MRI-Based Evaluation of Extremity Soft Tissue Tumors: Diagnostic Accuracy and Reliability of the Soft Tissue Tumor Reporting and Data System (ST-RADS)

Shaimaa Khaled Idris Abdelrahman Ghoneim[1], Khalid Mohamed Shawky [1], Alaa Ahmed Mostafa El-Negehy [2], Sameh Saber Hegab [1], Mohamed Abd El-Khalek Basha [1]

1 Department of Radio diagnosis, Faculty of Medicine, Zagazig University

2 Department of Orthopedic Surgery, Faculty of Medicine, Zagazig University

Corresponding Author: Shaimaa Khaled Idris Abdelrahman Ghoneim

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Abstract

Background: Soft tissue tumors of the extremities represent a heterogeneous group of lesions with wide variability in biological behavior, ranging from benign masses to highly aggressive sarcomas. Despite their rarity, accounting for less than 1% of adult malignancies, their clinical significance lies in the diagnostic challenges they pose and the potential for delayed diagnosis, particularly due to nonspecific clinical presentation . Magnetic resonance imaging (MRI) has emerged as the imaging modality of choice for evaluating soft tissue tumors owing to its superior soft tissue contrast, multiplanar capability, and ability to delineate lesion extent and relationship to adjacent structures. However, conventional MRI interpretation remains limited by overlap in imaging features between benign and malignant lesions and interobserver variability .

The Soft Tissue Tumor Reporting and Data System (ST-RADS) has been recently introduced as a structured MRI-based reporting framework aimed at standardizing lesion characterization, improving diagnostic accuracy, and enhancing communication between radiologists and clinicians. This review aims to evaluate the diagnostic accuracy and reliability of ST-RADS in the assessment of extremity soft tissue tumors, with particular emphasis on its role in differentiating benign from malignant lesions and its reproducibility among observers.

ST-RADS integrates multiple MRI features including lesion size, depth, signal characteristics, enhancement patterns, and relationship to surrounding anatomical structures into a categorical scoring system. Recent multi-institutional validation studies have demonstrated promising results, showing improved consistency in reporting and meaningful correlation with histopathological outcomes. Functional MRI techniques such as diffusion-weighted imaging (DWI) and dynamic contrast-enhanced MRI (DCE-MRI) further complement the ST-RADS framework by providing quantitative and perfusion-related data that may enhance lesion characterization.

Despite these advancements, limitations remain, including overlap in imaging characteristics, variability in advanced imaging interpretation, and the need for further large-scale validation. Nevertheless, ST-RADS represents a significant step toward standardized, reproducible, and clinically meaningful MRI reporting in musculoskeletal oncology.

In conclusion, MRI-based evaluation using ST-RADS shows substantial potential in improving the diagnostic performance and reliability of extremity soft tissue tumor assessment. Its integration into routine clinical practice may facilitate earlier diagnosis, optimize patient management, and support multidisciplinary decision-making, although continued refinement and validation are required.

Keywords: MRI-Based, Extremity Soft Tissue Tumors, Diagnostic Accuracy and Reliability, Soft Tissue Tumor Reporting and Data System (ST-RADS)

Introduction

Soft tissue tumors of the extremities represent a heterogeneous group of mesenchymal neoplasms with diverse histological subtypes and variable biological behavior. Despite their diversity, soft tissue sarcomas are relatively rare, accounting for less than 1% of adult malignancies, yet they pose significant diagnostic and clinical challenges due to their potential for aggressive progression and metastatic spread [1]. The extremities are the most common anatomical site of involvement, particularly the thigh, making accurate imaging evaluation essential for early detection and appropriate management [1].

Clinically, these tumors frequently present as painless, slowly enlarging masses, which may lead to delayed diagnosis. Importantly, malignant lesions are not always associated with pain or rapid growth, contributing to diagnostic uncertainty. Although certain clinical features such as increasing size, deep location, and lesion size greater than 5 cm raise suspicion for malignancy, these criteria lack specificity and cannot reliably distinguish benign from malignant lesions, emphasizing the need for advanced imaging assessment [1].

Magnetic resonance imaging (MRI) is considered the modality of choice for evaluating soft tissue tumors due to its superior soft tissue contrast, multiplanar capability, and ability to delineate lesion extent and relationship to adjacent structures. MRI plays a central role in lesion characterization, local staging, biopsy planning, and post-treatment follow-up. However, despite these advantages, conventional MRI interpretation remains limited by considerable overlap in imaging features between benign and malignant lesions, and it often lacks sufficient specificity for definitive diagnosis [1].

