ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Soft Tissue Tumour Histopathology and Immunohistochemistry (IHC) corelation, a Roadmap to Precision in Diagnostics: Study from a Tertiary Care Centre.

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ABSTRACT

Soft tissue tumors (STTs) are a heterogeneous group of mesenchymal neoplasms with varied clinical and histological features. Histopathology remains diagnostic gold standard, supplemented by immunohistochemistry (IHC) for precise subtyping. To study spectrum of soft tissue tumors in relation to age, sex, and anatomical distribution and to evaluate role of histopathology and IHC. This retrospective study was conducted in the Department of Pathology, PGIMS, Rohtak, over a two-year period, including 102 histopathologically confirmed cases of soft tissue tumors. Tumors were classified according to the WHO 2020 classification and graded by FNCLCC system. Ancillary IHC staining was applied in diagnostically challenging or poorly differentiated cases. Of the 102 cases analyzed, benign (59.8%), malignant (32.3%) and borderline (7.8%) tumors, with an overall benign-to-malignant ratio of approximately 1.8:1. Adipocytic tumors formed most frequent category (41%), followed by smooth muscle (13.7%) and fibroblastic/myofibroblastic (11.7%) tumors. Highest incidence was seen in the 30–45 years age group (37.2%), with a male-to-female ratio of 1.9:1. Head & neck (23.5%) and upper limb (22.5%) were most common anatomical sites. Among malignant, liposarcoma and rhabdomyosarcoma were predominant types. IHC proved particularly useful in differentiating morphologically overlapping entities, with vimentin being most consistently expressed marker, while lineage-specific markers such as S100, Desmin, Myogenin, and CD117 aided in subtyping. Benign tumors, especially adipocytic, are most prevalent. Malignant tumors were common in middle-aged males and showed a predilection for head and neck area. Integration of histopathology with IHC enhances diagnostic accuracy, especially in borderline and high-grade tumors.
Keywords: Soft tissue tumors, Histopathology, Immunohistochemistry.

https://doi.org/10.33887/rjpbcs/2025.16.6.9

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ISSN: 0975-8585

INTRODUCTION

Soft tissue can be defined as nonepithelial extra skeleton tissue of the body exclusive of the reticuloendothelial tissue, glia and supporting tissue of various parenchymal organs. It is represented by muscles, fat, fibrous tissue along with the vessels serving these tissues [1].

The annual incidence of soft tissue tumor is 1.4 per 100000 population worldwide [5]. Soft tissue tumors are the fourth most common malignancy in children, after hematopoietic neoplasm, neural tumor and Wilms tumor. Soft tissue sarcomas account for 15% of all childhood cancers. Benign tumors outnumber malignant ones by margin of 100:11 [5].

Soft tissue tumors are uncommon and comprises about 2% or less of surgical pathology cases. These are highly heterogenous group of tumors that are classified by the line of differentiation, according to the adult tissue they resemble [2]. The large majority of soft tissue tumours are benign, with a very high cure rate after surgical excision. Malignant mesenchymal neoplasms comprise less than 1% of the overall human burden of malignant tumours [4].

The etiology of most benign and malignant soft tissue tumors is unknown. In rare cases, genetic and environmental factors, irradiation, viral infections and immune deficiency have been associated with the development of usually malignant soft tissue tumours [6]. Minorities are associated with germline mutations in tumor suppressor genes and occur in familial cancer syndromes, such as neurofibromatosis type 1, Gardner syndrome, Li–Fraumeni syndrome, Osler–Weber Rendu syndrome, etc.

Unlike carcinomas, most sarcomas do not arise from well-defined precursor lesions. Events comprising multistage tumorigenesis with progressively accumulated genetic alterations have not yet been clearly identified in most soft tissue tumors. Some sarcomas recapitulate a recognizable mesenchymal lineage (e.g., skeletal muscle). However, they are believed to arise from pluripotent mesenchymal stem cells, which acquire somatic “driver” mutations in oncogenes and tumor suppressor genes [7].

The WHO classification system recognizes nine major types based on histologic differentiation: adipocytic, fibroblastic or myofibroblastic, fibrohistiocytic, smooth muscle, skeletal muscle, vascular, pericytic, and chondro-osseous tumors, as well as soft tissue tumors of uncertain differentiation (Table no. 2). Based on biological behavior, these are further subcategorized into benign (do not recur after resection), intermediate- locally aggressive (have high rate of recurrence but do not metastasize), intermediate-rarely metastasizing (metastasis in less than 2% cases) and malignant (high risk of metastasis) [3]. The incidence of benign soft tissue tumors is more when compared to the frequency of malignant ones. Malignant soft tissue tumors occur more commonly in males than females.

Histopathology is the gold standard for establishing the diagnosis and grade (FNCLCC grading system: Table no. 1) of soft tissue tumours. Immunohistochemistry is used to detect tumour specific alterations which add significantly to histological interpretation, but several groups of tumour still lack reliable IHC markers. Over the last decade, molecular genetic findings have led to the development of novel, inexpensive, and quick diagnostic tests with immunohistochemical stains. Recently described immunohistochemical markers are classified into three general categories: (1) protein correlates of molecular genetic alterations (e.g., β-catenin, MDM2, CDK4, H3K27me3, MYC, PDGFRA, RB1, SDHB, SMARCB1 [INI1], and SMARCA4 [BRG1]), (2) protein products of gene fusion (e.g., ALK, BCOR, CCNB3, CAMTA1, DDIT3, FOSB, SS18::SSX, TFE3, and pan-TRK), and (3) diagnostic markers identified by gene expression profiling (e.g., DOG1, ETV4, MUC4, NKX2-2, SATB2, and TLE1) [7].

In soft tissue tumor diagnosis, FNAC (fine needle aspiration cytology) offers a rapid, minimally invasive way to assess the nature of a mass, while radiological imaging (like MRI) helps visualize the tumor's size, location, and relation to surrounding tissues. Serum markers can play a supporting role, though their sensitivity and specificity are often limited for soft tissue tumors [8].

