

Imaging of Extremity Soft Tissue Sarcomas

2nd Singapore Sarcoma Consortium Education & Research Meeting 2014
26th April 2014

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I have nothing to disclose.



Igniting the Pioneer Spirit



Singapore
General Hospital
SingHealth

Soft Tissue Sarcoma (STS)

RARE TUMOURS

Arise from mesenchymal tissue.

Distribution –

- Extremity – 59%
- Trunk – 19%
- Retroperitoneum – 15%
- Head and Neck – 9%

2009 – USA

Est. 10,600 new cases of soft tissue sarcoma.

- 5.5% of breast cancer.
- 5% of lung cancer.

Over 50 Histologic Subtypes

- Pleomorphic Non-differentiated Sarcoma 28%
- Liposarcoma 15%
- Leiomyosarcoma 12%
- Unclassified Sarcoma 11%
- Synovial Sarcoma 10%
- Malignant Peripheral Nerve Sheath Tumour 6%
- Rhabdomyosarcoma 5%
- Fibrosarcoma 3%
- Ewing's Sarcoma 2%
- Angiosarcoma 2%
- Osteosarcoma 1%
- Epithelioid Sarcoma 1%
- Chondrosarcoma 1%
- Clear cell Sarcoma 1%
- Alveolar Soft Part Sarcoma 1%
- Malignant Haemangiopericytoma 0.5%

Soft Tissue Sarcoma

Adults > children

Incidence increases with age.

- Rhabdomyosarcoma is most common soft tissue sarcoma of childhood.

Metastases

Haematogenous – dominant.

Lymph nodes - <5%

- exceptions are epithelioid sarcoma, synovial sarcoma, angiosarcoma, rhabdomyosarcoma, clear cell sarcoma.

Radiation – known risk factor.

Risk is dose dependent.

Latent period of 10 years.

Over 50 Histologic Subtypes

Pleomorphic Non-differentiated Sarcoma 28%

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Synovial Sarcoma 10%

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Rhabdomyosarcoma 5%

Fibrosarcoma 3%

Ewing's Sarcoma 2%

Angiosarcoma 2%

Osteosarcoma 1%

Epithelioid Sarcoma 1%

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Risk is dose dependent.

Latent period of 10 years.

Most common in middle aged and older adults.

Relatively more common in children and young adults.

7-10% of paediatric malignancies.

Bone is 25% less than soft tissue sarcoma.

Represent a disproportionate cancer burden to the young (under 25 years).

Presentation and Diagnosis

Highly variable. Often delayed.

Asymptomatic , often pain free.

Increasing in size. May be slow!

Those in extremities often diagnosed earlier.

Lack of constitutional symptoms –

Fever, malaise, weight loss.

Grow in centrifugal manner.

Compress surrounding structures.

May impingement on bone or neurovascular bundles

– pain, oedema, swelling.

Presentation and Diagnosis

Diagnosis is often delayed!

High index of suspicion.

Any patient with a mass with indeterminate findings should be referred to an orthopaedic or musculoskeletal oncologist.

Management should be by experienced Multi-Disciplinary Teams.

Look out for

- Mass increasing in size.
- Size > 5 cm.
- Deep to the deep fascia.
- +/- Painful.

Purpose of Imaging

- Characterise.
- Localise.
- Stage.
- Plan treatment.
- Assess response to therapy.

Imaging

Radiographs (X-Rays)

Ultrasound

CT

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography

Imaging

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Ultrasound

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Imaging Guided Biopsy

Angiography

X- Rays of the Mass

- Size
- Appearance
- Calcification
- Other bony lesions

Chest X-Ray

Nodules

But - <4 mm may not be evident.



- Marginal or internal calcification seen in 10-30% of Synovial Sarcoma.

- Liposarcomas may be seen as more lucent areas. Up to 30% of dedifferentiated liposarcomas show internal calcification.

Imaging

Radiographs (X-Rays)

Ultrasound

CT

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography

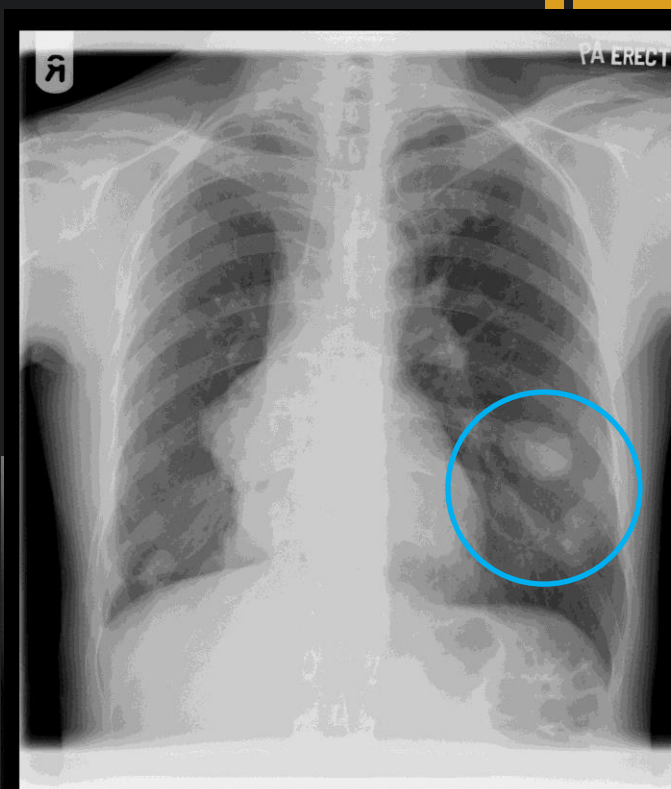
X- Rays of the Mass

- Size
- Appearance
- Calcification
- Other bony lesions

Chest X-Ray

Nodules

But - <4 mm may not be evident.



Imaging

Radiographs (X-Rays)

Ultrasound can be used to evaluate a mass in peripheral or superficial locations.

Ultrasound

Distinguish between solid and cystic.

CT

Assess vascularity.

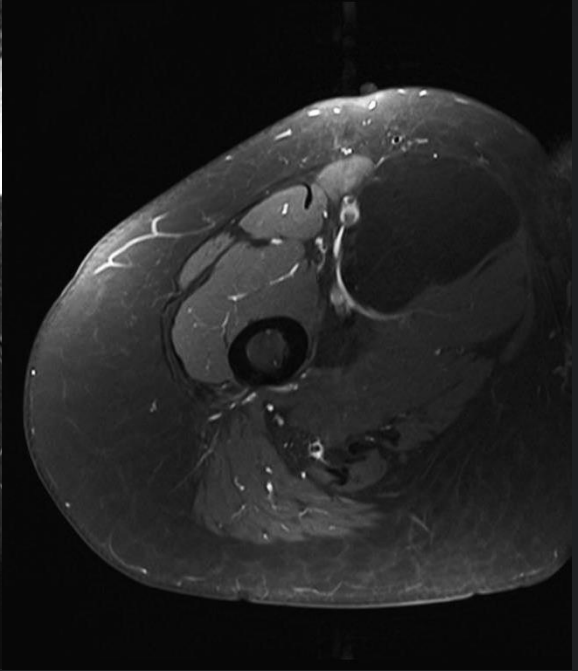
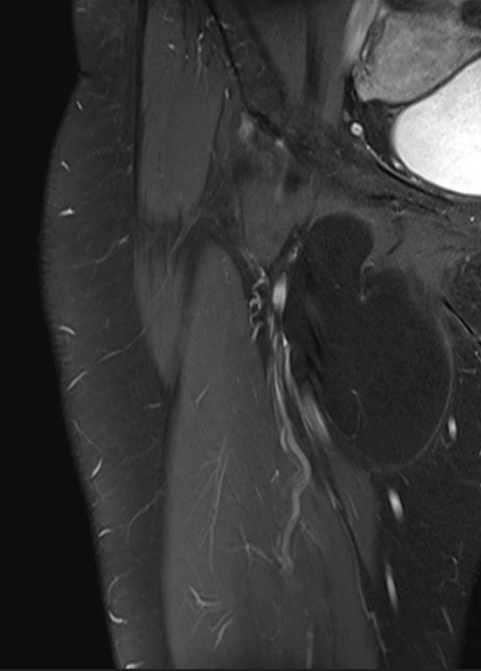
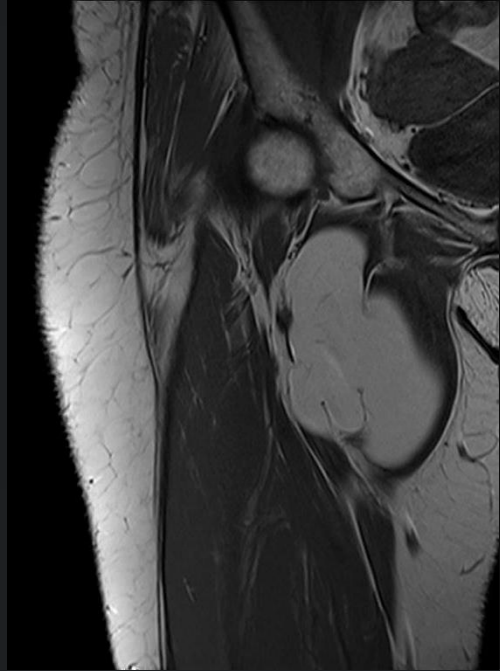
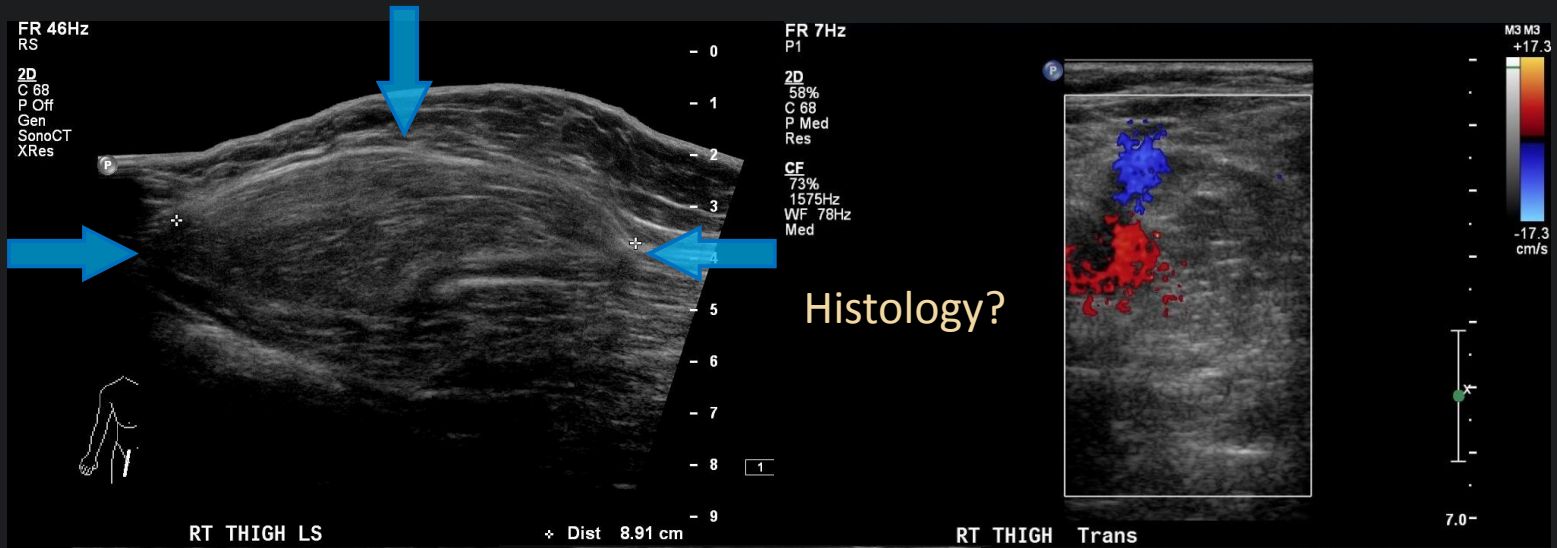
MRI

Assess adjacent structures.

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography



Imaging

Radiographs (X-Rays)

Fast. Readily available.

Ultrasound

Entails radiation exposure.

CT

Good spatial resolution.
Poor contrast resolution.

MRI

Requires iodinated contrast – risk of adverse reactions.

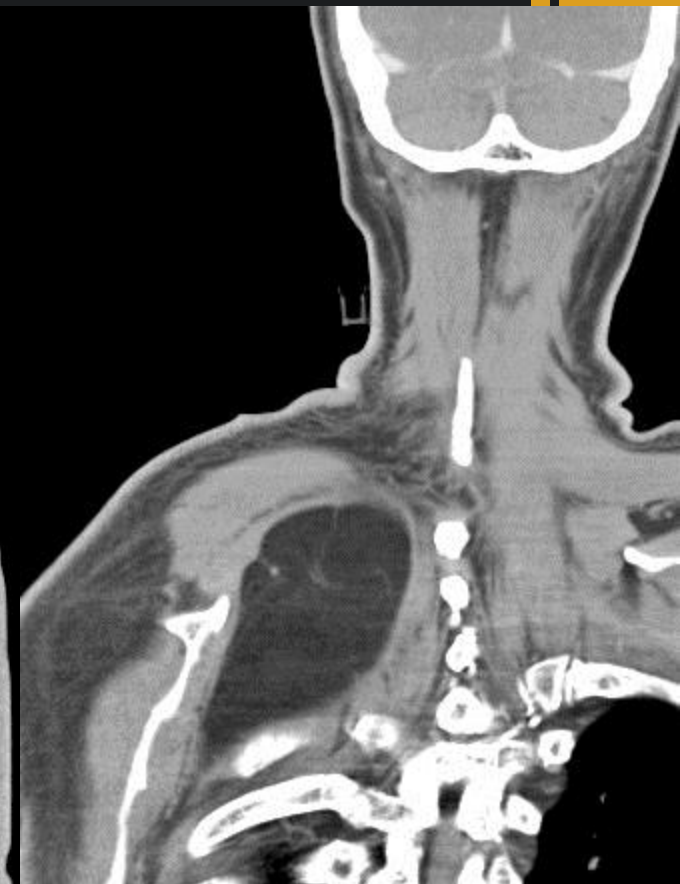
PET-CT/PET-MR

Concurrent use to assess lungs, liver and lymph nodes.

Imaging Guided Biopsy

MRI-Incompatible/Contra-indications.

Angiography



Imaging

Radiographs (X-Rays)

Ultrasound

CT

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography

MRI – Modality of Choice

Superior tissue contrast resolution.
Intravenous contrast aids in evaluation.

Detect subtle changes in lesion, delineate margins, assess for invasion and spread.