To overcome these limitations, structured reporting systems have been introduced to standardize imaging interpretation and improve diagnostic consistency. The Soft Tissue Tumor Reporting and Data System (ST-RADS) is a recently proposed MRI-based framework that integrates key imaging features into a categorical scoring system aimed at improving diagnostic accuracy and interobserver reliability. Early studies have demonstrated its potential in enhancing reproducibility and facilitating communication between radiologists and clinicians [2].

Nevertheless, evidence regarding the diagnostic performance and reliability of ST-RADS in extremity soft tissue tumors remains limited, and further evaluation is required to validate its clinical utility.

Therefore, this review aims to assess the diagnostic accuracy and reliability of ST-RADS in MRI evaluation of extremity soft tissue tumors, with emphasis on its role in lesion characterization and its potential to standardize radiological reporting.

Epidemiology and Clinical Characteristics of Extremity Soft Tissue Tumors

Soft tissue tumors of the extremities represent a relatively rare but clinically significant group of neoplasms, with soft tissue sarcomas accounting for less than 1% of all adult malignancies worldwide. Despite their low incidence, their clinical importance is substantial due to their potential for aggressive behavior and high rates of morbidity and mortality. The global incidence of soft tissue sarcomas ranges from approximately 1.8 to 5 cases per 100,000 individuals annually, with a higher prevalence observed in older populations, particularly those above 65 years of age [3]. These tumors occur more frequently than primary bone sarcomas and represent the majority of musculoskeletal sarcomas encountered in clinical practice.

The extremities are the most common site of involvement, accounting for approximately 60–75% of all soft tissue sarcomas, with the thigh being the predominant location. This anatomical predilection has significant implications for imaging, as lesions in the extremities are more accessible to clinical examination and imaging modalities compared to deeper locations such as the retroperitoneum. However, despite this accessibility, diagnosis is often delayed due to the indolent nature of many lesions and the lack of early alarming symptoms [3].

From a clinical standpoint, most soft tissue tumors present as painless, slowly enlarging masses. This characteristic presentation often leads to underestimation of disease severity and delayed referral to specialized centers. Notably, malignant lesions may remain asymptomatic for extended periods and do not

necessarily demonstrate rapid growth or pain, which are commonly assumed indicators of malignancy. This contributes to a diagnostic challenge and highlights the limitations of relying solely on clinical assessment for differentiation between benign and malignant lesions [3].

Several clinical features have been proposed to increase suspicion for malignancy, including lesion size greater than 5 cm, deep location relative to the fascia, progressive enlargement, and the presence of pain. Among these, increasing size is considered the most significant predictor. However, these criteria lack specificity, as benign lesions may also exhibit similar characteristics. Consequently, imaging plays a crucial role in further evaluation, particularly in characterizing lesion morphology and guiding subsequent diagnostic steps [3].

Metastatic potential is a critical determinant of prognosis in soft tissue sarcomas. The lungs represent the most common site of distant metastases due to hematogenous dissemination. At the time of diagnosis, approximately 10% of patients may already have metastatic disease, while up to 50% develop metastases during follow-up. Survival outcomes remain poor in metastatic cases, emphasizing the importance of early and accurate diagnosis [3].

The wide histological diversity of soft tissue tumors, with more than 100 recognized subtypes, further complicates clinical and radiological evaluation. Each subtype may exhibit distinct biological behavior, imaging characteristics, and treatment response. This heterogeneity highlights the necessity for a structured and standardized imaging approach, particularly MRI-based evaluation systems, to improve diagnostic consistency and support clinical decision-making.

maging Modalities in the Evaluation of Extremity Soft Tissue Tumors

The evaluation of soft tissue tumors relies on a multimodality imaging approach, as no single imaging technique is sufficient to comprehensively characterize all lesions. Imaging plays a crucial role not only in detecting the presence of a mass but also in assessing its size, location, extent, internal composition, and relationship to adjacent anatomical structures. This information is essential for narrowing the differential diagnosis, guiding biopsy, and planning treatment strategies [4].

Conventional radiography is typically the initial imaging modality used in the assessment of suspected soft tissue masses, particularly in the extremities. Although often limited in directly characterizing soft tissue lesions, radiographs provide valuable information regarding osseous involvement, presence of calcifications, and mineralization patterns that may suggest specific diagnoses. Additionally, radiographs help differentiate primary soft tissue lesions from bone-origin tumors and can detect secondary bone changes such as cortical erosion or periosteal reaction [4].

Ultrasound serves as a useful first-line imaging tool, especially for superficial soft tissue lesions. It is widely available, cost-effective, and allows real-time evaluation of lesion characteristics, including size, shape, echotexture, vascularity, and relationship to surrounding structures. Ultrasound is particularly valuable in distinguishing cystic from solid lesions and can guide image-assisted biopsy or aspiration procedures. However, its diagnostic accuracy is highly operator-dependent, and its utility is limited in evaluating deep-seated masses [4].

