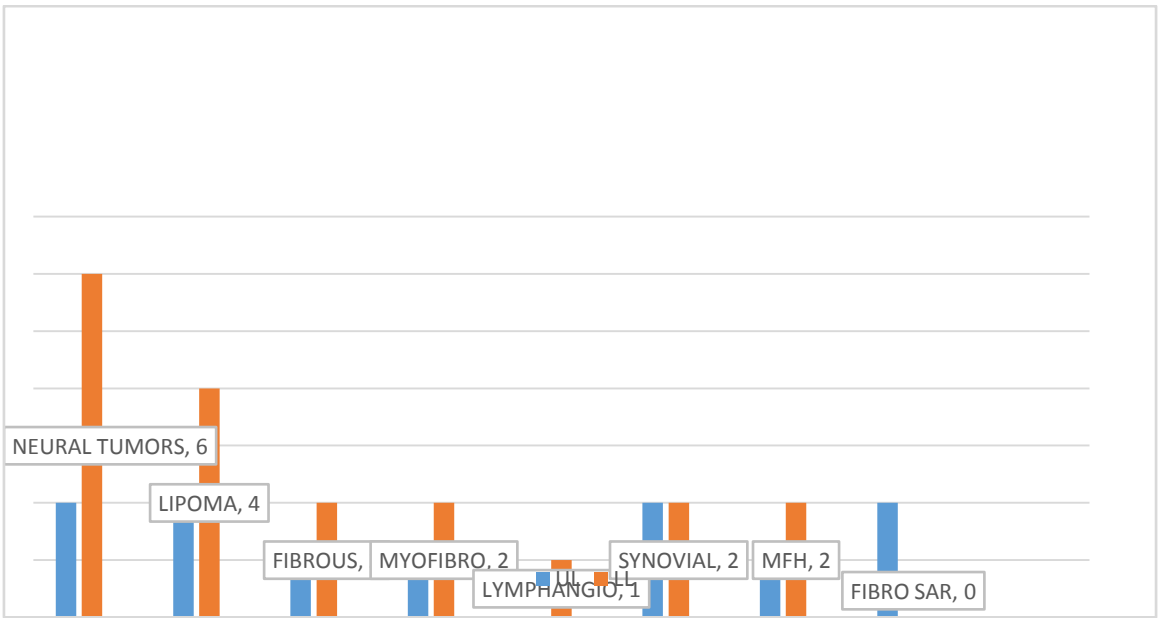


TABLE 6: DISTRIBUTION OF BENIGN & MALIGNANT STT BASEDON SIZE

size	Benign tumors	Malignant tumors
<5 cm	9	1
>5cm	12	11

DISTRIBUTION OF BENIGN & MALIGNANT STT BASEDON SIZE

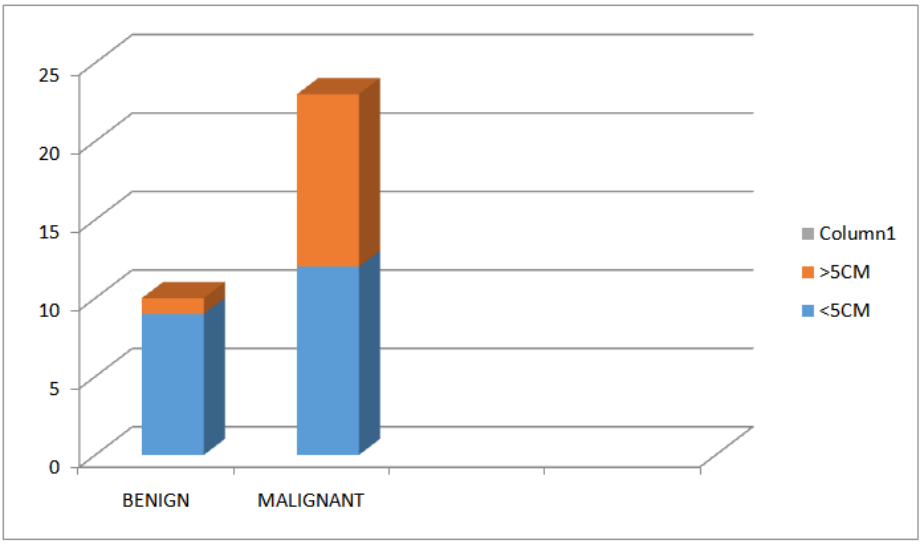
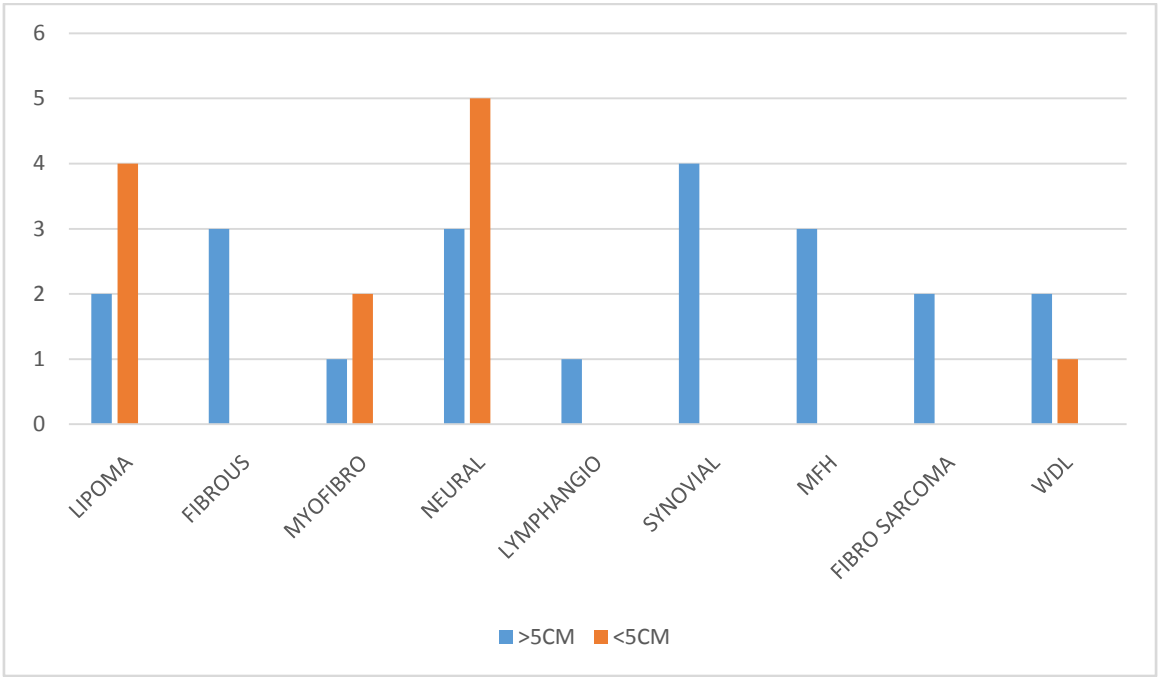


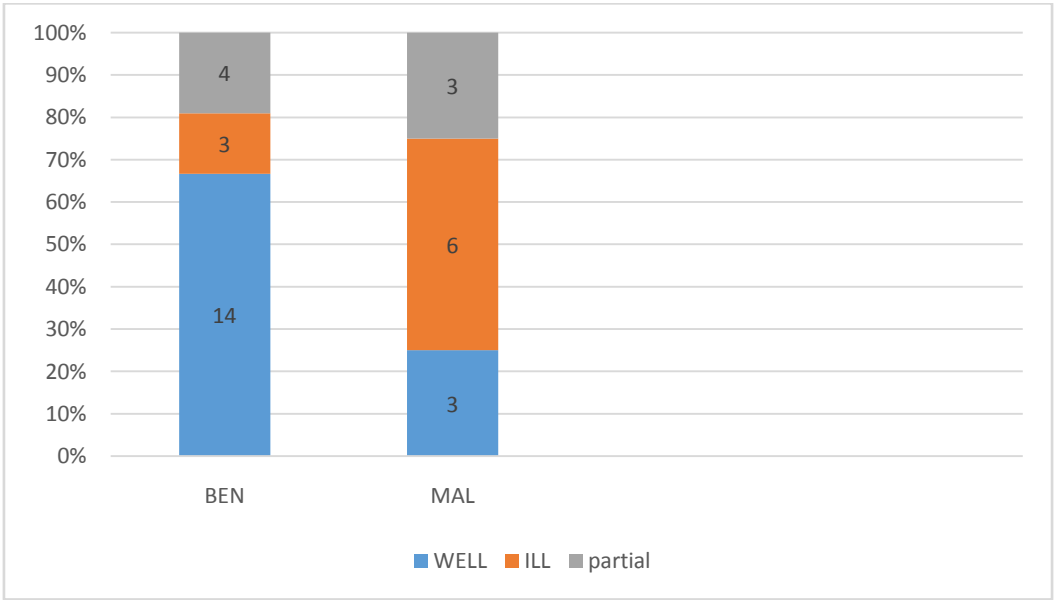
TABLE – 7: DISTRIBUTION OF STT BASED ON THEIR SIZE

SIZE	> 5 CM	< 5 CM
Lipoma	4	2
Benign myofibroblastic	1	2
Fibromatosis	3	0
Nerve sheath tumor	3	5
Lymphangioma	1	0
Malignant fibrous histiocytoma	3	0
Synovial sarcoma	4	0
Fibrosarcoma	2	0
WDL	2	1