MRI features

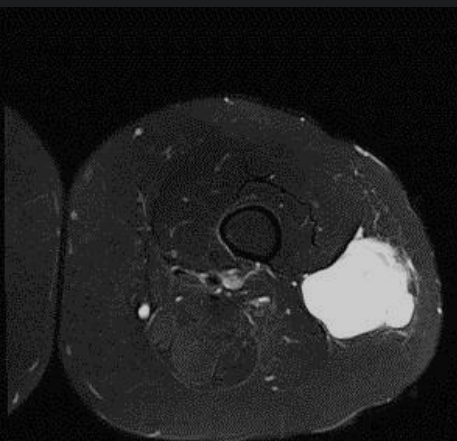
- T1 intermediate to low.
- T2 high to intermediate.
- Enhancement pattern variable
- Differentiate from oedema.

Malignant features

- > 5 cm.
- deep location.
- absent central enhancement.
- pseudocapsule.
- respect fascial borders and anatomic compartments till late.
- heterogeneous.

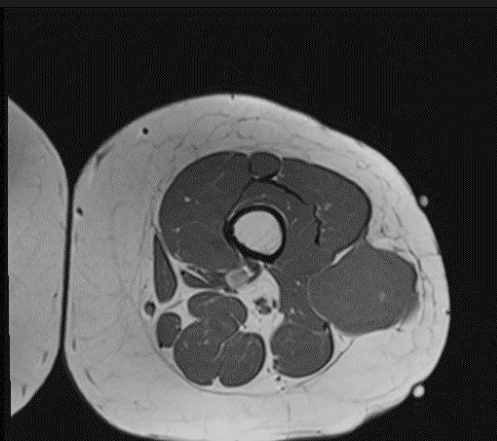


Myxoid Liposarcoma



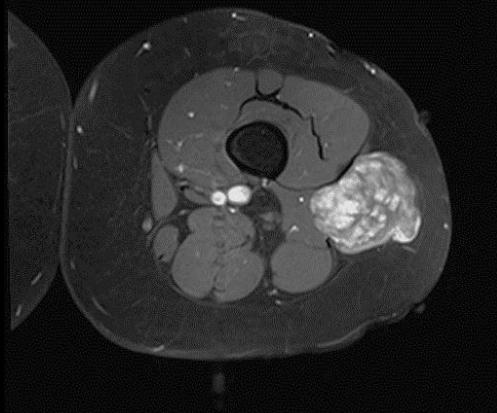
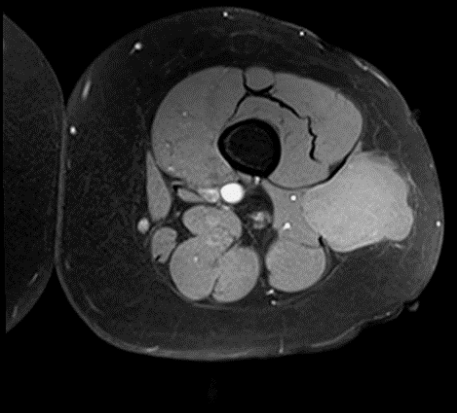
Axial T2 TSE

Axial T1 TSE FS



Axial T1 TSE

Axial T1 TSE FS + C



Coronal T2 TIRM

Coronal T1 TSE FS + C

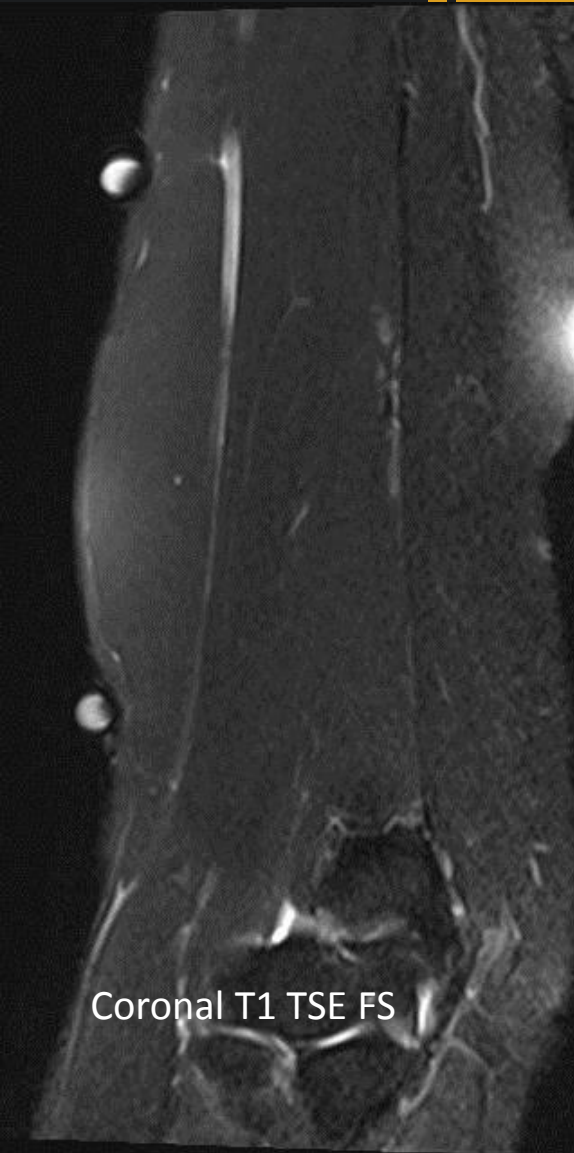
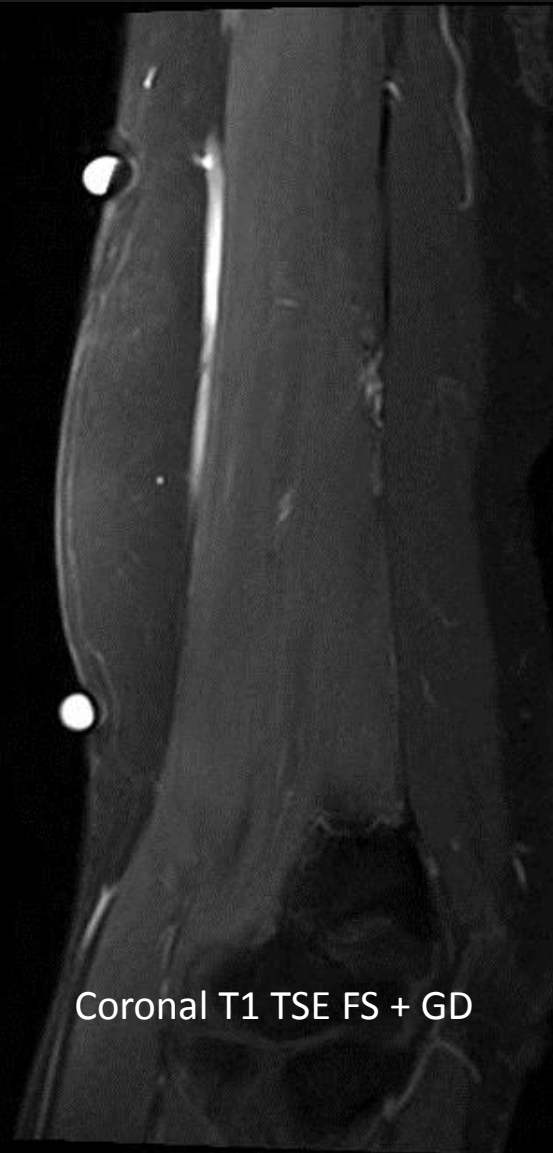
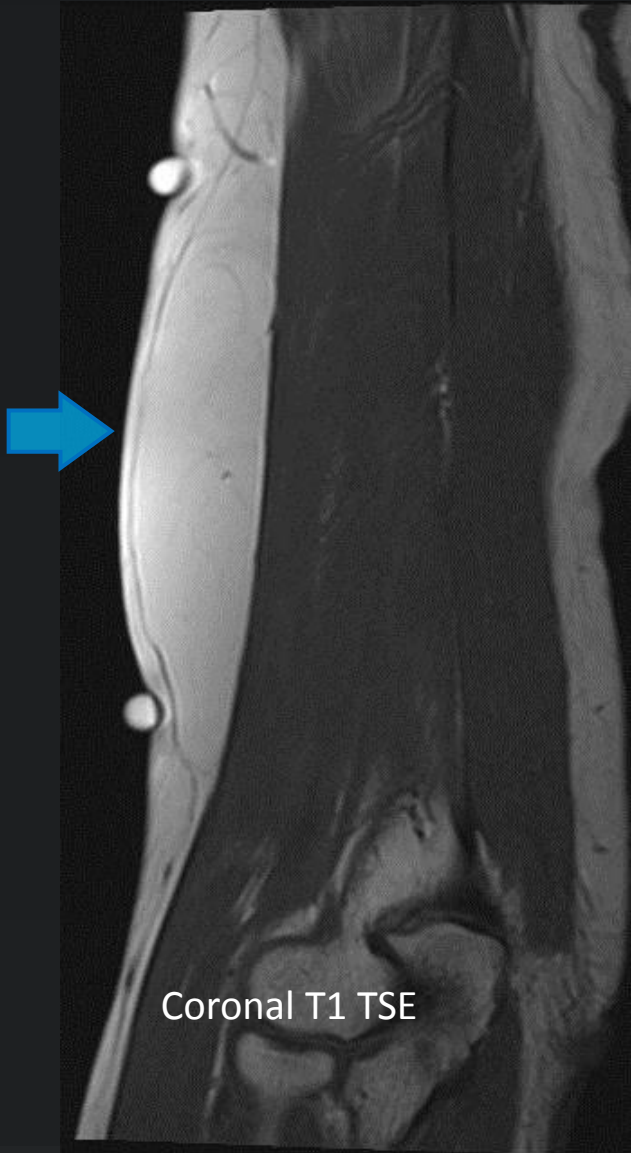


- Intermediate to high grade malignancy.
- ~ Round cell component.

MR Features

- Well-defined, multilobulated.
- T1w ↓.
- T2w ↑.
- <10% adipose tissue – lacy/linear T1w ↑.
- Enhancement -
 - peripheral nodular (60%)
 - central (45%)
 - diffuse (15%).

Benign Lipoma



Imaging

Radiographs (X-Rays)

Ultrasound

CT

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

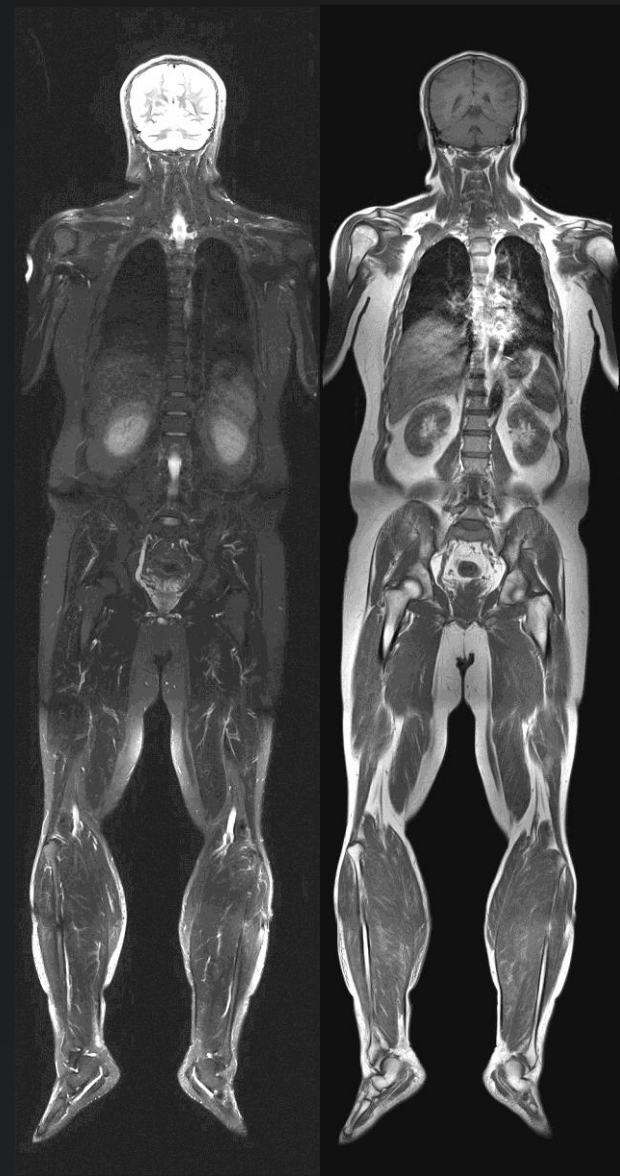
Angiography

Whole Body MRI? –
Controversial!

Variations in use.

Focused MR scanning –
localised to single limb/body
region.

- Entire long bone to exclude synchronous mass.
- Additional body regions if indicated by CT or other imaging methods.



Imaging

Radiographs (X-Rays)

^{18}F FDG – most common.

Tumour or physiologic tissue metabolism.

Ultrasound

CT/MR scanning – gives concurrent anatomical and functional imaging findings.

CT

Localisation of metabolically active component of the soft tissue sarcoma for optimal biopsy targeting.

MRI

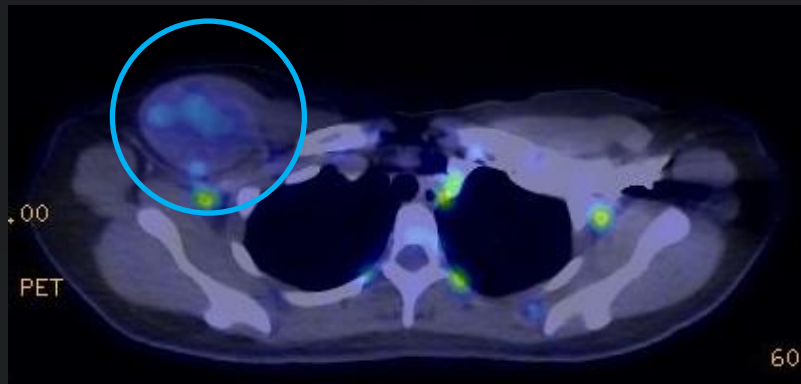
Detection of local recurrence and metastases.

PET-CT/PET-MR

Assess response to neoadjuvant chemotherapy.

Imaging Guided Biopsy

Angiography



- 45 M with pectoral histiocytoma.
- Bone metastases were found with FDG PET-CT.