Present study is performed with aim of studying soft tissue tumours in relation to different age groups, sex and site distribution and to diagnose soft tissue tumours on H & E sections and use of ancillary techniques wherever required.

MATERIALS AND METHODS

This retrospective study was conducted in the Department of Pathology, Pt. B.D. Sharma Post Graduate Institute of Medical Sciences (PGIMS), Rohtak, over a period of two years. A total of 102 histopathologically confirmed cases of soft tissue tumors were included in the study. The cases were retrieved from the pathology records and departmental archives. Relevant clinical data such as age, sex, site of lesion, and provisional diagnosis were obtained from patient requisition forms and hospital records.

Inclusion Criteria

All surgically excised or biopsied specimens diagnosed as soft tissue tumors on histopathological examination during the study period were included. Both benign and malignant mesenchymal tumors were considered.

Exclusion Criteria

Inadequately preserved or inconclusive specimens were omitted from the study.

Specimen Processing and Histopathological Examination

All specimens were fixed in 10% neutral buffered formalin, processed routinely, and embedded in paraffin. Sections of 4–5 µm thickness were cut and stained with hematoxylin and eosin (H&E). Detailed microscopic evaluation was performed to assess cellular morphology, mitotic activity, necrosis, and stromal characteristics. Tumors were classified according to the World Health Organization (WHO) Classification of Soft Tissue and Bone Tumours (2020).

The Fédération Nationale des Centres de Lutte Contre le Cancer (FNCLCC) grading system was used for grading malignant soft tissue tumors based on three parameters: tumor differentiation, mitotic count, and tumor necrosis. Scores from these parameters were added to determine the final histologic grade (Grade I, II, or III).

Immunohistochemistry (IHC)

IHC was performed in morphologically ambiguous or poorly differentiated tumors to confirm lineage and establish a definitive diagnosis. Sections were stained with a panel of antibodies including Vimentin, S100, Desmin, SMA, Myogenin, MyoD1, CD34, CD99, CD117, EMA, and Bcl2, among others, depending on the suspected tumor type. The results were interpreted semi-quantitatively based on cytoplasmic or nuclear staining patterns and correlated with histo-morphological findings.

Data Analysis

All findings were recorded, tabulated, and analyzed in relation to age, sex, site, and histologic subtype. Comparative analysis was performed with similar published studies to identify demographic and histopathological trends. Data were expressed as frequencies and percentages.

RESULTS

A total of 102 cases of soft tissue tumors were analyzed over a two-year period in the Department of Pathology, PGIMS, Rohtak. Out of these, 61 cases (59.8%) were benign, 8 cases (7.8%) were borderline or intermediate, and 33 cases (32.3%) were malignant, yielding a benign-to-malignant ratio of approximately 1.8:1. Adipocytic tumors formed the largest histological group, comprising 41% of all cases, followed by smooth muscle tumors (13.7%) and fibroblastic or myo-fibroblastic tumors (11.7%). Tumors of uncertain differentiation accounted for 16.6%, while skeletal muscle, peripheral nerve sheath, and vascular tumors constituted 7.8%, 5.8%, and 2.9% of cases respectively (TABLE- 3).

The age of patients ranged from 5 to 82 years, with the peak incidence observed in the 30–45 years age group (37.2%), followed by the 45–60 years group (27.4%). Pediatric cases (0–15 years) accounted for 6.8% of the total, while 15.6% occurred in the elderly (60–75 years). Benign lesions were predominantly seen in younger adults, whereas malignant tumors showed a peak incidence in the middle-aged population

(45–60 years). A definite male predominance was observed, with 65% of cases occurring in males and 35% in females, giving a male-to-female ratio of approximately 1.9:1 (TABLE-4).

Anatomical site analysis revealed that the head and neck region was the most commonly involved site, accounting for 23.5% of cases, followed closely by the upper limb (22.5%) and lower limb (17.6%). Other commonly affected regions included the pelvis and genital area (16.6%) and the retroperitoneum (10.7%). Less frequently involved sites were the back, abdomen, and chest wall, each contributing less than 5% of cases. Adipocytic tumors, particularly lipomas, were most commonly found in the head and neck and upper limb regions, whereas malignant lesions such as liposarcoma and rhabdomyosarcoma were more frequently seen in the retroperitoneum and pelvis (TABLE-6).

Immunohistochemistry (IHC) was performed in approximately 30 diagnostically challenging or poorly differentiated cases to confirm lineage and aid subtyping. Vimentin positivity was universal among mesenchymal tumors, while S100 showed reactivity in adipocytic and peripheral nerve sheath tumors. Desmin and smooth muscle actin (SMA) positivity were observed in smooth and skeletal muscle tumors, whereas CD34 and CD117 expression was seen in vascular and gastrointestinal stromal-type tumors. Myogenin and MyoD1 were consistently positive in rhabdomyosarcomas, while Bcl2 and CD99 positivity supported diagnoses of synovial sarcoma and primitive neuroectodermal tumors (PNET). The use of IHC significantly improved diagnostic accuracy in morphologically overlapping entities and was especially valuable in differentiating high-grade sarcomas of uncertain origin (TABLE-7).

