Soft Tissue Tumors

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5/21/15

- Introduction
- Utility of MR in differentiating benign vs malignant masses
- MR protocol and reporting
- WHO classification of soft tissue tumors
- Imaging features of soft tissue masses with distinct characteristics

- Imaging provides limited ability to reliably distinguish between benign and malignant soft tissue lesions
- Primary goal of imaging is to confirm presence of mass and assess extent in preparation of possible treatment
- In some cases, clinical and imaging information can narrow differential diagnosis
  - Clinical history
  - Lesion location
  - Mineralization on radiograph
  - Signal intensity characteristics on MR

Spectrum of Soft Tissue Lesions

- Histological classified on basis of soft-tissue component that comprise the lesion
  - Fat
  - Skeletal muscle
  - Peripheral nerves
  - Blood vessels
  - Fibrous tissue

Clinical History

- Age
- History of trauma – hematoma, myositis ossificans
- Anticoagulants
- Pain – inflammatory process
- Change in size – rapid growth from malignancy or hemorrhage of benign mass
- Fluctuation in size – engorged with blood or fluid (hemangioma, ganglia)
- h/o malignancy – soft tissue metastasis or radiation induced sarcoma
- Number of lesions – metastatic disease, syndromes

Location

- Certain masses occur in specific locations
  - Elastofibroma: inferomedial scapular border, bilateral
  - Interdigital neuroma: teardrop shaped mass in interspace of foot
  - Plantar fibromas, glomus tumors, popliteal cyst
- Masses arising from specific structure
  - Nerves
  - Vessels
  - Tendons

Radiographs

- Distortion of soft tissue planes
- Radiolucent masses
- Indolent or aggressive remodeling of bone
- Foreign bodies
- Soft tissue calcifications or ossifications
  - Mature ossification (can look like aggressive sarcoma on MR)
  - Hazy calcification, gouty tophus
  - Nonspecific dystrophic calcifications in lower extremity in young adult, synovial sarcoma

MR

- Most lesions show nonspecific signal characteristics
- Correct histologic diagnosis reached in only 25-50% of cases
- Some diagnoses can be made based on basis of lesion signal intensity, pattern of growth, location, and associated signs and findings

Benign vs Malignant

- Discrepancy in reliability of MR in distinguishing benign from malignant
- Berquist, et al. suggest that benign vs malignant can be differentiated in >90% cases
  - 95 soft tissue masses (50 benign, 45 malignant) with surgical pathology except post-traumatic hematomas

TABLE 1: Diagnoses of 95 Soft-Tissue Masses

Type of Mass	No. of Patients
Benign	
Cyst	12
Hematoma	9
Lipoma	8
Hemangioma	5
Desmoid	4
Neuroma	4
Abscess	2
Myxoma	2
Thrombosed aneurysm	1
Thrombosed vein	1
Epidermoid	1
Angiolipoma	1
Total	50
Malignant	
Malignant fibrous histiocytoma	17
Liposarcoma	7
Synovial sarcoma	6
Mesenchymal sarcoma	3
Rhabdomyosarcoma	3
Chondrosarcoma (soft tissue)	2
Leiomyosarcoma	2
Neurofibrosarcoma	2
Fibrosarcoma	1
Epithelioid sarcoma	1
Lymphoma	1
Total	45

TABLE 2: MR Features of Soft-Tissue Masses

Feature	No. (%)	
	Malignant (n = 45)	Benign (n = 50)
Size (cm)		
<1	0	1 (2)
1–3	0	10 (20)
3–5	6 (13)	14 (28)
>5	39 (87)	25 (50)
Margin		
Well defined	7 (15)	22 (44)
Partially irregular	13 (29)	20 (40)
Irregular	25 (56)	8 (16)
Signal intensity		
Homogeneous	2 (5)	21 (42)
Majority of mass homogeneous	11 (24)	17 (34)
Inhomogeneous	32 (71)	12 (24)

*involvement of neurovascular structures, hemorrhage, and/or edema around lesions, bone involvement

TABLE 3: Accuracy in Predicting Benign and Malignant Lesions

Observer No.	No. (%) (n = 95)		% of Diagnoses Changed with History
	Accuracy	Exact Histology	
1	85 (90)	15 (16)	13[a]
2	84 (88)	25 (26)	19[a]
3[b]	88 (93)	24 (25)	1

TABLE 4: Observer Performance for Detection of Soft-Tissue Masses

Type of Mass/ Statistical Measure	Observer No.			Average
	1	2	3*	
Benign				
Sensitivity (%)	90	82	90	88
Specificity (%)	90	83	96	90
Positive predictive value (%)	92	95	96	94
Negative predictive value (%)	88	83	90	87
Accuracy (%)	90	88	93	90
Malignant				
Sensitivity (%)	90	96	96	94
Specificity (%)	90	82	96	90
Positive predictive value (%)	88	93	90	87
Negative predictive value (%)	92	95	96	94
Accuracy (%)	90	88	93	90

* Physician experienced in MR imaging.

- Desmoid tumors and necrotic benign neoplasms most commonly classified incorrectly as malignant
- Synovial sarcoma was malignant lesion most commonly misclassified as benign
- Many benign lesions (ganglion cyst, lipoma, hemangioma, neuroma, hematomas) accurately diagnosed on basis of imaging findings alone

- Benign
  - Well marginated
  - Homogeneous signal intensity
  - Do not encase neurovascular structures
- Malignant
  - Irregular margins
  - Inhomogeneous signal intensity
  - More often encase neurovascular structures

- Crim, et al: 83 masses (49 benign and 34 malignant)
- Mean sensitivity 50% for benign lesions, 80% for malignant lesions

Table 2
Benign Masses Called Malignant by One or Both Readers

Diagnosis	No. of Cases
Hemangioma	4
Hematoma	4
Desmoid	4
Benign neural tumor	3
Reactive lymph nodes	2
Lipoma	2
Myxoma	2
Bursitis	2
Abscess	1
Myositis ossificans	1
Arteriovenous malformation	1

Table 3
Malignant Masses Called Benign by One or Both Readers

Diagnosis	No. of Cases
Liposarcoma, grade 1	2
Telangiectatic osteosarcoma	1
Dermatofibrosarcoma protuberans	1

- Tumor margin, signal intensity homogeneity, size, peritumoral high signal intensity, neurovascular bundle encasement, and bone invasion not reliable to differentiate benign vs. malignant

Table 4
Characteristics of Benign and Malignant Masses

Characteristic	No. of Masses*			
	Benign (n = 49)		Malignant (n = 34)	
	Reader 1	Reader 2	Reader 1	Reader 2
Margins				
Smooth	19 (39)	23 (47)	17 (50)	14 (41)
Partially irregular	16 (33)	7 (14)	13 (38)	11 (32)
Irregular	14 (29)	19 (39)	4 (12)	11 (32)
Infiltrative†	11 (22)	4 (8)	6 (18)	6 (18)
Signal intensity				
Homogeneous	11 (22)	15 (31)	1 (3)	3 (9)
Homogeneous, septated	9 (18)	12 (24)	2 (6)	2 (6)
Inhomogeneous	29 (59)	23 (47)	31 (91)	29 (85)
Size (cm)				
<1	0 (0)	0 (0)	0 (0)	0 (0)
<3	2 (4)	2 (4)	2 (6)	2 (6)
3–5	25 (51)	25 (51)	9 (26)	9 (26)
>5	22 (45)	22 (45)	23 (68)	23 (68)
Other				
Peritumoral edema	10 (20)	1 (2)	18 (53)	5 (15)
NVB‡ displaced	3 (6)	0 (0)	2 (6)	3 (9)
NVB encased	5 (10)	2 (4)	3 (9)	3 (9)
Bone involvement	0 (0)	1 (2)	2 (6)	2 (6)

* Numbers in parentheses are percentages.
† A mass could be considered infiltrative in addition to being either partially or fully irregular.
‡ NVB = neurovascular bundle.

- Factors that might explain differences in results in different studies…
  - Differences in patient population
  - Expertise of radiologist
  - Study samples not appropriate for lesion prevalence and differences in characterization and differentiation of malignant vs benign lesions

- Gielen et al
- 548 untreated soft tissue tumors from 58 MRI centers
- Images prospectively reviewed by 2 experienced radiologists (12 and 15 yrs experience)
- Threshold to differentiate b/t benign and malignant based on…
  - Origin, size, shape, margins, SI, signal homogeneity, grade and pattern of enhancement, low SI septations, peritumoral edema, distribution, fluid-fluid levels, signal voids, intra-tumoral necrosis
- Reference standard was histology by biopsy or resection (455) or follow-up in 6 months without clinical or MRI evolution of benign tumors (93)

- 123 malignant STT, 425 benign STT
- MRI reliability in identifying malignancy
  - Sensitivity: 93%, NPV: 98%
  - Specificity: 82%; PPV: 60%
- Exact histology predicted in 50%
  - 38% of malignant cases

Table 7 Diagnostic match between MRI first diagnosis and histology, benign cases

Histological diagnosis	MRI diagnosis	Total number	%
Lipoma	38	51	75
Schwannoma	15	41	37
Hemangioma	21	24	88
Giant cell tumor of tendon sheath	10	17	59
Pigmented villonodular synovitis	9	10	90
Fasciitis, nodular	5	10	50
Desmoid	8	10	80
Neuroma, Morton's	7	9	78
Neurofibroma	5	9	56
Cyst, ganglion	7	8	88
Cyst, synovial	5	8	63
Tumor-like	6	7	86
Endometrioma	3	7	43
Lymphadenitis	5	5	100
Chondromatosis	3	4	75
Neurinoma	1	4	25
Fibromatosis	3	4	75
Cyst, epidermoid	1	4	25
Fibrolipohamartoma	2	3	67
Myositis	4	4	133
Hematoma	5	5	167
Others	18	89	
Total	181	333	54

Table 8 Diagnostic match between MRI (first diagnosis) and histology, malignant cases (MPNST malignant peripheral nerve sheath tumor, NOS not otherwise specified)

APO diagnosis	MRI diagnosis	Total number	%
Liposarcoma	9	19	47
Leiomyosarcoma	1	16	6
Metastasis	5	14	36
Myxofibrosarcoma	2	11	18
Lymphoma	4	10	40
Synovial sarcoma	2	8	25
Rhabdomyosarcoma	2	7	29
Sarcoma, NOS	6	6	100
MPNST	5	5	100
Dermatofibrosarcoma	2	4	50
Chondrosarcoma	2	3	67
Osteosarcoma	1	3	33
Fibrosarcoma	0	3	0
Others	5	13	
Total	46	122	38

Optimizing MRI protocol

- Mark palpable lesion or site of tenderness
- Appropriate coil selection
- FOV
  - At least one sequence should include landmark(palpable or easily identified by intraoperative fluoroscopy) for measurement and surgical planning
- At least one T1-weighted sequence (more if lesion contains fat)
- Fluid sensitive sequences in 2 planes
  - Coronal and sagittal useful to describe shape
- T2-weighted without fat saturation for better evaluation of intensity variation
- STIR fat suppression nonspecific, can cause loss of signal of not only fat but also of other short T1 substances
- Gradient echo for evaluation for hemosiderin deposition
- Gadolinium, pre-contrast T1 fat sat

- Axial T1, T1 FS, PD FS; Coronal T2; Sagittal T2 FS and post contrast Axial and Coronal T1 FS