Imaging

Radiographs (X-Rays)

Ultrasound

CT

MRI

Nuclear Medicine

Imaging Guided Biopsy

Angiography

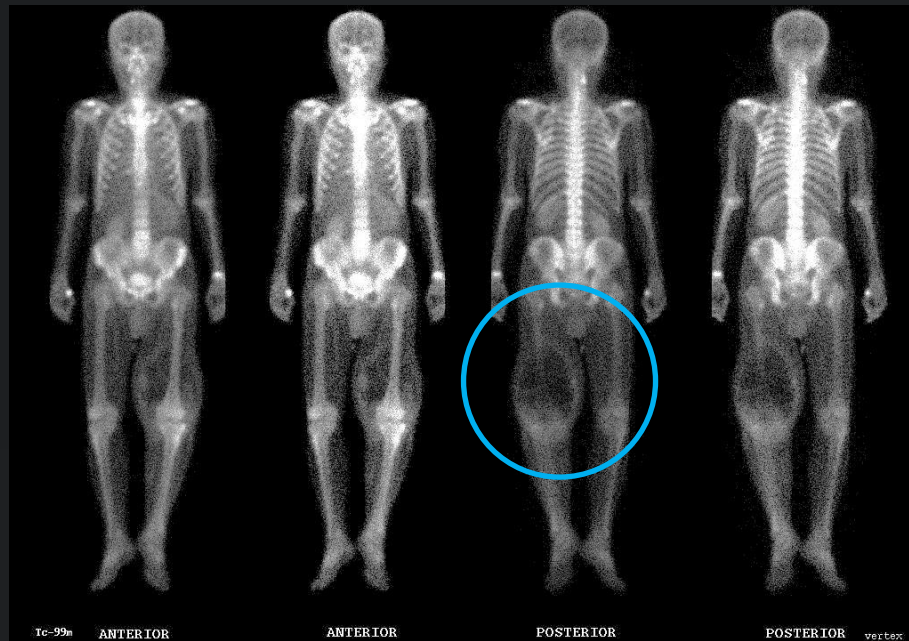
Tc99m BONE SCANS

Whole body imaging for low radiation dose.

High uptake in areas with bone repair or high turnover.

Lytic destructive lesions may give false negatives.

Part of initial imaging workup.



Imaging

Radiographs (X-Rays)

Under CT or US guidance.

Ultrasound

Approach and track location should be agreed after consultation with Orthopaedic Oncologists.

CT

Core biopsy vs Fine needle Aspiration.

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography

Imaging

Radiographs (X-Rays)

Lesion vascularity and blood supply.

Ultrasound

Pre-surgical embolisation.

CT

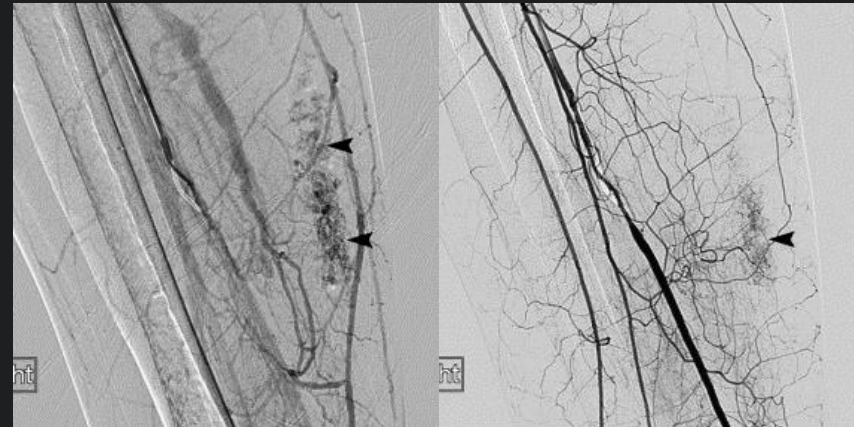
CT Angiography or MR Angiography are available options.

MRI

PET-CT/PET-MR

Imaging Guided Biopsy

Angiography



- Vascular neoplasms like haemangiopericytoma, haemangioendothelioma and angiosarcoma can affect both bone and soft tissues and often presents with bleeding.
- Angiosarcoma is an aggressive malignancy with high local recurrence and distant metastases.

So, which imaging modality?

P/W Rt Upper Limb Mass

Radiographs :

- Mass
- Chest (CXR)

MRI :

- Characterise the Mass.
- Assess surrounding structures.

CT :

- Screen for lung and liver metastases.

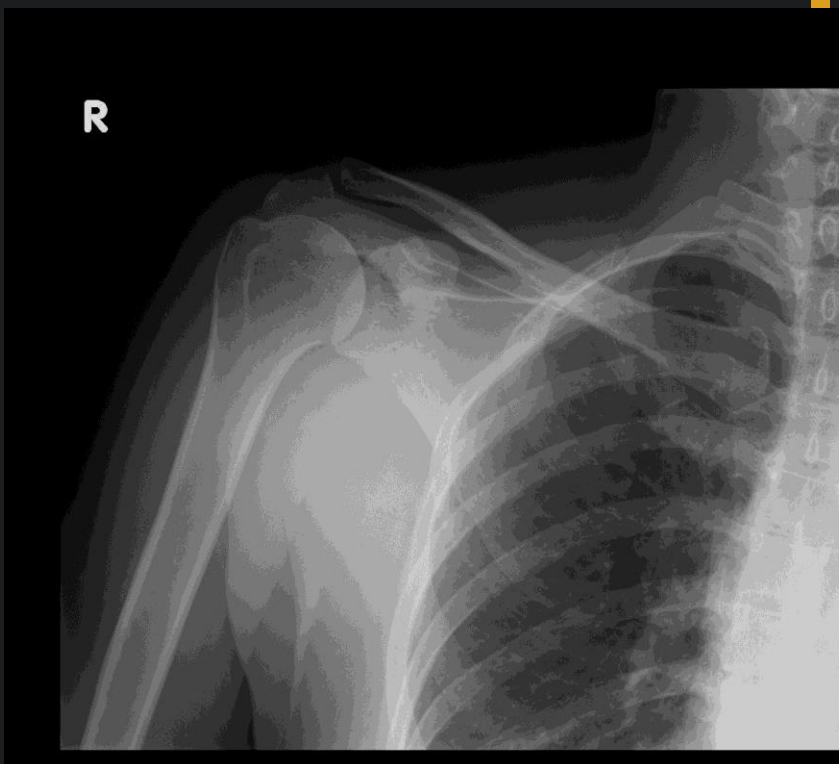
Nuclear Medicine :

PET/CT or PET/MR -

- Tissue activity and viability

Tc99m Bone Scan -

- Skeletal metastases.



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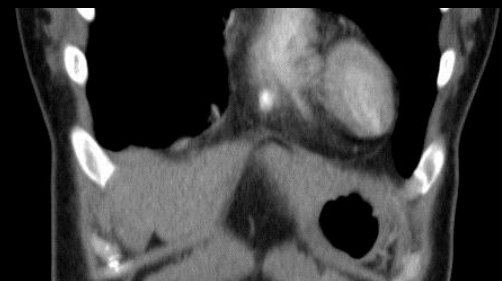
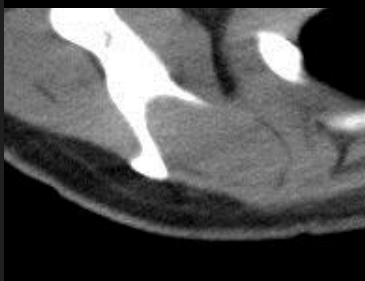
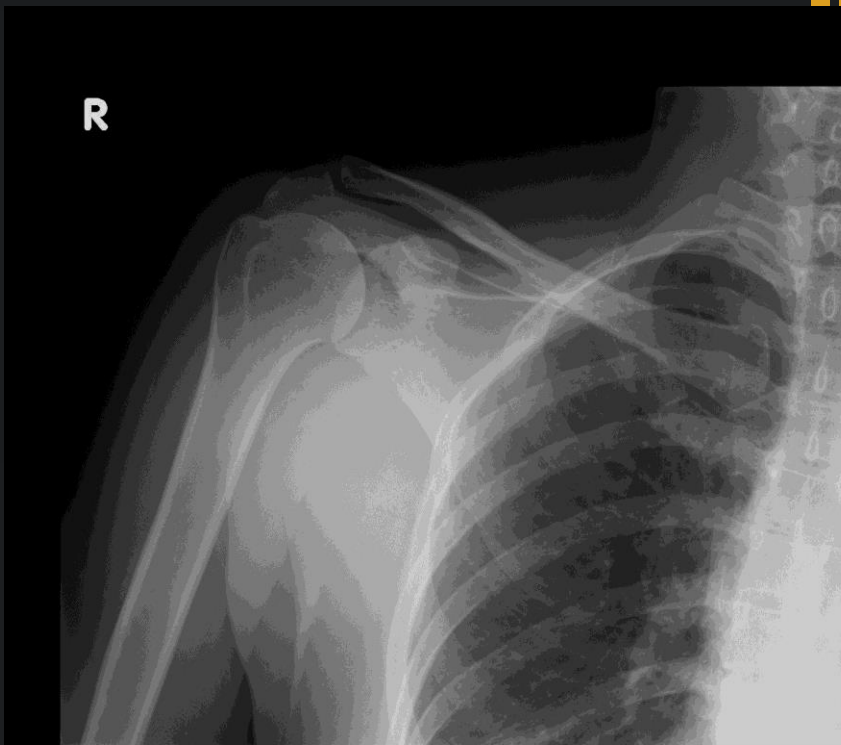
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So, which imaging modality?

Dx : Histiocytoma

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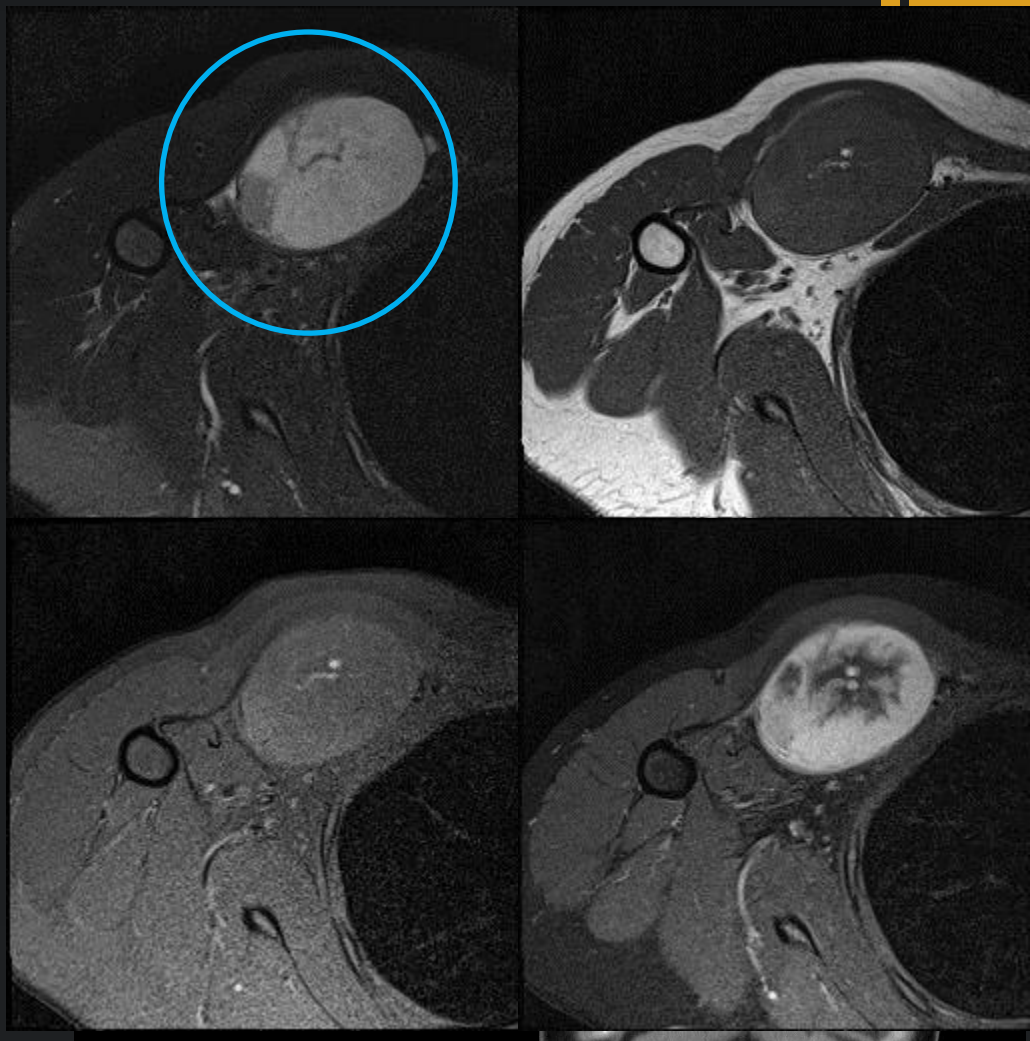
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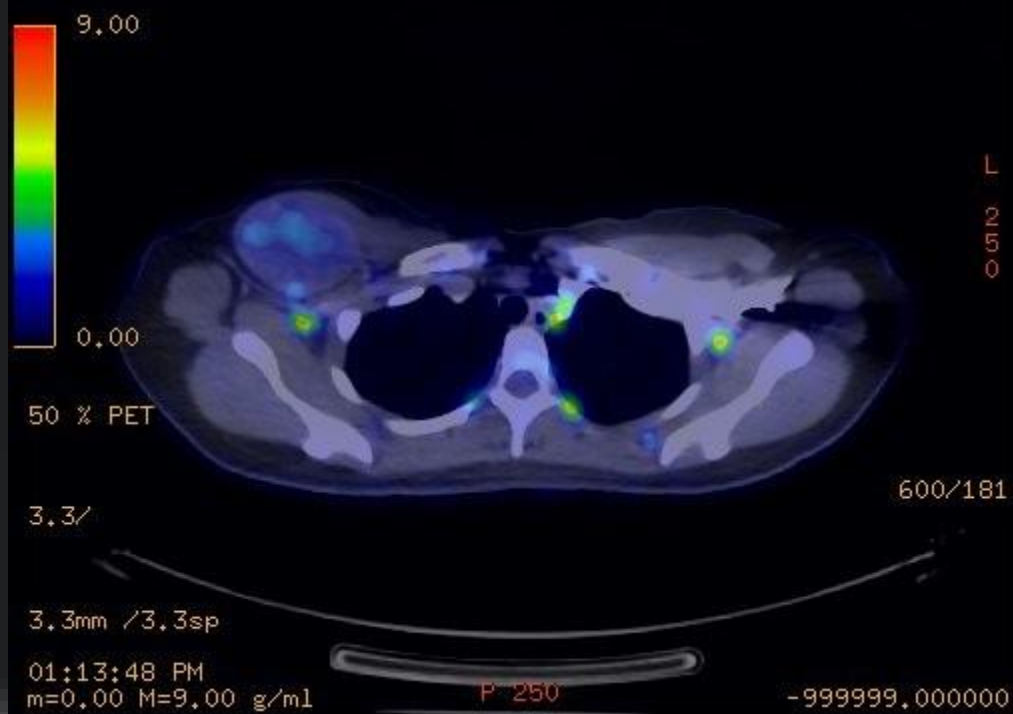
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Tc99m Bone Scan -

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MRI

MR Signal Characteristics

- T1w, T2w
- Enhancement

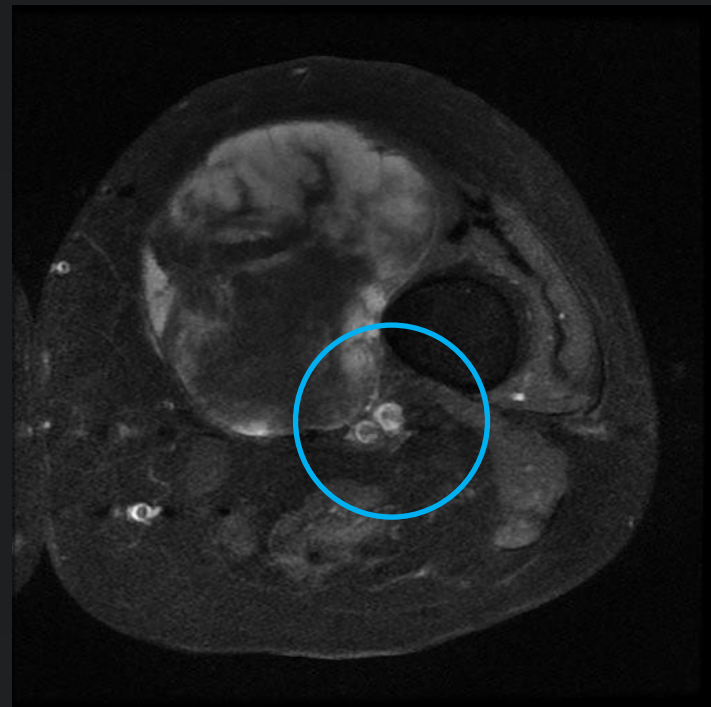
Location –

- deep or superficial.
- subcutaneous,
- intermuscular, intramuscular.
- adjacent structures – eg bone, solid organs.
- neurovascular bundle.
- invasion or clear fat-plane.
- wide margin of excision possible?
 - Aim for 1 cm clear margin.
- amenable to image guided biopsy?
- radiosensitive organs if planning for radiotherapy.

