

# Patient-directed follow-up for the clinical scaphoid fracture

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## Aims

Occult (clinical) injuries represent 15% of all scaphoid fractures, posing significant challenges to the clinician. MRI has been suggested as the gold standard for diagnosis, but remains expensive, time-consuming, and is in high demand. Conventional management with immobilization and serial radiography typically results in multiple follow-up attendances to clinic, radiation exposure, and delays return to work. Suboptimal management can result in significant disability and, frequently, litigation.

## Methods

We present a service evaluation report following the introduction of a quality-improvement themed, streamlined, clinical scaphoid pathway. Patients are offered a removable wrist splint with verbal and written instructions to remove it two weeks following injury, for self-assessment. The persistence of pain is the patient's guide to 'opt-in' and to self-refer for a follow-up appointment with a senior emergency physician. On confirmation of ongoing signs of clinical scaphoid injury, an urgent outpatient 'fast'-wrist protocol MRI scan is ordered, with instructions to maintain wrist immobilization. Patients with positive scan results are referred for specialist orthopaedic assessment via a virtual fracture clinic.

## Results

From February 2018 to January 2019, there were 442 patients diagnosed as clinical scaphoid fractures. 122 patients (28%) self-referred back to the emergency department at two weeks. Following clinical review, 53 patients were discharged; MRI was booked for 69 patients (16%). Overall, six patients (< 2% of total; 10% of those scanned) had positive scans for a scaphoid fracture. There were no known missed fractures, long-term non-unions or malunions resulting from this pathway. Costs were saved by avoiding face-to-face clinical review and MRI scanning.

## Conclusion

A patient-focused opt-in approach is safe and effective to managing the suspected occult (clinical) scaphoid fracture.

## Take home message

- Contrary to traditional thinking for the management of patients with a clinical scaphoid injury, the vast majority of these patients heal with conservative self-directed treatment without the need for follow-up imaging.
- Patients can be empowered to self-manage and refer for follow-up with appropriate advice.

## Introduction

The scaphoid is the most commonly fractured bone of the carpus (90%), with an estimated annual incidence of over 7,200.<sup>1</sup> The clinical scaphoid fracture is one which is not readily visible on plain X-ray imaging at presentation. This may variably be termed the 'occult' fracture or a 'suspected' fracture.

It is traditionally accepted that the consequences of a missed scaphoid fracture can be significant, with progression to displacement, malunion, or nonunion attributed to inadequate treatment (i.e. immobilization) in the early stages. Disruption to retrograde blood flow as a consequence of fracture can result in avascular necrosis of the proximal pole, and a considerable range of potential sequelae, including progressive post-traumatic osteoarthritis.<sup>2</sup> The resultant loss of function can be significant, particularly to the working-age predominantly male population who tend to experience this type of injury.

It is unknown if these adverse outcomes are limited to those fractures that are immediately obvious, or whether the clinical scaphoid fracture also has a significant potential for complication. This lack of clarity has led to management pathways erring on the side of caution, with a strong focus on detecting all fractures.

Traditional pathways have been driven by a fear of medicolegal litigation, but this has not been based on any strong evidence about the natural history of the truly occult fracture. Ring et al<sup>3</sup> reported that 36.3% of total orthopaedic claims in the UK between 1995 and 2012 were related to wrist and scaphoid injuries with an average settlement for scaphoid fractures of £51,500, with the primary reasons cited in over 85% of successful claims being delayed, incorrect, or missed diagnosis.

Conventional follow-up practice has often required follow-up appointments for repeated assessment in either an orthopaedic fracture clinic or emergency department (ED) returns clinic. Cross-sectional imaging has the potential to determine the presence of occult fracture sooner. MRI is considered the gold standard of imaging methods for demonstrating occult scaphoid pathology, with the National Institute for Clinical Excellence (NICE) recommending early consideration of MRI in the assessment of potential scaphoid fracture.<sup>4</sup> However, MRI scans are costly and the demand for the service is high, with limited accessibility to scanners within most NHS institutions.

