Original Article

Variability in orthopedic surgeon treatment preferences for nondisplaced scaphoid fractures: A cross-sectional survey

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ABSTRACT

Purpose: The absence of a best practice treatment standard contributes to clinical variation in medicine. Often in the absence of evidence, a standard of care is developed and treatment protocols are implemented. The purpose of this study was to examine whether the standard of care for the treatment of nondisplaced scaphoid fractures is uniform among orthopedic surgeons.

Methods: A survey of orthopedic surgeons actively practicing in the US or abroad was conducted to elicit preferred treatment strategies for nondisplaced scaphoid fractures. The surgeons were recruited at orthopedic conferences, clinical visits, and via email. The survey included demographic questions along with a short clinical vignette. The option for fracture management included surgical versus nonsurgical treatment. For those who chose nonsurgical treatment, type/duration of immobilization was recorded. Cost analysis was performed to estimate direct and indirect costs of various treatment options.

Results: A total of 494 orthopedic surgeons completed the survey. The preference for surgical treatment was preferred in 13% of respondents. Hand/upper extremity specialists were significantly more likely to operate compared with generalists ($p = 0.0002$). Surgeons younger than forty-five were nearly twice as likely to choose surgery ($p = 0.01$). There was no clear consensus on duration of immobilization as 30% of surgeons chose 6 weeks, 33% selected 8 weeks, and 27% opted for 12 weeks. Total cost of surgery was 49% greater than that of nonoperative treatment. With each additional week of immobilization for nonoperative treatment, the total costs of surgical treatment near that of nonoperative treatment.

Conclusion: There exist clear trends in how specific demographic groups choose to treat the nondisplaced scaphoid fracture. Whether these trends are the result of generational gaps or additional subspecialty training remains difficult to determine, but there is need to pursue a more consistent approach that benefits the patients and the health care system as a whole.

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1. Introduction

The scaphoid is the most commonly fractured carpal bone.¹ Scaphoid fractures are estimated to account for up to 90% of carpal fractures and 2–7% of all fractures, occurring mostly among active

adolescents and young adults.² The scaphoid is vulnerable to injury due to its anatomic position on the radial side of the wrist as the proximal extension of the thumb ray.³ The primary mechanism of injury is a fall on the outstretched hand with an extended, radially deviated wrist.

Scaphoid fracture may be classified as stable versus unstable using the Herbert classification.² The Herbert classification system was intended to identify scaphoid fractures that would benefit most from surgical fixation. It was proposed that unstable fractures should predominantly be treated operatively, while most stable fractures can be treated conservatively. Regardless of fracture

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stability, in order to promote anatomic union and avoid the potentially deleterious sequelae of radiocarpal and midcarpal arthrosis as well as carpal malalignment, it is important that each fracture type be immobilized in a timely manner.⁴ For displaced scaphoid fractures, there is a consensus that treatment should be surgical, typically via screw fixation.³ In contrast, the evidence for treatment of nondisplaced scaphoid fractures remains unclear.⁵

The purpose of this study was to evaluate the preferred treatment methods for nondisplaced scaphoid fractures by surgeons domestically and internationally in an effort to gain understanding of what procedures physicians prefer. We hypothesized that although evidence may be unclear in how to approach the nondisplaced scaphoid fracture, there is a standard of care among orthopedic surgeons whether or not to operate, and how long to immobilize this fracture.

2. Materials and methods

A survey was conducted over ten months from August 2012 to June 2013 to elicit the preferred treatment strategies for a nondisplaced scaphoid fracture. The survey included demographic questions with a short clinical vignette. The vignette included significant past medical history, history of present illness, pertinent physical exam findings, and radiographic images for a patient with a nondisplaced scaphoid fracture (Appendix 1). Participants answered questions regarding their preferred treatment recommendations.

Physicians were recruited at orthopedic conferences, outpatient and inpatient clinical visits, and via email. The surveys were offered in both paper and electronic formats. All participants were orthopedic surgeons currently practicing in the United States or internationally at the time the survey was conducted.

2.1. Statistical analysis

Direct medical costs were estimated using published national Medicare rates for 2014. Medicare reimbursement data to physicians and other individual providers provides an indication of the relative effort, skill, and risk associated with each procedure, overhead expenses, and malpractice insurance. The current procedural terminology codes (CPT) used were 25,622 for nonoperative treatment and 25,628 for surgical treatment. The anesthesia fee schedule for surgical procedures is based on procedure time, which we have assumed to be 2 h for each operative procedure. We assumed that all of the open procedures were conducted at an ambulatory surgical center that is also reimbursed. For this later fee, we relied on the Medicare reimbursement experience of a large facility in the greater Washington DC area. We assumed that the closed procedure was not done in such a facility but used the higher non-facility reimbursement rate since that fee includes the overhead of a physician's office.