For vessels –

Consider extent of circumference involved or in contact.

Perivascular spread or invasion?



MRI

MR Signal Characteristics

- T1w, T2w
- Enhancement

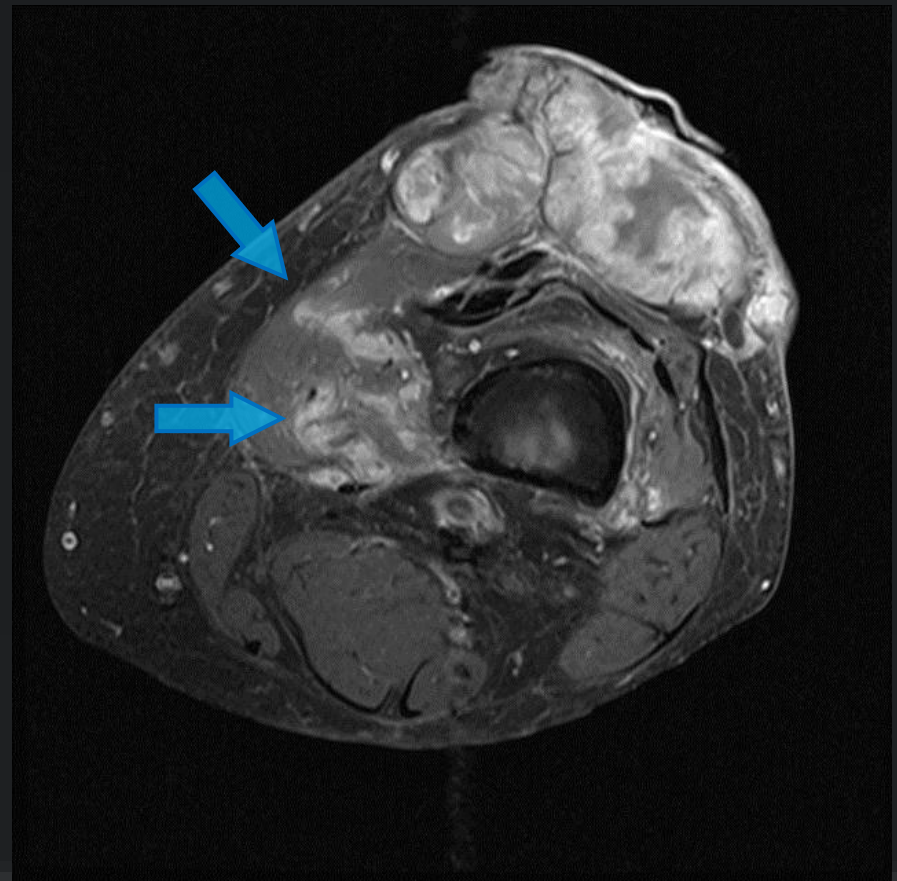
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Synovial Sarcoma

60% lower extremity.

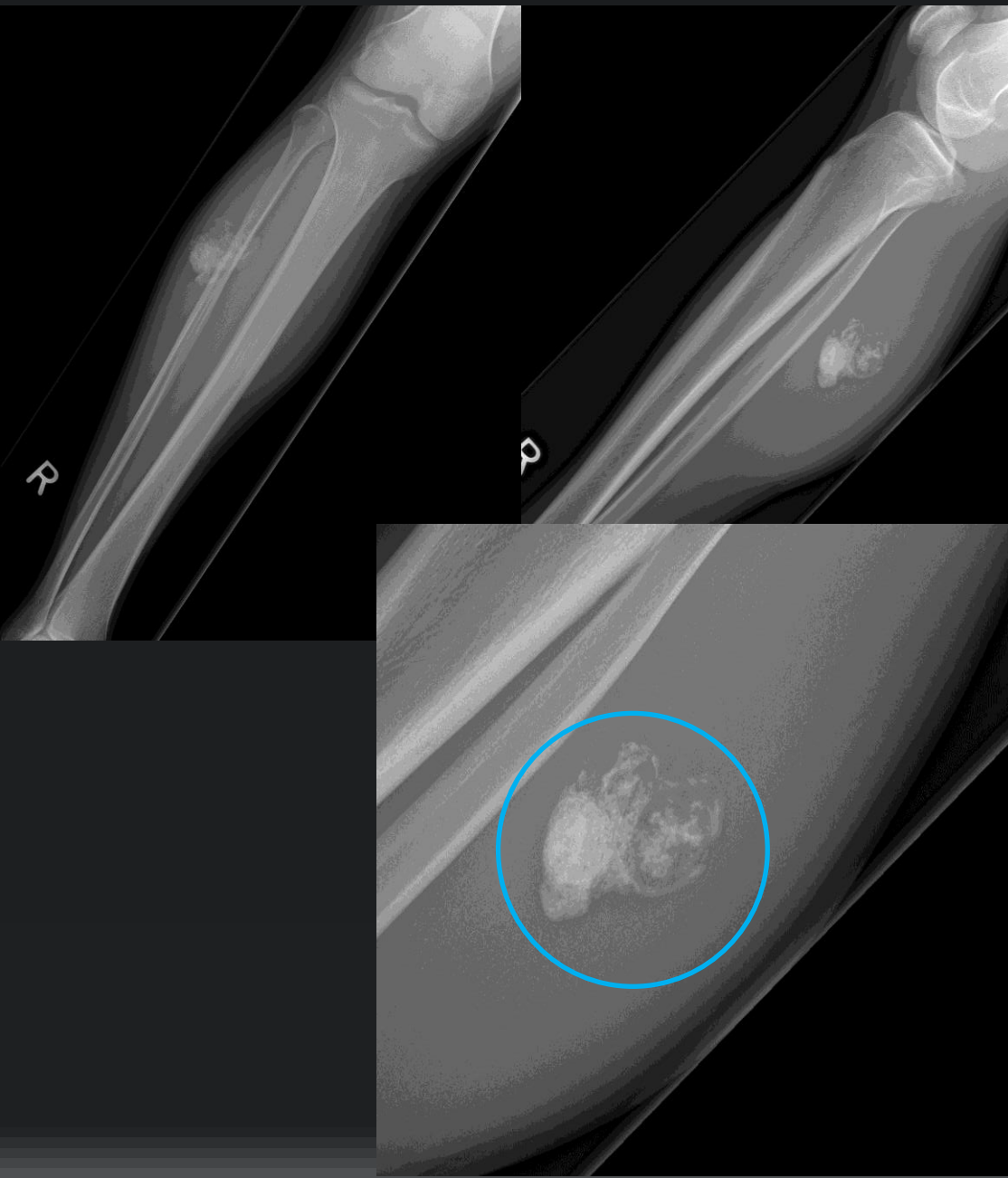
15% upper extremity.

5-10% intra-articular.

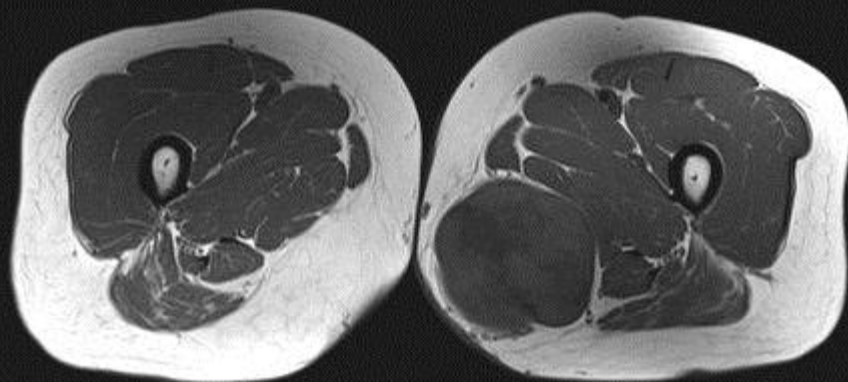
25-30% amorphous calcification.

10-20% bone invasion.

+/- juxta-articular osteoporosis.



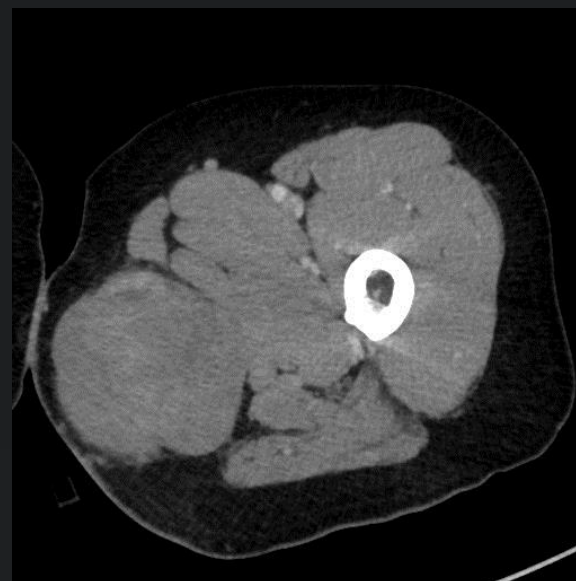
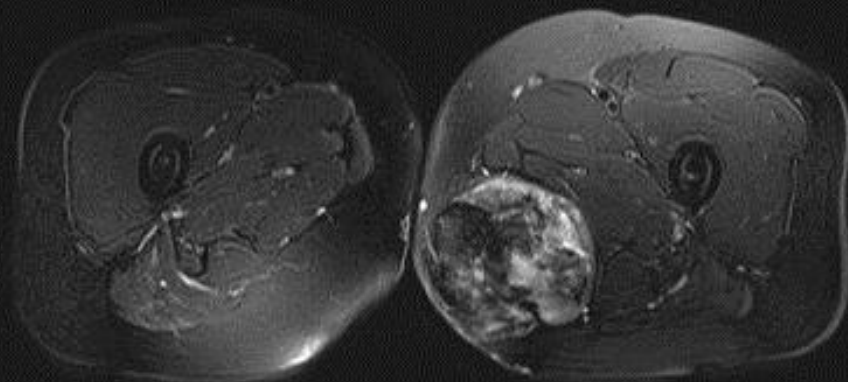
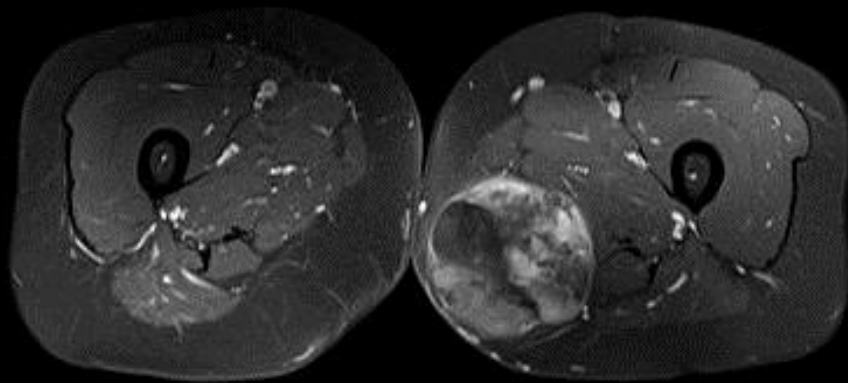
Synovial Sarcoma