Table 1: Definitions of Grading Parameters for FNCLCC System (Fédération Nationale des Centres de Lutte Contre le Cancer; 1993)

	Parameter	*Criterion*
1.	Tumor differentiation	
	Score-1	Sarcoma closely resembling normal adult mesenchymal tissue (e.g., well differentiated liposarcoma)
	Score-2	Sarcoma for which the histologic typing is certain (e.g., alveolar soft part sarcoma)
	Score-3	Embryonal and undifferentiated sarcomas.
2.	Mitosis Count	
	Score-1	0-9/ 10 HPF
	Score-2	10-19 / 10 HPF
	Score-3	20/10 HPF
3.	Tumor necrosis (microscopic)	
	Score-0	No necrosis
	Score-1	50% tumor necrosis
	Score_2	>50% tumor necrosis
4.	Histologic grade	
	Grade-1	Total score 2, 3
	Grade-2	Total score 4, 5
	Grade-3	Total score 6, 7, 8

ISSN: 0975-8585

Table 2: WHO classification 2020 of soft tissue tumors

Histologic Type	Benign	Intermediate, Locally Aggressive	Intermediate, Rarely Metastasizing	Malignant
Adipocytic	Lipoma and its variants (lipoblastoma, hibernoma, lipomatosis)	Atypical lipomatous tumor, well-differentiated liposarcoma	...	Liposarcoma
Fibroblastic/ myofibroblastic	Fibromatosis colli, myofibroma, giant cell angiofibroma	Desmoid-type fibromatosis	Solitary fibrous tumor, hemangiopericytoma, inflammatory myofibroblastic tumor (inflammatory pseudotumor)	Fibrosarcoma
So-called fibrohistiocytic	Benign fibrous histiocytoma, diffuse-type giant cell tumor (pigmented villonodular synovitis)	...	Giant cell tumor of soft tissues	Malignant fibrous histiocytoma (undifferentiated pleomorphic sarcoma)
Skeletal muscle	Rhabdomyoma	...	...	Rhabdomyosarcoma
Smooth muscle	Leiomyoma, angioleiomyoma	...	...	Leiomyosarcoma
Vascular	Hemangioma, lymphangioma	Kaposiform hemangioendothelioma	Kaposi sarcoma	Angiosarcoma
Perivascular	Glomus tumor, myopericytoma	...	...	Malignant glomus tumor
Chondro-osseous	Soft tissue chondroma	...	...	Mesenchymal chondrosarcoma, extraskeletal osteosarcoma
Uncertain differentiation	Myxoma	...	Ossifying fibromyxoid tumor	Synovial sarcoma, alveolar soft part sarcoma, primitive neuroectodermal tumor, Ewing sarcoma

Source.—Reference 7.

Table 3: Histogram & table showing distribution of soft tissue tumors according to different histopathological types

Sno	Type	Category			Total(%) (n=102)
		Benign	Borderline	Malignant	
1	Adipocytic	40	1	1	41%
2	Vascular	1	0	2	2.9%
3	PNST	2	0	4	5.8%
4	Fibroblastic	3	4	5	11.7%
5	Smooth muscle	6	2	6	13.7%
6	Skelton muscle	1	0	7	7.8%
7	Uncertain	3	1	13	16.6%
8	Total	61	8	33	

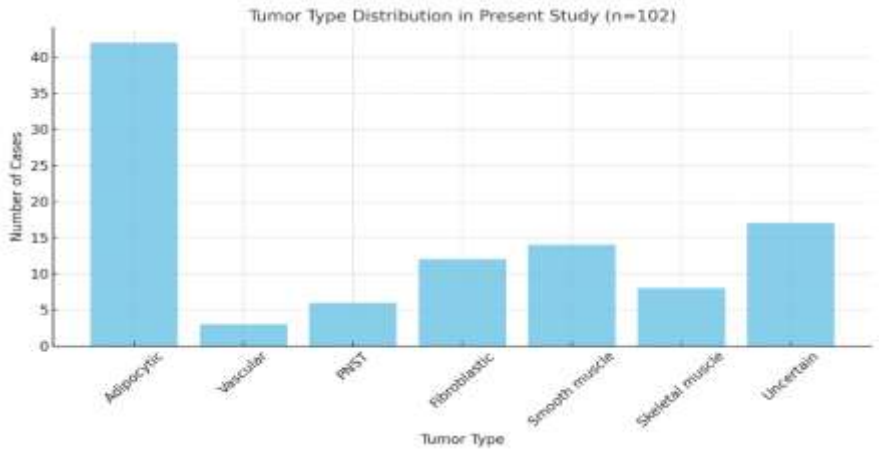

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Table 4: Age wise distribution with nature of tumor

Age grop	Category			Total (%)
	Benign	Borderline	Malignant	
0-15	6	0	1	6.8%
15-30	7	0	1	7.8%
30-45	25	3	10	37.2%
45-60	11	2	15	27.4%
60-75	10	2	4	15.6%
>75	2	1	2	4.9%

Table 5: Gender wise distribution of type of tumor

Type of tumor	Sex		Total (%)
	Male	Female	
Adipocytic	40	10	49%
Vascular	4	2	5.8%
PNST	4	3	6.8%
Fibroblastic	15	5	19.6%
Smooth muscle	2	6	7.8%
Skelton muscle	3	2	4.9%
Uncertain	5	2	6.8%

Table 6: Anatomical location of Soft tissue tumor according to category

Sno	Site of tumor	Category			Total (%)
		Benign	Borderline	Malignant	
1	Head & Neck	20	1	3	23.5%
2	Upper limb	20	2	1	22.5%
3	Lower limb	10	2	6	17.6%
4	Back	1	1	2	3.9%
5	Abdomen	1	0	2	2.9%
6	Chest	1	1	1	2.9%
7	Retroperitoneum	2	1	8	10.7%
8	Pelvis/Genitals	6	1	10	16.6%

Table 7: Immuno-histochemistry (IHC) expression among soft tissue tumors

S.NO	TUMOR DIFFERENTIATION	TUMOR TYPE	IHC (+)	IHC (-)
1.	VACULAR	ANGIOSARCOMA	CD31, CD34, CD35, S100, D240, CD99, BCl2	HMB45, CD68.S MA, MyoD1, CK, Melan A
2.	PNST	MPNST	S1OO VIMENTIN NSE CD99	Desmin Myogenin CK EMA
3.	FIBROBLASTIC	• FIBROSARCOMA	VIMENTIN	SMA Myogenin S100 NSE BCl2 CD99 Desmin
		• MYXOFIBROSARCOMA	VIMENTIN	CK BCl2 Desmin Myogenin CD34 EMA SMA LCA CD56