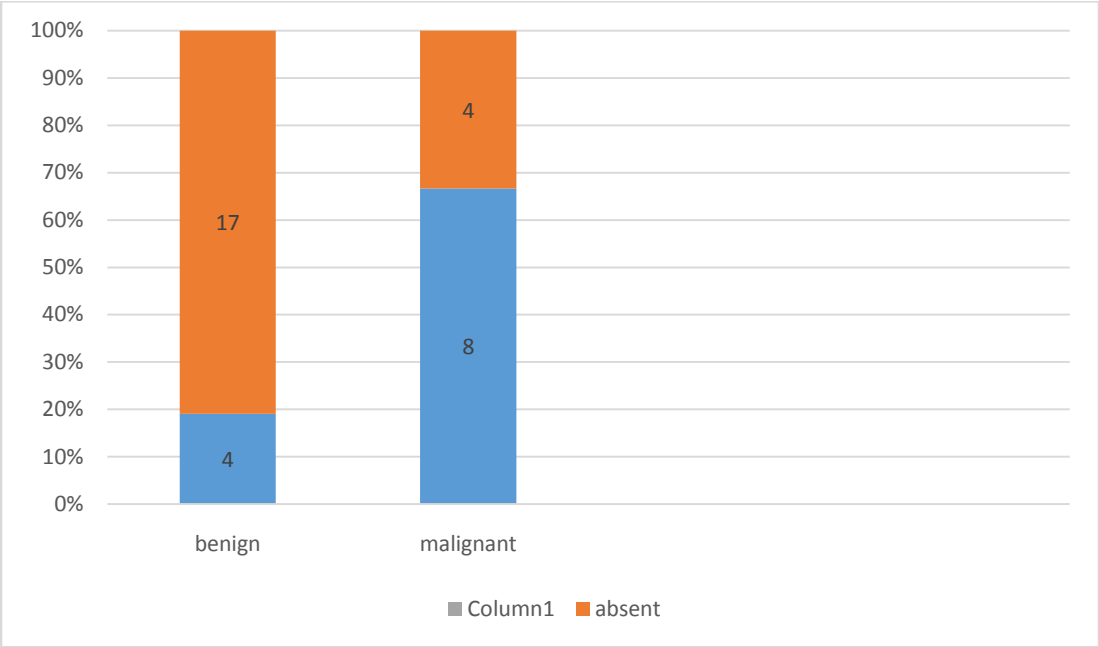
DISTRIBUTION OF STT BASED ON THEIR SIZE



DISTRIBUTION OF BENIGN & MALIGNANT STT BASED ON THEIR MARGIN ON MRI



DISTRIBUTION OF MRI FEATURES OF NEUROVASCULAR BUNDLE INVOLVEMENT IN BENIGN & MALIGNANT STT



DISTRIBUTION OF MRI FEATURES OF INTRATUMORAL HEMORRHAGE IN BENIGN & MALIGNANT STT

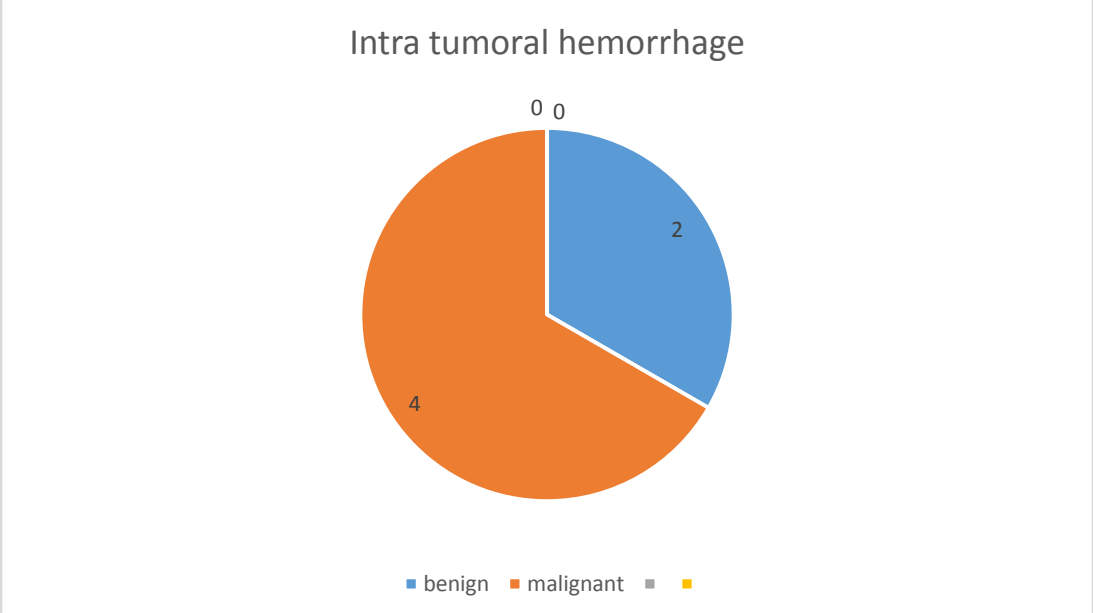


TABLE – 8: DISTRIBUTION OF STT BASED ON MARGIN CHARACTERISTICS ON MRI

MARGINS	WELL DEFINED	PARTIALLY DEFINED	ILL DEFINED
Lipoma	4	1	1
Benign myofibroblastic proliferation	2	1	0
Fibromatosis	2	0	1
Nerve sheath tumor	6	2	0
Lymphangioma	1	0	0
Malignant fibrous histiocytoma	1	1	1
Synovial sarcoma	1	1	2
Fibrosarcoma	1	0	1
Well differentiated liposarcoma	1	1	1
TOTAL :	**19**	**7**	**7**

