



Dr Grant Meikle

Radiologist

Otago Radiology

Musculoskeletal Radiology – Concurrent Workshop Repeated

Friday, 16 August 2013

Start 2:00pm

Duration: 55mins

Kandinsky

Start 3:05pm

Duration: 55mins

Kandinsky



South GP CME 2013

General Practice Conference & Medical Exhibition

15-18 August | Edgar Centre | Dunedin

MUSCULOSKELETAL IMAGING

An Update and Overview

Dr Grant Meikle

Consultant Radiologist



My Background

Consultant Radiologist

- MBChB 1994 Otago
- FRANZCR 2001
- Musculoskeletal Imaging Fellowship 2001/2002 Canberra, ACT, Australia.
- Current Appointments
 - SDHB Consultant Radiologist
 - Consultant Radiologist, Shareholder, Chairperson Otago Radiology Ltd (Part of the Pacific Radiology Group)
 - Honorary Senior Clinical Lecturer University of Otago Department of Medicine.
- Other commitments.
 - Part 2 examiner FRANZCR
 - External Advisor ACC Treatment Injury Claims Unit.



Workshop Structure

General Principles

The Modalities

Upper Limb

Lower Limb

Spine

How it all started?

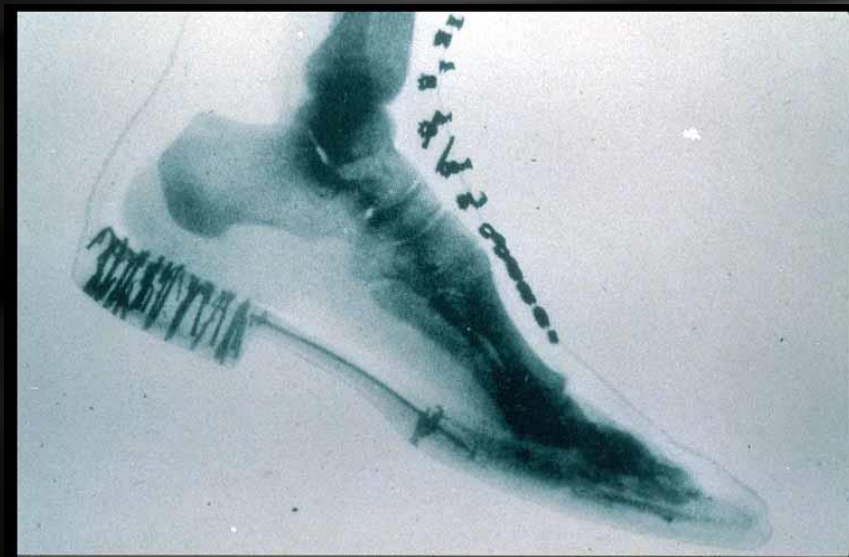


Roentgen 1896



Mrs Roentgen's Hand

Hindsight is wonderful thing!



Radiation Effects





Radiation Dose



Exam	Effective Dose (mSv)	No of CXRS	Days Background Radiation
CXR	0.013		2.4
L Spine AP/Lat	0.44	34	81.6
T Spine AP/Lat	0.3	23	55.2
Pelvis	0.41	32	76.8
CT L Spine	7.6	585	1404

Diagnostic Radiation Exposure Context

Procedure or event	Risk of Fatal Cancer	Equivalent number of cigarettes	Equivalent number of highway kilometres
CXR	1.3/1000000	9	37-62
CT Chest	400/10000000	2960	11420 - 19040
18 hour flight	1.3/1000000	9	37 - 62

Source = Inside Radiology (RANZCR website)

http://www.insideradiology.com.au/pages/view.php?T_id=57#.Ugixlqxafos



Cost



The cost of Imaging varies but is in the range of:

- Xray \$0 - \$150
- US \$0 - \$300
- CT \$0 - \$2000
- MRI \$0 - \$2000

The cost of an Imaging Examination is dependent on many factors including:-

- Equipment.
- Staff (MRTs ,Radiologists, Nurses, Clerical)
- IT.
- Public vs Private system
 - Government Funding/Insurance/ACC/Community Schemes.



Justification



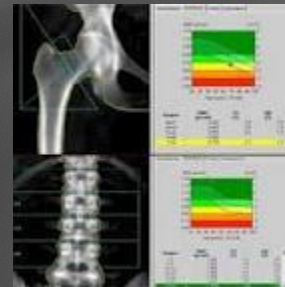
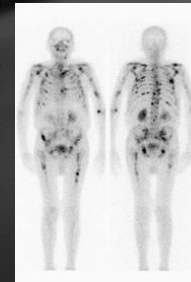
The most important consideration is balancing the risk (radiation), and cost of the examination against the clinical utility of the examination.

EXAMPLES

- Stubbed toe 2 hrs ago, weight bearing normally but sore toe.
- Persistent bony knee pain without history of trauma and increasing lethargy and weight loss.

The Modalities

When Imaging the Musculoskeletal System all modalities have a role but have different strengths and weaknesses.



Imaging Pathway

The Imaging Pathway Chosen will depend on multiple factors including.

- Guidelines
- Access (Location, Waiting Times etc)
- Local Availability and Expertise
- Cost
- Previous Experience

Modalities

Strengths and Weaknesses in Bone and Joint Imaging

	TISSUE				
MODALITY	Bone	Tendon Ligament	Cartilage	Peripheral Nerve	Vascular
Xrays	+++	+	+	+	+
CT	+++++	++	++	++	+++++
US	+	+++++	+	+++++	+++
MRI	++	+++++	+++++	+++++	+++++

Xray

Widely Available.

The usual starting point.

Easy to Interpret?

Radiation.

Limited soft tissue detail.

Limited Sensitivity.



Ultrasound

Widely available and accessible.

Relatively low cost

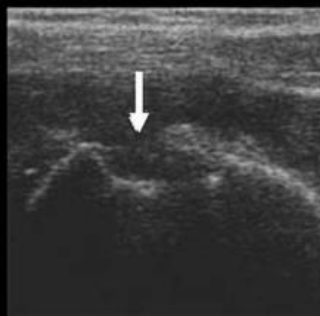
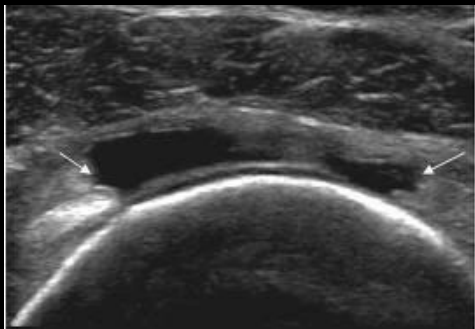
Dynamic

Can guide intervention

No radiation.

Operator and equipment dependant.

Limited detail deep structures.

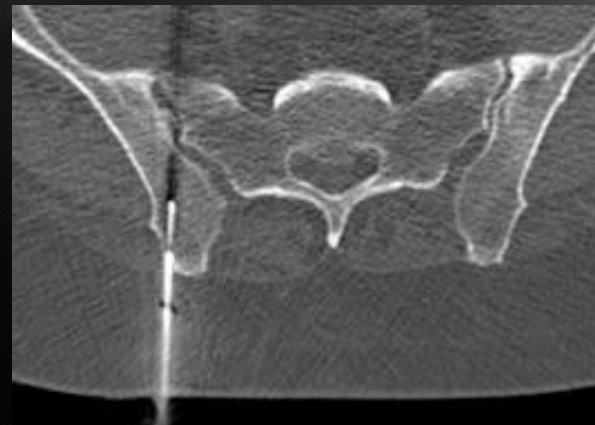
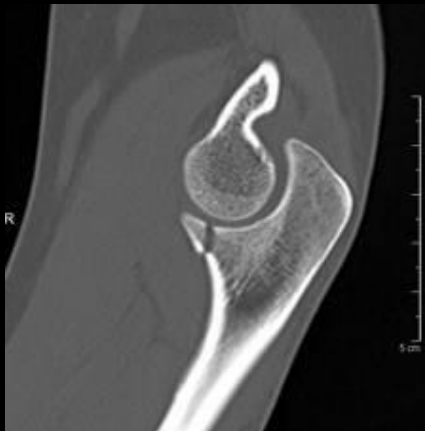


CT

Great bony detail
Can manipulate data
Quick
Widely available
(?accessible)
Can use to guide biopsy

Radiation

Cost



MRI

Great soft tissue contrast.

Multiplaner.

Sees deep structures well.

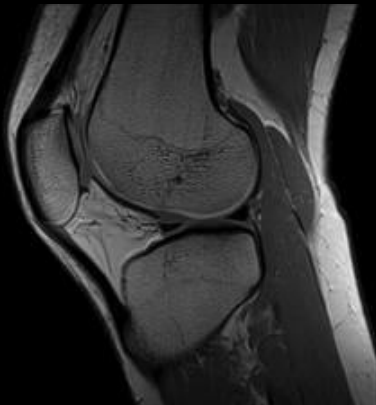
Can add arthrography.

Expensive.

Limited availability still.

Accessibililty Limited.

Some contraindications.



Nuclear Medicine – Bone Scan



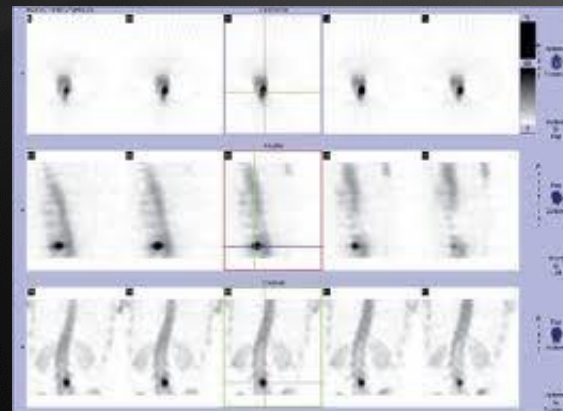
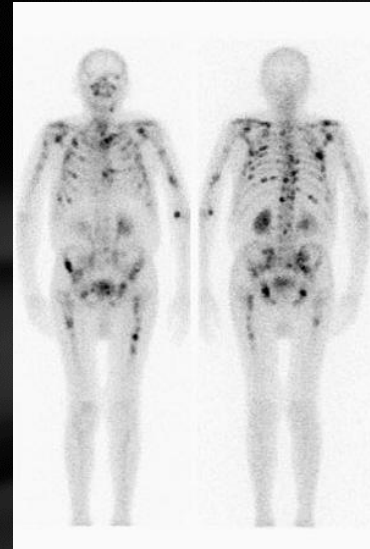
Great Sensitivity
regarding Bone
pathology.

Limited Specificity

Radiation

Limited Availability

PET – FDG/NaF



CASES



Shoulder

Case 1

A 18 yo male injures him self at rugby and presents to a GP clinic

He has a limited range of motion and is focally tender over the AC joint.

In terms of imaging what should you do next

- Nothing
- Xray
- Ultrasound
- CT
- MRI

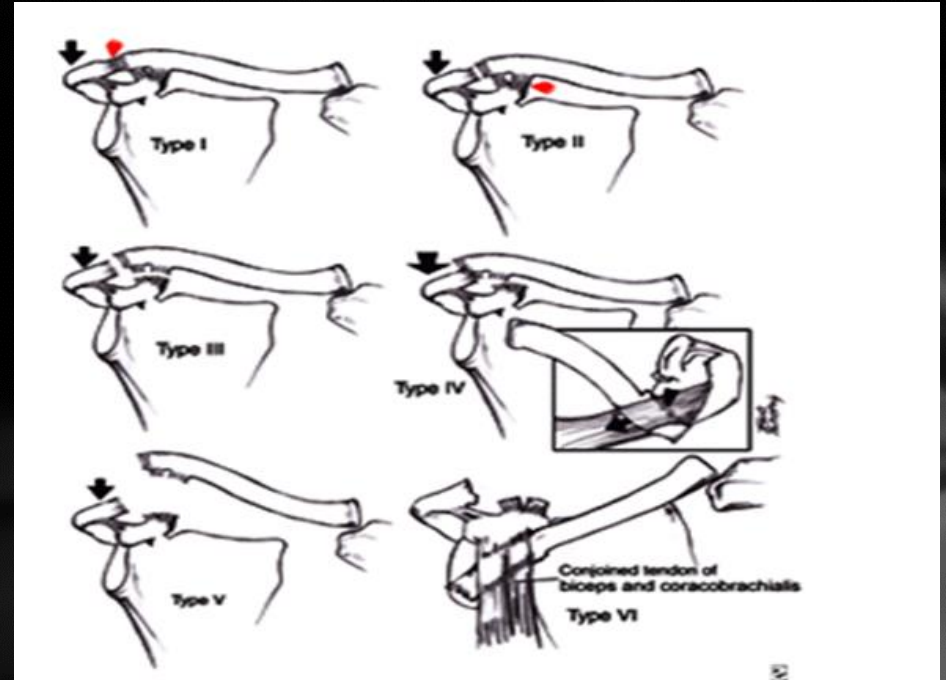
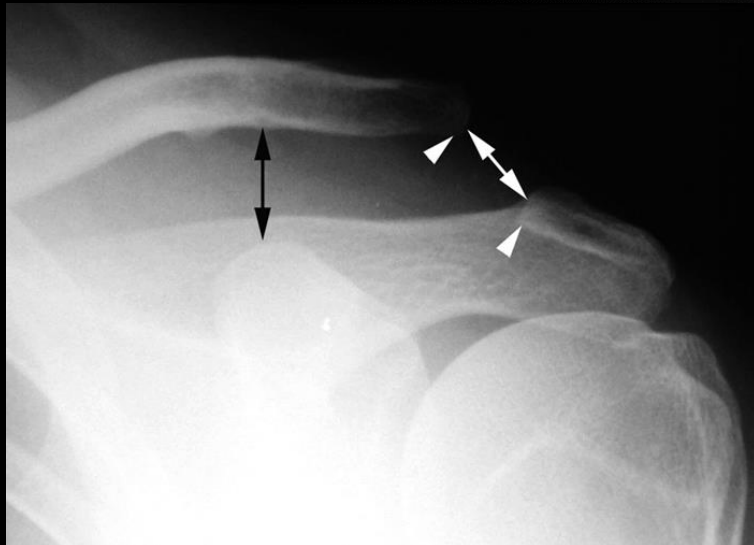
Shoulder

Case 1

Answer = Xray

Why?