		• DFSP	VIMENTIN CD68 CD34	DESMIM SMA S100 CK EMA Bcl2
4.	SMOOTH MUSCLE	• LEIOMYOMA	SMA VIMENTIN	CK CD68 DESMIN CD117
		• LIOMYOSARCOMA	VIMENTIN SMA DESMIN	S100 CK Myogenin Bcl2 CD117
		• GIST	CD117 CD34	S100 NSE
5.	SKELTON MUSCLE	• ALVEOLAR SOFT PART SARCOMA	DESMIN	SMA MYOGENIN
		• RHABDOMYOSARCOMA	VIMENTIN DESMIN MYOGENIN CD56 MYOD1	CK CD31 CD99 NSE HMB45 SMA EMA LCA CHROMOGRANIN
6.	ADIPOCYTIC	LIPOSARCOMA	S100 MELAN A	CK SMA
7.	UNCERTAIN	• SYNOVIAL SARCOMA	VIMENTIN CD99 BCl2	SMA S100 CD34 DESMIN EMA CK LCA
		• PLEOMORPHIC SARCOMA	VIMENTIN CD68	CK DESMIN SMA LCA CD99 MYOD1 BCL2
		• SMALL CELL OSTEOSARCOMA	VIMENTIN CD99	WT1 SMA EMA LCA TdT CD10
		• PNET	CD99 VIMENTIN	CK MYOGENIN LCA DESMIN
		• CLEAR CELL SARCOMA	VIMENTIN HMB 45	CK CD99

ISSN: 0975-8585

Table 9: Comparative Analysis of Soft Tissue Tumors with other studies

Study (Author, Year)	Study Type	Sample Size	Duration	Key Findings	Most Common Tumour Type	Benign: Malignant Ratio
Present Study (PGIMS, Rohtak)	Retrospective	102	2 years	Majority benign (59.8%). Most common site-Head &Neck Most common: adipocytic tumors. Male predominance.	Adipocytic (Benign)	61:33 ≈ 1.8:1
Jobanputra et al., 2016 (Gujarat)	Retrospective	140	10 months	Benign: 83.6%, Malignant: 16.4%. Most common site: Head &Neck. Lipoma commonest.	Adipocytic (Lipoma)	125:13≈ 9:1
Dowerah et al., 2016 (North east India)	Retrospective	50	1 year	Benign:88%, Malignant:10% Most common site- Head &Neck Most common tumours- Vascular	Vascular (Benign)	1.3:1
Vani et al., 2016 (Telangana)	Retrospective	104	2 years	Benign:88%,Malignant:12% Most common site- Lower limbs Lipoma most common benign tumor. Males more commonly affected.	Adipocytic (Lipoma)	92:12=7.6:1
Weiss et al., 2008 (Enzinger & Weiss) (Global Reference)	Textbook (Literature Review)	Not applicable	Not applicable	Benign tumors ~100x more common than malignant. Adipocytic tumors most frequent. Malignant mesenchymal tumors <1% of all cancers.	Adipocytic (Lipoma)	≈100:1
Mirza Asif Baig, 2015 (India)	Retrospective	137	3 years	Benign tumors more frequent. Most common site- Lower extremeties Lipoma most common benign, rhabdomyosarcoma most common malignant. Male predominance.	Adipocytic (Lipoma)	≈4:1

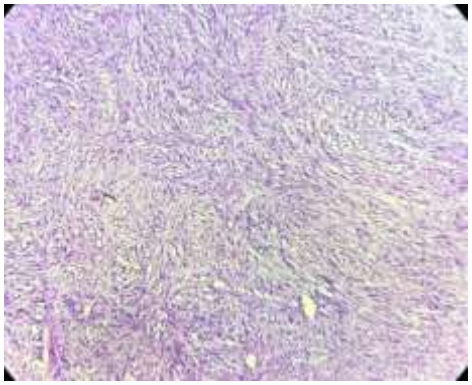

Figure 1(A): Fibrosarcoma showing atypical uniform cells in herringbone pattern (H&E; 10X)

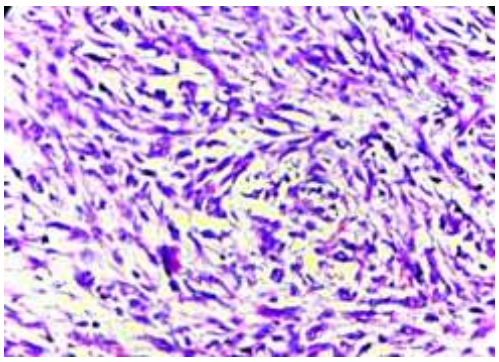

Figure 1(B): Fibrosarcoma showing pleomorphic spindle shaped cells with nuclear atypia (H & E 40 X)

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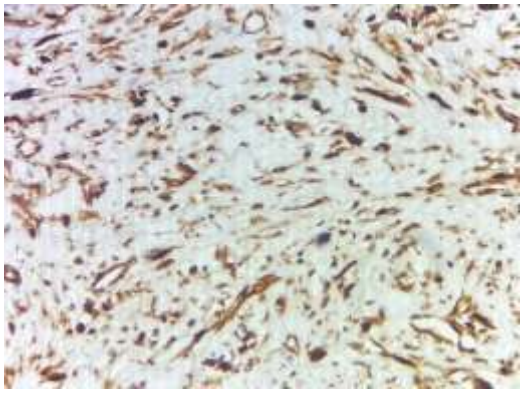

Figure 1(C): The tumour cells show positive staining for vimentin (immunohistochemical stain for vimentin; 40x)