Repeat attendance at follow-up appointments, or non-attendance at booked appointments, is also costly in terms of staff and clinic resource. Furthermore, re-attendance for follow-up maybe inconvenient or incur a cost for patients. There is therefore a challenge for emergency physicians and orthopaedic surgeons to balance a desire to detect all scaphoid fractures with the ambition to minimize over-investigation, over-use of a scarce radiological resource or unnecessary follow-up appointments.

The practice at our institution followed a traditional model of face-to-face follow-up review ten to 14 days after initial presentation in an ED returns clinic, with repeat clinical assessment and repeat plain radiography. This was in keeping with the majority of UK practice, as reported by Dean et al.<sup>5</sup> There was already an established practice of using wrist splints rather than backslabs for clinical scaphoid fracture with

normal initial X-rays. This is in keeping with most departments across Scotland and the UK as a whole. Local audit data demonstrated a high rate of non-attendance at follow-up appointments, as well as considerable variability between clinicians with respect to further imaging and onward referral to orthopaedic fracture clinic.

We sought to improve our service by developing a new model of care. This model was based on the principles of empowering the patient to opt-in for follow-up and reducing unnecessary variation at any subsequent follow-up. This was undertaken as a quality improvement project (QIP). The aim of this report is to investigate the clinical and process outcomes from the first year of operation of the new pathway.

## Methods

Our institution (Forth Valley Royal Hospital, UK) is the only acute hospital within the health board area. The ED is supported by one separate minor injuries unit (MIU), but both services refer in to a single review clinic and orthopaedic service. The health board covers a wide geographical area and has a catchment population of 306,000. Two-thirds of the population are of working age, and one-sixth is aged under 16 years.

### Initial audit

Local audit in 2017 reported a 40% non-attendance rate as well as considerable variability between clinicians with respect to further imaging. Most clinicians undertook plain radiography depending on repeat clinical assessment, with some referring on for orthopaedic assessment or cross-sectional imaging at variable subsequent phases, even if repeat plain radiography did not demonstrate a fracture.

Demographic analysis of the did-not-attend (DNA) patients revealed a median age of 28 years (interquartile range 12 to 41), with 49% being male. Figures for patients who did attend were very similar, with a median age of 31 years and 50% being male.

The non-attenders were not contacted with rescheduled appointments as per local hospital policy and there was no evidence via local reporting data that these patients came to harm from subsequent delayed presentation of malunion or nonunion.

### New opt-in pathway

Through an inter-specialty collaboration (emergency medicine, orthopaedics, and radiology), a new pathway (Figure 1) was designed on the premise that most patients with radial wrist pain, tenderness, and negative X-rays following trauma have an uncomplicated soft-tissue injury and will recover rapidly with rest and short-term joint immobilization, without the need for formal follow-up. This is in line with other recent work demonstrating the concept that patient-directed follow-up for some minor injuries is safe and effective.<sup>6-8</sup>

Due to the quality and service improvement nature of the project, neither ethical approval nor informed consent were required.

The new pathway was initiated into formal practice in February 2018. Patients with a mechanism of injury and clinical signs consistent with potential scaphoid fracture but no radiological abnormality are discharged with verbal and

written instructions provided by the emergency department clinician. These instructions emphasize the need to immobilize the wrist in a splint continuously and sets out a time schedule for the patient to assess their symptoms (Supplementary material 1).

If the patient has ongoing pain at two weeks post-injury, they are advised to self-refer for an appointment. At the review appointment, a repeat clinical assessment is conducted by an experienced senior emergency physician. Any clinical concern leads to an urgent outpatient MRI referral, and the patient is advised to maintain splint immobilization.

### MRI scanning protocol and result follow-up

A FAST trauma wrist scanning protocol was introduced as part of the quality improvement project. This is an abbreviated version of the formal wrist protocol and comprises two coronal 3 mm sequences: a T1 and Short Tau Inversion Recovery (STIR). Total scanning time is around six minutes. Khalid et al<sup>9</sup> reported their experience of using limited sequence MRI to focus assessment on the clinical question of the presence of a fracture.