- Fracture
- Grading
- Treatment



Shoulder

Case 2

A 18 yo male injures himself at rugby and presents to your clinic.

He has a limited range of motion and is focally tender over the AC joint.

You perform an Xray which is normal.

He however returns 3 months later with disabling ongoing pain and has a repeat Xray

What is the diagnosis?



Shoulder

Case 2

Answer = Distal Clavicular Osteolysis

Why does it matter?

Can be progressive and disabling. Consider Orthopaedic referral

Shoulder

Case 3

A 56yo female has a fall from a ladder and presents to your clinic.

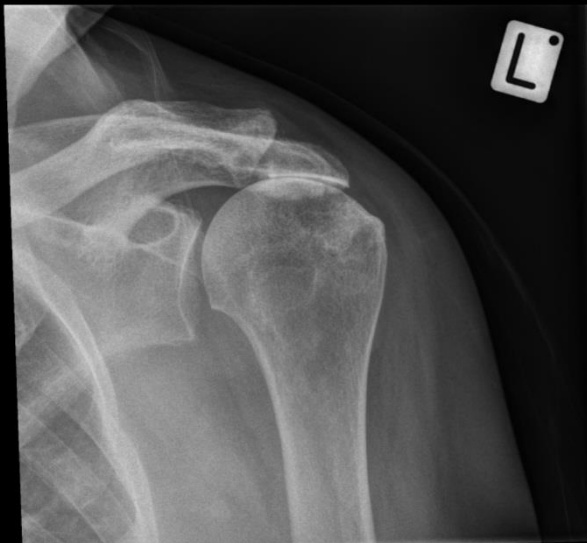
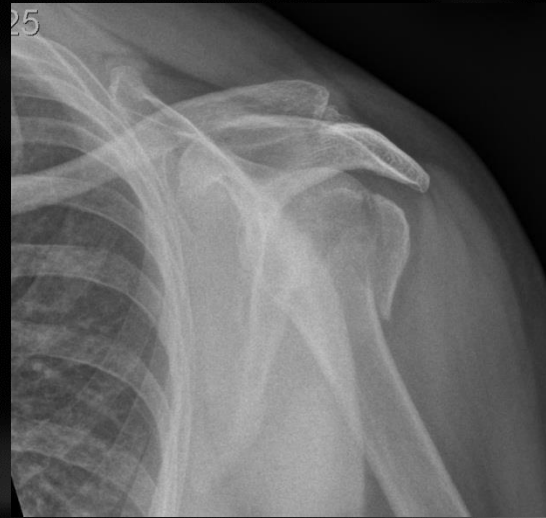
On examination she is generally tender but particularly over the proximal humerus.

Would you Xray?

Shoulder

Case 3

You do Xray and it is normal.



Shoulder

Case 3

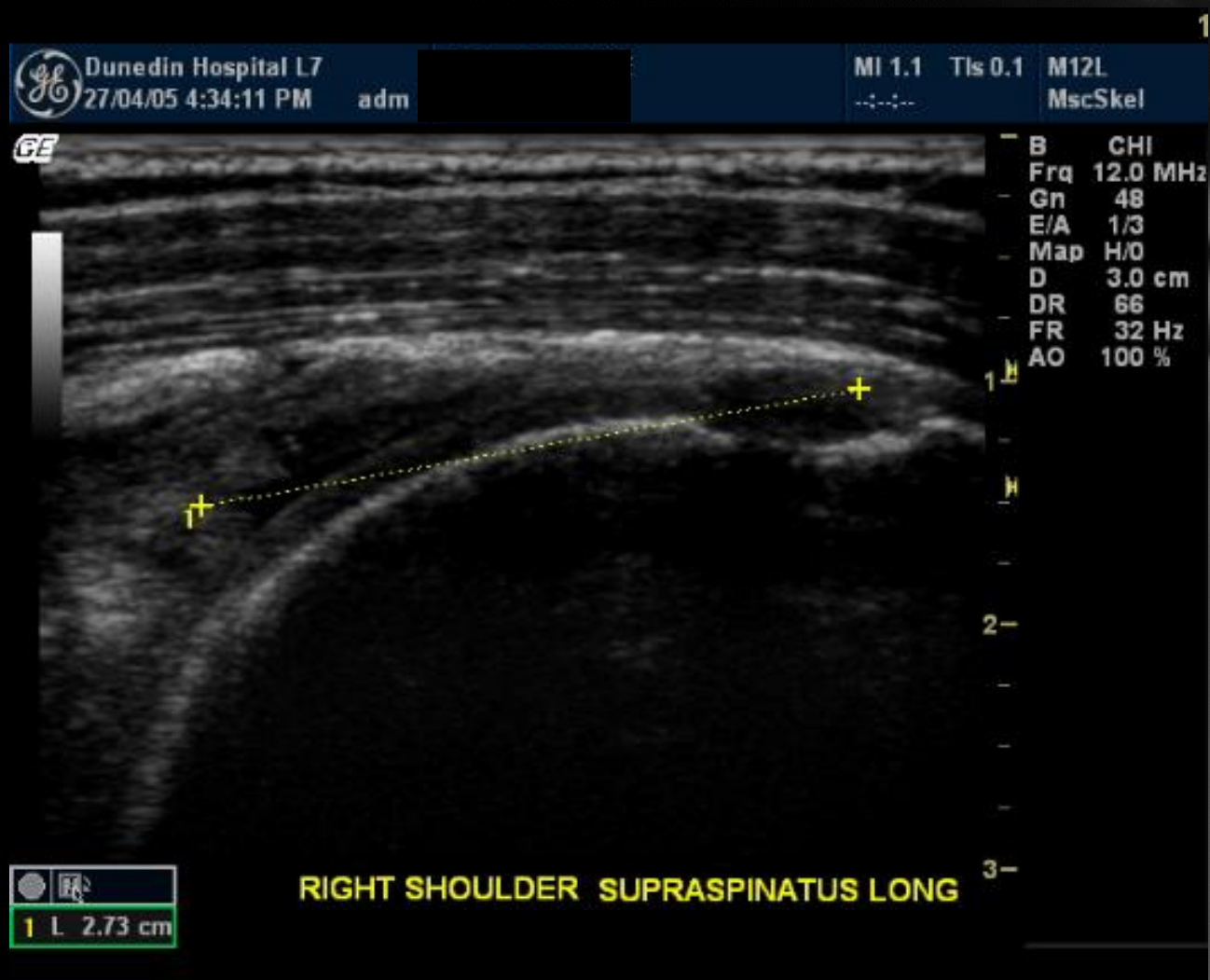
The patient returns 6 weeks later complaining of continuing pain and weakness.

On examination the patient has pain on abduction and has a positive Hawkins And Empty Can tests

What's the next most appropriate imaging study

- Repeat Xray
- Ultrasound
- MRI

US



MRI SHOULDER



Not for diagnostic use

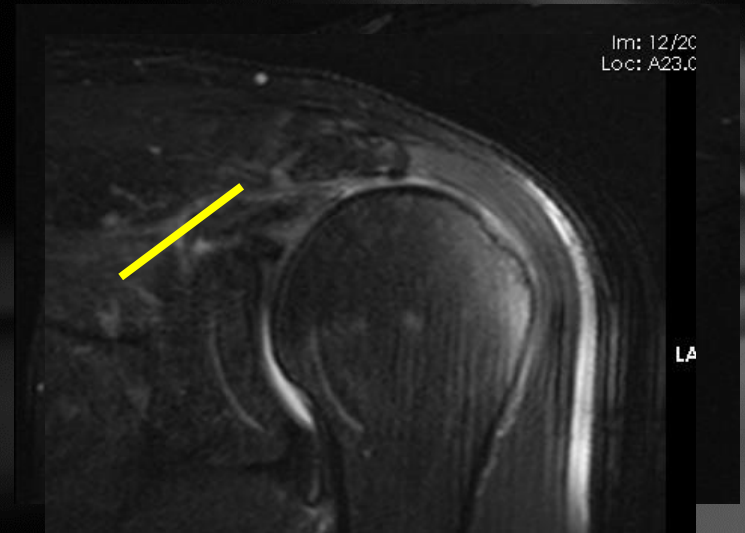


Not for diagnostic use



Not for diagnostic use

ROTATOR CUFF TEAR CHARACTERISATION



CASE 1

FFT SST large on US
? Suitable for repair
FFT SST large on US
? Suitable for repair



Shoulder Case 4

A 72 year old female diabetic presents with a 2 week history of increasing shoulder pain.

On examination she has painful global limited range of motion

Differential Diagnosis

- Septic Arthritis
- Adhesive Capsulitis
- Arthropathy

Tests

- Bloods ESR, CRP, FBC normal

Shoulder Case 4

Your presumptive diagnosis is Adhesive Capsulitis

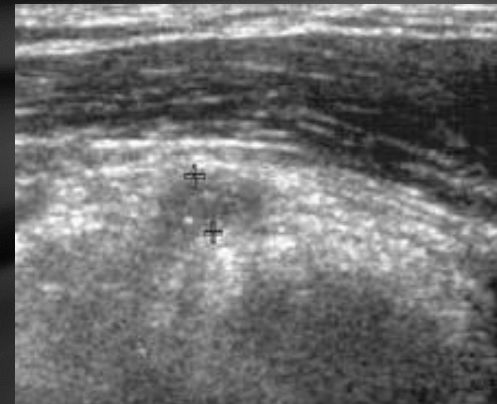
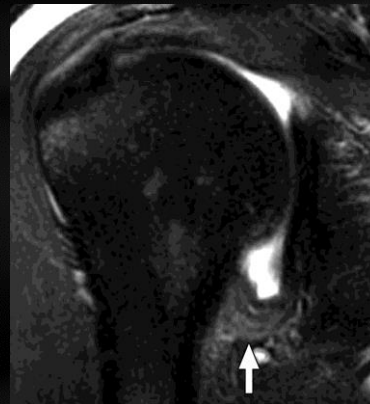
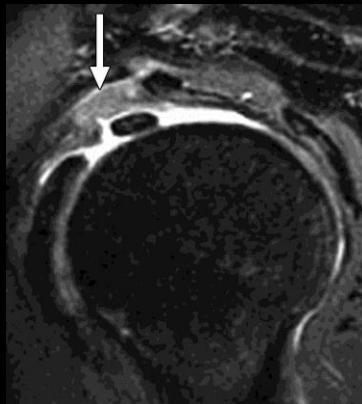
Should you do further Imaging?

Options

Xray

US

MRI



The patient returns 3 months later with severely limited ROM despite physio and NSAIDS. Are there any radiological treatment options?

Imaging guided treatment



BMC Musculoskelet Disord. 2008 Apr 19;9:53.

Hydrodilatation, corticosteroids and adhesive capsulitis: a randomized controlled trial.

Tveitå EK, Tarig R, Sesseng S, Juel NG, Bautz-Holter E.

Department of Physical Medicine and Rehabilitation, Ullevål University Hospital, Oslo, Norway. e.k.tveita@medisin.uio.no

Shoulder

Case 5

A 22 yo rugby player presents to an afterhours clinic following a presumed shoulder dislocation.

Examination confirms this.

Pre Xray.

Post Xray.

Shoulder

Case 5



Shoulder

Case 5 cont

He is discharged to his routine GP and rehabs over a period of 3 months.

On return to play he dislocates and self relocates 3 times over the next 3 months.

He presents with ongoing pain.

Imaging Options

Ultrasound

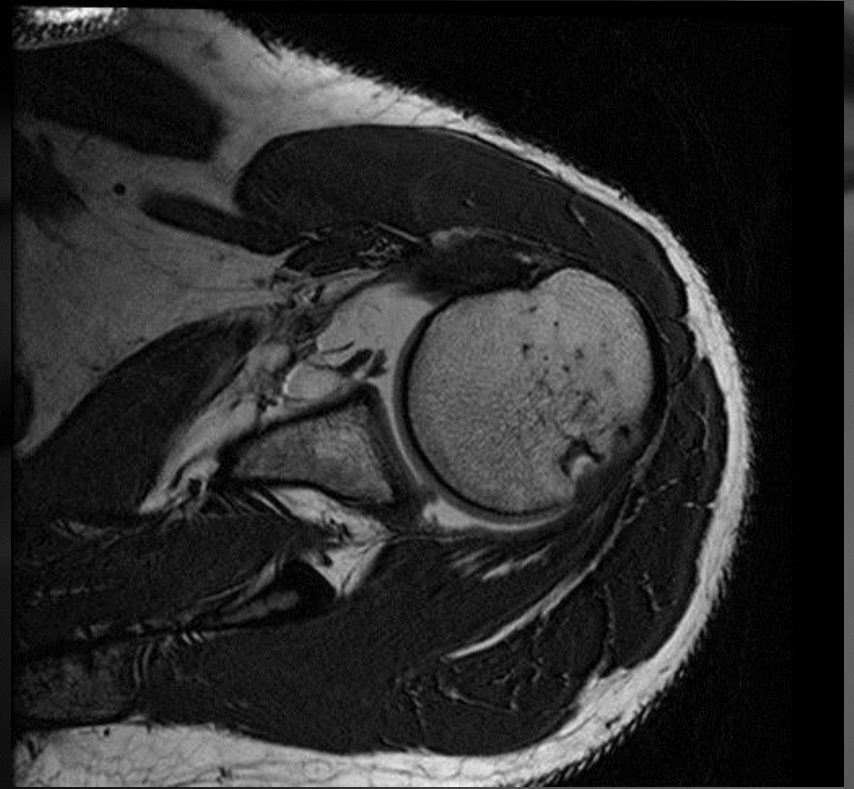
Repeat Xray

MRI

No imaging and refer on.

Shoulder

Case 5



Upper Limb Elbow



Elbow

Case 1

A manual labourer feels a sudden snap in the elbow.