Computed tomography (CT) plays a complementary role, particularly in evaluating lesions with suspected osseous involvement or complex anatomical relationships. CT is superior in detecting subtle calcifications, cortical bone destruction, and mineralized tumor matrices that may not be well visualized on MRI. It is also the preferred modality for assessing pulmonary metastases and is valuable in guiding interventional procedures such as biopsy. However, its limited soft tissue contrast compared to MRI restricts its role in primary lesion characterization [4].

Magnetic resonance imaging (MRI) is the modality of choice for comprehensive evaluation of soft tissue tumors due to its superior soft tissue contrast resolution and multiplanar imaging capability. MRI enables detailed assessment of lesion morphology, internal architecture, and extent, as well as its relationship to adjacent muscles, fascia, bone, and neurovascular structures. It is essential for local staging, biopsy planning, and follow-up after treatment. Despite its strengths, MRI interpretation can be limited by overlap in imaging features between benign and malignant lesions, necessitating structured approaches to improve diagnostic accuracy [4].

Advanced imaging modalities such as positron emission tomography (PET), particularly when combined with CT, may provide additional metabolic information that can aid in differentiating benign from malignant lesions and in detecting metastatic disease. However, these techniques are generally used as adjuncts rather than primary diagnostic tools in routine evaluation [5].

MRI Evaluation of Extremity Soft Tissue Tumors

Magnetic resonance imaging (MRI) represents the cornerstone in the evaluation of extremity soft tissue tumors due to its superior soft tissue contrast resolution and multiplanar imaging capability. It provides detailed information regarding lesion morphology, internal composition, anatomical extent, and relationship to surrounding structures, making it indispensable for diagnosis, local staging, biopsy planning, and post-treatment surveillance [6]. MRI is particularly valuable in assessing whether a lesion is solid or cystic, identifying fat content, and determining involvement of adjacent neurovascular bundles or bone structures.

A standard MRI protocol for soft tissue tumor evaluation includes imaging in at least two orthogonal planes using T1-weighted and fluid-sensitive sequences, often with fat suppression. T1-weighted images are useful for evaluating anatomical detail and detecting fat within lesions, while T2-weighted and fluid-sensitive sequences highlight areas of increased water content, such as edema, necrosis, or myxoid components. The addition of fat-suppressed T1-weighted images following gadolinium contrast administration allows differentiation between viable tumor tissue and necrotic or cystic areas, thereby improving lesion characterization and guiding biopsy targeting [6].

Signal intensity characteristics play an important role in MRI interpretation. Lesions that are hyperintense on T1-weighted images may contain fat, hemorrhage, proteinaceous material, or melanin, whereas hypointense signals on T2-weighted images are typically associated with fibrous tissue, hemosiderin, or calcification. However, many soft tissue tumors demonstrate nonspecific signal characteristics, and overlap between benign and malignant lesions is common, limiting the ability of MRI to provide definitive histological diagnosis based solely on signal patterns [6].

Morphological assessment is equally critical in MRI evaluation. Important features include lesion size, margins, internal heterogeneity, and anatomical location relative to the deep fascia. Features that favor malignancy include large lesion size, deep location, heterogeneous signal intensity due to necrosis or hemorrhage, and invasion or encasement of adjacent structures such as bone or neurovascular bundles. Nevertheless, these findings are not entirely specific, as some benign lesions may exhibit similar imaging appearances, further complicating differentiation [6].

Contrast-enhanced MRI plays a pivotal role in evaluating tumor vascularity and internal architecture. Malignant lesions often demonstrate early, rapid, and heterogeneous enhancement patterns, frequently with peripheral enhancement and central necrosis. In contrast, benign lesions tend to show more gradual and homogeneous enhancement, although exceptions exist. Dynamic contrast-enhanced MRI (DCE-MRI) can provide additional functional information regarding tumor perfusion and vascular permeability, aiding in differentiation and assessment of treatment response [6].

Diffusion-weighted imaging (DWI) has emerged as a valuable adjunct to conventional MRI sequences by providing information about tissue cellularity and membrane integrity. Malignant tumors, which are typically more cellular, tend to exhibit restricted diffusion with low apparent diffusion coefficient (ADC) values, whereas benign lesions generally show less restriction and higher ADC values. However, overlap in ADC values between benign and malignant lesions has been reported, limiting its standalone diagnostic utility but supporting its role as a complementary technique [6].

