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Case report

False negative 16 detector multislice CT for scaphoid fracture

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Abstract. We discuss a case of a 19-year-old man with scaphoid trauma. We describe the imaging findings on three sets of radiographs, bone scintigraphy, CT and MRI. CT failed to identify a scaphoid fracture, which was present on 6 week radiographs, MRI and scintigraphy. The case illustrates that despite multidetector technology, CT still relies upon cortical and or trabecular displacement to demonstrate fractures.

The scaphoid is the most common carpal bone to fracture [1]. However the incidence, mechanism, natural history and treatment of such fractures remain controversial [1]. The fracture must be identified early, as immediate treatment is required to minimize the chances of non-union and thus avoiding disability [2]. Unfortunately, clinical examination and plain radiographs are unreliable diagnostic tools [2].

We present a case of suspected scaphoid fracture, where multistage radiographs, CT, MRI and bone scintigraphy were all performed. The discordance between imaging modalities shown in this case (Table 1) illustrates that despite multidetector technology, CT relies upon cortical and or trabecular displacement to demonstrate fractures.

Case report

A 19-year-old man presented to the accident and emergency department having fallen on his outstretched left hand. On clinical examination he was found to be tender in the anatomical snuffbox. Radiographs of four views (including a Stretchers/30 degree angled view) of his scaphoid were obtained, but no fracture was demonstrated (Figure 1a). His wrist was splinted and he attended follow up 10 days later. He remained tender in the snuffbox and four further radiographic views of his wrist were performed. Once again no fracture was identified (Figure 1b). On the same day he was referred for conventional $^{99}Tc^{m}$-methylene diphosphonate (MDP) bone scintigraphy of his wrist. The scintigram showed increased MDP uptake in the scaphoid in keeping with a fracture (Figure 2). After scintigraphy the patient underwent 16 detector multislice CT. This was performed with the hand above the head and flat on the table. Images were acquired in the axial plane using 0.75 mm detectors and reconstructed in 0.5 mm slice widths. Images underwent multiplanar reconstruction and were viewed in interactive cine mode, but no fracture could be detected (Figure 3). As a result of these discrepant findings a 1.5 Tesla MRI examination of the wrist was undertaken 3 days later. On T_1 weighted images there was reduced signal seen in the marrow of the proximal scaphoid consistent with oedema (Figure 4a). T_2 weighted fat saturated images showed high signal in the proximal pole of the scaphoid and a suggestion of a linear low signal line transversing the proximal third of the bone (Figure 4b). Although the latter was equivocal it was thought to probably represent a fracture. The patient was treated for a scaphoid fracture and his wrist immobilized for 6 weeks. At this time further radiographs were performed which showed a fracture line at the lower pole (Figure 5).

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Discussion

The high sensitivity of skeletal scintigraphy in the detection of fractures is well established. For this reason, as well as its widespread availability, many investigators recommend its use in the detection of occult scaphoid fractures [2–4]. In recent years however, the increasing availability of MRI has led to its use in the diagnosis of various traumatic bone injuries, including scaphoid fracture. There are claims of benefit in diagnosis, cost and clinical impact using MRI [5–7].

CT has inherent advantages when examining high attenuation tissues such as bone. However, although methodology for examining the scaphoid successfully on CT has been described for many years [8], the use of CT to diagnose scaphoid fractures is rather limited. This may be the result in part of one early study, which suggested scintigraphy was significantly more sensitive than CT in the diagnosis of scaphoid fractures [4]. Since these early studies, the advent of multidetector technology has revolutionized the CT technique, allowing fine section,

Table 1. Summary of imaging findings

Imaging technique	Findings
Radiograph day of trauma	Normal
Radiograph day 10 after trauma	Normal
Bone scintigram day 10 after trauma	Scaphoid fracture
CT day 10 after trauma	Normal
MR day 14 after MRI	Probable scaphoid fracture
Radiograph day 42 after trauma	Scaphoid fracture

(a) (b)

Figure 1. (a) Dorsopalmar radiograph of the left wrist on the day of injury with no evidence of fracture. (b) Dorsopalmar radiograph of the left wrist 10 days post trauma. No evidence of fracture is seen.

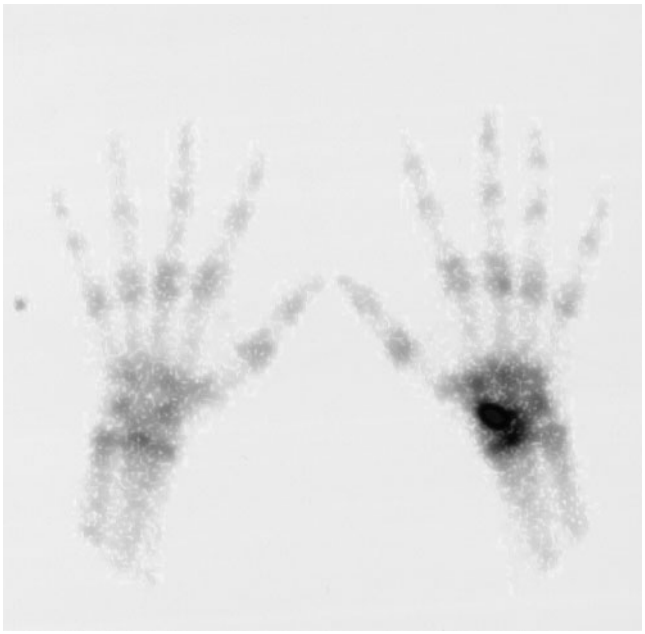


Figure 2. Local view of the hand from a $^{99}Tc^{m}$-methylene diphosphonate labelled bone scintigram showing increased tracer uptake in the region of the left scaphoid.