On examination there is weakness and pain on elbow flexion and a positive hook test

Provisonal Dx = Biceps Tendon tear

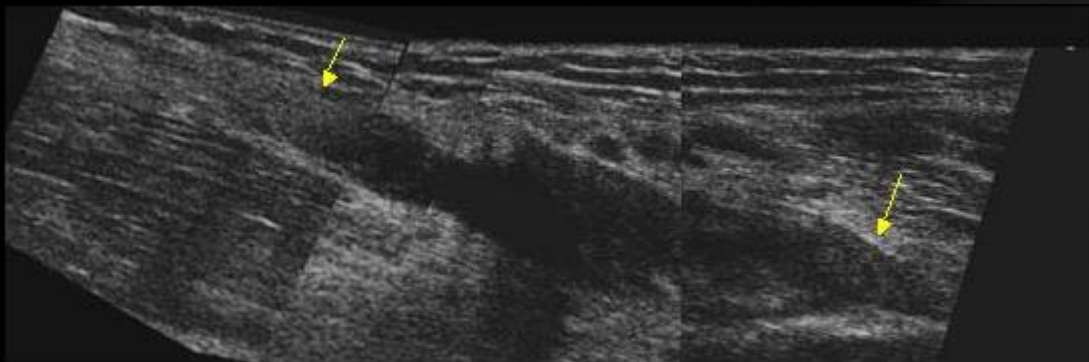
Xray

US

MRI

Elbow

Case 1



Elbow

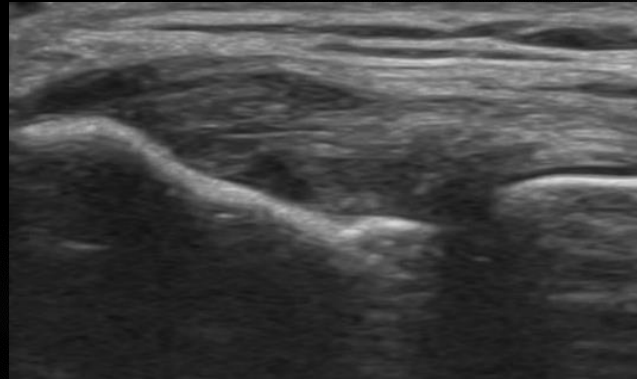
Case 2

A machinist presents with increasing lateral elbow pain over 3 months.

On examination they are tender over the lateral epicondyle.

You enrol the patient in a course of physio including an exercise programme and forearm bands but the patient returns complaining of pain limiting their work.

Imaging Options?



Imaging Treatment Options

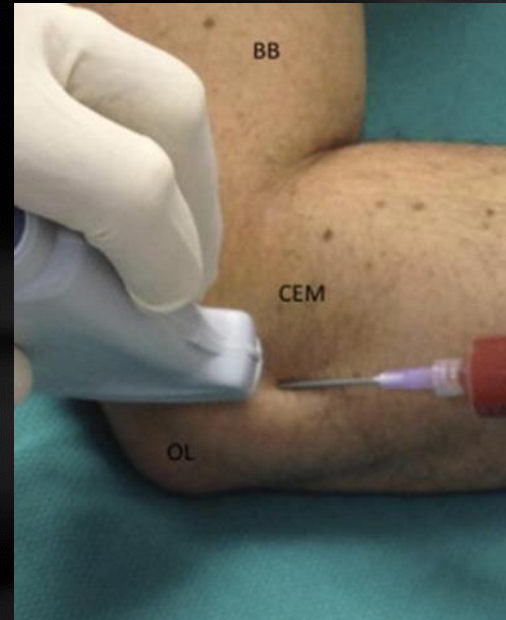
There are a host of options now available:-

Steroid

Dry Needling

Autologous Blood

PRP



Elbow

Case 3

An 6 yo presents after falling off a jungle gym on an outstretched arm.

She is difficult to examine and is tender around the elbow.

You order an Xray.

In a child an effusion usually means a fracture.



Wrist and Hand



Wrist and Hand

Case 1

A 25yo male snowboarder presents following a FOOSH.

On examination they are focally tender in the ASB.

You order an Xray.

Wrist and Hand

Case 1

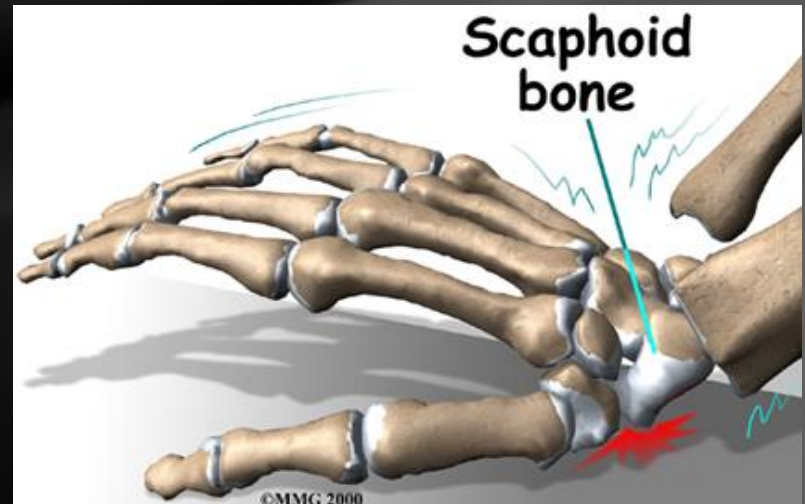


Wrist and Hand

Case 1

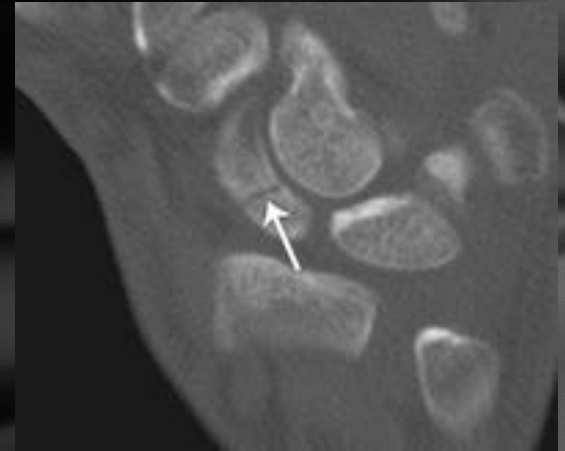
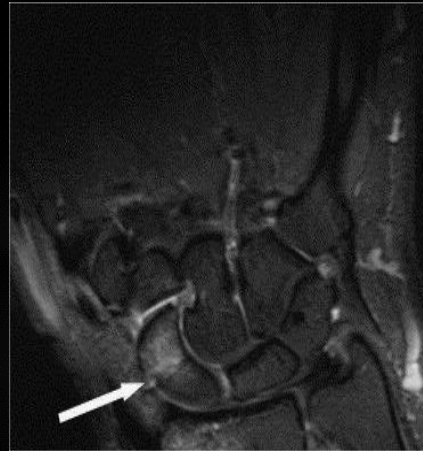
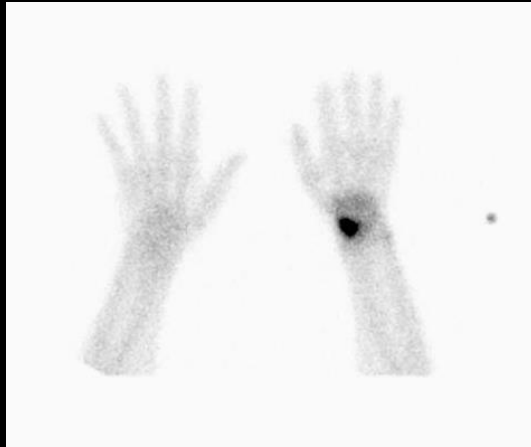
The patient is reluctant to be put into a cast with follow up.

Are there any other options?



Wrist and Hand

Case 1



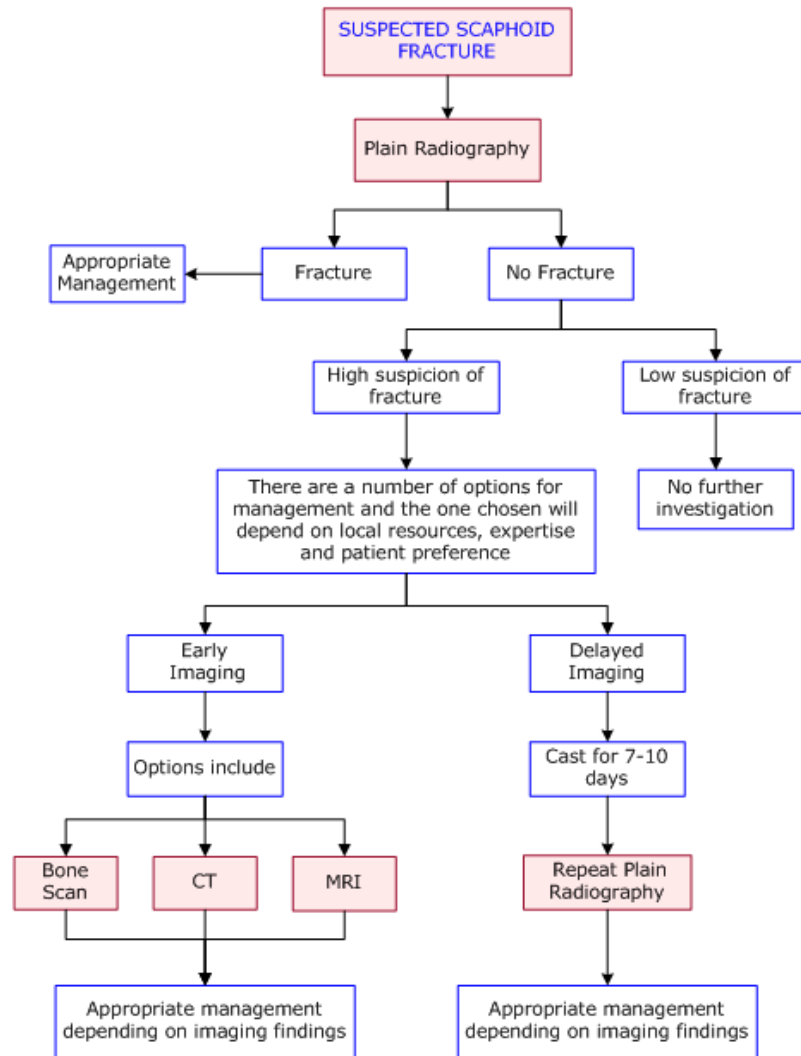
[N Z Med J](#), 2004 Sep 10;117(1201):U1049.

Cost analysis of traditional follow-up protocol versus MRI for radiographically occult scaphoid fractures: a pilot study for the Accident Compensation Corporation.

[Gooding A](#), [Coates M](#), [Rothwell A](#); [Accident Compensation Corporation](#).

Christchurch Public Hospital, Christchurch, New Zealand. andrewgooding@xtra.co.nz

Pathway Diagram



Wrist and Hand

Case 2

A 33yo female presents with a 5 month history of bilateral hand pain affecting the MCPJ's.

OE swelling around MCPJs and PIPJs.

Along with routine bloods you order Xrays of the Hands.

Dx = Rheumatoid Arthritis



Dx = Psoriatic Arthritis



Dx = Gout



Dx = CPPD (Pseudogout)



Wrist and Hand

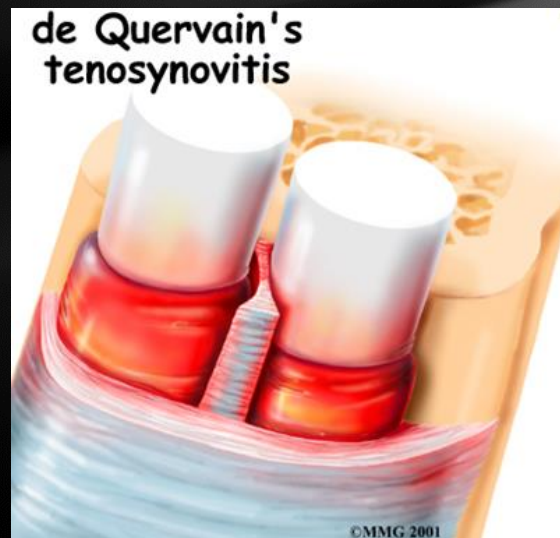
Case 3

A 35yo female chef presents with radial sided wrist pain and swelling

Doesn't settle with NSAIDs and Physio

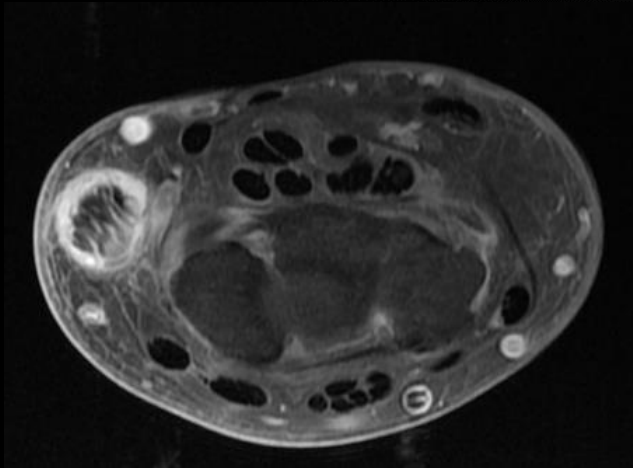
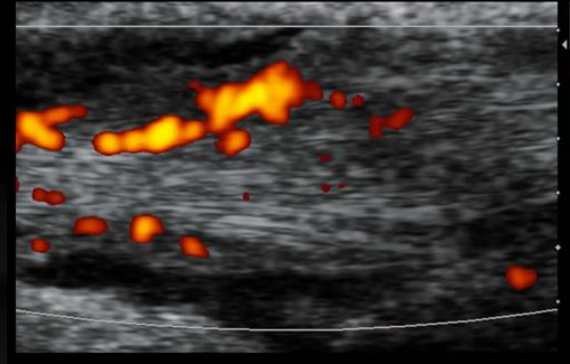
The Provisional Dx = De Quervains

Is Imaging Indicated?



Wrist and Hand

Case 3 = De Quervains



Lower Limb Pelvis/Hip



Pelvis and Hip

Case 1

You are called to a rest home to assess a demented patient who is distressed and unable to weight bear.