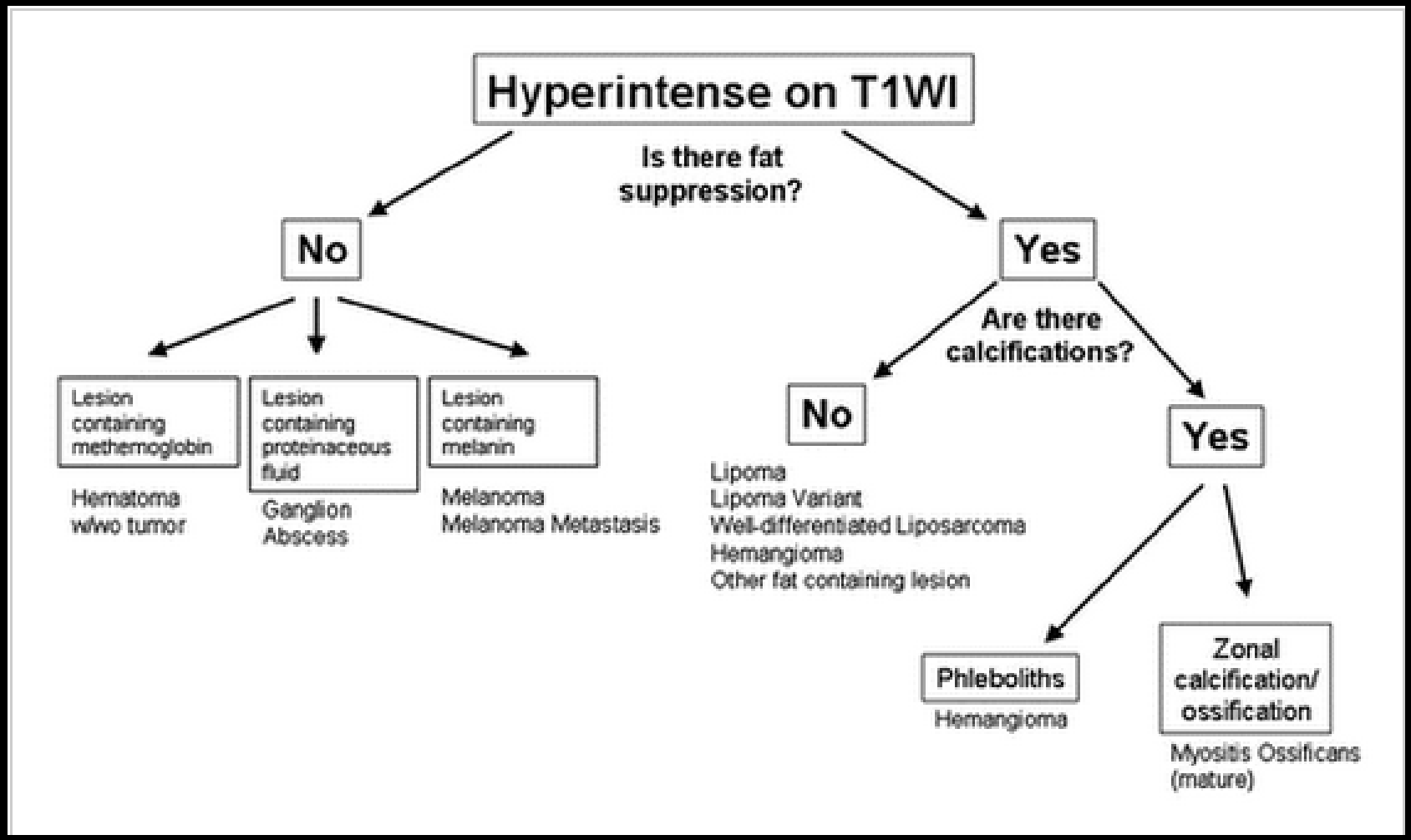
MRI Interpretation

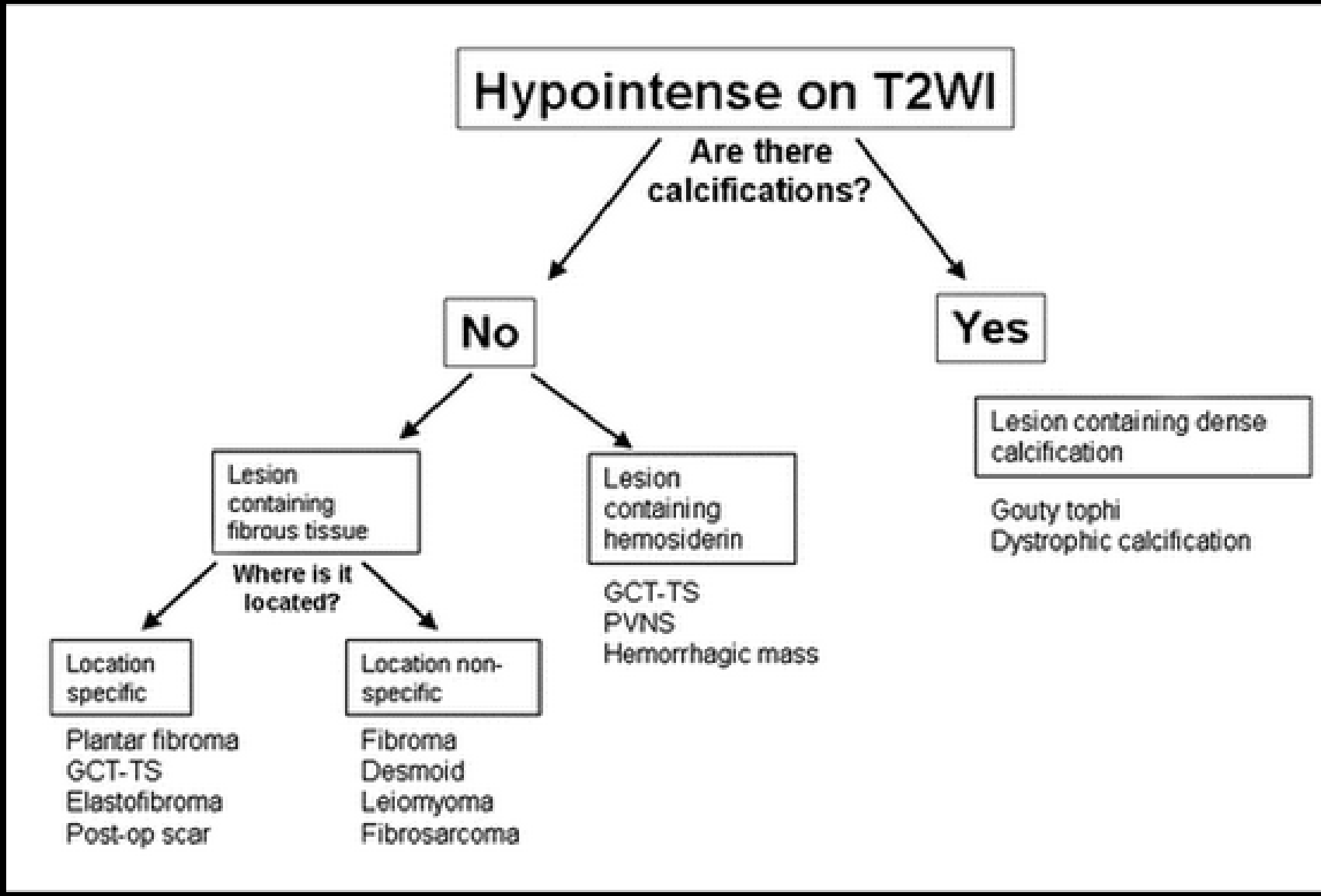
- Maximum transverse, vertical, sagittal dimensions
- Distance of lesion from chosen landmark
- Tissue in which the lesions arises
  - Muscle or fascial plane involved
- Neurovascular involvement
- Bone invasion or periosteal reaction
- Local invasiveness or clear plane or separation or pseudocapsule

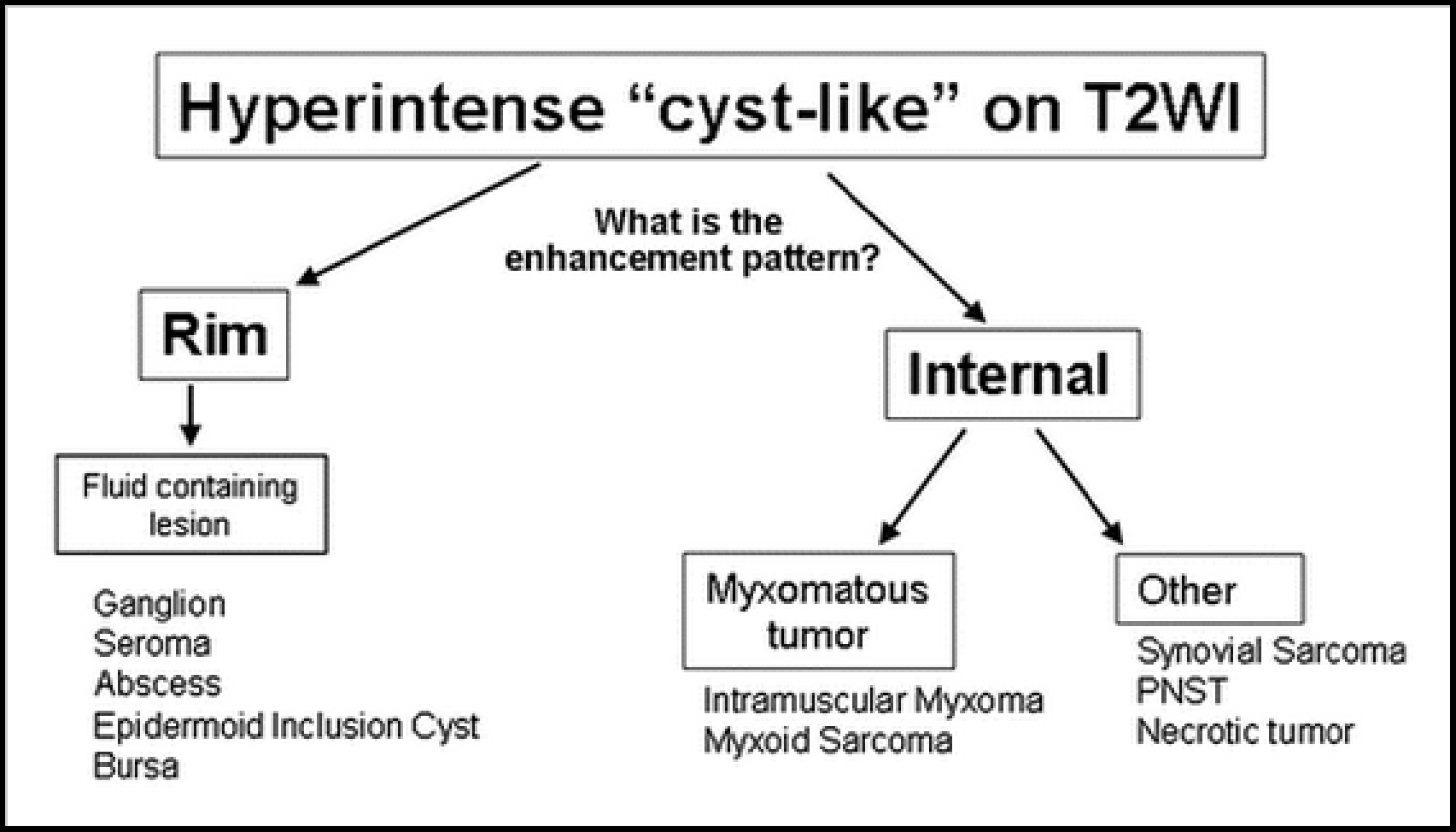
MRI Interpretation

- Describe intrinsic appearance
- SI on T1-weighted imaging related to muscle
- Hyperintense signal on fluid-sensitive images evaluated for homogeneity
- Specific features
  - Fluid levels, focal fluid collections, lobularity, leaking of fluid, prominent feeding vessels
- Describe pattern and degree of contrast enhancement
  - Degree of necrosis
- Biopsy site
  - Confer with surgeon, biopsy track resected along with lesion
  - Most aggressive site, avoid areas of necrosis, hemorrhage, or dystrophic calcifications

Lesion Characterization




Hypointense on T2WI
Are there calcifications?
No
Yes
Lesion containing fibrous tissue
Lesion containing hemosiderin
Lesion containing dense calcification
Gouty tophi
Dystrophic calcification
Where is it located?
GCT-TS
PVNS
Hemorrhagic mass
Location specific
Location non-specific
Plantar fibroma
GCT-TS
Elastofibroma
Post-op scar
Fibroma
Desmoid
Leiomyoma
Fibrosarcoma


Hyperintense "cyst-like" on T2WI
What is the enhancement pattern?
Rim
Internal
Fluid containing lesion
Ganglion
Seroma
Abscess
Epidermoid Inclusion Cyst
Bursa
Myxomatous tumor
Intramuscular Myxoma
Myxoid Sarcoma
Other
Synovial Sarcoma
PNST
Necrotic tumor

WHO Classification of Soft Tissue Tumors -2013

- 12 categories
- Each category divided into 4 biological behavior subgroups
  - Benign
  - Intermediate (locally aggressive)
  - Intermediate (rarely metastasizing)
  - Malignant