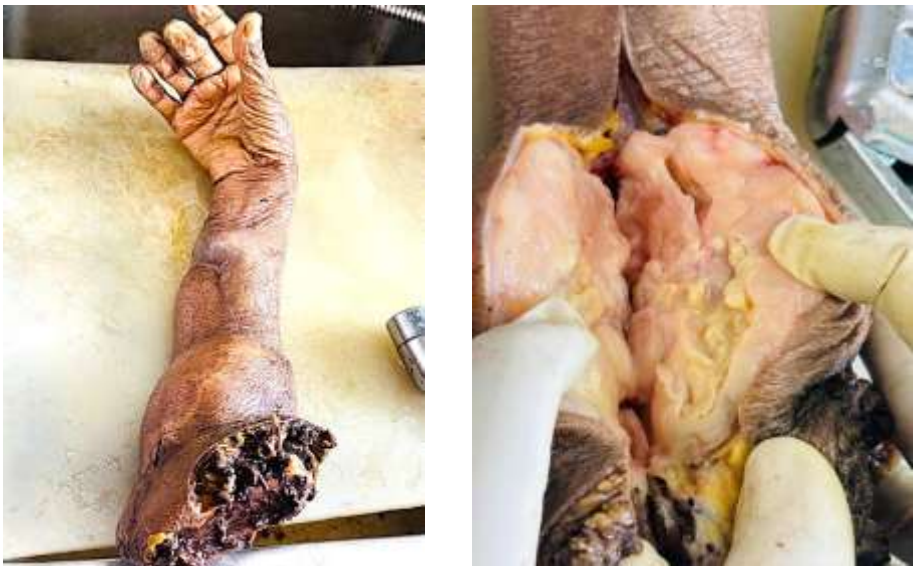

Figure 1(D): Gross Picture Of Fibrosarcoma

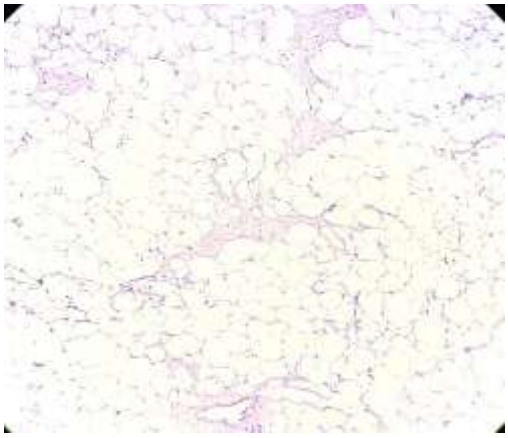

Figure 2(A): Microscopic picture of lipoma showing lobules of mature adipocytes separated by fibrovascular septae (H& E, 20X)

ISSN: 0975-8585

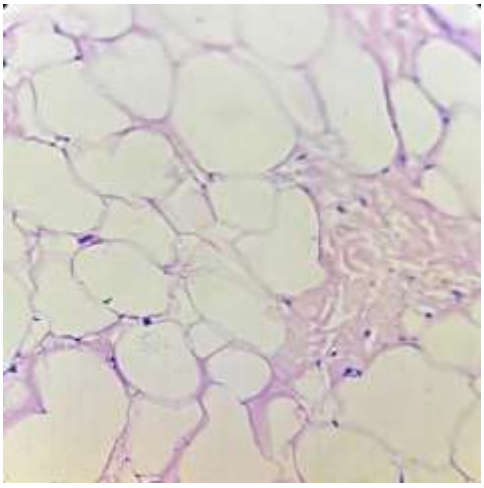

Figure 2(B): Microscopic picture of lipoma on high power (H& E;40X)

Figure 2(C): Gross Photograph Of Lipoma Showing Well Encapsulated Yellow Tumor Mass

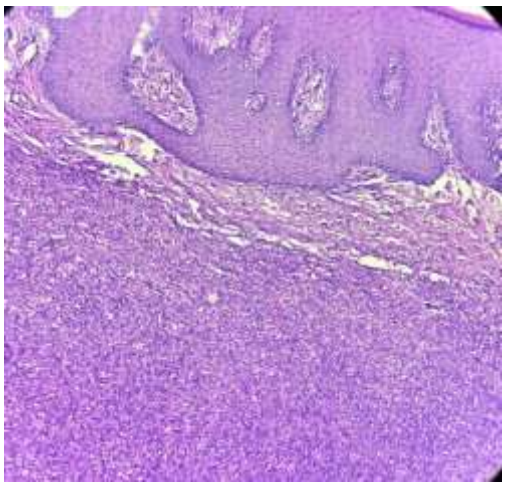

Figure 3(A): Microscopic Picture Of Dermatofibroma Showing Tumour Mass With Overlying Epidermis (H& E; 40x)

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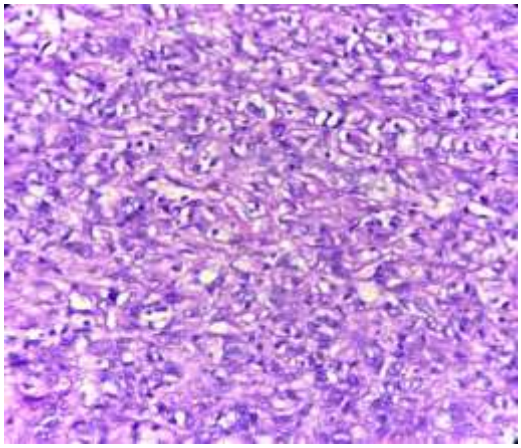

Figure 3 (B): Microscopic Picture Of Dermatofibroma On High Power (H&E; 100x)