The two MRI machines in use at our institution (Forth Valley Royal Hospital) are the 1.5 T Artist and 3 T Pioneer (GE Healthcare, USA). Each has a 16 channel dedicated wrist coil. Availability governs which scanner is used. The short scan time simplifies the scheduling process, creating slots between larger studies and facilitating urgent outpatient referrals to be performed within a few days.

All cases are reported by three radiologists (including MR) with specialist interest in musculoskeletal imaging, with 11, 14, and 19 years' consultant experience, respectively. This compares to the formal wrist protocol, which is four sequences and multiplanar rather than just coronal and takes 30 minutes. Positive scans are reported back to the referrer; the patient is contacted, advised to maintain splint-use, and referred on to a virtual fracture clinic for orthopaedic review.

### Data collection

Monthly reports were established through our information services department to facilitate the prospective audit: 1) All patients coded with clinical scaphoid injury from the emergency department or minor injuries unit; 2) all patients attending the emergency department review clinic; and 3) all patients with an initial diagnosis of clinical scaphoid injury who subsequently reattended within three months of the initial visit.

Patient records were scrutinized to ensure the new discharge information sheet had been provided and all patients who self-referred for a review appointment were followed up to record what the final diagnosis was (i.e. whether MRI was obtained and what the result of scan was if performed).

### Detection of complications

Regular communication was established between the ED and the orthopaedic hand service to hear if any cases of missed fracture were encountered. All radiology reports (from initial scaphoid radiograph series and MRI) were received by the referring team and cross-checked with the initial or review attendances. Any discrepancies were actioned.

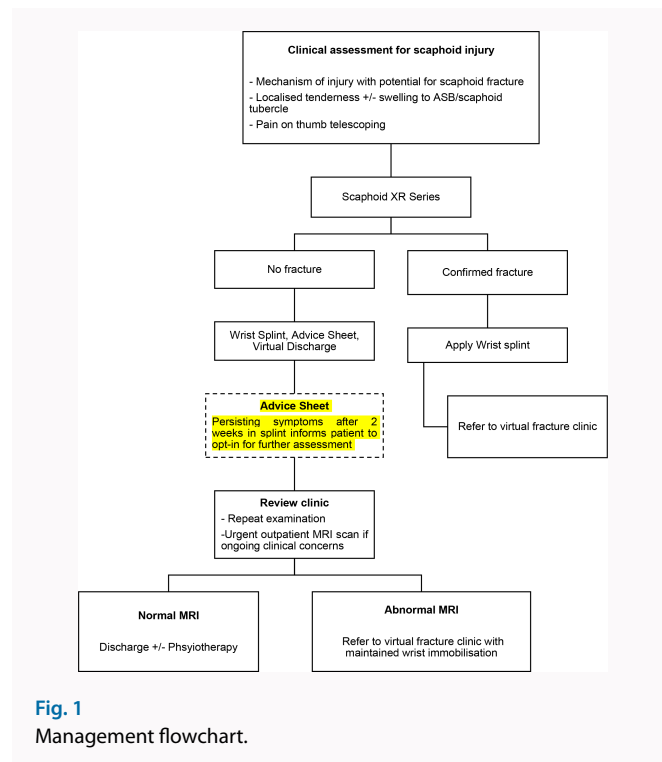


Fig. 1 Management flowchart.

Unplanned return visits for any patients were detected using the third information services report above, with the outcomes recorded to minimize any loss to follow-up. A further scrutiny of electronic patient records and liaison with primary care was carried out in April 2023 (> four years from index injury) to record a final outcome.