WHO Classification of Soft Tissue Tumors

- Adipocytic tumors
- Fibroblastic/myofibroblastic tumors
- So-called Fibrohistiocytic tumors
- Smooth muscle tumors
- Pericytic (perivascular) tumors
- Skeletal muscle tumors
- Vascular tumors
- Chondro-osseous tumors
- Gastrointestinal stromal tumors
- Nerve sheath tumors
- Tumors of uncertain differentiation
- Undifferentiated/unclassified sarcomas

*not included: ganglia/cyst, hematoma/abscess, granuloma, Morton neuroma, anatomical variants

Soft Tissue Tumors with Specific Characterization

- Group 1- Lipomatous tumors
- Group 2- Fibromatosi/Elastofibroma dorsi/Myositis Ossificans
- Groups 3- PVNS, GCTTS
- Group 5- Glomus
- Group 7- Hemangioma
- Group 9- Neurogenic tumors

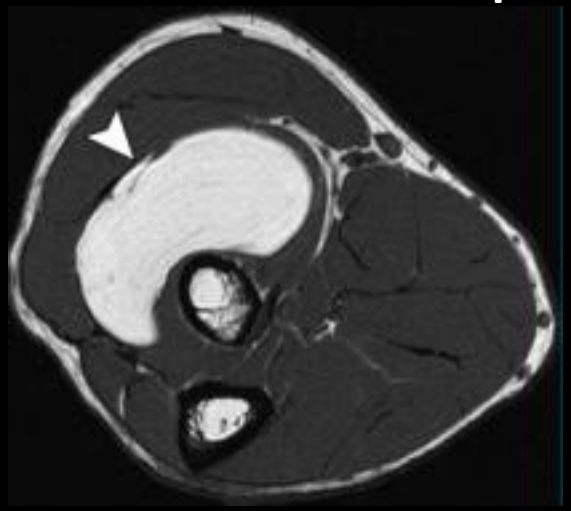
Adipocytic Tumors

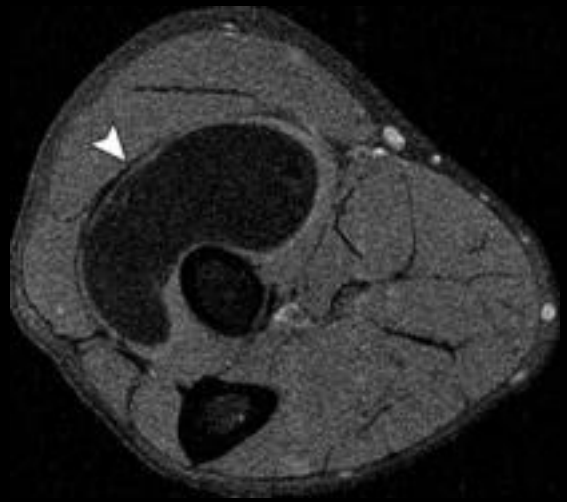
- Benign
  - Lipoma
  - Lipomatosis
  - Lipomatosis of nerve
  - Lipoblastoma/lipoblastomatosis
  - Angiolipoma
  - Myolipoma of soft tissue
  - Chondroid lipoma
  - Spindle cell lipoma/pleomorphic lipoma
  - Hibernoma
- Intermediate (locally aggressive)
  - Atypical lipomatous tumor/well differentiated liposarcoma
- Malignant
  - Dedifferentiated liposarcoma
  - Myxoid liposarcoma
  - Pleomorphic liposarcoma
  - Mixed-type liposarcoma

WHO classification

Lipomas and Lipomatous Lesions

- Most common soft tissue tumor
- 2.1 in 100 individuals
- Histologically identical to adipose fat
- Classic lipoma: entirely fat without nodularity or thickened septations





Lipoma vs. well-differentiated liposarcoma

- 60 patient: 35 lipomas, 25 well-differentiated liposarcoma

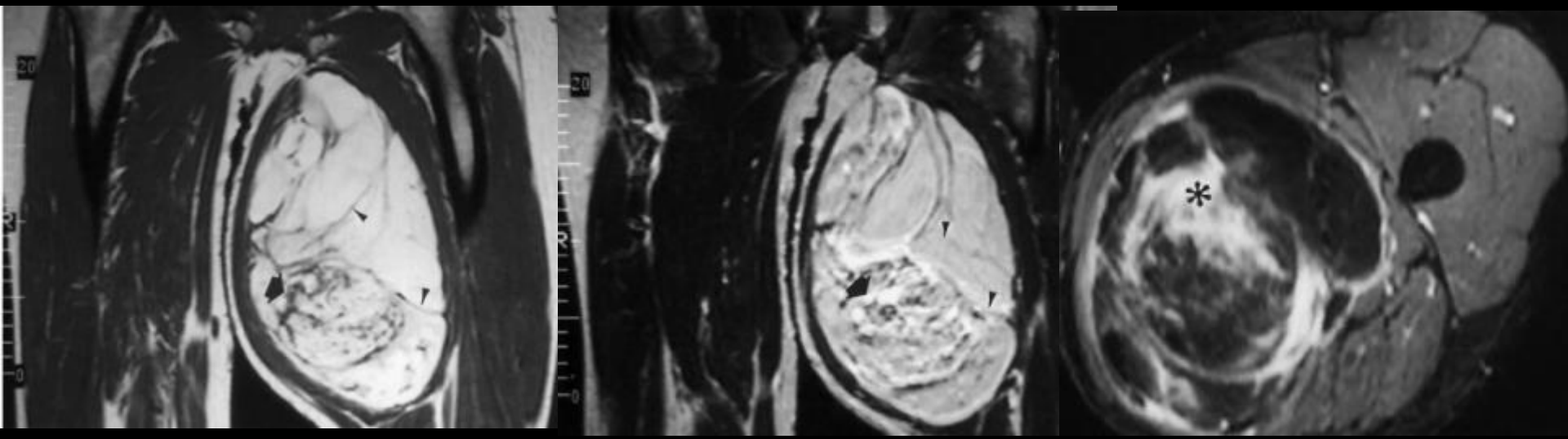
TABLE 2
Imaging Features

Feature	Lipoma (n = 35)	Liposarcoma (n = 25)	P Value*
Percentage fat†			<.001
Mean	1.2	2.6	
Median	1	2	
Range	0–4	1–4	
Calcification‡	3 (11%)	6 (32%)	
Greatest size (cm)			<.001
Mean	12.5	23.5	
Median	10	24	
Range	3–25	9–47	
Thin septa§			.11
Mean	1.1	1.4	
Median	1	2	
Range	0–2	0–3	
Thick septa§			.001
Mean	0.5	1.8	
Median	0	2	
Range	0–3	0–3	
Nodular and/or globular§			.003
Mean	0.4	1.3	
Median	0	1	
Range	0–3	0–3	
Mass‖	2 (6%)	10 (40%)	.001

TABLE 3
Odds Ratios for Features Favoring a Diagnosis of Liposarcoma versus Lipoma in 60 Patients

Feature	Odds Ratio	95% CI
Patient age > 60 years (vs age < 60 years)	6.0	0.8–19.7
Male (vs female)	3.0	1.0–8.7
Lesion size > 10 cm (vs size < 10 cm)	14.2	1.7–117.5
Lesion size > 20 cm (vs size < 20 cm)	5.1	1.7–15.6
Percentage fat < 75% (vs > 75%)	8.3	2.0–33.3
Thick septa (vs not present)	4.9	2.3–10.7
Thin septa (vs not present)	1.8	0.9–3.6
Nodular and/or globular area	2.3	1.3–4.1
Associated nonadipose mass	11.0	2.1–56.5
Lesion location in leg or thigh (vs other location)	2.1	0.6–7.0

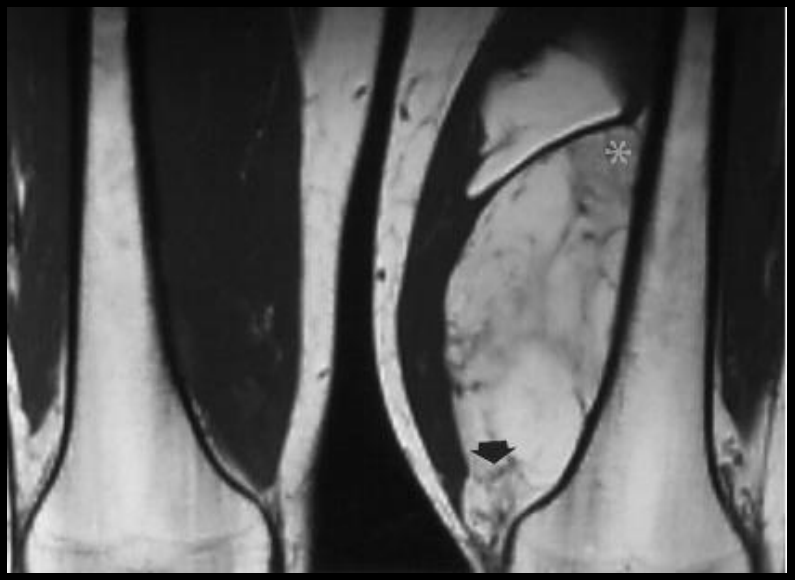
- 18 lesions had areas of increased signal intensity on fluid sensitive MR, 7 (39%) were benign

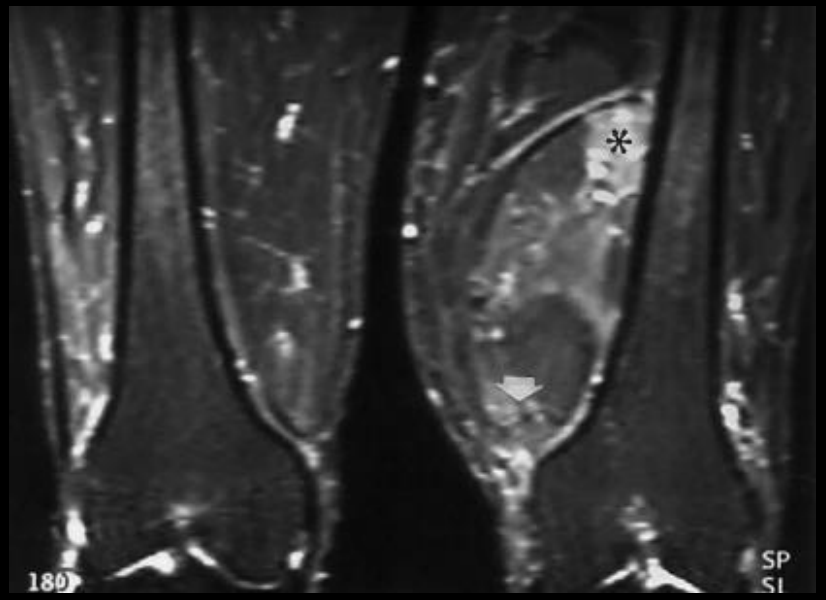


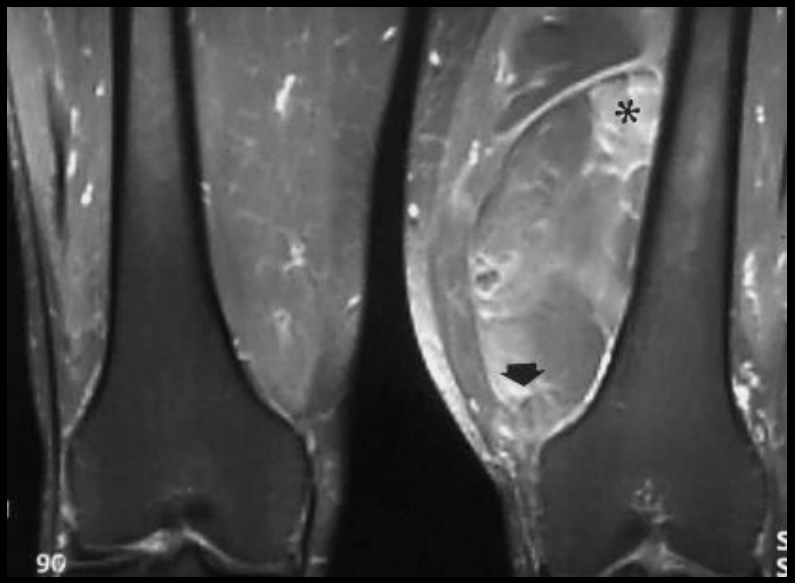
48 y/o M with lipoma in posterior compartment of thigh

