

■ WRIST & HAND

Virtual management of clinically suspected scaphoid fractures

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Aims

The aim of this study was to describe the introduction of a virtual pathway for the management of patients with a suspected fracture of the scaphoid, and to report patient-reported outcome measures (PROMs) and satisfaction following treatment using this service.

Methods

All adult patients who presented with a clinically suspected scaphoid fracture that was not visible on radiographs at the time of presentation during a one-year period were eligible for inclusion in the pathway. Demographic details, findings on examination, and routine four-view radiographs at the time of presentation were collected. All radiographs were reviewed virtually by a single consultant hand surgeon, with patient-initiated follow-up on request. PROMs were assessed at a minimum of one year after presentation and included the abbreviated version of the Disabilities of the Arm, Shoulder and Hand Score (Quick-DASH), the EuroQol five-dimension five-level health questionnaire (EQ-5D-5L), the Net Promoter Score (NPS), and return to work.

Results

A total of 221 patients were referred to the virtual pathway. Their mean age was 41 years (range 16 to 87) and there were 99 male patients (45%). A total of 189 patients (86%) were discharged with advice and 19 (9%) were recalled for clinical review: seven with an undisplaced scaphoid fracture, six with another fracture of the hand or wrist, two with a scapholunate ligament injury, and four in whom no abnormality was detected. A total of 13 patients (6%) initiated follow-up with the hand service: no fracture or ligament injury was identified in this group. PROMs were available for 179 patients (81%) at a mean follow-up of 19 months (range 13 to 33). The median QuickDASH score was 2.3 (interquartile range (IQR) 0 to 15.9), the median EQ-5D-5L was 0.85 (IQR 0.73 to 1.00), the NPS was 76, and 173 patients (97%) were satisfied with their treatment. There were no documented cases of symptomatic nonunion one year following injury.

Conclusion

We describe the introduction of a virtual pathway for the management of patients with a suspected scaphoid fracture. We found high levels of patient satisfaction, excellent PROMs, and no detrimental effects in the vast majority of cases.

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Introduction

Suspected or ‘clinical’ scaphoid fractures are wrist injuries without an immediately obvious scaphoid fracture on radiographs. They have traditionally been managed with immobilization, followed by an interval clinical examination and radiographs.¹ This, however, places a significant clinical and financial burden on fracture clinic resources, as only a small proportion of these patients will have an injury requiring formal immobilization and follow-up.

Recent guidelines published by the UK National Institute for Health and Care Excellence (formerly NICE) recommended that MRI should be considered as first-line imaging in patients with a suspected scaphoid fracture following a thorough clinical examination.² This has driven researchers to investigate the cost-effectiveness of MRI scanning to identify these injuries, with recent studies confirming that the increased cost is offset by the early diagnosis.^{3,4} However, MRI

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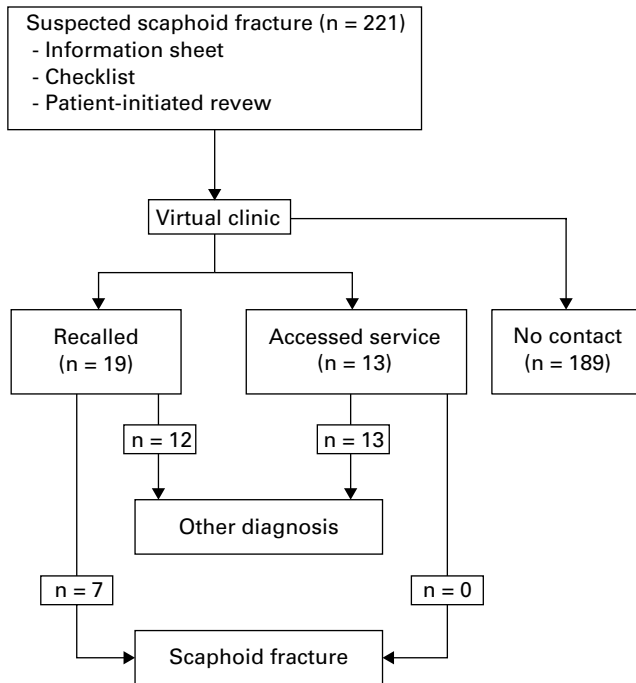


Fig. 1

Summary of the virtual scaphoid pathway.

may not be freely and readily accessible in every institution,⁵ potentiating a disparity in treatment which already exists in the UK.⁶⁻¹⁰

