Research Article

Recommendations Regarding Suspected Scaphoid Fractures Are Associated With Patient and Surgeon Comfort With Uncertainty

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ABSTRACT

Aims: In a scenario-based survey experiment, we evaluated the contributions of patient and surgeon tolerance for uncertainty to variation in management strategies for suspected scaphoid fractures. We asked the following: (1) Are patient and surgeon factors, including comfort with uncertainty, associated with the choice of management strategy for a suspected scaphoid fracture? and (2) What patient and surgeon factors are associated with comfort letting the patient decide how to manage their suspected scaphoid fracture?

Methods: Surgeon members of the Science of Variation Group completed the short-form Intolerance of Uncertainty Scale (IUS-12) and then reviewed eight clinical scenarios of patients with suspected scaphoid fractures with the following aspects randomized: pain intensity, mechanism of injury, patient's motivation to return to activities, willingness to accept risks, and confidence in decision making. Surgeons were asked to indicate their recommended management strategy and rated their comfort with letting the patient decide.

Results: Surgeon recommendation of additional imaging (the most popular strategy; 50%) was associated with higher energy of injury, greater pain intensity, lower patient comfort with uncertainty, and greater desire to go back to work. Lower comfort with allowing the patient to choose the management strategy was associated with higher pain intensity and lower surgeon tolerance of uncertainty.

Conclusion: This study suggests that efforts to reduce variation in the management of suspected scaphoid fractures can address variations in surgeon tolerance of uncertainty and surgeon regard for variations in symptom intensity and patient tolerance of uncertainty.

Clinical Relevance: Strategies for the management of suspected scaphoid fracture can be designed to increase surgeon comfort with the unavoidable uncertainty associated with management of

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Ring certifies receipt of personal payments or benefits, during the study period, in an amount of less than USD 100,000 from Skeletal Dynamics and less than USD 1,000 from Wolters-Kluwer. Neither of the following authors nor any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Davids and Doornberg.

Supplemental digital content is available for this article. Direct URL citation appears in the printed text and is provided in the HTML and PDF versions of this article on the journal's Web site (www.jaaos.org).

Ethical approval for this study was obtained at The University of Texas at Austin Institutional Review Board under protocol number 2020-05-0040.

J Am Acad Orthop Surg 2025;33:1339-1347

DOI: 10.5435/JAAOS-D-24-00959

suspected scaphoid fractures, and surgeon awareness of the limited correspondence between symptom intensity and pathophysiology severity.

Radiographs interpreted as normal in patients presenting with pain on the radial side of the wrist and tenderness of the scaphoid after injury do not exclude a scaphoid fracture.[1-3] Patients with a suspected scaphoid fracture may be immobilized for two weeks and then reexamined.4 Alternatives include immediate CT or MRI[1,5,6] or self-managed risk, meaning that the patient makes the decision regarding additional visits, tests, and treatments based on their understanding of the associated potential for harm and potential for benefit and considering what matters most to them.[7] Immediate CT or MRI in patients with a suspected scaphoid fracture has a high negative predictive value (advanced imaging that reveals that no fracture allows patients to return to work or sports) but a low positive predictive value (potential for overdiagnosis such as when a nonspecific signal abnormality or "bone bruise" is diagnosed as a fracture).[8] In addition, in many settings, MRI is not readily available.[9]

It seems plausible that most invisible, nondisplaced, scaphoid waist fractures heal naturally (without specific treatment) and that some nonunions are fibrous and might be harmless.[10] If true, that would mean that a person with a suspected scaphoid fracture who reduces activity for a few weeks is unlikely to experience nonunion and even less likely to develop arthritis or other consequences from the injury.[7] Many people would likely be comfortable with this limited potential to develop problems in the setting of a suspected scaphoid fracture.[7]

There is notable variation in the management of suspected scaphoid fractures between the surgeons.[11,12] Variation in care based on the specialist advising the patient raises the possibility that surgeon risk tolerance and surgeon opinions may be superseding patient values and preferences[13]. Although some clinicians may have limited tolerance for potential harms,[14,15] patients may be more willing to accept a limited probability of nonunion, future surgery for nonunion, or arthritis related to nonunion.[7] For instance, when 179 patients presenting to the emergency department with a suspected scaphoid fracture were offered a care pathway consisting of information (verbal and printed), specialist review of the images, and optional additional care were reviewed a minimum of one year after presentation, 97% were satisfied, and no documented symptomatic nonunions were observed.[7] As a representation of the types of uncertainty involved and to gauge your personal tolerance for certainty, consider that patients managed under this protocol were not reimaged and the rate of nonsymptomatic nonunions is unknown but is plausibly low. Given rising out-of-pocket expenses for health care in the United States, many people would likely appreciate the option to accept some potential for harm to avoid costs, worry, and exposure to additional tests and treatments.