Lipoma

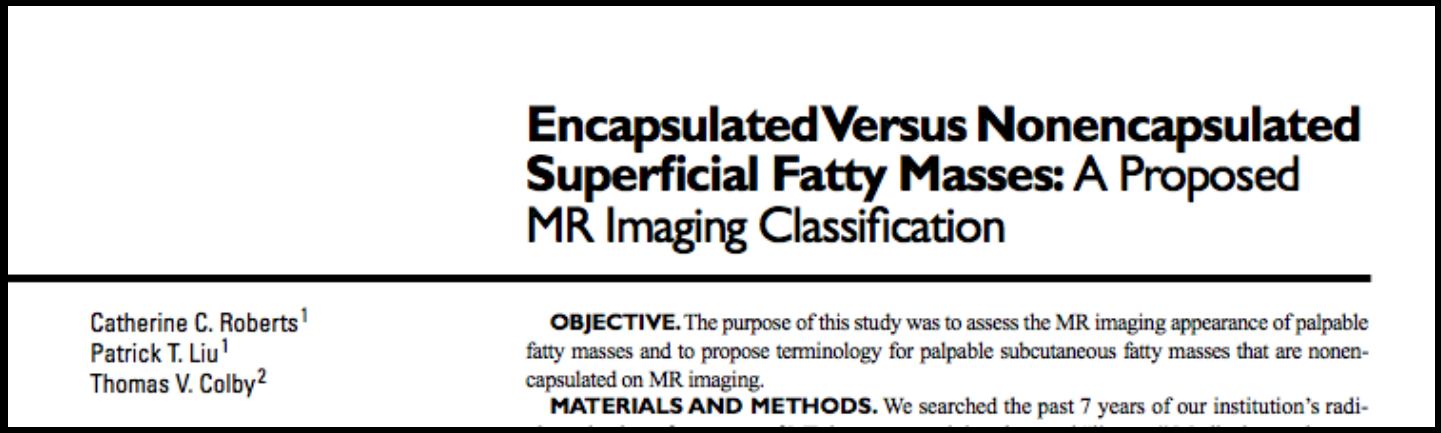
- 11 of 35 lipomas (31%) had significant nonadipose content
- Nonadipose content typically fat necrosis with associated calcification, fibrosis, inflammation, and areas of myxoid change
- 8 contrast enhanced studies available
  - 1 lipoma showed no enhancement while 3 showed mild linear enhancement
  - 4 liposarcomas showed mild to moderate enhancement







74 y/o M with liposarcoma in thigh



Encapsulated Versus Nonencapsulated Superficial Fatty Masses: A Proposed MR Imaging Classification

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Patrick T. Liu[1]
Thomas V. Colby[2]

OBJECTIVE. The purpose of this study was to assess the MR imaging appearance of palpable fatty masses and to propose terminology for palpable subcutaneous fatty masses that are nonencapsulated on MR imaging.

MATERIALS AND METHODS. We searched the past 7 years of our institution's radi-

184 palpable subcutaneous fatty masses evaluated on MR
-all masses localized with skin markers on images, MR reported stated that patient examined by radiologists and location of mass palpable, or exact location of recorded in medical record
-85 (46%) classified as partially or completely encapsulated
-99 (54%) classified as nonencapsulated
-no histologic analysis to determine if nonencapsulated masses differ from normal fat (fatty hypertrophy, asymmetric fatty deposition, or areas of fat surrounded by fibrosis)
-report as "nonencapsulated lipoma" instead of normal to avoid additional imaging

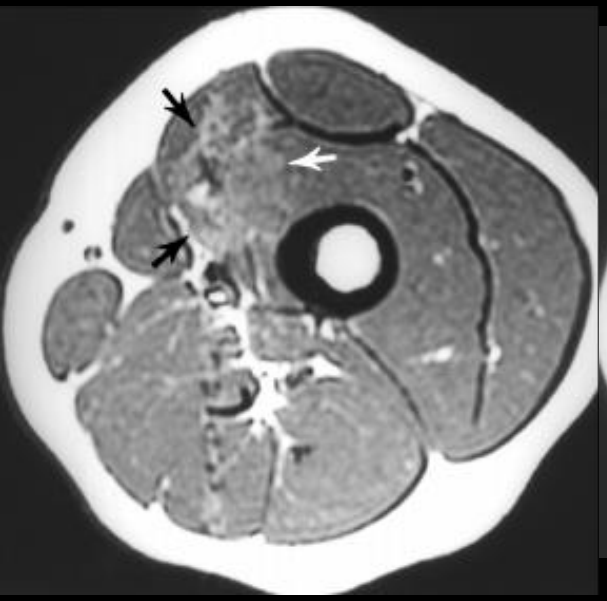
Hemangiomas

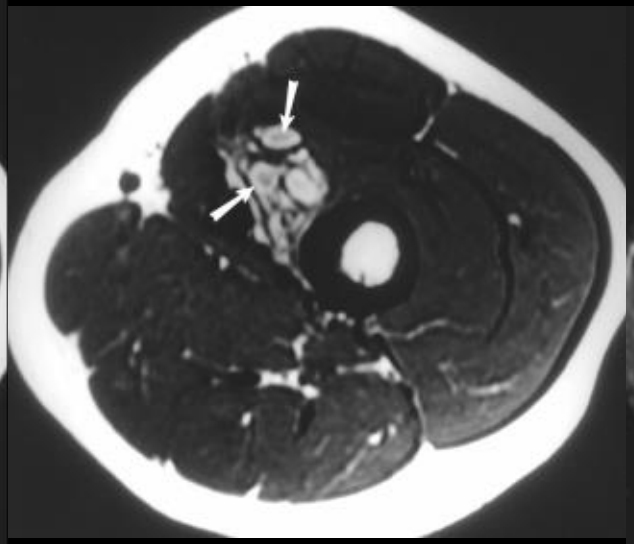
- Benign vascular lesions composed of various vessels, 7% of all benign soft tissue tumors
- Can be found in any organ
- Common in infancy and childhood but can occur in any age group
- Can manifest as bluish skin discoloration and history of size fluctuation
- Pain may occur following exercise owing to shunting of blood away from surrounding tissue

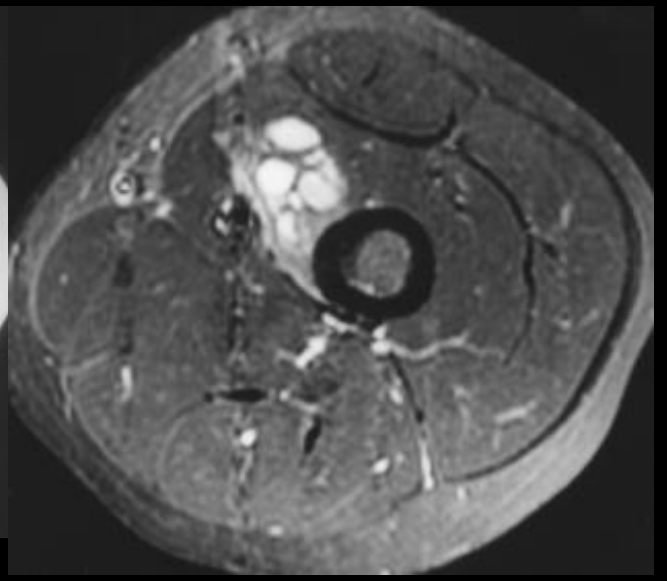
- Phleboliths on radiographs in 20-67% patients
- On MR, may be well-circumscribed or have poorly defined margins with varying amounts of T1 signal owing to either reactive fat overgrowth or hemorrhage
- Contain serpentine vessels, fat, smooth muscles, hemosiderin, and phleboliths
- Areas of slow flow have high T2 signal, rapid flow demonstrate flow void

Soft Tissue Hemangioma vs. Malignant Soft Tissue Masses

- Teo et al
- 22 peripheral hemangiomas and 22 primary malignant soft tissue masses (MFH, rhabdomyosarcoma, neurofibrosarcoma, primitive neuroectodermal tumors, 6 others)
- T1-weighted imaging
  - No reliable distinguishing feature
- T2-weighted imaging
  - Lobulation, septation, central low-intensity dots more frequently seen in hemangiomas, masses with all three were exclusively hemangiomas
    - Central low intensity dots represent fibrofatty septa seen in cross section, thrombosed vascular channels, smooth muscle components, fast flow, calcification or ossification
  - Higher T2 signal intensities
- Post-contrast T1-weighted imaging
  - Hemangiomas enhance markedly

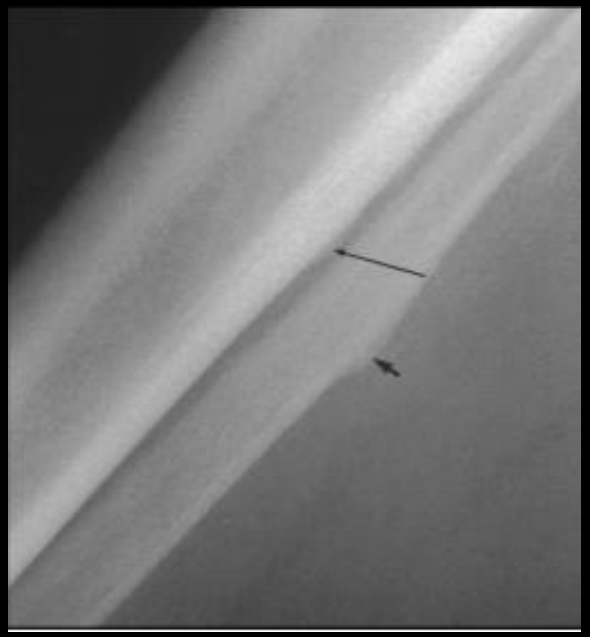


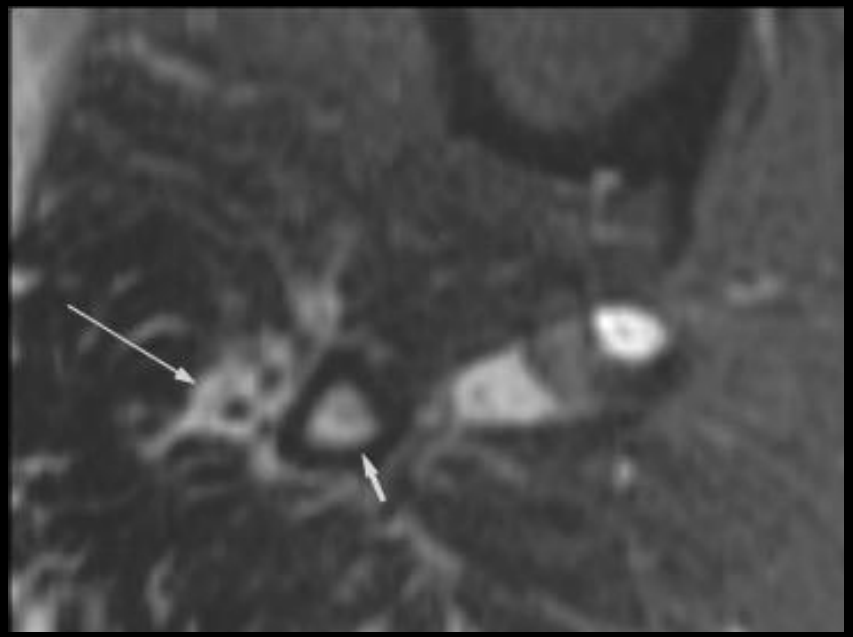




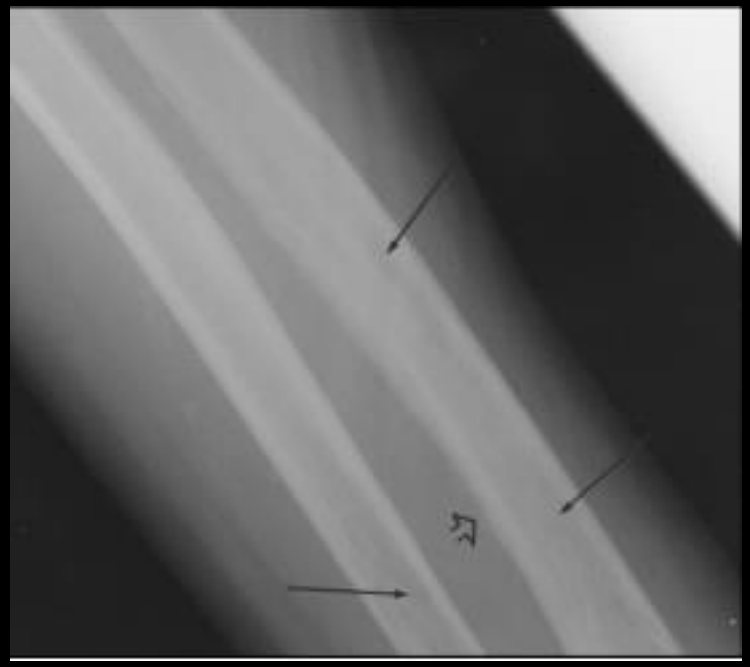
- Regional bone changes adjacent to soft tissue hemangiomas, exact mechanism unknown
- Radiographs and MR of 35 patients with pathologically proven hemangiomas reviewed
- 14/35 patients had osseous changes – periosteal (23%), cortical (31%), medullary (29%)
- No correlation between presence of symptoms and presence of osseous change