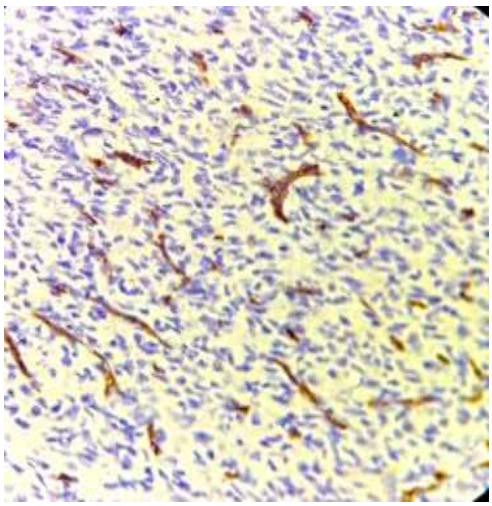

Figure 3(C) -The tumour cells show negative staining for CD 34 (immunohistochemical stain for CD 34;40x)

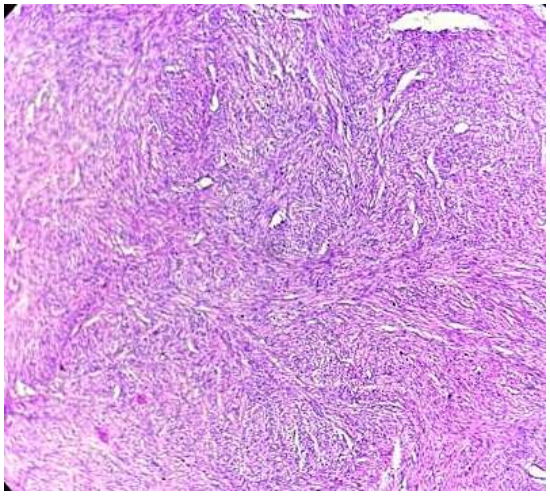

Figure no.4(A): Photomicrograph of broad ligament Leiomyoma showing smooth muscle cells arranged in fascicles and whorls. (H&E;40x)

ISSN: 0975-8585

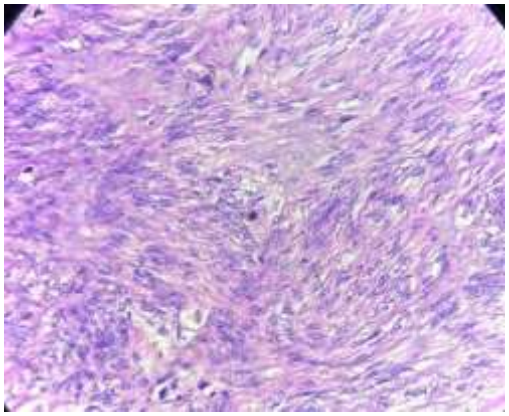

Figure 4 (B)- Microscopic Picture Of Leiomyoma On High Power (H&E; 100x)

Figure 4 (C) : Gross photograph broad ligament Leiomyoma.

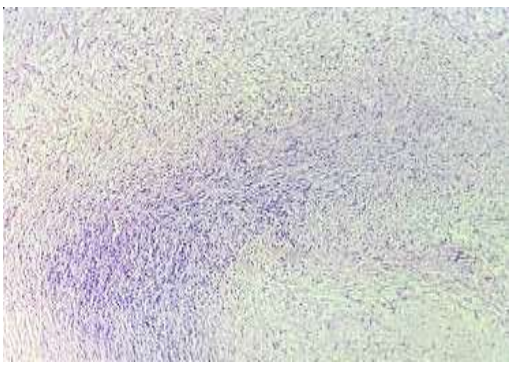

Figure 5 (A) : Photomicrograph of schwannoma showing well encapsulated tumor mass with Antoni A & Antoni B areas. (H&E, 20x)

ISSN: 0975-8585

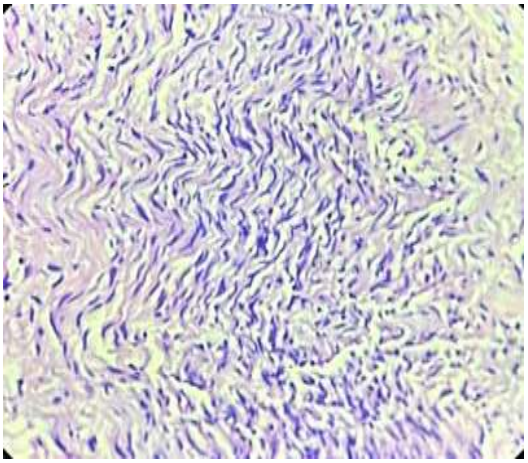

Figure 5(B): Photomicrograph of Schwannoma showing Antoni A areas with verocay bodies. (H&E, 40x)

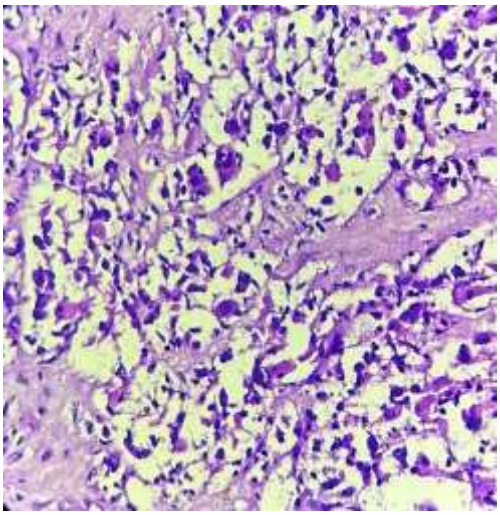

Figure 6 (A): Microscopic Picture Of Rhabdomyosarcoma Showing Loss Of Cellular Cohesion In The Centre Forms Alveolar Like Spaces (H & E;20x)

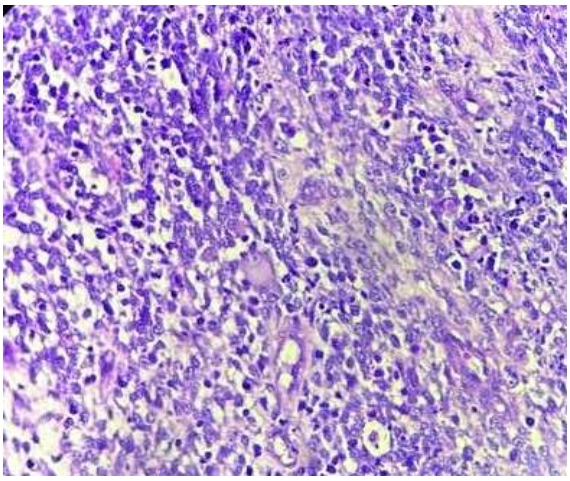

Figure 6 (B): Microscopic Picture Of Rhabdomyosarcoma Showing Rhabdomyoblasts (H&E;40x)