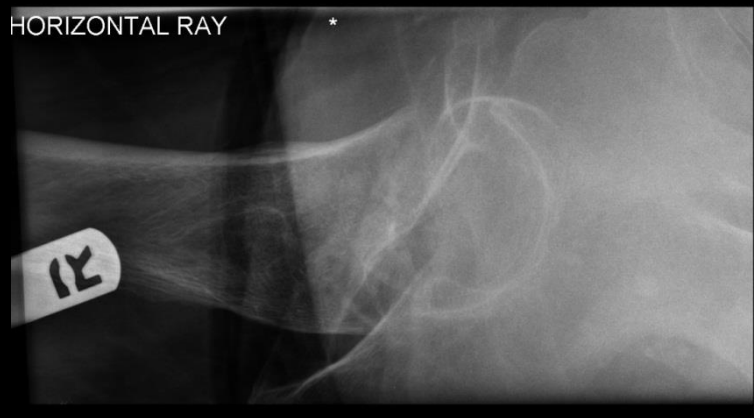
You want to exclude a NOF and order Xrays.

They are placed on bed rest but on review the following day they are deteriorating.

Imaging options?

Pelvis and Hip

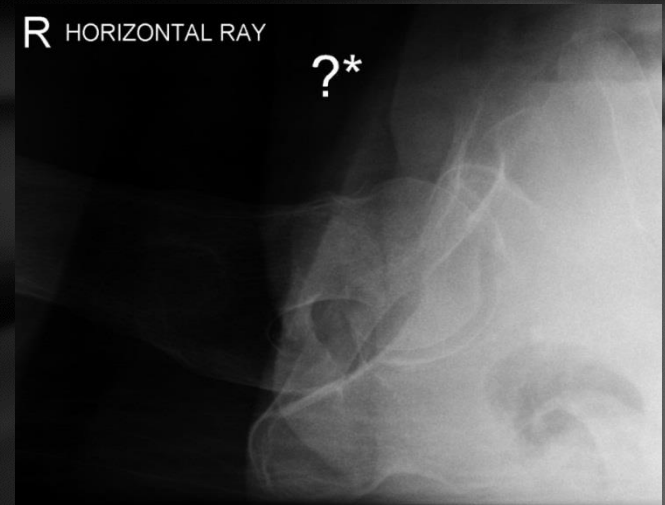
Case 1



Easy NOF

Pelvis and Hip

Case 1

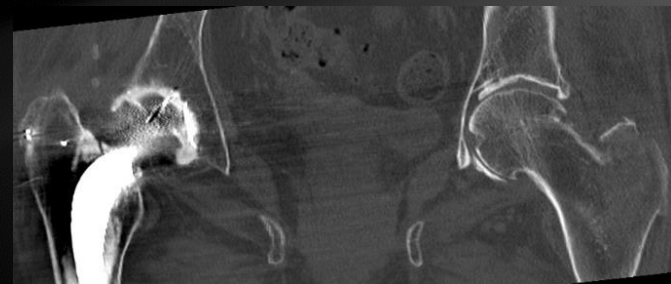
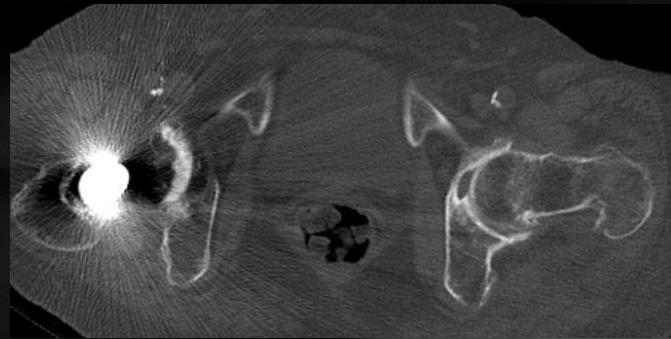
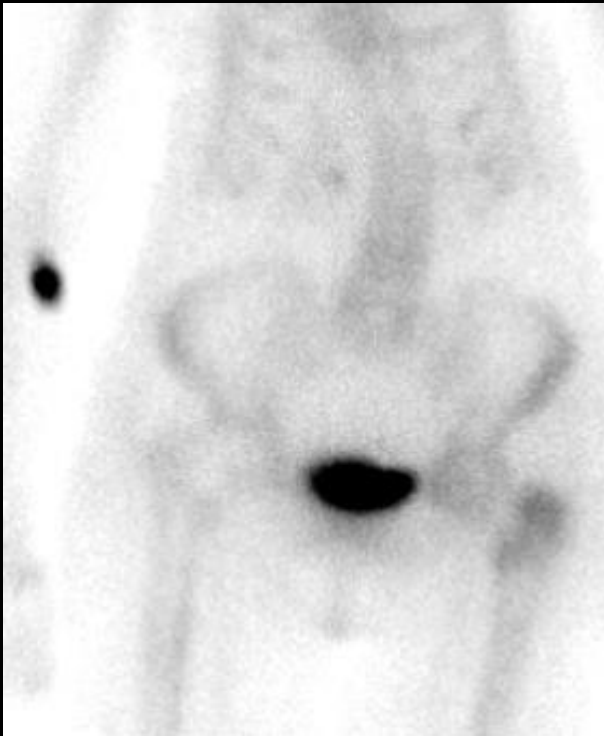


Subtle NOF

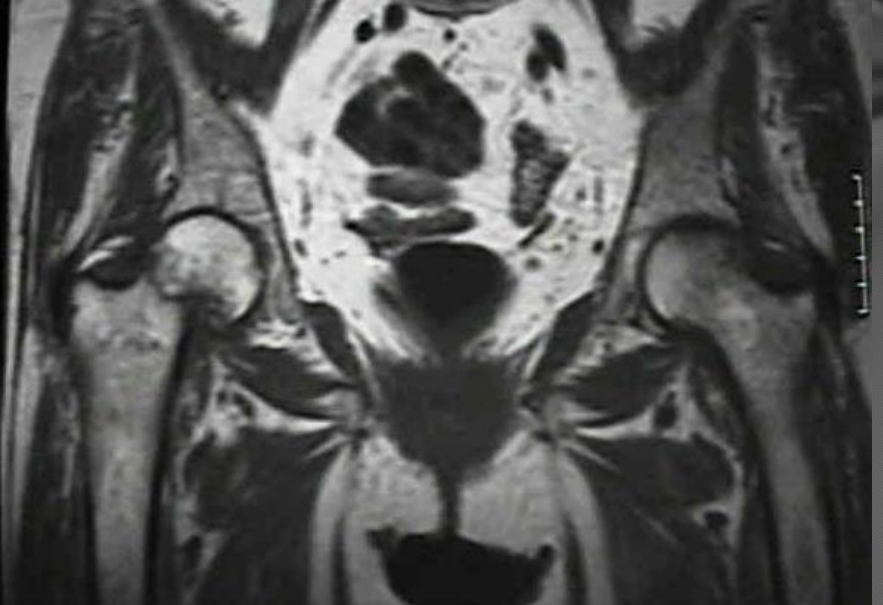
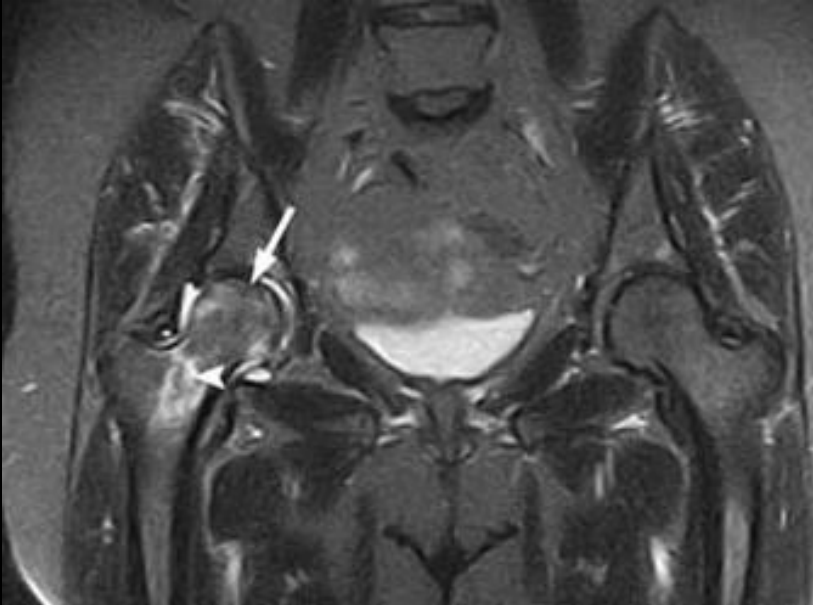
Pelvis and Hip

Case 1

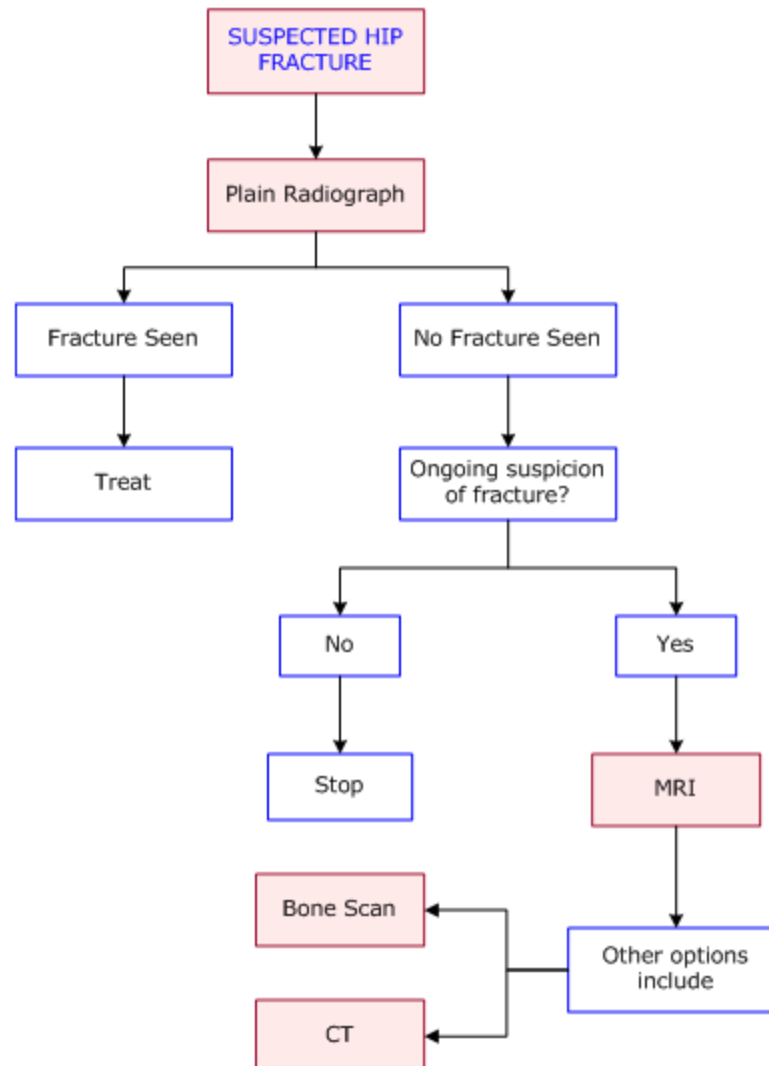
Advanced Imaging NOF



Advanced Imaging NOF



Pathway Diagram



Pelvis and Hip

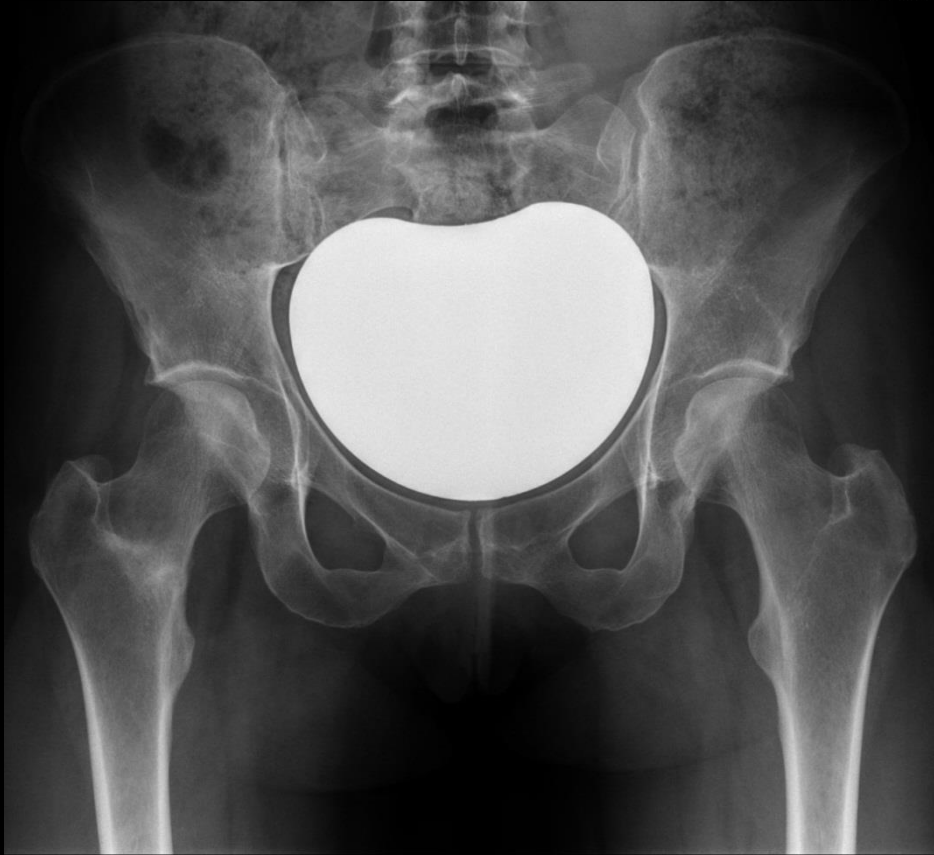
Case 2

An 18 yo female runner presents with worsening hip pain that develops during a run.

