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From Glasgow Royal Infirmary, Glasgow, UK

Correspondence should be sent to P. J. Ryan paulj.ryan32@gmail.com

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P. J. Ryan,[1] A. D. Duckworth,[2] J. E. McEachan,[3] P. J. Jenkins[4]

[1]Glasgow Royal Infirmary, Glasgow, UK
[2]Edinburgh Orthopaedics and University of Edinburgh, Edinburgh, UK
[3]Queen Margaret Hospital, Dunfermline, UK
[4]Centre for Sustainable Delivery (CfSD), NHS Golden Jubilee, Clydebank, UK

Aims

The underlying natural history of suspected scaphoid fractures (SSFs) is unclear and assumed poor. There is an urgent requirement to develop the literature around SSFs to quantify the actual prevalence of intervention following SSF. Defining the risk of intervention following SSF may influence the need for widespread surveillance and screening of SSF injuries, and could influence medicolegal actions around missed scaphoid fractures.

Methods

Data on SSF were retrospectively gathered from virtual fracture clinics (VFCs) across a large Scottish Health Board over a four-year period, from 1 January 2018 to 31 December 2021. The Bluespier Electronic Patient Record System identified any surgical procedure being undertaken in relation to a scaphoid injury over the same time period. Isolating patients who underwent surgical intervention for SSF was performed by cross-referencing the unique patient Community Health Index number for patients who underwent these scaphoid procedures with those seen at VFCs for SSF over this four-year period.

Results

In total, 1,739 patients were identified as having had a SSF. Five patients (0.28%) underwent early open reduction and internal fixation (ORIF). One patient (0.06%) developed a nonunion and underwent ORIF with bone grafting. All six patients undergoing surgery were male ($p = 0.005$). The overall rate of intervention following a SSF was 0.35%. The early intervention rate in those undergoing primary MRI was one (0.36%), compared with three in those without (0.27%) ($p > 0.576$).

Conclusion

Surgical intervention was rare following a SSF and was not required in females. A primary MRI policy did not appear to be associated with any change in primary or secondary intervention. These data are the first and largest in recent literature to quantify the prevalence of surgical intervention following a SSF, and may be used to guide surveillance and screening pathways as well as define medicolegal risk involved in missing a true fracture in SSFs.

Take home message

- This study provides longitudinal follow-up data of a large cohort of patients sustaining a suspected scaphoid fracture.
- The requirement for early or late surgical intervention following a suspected scaphoid fracture is rare.
- There does not appear to be any difference in outcome between departments that adopted an early MRI protocol and those that applied a more traditional approach of clinical review and repeated plain X-rays after two weeks.

Introduction

The diagnosis and management of suspected scaphoid fractures (SSFs)

presents a unique challenge to orthopaedic and emergency medicine departments. The incidence of scaphoid fracture is around 29 per 100,000 population per year.[1] The presentation of a scaphoid fracture can be classified into three main groups: 1) those that are initially displaced and detectable on early radiographs; 2) those that are undisplaced but are detectable; and 3) those that are undisplaced and not detectable on plain radiographs at the time of injury. The incidence of true scaphoid fractures in this last group varies in the literature, but is generally reported as 5% to 20%.

The natural history of the first two groups is well defined, and risk factors for the development of nonunion have been identified.[2-4] The natural history of the third group, those that are initially undetectable on plain radiographs, has been poorly defined by the literature. As a result, there is an assumption that the poor outcomes reported in the first two groups equally apply to this group. Although evidence has emerged to shorten the duration and extent of immobilization in patients with undisplaced fractures, the assumption regarding the incidence of nonunion has not been challenged. Historically, this meant that all patients with a SSF would be immobilized and return for re-examination, and further imaging approximately two weeks after injury. Ongoing symptoms could result in further periods of immobilization and radiographs. Cross-sectional imaging and other methods have been investigated to determine if a true fracture can be detected earlier. The cost-effectiveness of such imaging strategies has been investigated. A degree of uncertainty persists, however, since no imaging modality has 100% sensitivity. The current National Institute for Health and Care Excellence (NICE) guidelines for management of acute fractures recommends consideration of an MRI scan in the SSF.[5] Despite this recommendation, access to MRI in the acute setting remains limited.[6]

