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Diagnostic Imaging Pathways - Stress Fracture (Suspected)

Population Covered By The Guidance

This pathway provides guidance on the imaging of adult patients with suspected stress fractures.

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Quick User Guide

Move the mouse cursor over the PINK text boxes inside the flow chart to bring up a pop up box with salient points.
Clicking on the PINK text box will bring up the full text.
The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

Pathway Diagram

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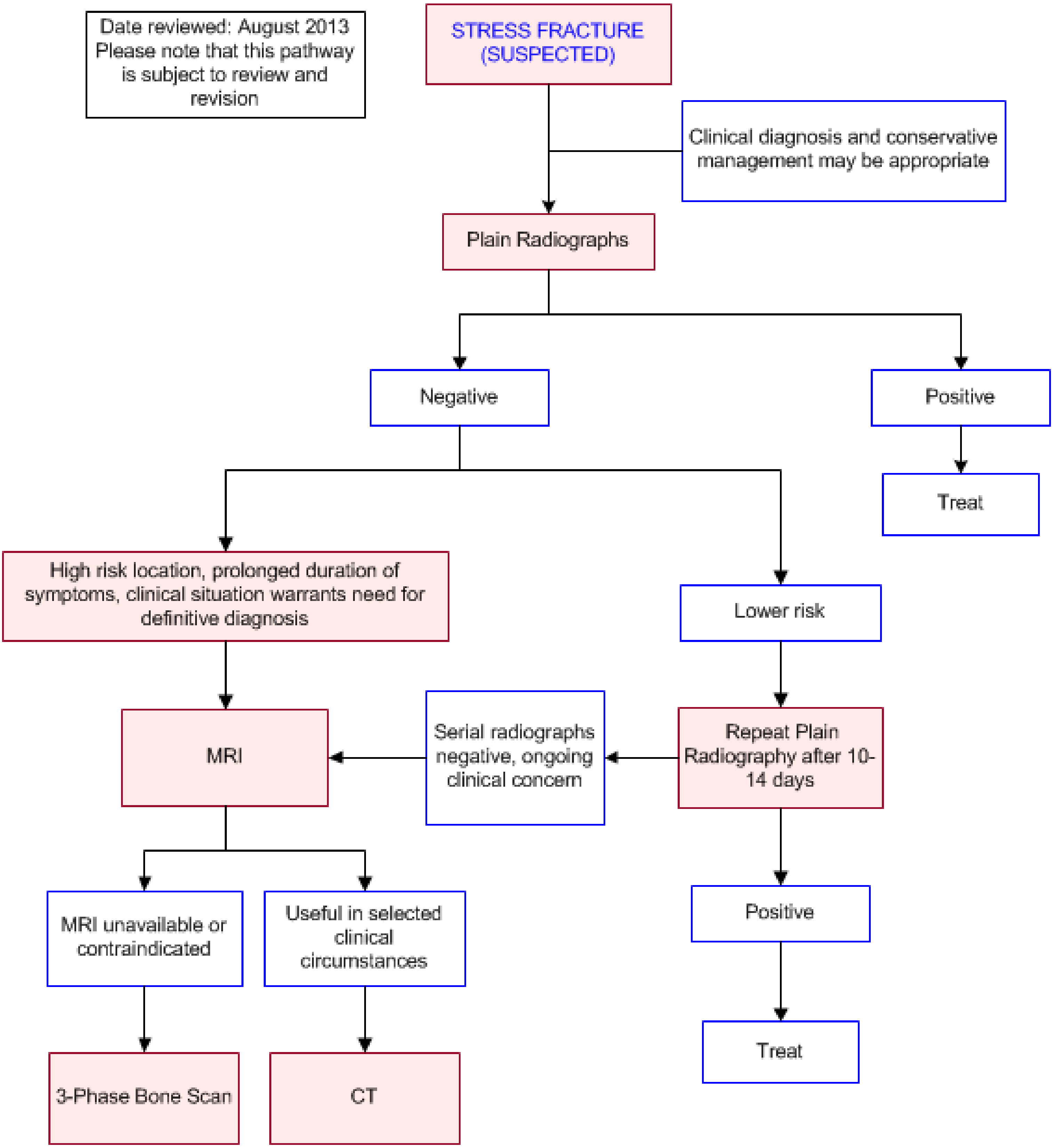

Image Gallery

Note: These images open in a new page

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Suspected Stress Fracture

1a

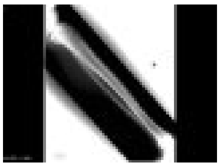

Image 1a (Plain Radiography): Normal x-ray in 18 yo male with medial tibial pain.

