American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Soft Tissue Masses**

Variant 1: **First study to order.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray area of interest	9	Necessary. Bone and soft tissue features assist in selecting second study.	NS
CT area of interest	1	Not first study.	NS
US area of interest	1	Not first study.	None
NUC bone scan targeted	1	Not first study.	Med
INV arthrography area of interest	1	Invasive, only useful for communicating cyst.	IP
MRI area of interest	1	Not indicated as first study, most often second study.	None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: **Radiograph negative.**

Radiologic Procedure	Rating	Comments	RRL*
MRI area of interest without contrast	9	Start without contrast. If mass indeterminate for malignancy, use contrast.	None
MRI area of interest without and with contrast	9	Start without contrast. If mass indeterminate for malignancy, use contrast.	None
US area of interest	7	With proper expertise, may be appropriate.	None
CT area of interest with contrast	4	May be useful if MRI is contraindicated.	NS
NUC bone scan targeted	1		Med
CT area of interest without contrast	1		NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition: **Soft Tissue Masses**

Variant 3: **Radiograph calcified soft tissue mass.**

Radiologic Procedure	Rating	Comments	RRL*
MRI area of interest without contrast	9	If not demonstrated by CT to be myositis ossificans.	None
CT area of interest without contrast	9	If myositis ossificans is suspected.	NS
MRI area of interest without and with contrast	9	If not demonstrated by CT to be myositis ossificans.	None
CT area of interest with contrast	4	If not myositis ossificans and MRI contraindicated.	NS
NUC bone scan targeted	1		Med
US area of interest	1		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Variant 4: **Superficial or near joint with or without radiographic abnormalities.**

Radiologic Procedure	Rating	Comments	RRL*
MRI area of interest without contrast	9	Start without contrast. If mass indeterminate for malignancy, use contrast.	None
MRI area of interest without and with contrast	9	Start without contrast. If mass indeterminate for malignancy, use contrast.	None
US area of interest	7	With proper expertise, could substitute for MRI. Especially if ganglion is suspected, particularly in the wrist.	None
CT area of interest with contrast	4	May be useful if MRI is contraindicated.	NS
NUC bone scan targeted	1		Med
INV arthrography area of interest	1		IP
CT area of interest without contrast	1		NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Clinical Condition: **Soft Tissue Masses**

Variant 5: **Abdominal or chest wall.**

Radiologic Procedure	Rating	Comments	RRL*
CT area of interest with contrast	9		NS
X-ray area of interest	9	Localization, calcification, etc., important for selecting additional studies.	NS
MRI area of interest without contrast	7	May be limited due to motion artifact.	None
MRI area of interest without and with contrast	7	May be limited due to motion artifact.	None
NUC bone scan targeted	4	If expertise available. Depends on the specific question to be answered.	Med
CT area of interest without contrast	4	May be indicated in specific situations such as hernia.	NS
US area of interest	1		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

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Summary of Literature Review

Imaging techniques for patients with suspected soft tissue masses may be requested because of a painful or painless soft tissue abnormality palpated by the patient or physician or because of symptoms such as pain or other complaints with no detectable mass on physical examination. The type of imaging technique initially selected varies depending on the history and physical findings as well as the suspected location of the lesion. It is well known that biopsy of a presumed soft tissue mass without an imaging work-up is inadvisable for a number of reasons.

There has been tremendous progress in imaging evaluation of soft tissue masses over the years. Routine radiographs still play an important role in identifying certain features that may either allow the diagnosis to be established or indicate which procedure might be most appropriate for further evaluation. Computed tomography (CT) and ultrasound (US) greatly improve the ability to detect and, in some cases, characterize the nature of soft tissue masses. With the advent of magnetic resonance imaging (MRI), lesion detection, differentiation of normal anatomic variants from true lesions, and characterization of lesions has improved because of its superior soft tissue contrast and multiple-image plane capabilities [1-4].

Routine radiography is an important first technique for evaluating patients with suspected soft tissue abnormality, especially those that are deep and nonpalpable. Certain features on the routine radiograph may provide valuable insight into the most appropriate additional studies that may be required. For example, well-defined lucency in the soft tissues may indicate a lipoma that could be evaluated with either CT or MRI. Patients with subtle bone change or soft tissue calcification may be more appropriately studied with CT, because lesion characterization may be improved with this imaging technique [4-6]. Also, lesions arising from bone (ie, osteochondroma or soft tissue component of a bone tumor) can present as deep soft tissue masses clinically.