As the underlying natural history of the undetectable scaphoid fracture remains unclear, there is uncertainty whether earlier diagnosis will result in a reduction in the incidence of nonunion and its consequences. A further study examining both radiographs and MRI scans demonstrated excellent results, with early mobilization in patients with scaphoid contusions and undisplaced fractures.[7] At least one UK Health Board area has implemented a redesign of their pathway to focus secondary imaging on patients who 'opt-in' with persisting symptoms.[8]

There is therefore an urgent requirement to develop the literature around SSFs, to quantify the actual prevalence of intervention following a SSF. This facilitates realistic judgements about the requirement for widespread surveillance and screening of wrist injuries for SSFs. Understanding the natural history informs the advice given to patients following such injuries. In addition, defining the risk of intervention following this injury can potentially influence medicolegal actions around 'missed scaphoid fractures'.

Therefore, the primary aim of this study was to investigate the prevalence of surgical intervention following a diagnosis of a SSF.

Methods

This study was performed across a regional Health Board area in the UK with a population of approximately 1.2 million people. Emergency trauma care was provided from four acute hospitals and a further three minor injuries units (MIUs). The orthopaedic departments are organized into three geographical sectors. During the study period, they all provided ambulatory orthopaedic trauma services via a virtual fracture clinic (VFC) model. Inclusion criteria were all patients presenting with SSFs over a four-year period from 1 January 2018 to 31 December 2021, with a minimum follow-up period of one year. This study was classed as clinical audit, and since existing clinical and administrative datasets were used, no patient was contacted and no treatment pathway was altered. Therefore, it did not attract the requirement for NHS Research Ethics Committee (REC) review.

Where there was a clinical suspicion of a scaphoid fracture because of radial sided wrist pain and anatomical snuff box tenderness following trauma, patients were assessed in an emergency department (ED) or MIU with four radiographs. If the radiograph did not show any fracture, they were provided with a wrist splint. The history and radiographs were subsequently reviewed by an orthopaedic consultant in a VFC. One sector operated a pathway that involved requesting a primary MRI scan, and the other two sectors operated a more traditional approach based on repeat review and imaging approximately two weeks after injury. If an injury became apparent during MRI or subsequent follow-up, patients were placed in a below elbow cast and monitored radiologically. If there were signs suggesting a risk of nonunion, they were offered intervention with open reduction and internal fixation (ORIF) of the scaphoid.

The Health Board operates the Bluespier Electronic Patient Record System (Bluespier, UK). A custom designed form is used to collect data on every VFC assessment, and this is used to generate a summary document for the medical records and communication to the general practitioner. This dataset was extracted for the period 1 January 2018 to 31 December 2021 (four years). There were 1,055 patients from Clyde sector, 348 patients from North sector, and 336 patients from South sector. There were 731 (42%) males and 1,008 (58%) females. The mean age of females presenting with a SSF was 44.0 years (standard deviation (SD) 19.0), higher than that of males (36.5 years; SD 18.7) (mean difference 7.42, 95% confidence interval (CI) 5.63 to 9.22; $p < 0.001$, independent-samples *t*-test).

The Bluespier system was also used to identify any surgical procedure being undertaken in relation to a scaphoid injury (including secondary reconstruction and salvage procedures) over the time period 1 January 2018 to 31 December 2021. The mean follow-up time was 1,728 days (381 to 1,728). There were 376 procedures meeting the criteria during the time period (Table I).

The VFC attendance data were linked to the surgical data by use of the unique patient identified (Community Health Index (CHI) number). This resulted in six procedures being linked to patients who attended the VFC with a SSF. The clinical records of these patients were examined to ensure that the primary injury was radiologically undetectable on plain radiographs at initial presentation.

There were 274 patients who underwent primary MRI scanning due to the policy of one sector.

Table I. Relevant procedures undertaken from 1 January 2018 to 31 December 2021 (may include some unrelated to primary scaphoid pathology).

Phase	Procedure	Number
Acute	ORIF scaphoid	150
	ORIF scaphoid nonunion	120
	Scapholunate surgery	18
	Other scaphoid surgery	12
Chronic	Proximal row carpectomy	13
	Four-corner fusion	21
	Partial wrist fusion	7
	Total wrist fusion	35

ORIF, open reduction and internal fixation.