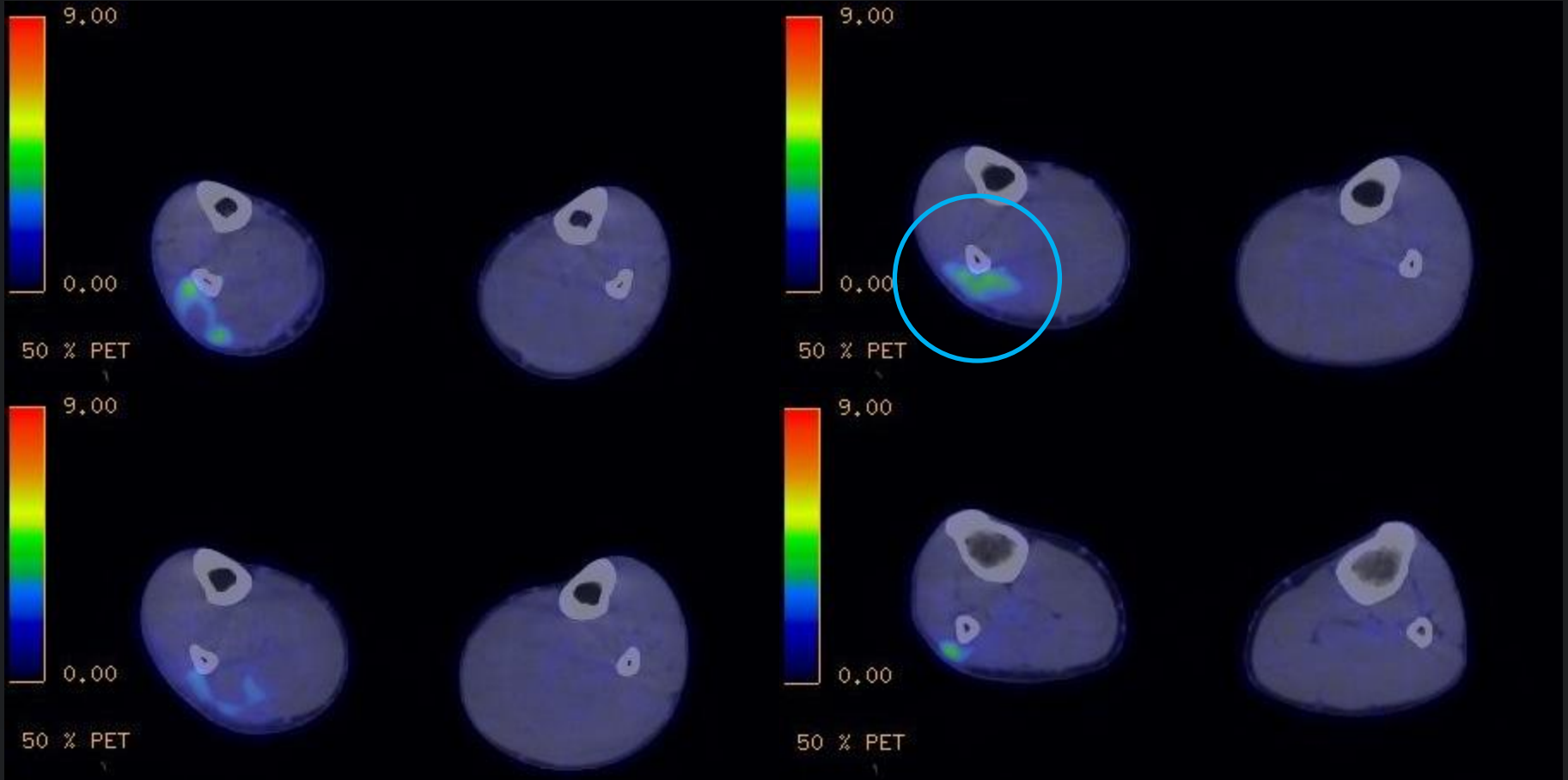


CT :

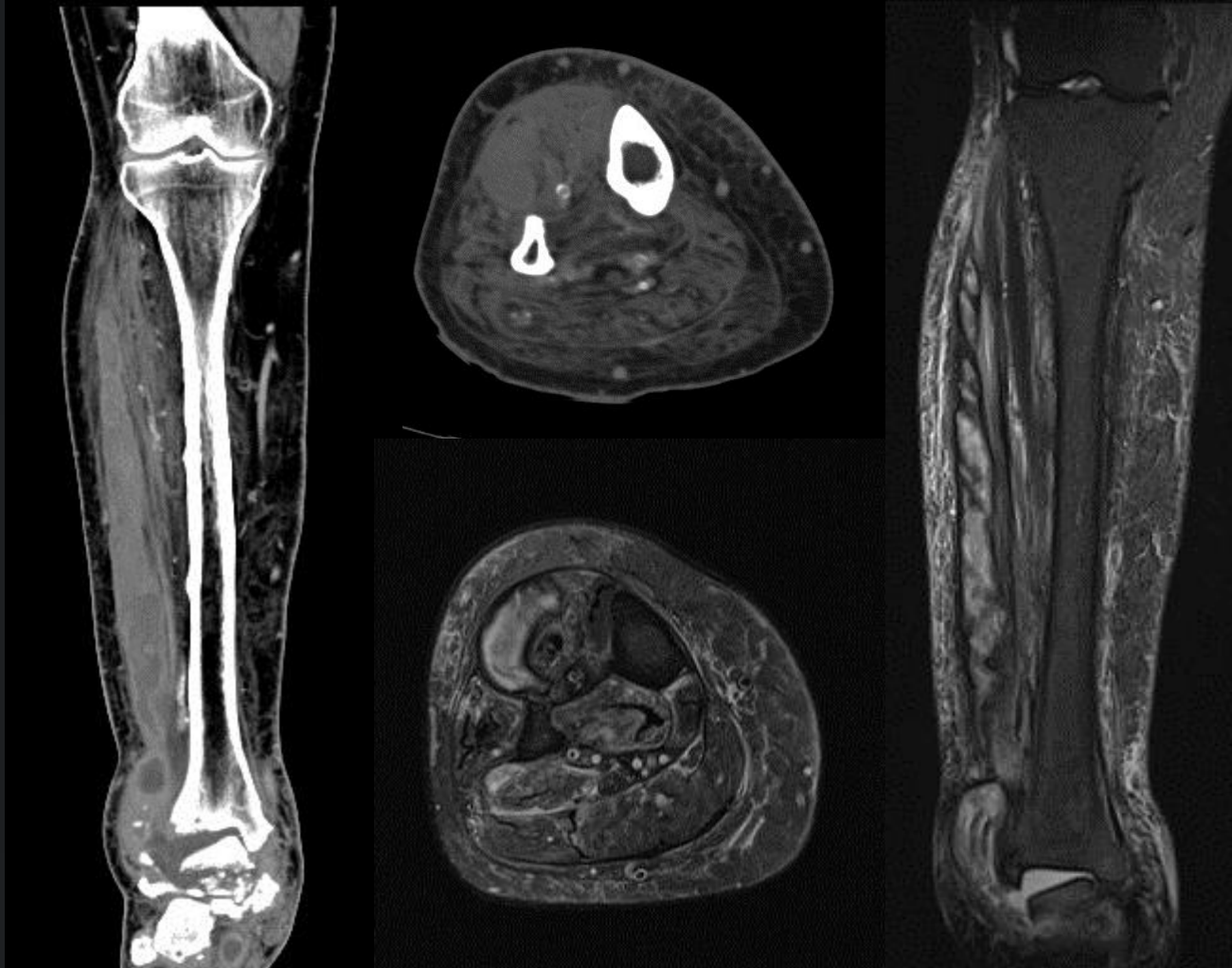
Iso-dense to muscle.

- Haemorrhage,
- Necrosis,
- Calcification,
- Enhancement ++





Differential Diagnosis



Abscesses.

Rapidly growing.

Painful.

Systemically unwell.

Early presentation.

Differential Diagnosis



Peripheral Schwannoma

Often, signs suggestive of schwannoma are present.

- Pain
- Paraesthesia / anaesthesiae.
- Tender if pressed.

Growth rate is variable.



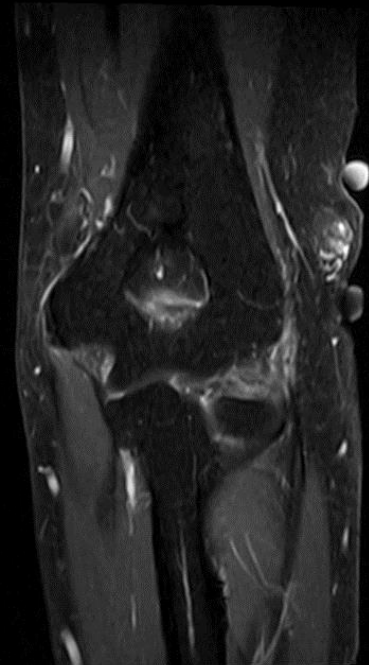
Differential Diagnosis

Sebaceous cysts.

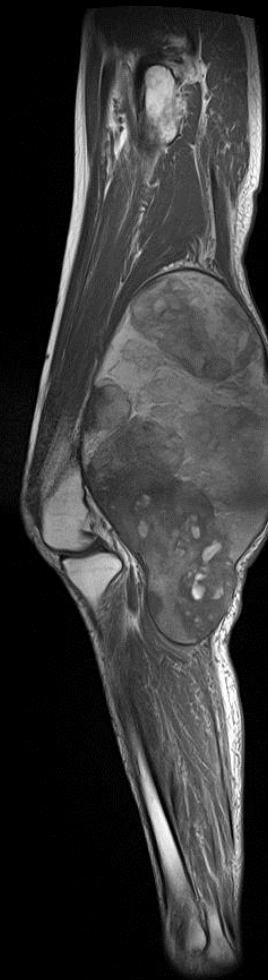
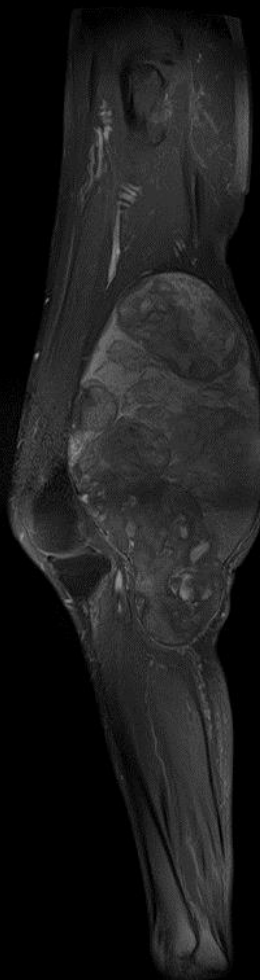
Inclusion cysts.

AVM

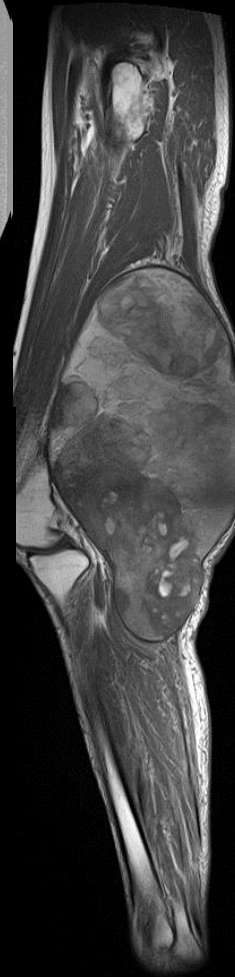
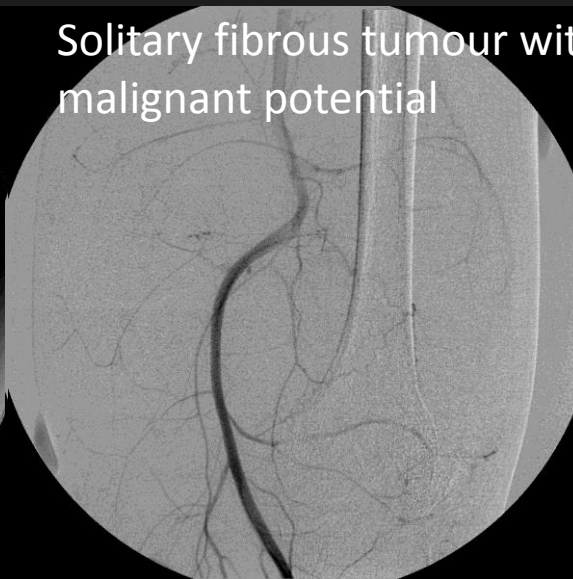
Etc..



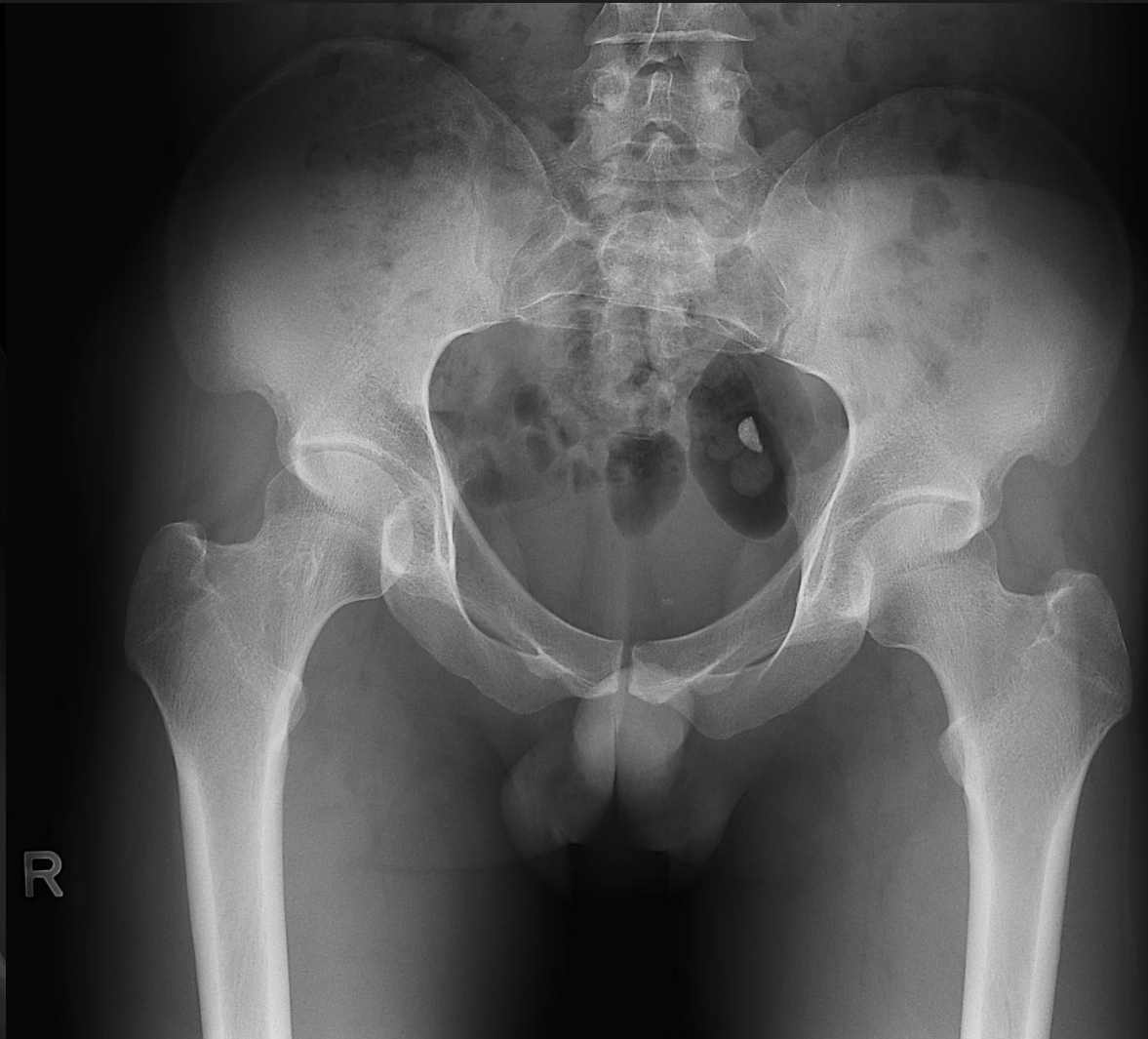
Solitary fibrous tumour with low malignant potential

