Diagnostic Imaging Pathways - Wrist Fracture (Suspected)

Population Covered By The Guidance

This pathway provides guidance on the imaging of adult patients with a suspected scaphoid fracture.

Date reviewed: July 2018
Date of next review: July 2021
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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.

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<tr>
<th>SYMBOL</th>
<th>RRL</th>
<th>EFFECTIVE DOSE RANGE</th>
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<td></td>
<td>None</td>
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<tr>
<td></td>
<td>Minimal</td>
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<td>Low</td>
<td>1-5 mSv</td>
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<td>5-10 mSv</td>
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<td></td>
<td>High</td>
<td>&gt;10 mSv</td>
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Pathway Diagram
SUSPECTED WRIST FRACTURE

Plain radiography

Fracture
- Appropriate management
  - Pre-operative planning may involve CT

No fracture
- High clinical suspicion of scaphoid fracture or significant ligamentous injury
  - MRI or CT available
    - MRI
    - MRI contraindicated or unavailable
      - CT
  - Delayed repeat plain radiographs

- Low suspicion of fracture or significant ligamentous injury
  - No further imaging

Image Gallery

Note: These images open in a new page
Scaphoid Fracture

Image 1 (Plain Radiograph): Fracture of the scaphoid bone.

Scaphoid Fracture

Image 2 (Plain Radiograph): Undisplaced fracture of the scaphoid bone (arrows).

Scaphoid Fracture


Scaphoid Fracture

Image 4 (Computed Tomography): Coronal image of the wrist showing fracture though the proximal waist of scaphoid (arrows).

Teaching Points

- Early identification of a fracture and the degree of displacement is important to prevent adverse complications such as avascular necrosis, non-union and osteoarthritis. The scaphoid, capitate and lunate are the carpal bones most vulnerable to avascular necrosis. Scaphoid fractures account for 80% of all carpal fractures.
- The initial diagnostic modality for suspected wrist fractures is plain radiography, but a proportion of fractures are radiographically occult at the time of presentation. In particular, up to 20-30% of scaphoid fractures are initially missed by plain radiographs.
- Early MRI is the preferred investigation for detecting occult scaphoid and distal radius fractures, and has the advantage of simultaneously evaluating bone marrow abnormalities and surrounding soft tissue injuries.
- If early MRI is unavailable or contraindicated, CT is an alternative.
- Depending on local resources, presumptive casting and repeat plain radiography remains an option for suspected scaphoid and distal radius fractures. If follow-up radiographs do not show a fracture but symptoms persist, further imaging with MRI is recommend to investigate for scaphoid fracture or other cause of symptoms.
- Imaging modality choice will depend on availability and patient factors including age of the fracture, preference, hand dominance and activity level.
- If CT and MRI resources are limited, use of advanced imaging may be reserved for specific cases where an early answer is required.
- Early imaging is preferred as it results in faster identification of fractures and other injuries and reduces unnecessary immobilisation. Early advanced imaging may also be cost-effective compared...
to immobilisation and repeat radiographs 5,6
- Evaluation of the diagnostic performance of different imaging modalities is limited by the lack of a consensus reference standard
- There is currently a lack of evidence to guide the imaging of suspected scaphoid fractures in children so most current guidelines are based on findings in adults 7

### Plain Radiography

- Initial investigation of choice for evaluating clinically suspected wrist fractures 3
- 20-30% of scaphoid fractures are radiographically occult at the time of presentation 4,8,9
- Plain radiographs are specific (95-99.5%) but may miss wrist fractures, with sensitivity of 45-70% for scaphoid fractures, up to 41-60% for other carpal bone fractures and 67-80% for fractures of the proximal metacarpus, distal ulna and radial fractures 4,8,10
- Traditionally, suspected scaphoid fractures have been treated with immobilisation for 7-10 days followed by repeat radiographs, although the exact time frame may vary 11
- Presumptive casting and follow-up radiographs, when resorption at the fracture line may make previously occult fractures visible, has an estimated pooled 91.1% sensitivity and 99.8% specificity in the diagnosis of suspected scaphoid fractures on meta-analysis. 12 Reported sensitivities vary considerably, possibly due to poor interobserver agreement of follow-up radiograph findings. 12,13
  - The meta-analysis included studies with follow-up radiographs performed between 10 days and one year later. The false negative rate was similar (6% vs 7%) between studies with repeat radiographs at more and less than six weeks
- The main disadvantage of presumptive casting is that a number of people will undergo unnecessary immobilisation. When the cost of lost productivity is taken into account, there is evidence that early advanced imaging may be more cost effective 5,6
- While useful if positive, follow-up radiographs cannot exclude fracture and further evaluation with MRI is recommended if there are persistent symptoms 12,13