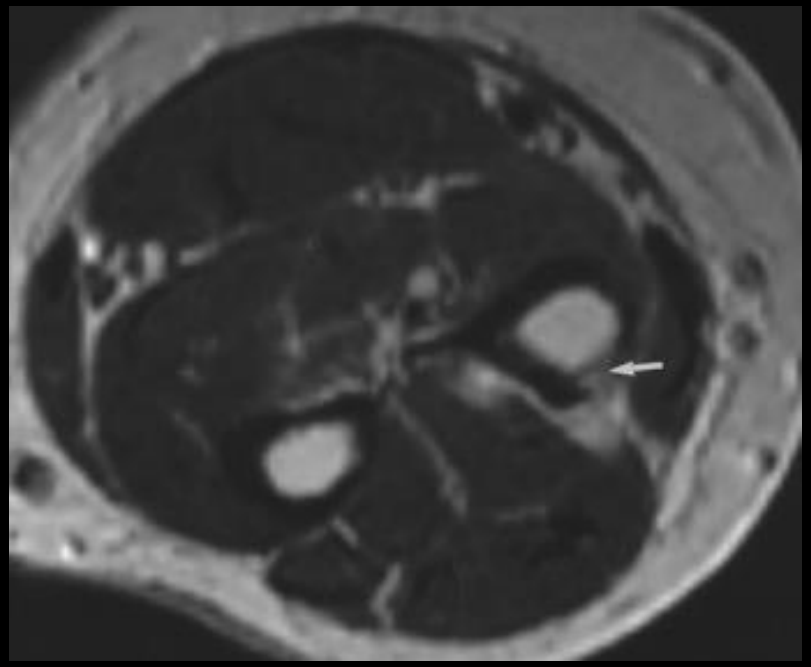
- Periosteal change characterized as nonaggressive (more common) (solid, continuous, undulating) or aggressive (spiculated, sunburst, irregular)

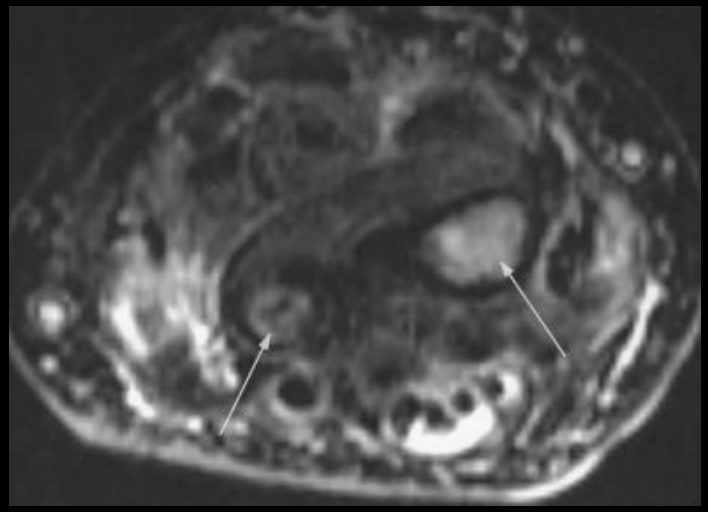




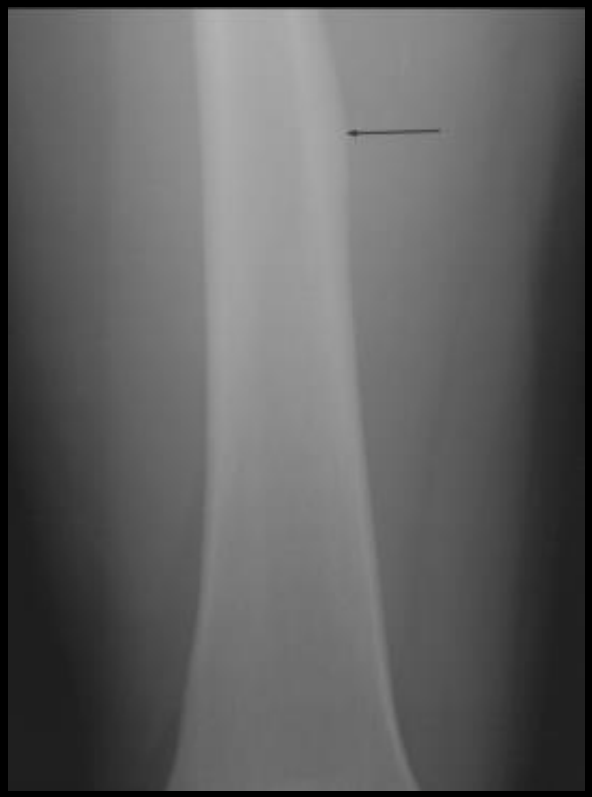
61 y/o M with palpable mass in lower leg

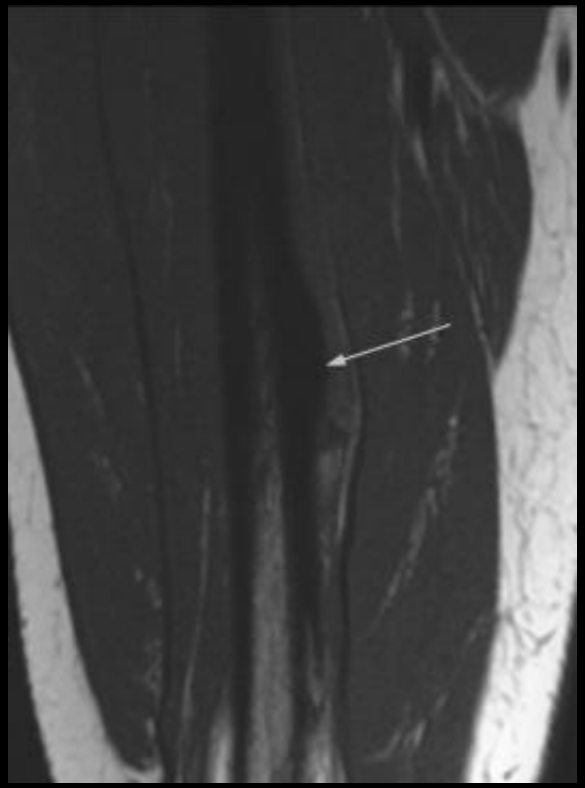


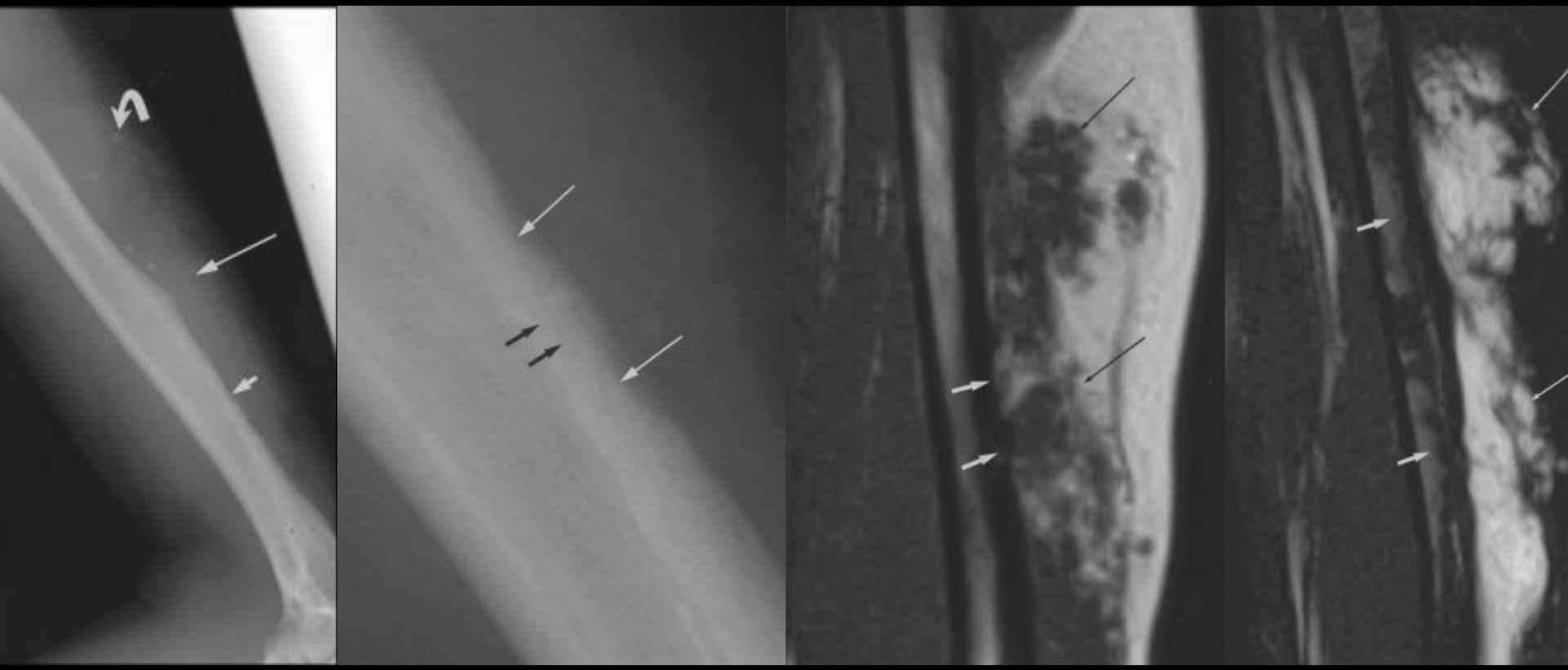




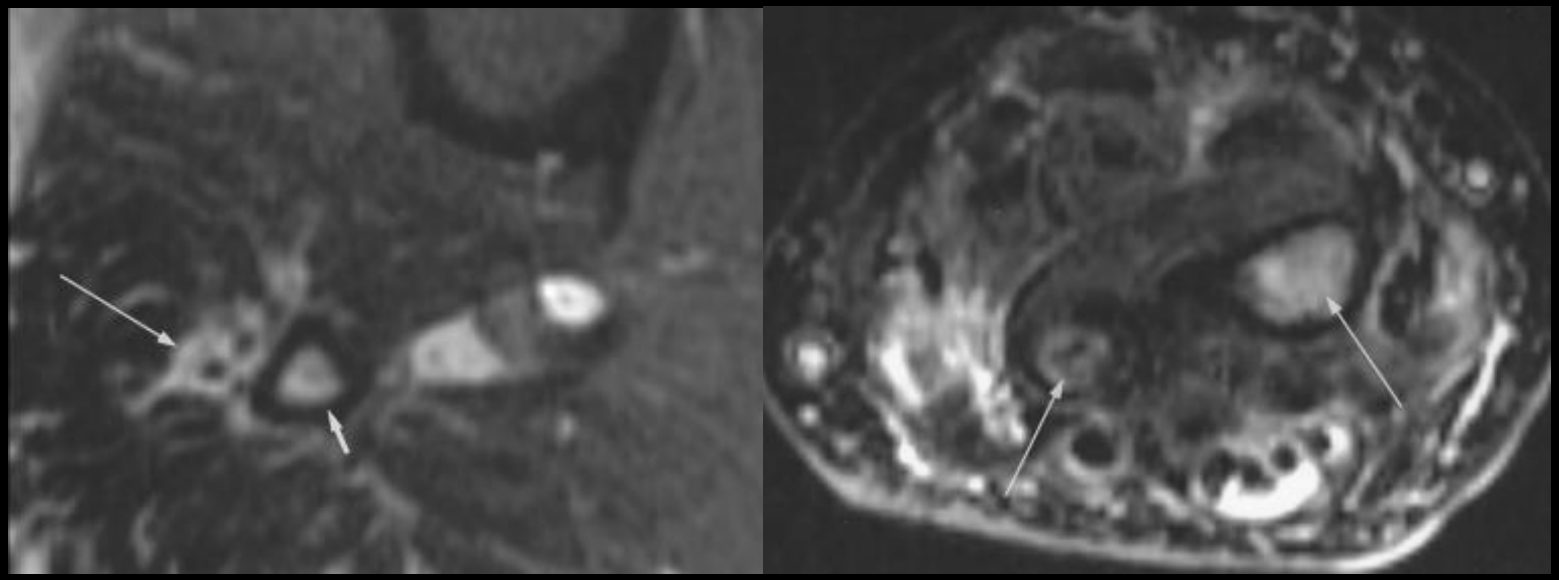
- Cortical findings:
  - Thickening, erosion, tunneling (pseudopermeative cortex, osteoporosis, radiation therapy), osteopenia