DISTRIBUTION OF STT BASED ON MARGIN CHARACTERISTICS ON MR

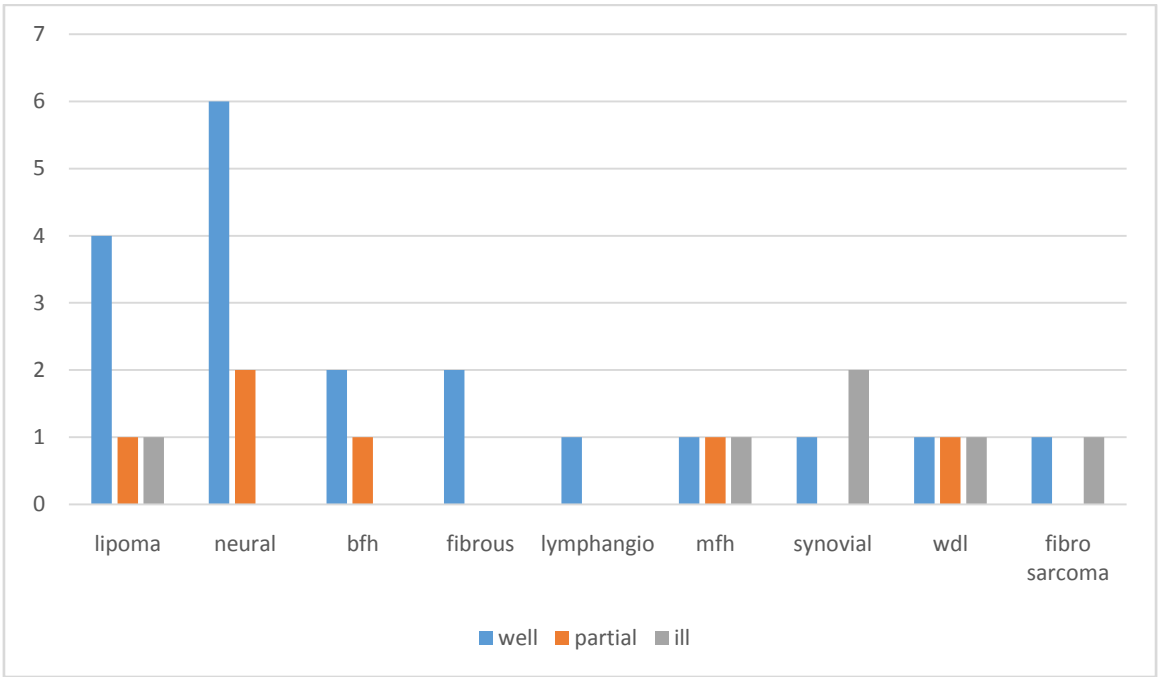
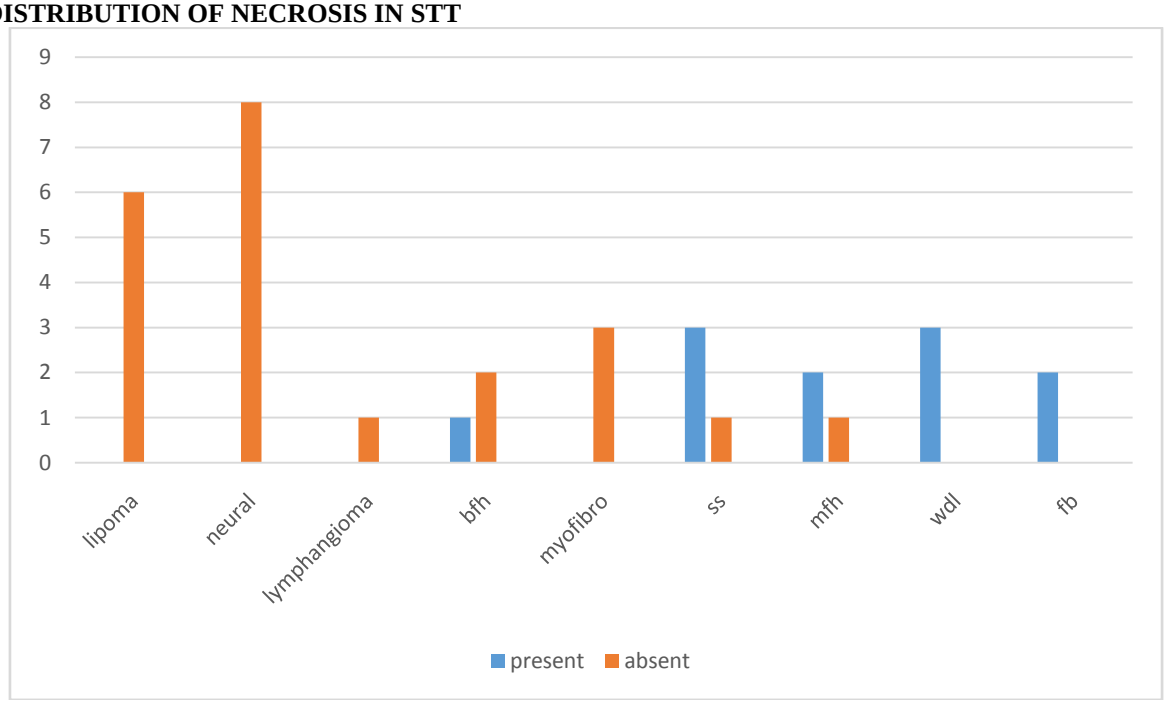


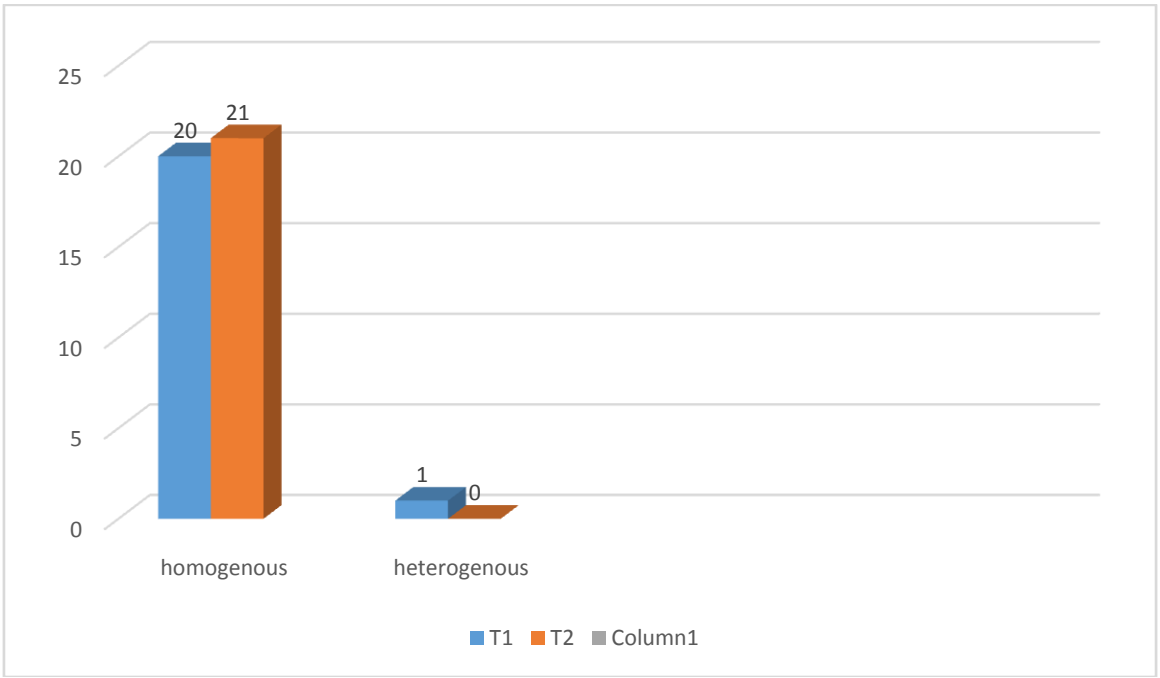
TABLE 9: DISTRIBUTION OF NECROSIS IN STT

NECROSIS	PRESENT	ABSENT
Lipoma	0	6
Benign myofibroblastic proliferation	1	2
Fibromatosis	0	3
Nerve sheath tumor	0	8
Malignant fibrous histiocytoma	2	1
Synovial sarcoma	3	1
Limphangioma	0	1
Fibrosarcoma	2	0
Well differentiated liposarcoma	3	0