You order an Xray

Pelvis and Hip

Case 2 - Xray



1978



/2010, 14:08:12

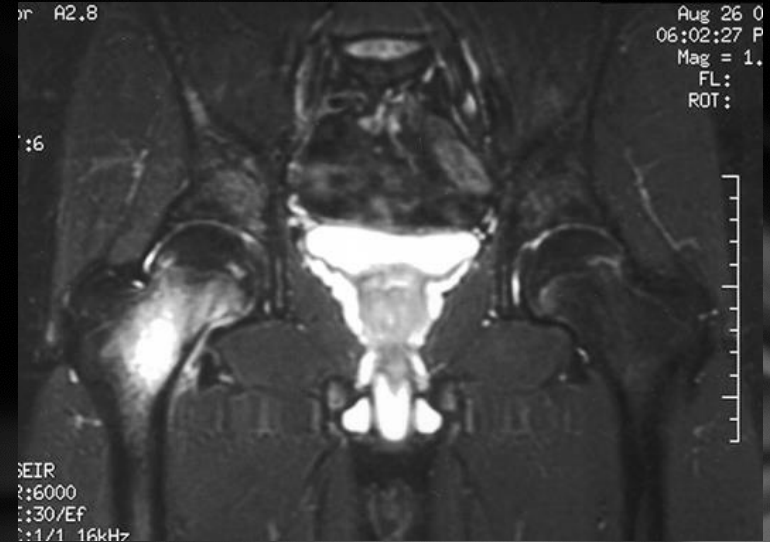
Pelvis and Hip

Case 2

The Xray is reported as normal.

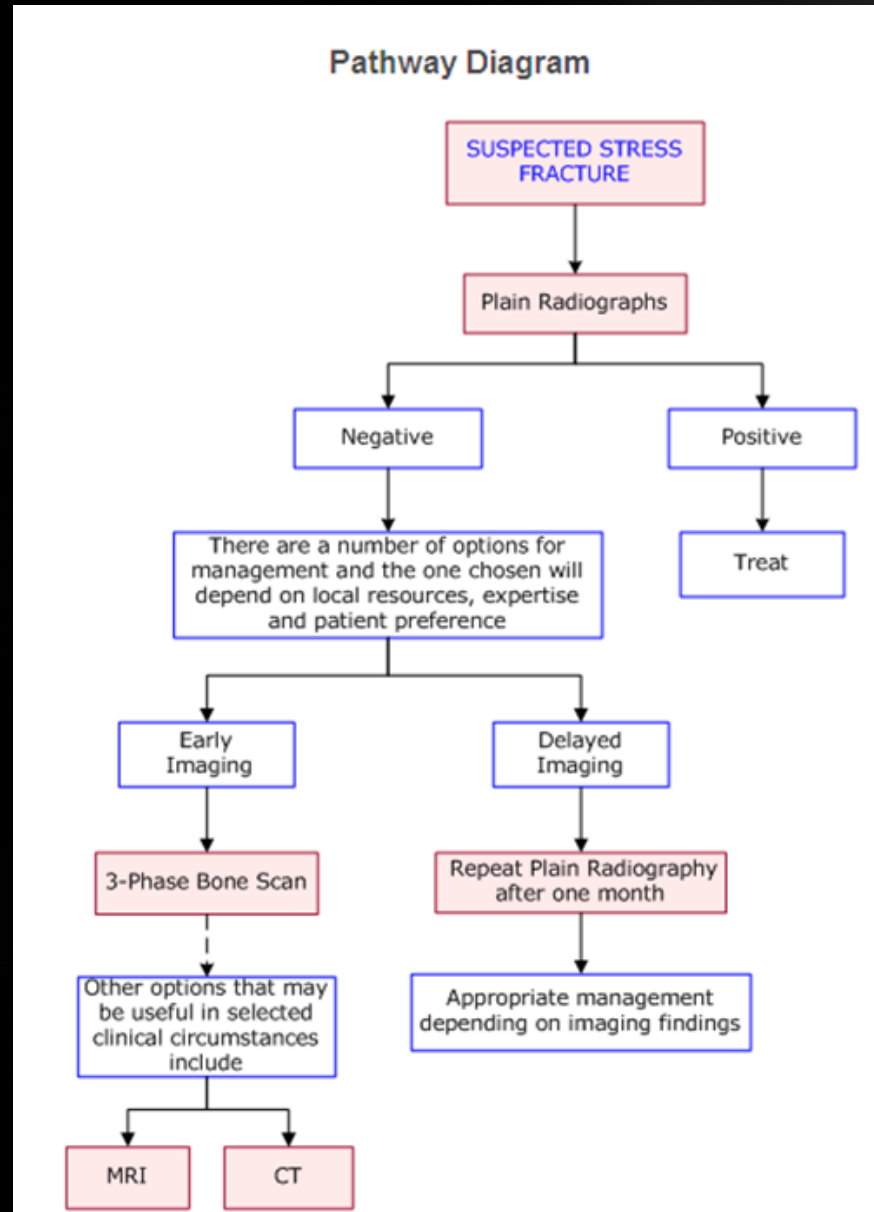
You are concerned that there is something going on.

Options?



Pelvis and Hip

Case 2



Pelvis and Hip

Case 3

37 yo male presents with pain and stiffness in the hips worsening over the last 3 years .

You order an Xray

Pelvis and Hip

Case 3



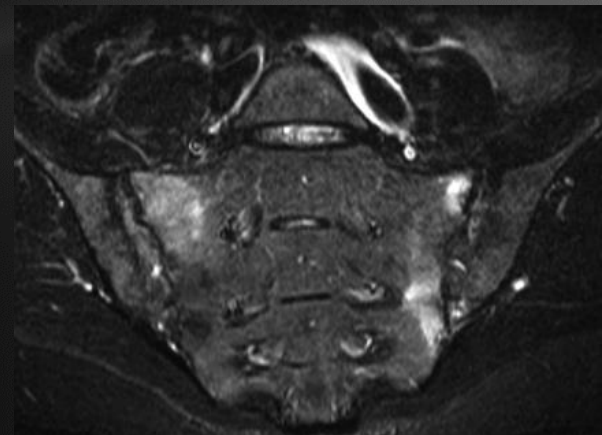


What is the role of Radiology in Spondyloarthropathy?

1. To help establish the diagnosis.
2. To provide evidence to support treatment decisions.



Grade	Appraisal
0	Normal—normal width, sharp joint margins
I	Suspicious
II	Sclerosis, some erosions
III	Severe erosions, pseudodilatation of the joint space, partial ankylosis
IV	Complete ankylosis



Pelvis and Hip

Case 4

A 9 year old presents with a 2 day history of left hip pain and an inability to weight bear.

They are afebrile and bloods are normal.