- Medullary findings:
  - Osteopenia, sclerosis, medullary MR signal changes
  - Correlation between lesion size and presence of medullary findings (typically 3x larger)
  - Possible due to reactive marrow edema or hematopoietic conversion associated with local hyyperemia



- Proximity of hemangioma correlates with all three categories of osseous change
- Hemangioma contacts bone in nearly all cases

Glomus Tumor

- Hamartoma arising from glomus body, an arteriovenous shunt within dermis that contributes to temperature regulation
- Each glomus body is 300 µm long
- Nail beds of fingers and toes contain 93-501 glomus bodies per square centimeter

Glomus tumor

Epidemiology

- Rare, <2% of soft tissue tumors
- Multiple lesions in 10%
- Malignant in <10%
- No sex predilection except in subungal- F>M

Site of involvement

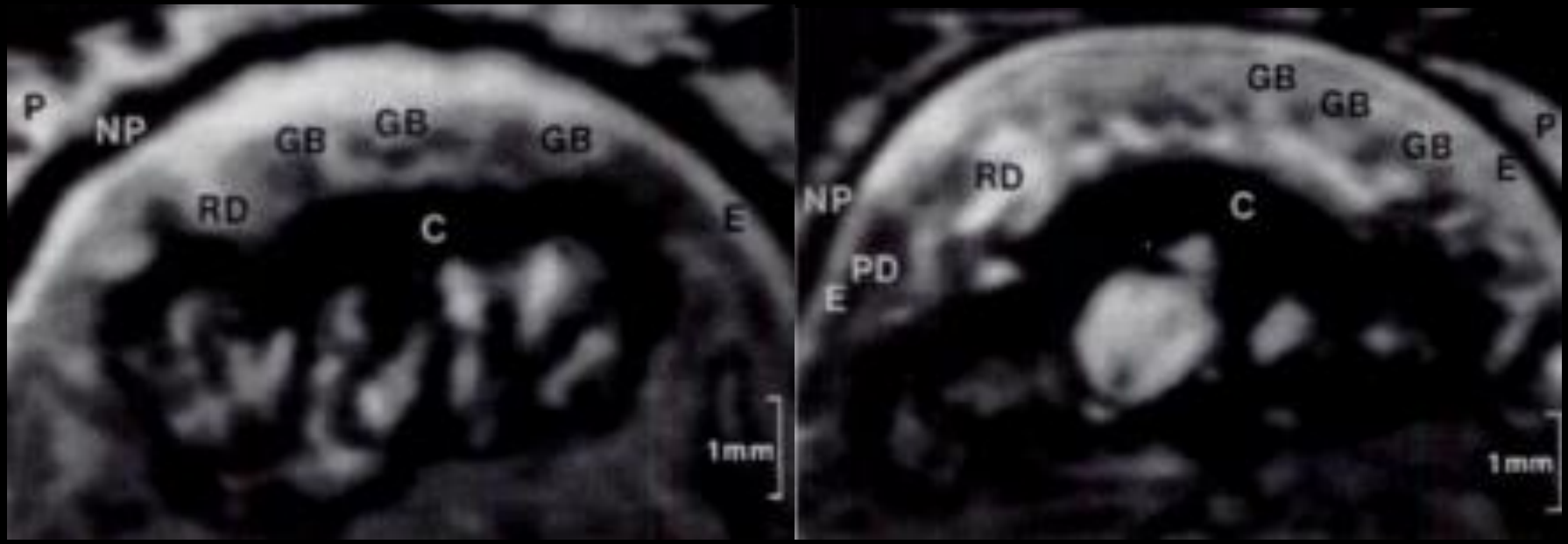
- Majority occur in distal extremities
  - Subungal, hand, wrist, foot
- Reported in every location
  - Stomach, penis, mediastinum, nerve, bone, lung
- Almost always in skin or superficial soft tissue
- Malignant tumors usually deeply seated

Glomus Tumor

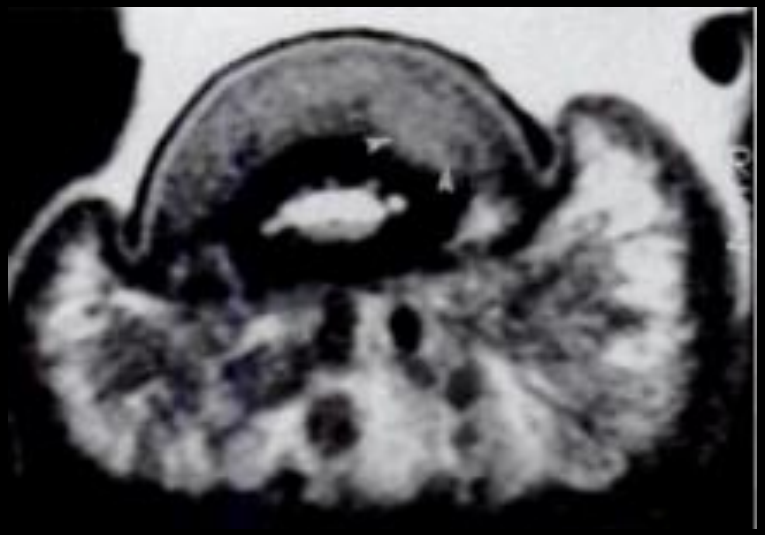
Clinical features

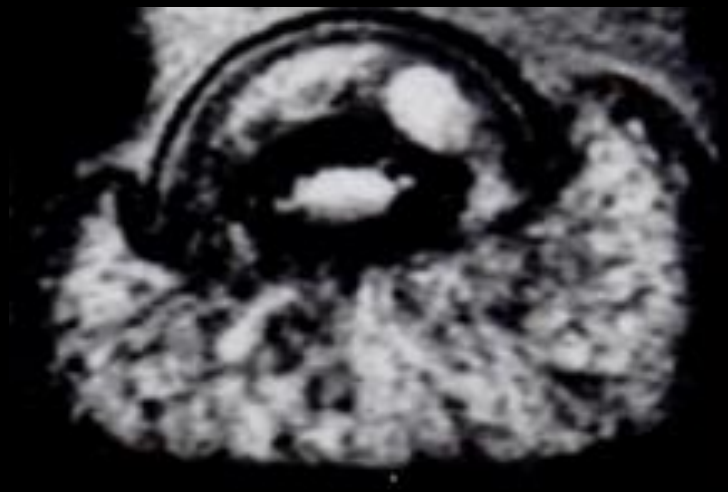
- Typically small, <1 cm
- Red-blue nodules a/w long history of pain, particularly with exposure to cold or minor tactile stimulation
- Deeply seated tumors are asymptomatic or have pain referable to involved organ
- Hildreth sign: disappearance of pain after tourniquet application, diagnostic
- Treatment
  - Surgical resection leads to immediate pain relief
  - Recurrence 12-24%

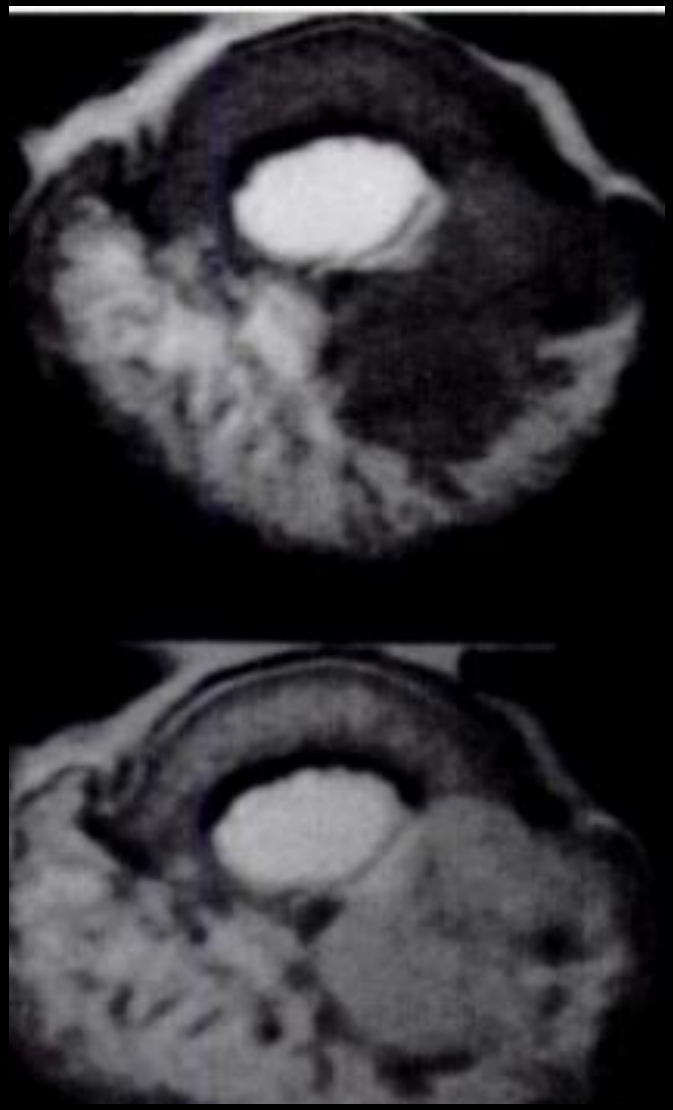
Glomus Tumor

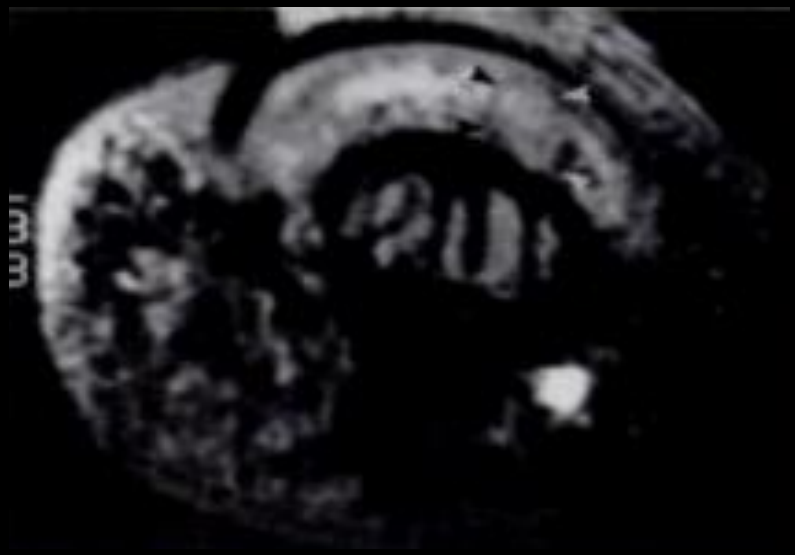


- Most tumors surrounded by capsule, as secondary reaction of surrounding tissue
  - Dark rim on T2 weighted images
- T2 hyperintense
- Variable T1 signal intensity, low signal to moderate high signal
  - Increased T1 signal due to hemorrhage or vascularity
- Intense enhancement
- Bone erosion, 15-65%
  - Smooth bony expansion









