

Original Research Article

Role of early CT scan in diagnosis of occult scaphoid fractures- a prospective study

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ABSTRACT

Background: Wrists injuries are one of the common presentations to emergency departments and orthopaedic clinics. The scaphoid bone is the most commonly injured of the carpal bones accounting for 50-80% of carpal injuries and predominantly occurs in young healthy individuals. Scaphoid fractures are the most problematic to diagnose in a clinical setting because it can take up to 6 weeks for scaphoid fractures to become conclusive on plain X-ray films. Aim of the study was to retrospective study was carried out to study the role of early CT scan in diagnosis of occult scaphoid fractures.

Methods: A total of 123 patients presented with an acute wrist injury with subsequent signs of scaphoid injury in the absence of a diagnostic fracture on plain X-ray within the time period from June 2014 to May 2016 in a tertiary care centre.

Results: This study shows that 31% of normal X-rays were pathological on CT scan and out of these; scaphoid fractures (74% of pathologies) represent a large number of patients with fractures that were missed by initial plain films.

Conclusions: This study shows an extremely high false-negative rate for plain X-rays and advocate CT at the first attendance to fracture clinic if there is suspicion of scaphoid injury. An earlier diagnosis leads to appropriate management and reduces restrictions to the patient in terms of prolonged immobilization and repeated clinical reviews.

Keywords: Clinical scaphoid, CT scan, Occult fracture

INTRODUCTION

Scaphoid fractures are commonly seen in orthopedic practice. An organized and thoughtful approach to diagnosis and treatment can facilitate good outcomes. The scaphoid bone is the most commonly injured of the carpal bones accounting for 50-80% of carpal injuries and predominantly occurs in young healthy individuals.^{1,2} The diagnosis of a scaphoid fracture can sometimes be difficult to establish, as patients may have normal radiographs early in their clinical course. Scaphoid

fractures are difficult to diagnose early as they can take up to six weeks to appear radiologically. It is estimated that up to 40% of scaphoid fractures are missed at first presentation.^{3,4} A recent meta-analysis of scaphoid fractures calculated that the positive predictive value of clinical examination (those who proved to be 'clinical scaphoid' warranted X-rays of scaphoid views who subsequently had scaphoid fracture) is in the range 13-69% with an average of 21%.⁵ This means that four out of five patients without a fracture will be unnecessarily immobilized before radiological diagnosis is confirmed.

The diagnosis of a scaphoid fracture can usually be established on the basis that most patients demonstrate tenderness over the anatomic snuff box or over the distal scaphoid tubercle, pain with longitudinal compression of the thumb, and limited range of motion and pain at the end arc of motion, especially with flexion and radial deviation. Reduced grip strength may be noted. Immediately after injury, up to 65% of scaphoid fractures remain radiographically occult.⁶ For patients with a high clinical probability of a scaphoid fracture but unremarkable radiographs, it is therefore a common practice to place the wrist in a scaphoid cast until the scaphoid fracture is ruled out on follow-up radiographs obtained 2, 4, and 6 weeks after the trauma. If no fracture is visible on radiographs up to six weeks after trauma, it is considered safe to discontinue immobilization. This protocol however takes weeks-long unnecessary immobilization in some patients, which results in both a reduction in the quality of life and an increase in health care costs.

METHODS

A prospective study of patients was done who sustained acute wrist injury with suspected scaphoid fracture attending the emergency or OPD clinic a tertiary care hospital from June 2014 to May 2016. A total of 123 patients came to emergency room or OPD with an acute wrist injury with clinical signs of scaphoid injury. Patients with no X-ray findings but clinical signs suggestive of scaphoid injury satisfied the criteria for CT in this study. Clinical signs as criteria for getting CT-scan were tenderness over the anatomical snuffbox, pain on axial loading of first metacarpal and tenderness over scaphoid tubercle. Patients with clinical indications of scaphoid fracture but normal plain films had their wrists immobilized in a scaphoid cast.

CT scans, whenever necessary, were carried out on the same day as review on the first presentation to the OPD with results available immediately. This facility was made available by the radiology department.

RESULTS

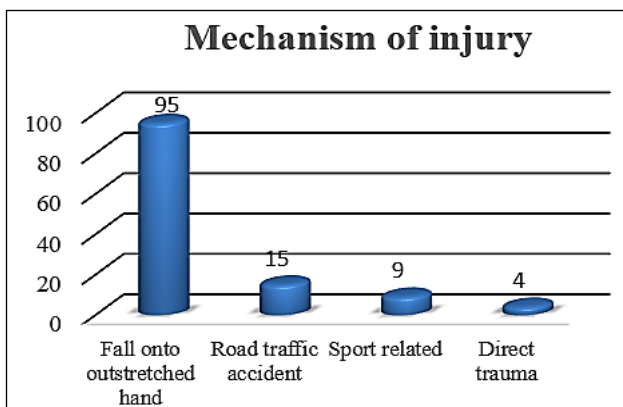


Figure 1: Mechanism of injury.