What would be an appropriate imaging strategy

Xray

US

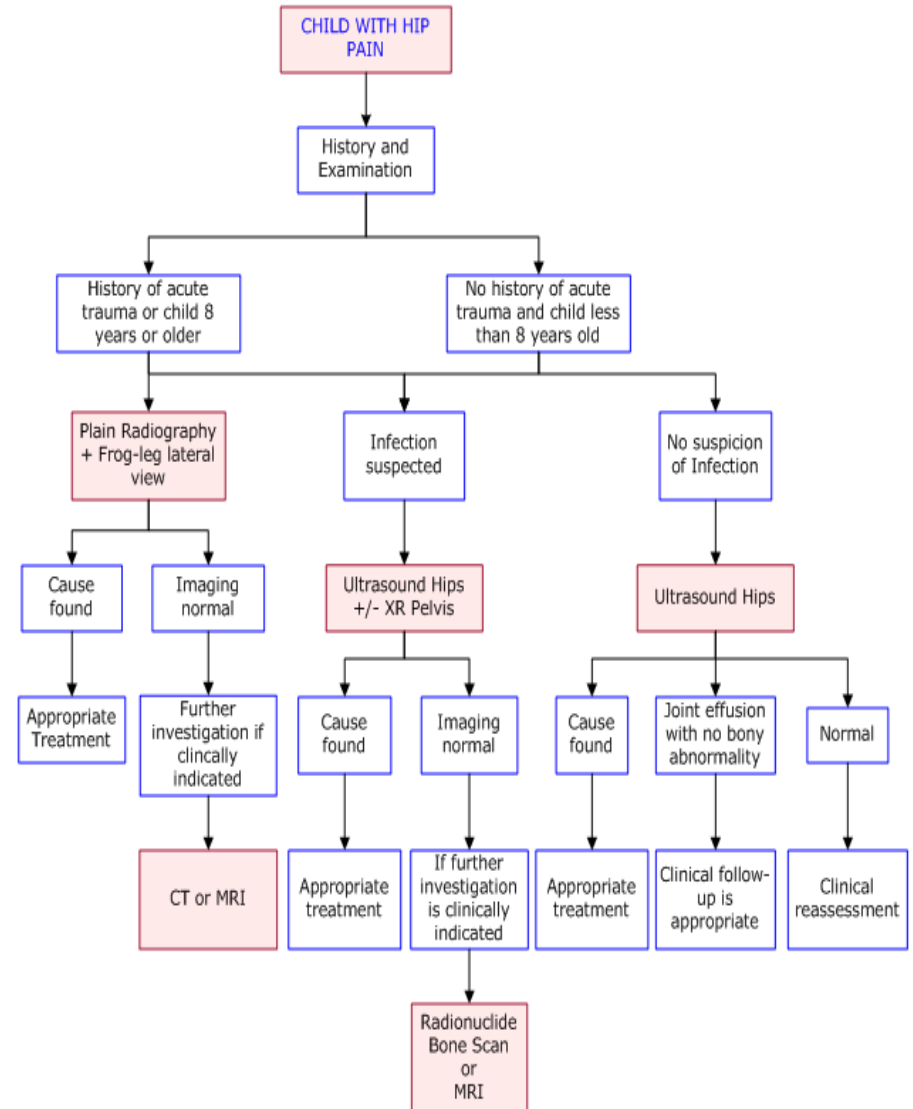
MRI

Pelvis and Hip

Case 4



Pathway Diagram



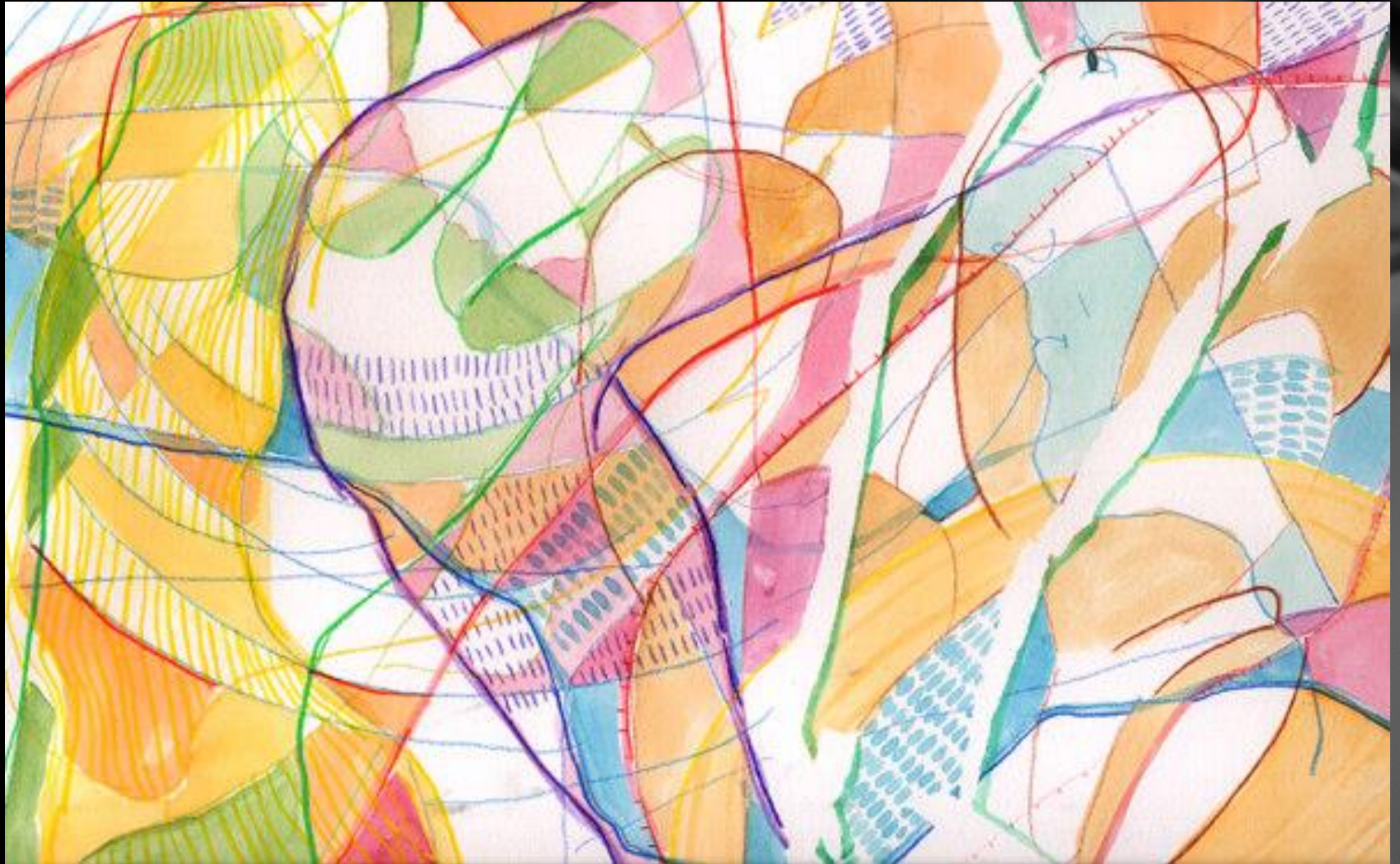
Pelvis and Hip

Case 4



Lower Limb

Knee



Knee

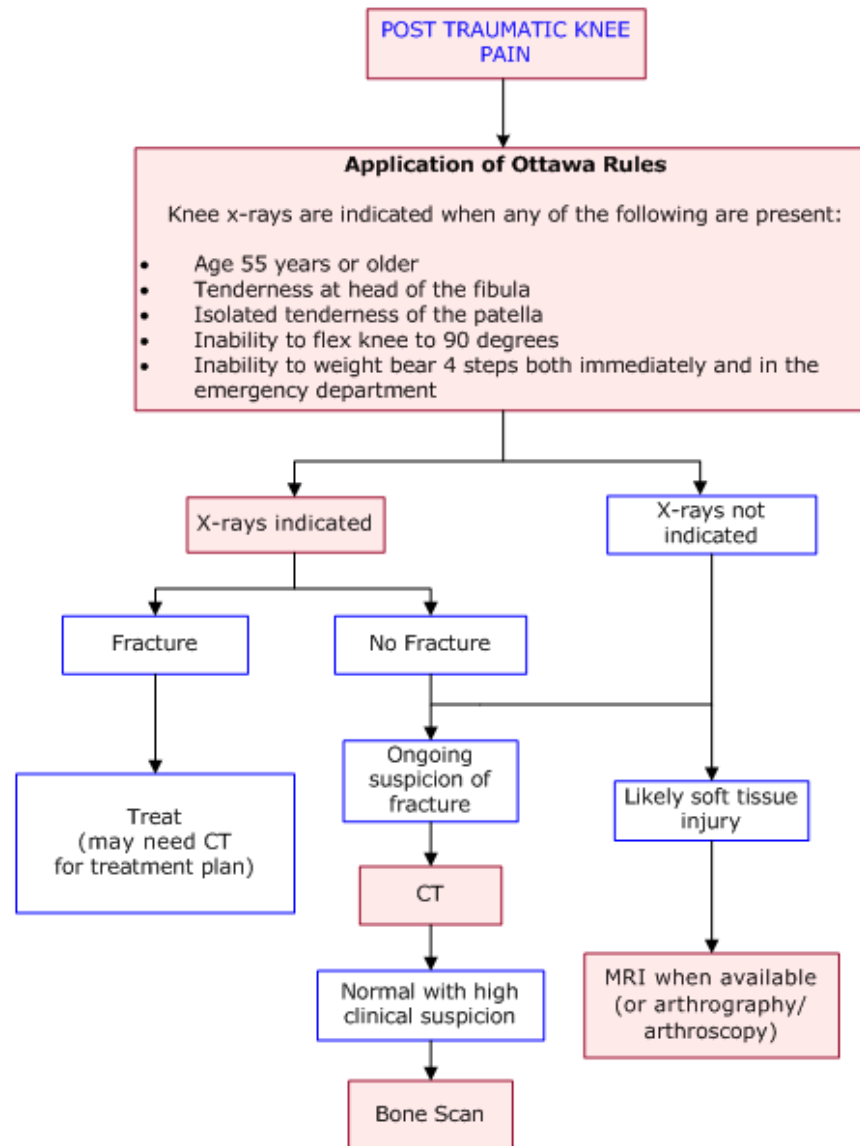
Case 1

A 47 yo weekend warrior hurts his knee at a weekend soccer game.

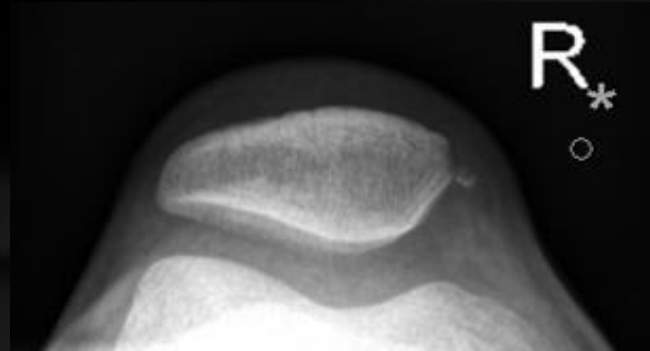
It is intermittently locking and is swollen.

Should you Xray?

Pathway Diagram



Xrays are seldom helpful.



Knee

Case 2

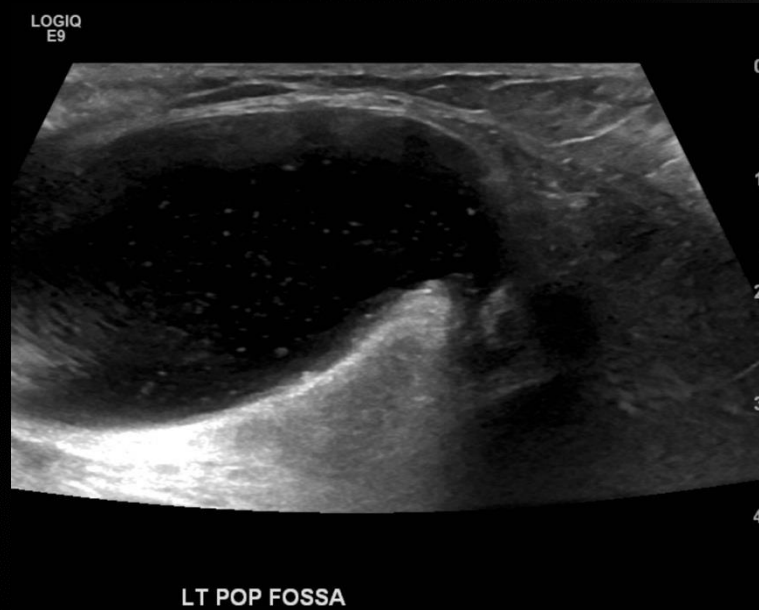
A 65 yo female presents with increasing tense swelling at the posterior aspect of the knee.

Xrays are unremarkable apart from mild medial compartment OA.

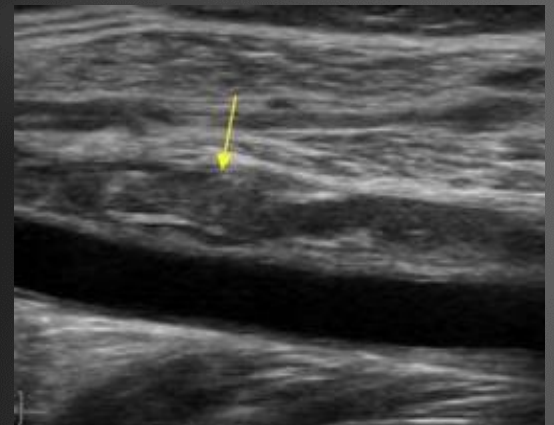
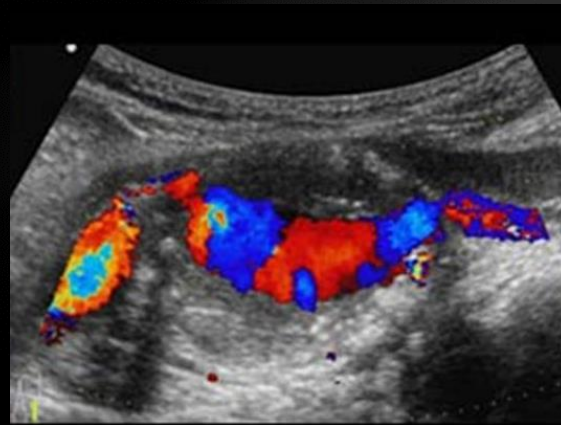
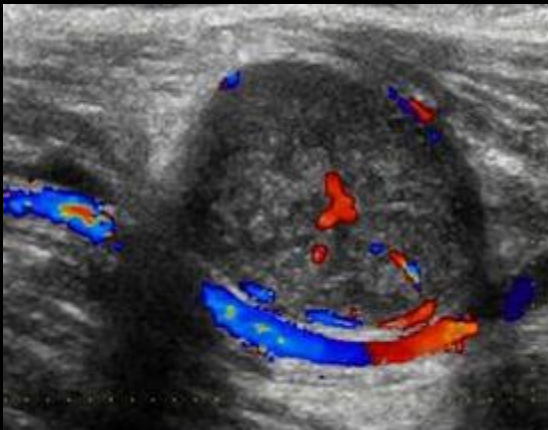
What next?

Knee

Case 2



LT POP FOSSA



What is the role of US?

ACC warning recently issued regarding the use of Knee US in the context of injury.

US has a limited role:-

- Patella/Quads rupture

- Problem Solving a swelling

 - ? Bakers Cyst

Knee

Case 3

A 25yo basketball player has a long history of anterior knee pain.

You make the diagnosis of Jumpers Knee.

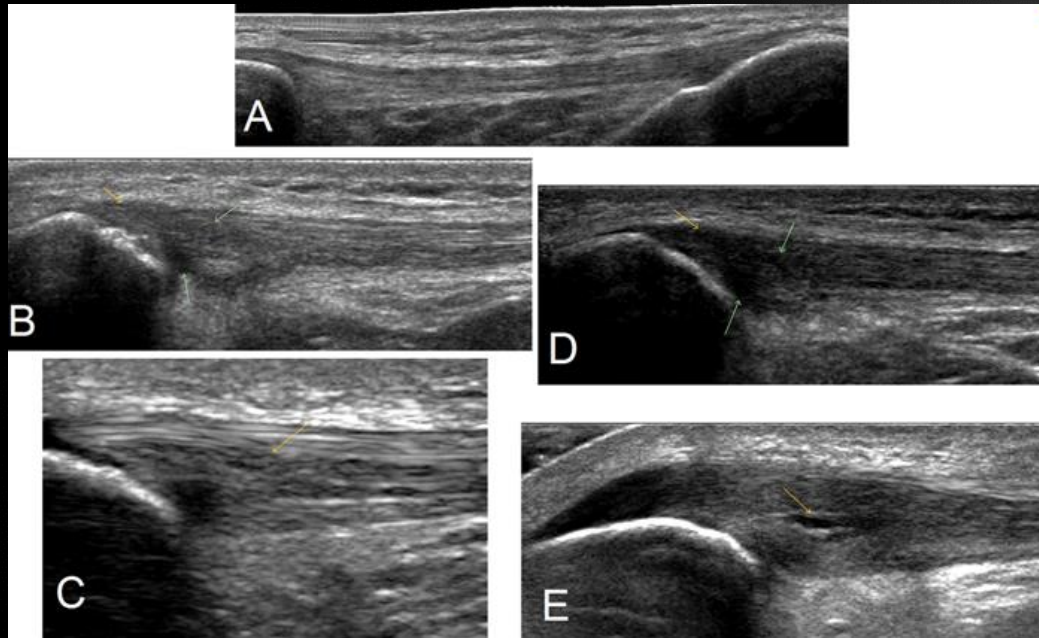
An exercise and physio program are ineffective.

NSAIDS help but the patient is reluctant to continue with these long term.

Are there other options.

Knee

Case 3



Knee Case 4

A 28 year old presents with intermittent knee locking and swelling 6 weeks after a rugby injury.

On examination they have a positive McMurrays test. There ACL is difficult to assess because of apprehension.

What is the most appropriate imaging step

Xray

CT

US

MRI

Knee Case 4



Knee Case 4



GP Access to Advanced Imaging

There is certainly evidence out the UK that this is feasible.

DAMASK trial

Too expensive?

No cost effective.

More efficient?

Yes

Better outcomes?

Yes better QALY measures of knee function.

Lower Limb Ankle/Foot



Ankle and Foot

Case 1

A 47yo overweight male presents with swelling and increasing pain in the right Achilles tendon over a period of 4 months.

The day prior he had a sudden deterioration.

You are concerned re a tendon rupture.

Imaging Options

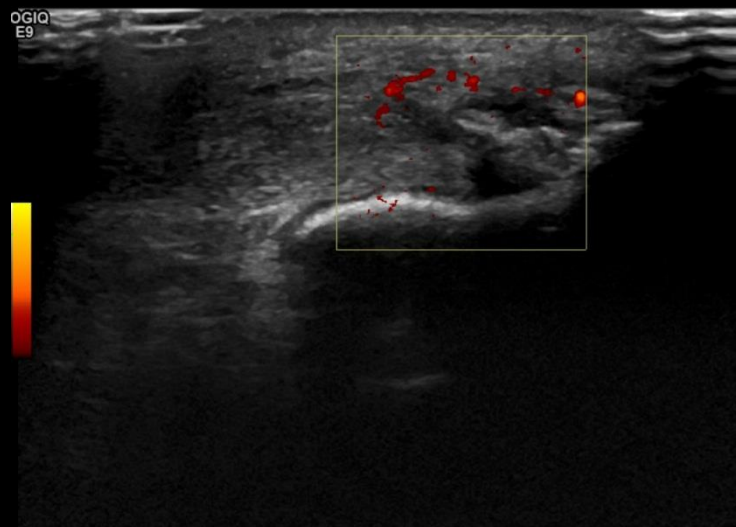
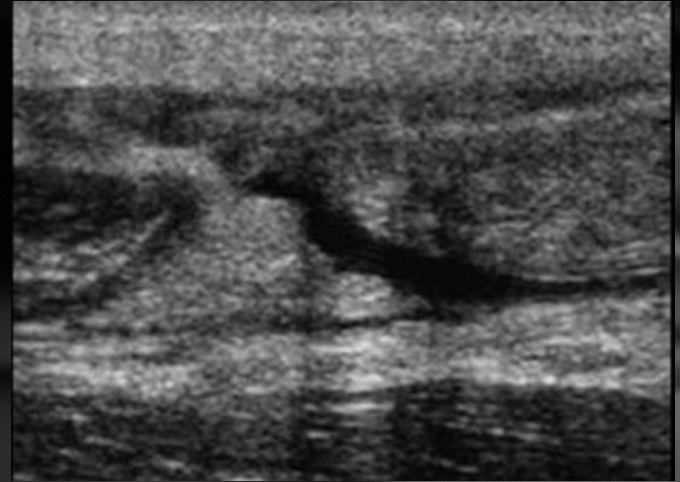
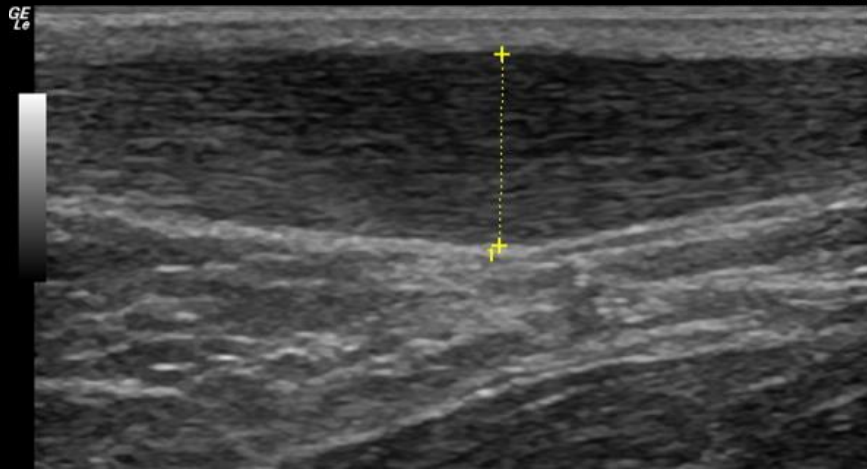
US

MRI



Ankle and Foot

Case 1



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media: ultrasound 3

RIGHT ACHILLES TENDON LS DOP



Ankle and Foot

Case 1

The ultrasound shows tendinosis but no features of a tear.