Although there is evidence to suggest that nonunion of a scaphoid fracture is more likely to occur when there has been no initial immobilization,¹¹ there is no evidence to suggest that the natural history of an occult scaphoid fracture differs with a delay to immobilization in a splint or plaster cast. The rate of nonunion in established fractures of the scaphoid is approximately 10%,¹² and this is likely to be far lower in undisplaced fractures.^{13,14} As a result, some occult injuries may become nonunions regardless of whether or not the patients are initially immobilized. It is also possible that some patients sustain a scaphoid fracture and never seek medical advice, believing the injury to be a sprain. It is not feasible to investigate the natural history of that particular group of patients, although a previous study reported that the prevalence of asymptomatic scaphoid nonunions in the general population, detected as incidental radiological findings, is 0.14%.¹⁵

Fear of missing a fracture that could potentially become a nonunion drives the concept that no fracture should be missed, diverting resources towards investigation and over-treatment, the onus being on the clinician to detect the injury. Thus, many young active patients are unnecessarily immobilized, and have time off work. Virtual fracture clinics have become the forum for screening and identifying unstable injuries or definite fractures with recommendations for treatment.¹⁶ One of the fundamental principles of a virtual fracture clinic is the provision of information about the uncertainties which are associated with a patient's injury.¹⁷ If this information is of sufficient quality, a significant proportion of patients can be relied upon to present

Table I. Summary of further investigations and diagnoses in the 13 patients who initiated follow-up.

Diagnosis/imaging modality	n (%)
Further radiographs	6 (46)
MRI	4 (31)
No abnormality detected	6 (46)
Arthritis of the first carpometacarpal joint	1 (8)
de Quervain's syndrome	2 (15)
Soft-tissue injury	4 (31)
Dorsal carpal avulsion fracture	2 (5)
Radial head fracture	1 (3)
Chronic shoulder pain	1 (3)
Distal radial fracture	1 (3)

again if there are persistent symptoms. This principle has been demonstrated in previous reports of these clinics.^{18,19}

The Fife Virtual Hand Clinic was set up in 2012 with the aim of informing and educating patients about the condition for which they had been referred, promoting a patient-initiated review process for access to a face-to-face appointment in the hand clinic. In January 2019 we introduced a virtual pathway for patients with a suspected scaphoid fracture, discharging them from the emergency department (ED) with an information sheet, a recovery checklist, and access to a patient-initiated review if they wished it. The aims of this study were to describe the introduction and assessment of this pathway, and to report the patient-reported outcome measures (PROMs) and satisfaction following treatment with this service.

Methods

This was a prospective study evaluating the introduction and performance of a clinical pathway. It was undertaken in a single healthcare trust which provides trauma and orthopaedic services to an estimated population of 370,000. ED services are provided at a single large institution, which is a level III trauma centre, with an additional minor injuries unit staffed by nurse practitioners at a separate hospital.

The study was registered with the local musculoskeletal quality improvement department. All skeletally mature patients with a clinically suspected scaphoid fracture that was not visible on radiographs at the time of presentation were eligible for inclusion in the pathway. They were treated with a removable velcro wrist support when discharged from the ED with advice to wear themselves from this as pain permitted over the following six weeks. They were given an information sheet explaining suspected scaphoid fractures (Supplementary Material) and instructed to contact the hand surgery service should they wish to arrange follow-up. There was no time limit following injury for patients to initiate review, if they wished it. When completing the virtual pathway referral, the member of staff in the ED who had assessed and treated the patient was required to record the demographic details, mechanism of injury, and examination findings on a proforma (Supplementary Material).

All radiographs and notes relating to the injury and any relevant past medical history were reviewed virtually by a single consultant hand surgeon (JEM) with level IV experience²⁰ at a weekly virtual clinic. Patients were contacted and brought

Table II. Concurrent upper limb diagnoses in 43 patients with self-reported Hand Normality Scores of < 75.

Diagnosis	n (%)
No abnormality detected	18 (42)
Thumb base arthritis	10 (23)
Triscaphoid arthritis	4 (9)
Carpal tunnel syndrome	3 (7)
Previous injury to the hand	2 (5)
Rheumatoid arthritis	2 (5)
Radial head fracture	1 (2)
Cervical radiculopathy	1 (2)
Distal radial fracture	1 (2)
de Quervain's syndrome	1 (2)

back for review if there was a visible fracture or significant abnormality on the initial radiographs, or if the consultant was concerned that the mechanism of injury and characteristics of the patient were more likely to be associated with a fracture.²¹ Higher-energy mechanisms including a fall from a height of more than 2 metres, a road traffic accident, sporting injuries, and punching injuries were felt to be associated with a greater likelihood of fracture.²²⁻²⁵ The exact details of the mechanism of injury as documented on the referral form were reviewed. A summary of the pathway is shown in Figure 1.