ISSN: 0975-8585

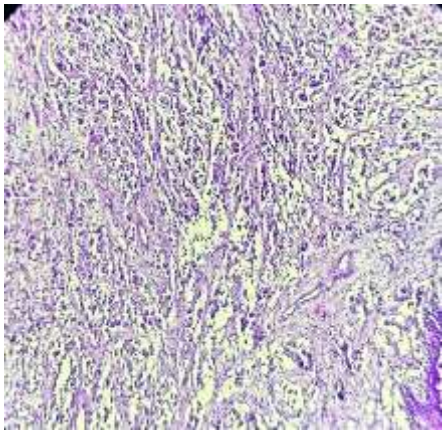

Figure 6 (C): Microscopic Picture Of Rhabdomyosarcoma Showing Pseudoalveolar Architecture (H&E;40x)

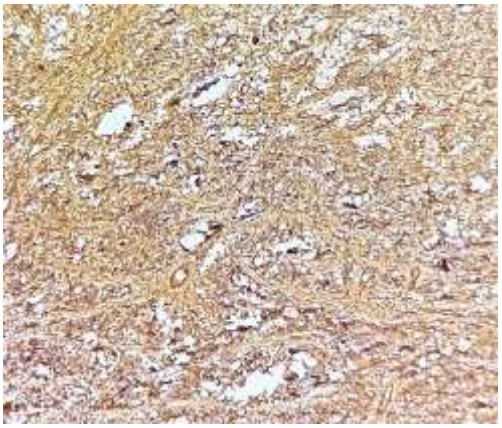

Figure 6 (D): Vimentin Positivity In Rhabdomyosarcoma (IHC; 40x)

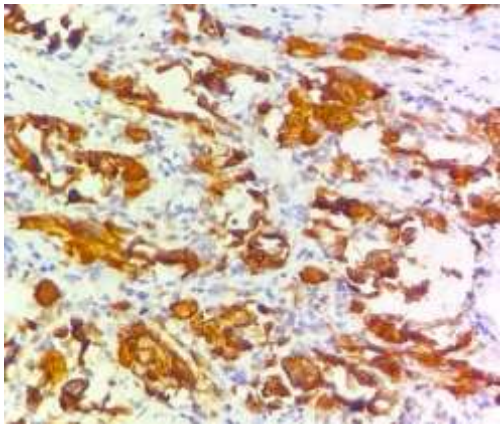

Figure 6 (E): Desmin Positivity In Rhabdomyosarcoma (IHC;40x)

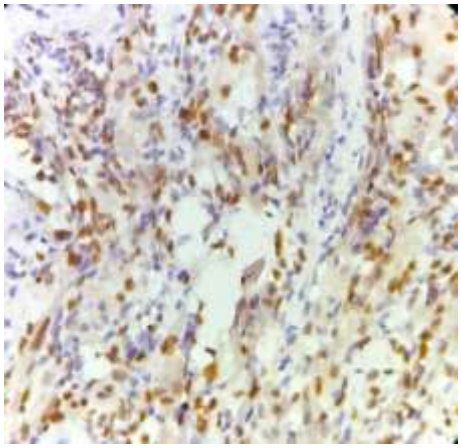

Figure 6(F): Myo D1 Positivity In Rhabdomyosarcoma (IHC;40x)

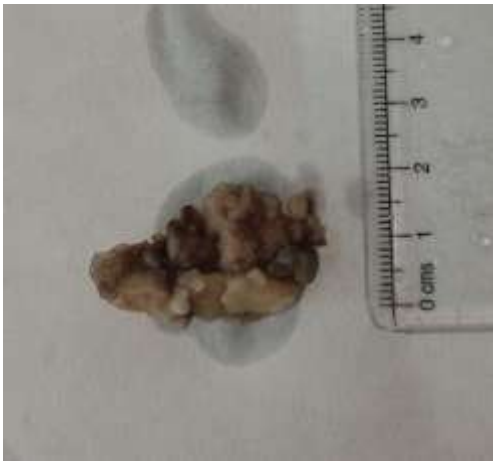

Figure 6(G): Gross Picture Of Rhabdomyosarcoma

DISCUSSION

In terms of age distribution, the highest number of cases occurred between 30–45 years (37.2%), followed by 45–60 years (27.4%). Malignant tumors showed a peak incidence in the 45–60year age group. This trend is comparable to studies by Jobanputra et al and Baig, which also reported soft tissue malignancies to be more prevalent in middle-aged adults. Pediatric soft tissue tumors comprised a small proportion (6.8%), with rhabdomyosarcoma being the most common, similar to global epidemiological patterns where it accounts for the majority of childhood sarcomas.

Regarding sex distribution, a male predominance was observed, with males constituting 65% of cases. These finding parallels previous studies Jobanputra et al (58.3%) and Kransdorf et al (54.55%) [2, 9], which also documented male preponderance. Hormonal, occupational, and genetic factors may underlie this difference, though further studies are warranted.

Soft tissue tumors constitute a diverse group of neoplasms with variable clinical, histological, and biological behaviour. The annual incidence of soft tissue tumor is 1.4 per 100000 population worldwide [5].

Present study showed benign tumors outnumbering malignant ones (59.8% vs 32.3%), yielding a benign-to-malignant ratio of approximately 1.8:1. This finding is consistent with earlier reports by Mirza Asif Baig et al and Vani et al, who also observed a predominance of benign lesions, although their ratios were higher (4:1 and 7.6:1, respectively). The lower ratio in the present study may be attributed to referral bias, as our institute is a tertiary care centre where advanced or malignant cases are more frequently received.