Despite the comprehensive information provided by MRI, its ability to reliably distinguish benign from malignant soft tissue tumors remains limited due to significant overlap in imaging characteristics. Consequently, MRI findings must be interpreted in conjunction with clinical and, when necessary, histopathological data. These limitations have driven the development of structured reporting systems such as ST-RADS, which aim to standardize MRI interpretation and improve diagnostic consistency.

Soft Tissue Tumor Reporting and Data System (ST-RADS): Concept, Application, and Diagnostic Performance

The Soft Tissue Tumor Reporting and Data System (ST-RADS) has been introduced as a structured MRI-based framework aimed at standardizing the evaluation and reporting of soft tissue tumors. This system was developed to address the inherent limitations of conventional MRI interpretation, particularly the overlap in imaging features between benign and malignant lesions and the variability in radiologist reporting. By providing a consistent and reproducible classification method, ST-RADS seeks to enhance diagnostic accuracy, improve interobserver agreement, and facilitate clearer communication between radiologists and clinicians [7].

ST-RADS is conceptually modeled after other established radiological reporting systems and incorporates a combination of key MRI features into a categorical scoring system. These features include lesion size, depth relative to the fascia, signal intensity characteristics, internal heterogeneity, enhancement patterns, and relationship to adjacent anatomical structures. Each of these parameters contributes to an overall assessment that stratifies lesions according to their likelihood of malignancy, thereby guiding clinical decision-making and management strategies [7].

A fundamental aspect of ST-RADS is its ability to translate complex imaging findings into standardized categories that reflect the probability of malignancy. Lesions are typically classified along a spectrum ranging from likely benign to highly suspicious for malignancy. This structured approach reduces subjective interpretation and allows for more uniform reporting across different institutions and levels of radiologist experience. As a result, ST-RADS has demonstrated potential in improving diagnostic confidence and reducing variability in MRI interpretation [7].

One of the key strengths of ST-RADS lies in its integration of both morphological and functional imaging features. Conventional MRI parameters, such as lesion size, margin definition, and signal heterogeneity, are combined with advanced imaging findings, including contrast enhancement characteristics and diffusion-weighted imaging (DWI) metrics. This comprehensive assessment enhances the ability to characterize lesions more accurately than relying on individual imaging features alone. In particular, the inclusion of functional imaging data provides additional insight into tumor vascularity and cellularity, which are important indicators of malignancy [6,7].

Recent validation studies have demonstrated promising results regarding the diagnostic performance of ST-RADS. These studies have reported improved sensitivity and specificity in differentiating benign from malignant soft tissue tumors when compared to conventional unstructured MRI assessment. Additionally, ST-RADS has shown good to excellent interobserver agreement, indicating its reliability as a standardized reporting tool across different readers and institutions [7].

Despite these advantages, certain limitations of ST-RADS should be acknowledged. Overlap in imaging characteristics between benign and malignant lesions remains a challenge, particularly in cases of atypical presentations or low-grade malignancies. Furthermore, interpretation of advanced imaging techniques such as DWI and dynamic contrast-enhanced MRI may introduce variability depending on technical factors and radiologist expertise. Therefore, while ST-RADS provides a valuable framework, it should be used in conjunction with clinical findings and, when necessary, histopathological confirmation [6].

Overall, ST-RADS represents a significant advancement in the radiological evaluation of soft tissue tumors, offering a structured and reproducible approach that enhances diagnostic accuracy and reporting consistency. Its application in extremity soft tissue tumors is particularly valuable, where accurate characterization is essential for guiding biopsy, treatment planning, and prognostic assessment.

Diagnostic Accuracy and Reliability of ST-RADS in MRI Evaluation of Extremity Soft Tissue Tumors

The diagnostic accuracy and reliability of MRI in evaluating soft tissue tumors have long been challenged by the significant overlap in imaging features between benign and malignant lesions. Conventional MRI, while highly sensitive in detecting soft tissue masses and delineating their anatomical extent, has limited specificity in determining histological nature. This limitation has driven the development of structured reporting systems such as ST-RADS, which aim to improve diagnostic performance through standardized interpretation of imaging findings [8,9].

ST-RADS enhances diagnostic accuracy by systematically incorporating multiple imaging parameters into

a unified scoring framework. These parameters include lesion size, depth, signal characteristics, internal architecture, and contrast enhancement patterns, all of which are known to correlate with malignancy risk. Studies evaluating MRI features have demonstrated that characteristics such as large size, deep fascial location, heterogeneous signal intensity, and necrosis are significantly associated with malignant soft tissue tumors. However, when assessed individually, these features lack sufficient specificity, reinforcing the importance of a combined, structured approach as implemented in ST-RADS [9,10].