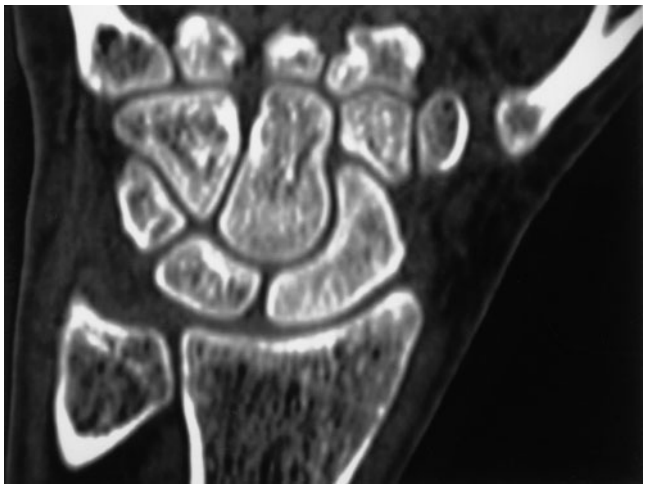
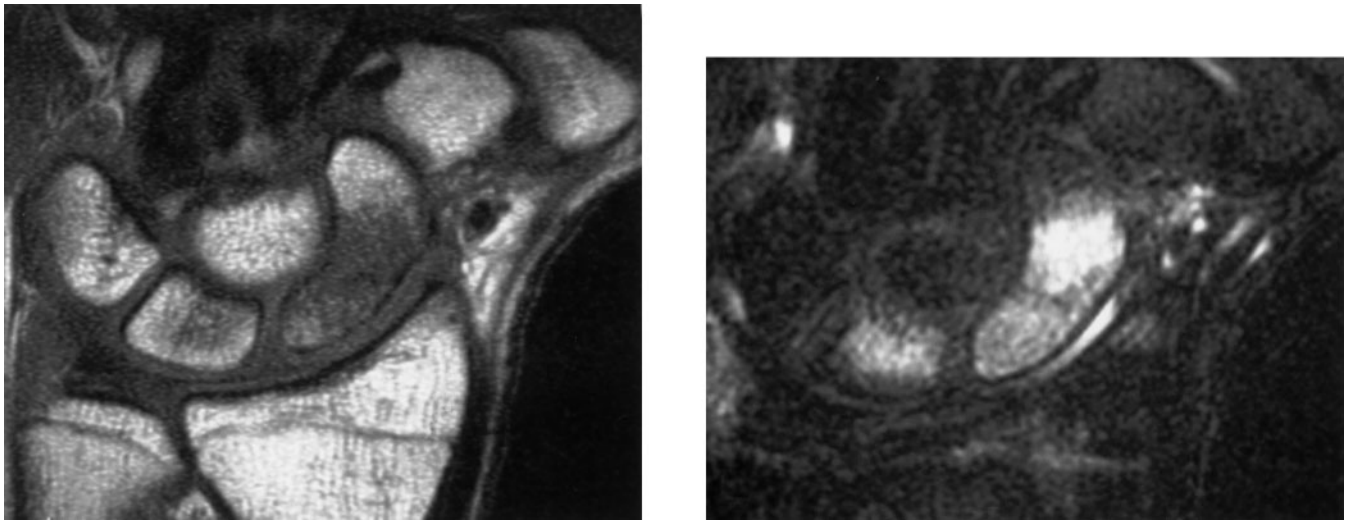


Figure 3. Coronal reconstruction from a 16-detector multidetector CT of the left wrist 10 days post injury. The image was obtained using the 0.75 mm detectors and reconstructed in 0.5 mm intervals using a hard tissue algorithm. No fracture is identified.



(a) (b)

Figure 4. (a) T_1 weighted coronal MRI of the left wrist performed 13 days post trauma showing reduced signal in scaphoid. (b) Fat saturated T_2 weighted coronal MRI of the left wrist performed 13 days post trauma showing high signal in the scaphoid. There is a suggestion of a fracture line in the proximal one third.

Figure 5. Dorsopalmar radiograph of the left wrist 6 weeks post injury. A fracture is identified affecting the proximal pole of the scaphoid.

multiplanar reconstructions from isometric voxels at subminute examination times. These advances have led CT to exquisitely demonstrate bone cortex and trabecula pattern, which should in theory aid the detection of bone fracture. In this case, the isometric voxels allow multiplanar reconstructions through the long axis of the scaphoid and thus diminishes the necessity to perform true coronal sections of the wrist in ulnar deviation. These advances in CT have led our institution to investigate the potential use of this technology in diagnosing fractures.

Despite the most modern CT machines, with use of 0.5 mm sections and multiplanar examination, this case demonstrates the potential fallibility of the technique against the sensitivity of conventional scintigraphy and MRI. The case illustrates that despite multidetector technology, CT still relies upon cortical and/or trabecular displacement to demonstrate fractures.

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