

# 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.

**Date reviewed: August 2013**

**Date of next review: 2017/2018**






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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.

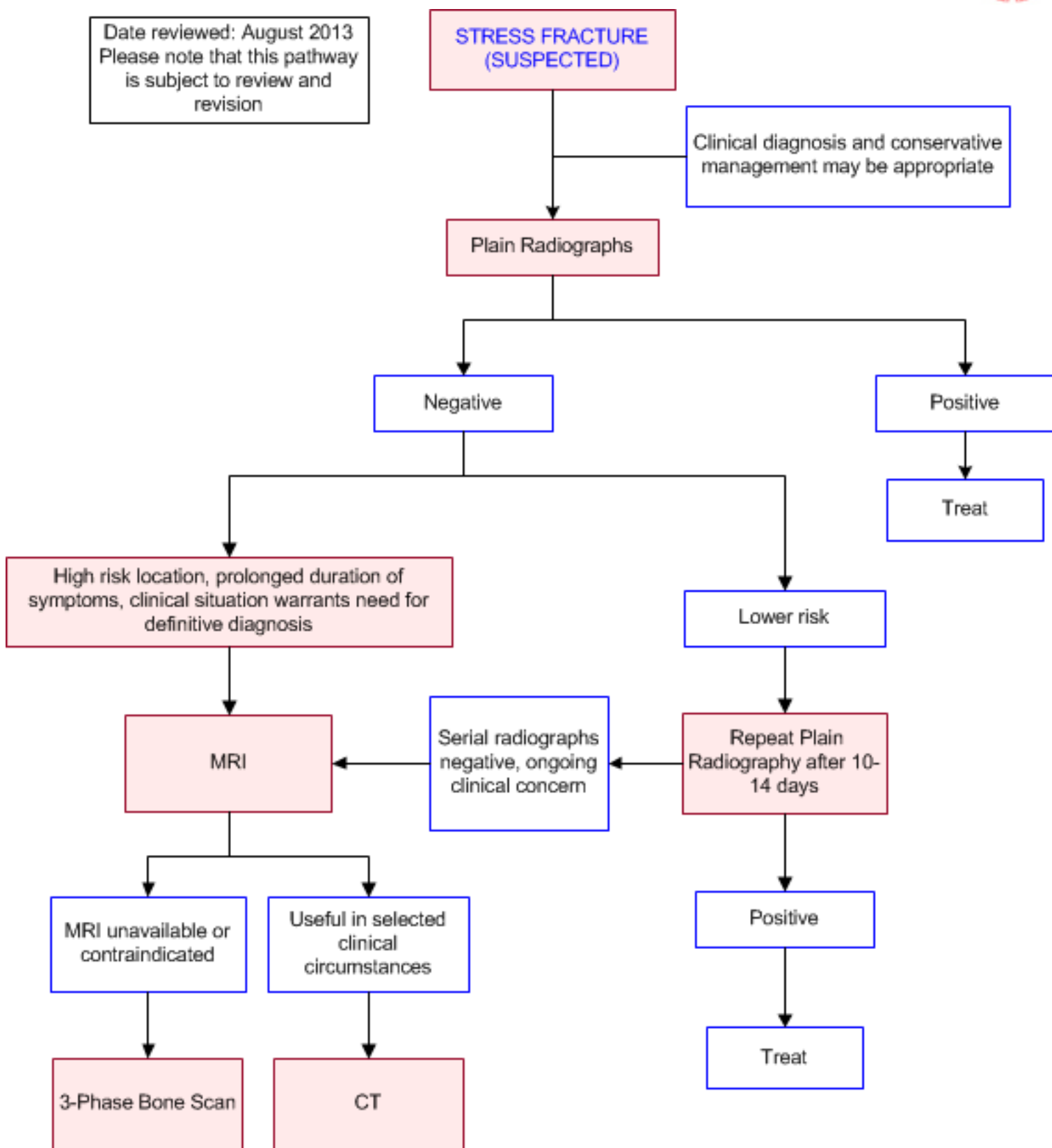
Clicking on the **PINK** text box will bring up the full text.

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

Date reviewed: August 2013  
 Please note that this pathway is subject to review and revision



## Image Gallery

*Note: These images open in a new page*

1a



### Suspected Stress Fracture

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

1b

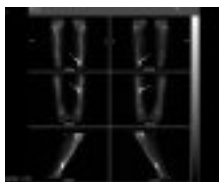


Image 1b (Bone Scan): Delayed phase of bone scan showing focal uptake in the posteromedial cortex typical of a stress fracture (arrow).

## 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

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-Techneium-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 findings [17](#)
- 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

## References

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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