Most efforts to improve the efficiency and effectiveness of the management of suspected scaphoid fractures have focused on more sophisticated imaging applied earlier in the process. Because this approach cannot eliminate uncertainty regarding the presence of a scaphoid fracture and potential adverse outcomes, and diagnostic tests also have potential for harm, the approach of allowing patients to choose the acceptable level of potential harm balanced with costs and inconveniences has merit.[16] As a next step in exploring this approach, it might be useful to improve our understanding of relative patient and specialist comfort with uncertainty and risk tolerance and how these might lead to different treatment strategies.

We asked the following: (1) Are patient and surgeon factors, including comfort with uncertainty, associated with the choice of management strategy for a suspected scaphoid fracture? and (2) What patient and surgeon factors are associated with comfort letting the patient decide how to manage their suspected scaphoid fracture?

Methods

Study Design and Setting

We conducted a randomized scenario study among members of the Science of Variation Group (SOVG). Participants were asked to complete the short-form Intolerance of Uncertainty Scale[17] (IUS). They then reviewed eight clinical scenarios of patients with suspected scaphoid fractures where the following factors were randomized: pain intensity, simple fall versus high-energy sport fall, motivated to return as quickly as possible to work or sport versus will be doing simple, safe tasks that will not be altered by diagnosis, the patient is willing versus not willing to accept some chance of missing a true fracture, and the patient feels confident about making a decision versus wants to defer

to the clinician regarding the decision (Appendix A, http://links.lww.com/JAAOS/B321). The sex and age of the patients were also randomized but were not used for analyses.

Surgeons then chose one of the following recommended management strategies: (1) obtain advanced imaging, (2) offer supportive treatment and reassess within 2 weeks, or (3) provide the patient information about a suspected scaphoid fracture and send them home with printed information on how they can reenter care if desired.[7] Surgeons then rated their comfort letting the patient decide.

We recorded the following surgeon characteristics: sex, location of practice, years of experience, subspecialty, and whether the surgeon supervises trainees. The experiment was created and distributed through an online survey design tool (SurveyMonkey).

Participants

In April 2022, all upper limb specialist members of the SOVG were invited to participate through e-mail. The SOVG is an international group of orthopaedic, plastic, and fracture surgeons collaborating on studies that address sources of variation in care. Two weekly reminders were sent to nonresponders. Among approximately 200 surgeons who participate in at least one survey a year, 112 surgeons completed the experiment. Most of the surgeons, 93% (n = 103), were men, and most of the participants practiced in the United States (48%) and Europe (37%; Table 1).

Table 1. Surgeon Demographics (N = 112)

Variables	Value[a]
Men	92% (103)
Women	8% (9)
Continent	
United States	48% (54)
Europe	37% (41)
Other	15% (17)
Years of practice	
0-5	19% (21)
6-10	26% (29)
11-20	39% (33)
21-30	26% (29)
Supervising trainees	85% (95)
Subspecialty	
Hand and wrist	36% (40)
Shoulder and elbow	13% (14)
Fracture surgeon	38% (43)
Other	13% (15)
Intolerance of uncertainty score	25 (21-32)

[a]Value is displayed as percentage with number for categorial variables and as median with interquartile range for continuous nonparametric variables.

Outcome Measures

Our primary outcome was the surgeon's recommended management strategy. Secondarily, we measured the surgeon's comfort with letting an informed patient decide on their management strategy on a 0 to 100-point ordinal scale (0 meaning not at all comfortable and 100 being completely comfortable).

