



CLINICAL PROFILE AND ULTRASONOGRAPHY AND MAGNETIC RESONANCE IMAGING FINDINGS IN SOFT TISSUE TUMORS: A PROSPECTIVE STUDY

Radiology

Dr. Dishank Anand*

Junior Resident, Department of Radiodiagnosis, C.U. Shah Medical College and Shrimad Rajchandra Sarvamangal Hospital, Surendranagar, Gujarat, India*Corresponding Author

Dr. Mehul Bavishi

Professor, Department of Radiodiagnosis, C.U. Shah Medical College and Shrimad Rajchandra Sarvamangal Hospital, Surendranagar, Gujarat, India

ABSTRACT

Soft tissue tumors range from common benign lesions to rare sarcomas, and imaging decides who needs biopsy. This prospective observational study describes the clinical profile and ultrasonography (USG) and magnetic resonance imaging (MRI) findings of soft tissue tumors and assesses both modalities in identifying malignancy. Seventy-five patients with soft tissue tumors underwent grayscale and Doppler USG followed by 1.5 T MRI at a tertiary care hospital in Gujarat, India, between March 2024 and August 2025, and imaging impressions were compared with the final diagnosis. Patients were most often aged 30–49 years (46.67%), 60.00% were male, and the lower limb was the commonest site (33.33%). Benign lesions predominated (89.33%), led by lipoma (46.67%), while sarcomas formed 10.67%. Fifteen lesions were heterogeneous, ill-defined, and vascular on USG and locally invasive on MRI; eight were sarcomas and seven were nerve sheath tumors. USG and MRI impressions agreed in all patients, each giving 100% sensitivity, 89.55% specificity, 53.33% positive predictive value, and 90.67% accuracy for malignancy. USG reliably characterizes typical benign masses, whereas heterogeneous, vascular, or large lesions need MRI to separate nerve sheath tumors from sarcomas and to define local extent before biopsy.

KEYWORDS

Soft Tissue Neoplasms, Ultrasonography, Magnetic Resonance Imaging, Sarcoma

INTRODUCTION

Soft tissue tumors are a heterogeneous group of lesions arising from nonepithelial, extraskeletal tissues such as fat, fibrous tissue, muscle, vessels, and peripheral nerves (WHO Classification of Tumours Editorial Board, 2020). Benign tumors far outnumber malignant ones (Kransdorf, 1995a, 1995b). Soft tissue sarcomas account for less than 1% of adult malignancies, yet a missed sarcoma carries substantial morbidity (WHO Classification of Tumours Editorial Board, 2020). Most patients present with a painless, slowly enlarging lump, so clinical examination alone rarely separates a lipoma from a sarcoma.

Ultrasonography (USG) is usually the first investigation because it is inexpensive, widely available, radiation-free, and assesses vascularity in real time (Hung et al., 2014). Magnetic resonance imaging (MRI) offers superior contrast resolution and multiplanar display, characterizes fat, fluid, hemorrhage, and necrosis, and defines compartmental and neurovascular involvement before surgery (Gielen et al., 2004; Wu & Hochman, 2009). Indian prospective data, such as those of Daniel et al. (2009), have focused mainly on MRI.

This study aimed to describe the clinical profile and USG and MRI features of soft tissue tumors and to assess USG–MRI agreement and diagnostic performance for malignancy.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Radiodiagnosis, C.U. Shah Medical College and Shrimad Rajchandra Sarvamangal Hospital, Surendranagar, Gujarat, from March 2024 to August 2025, after approval from the Institutional Ethics Committee. Written informed consent was obtained from all patients. Patients with a clinically palpable swelling diagnosed radiologically as a soft tissue tumor were included, without exclusion criteria. The sample size of 75 was based on patient flow, feasibility, and previous studies. Age, sex, site, duration, pain, trauma, and clinical findings were recorded.

Grayscale USG was performed with a 12–5 MHz linear transducer, supplemented by a 5–2 MHz curvilinear transducer for deep lesions, to assess size, margins, depth relative to the deep fascia, echotexture, internal architecture, and posterior acoustic features. Color and power Doppler imaging graded internal vascularity.

MRI was performed on a 1.5 T scanner with T1-weighted, T2-weighted, short tau inversion recovery (STIR) or fat-suppressed, and diffusion-weighted sequences with apparent diffusion coefficient (ADC) maps, adding contrast-enhanced fat-suppressed T1-weighted images when contrast was given. Size, compartment, signal characteristics, internal composition, diffusion restriction, and fascial,

osseous, or neurovascular involvement were assessed. Each lesion was labeled benign or malignant on USG and on MRI. Histopathology, wherever available, served as the reference standard for the final diagnosis. Categorical data are presented as frequencies and percentages. Sensitivity, specificity, predictive values, and accuracy for malignancy were calculated with Wilson 95% confidence intervals (CI), and USG–MRI agreement was expressed as percentage concordance and Cohen's kappa. Lesion size was compared between benign and malignant groups using the Mann–Whitney U test, with $p < 0.05$ considered significant.