Indirect medical costs were estimated using a set of stylized assumptions. We assumed the following indirect costs: 80 min per physician visit, and based on the duration of immobilization or a cast, 15 min per day in activities of daily living, 30 min per week for missed opportunities and assistance from others, and 600 min per week in foregone productivity. The value of time was based on the average annual salary estimated by the Social Security actuaries, which for 2014 is assumed to be \$49,372.25.

The assumptions were meant to capture the possibility of missed opportunities; which may arise from medical visits and reduced capacity. The value of this time was based on the estimated average wages used by the Office of the Actuary for Social Security.

A statistical analysis of the data was performed. Univariate analysis was run by applying chi-squared goodness of fit and Fisher exact tests to investigate the differences for categorical variables. A *p*-value of <0.05 was considered to be statistically significant.

2.2. Ethics, consent and permissions

The Georgetown University Institutional Review Board reviewed and deemed this study exempt on August 31, 2012. All participants gave implied informed consent.

3. Results

Overall, 493 physicians participated in the survey. The survey participants represented a fair reflection of the demographic composition of the field of orthopedics, according to the most recent release of Orthopedic Practice in the US in 2012 by the American Academy of Orthopedic Surgeons (AAOS). Concerning gender, the participants were 93.1% male and 5.9% female (AAOS – 92.9% and 4.9% respectively). In terms of degree of specialization, 30.4% considered themselves general orthopedic surgeons as opposed to 66.1% that subspecialize (AAOS – 23% and 77% respectively) [Table 1]. Of the 493 respondents, the distribution of treatment methods for nondisplaced scaphoid fractures varied widely.

3.1. Surgical versus nonsurgical treatment

Surgical treatment was less commonly recommended compared with nonsurgical treatment (13% versus 80.3%) [Fig. 1].

Table 1
Characteristics of the study sample (*n* = 493).

	N	%
Age		
<46	228	46.2%
46–60	167	33.9%
>60	95	19.3%
Other	3	0.6%
Gender		
Male	459	93.1%
Female	29	5.9%
Other	5	1.0%
Setting		
Private practice	320	64.9%
MedSpec clinic	7	1.42%
University	28	5.68%
Other	138	27.99%
Classification		
General ortho surgeon	150	30.4%
Subspecialty orthopedist	326	66.1%
Other	17	3.4%
Subspecialty (<i>n</i> = 326)		
Adult reconstruction	14	4.3%
Arthroscopy	3	0.9%
Foot/ankle	60	18.4%
Hand	29	8.9%
Elbow/upper extremity	28	8.6%
Hip/knee/lower extremity	30	9.2%
Joints	26	8.0%
Trauma	24	7.4%
Pediatrics	24	7.4%
Spine	17	5.2%
Sports medicine	59	18.1%
Other	12	3.7%
Country		
United States	346	70.2%
International	147	29.8%
Time with patients (%)		
≤50	76	15.4%
51–75	80	16.2%
>75	323	65.6%

Distribution of Treatment Selection

Fig. 1. Distribution of treatment selection. The 'other' category in this case refers to all responses classified as non-surgical interventions that did not specify long arm or short arm casting, involved a combination of the two, or were non-specific in nature, as well as responses that were ambiguous or non-specific as to whether the intervention was surgical or not.

General orthopedic surgeons recommended surgery in only 6.0% of the cases, while subspecialists within orthopedics recommended surgery 16.9% of the time [Fig. 2]. Orthopedic surgeons subspecializing in hand/upper extremity were more likely to select surgical intervention compared with generalists (34.6% versus 6.0%, $p = 0.0002$). When grouped by age, surgeons age forty-five and younger chose surgical treatment nearly twice as much as their older colleagues aged 46–59 (17.5% versus 10.2%, $p = 0.01$). Only 7.4% of surgeons sixty years of age and older elected to perform surgery [Fig. 2].

3.2. Length/type of immobilization

For those that selected the nonoperative approach, responses for length of immobilization included 6 weeks (33.1%), 8 weeks (36.5%), and up to 12 weeks (30.4%) [Figs. 3 and 4]. A similar trend is observed between both generalists (31.5%, 37.1%, 31.5% respectively) and specialists (29.6%, 35.4%, 35.0% respectively) [Fig. 4]. Forty-one respondents (9.8%) provided length of immobilization outside of these distinct values of time. A short arm thumb spica was chosen by 51.9% of surgeons, compared to a long arm thumb spica selected by 28.4% [Fig. 1]. The therapeutic approach to nondisplaced scaphoid fractures was similar in terms of conservative versus surgical and length of immobilization among orthopedic surgeons in the US and internationally [Tables 2 and 3].