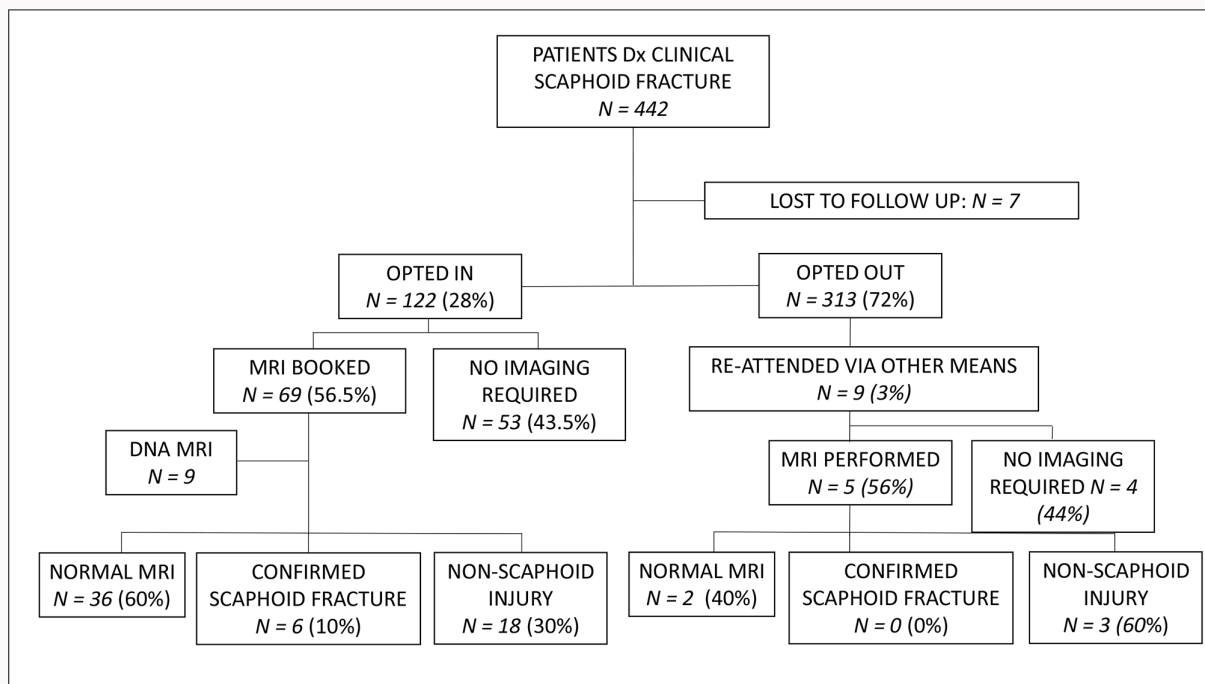
### Results

Between February 2018 to January 2019, there were 442 patients (177 males; median age 37 years; 8 to 88) diagnosed with clinical scaphoid fracture (Figure 2). All were discharged with verbal and written information provided.

At two weeks, 122 patients (28%) opted-in for a review appointment. Following clinical review, 53 patients were discharged, and MRI was booked for 69 patients (16% overall). In all, six patients had a confirmed scaphoid fracture (1.4% overall; 5% of those who opted-in). Alternative injuries were identified in 18 patients (4% overall; 15% of those who opted-in). These included triangular fibrocartilage complex tears, non-scaphoid fractures, and metacarpal bone contusion.

Of those patients who opted-out (313; 72% overall), nine re-presented via other means to orthopaedic clinic (e.g. primary care referral). MRI was performed in five of these patients with no scaphoid fractures or other significant injuries identified. Nine patients were lost to follow-up overall, but no cases of scaphoid nonunion or malunion have been encountered since the change in practice.

In terms of the overall MRI-positive rate for confirmed scaphoid fracture, this was 8%. The rate of acute occult fracture diagnosed by MRI in the previous 12 months (February 2017 to February 2018) was 11%. No patients required surgical intervention and no cases of malunion or nonunion were encountered.



**Fig. 2**  
Patient outcomes flowchart.

### Cost savings

The new pathway saved 304 ED clinic appointments and 69 appointments to fracture clinic (in comparison with previous model of care). This yielded an estimated combined cost-saving of £26,964 (£86 per ED clinic appointment and £120 per fracture clinic appointment).<sup>10</sup> Additional estimated cost savings of £9,724 (£22 per radiograph) were gained from eliminating a second plain radiograph series.