Explanatory surgeon variables were sex, years of practice (0-5, 6-10, 11-20, or 21-30 years), continent (United States, Europe, or other), subspecialty (hand and wrist, shoulder and elbow, fracture, or other), and supervising trainees (yes/no). Explanatory randomized patient factors were pain intensity on a 0 to 10-point ordinal scale, energy of injury (simple versus high energy), desire to return as quickly as possible to work or sport (versus doing simple, safe tasks), patient is willing to accept some chance of missing a fracture (yes/no), and patient feels confident about making a decision (yes/no).

The short-form Intolerance of Uncertainty Scale (IUS-12)[17,18] was used to measure discomfort with uncertainty among the participating surgeons (Appendix B, http://links.lww.com/JAAOS/B322). Because of an oversight, question 7 of the IUS-12 was duplicated ("I should be able to organize everything in advance"), and question 12 ("I must get away from all uncertain situations") was missing. As this questionnaire has good internal consistency, we decided to sum the scores of the 12 questions we used in survey to calculate the total IUS. A higher score indicates a higher intolerance of uncertainty. The median (interquartile range) IUS was 25 (21 to 32).

Statistical Analysis

Descriptive statistics were done for all participants. We used multilevel logistic regression analyses to identify patient factors associated with surgeon recommendation for (1) ordering advanced imaging, (2) offering supportive treatment and reassess within 2 weeks, or (3) provide the patient information and send them home and to identify patient factors associated with surgeon's comfort on letting the patient decide on the diagnostic strategy. A logistic regression analysis was used to identify surgeon factors associated with treatment

recommendations. All variables with a P value of <0.05 were considered statistically significant.

Protocol Accessibility

If more information about the data analysis is desired, please reach out to the stated address for correspondence.

Results

Factors Associated with Management Strategy

In a mixed, multilevel, logistic regression analysis, surgeon recommendation of CT or MRI was the most popular management strategy (50%) and was associated with higher energy of injury, greater pain intensity, lower patient comfort with uncertainty, and greater desire to go back to work (Table 2). Surgeon factors associated with recommendation of advanced imaging included practicing outside the United States or Europe, having 11 to 20 years of practice experience, and supervising trainees but not level of intolerance of uncertainty (Table 3).

Recommendation of supportive treatment and reassessment in 2 weeks (44%) was associated with lower pain intensity, greater patient comfort with uncertainty, and lower patient desire to go back to work or sport (Table 2). Surgeon factors associated with supportive treatment were practicing outside the United States or Europe and subspecialty other than hand/wrist, shoulder/elbow, or fracture (Table 3).

Recommendation for providing printed patient information and sending the patient home with information on how to reenter care (5%) was associated with lower pain intensity (Table 2). Surgeon factors associated with putting the patient in charge were 6 to 10 years and 11 to 20 years of practice experience, not supervising trainees, subspecialty other than hand/wrist, shoulder/elbow, or fracture, and higher surgeon intolerance of uncertainty score (Table 3).

Factors Associated With Comfort Letting the Patient Decide

In a multilevel linear regression model, the only patient factor associated with lower surgeon comfort with letting the patient decide the management strategy was the highest level of pain intensity (NRS pain score of 8; Table 4). In a negative binominal regression analysis, greater surgeon comfort with letting the patient decide the management strategy was associated with lower intolerance of uncertainty scores, having 6 to 10 and 11 to 20 years of practice experience, and not being a shoulder/elbow subspecialist (Table 5).

Discussion

The optimal diagnostic and treatment strategy for suspected scaphoid fractures remains a subject of debate. Consequently, there is notable variation in the care of suspected scaphoid fractures.[11,12] The purpose of this study was to measure the association of patient and surgeon tolerance of uncertainty with variation in recommendations for suspected scaphoid fractures. We found that surgeons were more willing to forego advanced imaging when patients were more comfortable with uncertainty. Surgeons with greater tolerance for uncertainty were more comfortable, allowing the patient to decide on the strategy and self-manage potential harms.