A 6 month period of conservative treatment fails

Treatment options

Surgery

Injection Therapy



Ankle and Foot

Case 2

A 49yo recreational walker complains of heel pain which worsens on activity and is keeping her up a night.

You order an Xray which shows a planter spur.

Treatment for Planter fasciitis fails.

A bone scan is ordered.



L LATERAL
08/09/11 16:05:37

Ankle and Foot

Case 3

A 49yo recreational walker complains of heel pain which worsens on activity and is particularly troublesome first thing in the morning and in the evening.

You order an Xray.

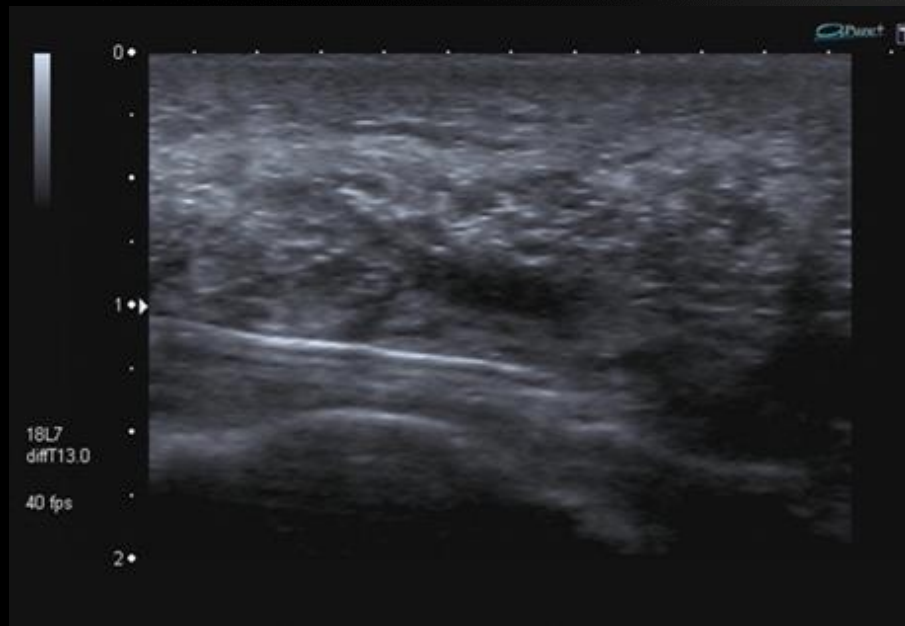


Ankle and Foot Case 3

Podiatry, NSAIDS fail.

An US is ordered.

A planter fascia injection is contemplated.



Ankle and Foot

Case 4

A 55 yo female high heel fan complains of a burning pain in the 3rd/4th interspace.

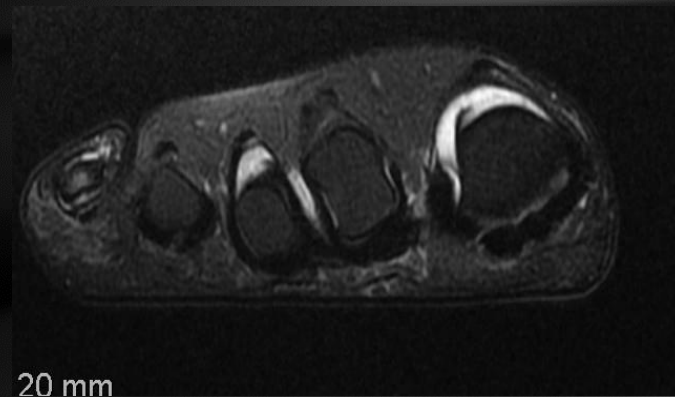
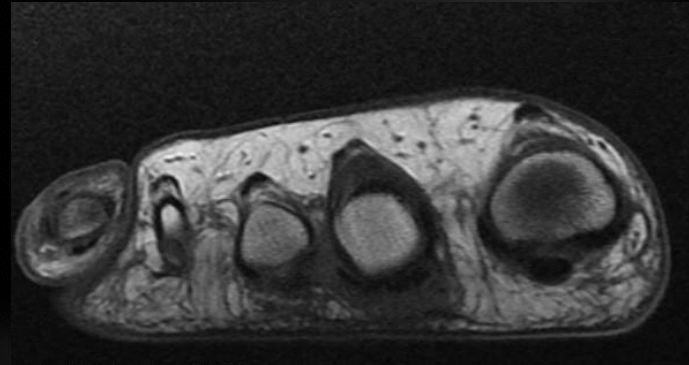
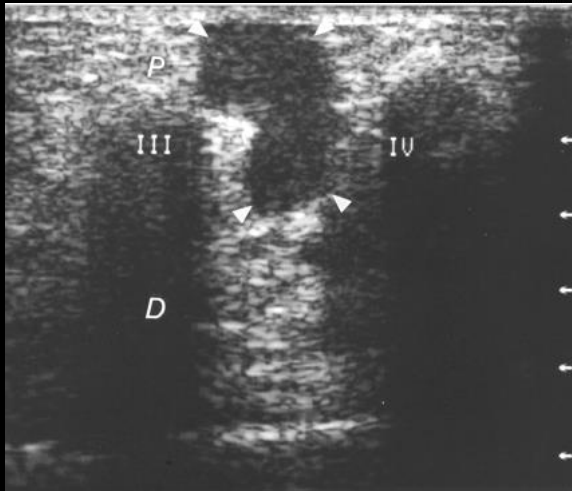
Conservative treatments fail

What Imaging options are there?



Ankle and Foot

Case 4



[AJR Am J Roentgenol](#), 2000 Jun;174(6):1723-8.

Sonography of Morton's neuromas.

[Quinn TJ](#), [Jacobson JA](#), [Craig JG](#), [van Holsbeeck MT](#).

Department of Radiology, University of Michigan Medical Center, Ann Arbor 48109-0326, USA.

Ankle and Foot

Case 4

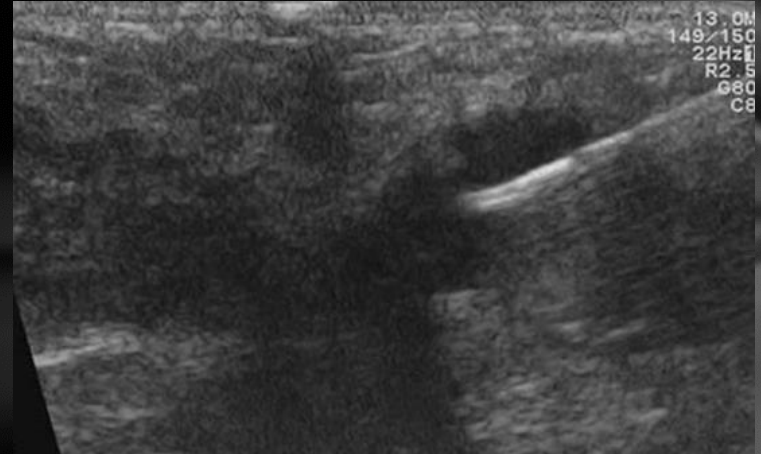
Are there any
Radiological Treatment
options?

US guided Injections.

Steroid

Alcohol

RFA



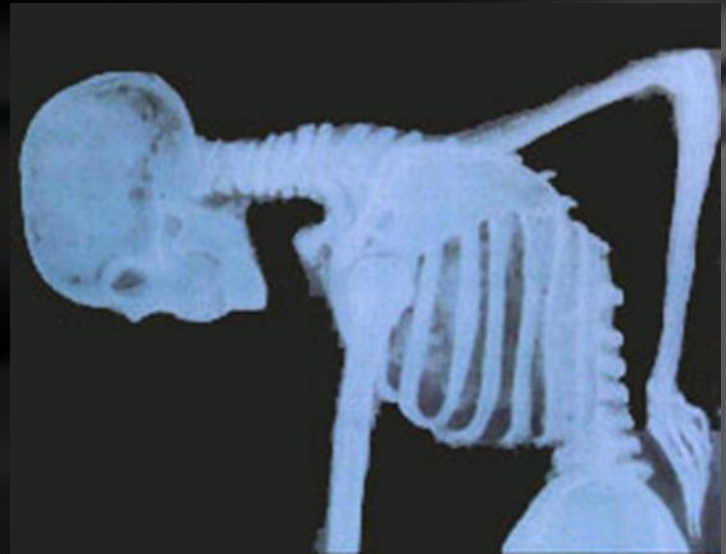
[Foot Ankle Int.](#) 2008 May;29(5):483-7.

Effectiveness of ultrasound-guided corticosteroid injection in the treatment of Morton's neuroma.

[Markovic M.](#), [Crichton K.](#), [Read JW.](#), [Lam P.](#), [Slater HK.](#)

University of Sydney Sports Clinic, Western Ave & Physics Rd, University of Sydney, NSW 2006, Australia. majam@amsc.com.au

The Spine



Spine

Case 1

An 26 year old cricketer presents with a 3 month history of lower back pain unresponsive to physio.

Imaging options

- Xray
- NM
- MRI
- CT

Spine

Case 1

You order an Xray.

What if it is normal?

What's the next best test?



Spine

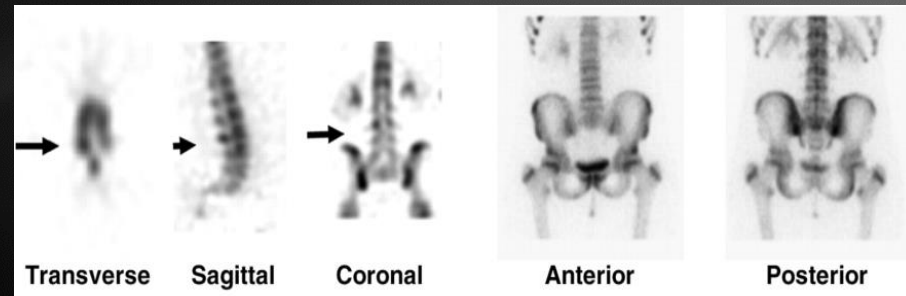
Case 1

A Nuclear Medicine
Bone Scan

High Sensitivity

Even better with SPECT

Better Specificity



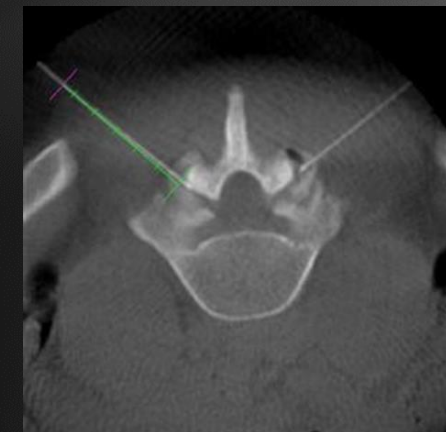
Spine

Case 1

Do MRI and CT have a role?

CT can help characterise a pars defect in terms of healing etc.

MRI can help exclude other causes of back pain but the defect itself is quite hard to see.



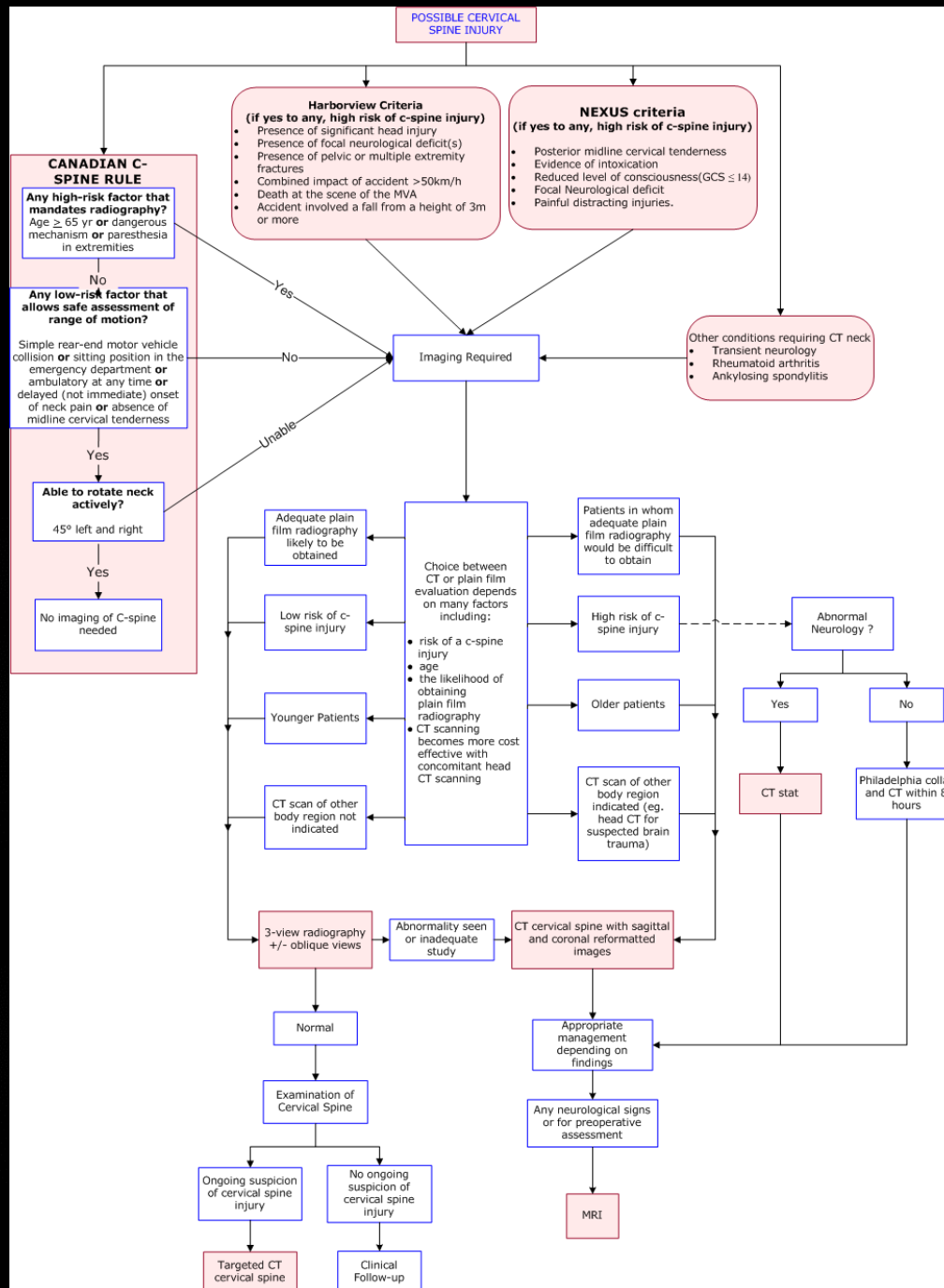
Spine

Case 2

You are staffing a rural hospital.