The age range was 18-70 years and the majority of patients were 29-45 years old. Out of these patients, 52% were females and 48% were males. About seventy five percent patients had CT imaging of their scaphoid within first week of injury and 99% patients had CT imaging within two weeks of injury.

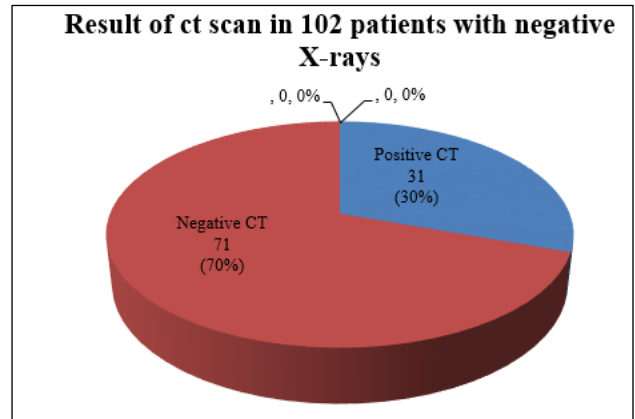


Figure 2: Results of CT scan done in 102 patients.

Out of these 123 patients, 21 patients had clear diagnosis on X-ray; out of which 12 were displaced scaphoid fractures, 5 were distal end radius fractures and 4 were metacarpal base fractures. Overall, 102 patients had a clinical scaphoid injury but negative X-rays. Of these 102 patients with negative X-rays, 31 had positive CT findings. Of these 31 patients with positive CT scans, 23 had scaphoid fractures. The other 8 diagnoses included were two capitates, three distal radial fractures, two scaphoid cysts and one distal radial fracture.

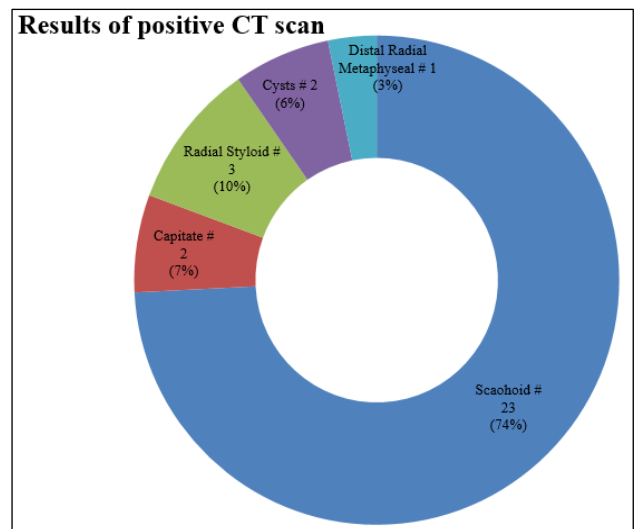


Figure 3: The causes of a positive CT scan in 102 patients.

Of patients with normal plain radiographs, 31% (31 of 102) had positive findings on CT-scans; out of which 22% (23 of 102) were scaphoid fractures. Of the patients with normal X-rays, 31% had positive findings on CT.

The proportion of positive findings for an acute scaphoid fracture was 74% (23 of 31).



Figure 1: Occult scaphoid fracture at the time of injury.

Eighty patients had normal CT findings. All patients were immobilized in a scaphoid cast until the fracture healed (for a period of 6-9 weeks) and discharged.

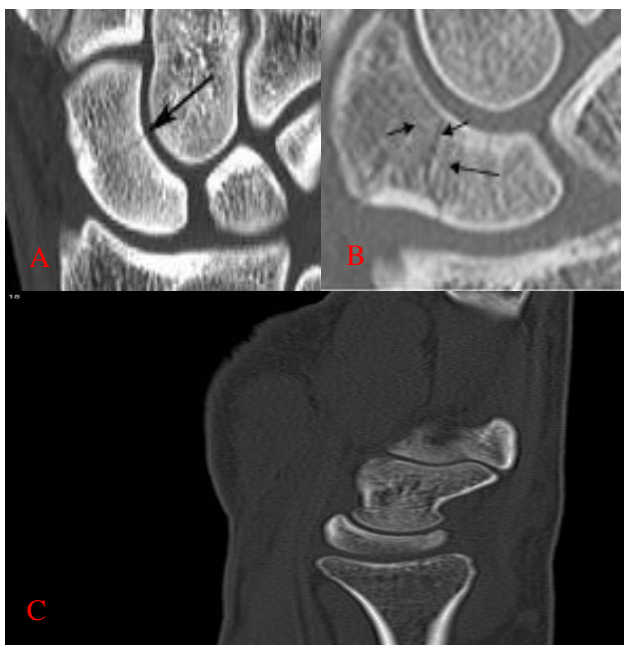


Figure 2: A, B, C- fracture scaphoid in CT scan of the same patient on day 1 injury.