RESULTS

The clinical profile is summarized in Table 1. The commonest age group was 30–39 years (24.00%), followed by 40–49 years (22.67%). Males outnumbered females (60.00% vs 40.00%). The lower limb (33.33%) and upper limb (26.67%) were the commonest sites, and 73.33% of lesions were superficial to the deep fascia.

Table 1: Clinical profile of the study population (n = 75)

Variable	n (%)
Age group (years)	
10–19	5 (6.67%)
20–29	15 (20.00%)
30–39	18 (24.00%)
40–49	17 (22.67%)
50–59	12 (16.00%)
60–70	8 (10.67%)
Sex	
Male	45 (60.00%)
Female	30 (40.00%)
Site	
Lower limb	25 (33.33%)
Upper limb	20 (26.67%)
Back	12 (16.00%)
Head and neck	7 (9.33%)
Chest	6 (8.00%)
Buttocks	5 (6.67%)
Compartment	
Superficial	55 (73.33%)
Deep	20 (26.67%)

Benign lesions accounted for 67 (89.33%) cases and malignant tumors for 8 (10.67%) (Table 2). Lipoma was the commonest diagnosis, followed by epidermal inclusion cyst and ganglion cyst. Nerve sheath tumors comprised four neurofibromas and three schwannomas, and sarcomas comprised five fibrosarcomas, two liposarcomas, and one synovial sarcoma.

Lipomas were homogeneous, well-defined, and avascular, with fat suppression on MRI. Epidermal inclusion cysts and ganglion cysts were well-defined and avascular, with fluid signal on MRI. Internal vascularity was seen in 15 (20.00%) lesions, necrosis in 11 (14.67%), cystic change in 6 (8.00%), and calcification in 7 (9.33%). All 15 nerve sheath tumors and sarcomas were heterogeneous, ill-defined, and internally vascular on USG and heterogeneous and locally invasive on MRI. Cystic change and calcification were confined to sarcomas.

Malignant tumors were larger than benign lesions (maximum MRI dimension 9.35 ± 2.00 vs 4.94 ± 2.48 cm; $p < 0.001$). All sarcomas exceeded 5 cm, as did 30 of 67 (44.78%) benign lesions. USG and MRI measurements correlated closely ($r = 0.99$; mean difference -0.01 ± 0.37 cm).

USG and MRI each classified 15 lesions as malignant: eight sarcomas and seven nerve sheath tumors. No sarcoma was missed. Both therefore showed sensitivity of 100% (95% CI 67.56%–100%), specificity of 89.55% (79.97%–94.85%), positive predictive value of 53.33% (30.12%–75.19%), negative predictive value of 100% (93.98%–100%), and accuracy of 90.67% (81.97%–95.41%). USG and MRI impressions were concordant in all 75 patients (100%; $\kappa = 1.00$).

Table 2: Final diagnosis with characteristic USG and MRI findings (n = 75)

Final diagnosis, n (%)	USG and MRI findings	Impression
Lipoma 35 (46.67%)	USG: homogeneous, well-defined, avascular MRI: T1 and T2 hyperintense, suppressed on fat-saturated images Size: 5.76 ± 1.80 cm	Benign
Epidermal inclusion cyst 15 (20.00%)	USG: heterogeneous, well-defined, avascular MRI: T1 hypointense, T2 hyperintense Size: 2.88 ± 0.93 cm	Benign
Ganglion cyst 10 (13.33%)	USG: anechoic, well-defined, avascular MRI: T1 hypointense, T2 hyperintense Size: 2.62 ± 0.89 cm	Benign
Nerve sheath tumor 7 (9.33%)	USG: heterogeneous, ill-defined, vascular MRI: T1 isointense, heterogeneous T2/STIR, local invasion Size: 8.51 ± 2.77 cm	Malignant (false positive)
Sarcoma 8 (10.67%)	USG: heterogeneous, ill-defined, vascular MRI: T1 isointense, heterogeneous T2/STIR, local invasion Size: 9.35 ± 2.00 cm	Malignant (true positive)

Size: maximum MRI dimension, mean $\pm$ standard deviation. STIR, short tau inversion recovery.

DISCUSSION

In this series, benign lesions formed nearly nine-tenths of soft tissue tumors and lipoma was the commonest diagnosis, mirroring the large referral data of Kransdorf (1995a). The clustering in the fourth and fifth decades, the male excess, and lower limb involvement also agree with that series (Kransdorf, 1995b). The sarcoma proportion (10.67%) reflects tertiary referral of larger, symptomatic masses rather than population frequency.

Typical benign lesions were confidently characterized on USG, and MRI merely confirmed fat suppression or fluid signal. Hung et al. (2014) similarly reported high USG accuracy for superficial tumors, with 94.1% sensitivity and 99.7% specificity for malignancy. When clinical and USG features are typical, such lesions may not need MRI.