Adipocytic tumors emerged as the most common histological subtype (41%), with lipomas being the predominant benign lesion. This is in line with several Indian and global studies, including those by Jobanputra et al [2] (28.5 %), which consistently report lipomas as the most frequent soft tissue tumors. Among malignant lesions, liposarcoma and rhabdomyosarcoma were relatively more frequent, echoing the findings of Mirza Asif Baig[5](12.5%).

The anatomical distribution of tumors in our study showed the head and neck region (23.5%) and upper limb (22.5%) as the most common sites, followed by pelvis/genital region (16.6%) and retroperitoneum (10.7%). This contrasts with the findings of Vani et al and Baig et al (50%) [5, 6], where the lower extremities were more commonly involved. The variation could be explained by geographical and referral differences, as well as population-specific exposure and genetic predisposition.

Immunohistochemistry (IHC) proved valuable in resolving diagnostic dilemmas, particularly in cases of spindle cell and poorly differentiated sarcomas. Vimentin was the most commonly expressed marker across different sarcomas, while lineage-specific markers such as S100, Desmin, Myogenin, CD34, and CD117 facilitated further subtyping. The role of IHC as an adjunct to morphology is well-established, but as highlighted by Choi & Ro et al [7], integration of molecular diagnostics and gene fusion markers is revolutionizing soft tissue tumor classification. Our findings reaffirm the necessity of ancillary techniques in confirming diagnosis and guiding therapy, especially in borderline and high-grade tumors. When compared with other regional studies, our data highlights both similarities and differences. While the predominance of adipocytic tumors and male preponderance are consistent, the relatively higher frequency of malignant tumors and site predilection for head and neck in our cohort represent noteworthy variations. These differences emphasize the influence of demographic, environmental, and referral factors on tumor profiles.

Limitations of the present study include its retrospective design, relatively small sample size, and single-institutional data, which may limit generalizability. However, the study provides valuable insights into the spectrum of soft tissue tumors in this region and underscores the importance of combining histopathology with IHC for accurate classification.

The present study reaffirms that most soft tissue tumors are benign, with adipocytic tumors being the most frequent. Malignancies are more common in middle-aged males and frequently involve the head and neck region in our setting. Ancillary diagnostic modalities, particularly IHC, remain indispensable in achieving diagnostic precision, and future integration of molecular techniques will further refine classification and management.

CONCLUSION

Soft tissue tumors represent a histologically diverse group of neoplasms with varied clinical presentations and biological behaviours. The present study highlights that benign tumors continue to outnumber malignant ones, with adipocytic tumors being the most prevalent subtype. Malignant soft tissue tumors were more commonly observed in middle-aged males, with a predilection for the head and neck region in our cohort—an observation that differs from previous studies and underscores the importance of regional data.

Histopathology remains the cornerstone of diagnosis, but the application of immunohistochemistry significantly enhances diagnostic accuracy, especially in poorly differentiated or ambiguous lesions. Integration of these diagnostic tools is essential not only for accurate classification but also for guiding appropriate therapeutic strategies.

Although this study limited by its retrospective nature and single-centre scope, this study contributes valuable insight into the spectrum of soft tissue tumors in this geographic region. Further multi-centric studies with larger sample sizes and molecular profiling are recommended to deepen our understanding and improve the precision of soft tissue tumor diagnosis and treatment.

ACKNOWLEDGMENT

The authors sincerely acknowledge the support and guidance of the Department of Pathology, Pt. B.D. Sharma PGIMS, Rohtak, for providing the necessary facilities and resources to carry out this study. We

extend our heartfelt gratitude to our respected teachers, mentors, and colleagues for their valuable suggestions and constant encouragement throughout the research work. We also thank the technical staff and laboratory personnel for their assistance in specimen processing and immunohistochemical procedures. Finally, we express our appreciation to the patients whose samples contributed to this study.

REFERENCES

[1] Weiss SW, Goldblum JR, Folpe AL. Enzinger and Weiss' Soft Tissue Tumors. 6th ed. St. Louis: Mosby; 2008. p. 1–1220.
[2] Jobanputra GP, Parikh UR, Goswami HM. Histopathological Study of Soft Tissue Tumors (A Study of 140 Cases) in Tertiary Care Center. Int J Cur Res Rev 2016; 8:43-48.
[3] Baheti AD, O'Malley RB, Kim S, Keraliya AR, Tirumani SH, Ramaiya NH, Wang CL. Soft-tissue sarcomas: an update for radiologists based on the revised 2013 World Health Organization classification. Am J Roentgenol 2016;206(5):924-32.
[4] Dowerah Swagata, Thapa Gobil, Saikia Projnan. Spectrum of soft tissue tumours at a tertiary care center in North East India. Indian Journal of Basic and Applied Medical Research 2016; 5:303-06.
[5] Mirza Asif Baig. Histopathological Study of Soft Tissue Tumours (Three Years Study). International Journal of Science and Research 2015; 4:1039-49.
[6] Vani Tellapuram, Sirisha Ommini, Vijay Sreedhar Veldurthy, Charan Paul, Narsing Rao M. Spectrum of soft tissue tumours in rural area of Telangana. Int J Res Health Sci 2016; 4:81-87.
[7] Choi, J.H.; Ro, J.Y. The Recent Advances in Molecular Diagnosis of Soft Tissue Tumors. Int J Mol Sc. 2023; 24: 5934.
[8] Achar S, Yamanaka J, Oberstar J. Soft Tissue Masses: Evaluation and Treatment. Am Fam Physician 2022;105(6):602-612.
[9] Kransdorf MJ. Benign soft tissue tumors in a large referral population: Distribution of specific diagnosis by age, sex and location. Am J Roentgenol 1995; 164: 395