### Computed Tomography (CT)

- In two meta-analyses, the sensitivity and specificity of CT for scaphoid fractures were 72-85.2% and 99.0-99.5% respectively, which was slightly inferior but comparable to MRI 12,14
- May be used for suspected radiographically occult scaphoid fracture as an alternative when MRI is contraindicated or unavailable 3,8
- Preferred to MRI to evaluate suspected occult hook of hamate fractures 3
- Useful in
  1. Depicting occult scaphoid and other fractures of the wrist, where it is superior to plain radiographs 8,9,15
  2. Detecting scaphoid fracture displacement. CT is 77-80% sensitive for scaphoid displacement 10,16 This is important given it affects the decision to proceed to surgery over conservative management, and the risk of non-union 17
  3. Demonstrating distal radio-ulnar joint involvement 15 and other carpal joint instability 18
  4. Surgical planning of complex fractures 19
  5. Diagnosis of union; trabecular bone bridging on CT is currently the best way to evaluate scaphoid union 20,21
- Unlike MRI, CT involves exposure to ionising radiation although the dose for imaging the wrist is very low at 0.03-0.1mSv 9,22
Magnetic Resonance Imaging (MRI)

- MRI is considered the best advanced imaging modality for suspected radiographically occult scaphoid and distal radius fractures.\(^3,8,12,23\)
- Two meta-analyses estimated a pooled sensitivity of 88-97.7% and specificity approaching 100% with excellent reliability for the diagnosis of suspected scaphoid fractures, more sensitive than CT or follow-up radiography.\(^12,14\)
- There is mounting evidence that early MRI is cost effective compared to conventional management with immobilisation and reassessment and may reduce the potentially large societal cost of unnecessary immobilisation, but is influenced by local availability of scanning resources.\(^5,6,24\)
- Hospitals with the facilities to implement early MRI have found it to have a high clinical impact.\(^8,25,26\)
- Can evaluate bony and soft tissue injuries in one test without ionising radiation, including:
  - Occult scaphoid and other carpal bone fractures
  - Accompanying soft tissue injuries, a minority of which have the potential for significant morbidity, such as triangular fibrocartilage injuries and scapholunate ligament injuries.\(^27-29\)
  - Bone marrow abnormalities, such as avascular necrosis, and bone marrow oedema or ‘bruising’, which was reported to have a 2% risk of occult fracture development in one prospective study.\(^30,31\)
- Preoperative gadolinium-enhanced MRI can be used to evaluate the vascularity of the proximal pole in scaphoid non-unions which can help inform surgical decision to use a vascularised rather than standard non-vascularised bone graft.\(^32,33\) However, it is relatively insensitive compared to intra-operative assessment as the gold standard and cannot reliably predict prognosis in these patients.\(^34\)
- Contrast enhanced MRI is also useful in post-operative monitoring.\(^35\)
- Disadvantages compared to CT include:
  - Inferior to CT in depicting cortical involvement in occult scaphoid fractures.\(^36\)
  - Longer scanning time needed; is difficult for some patients where claustrophobia or pain may lead to increased risk of movement artefact
- Bone scintigraphy has also been shown to be accurate for diagnosing occult scaphoid fractures,\(^14\) but it does not have the same soft tissue resolution as MRI and is not routinely used as it is time consuming and involves considerable ionising radiation, about 4mSv.\(^37\)

References

**Date of literature search: April-July 2018**

The search methodology is available on request. [Email](mailto:info@imagingpathways.health.wa.gov.au)

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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