Recent investigations into ST-RADS have shown that its application improves the ability to differentiate benign from malignant lesions compared to conventional unstructured MRI reporting. By assigning lesions to standardized categories based on malignancy probability, ST-RADS provides a more objective assessment, reducing subjective variability. Multi-institutional validation studies have reported improved sensitivity and specificity in tumor characterization, highlighting its potential as a reliable diagnostic tool in musculoskeletal imaging [11].

Interobserver reliability is a critical component in evaluating any reporting system, particularly in radiology where interpretation variability can significantly impact clinical decision-making. ST-RADS has demonstrated good to excellent interobserver agreement across radiologists with varying levels of experience. This improvement is largely attributed to its structured format, which minimizes ambiguity in image interpretation and promotes consistent evaluation criteria. Such reproducibility is essential for ensuring uniform patient management, especially in multidisciplinary settings [11,12].

The integration of advanced MRI techniques further contributes to the diagnostic performance of ST-RADS. Diffusion-weighted imaging (DWI) provides quantitative assessment of tissue cellularity through apparent diffusion coefficient (ADC) values, with malignant tumors generally exhibiting lower ADC values due to higher cellular density. Similarly, dynamic contrast-enhanced MRI (DCE-MRI) offers insight into tumor vascularity and perfusion characteristics, with malignant lesions typically demonstrating rapid and heterogeneous enhancement patterns. When incorporated into a structured system like ST-RADS, these functional imaging parameters enhance lesion characterization and support more accurate classification [13,14].

Despite these advancements, certain limitations persist. Overlap in imaging features remains a challenge, particularly in cases of low-grade malignancies or atypical benign lesions. Additionally, variability in acquisition protocols and interpretation of advanced imaging techniques may influence diagnostic outcomes. Some studies have also reported overlapping ADC values between benign and malignant lesions, which may limit the standalone utility of diffusion imaging. Therefore, while ST-RADS significantly improves diagnostic consistency, it should be considered as part of a comprehensive diagnostic approach that includes clinical and histopathological correlation [13,15].

The evaluation of extremity soft tissue tumors remains a complex diagnostic challenge due to their marked heterogeneity and the significant overlap in imaging characteristics between benign and malignant lesions. While MRI has established itself as the cornerstone imaging modality because of its superior soft tissue contrast and multiplanar capability, its diagnostic specificity remains limited when used in an unstructured manner. This limitation is well-documented, with several studies demonstrating that conventional MRI alone cannot reliably distinguish between benign and malignant soft tissue tumors based solely on morphological and signal intensity characteristics [16,17].

The introduction of structured reporting systems such as ST-RADS represents a significant advancement in addressing these limitations. By integrating multiple imaging features into a standardized classification system, ST-RADS reduces subjectivity and enhances consistency in image interpretation. This structured approach aligns with similar successful frameworks in other radiological subspecialties and reflects a broader shift toward standardized, evidence-based reporting in radiology. The ability of ST-RADS to stratify lesions according to malignancy risk provides clinically meaningful guidance, particularly in determining the need for biopsy, follow-up, or surgical intervention [11,16].

One of the key strengths of ST-RADS is its incorporation of both conventional and advanced MRI parameters. Traditional features such as lesion size, depth, and heterogeneity are complemented by functional imaging techniques, including diffusion-weighted imaging and dynamic contrast-enhanced

MRI. This multimodal integration allows for a more comprehensive assessment of tumor biology, including cellularity and vascularity, which are critical factors in distinguishing malignant from benign lesions. Studies have shown that combining these parameters improves diagnostic accuracy compared to relying on individual imaging features alone [13,18].

Another important advantage of ST-RADS is its demonstrated interobserver reliability. Variability in radiological interpretation has long been a concern in musculoskeletal imaging, particularly in the evaluation of soft tissue tumors. The structured nature of ST-RADS provides clear criteria for lesion assessment, which reduces ambiguity and improves agreement among radiologists with different levels of expertise. This reproducibility is essential for ensuring consistent patient management and facilitating multidisciplinary communication, especially in oncologic settings where treatment decisions depend heavily on imaging findings [11,12].

Despite these benefits, several limitations must be considered. Overlap in imaging characteristics remains an inherent challenge, particularly in low-grade sarcomas and certain benign lesions that may mimic malignancy on MRI. Additionally, the interpretation of advanced imaging techniques such as DWI and DCE-MRI may be influenced by technical factors, including acquisition protocols and equipment variability. These factors can affect quantitative measurements such as ADC values and enhancement kinetics, potentially limiting reproducibility across institutions [13,15].