1b

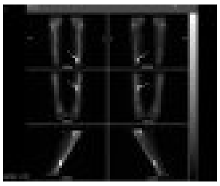

Image 1b (Bone Scan): Delayed phase of bone scan showing focal uptake in the posteromedial cortex typical of a stress fracture (arrow).

Teaching Points

- Plain radiographs are the initial imaging modality of choice, but are limited due to their inability to detect bony changes early in the development of a stress fracture
- Early radiographs are often normal. Consider repeat plain radiography at 10-14 days
- MRI is the most sensitive and specific investigation to diagnose a stress fracture when radiographs are normal or equivocal and can best evaluate for other differential diagnoses
- Scintigraphy has high sensitivity for stress fracture but poorer specificity, and is associated with ionising radiation exposure. It is an alternative when MRI is contraindicated or unavailable
- CT can be helpful as an alternative to MRI to demonstrate bony changes but is less sensitive

Plain Radiographs

- Initial imaging modality of choice for detection of suspected stress fractures 3
- Highly specific (~96%) but poorly sensitive (~56%), limiting accuracy (~67%) 4
  - When plain radiographs demonstrate changes consistent with stress fracture, such as linear cortical radiolucency or localised periosteal reaction 5-7, no further imaging is indicated 3
  - Early radiographs are often normal or nonspecific. The lag time between manifestation of initial symptoms and detection of radiographic findings ranges from 1 week to several months 8
  - Radiographs may be negative initially in 60-90% of patients and remain negative in 40-60% of stress fractures 5-7,9
- If the plain radiographs are normal or non-diagnostic, options include
  - Treat the patient for a presumed fracture and repeat radiography in 2-3 weeks. The American College of Radiology Expert Panel suggest repeat radiography in 10-14 days 3
- If definitive diagnosis is needed, further investigate with MRI (preferred over bone scan due to higher specificity and absence of ionising radiation)

Magnetic Resonance Imaging

- Comparable sensitivity and superior specificity to that of bone scan for detection of bone abnormalities 4,7,15-20
- Aids in differentiating pathologic fractures from stress and insufficiency fractures 21 and superior soft tissue visualisation aids in differential diagnosis of pain
- Multiple classification systems for stress fractures have been developed to evaluate stress

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fractures and a 'gold standard' is yet to be developed 22 Two four-stage grading scales using MRI have been published
  - Arendt and Griffiths' scale has been used for the femur, tibia, fibular, navicular, calcaneus and forefoot and has prognostic implications regarding time of healing 23
  - Fredericson and colleagues' scale was developed using tibia data, and found presence of a fracture or cortical abnormality opposed to oedema alone predicted a longer symptomatic period in runners. 7 These findings were not replicated in a more heterogeneous study population 24

Three-Phase Bone Scintigraphy

- A radiotracer (e.g. 99-Technetium-MDP) is injected into a vein after which a series of images are taken immediately (dynamic phase, demonstrating perfusion to a lesion), shortly after the injection (blood pool phase) and again 3-4 hours later (demonstrating relative bone turnover associated with a lesion)
- High sensitivity (~100%) for stress fractures. 4,12,25,26 80% of all fractures show some scan abnormality 24 hours post-injury and 95% at 72 hours. 26 Classical findings include focally intense and fusiform cortical uptake
- The addition of SPECT to planar scintigraphy improves accuracy 27
- Less specific than MRI. False positives can occur in osteoid osteoma, osteomyelitis, or metastatic disease 4,17
- Not as useful in follow-up care as uptake can persist for months after clinical healing 28
- Due to the radiation exposure and poorer specificity, the role of bone scintigraphy should be reserved to exclude a radiographically occult fracture in patients unable to undergo MRI or after an inconclusive MRI examination 19

Computed Tomography

- Less sensitive than bone scintigraphy or MRI in the detection of stress fractures 17,29,30, but may better define an abnormality discovered with another modality 13 and have played a role in the diagnosis of longitudinal fractures 31
- CT may occasionally depict osteopaenia, the earliest finding of a cortical stress injury, in symptomatic patients with normal MRI findings17
- May be useful in follow-up evaluation of healing in radiographically-occult fractures

Ultrasound

- While less accurate than MRI, use of ultrasound to evaluate stress fractures in the metatarsal bones has been evaluated with a reported 83% sensitivity and 76% specificity, compared to MRI as the gold standard 32
- Performance has been poor in more common sites of stress fracture 33,34
- Further studies are needed to determine the role of ultrasound in the evaluation of stress fracture

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Date of literature search: April 2013

The search methodology is available on request. Email

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. Download the document

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