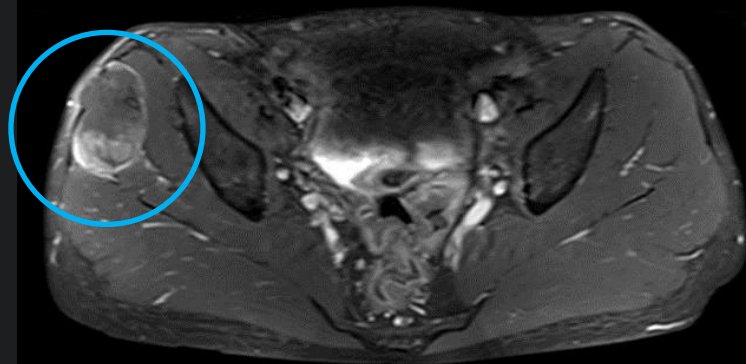


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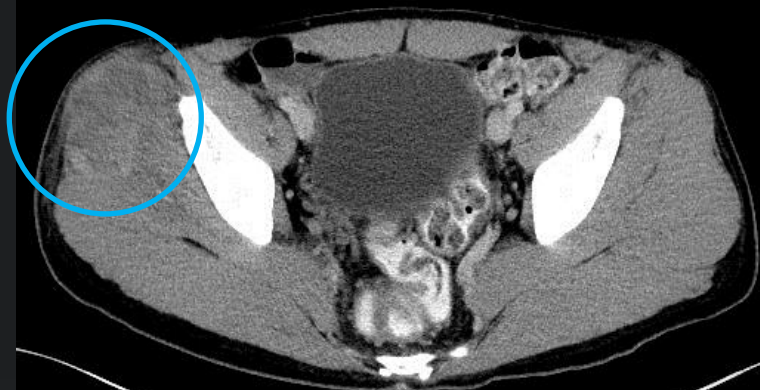


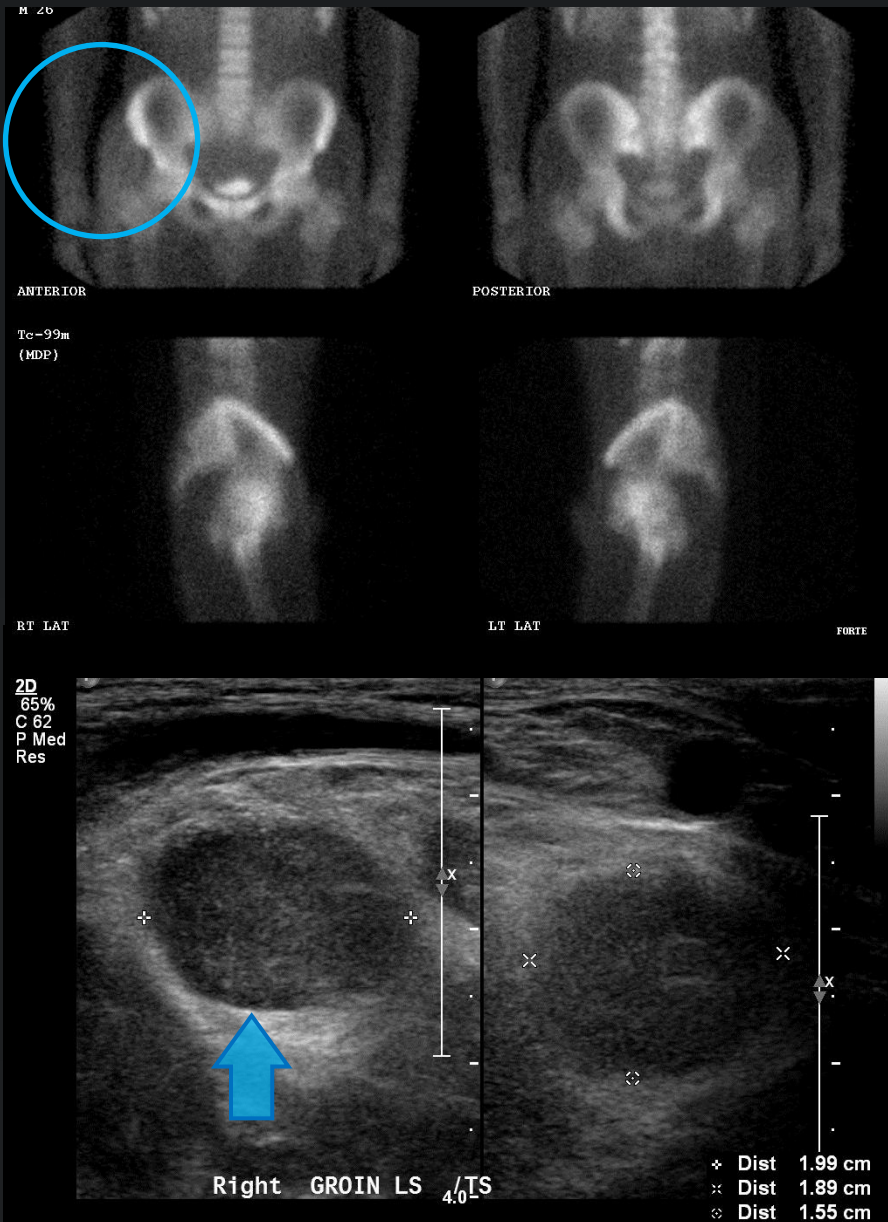
First presentation with vague lump
over right hip region.





06/12/2013 MRI
20/12/2013 CT

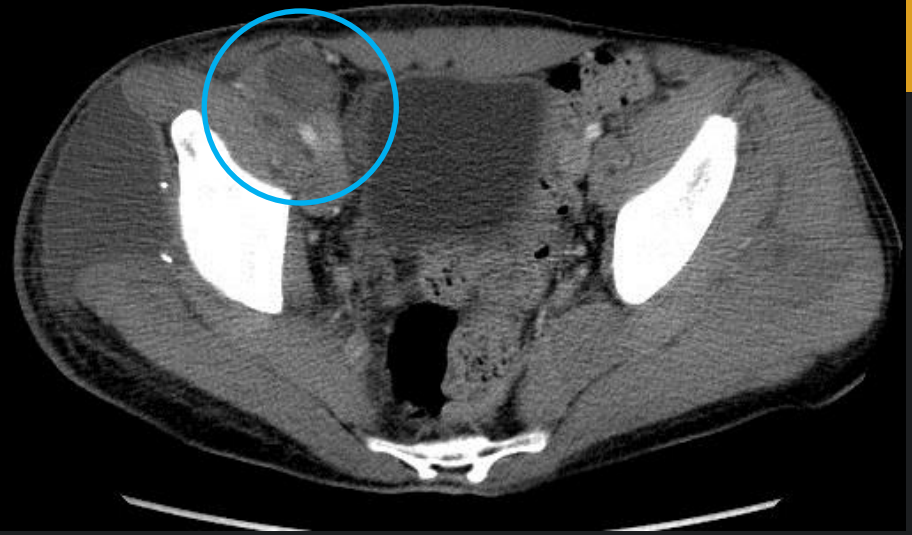




Bone Scan 26/12/2013

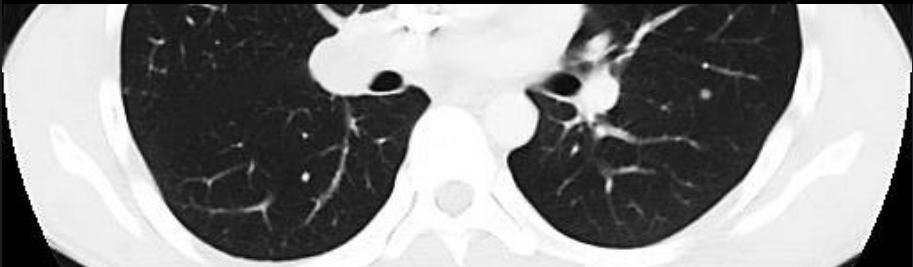
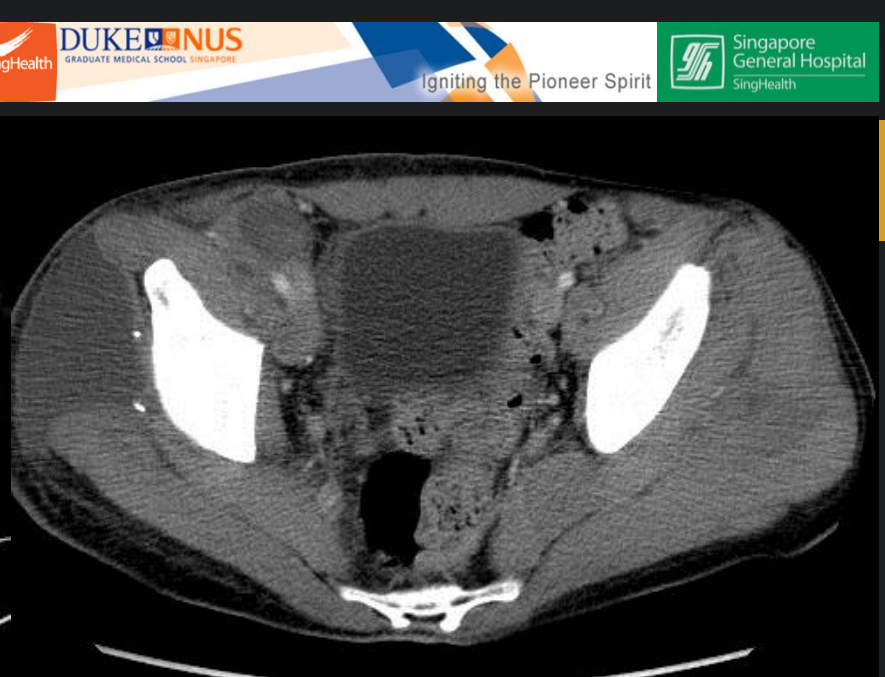
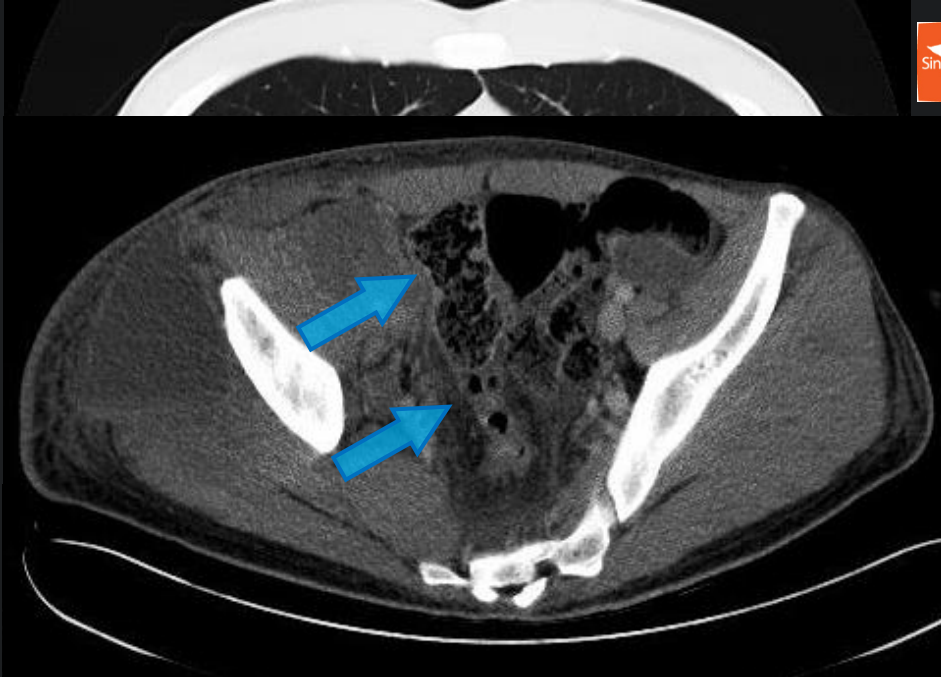
Three months later...

- Palpable lump in right groin.
- US done on 02/2014



Three months later...

- CT done late 02/2014.

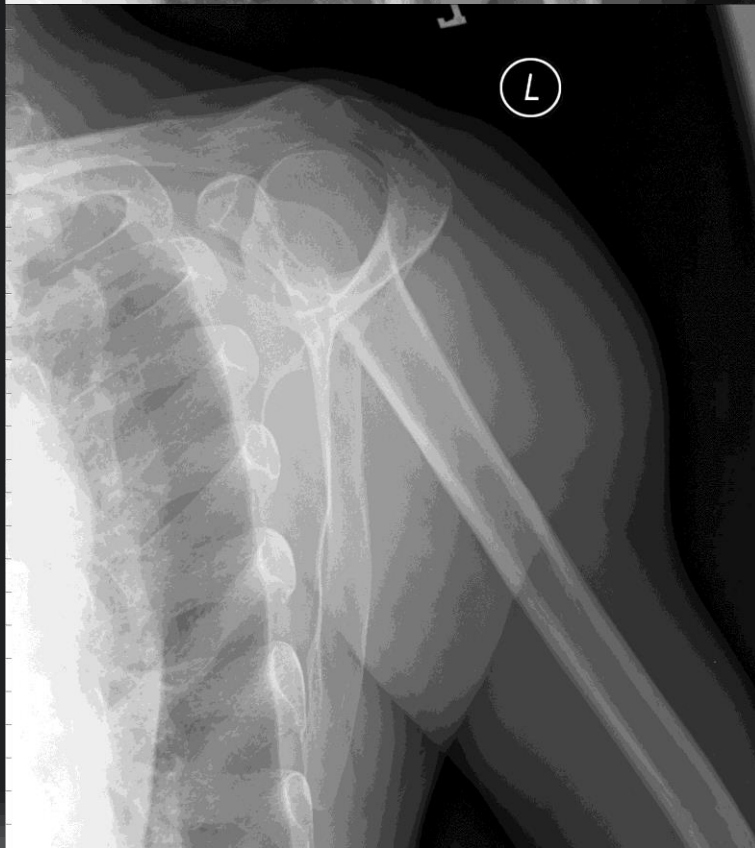


- CT Scan –
- Local recurrence.
 - Right Inguinal Lymph Nodal recurrence.
 - Lung Metastases.

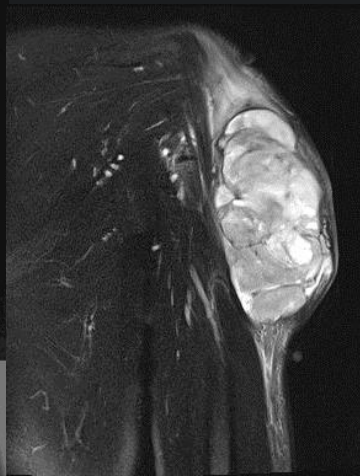
Rapidly spread.