Glomus Tumor

- Differential diagnosis
  - Mucous cysts
    - Commonly seen dorsal aspect DIP
    - Fluid signal
    - No enhancement
  - Epidermoid inclusion cyst
    - Can be similar to glomus tumor in signal intensity
    - Bone expansion uncommon
    - Unlikely to be centered at nail bed
    - History of penetrating trauma
    - Painless
  - Giant cell tumor of tendon sheath
    - Proximity to tendon sheath
    - Lower T2 signal intensity
    - Hemosiderin

Giant Cell Tumor of Tendon Sheath

- Histologically identical to intra-articular pigmented villonodular synovitis
- Most commonly seen in the hand, adjacent to an interphalangeal joint
- Manifest as small slow-growing mass with or without pain
- Radiographs normal or reveal nonaggressive remodeling of bone

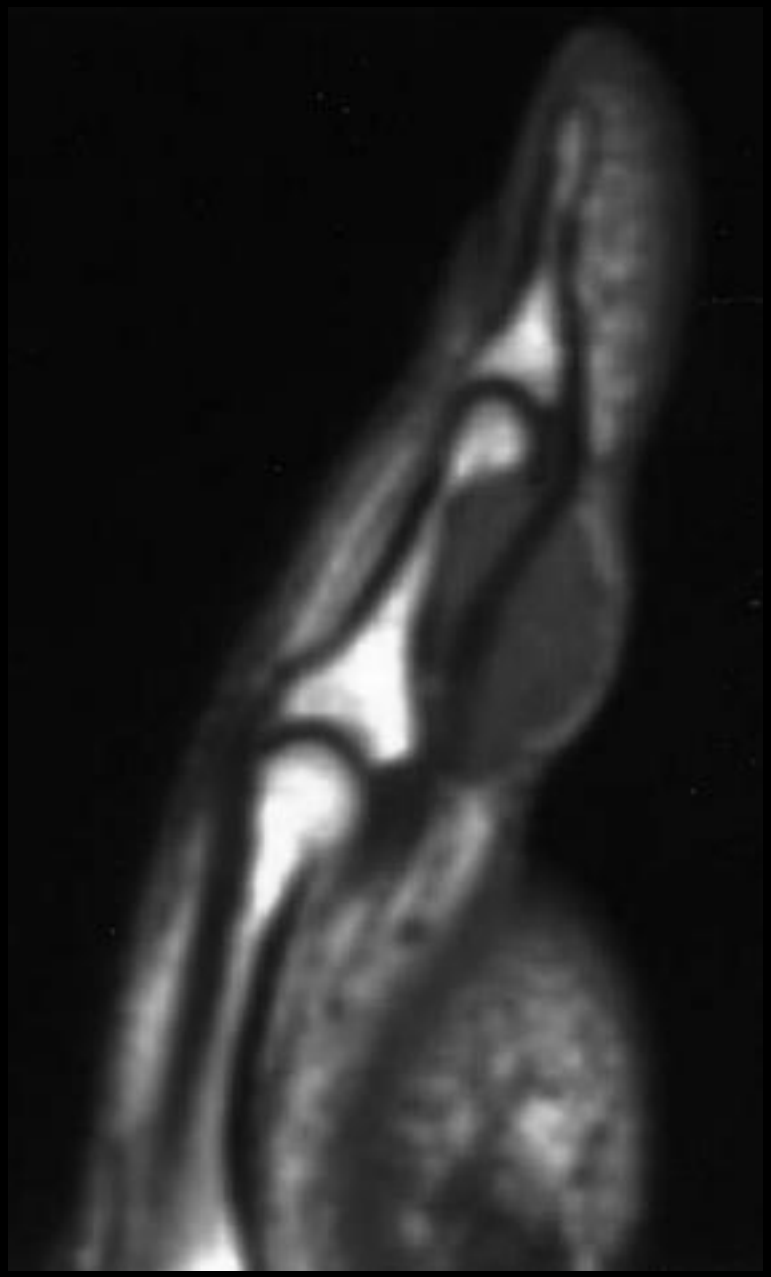
Giant Cell Tumor of Tendon Sheath

- Sites of involvement
  - Second most common soft tissue tumor in hand after ganglion cyst
  - 85% occur in fingers
  - Infrequently erode or infiltrate bone
  - Other sites: wrist, ankle/foot, knee, hip
- Clinical features
  - Benign lesion with local recurrence 9-44% after recurrence
  - 30-50 y/o
  - Most commonly present as painless swelling

GSTTS

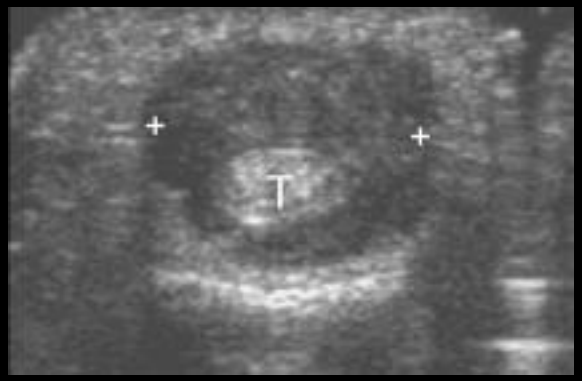
MR features

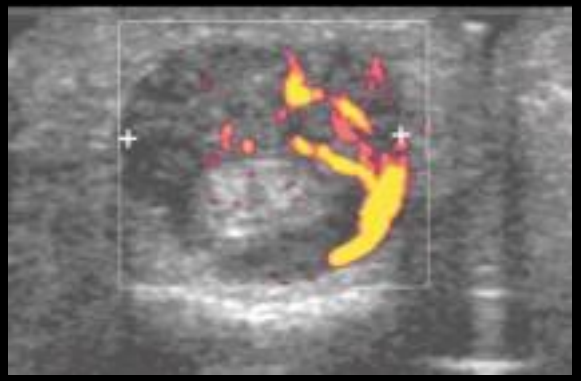
- Well marginated
- Isointense or hypointense to muscle on T1- and T2-weighted MR owing to abundant collagen and hemosiderin
  - Some lesions don’t contain enough hemosiderin to be T1 and T2 hypointense
- Inhomogeneous signal intensities with nodular, linear, or peripheral low signal areas
- Strong enhancement
- Difficult to differentiate from fibroma of tendon sheath
  - Fibromas occur in slightly younger population and more common in men

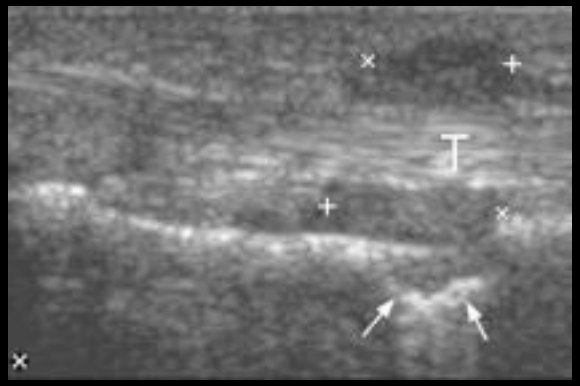


Sonographic Features of GCTTS

- Hypoechoic
- Homogeneous (rarely heterogeneous)
- Posterior acoustic enhancement occasionally seen
- No cystic elements or calcifications
- Vascularity, both central and peripheral
- Circumferential contact with tendon on short axis ranged from 30 to 360 degrees
- Tumors do not move with affected digit flexed or extended







Myositis Ossificans

- Benign, solitary, self limiting, ossifying soft tissue mass occurring within skeletal muscle
- Often no history of trauma
- No association with primary inflammation of muscle
- Clinical features
  - Frequently present with pain and tenderness and soft tissue mass
  - May be incidental finding
  - 80% arise in large muscles of extremities

Myositis Ossificans

- Imaging features dependent on age of lesion
- Full course of growth 7-8 weeks from inception
- 30% demonstrate spontaneous regression

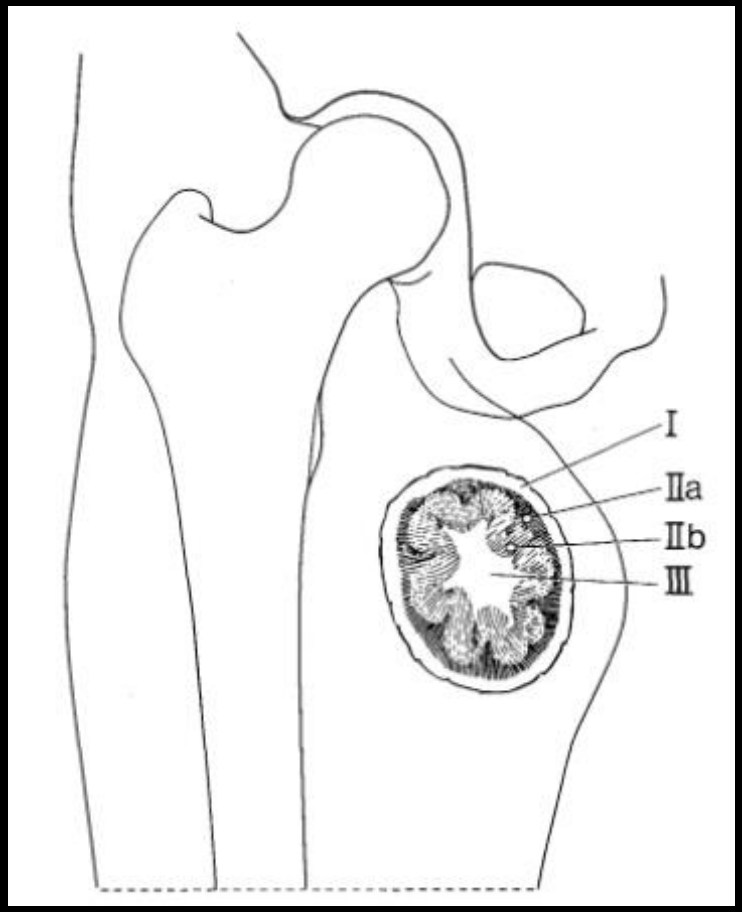
Table I. — Histological presentation (4)

Early stage
- Major non-ossified central core of proliferating fibroblasts and myofibroblasts
- Minor component of osteoid and mature lamellar bone at the periphery

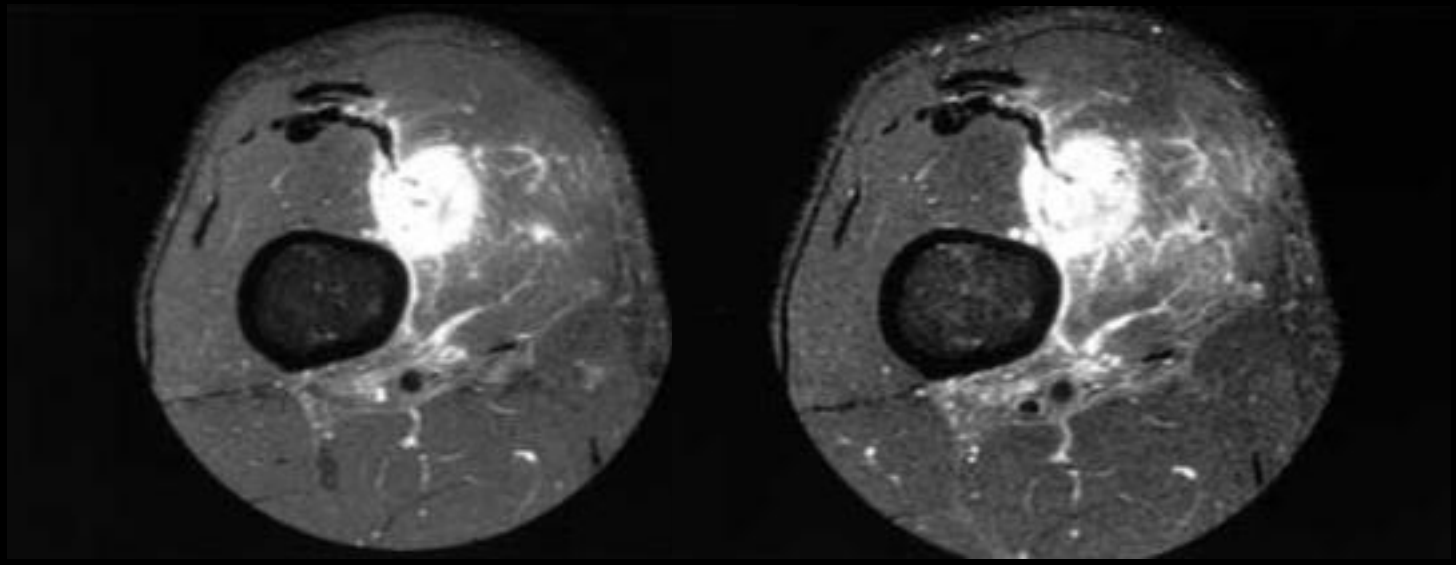
Intermediate stage
- Either minor or no proliferating fibroblastic core
- Almost entirely osteoid component rimmed by active osteoblasts
- Surrounded by a shell of mature lamellar bone