In our institution, the cost of a single MRI wrist scan costs £140. If all patients had undergone an MRI scan, as is the practice in some institutions, this would have required 442 scans at a total cost of £61,880. Instead, this pathway used 74 scans (including DNA slots), thereby potentially saving £51,520.

### Discussion

This project has demonstrated that a new opt-in pathway has been successful in the management of suspected scaphoid fractures in our health board. It reduced the need for follow-up attendance by providing specific verbal and written information, and resulted in cost-savings by avoiding unnecessary clinic appointments, repeat radiograph series and MRI scans. No adverse events were detected, such as a missed fracture.

The new pathway streamlines clinical scaphoid fracture management. The reasons for success are manifold. Analysis of past practice indicated that despite initial clinical signs to the contrary, the majority of such injuries recover quickly with time honoured, conservative measures – splintage and analgesia. Verbal and written information educates patients about their injury – the probable as well as the potential; expectations are also managed. This empowers patients to direct their own recovery or recognize the need for ongoing medical attention. With this manner of comprehensive safety-netting, the onus for further action can be safely passed

on to the patient while maintaining a medico-legal duty of care with verbal and written information and an easy way back into the 'system'<sup>11,12</sup>

The cohort of patients that self-refer for a repeat assessment typically leave that stage with either a firm reassurance of clinical improvement or a plan for a formal MRI-proven diagnosis. This circumvents the second radiograph series, thereby removing a non-value-added step and saving money. The new pathway facilitates definitive diagnosis within a much shorter time frame than would have been feasible with conventional practice, allowing patients to return to normal activities earlier.

Where acute pathology is established by MRI, the patient can be reassured that the mainstay of management of most minimally or undisplaced scaphoid fractures is unchanged with continued immobilization, thereby placing the patient already two weeks into definitive treatment.<sup>13</sup> At fracture clinic review, the splint is usually changed to a lightweight cast.

In cases where fixation is recommended, such as proximal pole fractures, scheduling surgery is still achievable at that early stage. Additionally, the time frame from such MRI-proven scaphoid fractures to surgical fixation does not significantly affect the overall rate of postoperative union.<sup>14,15</sup>

NICE guidelines recommend MRI as the imaging modality of choice if plain radiographs are normal.<sup>4</sup> There is increasing demand for this resource, acutely and electively, within orthopaedics, as well as other specialties, making time in the scanner very precious. The SUSPECT study group recently found that only a minority of emergency departments in the UK have direct availability of MRI scans to diagnose clinically suspected scaphoid fractures.<sup>5</sup>

Rua et al<sup>16</sup> reported the results of the SMaRT trial, randomizing clinically suspected and radiologically unfound

scaphoid injuries to two arms: a conventional pathway, or immediate MRI assessment. The immediate MRI pathway seeks to provide patients with a more accurate earlier diagnosis so that definitive management can be commenced sooner. In this study, an MRI proven/occult scaphoid fracture was discovered in just over 10% of cases; alternate injuries were found in one-fifth of cases.

Our opt-in pathway permits judicious use of the scarce MRI resource by pragmatically filtering those patients destined to improve spontaneously with time. An encouraging and reassuring finding was that the rate of scaphoid fracture in the opt-in cohort that underwent MRI scanning was not significantly different to the fracture rate in the previous conventional pathway (8% vs 11%). Furthermore, the British Society for Surgery of the Hand Suspected Scaphoid Fracture Group (SSFG) found an acute occult scaphoid fracture incidence at MRI of 11% across 22 centres in the UK.<sup>17</sup>

Another strength of our pathway is a reduction in review clinic appointments and the subsequent release of senior clinical time. Reducing the burden on clinics of unnecessary review facilitates provision of earlier appointments for other patients. This is in keeping with the Scottish Government's efforts in the Modern Outpatient Collaborative, in particular the aim to reduce/eliminate unnecessary new and return appointments.<sup>18</sup>

As the premise of this pathway is a virtual discharge of all clinical scaphoid injuries and patient-directed follow-up, this does introduce potential limitations. Although data was prospectively managed, randomization of patients was not possible due to the quality improvement nature of the study. This allowed us to maximize the cohort size to better reflect the population and downstream effect associated with the pathway, and quality improvement methodology permitted rapid cycles of evaluation and change along the way.