Length of Immobilization

Fig. 3. Frequency of length of immobilization preferred by all participating physicians. Note that this does not include 41 participants that preferred cast immobilization, but elect for different time lengths. p -Value 0.75.

3.3. Cost implications

Each treatment choice is likely to impose different cost implications for health care resources and society. The direct cost of the average surgical procedure (\$3721) is more than 5 times the direct cost of casting (\$699). However, casting can have a profound impact on indirect costs, depending on occupation, whether the arm with the fracture is dominant, and the duration of the cast. For example, in Table 4, below, we compare treating our hypothetical patient with a cast for 8 weeks followed by 3 weeks of immobilization. The indirect costs of surgery may be 60% less than the indirect costs of casting, but the significantly greater direct costs leave the total costs of surgery about 49% greater than casting.

While 8 weeks of casting was the most common survey response, about 30.4% of respondents said they would cast for 12 weeks while nearly 34% said they would cast for 6 weeks. The total costs of surgery would exceed that of 6 weeks of casting by 94%.

4. Discussion

The treatment for the nondisplaced scaphoid fracture holds important value that impacts personal lifestyle as well as economic realization. Despite the common occurrence and importance in

Fig. 2. Frequency of surgical treatment selection by age of physician and degree of specialization.

Fig. 4. Frequency of length of immobilization preferred by all participating physicians versus generalist versus subspecialist. Note that this does not include 41 participants that preferred cast immobilization, but elected for different time lengths.

treating this fracture, our results suggest that orthopedic surgeons are approaching nondisplaced scaphoid fractures without therapeutic consistency. This may be attributed to failure to follow evidence-based approaches or lack of statistically relevant studies to support one treatment modality over another. It is important that an effort be made to treat these fractures in a reliable manner that is as abbreviated and least cumbersome as possible, especially given the patient population that is predominantly affected by this injury.

The fact that a nearly equal percentage of surgeons participating in our study elected for immobilization of 6 weeks (33.1%), 8 weeks (36.5%), and 12 weeks (30.4%) is alarming. Based on these results, it is clear that there is no widely accepted standard of care in the non-operative treatment of nondisplaced scaphoid fractures. There is literature that supports casting for 3 months since 90% to

95% of scaphoid waist fractures will predictably heal over that timeframe.⁶ However, in another study of scaphoid fractures, a majority of cases (58 out of 71 studied) were clinically consolidated after an immobilization period of 6 weeks.² Of note, the outcomes in this study were determined clinically rather than radiographically since radiographic evidence of consolidation is less appropriate given that the scaphoid is composed of >80% cartilage and nondisplaced fractures frequently show no radiographic consolidation. This disparity of up to 6 weeks between time required for healing is most likely the result of the lack of consensus approach rather than varied healing characteristics of the patient population. Furthermore, the difference between 6 and 12 weeks of immobilization can have considerable implications for societal costs.

Table 2
Length of immobilization.

	All n=419		Length of immobilization							
			6 weeks n=125 (29.8%)		8 weeks n=138 (32.9%)		12 weeks n=115 (27.4%)		Other n=41 (9.8%)	
Age										
Under 46	186	44.4%	56	30.1%	57	30.6%	54	29.0%	19	10.2%
46 and older	230	54.9%	68	29.6%	80	34.8%	60	26.1%	22	9.6%
60 and older	86	20.5%	23	26.7%	30	34.9%	25	29.1%	8	9.3%
Unknown	3	0.7%	1	33.3%	1	33.3%	1	33.3%	0	0.0%
Gender										
Male	391	93.3%	112	28.6%	129	33.0%	109	27.9%	41	10.5%
Female	24	5.7%	10	41.7%	9	37.5%	5	20.8%	0	0.0%
Unknown	4	1.0%	3	75.0%	0	0.0%	1	25.0%	0	0.0%
Specialization										
Generalist	138	32.9%	39	28.3%	46	33.3%	39	28.3%	14	10.1%
Subspecialty	264	63.0%	84	31.8%	85	32.2%	71	26.9%	24	9.1%
Hand	17	4.1%	2	11.8%	9	52.9%	3	17.6%	3	17.6%
Unknown	17	4.1%	2	11.8%	7	41.2%	5	29.4%	3	17.6%
Nationality										
USA	299	71.4%	93	31.1%	94	31.4%	84	28.1%	28	9.4%
International	120	28.6%	32	26.7%	44	36.7%	31	25.8%	13	10.8%

Table 3

Treatment type.