Furthermore, while ST-RADS provides a structured framework, it does not replace the need for clinical correlation and histopathological confirmation. Imaging findings must always be interpreted in the context of patient history, clinical examination, and, when indicated, biopsy results. The role of ST-RADS should therefore be viewed as complementary, enhancing diagnostic confidence rather than serving as a standalone diagnostic tool [16].

Future directions in the evaluation of soft tissue tumors may include further refinement of ST-RADS through large-scale multicenter validation studies and integration with emerging technologies such as artificial intelligence and radiomics. These advancements have the potential to further improve diagnostic accuracy, automate lesion characterization, and provide quantitative risk stratification, thereby enhancing the overall utility of MRI in musculoskeletal oncology [18].

In summary, ST-RADS represents a meaningful step toward standardized, reliable, and clinically relevant MRI reporting in extremity soft tissue tumors. While it significantly improves diagnostic consistency and accuracy, ongoing validation and technological integration are essential to fully realize its potential in clinical practice.

Table (1): Tumor imaging

Classification	Category	Management	Likelihood of malignancy
ST-RADS 0	Incomplete imaging	Recall for additional imaging and/or await prior examinations.	N/A
ST-RADS I	No lesion identified	No further imaging follow-up	Essentially 0%
ST-RADS II	Definitely benign	Follow-up as per clinical team recommendations	Essentially 0%
ST-RADS III	Probably benign	Follow-up in 3 months, six months, one year, and two years or <2years/ shorter-term follow-up if the lesion resolves or significantly regresses	Less than or equal to 2%
ST-RADS IV	Suspicious for malignancy or indeterminate	Tissue diagnosis or follow-up in 4-6 weeks interval, and regular interval follow-up for upto 2years	More than 2% and less than 50%
ST-RADS V	Highly suggestive of malignancy	Tissue diagnosis	More than or equal to 50%
ST-RADS VI	Known biopsy-proven malignancy or recurrent malignancy in the tumor bed	Surgical excision or further treatment as clinically appropriate	N/A

Table (2): Spectrum of commonly encountered histologies in various categories of ST-RADS

Classification	Adipocytic tumors	T2 hyperintense lesions	T2 hypointense lesions
STRAD 0	Incomplete imaging	Incomplete imaging	Incomplete imaging
STRAD I	No identified lesions	No identified lesions	No identified lesions
STRAD II	• Lipomatosis • Lipoma • Fibrolipoma of nerve • Dermatolipoma • Fat necrosis • Hematoma • Hemangioma • Lymphedema • Lipoma arborescence • Elastofibroma	• Geyser • Parameniscal cyst • Heamangioma • Paralabral cyst • Venous malformation • Degloving lesion • Ganglion cyst	• Planter fibroma • Gout
STRAD III	• Lipoblastoma • Angiolipoma • Myolipoma of soft tissue • Chondroid lipoma • Spindle cell/pleomorphic lipoma	• Myxoma • Buristis (Rheumatoid subtendinous/adventitial) • Hematoma • Intraneural ganglion • Seroma • Benign PNST • Cysticerosis • Mycobacterial TS • Abscess • Desmoid	• Desmoid • TSGCT • Desmoplastic fibroblastoma • Ossifying fibromyxoid tumor • Pilomatricoma • Fibroma of tendon sheath • Granular cell tumor
STRAD IV	• Atypical lipomatous tumor • Well differentiated liposarcoma	• Cellular fibromatosis	
STRAD V	• Dediffrentiated liposarcoma	• Sarcoma • Synovial sarcoma • Myxoid liposarcoma	• Undifferentiated pleomorphic liposarcoma • Extraskeletal osteosarcoma

			• Synovial sarcoma • Fibrosarcoma epithelioid • Myxofibrosarcoma • Fibromyxoid sarcoma • Sarcoma NOS