Table II. Patients proceeding to surgical intervention following an initial suspected scaphoid fracture.

Time to surgery, days	Sex	Age, yrs	Procedure	Side	Early MRI
10	Male	29	ORIF	Right	No
52	Male	33	ORIF	Bilateral	No
58	Male	22	ORIF	Left	Yes
595	Male	25	ORIF + BG	Right	Yes
98	Male	40	ORIF	Left	No
38	Male	27	ORIF	Right	No

BG, bone graft; ORIF, open reduction and internal fixation.

Statistical analysis

Count data are presented as simple percentages. Central tendencies are reported as means, with dispersions reported as standard deviations. Statistical significance testing of comparisons of categorical data was performed with chi-squared tests (Fisher's exact test was used if one of the values was less than 5). Continuous data were compared with two-tailed independent-samples *t*-test, and reported with a mean difference, p-value, and 95% CI. The level of statistical significance was set at $p < 0.05$.

Results

There were 1,739 patients managed via the VFC with a SSF during the study period. There were five patients (0.28%) who underwent early ORIF at a mean time of 51.2 days following injury (SD 32.1; 10 to 98). One patient (0.06%) also developed a nonunion and underwent ORIF with bone grafting at 595 days following injury (Table II). This patient had been identified with a fracture within two weeks of injury with a primary MRI scan and was treated nonoperatively initially.

While males comprised 42% (n = 731) of the overall study group, all patients undergoing surgery were male (n = 6, 0.82% of males had surgery vs 0% of females; p = 0.005, Fisher's exact test).

Two patients in the department who undertook universal primary MRI scanning had their fractures detected on an early MRI. The other fractures in the other two sectors were detected following repeat examination and imaging. The early intervention rate in those undergoing primary MRI was one (0.36%), compared with three in those without primary MRI (0.27%) (p > 0.576, Fisher's exact test).

Discussion

The overall rate of intervention following a SSF was 0.35% (1 in 290 patients). The majority were ORIFs performed within four months of injury for failure of conservative management. A single injury that had been diagnosed early with MRI did not unite, and went on to later ORIF with bone grafting. While females comprised the majority of patients with SSF, there were no fractures requiring surgery in the female group. There was no difference in intervention between the units in the region that used a primary MRI pathway and those with clinical and radiological follow-up.

Although the use of MRI scanning in an attempt to achieve diagnostic certainty is attractive, there are potential drawbacks.[9] In many areas, it is a limited resource. Recommending use for this injury may increase waiting times for patients being investigated for cancer or other serious conditions. The use of MRI for every patient necessitates a further attendance at hospital, along with robust processes to review the reports and discuss the results with the patients. As a modality, it can diagnose a number of other issues of uncertain importance, but even despite its sensitivity, application in a low prevalence population results in a positive predictive value of 88%.[10] Bone bruises are often reported, along with partial carpal ligament sprains. Undisplaced fractures of metacarpals or distal radius can also be seen. Diagnosing these injuries does not alter management, as the treatment for all of them is symptomatic with rest, analgesia, and return to function as natural healing occurs.[10] Some strategies that could be useful are the use of clinical prediction tools to reduce the burden of secondary imaging.[11,12] Applying a prism of 'realistic medicine' requires a critical appraisal of the reasoning behind a search for diagnostic certainty.

Grewal et al[13] reported the outcomes of treatment for subacute scaphoid fractures. These are defined as fractures where treatment commenced between six weeks and six months after injury. It is unknown how many of these would have been radiologically undetectable at the time of injury. Even with delayed commencement of immobilization, union was achieved in 96% of cases. This contrasts with an earlier study that examined a series of nonunions to look at delays to immobilization.[14] This study again did not specifically examine the group of radiologically undetectable fractures, but did report successful union where immobilization was commenced within four weeks.

Cost-effectiveness modelling of widespread MRI imaging has reported favourable results, but it is based on assumptions regarding the true rate of fracture and long-term arthritis if not immobilized in cast.[15,16] It also does not recognize the reality of providing time on scanners that are already in major demand for other acute and chronic conditions.