US is not frequently used for evaluating soft tissue masses at most institutions. This technique is valuable in differentiating cystic from solid lesions and has also been used to study vascularity of lesions [5,7,8]. For soft tissue prominence at a joint, US may offer a specific diagnosis (eg, ganglion cyst, paralabral or parameniscal cyst). However, US is not as useful for characterizing pathology or defining the extent of true soft tissue masses [9].

Since the introduction of MRI, CT has largely been replaced as the technique of choice for evaluating soft tissue masses. However, in some cases, CT may still be appropriate for evaluating soft tissue lesions. Situations such as suspected lipoma, calcification in soft tissue lesions seen on routine radiographs, or suspected myositis ossificans based on clinical or radiographic data might be better evaluated with CT. Lipomas are easily characterized on both CT and MRI [4,6]. In addition, patient size or location of lesion may dictate that CT would be the preferred technique. Such locations include the abdominal or chest wall, where motion artifact can create suboptimal imaging with MRI [4,10]. A report of the Radiology Diagnostic Oncology Group on 133 soft tissue tumors suggested that MRI and contrast-enhanced CT are comparable with reference to determining tumor size and involvement of surrounding structures [11].

MRI has become the technique of choice for detecting and characterizing soft tissue masses. Its improved soft tissue contrast and multiple-image plane capabilities have provided significant advantages for lesion conspicuity, characterization, and determining the extent of involvement [2-4,10,12-14]. Vascular structures can also be more easily identified and evaluated without the need for intravenous contrast agents [4]. Vascular structures and neurovascular involvement are more easily defined in 20% of cases compared with CT [4]. Cortical bone involvement by soft tissue masses can be identified equally by both CT and MRI [2,4,10,11]. However, the extent of marrow involvement can be difficult to determine by CT, and there is evidence that tumor infiltration can extend beyond the apparent margin of the mass [15].

Though lesions are more easily detected with MRI, its ability to differentiate benign from malignant lesions remains controversial. Numerous studies have evaluated

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MR imaging features of soft tissue lesions [1,11,14-23]. Reports discussing correct histologic diagnosis or differentiating benign from malignant lesions describe accuracy ranges from 24%-90%. Though imperfect, the superior soft tissue contrast provided by T2-weighted MR images provides features that are useful for characterizing lesions. Malignant lesions are heterogeneous (72%-94%), larger (90% > 33 mm), and more frequently involve bone and neurovascular structures [2,10,14]. The pattern of gadolinium enhancement may help identify some lesions as malignant, such as myxoid liposarcoma, and has shown utility in evaluating aggressiveness of vascular and lipomatous masses [18,19].

Contrast is useful for identifying cystic and necrotic components of soft tissue masses, helping to characterize lesions and identifying solid areas for biopsy. Dynamic gadolinium enhancement characteristics may be useful, but there is overlap between benign and malignant lesions [20,21]. Advanced MRI techniques such as spectroscopy and diffusion-weighted imaging have potential for differentiating benign from malignant lesions but need more refinement [6,22-24]. Even when MRI cannot characterize the type of lesion, it remains very useful for percutaneous biopsy and surgical planning.

Radionuclide studies are not indicated in most situations for evaluation of soft tissue masses. Techniques such as PET scanning have been used mainly for evaluating metastatic disease and follow-up of treated lesions.

Arthrography or invasive techniques are also rarely indicated, if at all, for evaluating soft tissue masses. Popliteal cysts or communicating cystic lesions can be identified by introducing contrast material into the joints. However, this is not a well accepted and is rarely performed today. With few exceptions, such as AV malformations or hemangiomas, angiography is also not frequently performed for the detection or staging of soft tissue lesions [5].

Anticipated Exceptions

As a general rule, MRI is the technique of choice for evaluating patients with suspected soft tissue masses [2,10,12,14]. There are some exceptions where other techniques may be of equal or greater value. CT may be of greater value in patients who demonstrate subtle cortical bone evolvement or soft tissue calcifications on routine radiographs. Patient size, patients with certain metallic or electrical implants, claustrophobic patients, and patients who are unable to remain motionless (because of pain, Parkinson's disease, etc.) for the length of an MRI examination may have to be studied with an alternate technique. CT would be selected in most situations.

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