Two patients treated with plaster had continuing pain and underwent MRI scanning confirming no positive findings. One patient with a proximal pole fracture treated with plaster for 3 months, successfully underwent open reduction and internal fixation after a subsequent CT scan showed non-union.

DISCUSSION

Failure to diagnose and immobilize scaphoid injuries can lead to osteoarthritis, mal-union, non-union and avascular necrosis; non-union is in the order of 5-12%.^{7,8} Even

asymptomatic non-union has been shown to lead to deterioration, both clinically and radiologically, with time.⁹ Fracture of the scaphoid bone can be difficult to diagnose because it may take up to several weeks for radiological evidence to be conclusive.¹⁰

Although this remains an accepted treatment option, it may result in unnecessary immobilization, with adverse effects upon return to work and the need for repeat radiographs, clinical examinations, and splint or cast changes.¹¹⁻¹³

Alternative imaging techniques may be useful for diagnosing a fracture, and magnetic resonance imaging (MRI) is superior to repeat radiographs for detecting an occult scaphoid fracture.¹⁴ Bone scans are sensitive but not specific for diagnosing a scaphoid fracture.¹⁵ Bone scintigraphy has demonstrated 100% sensitivity and 98% specificity for a scaphoid fracture compared with approximately 65%-70% sensitivity for plain radiography.¹⁶

Initial radiographic sensitivity can be up to 64% and falls on further imaging to only 30%.¹⁷ Immobilization for a clinical scaphoid injury is usually in a scaphoid cast for at least 6 weeks until a conclusion is drawn from imaging in conjunction with repeated clinical examination. In such cases, the options available are a modified carpal view, bone scintigraphy, MRI, and CT. Some use modified views first and then proceed to CT when diagnosis is still in doubt.¹⁸

CT is an accurate and reliable source of imaging to diagnose scaphoid fractures and has been shown to be more sensitive than bone scintigraphy (sensitivity, specificity and positive and negative predicted value of CT is 100% compared to 78%, 90%, 78% and 90%, respectively, for bone scintigraphy).¹⁹

It has been suggested that MRI should be used as the gold standard to diagnose scaphoid injuries.²⁰ Some authors advocate that CT could be used as gold standard to record whether union has been achieved.²¹

MRI has definite advantages in that it provides an accurate diagnosis of scaphoid fractures including information on the vascularity of the fragments involved and elucidates soft tissue injuries that conventional scaphoid views, modified carpal box view and CT are not able to delineate. However, the use of MRI in most hospitals to elucidate scaphoid injury in an acute setting is usually not practical.

In this study use of CT was used to image the 'clinical' scaphoid when initial films of scaphoid views fail to show pathology. 31% of normal X-rays were pathological on CT imaging and the most of these were scaphoid fractures (74% of pathologies) which represent many patients with scaphoid fractures that were missed by initial plain films.

Moreover, they also represent an even larger number of patients (69%) with clinical scaphoid that would have been plastered for at least 6 weeks and asked to re-attend fracture/hand clinic at least three times before discharge, confirming the prophecy 'we over-treat a lot of patients to avoid under-treating a few. Pillai and Jain reported a needless immobilization rate of >80% when all clinically suspected scaphoid fractures with negative radiographs were immobilized in the traditional treatment algorithm which suggested that the cost of needless immobilization, with further clinical and radiographic studies, would have exceeded early alternative investigations, such as MRI or bone scan or CT scan, which frequently were ultimately required anyway.²² In addition, CT scans can help the surgeon decide whether a structural bone graft is required, the preferred screw fixation and whether a volar or dorsal approach is more appropriate.

CONCLUSION

This study shows an extremely high false-negative rate for plain X-rays and advocate CT at the first attendance to fracture clinic if there is suspicion of scaphoid injury. An earlier diagnosis leads to appropriate management and reduces restrictions to the patient in terms of prolonged immobilization and repeated clinical reviews. Given its relatively low cost and high diagnostic accuracy, advanced imaging for suspected scaphoid fractures in the setting of negative radiographs represents a cost-effective strategy for reducing both costs and morbidity; therefore, use of CT imaging as a second-line investigation is recommended.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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