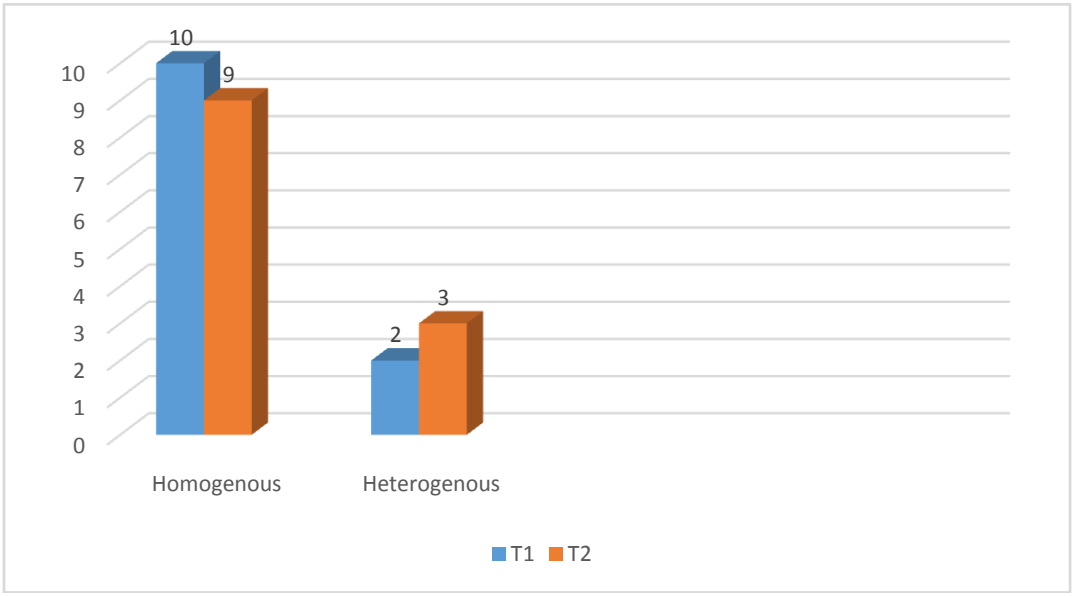
DISTRIBUTION OF NECROSIS IN STT



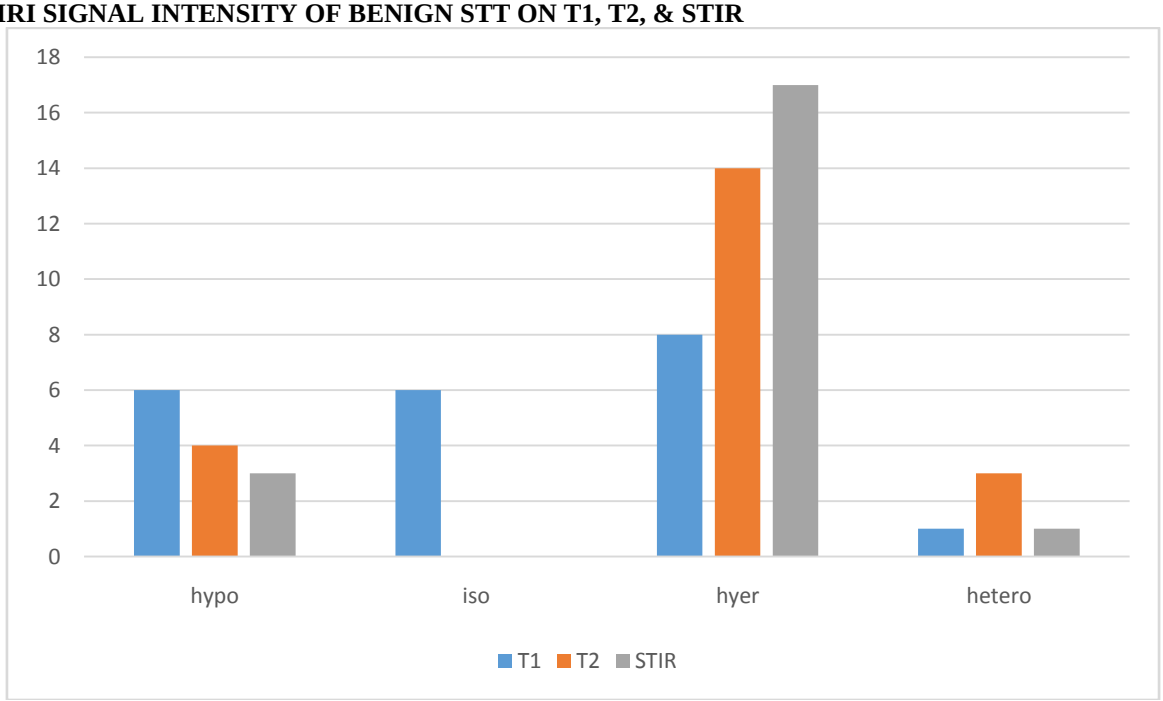
MRI FEATURES OF HOMOGENEITY ON T1 & T2 WEIGHTED IMAGES IN BENIGN TUMORS



MRI FEATURES OF HOMOGENEITY ON T1 & T2 WEIGHTED IMAGES IN MALIGNANT STT



MRI SIGNAL INTENSITY OF BENIGN STT ON T1, T2, & STIR



MRI SIGNAL INTENSITY IN MALIGNANT STT ON T1, T2 &STIR

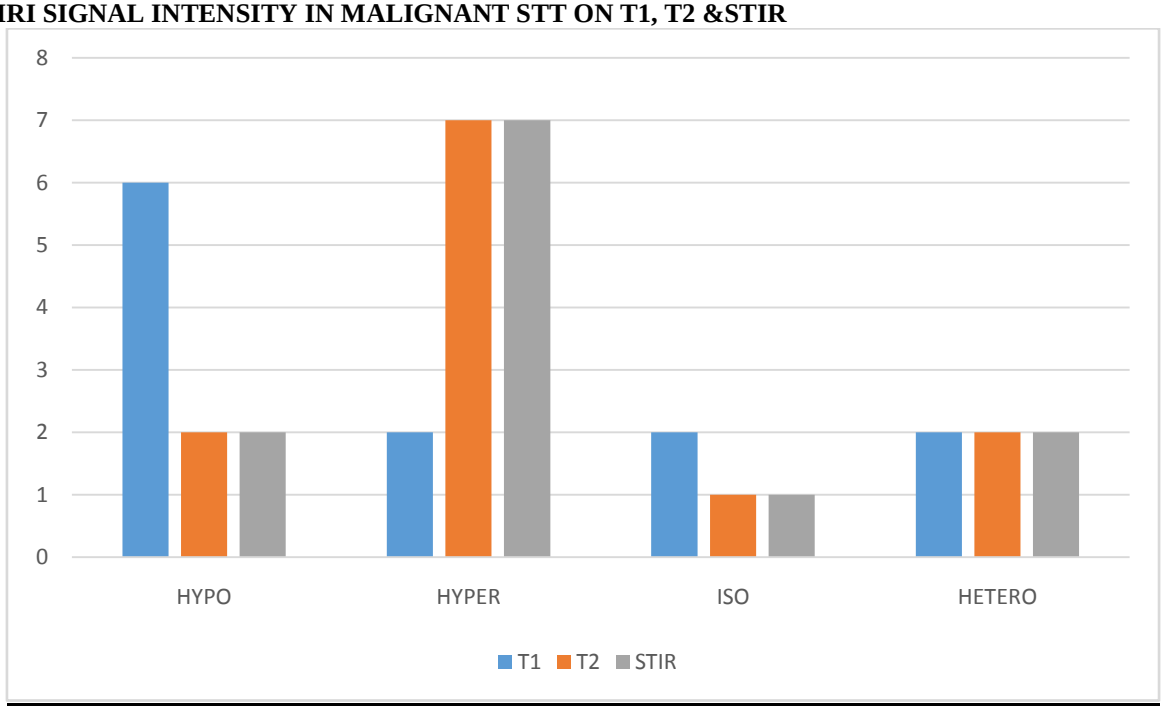


TABLE 10: MRI SIGNAL INTENSITY CHARACTERISTICS IN NERVE SHEATH TUMORS (n=8)

Signal intensity	T1 W	T2 W	STIR
Hypointense	3	0	0
Isointense	3	0	0
Hyperintense	2	8	8

MRI SIGNAL INTENSITY CHARACTERISTICS IN NERVE SHEATH TUMORS(n=8)

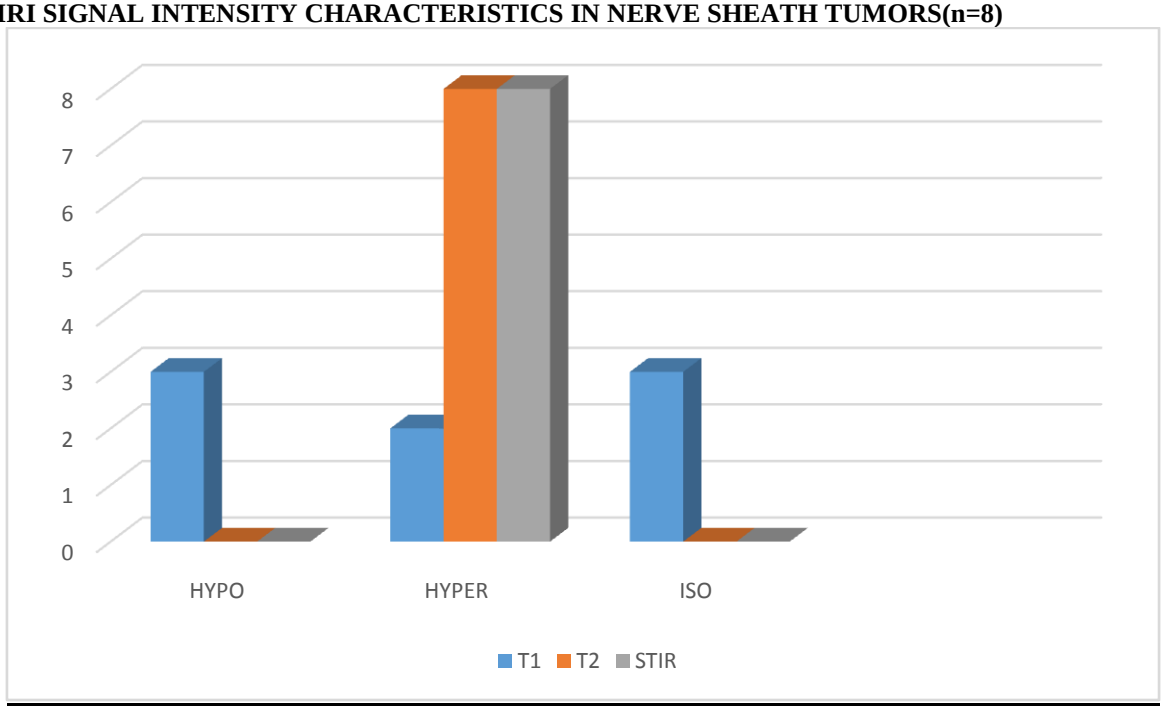


TABLE 11: MRI SIGNAL INTENSITY CHARACTERISTICS IN LIPOMAS(n=6)