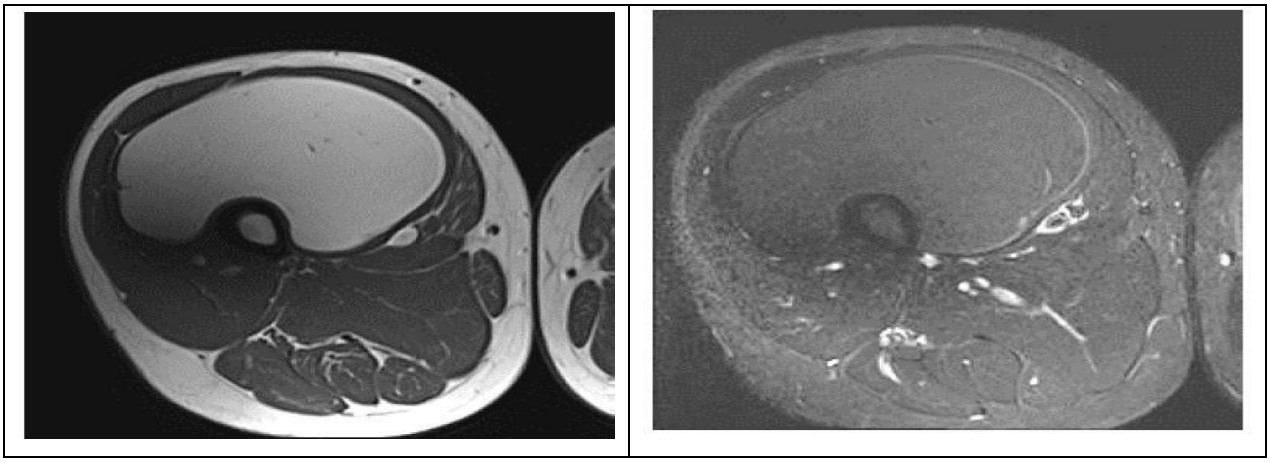

Figure (1): ST-RADS II-Axial T1W image and a fat suppressed image show a well-defined T1- hyperintense homogenous anterior thigh mass completely suppressed on fat- saturated images with no enhancement, with a pathological diagnosis of simple lipoma. All readers classified this lesion as ST- RADS II.

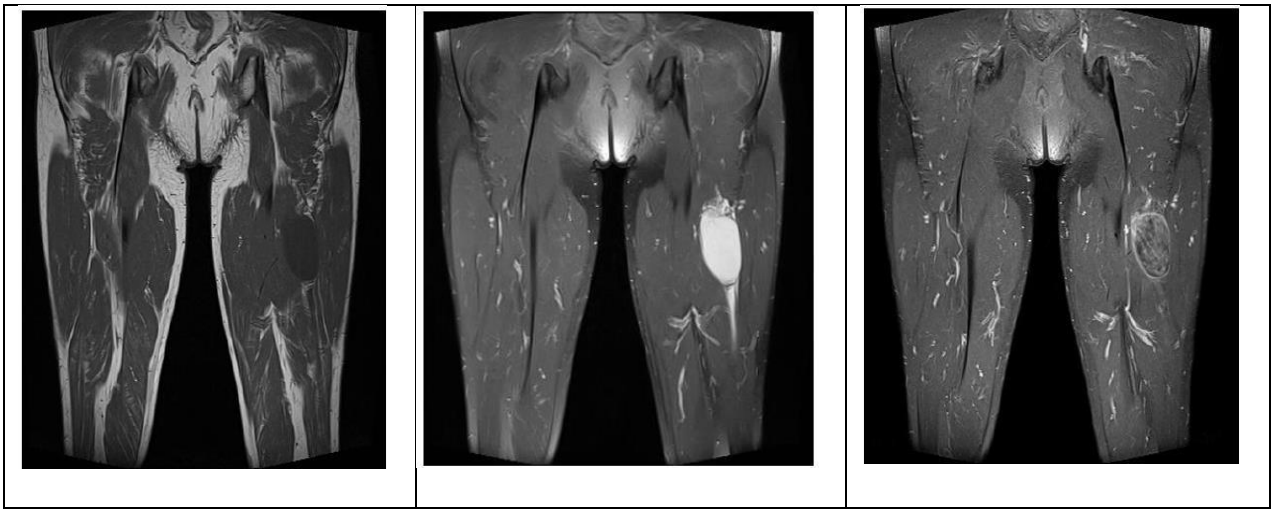

Figure (2): ST-RADS III-Coronal T1W image, fat suppressed T2W image and post contrast T1W image show a well-defined T1- hypointense, T2-hyperintense thigh mass with heterogeneous enhancement in intramuscular location, with pathological diagnosis of myxoma. Different readers classified this lesion as ST-RADS II, III, and IV.