Limitations

This study has several limitations. First, most surgeon members of the SOVG are men working in an academic setting (eg, 85% supervises trainees) and their practice might differ from the average (nonacademic) surgeon population. Nevertheless, participant opinions and ratings of the participants were sufficiently variable that they might represent diversity of opinion sufficient to measure statistical variations for nonsurgeon factors. Nevertheless, the findings of this study merit testing in other populations of specialists. The statistical relationships identified in this sample are likely reproducible in any sufficiently variable sample, but the absolute rates are specific to this sample and are therefore not particularly useful. Second, surgeons based their management strategy on fictional clinical vignettes and without access to radiographs. We intentionally simplified the circumstances and limited varied interpretation of radiographs to more directly and practically isolate factors that can then be addressed in clinical studies. Surgeon recommendations might be different in a clinical setting with real patients, and these types of scenario studies can inform subsequent studies with actual patients. Third, because of human error, one question in the IUS-12 questionnaire was duplicated, and another was missing. Given the good internal consistency of the items on the measure ($\alpha = 0.91$),[17] we feel that this mistake had little effect on assessment of tolerance of uncertainty and the overall results. Finally, judgments about what constitutes low or acceptable probability of an adverse outcome, and the degree to which adverse outcomes such as nonunion and arthritis are considered desirable to avoid, are matters of opinion and personal preference.

Table 2. Mixed MultiLevel Logistic Regression Analysis of Patient Factors Associated With Surgeon Choice of Management Strategy for a Suspected Scaphoid Fracture

	Order Advanced Imaging			Offer Supportive Treatment and Reassess within 2 Weeks			Provide Printed Information and Send Patient Home		
	50% (432)			44% (378)			5% (47)		
N	Odds Ratio (95% Confidence Interval)	Standard Error	*P* Value	Odds Ratio (95% Confidence Interval)	Standard Error	*P* Value	Odds Ratio (95% Confidence Interval)	Standard Error	*P* Value
Energy of injury									
High-energy sport fall	Reference value	—	—	Reference value	—	—	Reference value	—	—
Simple fall	0.56 (0.35-0.90)	0.14	**0.016**	1.3 (0.87-2.0)	0.28	0.195	1.6 (0.73-3.3)	0.61	0.25
Pain intensity on a 0-10-point ordinal scale									
2	Reference value	—	—	Reference value	—	—	Reference value	—	—
5	5.0 (2.8-9.1)	1.5	<**0.001**	0.40 (0.24-0.67)	0.10	<**0.001**	0.32 (0.13-0.75)	0.14	**0.009**
8	18 (9.2-35)	6.2	<**0.001**	0.16 (0.091-0.27)	0.044	<**0.001**	0.11 (0.032-0.35)	0.064	<**0.001**
Patient's comfort with uncertainty									
Accepting risk of a missed fracture	Reference value	—	—	Reference value	—	—	Reference value	—	—
Not accepting risk of a missed fracture	9.0 (5.3-15)	2.5	<**0.001**	0.18 (0.11-0.28)	0.042	<**0.001**	0.50 (0.23-1.1)	0.20	0.080
Desire to immediately get back to work									
Motivated to return as quickly as possible to work or sport	Reference value	—	—	Reference value	—	—	Reference value	—	—
Will be doing simple, safe tasks	0.24 (0.15-0.41)	0.064	<**0.001**	2.7 (1.7-4.2)	0.60	<**0.001**	1.8 (0.78-4.1)	0.76	0.17
Desire for agency									
Patient feels confident about making a decision	Reference value	—	—	Reference value	—	—	Reference value	—	—
Patient wants to defer to the clinician regarding the decision	1.5 (0.92-2.3)	0.35	0.11	0.76 (0.50-1.2)	0.16	0.20	0.55 (0.25-1.2)	0.22	0.14

Table 3. Logistic Regression Analysis of Surgeon Factors Associated With Surgeon Choice of Management Strategy for a Suspected Scaphoid Fracture

