

Retrospective Review of the Adequacy of Community Magnetic Resonance Imaging (MRI) for Soft Tissue Sarcoma in the Periphery

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INTRODUCTION: Soft tissue sarcomas occur in approximately 11,280 patients per year in the United States (1). Many community-based physicians may be unaware of the appropriate magnetic resonance imaging (MRI) evaluation of a suspected soft tissue neoplasm. While MRI protocols are variable across different imaging sites, several important principles should be applied in the evaluation of musculoskeletal neoplasms. Multi-weighted (T1-w, T2-w, and fat suppressed) and multi-planar (axial, sagittal, and coronal) contrast-enhanced MR imaging should be utilized to improve diagnostic accuracy and predict resectability during preoperative planning (2-4). Contrast-enhanced imaging is imperative as myxoid neoplasms (i.e. myxoid liposarcoma) may mimic simple cystic lesions (i.e. ganglion cyst) on T2-w imaging if intravenous contrast is not administered (4, 5). The entire muscular compartment must be imaged to accurately determine local extent of disease and define the reactive zone which may harbor microscopic cancer cells (5). Failure to adhere to these basic principles may result in inadequate MRIs requiring repeat imaging leading to delays in diagnosis, delays in treatment, and increased costs. The objective of our study was to evaluate pre-referral MRIs of patients with subsequently proven soft tissue sarcomas of the extremity to determine frequency of inadequate imaging and frequency of repeat imaging. We also sought to determine which type of physician ordered the examination and define reasons the MRIs were deemed inadequate.

METHODS: A retrospective chart review was performed from a patient list created from the Moffitt Cancer Center (MCC) cancer registry. All new patients referred to MCC between 12/9/2012 - 12/9/2014 with a soft tissue mass of the extremity (including the outer pelvis and scapular area) subsequently proven to represent sarcoma who presented with an outside pre-referral MRI were identified. Exclusion criteria included: patients with known metastatic disease; patients in surveillance for previously diagnosed sarcoma; and patients who did not complete care at MCC. Patient medical records and pre-referral MRIs were reviewed to determine, based on specific criteria, whether or not an outside MRI was adequate. Criteria included: complete muscle compartment visualization including "joint-to-joint" imaging; multi-weighted imaging including a combination of T1-weighting, T2-weighting or short tau inversion recovery (STIR) imaging, fat-suppression, and IV contrast-enhanced imaging; and multi-planar imaging in at least two planes. We also sought to identify reasons for or against obtaining repeat imaging through chart review.

RESULTS: We identified 193 patients from the registry, of which 90 had pre-referral MRIs prior to presentation at Moffitt Cancer Center. There were 38 females and 52 males with an average age of 64.0 years. Of these, only 10% (N=9) were deemed adequate per our specific imaging criteria. Of the remaining 81 patients with inadequate imaging, 51.8% (N=42) had repeat MRI performed; 48.2% (N=39) did not as the treatment plan (biopsy, chemotherapy, radiation therapy or surgery) would not have been significantly altered. The reasons for repeat imaging in 42 patients included incomplete compartmental imaging, lack of intravenous contrast, incomplete orthogonal imaging, and incomplete visualization of the mass or reactive zone. The most common reasons for repeat imaging were incomplete compartmental imaging (N=38) and/or lack of intravenous contrast (N=18); these were not mutually exclusive as several studies had more than one reason for being repeated. Twenty-three pre-referral MRIs did not include contrast-enhanced imaging (of which, 18 were repeated as above); 26.1% (N=6) were ordered by orthopaedic surgeons.

Findings lacking on inadequate pre-referral MRIs				
Inadequate MRIs (N=81)	IV Contrast	Entire Muscle Compartment	Orthogonal Imaging	Part of Mass or Reactive Zone
Number of MRIs	23	74	15	2
Percentage of MRI	28.4%	91.3%	18.5%	2.4%

Specialty of physician ordering pre-referral MRI which did not include IV contrast						
Orthopaedic Surgery	Surgery Other	PCP	ED	Medical Oncologist	Radiation Oncologist	Hospitalist
6	6	5	1	2	1	2

CONCLUSION: Pre-referral MRIs from community-based imaging centers requested by orthopaedists and primary care providers are often deemed inadequate for evaluation of soft tissue masses due to incomplete compartmental coverage and lack of intravenous contrast. Repeat MRIs at specialized centers subject the patient and health care system to additional time and monetary expense, but are often necessary for treatment/surgical planning. At the same time, these additional examinations can be denied by insurance companies. As such, it is a shared responsibility of ordering physicians and imaging centers to initially request and perform adequate diagnostic imaging in cases of suspected soft tissue neoplasms and obviate repeat imaging. While further education of community health care providers and radiologists would be helpful, standardized imaging protocols could be established to appropriately evaluate soft tissue neoplasms.