Signal intensity	T1w	T2 w	STIR
Hypointense	0	0	4
Isointense	1	0	0
Hyperintense	5	6	1
Mixed	0	0	1

MRI SIGNAL INTENSITY CHARACTERISTICS IN LIPOMAS(n=6)

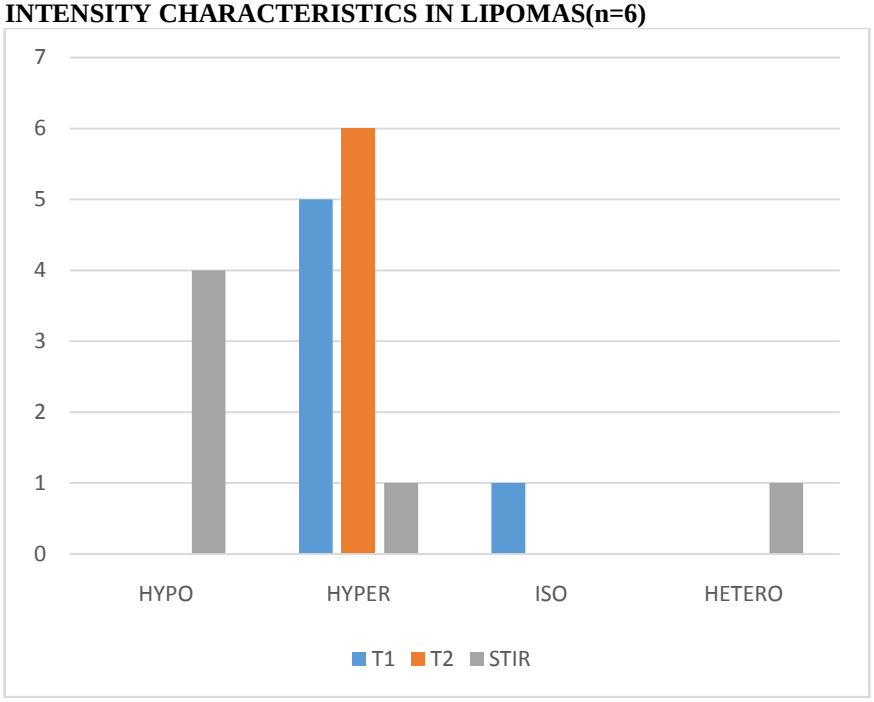


TABLE 12: MRI SIGNAL INTENSITY CHARACTERISTICS IN BENIGN MYOFIBROBLASTIC PROLIFERATION(n=3)

Signal intensity	T1 W	T2 W	STIR
Hypointense	**3**	**2**	**0**
Isointense	**0**	**0**	**0**
Hyperintense	**0**	**1**	**3**

MRI SIGNAL INTENSITY CHARACTERISTICS IN BENIGN MYOFIBROBLASTIC PROLIFERATION(N=3)

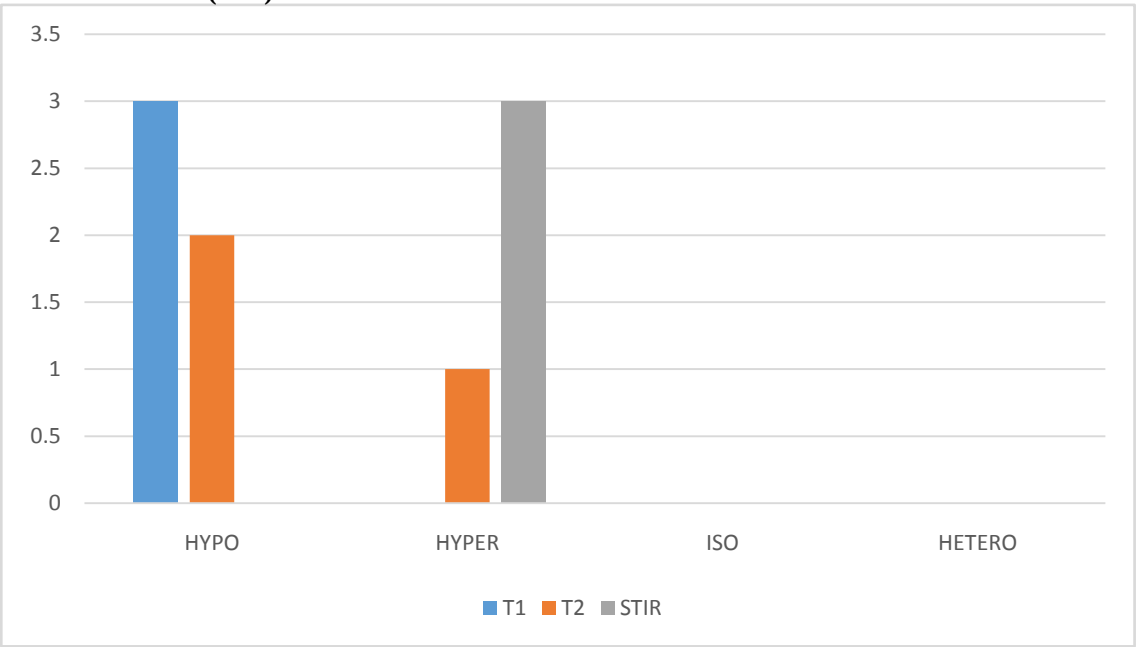


TABLE 13: MRI SIGNAL INTENSITY CHARACTERISTICS IN FIBROMATOSIS(n=3)

SIGNAL INTENSITY	T1	T2	STIR
HYPO	**1**	**2**	**0**
HYPER	**0**	**1**	**3**
HETERO	**1**	**0**	**0**
ISO	**1**	**0**	**0**

MRI SIGNAL INTENSITY CHARACTERISTICS IN FIBROMATOSIS(n=3)

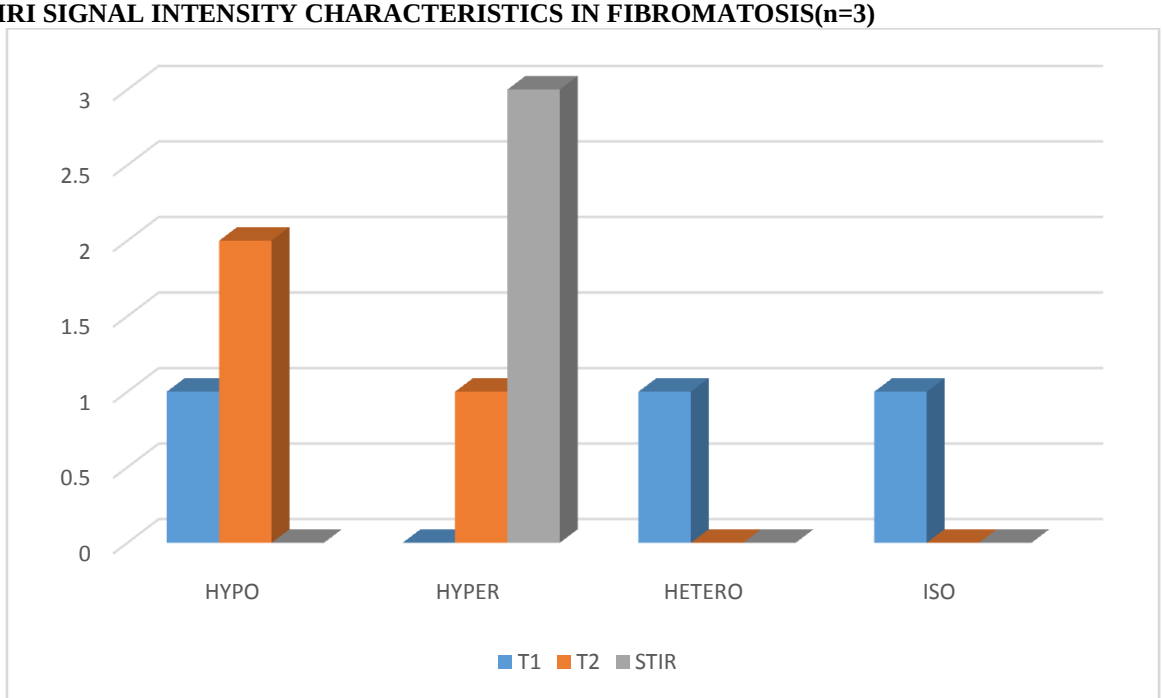


TABLE 14: MRI SIGNAL INTENSITY CHARACTERISTICS IN LYMPHANGIOMA (N=1)