	Order Advanced Imaging			Offer Supportive Treatment and Reassess within 2 wk			Provide Printed Information and Send Patient Home		
	50% (432)			44% (378)			5% (47)		
N	Odds ratio (95% confidence interval)	Standard error	*P* value	Odds ratio (95% confidence interval)	Standard error	*P* value	Odds ratio (95% confidence interval)	Standard error	*P* Value
Sex									
Women	Reference value	—	—	Reference value	—	—	—	—	—
Men	1.6 (0.91-2.6)	0.42	0.11	0.75 (0.44-1.3)	0.20	0.28	0.61 (0.19-1.9)	0.36	0.41
Continent									
United States	Reference value	—	—	Reference value	—	—	—	—	—
Europe	1.2 (0.88-1.7)	0.21	0.22	0.76 (0.54-1.1)	0.13	0.11	1.5 (0.69-3.5)	0.64	0.29
Other	3.1 (1.9-4.9)	0.73	<**0.001**	0.34 (0.22-0.55)	0.083	<**0.001**	0.68 (0.17-2.6)	0.47	0.57
Years of practice									
0-5	Reference value	—	—	Reference value	—	—	—	—	—
6-10	0.73 (0.48-1.1)	0.16	0.16	1.1 (0.70-1.7)	0.24	0.70	5.3 (1.3-21)	3.7	**0.019**
11-20	0.58 (0.38-0.89)	0.12	**0.012**	1.2 (0.77-1.8)	0.25	0.47	10 (2.7-40)	7.1	**0.001**
21-30	0.66 (0.43-1.0)	0.14	0.054	1.4 (0.88-2.1)	0.30	0.16	2.7 (0.63-12)	2.0	0.18
Supervising trainees									
No	Reference value	—	—	Reference value	—	—	—	—	—
Yes	1.6 (1.0-2.4)	0.33	**0.031**	0.75 (0.50-1.1)	0.15	0.16	0.37 (0.14-1.0)	0.19	**0.049**
Subspecialty									
Hand and wrist	Reference value	—	—	Reference value	—	—	—	—	—
Shoulder and elbow	1.4 (0.88-2.3)	0.34	0.16	0.86 (0.54-1.4)	0.21	0.54	n/a[a]	n/a[a]	n/a[a]
Fracture surgeon	0.85 (0.58-1.2)	0.16	0.38	1.0 (0.72-1.5)	0.19	0.86	2.0 (0.84-4.6)	0.85	0.12
Other	1.3 (0.79-2.0)	0.31	0.32	0.53 (0.33-0.87)	0.13	**0.012**	4.9 (1.9-13)	2.4	**0.001**
Intolerance of uncertainty score	0.99 (0.97-1.0)	0.0098	0.20	1.0 (0.99-1.0)	0.010	0.65	1.04 (1.00-1.09)	0.022	**0.049**

[a]No observations in this group.
Bold indicates statistical significance, $P < 0.05$.

Factors Associated With Management Strategy

The findings that more interventional approaches were associated with greater pain intensity and lower patient tolerance of uncertainty seems consistent with the current management of suspected scaphoid fractures. Variation in the management of suspected scaphoid fractures might decrease with less emphasis on symptom intensity, which is often tied to the mindset rather than pathophysiology.[19-22] A study of 117 patients with fractures expected to heal found that the intensity of pain experienced on physical examination correlated with measures of mindsets regarding sensation, pain self-efficacy, and pain interference specifically.[22] In other words, fracture tenderness seems to vary by

Table 4. **Mixed MultiLevel Linear Regression Analysis of Patient Factors Associated With Surgeon Comfort Letting the Patient Decide on Management Strategy**

Factor or Variable	Regression Coefficient (95% Confidence Interval)	Standard Error	*P* Value
Energy of injury			
High-energy sport fall	Reference value	—	—
Simple fall	0.17 (−1.9 to 2.2)	1.0	0.87
Pain intensity on a 0-10-point ordinal scale			
2	Reference value	—	—
5	−0.78 (−3.2 to 1.6)	1.2	0.53
8	−5.1 (−7.6 to −2.7)	1.2	**<0.001**
Patient's comfort with uncertainty			
Accepting risk of a missed fracture	Reference value	—	—
Not accepting risk of a missed fracture	−0.57 (−2.6 to 1.5)	1.0	0.58
Desire to immediately get back to work			
Motivated to return as quickly as possible to work or sport	Reference value	—	—
Will be doing simple, safe tasks	−0.56 (−2.6 to 1.5)	1.0	0.59
Desire for agency			
Patient feels confident about making a decision	Reference value	—	—
Patient wants to defer to the clinician regarding the decision	0.31 (−1.7 to 2.3)	1.0	0.76