All patients who were reviewed were contacted at a minimum of one year after injury and sent a questionnaire by post. Those who did not return the questionnaire were contacted by telephone. Review of the notes and a search of the Scottish national picture archiving and communication system (PACS) was undertaken electronically for all patients, to determine if any had presented again with persistent symptoms and had further radiographs, either regionally or nationally. When patients could not be contacted, a telephone call was made to their general practitioner (GP) to determine whether they had presented again to them within the time period with persistent symptoms relating to the injury.

In order to assess hand and wrist function, the patients completed the abbreviated version of the Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire,²⁶ and the EuroQol five-dimension five-level health questionnaire (EQ-5D-5L)²⁷ was used to assess their health-related quality of life (HRQoL). We also asked them "how normal is your hand?" and scored responses on a 100-point visual analogue scale (VAS) from 0 (least normal) to 100 (most normal). This represents a single-item adjunct to validated upper limb PROMs, which has recently been used in patients with a distal radial fracture²⁸ and Dupuytren's disease.²⁹ The patients reported their overall satisfaction with the virtual service on a 100-point VAS. Those who scored > 50 were considered to be satisfied, in line with previous studies investigating satisfaction in hand surgery.³⁰ They also completed the Net Promoter Score (NPS). This is a complex metric which is obtained by asking how likely patients are to recommend a service to their friends or members of their family with the same condition. It is derived from the NHS "friends and family test", and was originally developed to gauge consumer loyalty in business.³¹ It has recently been used as an alternative PROM in hand³² and hip and knee surgery.³³ Patients were asked "how likely are you to recommend the

Table III. Non-responder analysis.

Variable	Responders	Non-responders	p-value
Total, n	179	42	
Male, n (%)	79 (44)	20 (48)	0.682*
Mean age, yrs (SD)	42 (18.2)	36 (18.9)	0.058†
CSS ≥ 4 (n, %)	55 (31)	23 (55)	0.003*

*Chi-square test.

†Independent-samples *t*-test.

CSS, Clinical Scaphoid Score; SD, standard deviation.

virtual scaphoid pathway to a friend or family member with the same injury?" and recorded responses on a 100-point VAS from 0 ("not at all likely") to 100 ("definitely recommend"). Patients scoring > 90 are classified as promoters and would recommend the service; those scoring between 70 and 89 are "passives", and would neither recommend the service nor recommend against; those scoring < 70 are "detractors" and would discourage others from using the service. The percentage of promoters minus the percentage of detractors gives the NPS, with positive scores (> 0) indicating a service which is highly valued by its users.

Statistical analysis. The Shapiro-Wilk test was used to check data for normality. Parametric data are reported as mean and standard deviation (SD) and non-parametric data as median and interquartile range (IQR). Non-responder analysis was undertaken. Categorical variables were compared between groups using the chi-square test or Fisher's exact test if there were fewer than five observations. Continuous variables were compared using the independent-samples *t*-test for parametric data and the Mann-Whitney U test for non-parametric data. In order to investigate the likelihood of missed fractures in the non-responder group, we retrospectively calculated the Clinical Scaphoid Score (CSS)³⁴ for each patient, based on the information provided on the original referral forms. The CSS is a clinical prediction rule which scores patients based on the presence of: tenderness in the anatomical snuffbox with an ulnar deviated wrist (3 points); scaphoid tubercle tenderness (2 points); and pain on axial loading of the thumb (1 point). It has been suggested that patients with a CSS of ≥ 4 are at a higher risk of having an occult fracture.³⁴ In this study, the CSS was only calculated and used retrospectively in order to describe the mechanisms of injury and the likelihood of a true scaphoid fracture. It was calculated for patients once the follow-up PROMs were available, and all clinical decisions were made without consideration of the CSS. Significance was set at $p < 0.05$. Data analysis was undertaken using Excel (Microsoft, USA).