Litigation relating to the scaphoid comprised 36% of all hand and wrist litigation claims, with missed or delayed diagnosis cited as a factor in 44% of claims.[17-20] It is unclear how much of this activity relates to complications arising from a fracture that was appropriately radiographed at the time of injury, but was undetected. Jamjoom and Davis[21] reported on 52 medicolegal cases of missed scaphoid injuries. They found that in 49 of the 52 cases, scaphoid injury was never considered at the initial consultation, concluding that early MRI pathways would be unlikely to impact on medicolegal claims. The perceived potential for late complications of SSFs leads to fear of medicolegal action. This results in the application of 'defensive medicine' to minimize risk.[17,18] This is compounded by the nature of the medicolegal process, where decisions on the presence or absence of negligent treatment are made on the basis of reports from one or two expert witnesses, whose opinion may not reflect a complete understanding of the literature.

Some clinicians have introduced novel pathways to manage wrist injuries with normal initial radiographs.[8] They have revised their protocols to introduce an element of 'opt-in'. In these pathways, patients are provided with a splint and advice regarding symptomatic relief. For those remaining symptomatic at two weeks, there is the option of opt-in and the likely prompting for further review and imaging. This is within a timescale where the evidence supports similar outcomes in terms of union, and ORIF could still be undertaken within the timescales found in this study.

The current study is a large series of SSFs, followed through to detect the requirement for surgery or later complication. It was possible through the study of multiple centres in a very large region, based on a common electronic patient record and VFC protocol. A limitation of this study is that we were not able to explicitly review patients for ongoing symptoms or radiological appearances. This was outwith the resources available for this study. We selected the pragmatic clinically relevant outcome of symptomatic nonunion as the endpoint of interest.

This study could not define the true scaphoid fracture rate in this population given the different methods used across the region, but this has been previously identified in similar populations.[5,16,22] It is also possible that some fractures will proceed to the long-term complications of scaphoid nonunion over a longer period of time. We selected a minimum follow-up period of one year. This was dictated by the nature of the VFC database, which started specifically collecting data on SSFs at the start of 2018. The patient detected with a nonunion was treated within two years of their initial injury. This seems unlikely based on the pattern of one out of 1,739 becoming a nonunion, with a further five pre-emptive ORIFs. It is also not possible to extrapolate from this study what might happen if SSFs were discharged to an 'opt-in' pathway. The authors are of the opinion that the large denominator provided by this study guards against this potential error. This should become the focus of future audited clinical pathways.

In conclusion, surgical intervention was rare following a SSF and was not required in females. A primary MRI policy did not appear be associated with any change in primary or secondary intervention. These data are the first in recent literature to quantify the prevalence of surgical intervention following a SSF, with the largest population reported in the literature. The data are useful in defining the medicolegal risk of missing a true fracture in a case where the original imaging is normal, along with matters of causation of long-term complications. The data are also useful in designing consideration or the redesign of pathways around the management of SSFs.

Social media

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Author information

P. J. Ryan, BSc (Hons), MB BCh, BAO (Hons), Orthopaedic Registrar, Glasgow Royal Infirmary, Glasgow, UK.

A. D. Duckworth, BSc(Hons), MBChB, MSc, FRCSEd(Tr&Orth), PhD, Senior Clinical Lecturer and Consultant Orthopaedic Trauma Surgeon, Edinburgh Orthopaedics and University of Edinburgh, Edinburgh, UK.

J. E. McEachan, MB. ChB., FRCS (Orth), Consultant Orthopaedic Surgeon, Queen Margaret Hospital, Dunfermline, UK.

P. J. Jenkins, MBChB, MD, FRCSEd(Tr&Orth), National Clinical Lead, Centre for Sustainable Delivery (CfSD), NHS Golden Jubilee, Clydebank, UK.

Author contributions

P. J. Ryan: Project administration, Investigation, Writing – review & editing.
A. D. Duckworth: Project administration, Investigation, Writing – review & editing.
J. E. McEachan: Project administration, Investigation, Writing – review & editing.
P. J. Jenkins: Conceptualization, Formal analysis, Funding acquisition, Supervision, Writing – review & editing, Project administration, Investigation.

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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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