Bold indicates statistical significance, $P < 0.05$.

mindsets rather than pathophysiology. This evidence has the potential to reduce the specialist weighting of pain and tenderness in the attempt to distinguish true fractures from suspected fractures. Specialists' relative reluctance to allow patients to decide on visits, tests, and treatments that might further reduce the probability of nonunion and arthritis related to an undiagnosed fracture (the least popular choice in this study) might also evolve. The concept of allowing the informed and reassured patient to decide their preferred level of potential harm, after reorientation of common misconceptions and alleviation of worry and despair, which are often signaled by disproportionate pain intensity,[22] merits additional attention.[7]

The observation that surgeons were more likely to offer imaging to people motivated to return to work is consistent with the high negative predictive value of imaging in the setting of suspected scaphoid fracture and the desire of some people to reduce the probability of undiagnosed fracture as much as possible.[9,23-25] The observation that higher energy injury is associated with stronger specialist recommendation for imaging makes sense based on the association of scaphoid fracture displacement and perilunate carpal dislocations with relatively high-energy injuries.5

Factors Associated With Comfort Letting the Patient Decide

The observation that surgeon factors, greater surgeon intolerance of uncertainty in particular, were associated with lower comfort with letting the patient decide on the management strategy emphasizes the need for improved strategies for prioritizing the patient's values and preferences, unclouded either by the surgeon's values and mindsets, or by common misconceptions, feelings of distress, and limited tolerance for uncertainty. One important contributor to elevated specialist intolerance of uncertainty could be fear of medicolegal consequences in case of a missed fracture. The goal can be conceptualized as helping a patient become aware of what matters most to them (their values) and making decisions consistent with those values independent of the specific specialist guiding them through the process and that particular specialist's views on the matter. Specialists have an ethical duty to ensure that people do not make choices based on

Table 5. **Negative Binominal Regression Analysis of Surgeon Factors Associated With Surgeon Comfort Letting the Patient Decide on Management Strategy**

Factor or Variable	Regression Coefficient (95% Confidence Interval)	Standard Error	*P* Value
Sex			
Women	Reference value	—	—
Men	−0.11 (−0.31 to 0.084)	0.099	0.26
Continent			
United States	Reference value	—	—
Europe	−0.12 (−0.24 to −0.0014)	0.062	0.053
Other	0.14 (−0.021 to 0.30)	0.082	0.089
Years of practice			
0-5	Reference value	—	—
6-10	0.16 (0.0028 to 0.31)	0.078	**0.046**
11-20	0.22 (0.064 to 0.37)	0.078	**0.005**
21-30	−0.092 (−0.25 to 0.066)	0.081	0.25
Supervising trainees			
No	Reference value	—	—
Yes	−0.14 (−0.29 to 0.011)	0.076	0.069
Subspecialty			
Hand and wrist	Reference value	—	—
Shoulder and elbow	−0.22 (−0.39 to −0.045)	0.088	**0.014**
Fracture surgeon	0.0028 (−0.13 to 0.14)	0.069	0.97
Other	0.062 (−0.11 to 0.23)	0.088	0.48
Intolerance of uncertainty score	−0.013 (−0.020 to −0.0054)	0.0037	**0.001**

Bold indicates statistical significance, $P < 0.05$.

misconceptions or false hope, both of which are key features of human illness behavior.[26] Tools such as decision aids could help patients with this process.[27] Although given the limited effect of decision aids to date,[28] it may also be important to strategize and test alternative clinician communication strategies.

Conclusion

We found notable surgeon variation in the management of a suspected scaphoid fracture that seemed related in part not only to desire to return to work and concerns about higher-energy injury but also to how surgeons interpret pain intensity and how surgeons manage uncertainty. There is an inevitable potential for harm in the treatment of suspected scaphoid fractures. In particular, uncertainty cannot be eliminated. This creates a window of opportunity to help surgeons guide patients away from decisions based on symptom intensity, and feelings of worry or despair, which may, to a degree, be worse in a setting of inherent uncertainty. Future research might focus on the implementation of management strategies for suspected scaphoid fractures that put greater weight on what matters most to patients, including the development of pathways that help identify and match patient preferences for managing potential benefits and potential harms of various visit, test, and treatment strategies.

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