Signal intensity	T1W	T2 W	STIR
Hypointense	1	0	0
Isointense	0	0	0
Hyperintense	0	1	1
Mixed	0	0	0

MRI SIGNAL INTENSITY CHARACTERISTICS IN LYMPHANGIOMA (N=1)

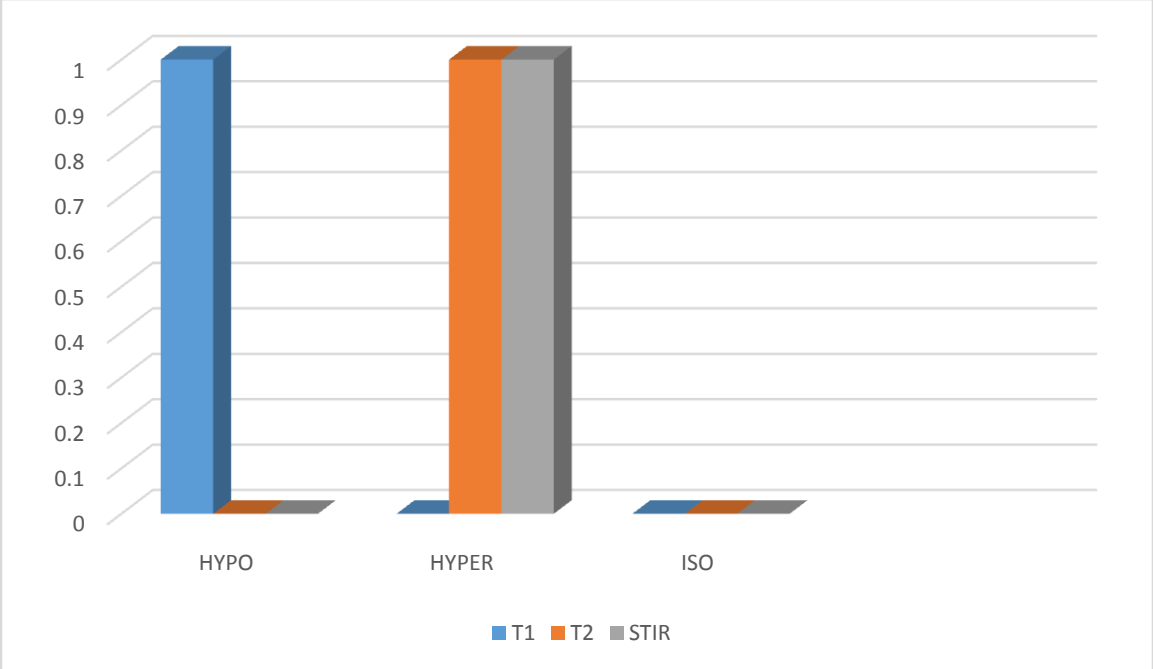


TABLE 15: MRI SIGNAL INTENSITY CHARACTERISTICS IN SYNOVIAL SARCOMA (N=4)

Signal intensity	T1W	T2 W	STIR
Hypointense	2	0	0
Isointense	1	0	0
Hyperintense	1	4	4
mixed	0	0	0

MRI SIGNAL INTENSITY CHARACTERISTICS IN SYNOVIAL SARCOMA (N=3)

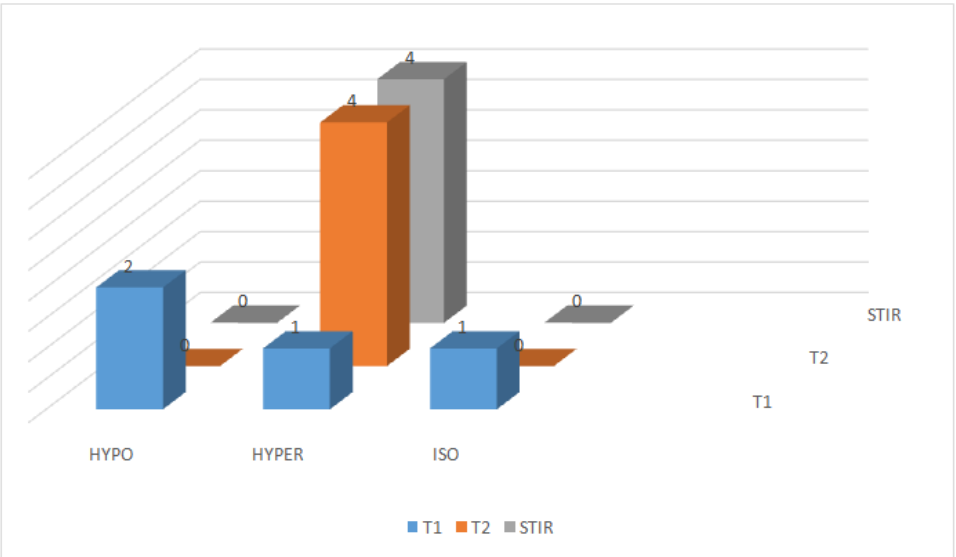


TABLE 16: MRI SIGNAL INTENSITY CHARACTERISTICS IN MALIGNANT FIBROUS HISTIOCYTOMA (N=3)

Signal intensity	T1W	T2 W	STIR
Hypointense	3	0	0
Isointense	0	0	0
Hyperintense	0	2	2
Heterogenous	0	1	1

MRI SIGNAL INTENSITY CHARACTERISTICS IN MALIGNANT FIBROUS HISTIOCYTOMA (N=3)

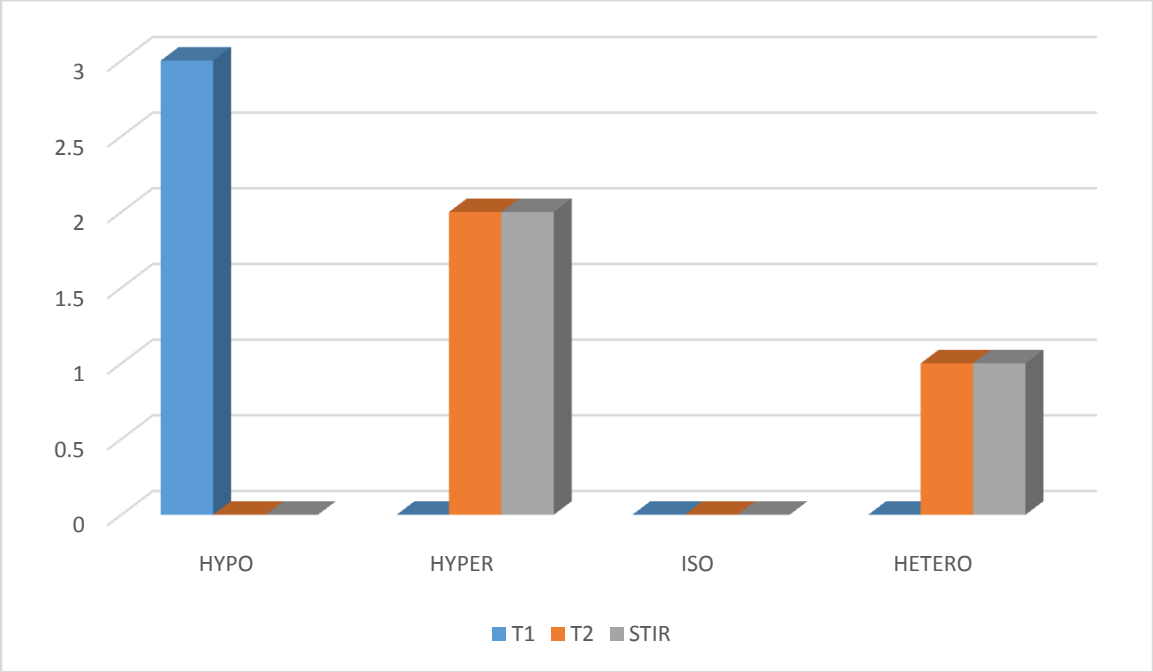
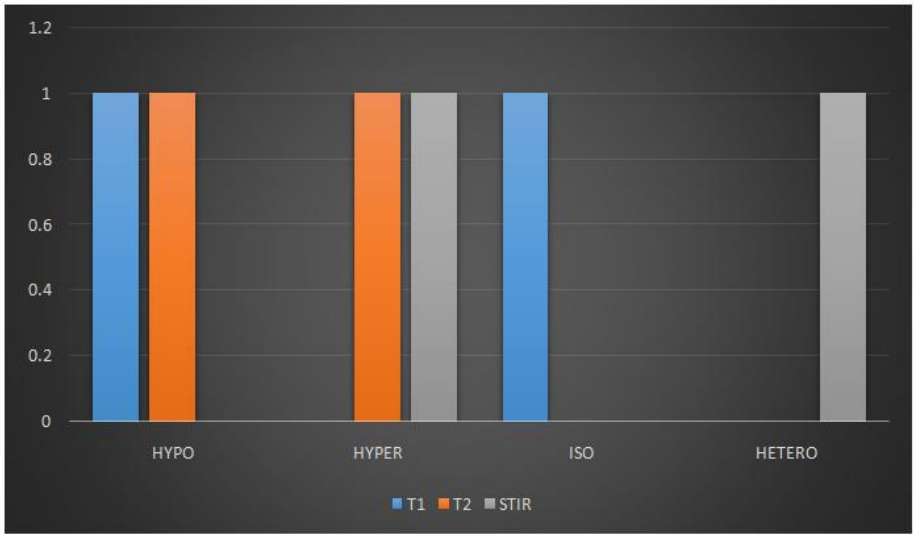