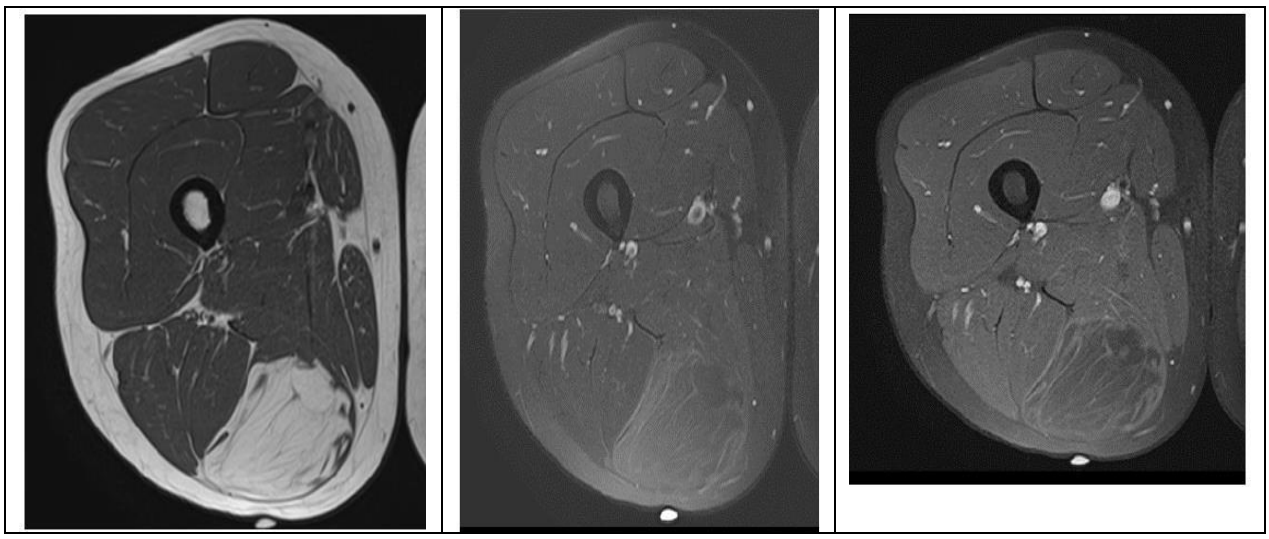

Figure (3): ST-RADS IV-Axial T1W image, fat suppressed T2W image and post contrast T1WI show a well-defined mildly heterogeneously T1-hyperintense mass with multiple septations, with incomplete signal suppression on fat saturation and mild enhancement of the internal septations, with pathological diagnosis of atypical lipomatous tumor. The readers classified this lesion as ST-RADS IV and V.

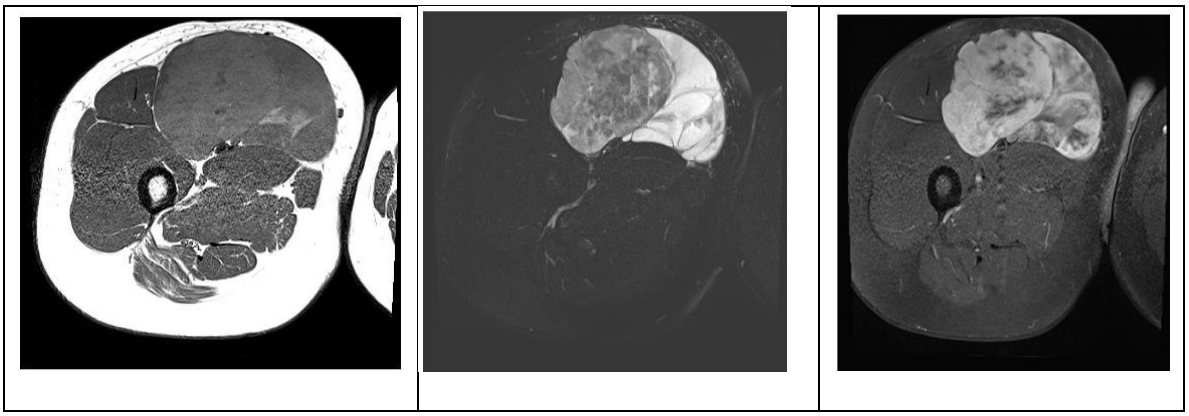

Figure (4): ST-RADS -Axial T1W image, fat suppressed T2W image and post contrast image show a heterogeneous anterior thigh mass with small T1-hyperintense fat component, predominantly T2-hyperintense heterogeneous signal with heterogeneous enhancement, with pathological diagnosis of myxoid liposarcoma. All readers classified this lesion as ST-RADS V.

Conclusion

The MRI-based evaluation of extremity soft tissue tumors remains essential for accurate lesion characterization, staging, and management planning; however, conventional MRI interpretation is limited by overlap in imaging features and interobserver variability. The introduction of the Soft Tissue Tumor Reporting and Data System (ST-RADS) represents a significant advancement by providing a structured, standardized framework that integrates key morphological and functional imaging features into a reproducible classification system. Current evidence indicates that ST-RADS improves diagnostic accuracy, enhances interobserver reliability, and facilitates more consistent communication in multidisciplinary care. Despite these advantages, limitations such as imaging overlap and variability in advanced MRI techniques persist, necessitating continued reliance on clinical and histopathological

correlation. Overall, ST-RADS holds substantial promise in optimizing MRI reporting and improving clinical decision-making in extremity soft tissue tumors, with further validation and refinement expected to enhance its role in routine radiological practice.

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