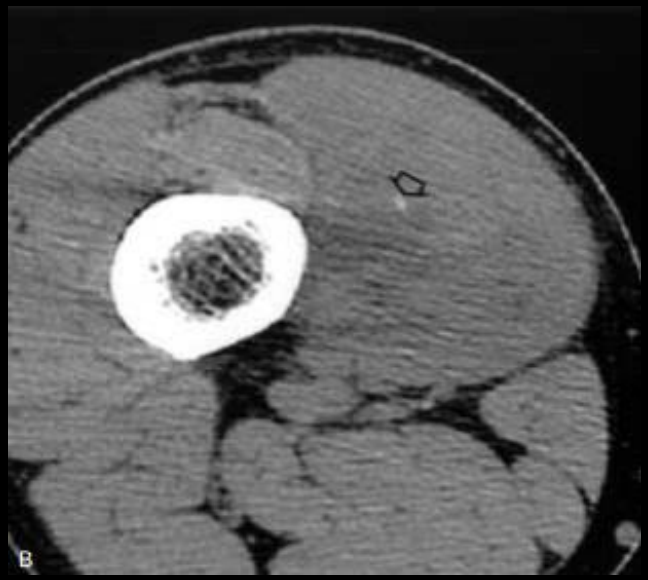
Late stage
- Mature lamellar bone

Typical zonal pattern
- Innermost part: proliferating (myo)fibroblasts with areas of hemorrhage and muscle necrosis
- Intermediate zone: osteoblasts with immature osteoid formation
- peripheral zone: mature bone



- Early lesion
  - Radiographs: normal
  - T2: iso-to hyperintense to muscle
  - T1: iso- to hyperintense
  - +/- T2 hypointense rim
  - Heterogeneous with surrounding soft tissue edema
  - Poorly marginated and may be recognized only secondarily due to mass effect and displacement of fascial planes
  - Marked enhancement

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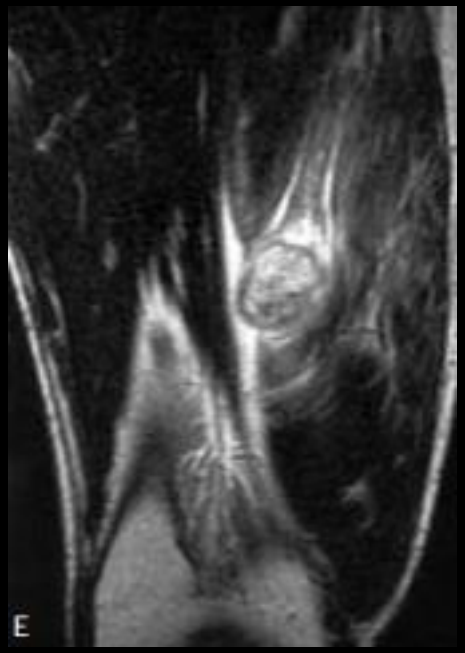
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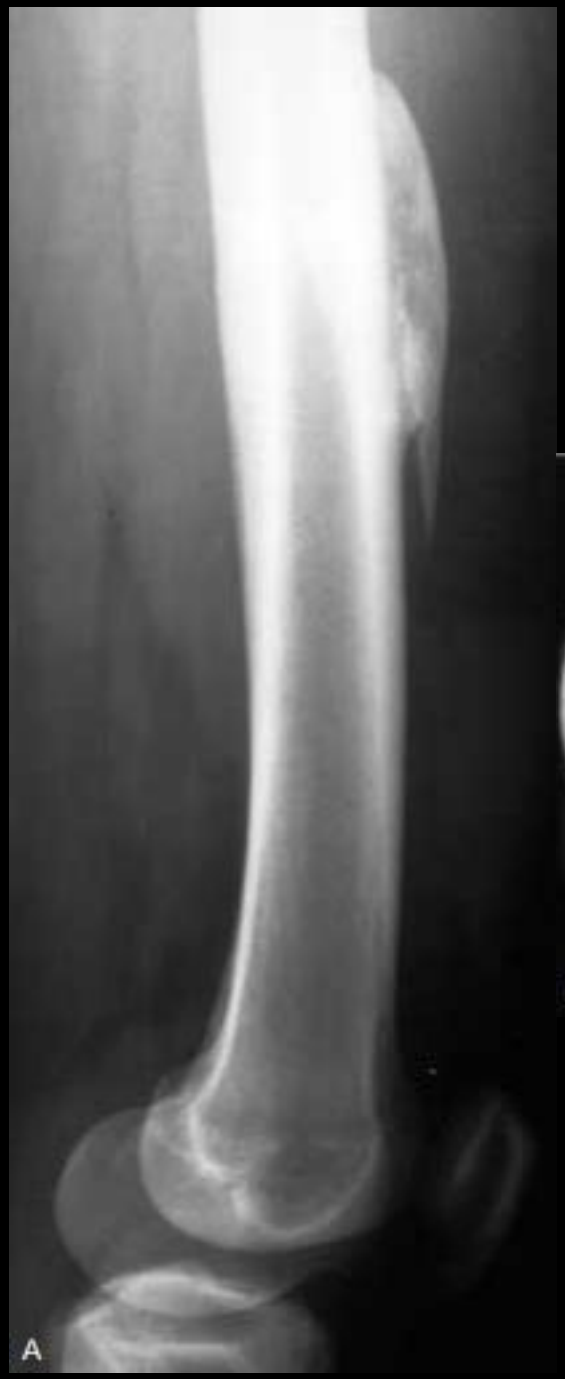
- Intermediate stage
  - Radiographs: continuous/noncontinuous peripheral calcification with central lucent core, faint irregular calcifications within lesion
  - MRI
    - Inhomogeneous, variable signal at center on T2
    - Well defined, decreased signal rim of varying thickness on all sequences
    - Varying, nonspecific enhancement
    - Decreased perilesional abnormal signal

- Late stage
  - Radiographs: heavily calcified lesion with trabecular bone formation, may merge with adjacent bone
  - MRI:
    - Overall low signal due to ossification, fibrosis, hemosiderin
    - Areas of signal identical to normal bone marrow corresponding to fatty marrow formation
    - Resolution of perilesional edema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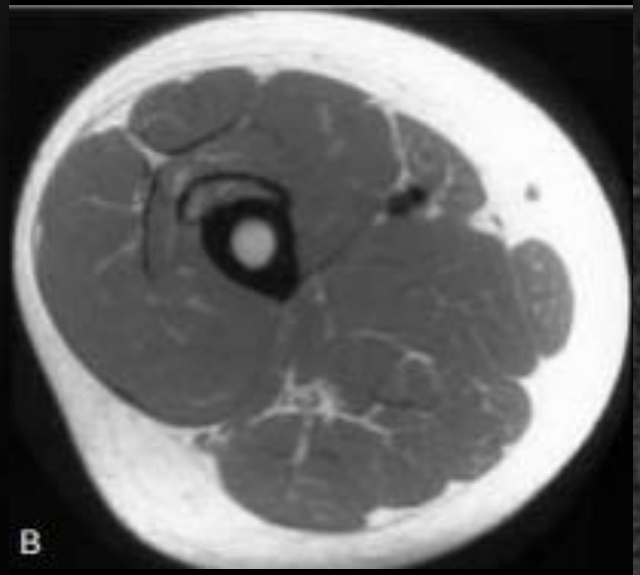
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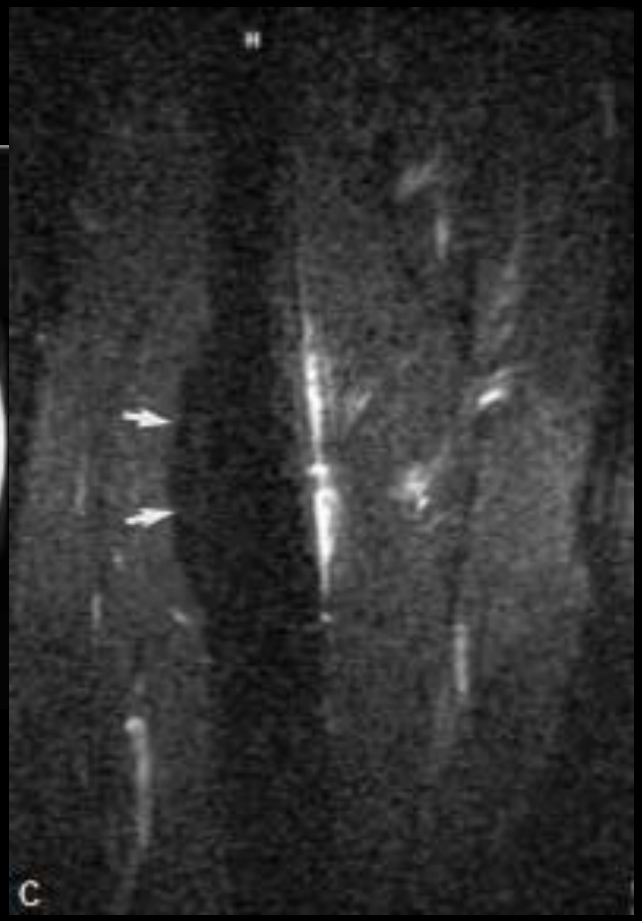
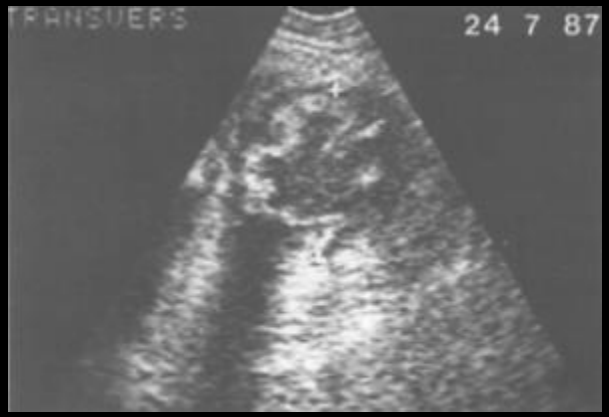
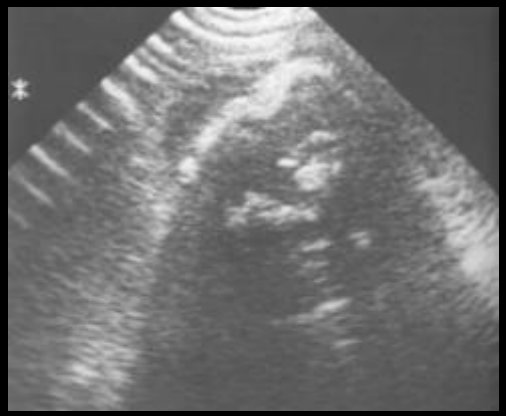
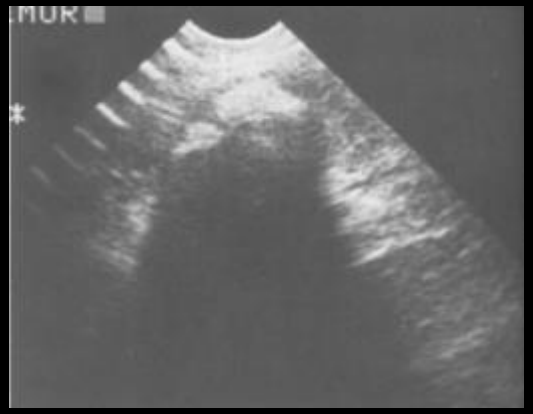

C

Sonographic Features of Myositis Ossificans

- Early
  - Thin echo-poor zone I in surrounding muscle
  - Broad, reflective zone II
  - Amorphous, echo free zone III
- Intermediate→Mature
  - Zone II more reflective due to increased mineralization







- Most soft tissue tumors have nonspecific imaging characteristics
- Identify benign lesions to avoid unnecessary intervention
- Any indeterminate lesions should be biopsied

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