TABLE 17: MRI SIGNAL INTENSITY CHARACTERISTICS IN FIBROSARCOMA (N=2)

Signal intensity	T1w	T2 w	STIR
Hypointense	1	1	0
Isointense	1	0	0
Hyperintense	0	1	1
mixed	0	0	1

MRI SIGNAL INTENSITY CHARACTERISTICS IN FIBROSARCOMA (N=3)



Sigal intensity	T1W	T2 W	STIR
Hypointense	**1**	**0**	**1**
Isointense	**0**	**0**	**0**
Hyperintense	**0**	**1**	**0**
Mixed	**2**	**2**	**2**

V. Discussion

Our present study consisted 33patients of soft tissue tumors who underwent MRI examination. Among these benign tumors were common accounting for 21 & malignant tumors were 12 in number out of 33 total number of STT. Nerve sheath tumors were the most common tumors followed by the Lipomas. Jonathan S. Moulton et al[14]in their study of 225 soft tissue tumors found 179 benign tumors & 49 malignant tumors indicating that benign soft tissue tumors are more common than malignant soft tissue tumors. Mark J. Knansdorf et al[15] 39,179 lesions occurring in 38,484 patients of which approximately 2 thirds of soft-tissue tumors were benign & these were further classified into seven diagnostic categories: lipoma and lipoma variants (16%) followed by fibrous histiocytoma (13%), nodular fasciitis (11%), hemangioma (8%), fibromatosis (7%), neurofibroma (5%), and schwannoma (5%).Similarly in our study benign tumors accounted for approximately 63% of the soft tissue tumors in which Nerve sheath tumors were the most common occurring in 8 patients (24.2 %)followed by Lipomas which were second most common lesions occurring in 6 patients (18.1%) .

.In our study, 8(38%) benign tumors were hypointense, 8(38%) were hyperintense & 5(24%) were isointense on T1-weighted images. On T2-weigted images, 12(58%) benign tumors were hyperintense, 3(14%) were isointense &hypointense. 6(28%), on T1 –weighted images 6(50%)of malignant masses were hypointense , 3(25%) was hyperintense , 3(25%) was having mixed signal intensity. 5(45.46%) were isointense . On T2-weigted images, 10(92%) malignant tumors were hyperintense & 1(8%) were having mixed signal intensity. Similarly Harmannet al.[16] reported that 17% benign tumors were hypointense and 58% were hyperintense on T1-weighted images and 85% benign tumors were hyperintense on T2-weighted images. Forty percent of the malignant tumors were hyperintense on T1-weighted images and 100% were hyperintense on T2-weighted images.

Hermann et al.[16]reported that changing homogeneity (from homogenous on T1 weighted images to heterogenous on T2-weighted images) and the presence of lobular morphology with intervening low signal intratumoralseptations had a sensitivity of 72% and 80%, respectively, and a specificity of 87% and 91%, respectively, in predicting malignancy. Similarly, sensitivity, specificity, PPV, NPV, and accuracy for predicting malignancy if necrosis is present were 82%, 76.4%, 37.4%, 95.0%, and 78.8%, respectively in our study.

Schepperet al[17]. reported that the involvement of , extra compartmentaldistribution and encasement of the neurovascular bundle are relatively uncommon findings that are specific but are insensitive signs of malignancy. Crimet al.[18]reported neurovascular bundle involvement in 4% benign and 18% malignant tumors. Berquistet al.[19]found neurovascular bundle involvement in 78% malignant tumors. This was also observed with desmoid tumor (benign) in their series. Similarly, in our series 6 benign (28%) and 5 malignant tumors (41.7%) showed neurovascular bundle involvement

In a study by Moulton et al,[14]intratumoral hemorrhage was observed in 23 benign and in 5 malignant tumors among a total of 225 masses. Our study detected intratumoral hemorrhage in 1 benign (4.7%) and 4 malignant tumors (33%) among a total of 33 cases.

Berquist*et al*[19] reported sensitivity and specificity of 88% and 90%, respectively, for the diagnosis of benign tumors and 94% and 90%, respectively, for the diagnosis of malignant tumors. For the diagnosis of malignant lesions, Moulton *et al.*[14]reported a sensitivity of 78%, specificity of 89%, PPV of 65%, and NPV of 94%.Malignant lesions were correctly diagnosed in 10 of 11 cases. Sensitivity, specificity, PPV, NPV, and accuracy of MRI for diagnosing malignant mass lesions were found to be 20.9%, 86%, 69.7%, 95.2%, and 86.3%, respectively.

Nerve sheath tumors:

These are the most common tumors in our study.

Nerve sheath tumors typically demonstrate a beaded, undulating appearance, isointense to muscle on T1-W MR imaging and hyperintense on T2-W sequences, enhancing vigorously[8]. Similar MR features are present in 4 (50%) nerve sheath tumors in the present study. There was an exception in 2 patient where the tumor showed T1 hyperintensity.

In cross section, neurofibromas demonstrate a ‘‘target’’ appearance on T2-W sequences, resulting from a central zone of tightly packed hypointense dense collagen surrounded by hyperintense myxomatous matrix[8,9].

Target appearance was seen in 3 of 8 lesions which is the characteristic feature which if found is specific for nerve sheath tumor.

Intratumoral hemorrhage was seen in 1 patient which resulted in heterogenous appearance with foci of T1 hyperintensity ill defined margins & wrongly misdiagnosed as malignant. Inhomogeneity due to hemorrhage or necrosis, along with patchy contrast enhancement, infiltrative margins, indicate malignant degeneration, but this too was not entirely reliable. They found these characteristics also in benign nerve sheath tumors.[1,8,9,10,11, .]

The lesions were diagnosed as benign in 7 cases & falsely as malignant in 1 cases. Malignancy was considered in 2 cases due to vascular involvement in 1 case & heterogenous ill defined margins with intratumoral hemorrhage . Characterisation of these tumors into neurofibromas was done in 5 cases &schwanoma in 2 cases.

LIPOMA.

Mark j. Kransdorf LTC, MC, USAR et al& Mark D. Murphey, MD et al [7]retrospectively studied Benign Musculoskeletal Lipomatous Lesions &Fat-containing Soft-Tissue Masses of the Extremities respectively & reported that lipoma is the most common benign mesenchymal tumor composed of mature adipose tissue occurring in ring age (5^{th} and 6^{th} decades) with no gender predilection.In our study they are second commonest benign extremity tumors and common in females and upper extremity with age group from 20 to 60 years.

BENIGN MYOFIBROBLASTIC PROLIFERATION:

Philip A. Dinauer, MD et al& Mark j. Kransdorf et al[15] reported that benign fibrous lesions usually occur in early adult life with predominance in lower extremity & male population. In our present study benign myofibroblastic proliferation were constituting 9%(no of cases=3) of all lesions with mean age of presentation at 33years with male predominance & 2 of the 3 lesions were seen in lower extremity.

***Fibromatosis*:**

Philip A. Dinauer, MD et al& Mark j. Kransdorf et al[15] reported that fibromatosis usually occur in early adult life with predominance in lower extremity .Male predilection is seen in superficial fibromatosis & female predilection in deep fibromatosis . Deep fibromatosis is common when compared to superficial fibromatosis. In our study the tumors also occurred in early adult life with a mean age of 38.8 years ,with male predilection in both deep and superficial fibromatosis,& were located predominantly in upper extremity.