Results

During a 12-month period between January and December 2019, 221 eligible patients were referred to the virtual scaphoid pathway. There were 99 male patients (45%), and the mean age was 41 years (range 16 to 87). A total of 189 patients (86%) were discharged with patient-initiated review and received no further treatment, while 19 (9%) were recalled following review in the virtual clinic either because of an injury identified radiologically, or a concern about the mechanism of injury. Of the patients who were recalled, seven were diagnosed with an undisplaced scaphoid fracture, two with a scapholunate ligament injury (one of which required repair), six patients with

other fractures, and no injury was identified in four patients. A total of 13 patients (6%) initiated follow-up with the hand service and were reviewed at a mean of 41 days (range 10 to 83) after the injury. In six of these patients, no injury was identified; four were diagnosed as having a sprain, one had arthritis of the first carpometacarpal joint, and two had de Quervain's syndrome. The further imaging and diagnoses are summarized in Table I.

A total of 61 patients (28%) had a mechanism of injury which was more likely to result in a scaphoid fracture: 33 had a road traffic accident, 14 had a sporting injury, seven each had an assault or punching injury, or a fall from a height of > 2 metres, and nine required review in clinic. There was no significant difference in the number of patients who returned for clinical review (nine patients (15%) vs 22 patients (14%); $p = 0.848$, chi-square test) or in the number of scaphoid fractures which were identified (one fracture (2%) vs six fractures (4%); $p = 0.676$, Fisher's exact test) between patients with higher or lower mechanisms of injury.

PROMs were available for 179 patients (81%) at a mean follow-up of 19 months (range 13.0 to 33.4). The median QuickDASH score was 2.3 (IQR 0 to 15.9), the median EQ-5D-5L was 0.85 (IQR 0.73 to 1.00), and the median Hand Normality Score was 92 (IQR 80 to 100). A total of 173 patients (97%) were satisfied with the treatment they received and the NPS was 76. Of the patients who responded, 128 (72%) were employed at the time of injury: 96 (75%) returned to work at a median of one week after the injury (IQR 0 to 3), 15 (12%) changed jobs for reasons unrelated to their health, six (5%) stopped working due to health reasons, six (5%) were furloughed as a result of the COVID-19 pandemic, and five (4%) had retired.

Although the median PROM scores indicated excellent hand function and minimal symptoms, we were concerned about the possibility of missing symptoms in patients with undiagnosed injuries. We therefore selected all patients with a self-reported Hand Normality Score of < 75 for further review ($n = 43$). These were contacted by the senior author (JEM), who also reviewed all available imaging and clinical notes. A total of 31 of these patients (74%) had clinical or radiological evidence of other unrelated upper limb conditions which were felt to account for the persistent symptoms (Table II), while 17 with persistent symptoms and no obvious explanation were invited for a face-to-face clinic appointment with repeat radiographs. The uptake of this offer was poor, and only six patients attended (overall attendance rate of 35%). A single patient was identified at this further appointment as having sustained an undisplaced atypical fracture of the proximal pole of the scaphoid that was not visible on the initial radiographs. This patient had sought advice from their GP who had referred them to a general fracture clinic. The wrist was immobilized at this appointment, 25 days following injury, and the fracture united unremarkably. We are not certain why this patient contacted their GP rather than the virtual clinic, and we only became aware of this case when reviewing one-year PROMs.

The analysis of those who did not respond is shown in Table III. Of the 42 patients who did not return their questionnaires, three had died and one declined to participate.

No significant differences were seen in age or sex between responders and non-responders, although a significantly greater proportion of non-responders had an initial CSS of ≥ 4 . Three non-responders had accessed the service with persistent symptoms: two had MRI scans, one of which revealed an undisplaced distal radial fracture which was treated conservatively, and the other showed no abnormality. The third non-responder who had accessed the service had been diagnosed with an undisplaced fracture of the base of the fifth metacarpal, which was treated conservatively. A review of the national PACS archive revealed no radiologically confirmed scaphoid fractures in the entire cohort. None of the non-responders had sought further treatment from their GP for persistent symptoms.

Discussion

We report the introduction and evaluation of a virtual pathway for patients with a suspected fracture of the scaphoid that educates them about their injury, and empowers them to initiate follow-up if they wish using a checklist for their guidance. This contrasts with traditional pathways that mandate up to two weeks of immobilization and further clinical assessment, and more recent studies that advocate advanced imaging for all patients. We found that a virtual approach is well regarded by patients, with high levels of satisfaction and a high NPS. Moreover, the excellent PROMs and the fact that there were no documented cases of symptomatic nonunion suggests that this form of management is not detrimental, and is clinically appropriate in the vast majority of cases.