A staunch farmer present with a sore neck after rolling their quadbike earlier in the day.

How do you “clear” the cervical spine?



Clinical Assessment

If five clinical criteria are met the chance of significant C spine injury is virtually zero.

- 1.No midline cervical tenderness.
- 2.No focal neurological deficit.
- 3.Normal alertness.
- 4.No intoxication.
- 5.No painful distracting injury.

Imaging Options Plain films

Cross table lateral

3 view series

5 view series

+/-flexion extension

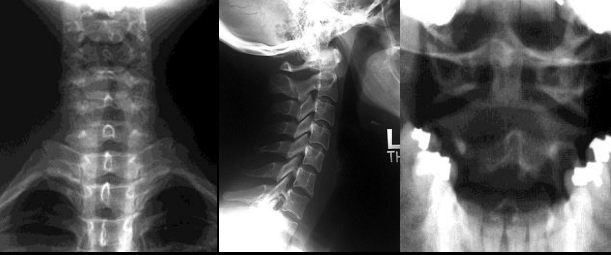
Cross table lateral

Usually obtained initially in patients who are obtunded.

Technical adequacy a problem due to patient group. Approx 33% of films inadequate ie. Don't see C7/T1.

NOT ADEQUATE IN ISOLATION.





3 View Series

AP, Lat , Peg views

NEXUS trial data showed that 3 view series revealed 932/1496 fractures but missed 564/1496 fractures.

However 436/564 missed fractures showed abnormalities on the series or were technically inadequate (30% of missed #'s)

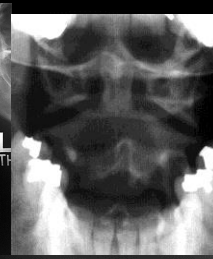
35 (2.8%) injuries not seen on adequate films with 3 being unstable.

Sensitivity 83-94%, Specificity 78-96%

Therefore adequate screening test.

5 View Series

AP, Lat, Peg, Obliques x2



Increase rate of technical adequacy ie seeing C7/T1 on initial series therefore making it more cost effective and timely.

Only slight increase in # detection mainly in relation to the posterior elements.

More likely to be successful and safer than a Swimmers view.

Points re plain films

Adequacy (particularly C7/T1)

Alignment.

- Subluxations (Antero vs Retrolisthesis)

- Focal Kyphosis or Lordosis

Soft tissue swelling.

- Degree (2 at 7, 7 at 2)

- Contour (shelf at C5)

Disc Spaces (Anterior/Posterior)

C1/C2 and Occi/C1



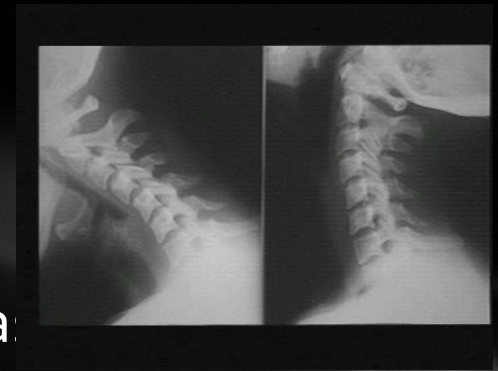
Flexion/Extension Views

Fallen out of favour in the acute assessment phase due to high false +ve and high false -ve rate.

Still role when patients reassessed at later date after conservative therapy.

AP motion of $>2\text{mm}$ and/or angular motion $>11-20$ degrees.

Some centres using II in intubated patients to exclude ligamentous injury.



Spine

Case 3

A 49yo presents with a 4 day history of lumbago following shifting house.

There is no sciatica and on examination no abnormality is found except for some reduced ROM.

Should you do an Xray?

Spine

Case 3

NEUROLOGICAL DEFICIT

Significant trauma

History of cancer

Weight loss

Intravenous drug use

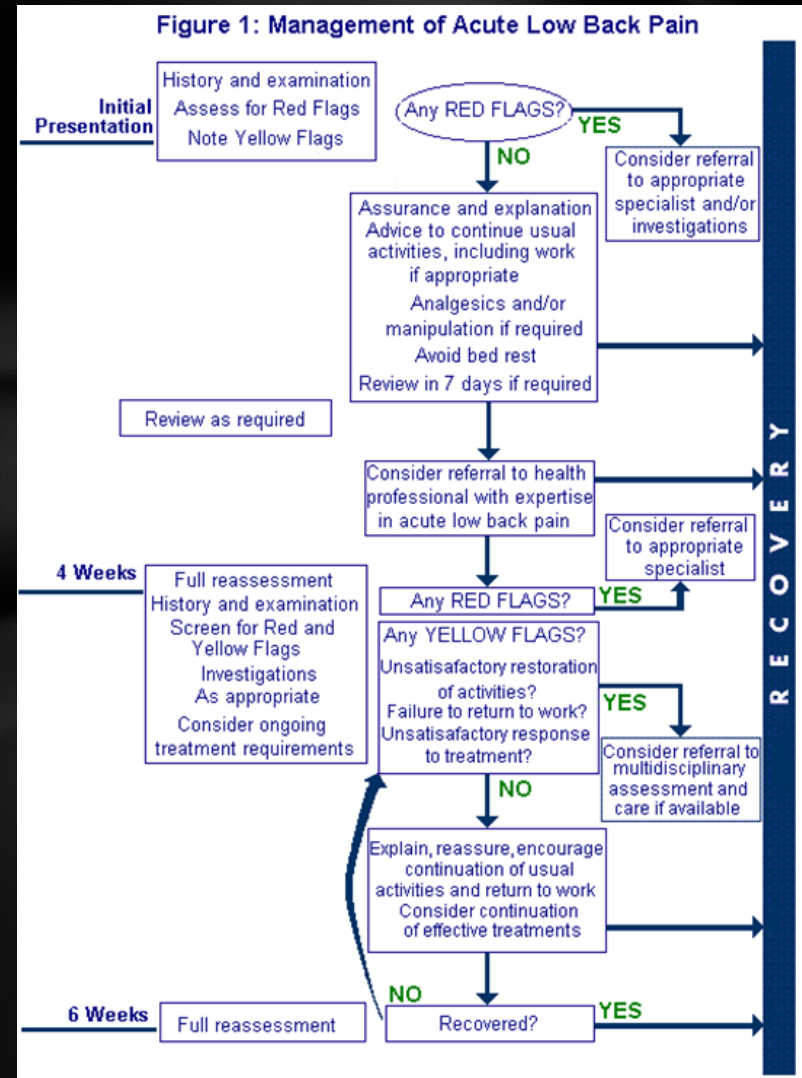
Fever

Patient aged >50 years

Severe, unremitting night-time pain

Steroid use

Pain that gets worse when lying down



Spine

Case 3



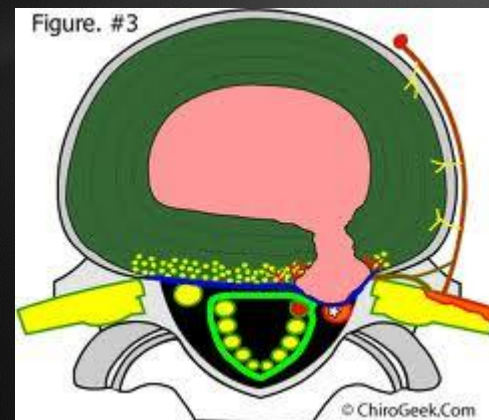
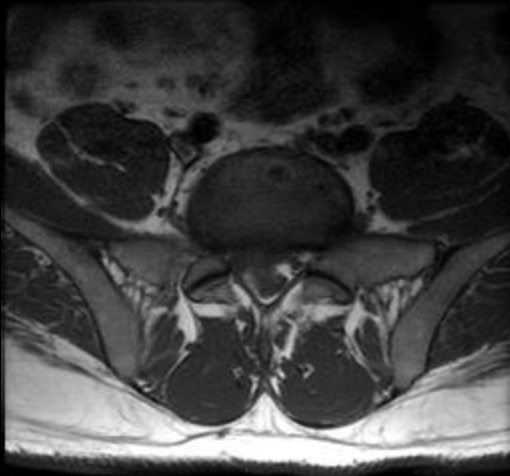
Spine

Case 4

A 45yo presents with a 4 month long history of back pain with intermittent sciatica which has been extensively investigated. He has rehabed religiously, tried multiple meds and is reluctant to consider surgical options.

On examination he has mild nerve root signs.

Are there any other options?



Nerve Root and Interlaminar Epidural blocks

Generally referred by a specialist.

Diagnostic and Therapeutic Role

Indications

- Radiculopathy
- Discogenic Pain

Fluoro or CT Guidance

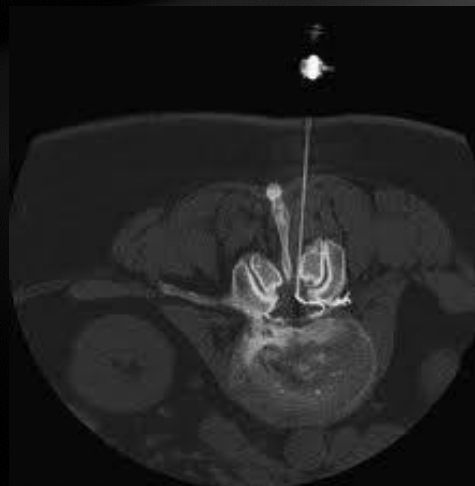
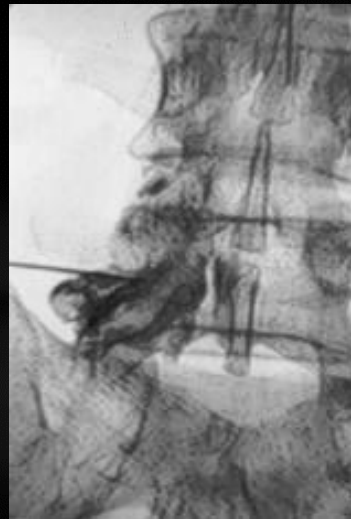
LA and Steroid

Risks small but real

- Infection
- Cord infarction

Mechanism

- Reset nerve
- Inflammatory Component



The Last Case

A 25yo presents with a mass in the forearm.

She injured her arm playing hockey 1 year ago in this area.

It has been present since this time is slowly enlarging.

It is not painful.

On examination it is approx 4cm in width and is soft.

What do you do?

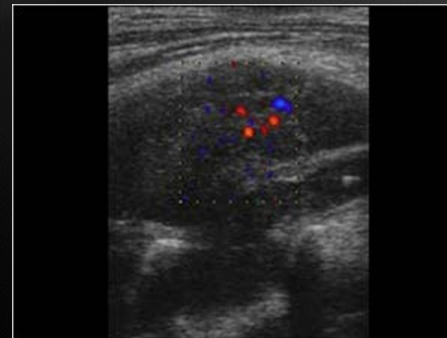
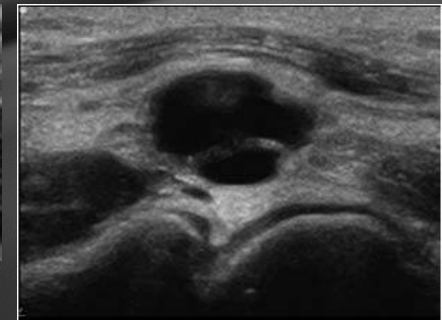
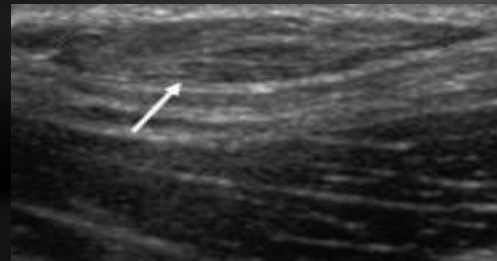
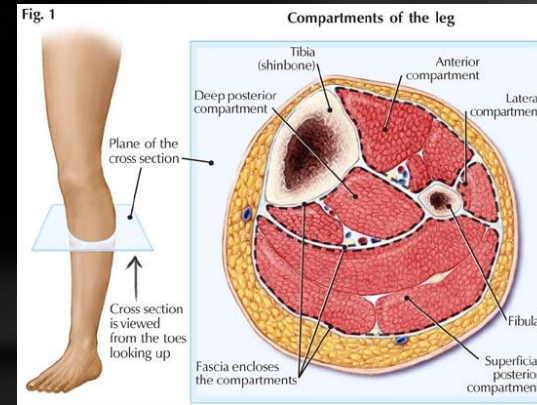
Image?

Refer?

Biopsy?

Lumps and Bumps

- DON'T biopsy soft tissue masses without specialist orthopaedic guidance.
- US is limited in assessing a soft tissue mass.
 - Cyst
 - Lipoma?
- Beware of the “chronic haematoma”

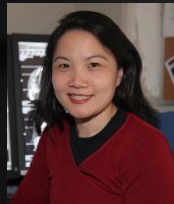
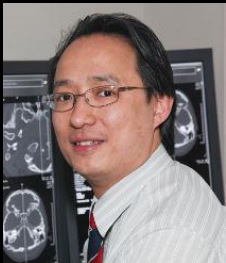


Conclusions

Always consider risk and cost.

Follow guidelines

Talk to a friendly Radiologist to guide you down the imaging path.



Thank you for your attention.