The lesions were diagnosed as benign in 2 patients & misdiagnosed as malignant in 1 patient. Malignancy was considered in 1 based on MR imaging. Characterisation of these tumors into soft tissue sarcoma was done in this lesion. due to vascular involvement andill defined margins with intratumoral hemorrhage.The classic MR characteristics were seen in 2 patients & were diagnosed as benign fibromatosis. .

Lymphangioma:

Lymphangioma on MRI is hypointense on T1 & markedly hyperintense on T2 [8] which correlated with the MR features of our study.

Synovial sarcoma:

In our study Synovial sarcoma was the most common malignant tumor accounting for 12.12% (n=4) of the total lesions (n=33). The age group involved was between 16-65 years . The male: female ratio was 1:1.

On MRI T1 weighted images 2 lesions were hypointense & 1 lesion was isointense and 1 lesion was hyperintense, On T2 & STIR weighted images all were hyperintense with NVB involvement observed in 2 tumour. Laura W. Bancroft, MD et al[12]reported synovial sarcoma on MRI demonstrates heterogeneous signal intensity with intensity approximately equal to muscle on T1-weighted images and increased signal intensity on T2-weighted sequences.

Malignant fibrous histiocytoma:

In our series Malignant fibrous histiocytoma (MFH) was constituting3(9%) of the lesions. The age group involved was between 49 and 79 years. There was female predominance (F:M=2:1) with 2 of the 3 tumors occurring in lower extremity . MFH are usually seen in patients above 40 years with slight male predominance[12].

Well differentiated liposarcoma:

In our series they constituted 9% (n=3) of all lesions. They were common in male.(M:F 2:1).Common in lower extremity with age group between 33 and 59 years.

The signal intensity features on MRI include heterogenous hyperintense signal intensity on T1 weighted images & heterogenous hyperintense signal intensity on T2 & heterogenous hypointense on STIR weighted images with NVB & muscle infiltration in 2 cases and homogenous signal of hypo intensity on T1 and hyper on T2 in 1 case. The lesions showed predominant fatty component with non adipose soft tissue. William D. Craig et alrepoted Well-differentiated liposarcomas frequently contain septa, as well as occasional nonadipose, solid-appearing regions. These nonfatty areas are hypointense relative to skeletal muscle on T1-weighted images and iso- to hyperintense on T2-weighted images. The solid-appearing regions are poorly defined, with no clear demarcation between them and fat. The lesion was correctly diagnosed as liposarcoma in 2 cases and soft tissue tumor in 1 case based on imaging.

Fibrosarcoma :

Fibrosarcoma was accounting for6 %(n=2) of the lesions(n=33) in our study. The age group involved was between 9-40 years. The M:F ratio was 1:1. Both 2 tumors were seen arising from upper extremity (forearm & hand).Fibrosarcoma occurs primarily in adults & there is an infantile form with similar histology found shortly after birth. These tumors most commonly arises in the extremities and trunk[13]

On Imaging the lesions were diagnosed as malignant in both cases.Both were diagnosed as soft tissue sarcoma. Further characterization into fibrosarcoma was not possible.The imaging appearance of fibrosarcomas is nonspecific. On MR imaging, fibrosarcoma has been reported to be of low to- intermediate signal intensity on all imaging sequences[79].They metastasize in greater than *60%*of lesions[13.]

VI. Conclusion

1) Our prospective study concluded that MRI is an excellent modality for evaluating the size, extent and involvement of surrounding structures in soft tissue tumors on correlation with histological findings.
2) Differences between Benign & malignant soft tissue tumors cannot be correctly diagnosed based on any single criteria. Most of the soft tissue tumors can be diagnosed as benign or malignant by using combined criteria.
3) Specific diagnosis of soft tissue tumors was correctly done in all lipomas, , lymphangioma, well differentiated liposarcoma and few nerve sheath tumorsbasedon MRI.
4.) Nerve sheath tumors were the major subset of the study population and MRI helped in specific diagnosis in majority of cases characterized by T1hypointensity& T2 hyperintensity suppressed on STIR sequence.Target sign is useful in the diagnosis of neural sheath tumors.
6.) Size >5 cm alone is not a criteria for predicting malignancy as most of the benign tumors were also having size more than 5 cm. Additional features must be seen for malignancy to be considered.
7.) When necrosis is seen along with tumor measuring more than 5 cm, Malignancy should be considered as a priority.
8.) Soft tissue tumor with partially &illdefined margins had low sensitivity but high specificity in diagnosing malignant lesions.
9.) Neurovascular bundle involvement is not a strict criteria for malignancy and was also seen in benign tumors.
10.) Intratumoral hemorrhage was commonly associated with malignant lesions when compared to benign tumors.
11) T1& T2 hypointense signals usually suggest the Fibrous nature of the lesion.

References

[1]. Marilyn J. Siegel, MD,et al: Magnetic resonance imaging of musculoskeletal soft tissue masses :Radiologic clinics of north america ,volume-39.Number-4. July 2001.
[2]. Bisset GS MR imaging of soft-tissue masses in children.MagnReson Imaging Clin North Am 4:697-719, 1996.
[3]. Kransdorf MJ, Jelinek JS, Moser RP, et al JR: Imaging of soft-tissue tumors. RadiolClin North Am 31:359-372, 1993.
[4]. Moulton JS, Blebea JS, Dunco DM, et al: MR imaging of soft-tissue masses: Diagnostic efficacy and value of distinguishing between benign and malignant lesions.AJRAm J Roentgenol 164:1191-1199, 1995.
[5]. Siegel MJ: Hematoma. In Siegel BA, Siegel MJ (eds):Body MRI Test and Syllabus. Reston, VA, American College of Radiology, 2000, pp 1-16.
[6]. Mark D. Murphey, MD ● John F. Carroll, MD et al .From the Archives of the AFIP benign musculoskeletal lipomatous lesions. Radiographics 2004; 24:1433–1466.
[7]. Rebecca Stein-Wexler, MD et al MR Imaging of Soft Tissue Masses In Children .RadiolClin N AM, 47 (2009) 977–995.
[8]. Bhargava R, Parham DM, Lasater OE, et a1 MR imaging differentiation of benign and malignant peripheral nerve sheath tumors: Use of the target sign. PediatrRadiol 27126129, 1997.
[9]. Varma DGK, Moulopoulos A, Sara AS, et al: MR imaging of extracranial nerve sheath tumors. J Comput Assist Tomogr 16448453, 1992
[10]. Suh JS, Abenoza P, Galloway HR, et al: Peripheral (extracranial) nerve tumors: Correlation of MR imaging and histologic findings. Radiology 183:341-346, 1992.

[11]. LauraW. Bancroft, MDa,b,*, JeffreyJ. Peterson, MDc,Mark J. Kransdorf, MDc Imaging of Soft Tissue Lesions of the Foot and Ankle ;RadiolClin N Am 46 (2008) 1093–1103
[12]. OConnell TE, Castillo M, Mukheji SK: Fibrosarcoma arising in the maxillary sinus: CT and MR features. J Comput Assist Tomogr 20:736-738, 1996.
[13]. Jonathan S. Moulton, Judy S. Blebea, Douglas M. Dunco, Susan E. Braley,George S. Bisset, Kathleen H. Emery et al MR Imaging of Soft-Tissue Masses: Diagnostic Efficacy and Value of Distinguishing Between Benign and Malignant Lesions AJR 1995;164:1191-1199.
[14]. Mark J. Knansdorf et al Benign Soft-Tissue Tumors in a Large Referral Population: Distribution of Specific Diagnoses by Age, Sex, and Location. AJR 1995; 164:395-402.
[15]. Hermann G, Abdelwahab IF, Miller TT, Klien MJ, Lewis MM. Tumour and tumour -like conditions of the soft tissue: Magnetic resonance imaging features differentiating benign from malignant masses. Br J Radiol 1992; 65:14-20.
[16]. Schepper AM De. Grading and characteristics of soft tissue. 2nd ed. Imaging of soft tissue tumours. In: Schepper AM De, Parizel PM, Buckelaer L De, editors. Berlin: Springer; 2001. p. 123-41.
[17]. Crim JR, Seeger LL, Yao L, Chandnani V, Eckardt J. Diagnosis of soft tissue masses with MR imaging: Can benign masses be differentiated from malignant ones? Radiology 1992; 185:581-6.
[18]. Berquist TH, Ehman RL, King BF, Hodgman CG, Ilstrup DM. Value of MR imaging in differentiating benign from malignant soft tissue masses: Study of 95 lesions.Am J Roentgenol 1990; 155:1251-5.

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