The overall detected occult scaphoid fracture rate in our study was 1.4%. This is lower than previously quoted in the literature of between 5% and 20%,<sup>19</sup> but the methodology of reporting this rate is wide and variable between studies. Our lower detection rate is to be expected in view of the opt-in nature of the pathway. There are likely to have been some patients with occult fractures who did not opt-in for follow-up. We hypothesize that these undetected occult fractures are likely to have been minor scaphoid fractures with a very low chance of complication. With a repeat electronic patient record scrutiny after four years and a single-centre institution, we are confident that this study demonstrates it is highly unlikely any of these patients came to harm.

Stirling et al<sup>20</sup> have reported their successful experience of a virtual discharge model for patients with clinical scaphoid injury. The protocol they describe differs from ours by including a weekly review, by a hand specialist, of all clinical scaphoid discharges from the ED. Follow-up at one-year post-injury by questionnaire or telephone call revealed excellent patient-reported outcome measures and that the vast majority (97%) of patients expressed satisfaction with the service. The occult scaphoid fracture detection rate in this study was 3%, also less than the previously quoted rate in the literature and likely to be due to similar reasons as our study.

There is the potential for error with our study due to a possible lack of specific patient-reported outcome data.

However, no cases of adverse outcome during the study period have been encountered. We are satisfied that this result is valid due to all subsequent management from the ED being at one orthopaedic department, and all scaphoid fixation procedures within our health board carried out by one orthopaedic hand surgeon (AP).

It could be argued that using emergency physicians to follow-up these patients is a poor use of a scarce resource, or that these physicians have a higher referral rate for MRI than either general trauma & orthopaedic surgeons or specialist hand surgeons. However, the reported cost for an ED attendance (£86) is less than an outpatient clinic appointment (£120). Furthermore, our study has shown that the MRI referral rates were broadly the same (56%) for patients who opted-in (and were reviewed by an emergency physician) and patients who re-presented to fracture clinic (and were reviewed by a general trauma & orthopaedic surgeon) via other means, although numbers re-presenting via other means were small. We would argue that utilizing a specialist hand surgeon to virtually review all clinical scaphoid fractures diagnosed in the emergency department, as in the study by Stirling et al,<sup>20</sup> may not be the best use of an even scarcer resource.

McLaughlin et al<sup>21</sup> in 1969 noted that fractures of the scaphoid that were not visible on initial radiograph were 'class A fractures': undisplaced fractures that were little more than a split in the articular cartilage. They stated that 'it was abundantly clear that, barring a re-injury, the fractures in this group would heal under almost any circumstance'. It is interesting to note how clinical management has changed since then, but perhaps the time has come to reflect on current practice and pledge to be less defensive and more realistic in the professional advice we give to our patients.

We conclude that the use of an opt-in pathway for the management of suspected scaphoid injuries is safe, efficient and effective. It reduces unnecessary attendances and immobilization time for patients, and yields a cost-saving in review appointments and MRI use, to ensure the most value-added benefit from these scarce resources.

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## Supplementary material

Patient discharge advice sheet.

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M. Roger: Conceptualization.

A. Putti: Conceptualization.

P. J. Jenkins: Writing – review & editing.

S. Feltbower: Conceptualization, Supervision, Validation, Review & Editing

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P. Jenkins declares that he undertake medicolegal reporting for a variety of legal firms covering personal injury and clinical negligence; and being on on the data monitoring committee of the RAPSODI study, trustee/treasurer of the British Elbow and Shoulder Society, and chairman of the Scottish Committee for Orthopaedics and Trauma, all of which is unrelated to this article. All other authors have no conflicts to disclose.

### Data sharing

The datasets generated and analyzed in the current study are not publicly available due to data protection regulations. Access to data is limited to the researchers who have obtained permission for data processing. Further inquiries can be made to the corresponding author

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