There will always be an element of uncertainty and risk when treating patients with a suspected fracture of the scaphoid, due to the potential for nonunion and arthritis. The natural history of untreated non-displaced (radiologically invisible) scaphoid fractures, and those treated conservatively that fail to unite, is not well understood,³⁵ and the progression to symptomatic pancarpal arthritis is variable. Furthermore, the optimum treatment of an established nonunion is yet to be defined, and surgical fixation does not necessarily prevent nonunion, advanced collapse, or arthritis.³⁵ Therefore, the assumption that a missed scaphoid fracture which is not visible on plain radiographs at the time of presentation will go on to nonunion and advanced collapse, unless stabilized using a cast or surgery, is based on theory rather than evidence.

The suggestion that advanced early imaging should be used for all patients with a suspected fracture is also controversial. Mallee et al,³⁶ in a Cochrane review, reported that the positive predictive value of MRI was only 88%, and that for every 1,000 suspected scaphoid fractures imaged with MRI, 24 would be missed. The main limitation of using advanced imaging methods such as MRI is that the prevalence of true fractures among patients with a suspected fracture is very low, particularly if all patients with radial-sided wrist pain and normal radiographs have MRI scans at the time of presentation. This low prevalence greatly decreases the probability that a positive radiological diagnosis will correspond to a true scaphoid fracture, and this is the situation that is routinely encountered in clinical practice. This is exemplified by our finding that many patients referred with a suspected fracture were female. This finding does not correlate with the epidemiology of true scaphoid fractures,²³

but is in keeping with previous studies describing the epidemiology of suspected, rather than confirmed, fractures.³⁷ This is why clinical prediction rules that target further assessment and/or imaging to high-risk patients only would seem more logical and efficient.³⁷

The use of PROMs in our study represents a ‘safety net’ at one year after injury to identify patients with persistent symptoms who have not initiated follow-up, although it should be noted that in most patients with poor one-year PROMs, an alternative cause for persistent symptoms was identified. Most patients in this study reported excellent QuickDASH and Hand Normality Scores, suggesting that their management was safe and effective. Despite offering patients with low scores face-to-face appointments, the uptake of this service was low. This raises an important question about the responsibility for managing persistent symptoms in these patients: does this still lie with the treating surgeon, and what degree of information and administration is required before this responsibility can be transferred back to the patient?

The main limitation of this study is the number of patients who were lost to follow-up, which raises the possibility of missed occult scaphoid fractures. The proportions of males in the responder and non-responder groups were comparable, although the mean age was lower in the non-responder group. Moreover, a significantly greater proportion of non-responders reported a CSS ≥ 4 , which raises the possibility that a true scaphoid fracture was more likely in this group than in those who responded. We attempted to mitigate this by reviewing the National PACS archive and contacting the GPs of these patients, but we are unable to report definitively that no nonunion occurred in this group. This limitation is analogous to an unexplained “did not attend” outcome in the more traditional fracture clinic. A further limitation is the absence of standardized radiological follow-up for all patients irrespective of symptoms, which prevents calculation of the prevalence of a true scaphoid fracture in this group. In combination, these limitations raise a degree of uncertainty about the ultimate diagnoses and clinical outcomes for the non-responders.

All pathways for this type of injury carry a risk. With traditional fracture clinics, unnecessary immobilization may affect a patient’s ability to work. Routine MRI scanning may medicalize stable injuries that would not be picked up routinely and that do not require formal treatment. Furthermore, survey data suggest that there is a wide variation in management protocols for patients with a suspected fracture of the scaphoid both in the UK³⁸ and internationally,⁸ while another survey revealed that just over half of UK trusts could offer acute MRI scans for patients with a suspected scaphoid fracture.⁷ Virtual fracture clinics have been used increasingly in hand surgery in recent years,^{18,19} although previous attempts to develop a virtual pathway for suspected scaphoid fractures mandated an MRI³⁹ or CT⁴⁰ scan prior to virtual review. Our findings suggest that the virtual management of these patients without routine further imaging is safe and appropriate, as evidenced by excellent PROMs, high levels of patient satisfaction, and no documented cases of symptomatic nonunion at a minimum of one year following injury.



Take home message

- Virtual management of clinical scaphoid fractures is safe, effective, and highly regarded by patients.

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Supplementary material



Information sheet provided to patients on discharge from the emergency department (ED), and virtual scaphoid proforma that is completed by ED staff when referring to the virtual scaphoid clinic.

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Ethical review statement:

This was a service evaluation of a musculoskeletal treatment pathway. There was no allocation or concealment of treatment. Thus, this study did not meet the criteria for formal ethical committee review. The study was registered with the local musculoskeletal audit department.

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