Dx : Clear Cell Sarcoma

L



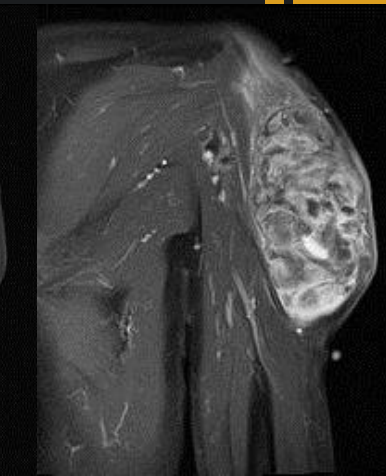
Left arm swelling 2010



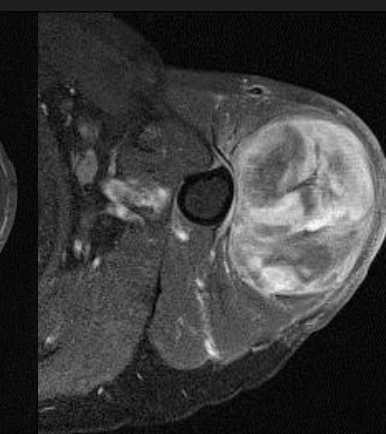
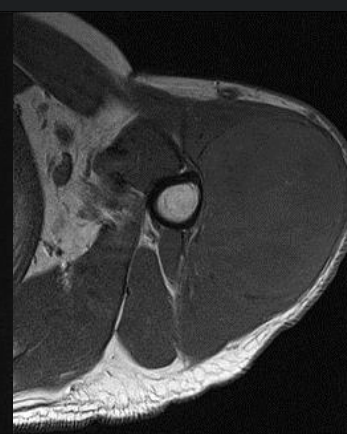
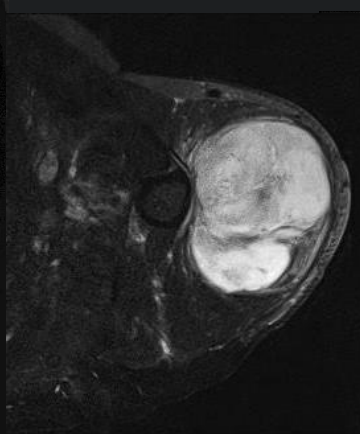
T2 TSE FS

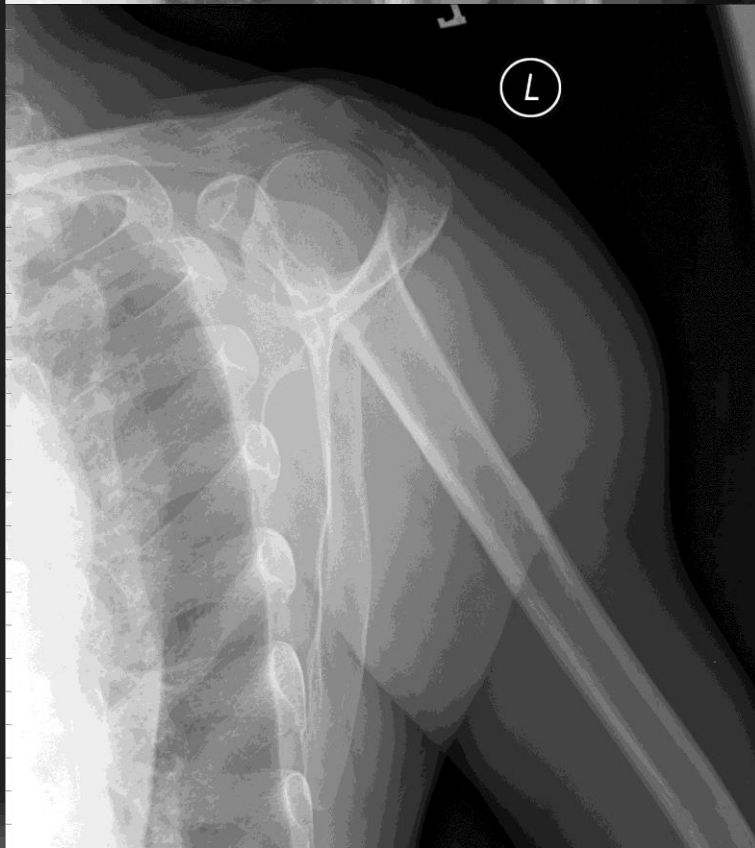


T1 TSE



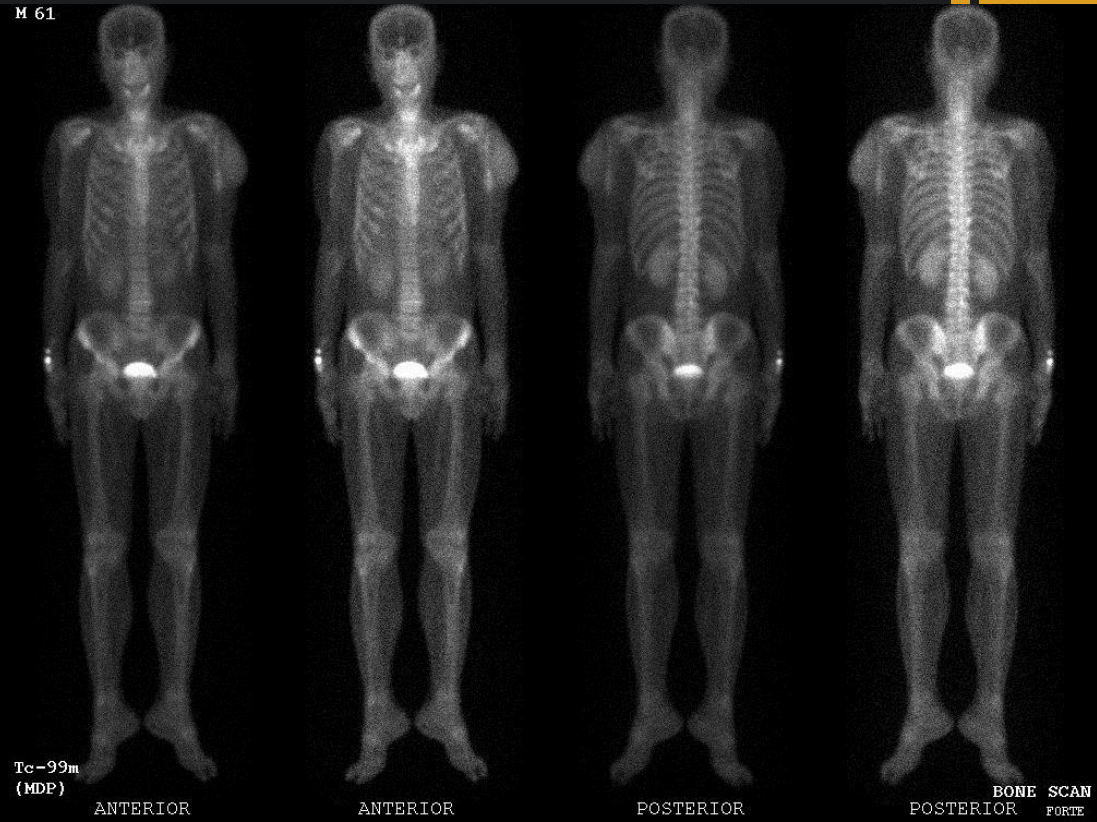
T1 TSE FS + Gd





Dx : Myxofibrosarcoma

M 61



Tc-99m (MDP)

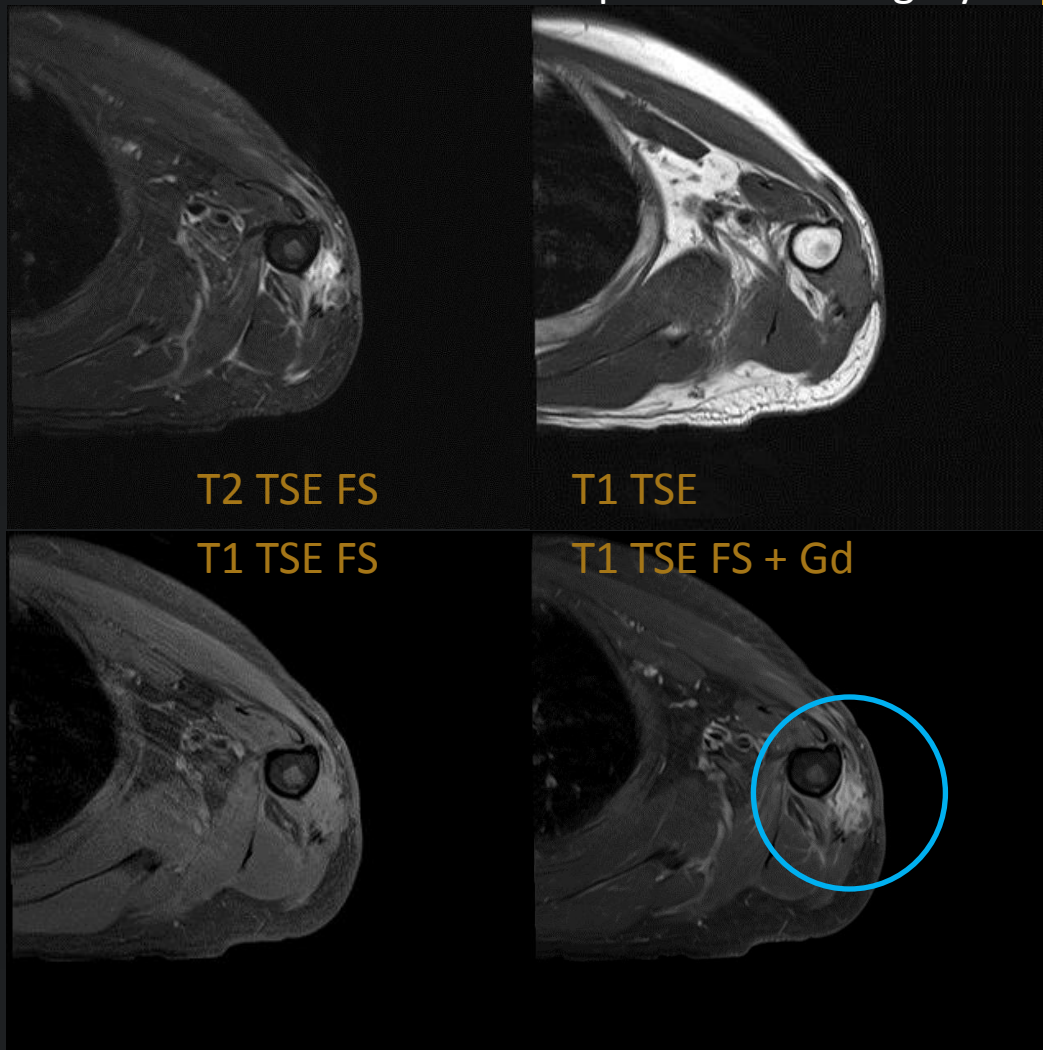
ANTERIOR

ANTERIOR

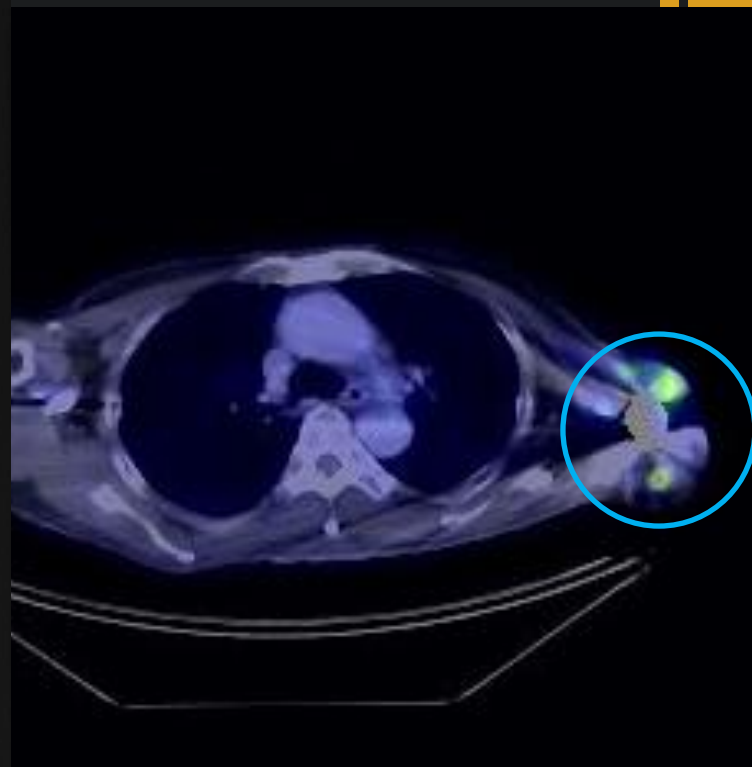
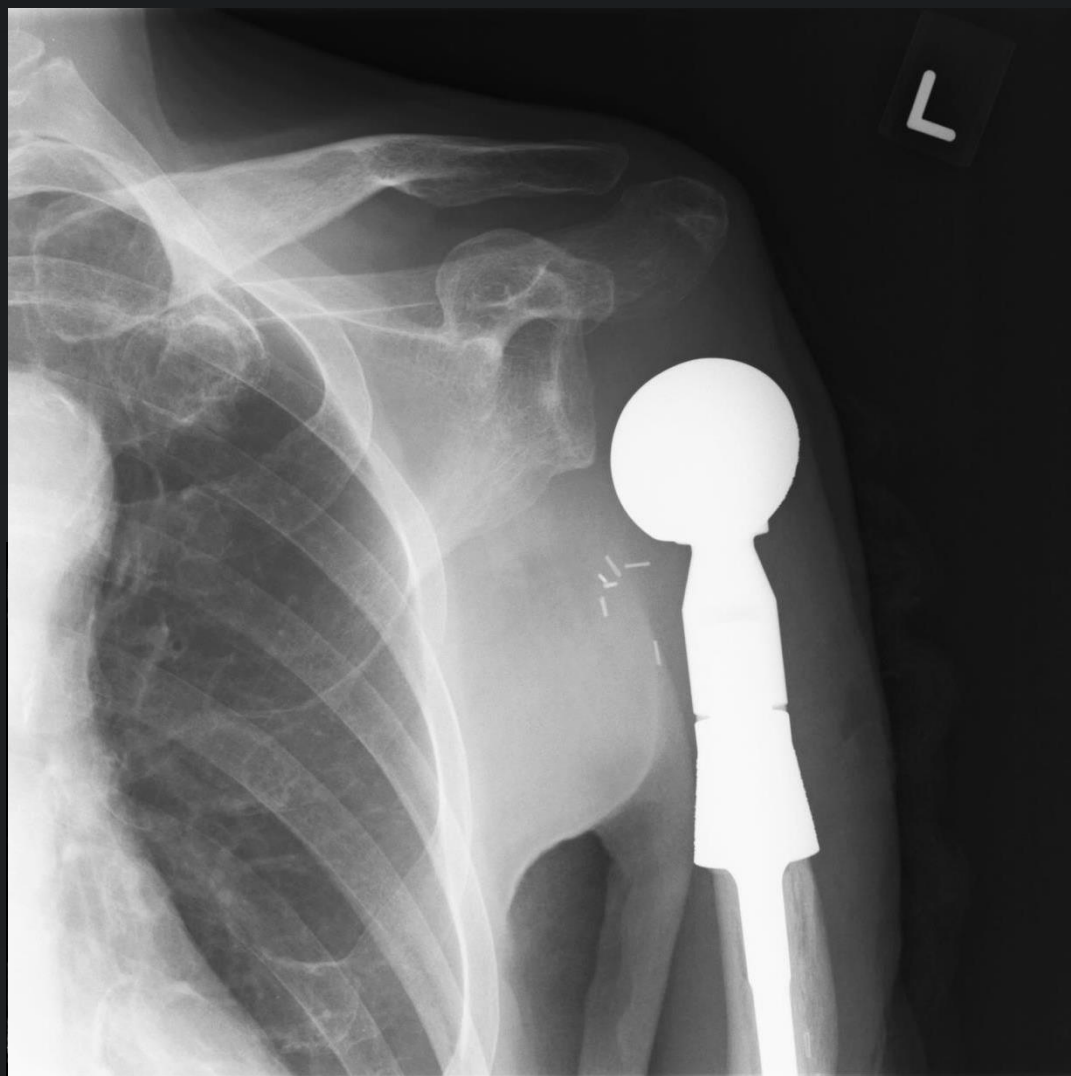
POSTERIOR

BONE SCAN PORT
POSTERIOR

2012 – New lumps felt after surgery.