All sarcomas were heterogeneous, ill-defined, vascular, and larger than 5 cm, so neither modality missed a malignancy. Size above 5 cm is a recognized warning sign (Chiou et al., 2009; Datir et al., 2008), but it was also present in 44.78% of benign lesions, mostly lipomas, limiting

its specificity when used alone. Nerve sheath tumors caused every false-positive result. They mimicked sarcomas in size, heterogeneity, and vascularity. Cystic degeneration, hemorrhage, and hypervascularity are well described in schwannomas, and signs such as an entering and exiting nerve, the target sign, and the split-fat sign should be actively sought on MRI (Beaman et al., 2004; Wu & Hochman, 2009). Our specificity (89.55%) and positive predictive value (53.33%) were close to the 82% specificity and 60% positive predictive value of Gielen et al. (2004) and the 84% specificity of Daniel et al. (2009), whose sensitivities were 93% and 95%, respectively.

Complete USG–MRI concordance for the benign–malignant call shows that USG is an efficient triage tool. MRI nevertheless remains indispensable for indeterminate lesions because it maps compartmental spread and neurovascular and osseous involvement and guides biopsy and surgery (Wu & Hochman, 2009).

Limitations include the single-center design, the small number of sarcomas, which widens the CIs, histopathological confirmation only where available, nonblinded interpretation, and the absence of quantitative ADC analysis.

CONCLUSION

Soft tissue tumors in this series were predominantly benign, with lipoma the commonest lesion, and more often affected men, adults aged 30–49 years, and the lower limb. USG accurately identified typical benign masses and agreed completely with MRI in the benign–malignant call, missing no sarcoma. Nerve sheath tumors were the main mimic of malignancy, so heterogeneous, vascular, or large lesions should undergo MRI for characterization and local staging, followed by histopathology.

REFERENCES

1. Beaman, F. D., Kransdorf, M. J., & Menke, D. M. (2004). Schwannoma: Radiologic-pathologic correlation. *RadioGraphics*, 24(5), 1477–1481. <https://doi.org/10.1148/rg.245045001>
2. Chiou, H. J., Chou, Y. H., Chiu, S. Y., Wang, H. K., Chen, W. M., Chen, T. H., & Chang, C. Y. (2009). Differentiation of benign and malignant superficial soft-tissue masses using grayscale and color Doppler ultrasonography. *Journal of the Chinese Medical Association*, 72(6), 307–315. [https://doi.org/10.1016/S1726-4901\(09\)70377-6](https://doi.org/10.1016/S1726-4901(09)70377-6)
3. Daniel, A., Ullah, E., Wahab, S., & Kumar, V. (2009). Relevance of MRI in prediction of malignancy of musculoskeletal system—A prospective evaluation. *BMC Musculoskeletal Disorders*, 10, 125. <https://doi.org/10.1186/1471-2474-10-125>
4. Datir, A., James, S. L. J., Ali, K., Lee, J., Ahmad, M., & Saifuddin, A. (2008). MRI of soft-tissue masses: The relationship between lesion size, depth, and diagnosis. *Clinical Radiology*, 63(4), 373–378. <https://doi.org/10.1016/j.crad.2007.08.016>
5. Gielen, J. L. M. A., De Schepper, A. M., Vanhoenacker, F., Parizel, P. M., Wang, X. L., Sciort, R., & Weyler, J. (2004). Accuracy of MRI in characterization of soft tissue tumors and tumor-like lesions: A prospective study in 548 patients. *European Radiology*, 14(12), 2320–2330. <https://doi.org/10.1007/s00330-004-2431-0>
6. Hung, E. H. Y., Griffith, J. F., Ng, A. W. H., Lee, R. K. L., Lau, D. T. Y., & Leung, J. C. S. (2014). Ultrasound of musculoskeletal soft-tissue tumors superficial to the investing fascia. *American Journal of Roentgenology*, 202(6), W532–W540. <https://doi.org/10.2214/AJR.13.11457>
7. Kransdorf, M. J. (1995a). Benign soft-tissue tumors in a large referral population: Distribution of specific diagnoses by age, sex, and location. *American Journal of Roentgenology*, 164(2), 395–402. <https://doi.org/10.2214/ajr.164.2.7839977>
8. Kransdorf, M. J. (1995b). Malignant soft-tissue tumors in a large referral population: Distribution of diagnoses by age, sex, and location. *American Journal of Roentgenology*, 164(1), 129–134. <https://doi.org/10.2214/ajr.164.1.7998525>
9. WHO Classification of Tumours Editorial Board. (2020). *Soft tissue and bone tumours* (5th ed., Vol. 3). International Agency for Research on Cancer.
10. Wu, J. S., & Hochman, M. G. (2009). Soft-tissue tumors and tumorlike lesions: A systematic imaging approach. *Radiology*, 253(2), 297–316. <https://doi.org/10.1148/radiol.2532081199>