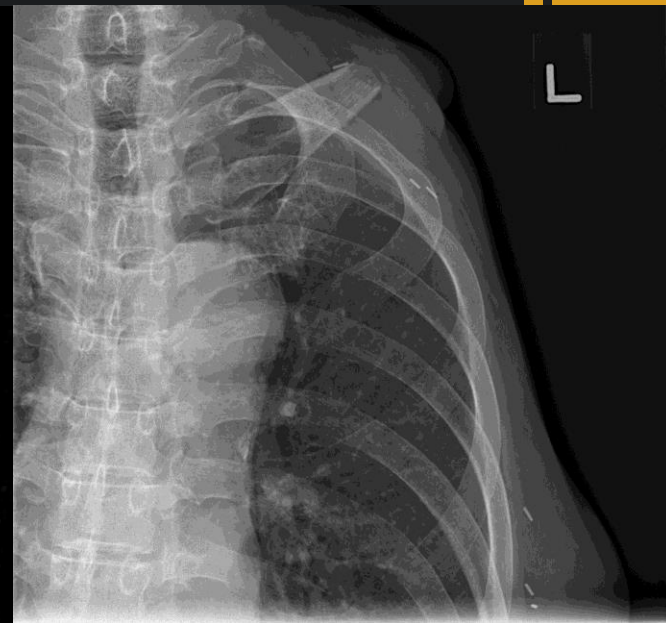
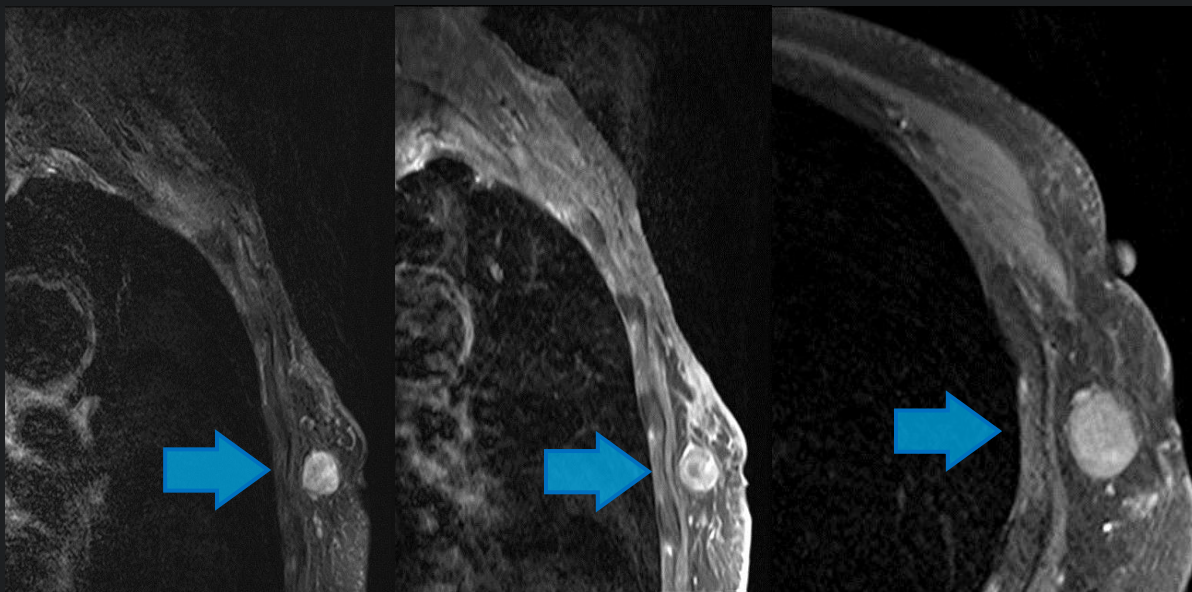
2013 – More local recurrence.



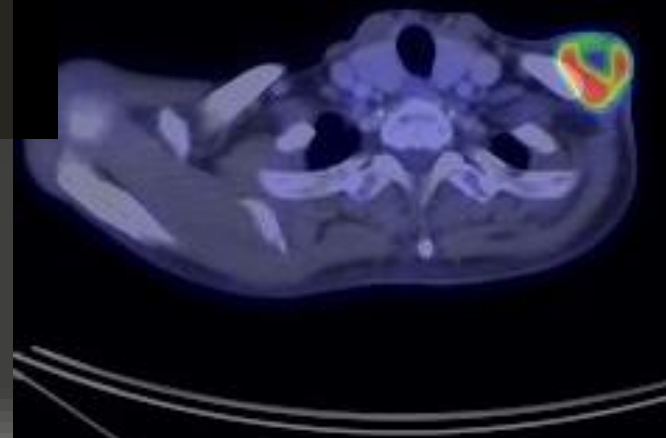
Surgery – Function sparing surgery with megaprotheses.

2014 – Re-recurrence Again

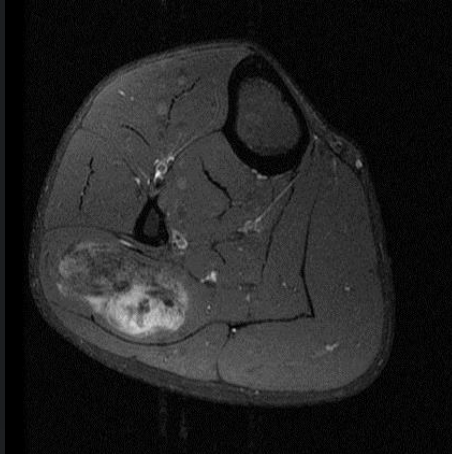
2013 Dec – Forequarter amputation



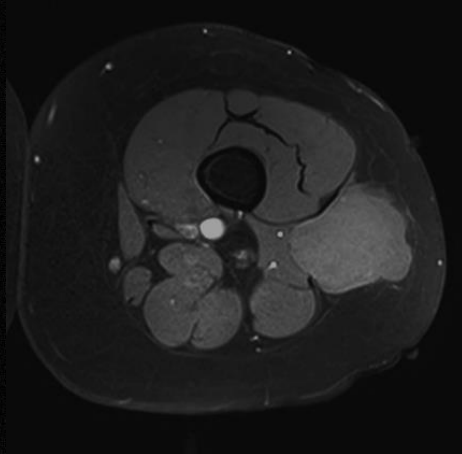
- Lower extremity 50%, upper extremity 25%, retroperitoneum 15%.
- Deep intramuscular 70%. Subcutaneous 5-10%
- T1w intermediate signal.
- T2w intermediate to high signal.
- Heterogeneous – collagen, myxoid tissue, necrosis +/- haemorrhage.
- Fibrous pseudocapsule – well defined margins.
- Destruction of adjacent bone.



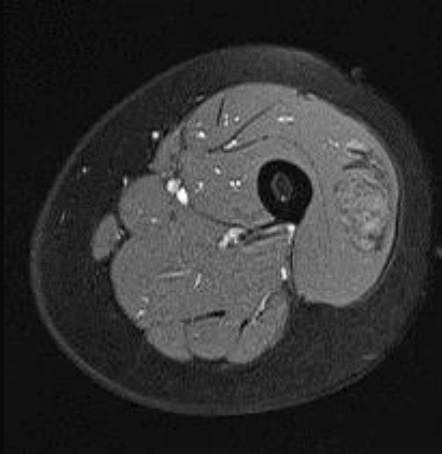
Diagnostic and Management Dilemma



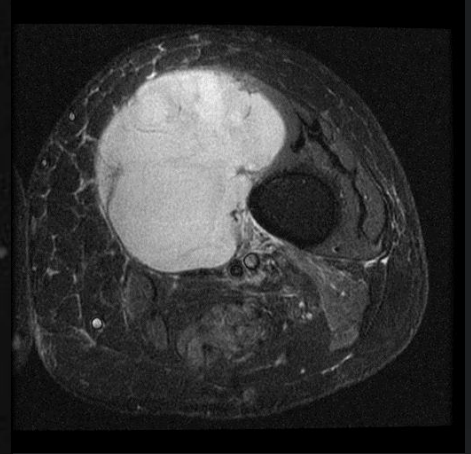
Synovial Sarcoma
Subcut AVM



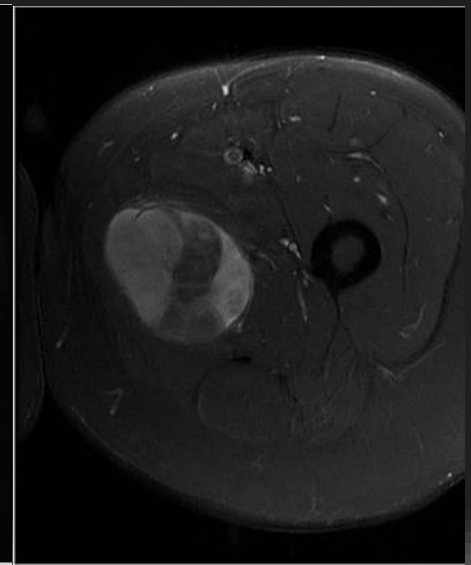
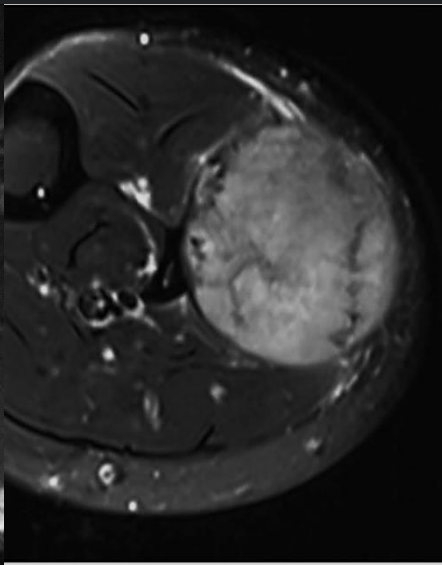
Myxoid Liposarcoma
Intramuscular Lipoma



Well Diffd Liposarcoma
Alveolar Soft Part Sarcoma



Myxofibrosarcoma
Pleomorphic Sarcoma



Unable to accurately diagnose the histology of the soft tissue sarcoma.

Imaging features are non-specific and indeterminate with current imaging modalities.

Imaging guided percutaneous or surgical open biopsy.

Consultation with Orthopaedic surgeon is essential prior to any imaging guided biopsy
- to avoid seeding of track.



Liposarcoma with recurrence.

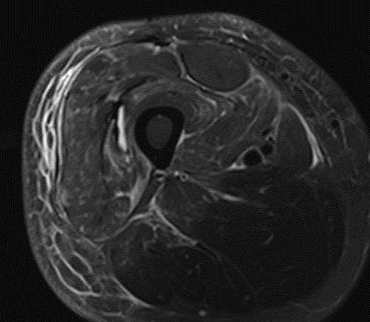
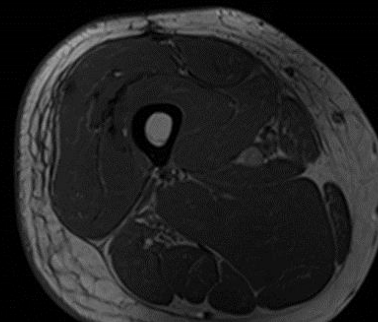
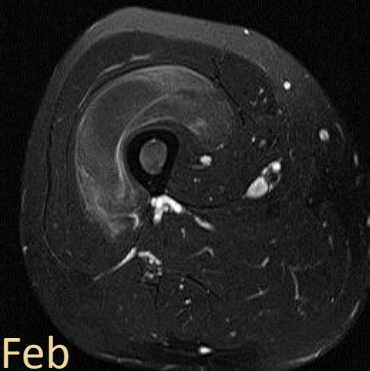
Continued and frequent follow up imaging is essential as recurrence is common.

Follow up can be –

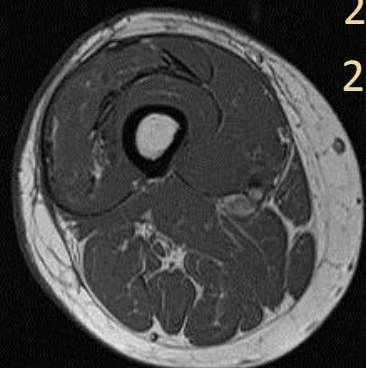
- Just XRs.
- XRs with MR
- XRs with MR +/- PET-CT



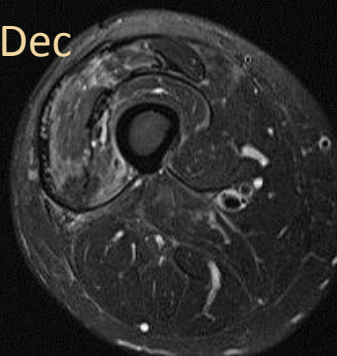
2011 Feb



2011 Dec



2012 Dec



Finally...

For suspected soft tissue sarcoma –

Get X-Rays of the affected body part/extremity.

Get Chest X-Ray.

Consider MRI – focused to the Region of Interest!

Assess the patient for eligibility for intravenous contrast (Gadolinium-chelate) administration.

Consider CT

- If MRI is contra-indicated/not available.
- To characterise the calcifications.

Nuclear Imaging – PET-CT/PET-MR, Bone scans,

- Problem-solver.
- Follow up after therapy.

Multi-Disciplinary Team involvement and discussion essential.

Thank you for listening.

- steven.wong@sgh.com.sg

My thanks to –

SGH Diagnostic Radiology Imaging Specialists

SGH Musculoskeletal Radiology Team

The Organising Committee.