	All n = 493		Treatment type							
			Short arm thumb spica n = 256 (51.9%)		Long arm thumb spica n = 140 (28.4%)		Surgery n = 64 (13.0%)		Unknown n = 33 (6.7%)	
Age										
Under 46	228	46.2%	118	51.8%	57	25.0%	40	17.5%	13	5.7%
46 and older	262	53.1%	135	51.5%	83	31.7%	24	9.2%	20	7.6%
60 and older	95	19.3%	52	54.7%	31	32.6%	7	7.4%	5	5.3%
Unknown	3	0.6%	3	100.0%	0	0.0%	0	0.0%	0	0.0%
Gender										
Male	459	93.1%	238	51.9%	132	28.8%	59	12.9%	30	6.5%
Female	29	5.9%	16	55.2%	6	20.7%	4	13.8%	3	10.3%
Unknown	5	1.0%	2	40.0%	2	40.0%	1	20.0%	0	0.0%
Specialization										
Generalist	150	30.4%	87	58.0%	46	30.7%	9	6.0%	8	5.3%
Subspecialty	326	66.1%	154	47.2%	92	28.2%	55	16.9%	25	7.7%
Hand	26	5.3%	13	50.0%	1	3.8%	9	34.6%	3	11.5%
Unknown	17	3.4%	15	88.2%	2	11.8%	0	0.0%	0	0.0%
Nationality										
USA	346	70.2%	178	51.4%	106	30.6%	41	11.8%	21	6.1%
International	147	29.8%	78	53.1%	34	23.1%	23	15.6%	12	8.2%

Table 4

Direct versus indirect cost of conservative compared to surgical treatment.

	Closed treatment 8 weeks in a cast	Open treatment 2 weeks in a splint (followed by 2 weeks in a removable splint)	Relative difference of open relative to closed treatment
Direct medical costs	698.31	3721.69	433%
Indirect costs	2452.79	972.21	−60%
Total costs	3151.10	4693.90	49%

Davis et al. performed a cost/utility analysis of open reduction and internal fixation versus cast immobilization for acute, nondisplaced scaphoid fractures.⁷ Using a decision analytical model, they attempted to measure differences in quality of life and cost in relation to these two treatment modalities. They found that compared to casting, surgical fixation offers greater quality-adjusted life-years compared with casting and is less costly overall (\$7940 versus \$13,851). In our cost analysis, we found while the direct costs of surgery are up to 433% higher than nonoperative treatment, after indirect costs are taken into account, surgical treatment is 50% more costly. With each additional week of immobilization for nonoperative treatment, the total costs of surgical treatment near that of nonoperative treatment.

A limitation of this study is that no occupation was accounted for in the vignette. Certain occupations may dictate the direction of treatment by physicians. Vinnars et al. performed a randomized trial involving 52 patients with acute scaphoid fractures exploring direct and indirect costs of internal fixation versus cast immobilization, looking specifically at manual versus non-manual laborers.⁸ They concluded that there was a longer period of absence from work after cast immobilization in manual, but not in non-manual workers. Furthermore, the total costs were lower following conservative treatment in non-manual workers. Therefore, it seems reasonable that patients with nondisplaced scaphoid fractures who are dependent on hand function be given the option for surgical intervention, while others should be treated conservatively to minimize costs. These studies explain some of the variance found in our study results. On the other hand, it may be reasonable to assume that physicians fail to consider these factors on a regular basis and the variance in treatment stems more from an overall inconsistent approach.

Our survey results demonstrated that overall preferences for cast-type were almost equally as varied, with 28.4% of recruited physicians electing to use a long arm thumb spica cast compared to 51.93% selecting a short arm spica cast. Doornberg et al. performed a meta-analysis of randomized controlled trials comparing various nonoperative treatment methods for acute scaphoid fractures to determine best available evidence and found that there was no significant difference between different types of casts in regards to selected secondary outcomes (pain, grip, strength, time to union, AVN, immobilization time and range of motion).⁶ Thus, without support for any particular cast type, it seems reasonable that orthopedists immobilize patients with the least cumbersome cast (i.e. short arm thumb spica), yet that does not seem to be the case based on the results of this study.

Finally, the election for surgery over conservative treatment offered another interesting and varied distribution amongst orthopedic surgeons. Ram et al. developed an evidence-based approach for acute, nondisplaced scaphoid fractures using a compilation of current best evidence and found no evidence to support one treatment modality over another.⁶ They concluded that the best approach to a patient with an acute, nondisplaced scaphoid waist fracture is to combine consideration of the individual's unique circumstances with a well-reasoned algorithm. However, the lack of an accepted algorithm has led to a curious demographic trend amongst orthopedic surgeons as to whether one should treat these operatively or nonoperatively. From our survey results, it is clear that younger orthopedists preferentially approach these fractures surgically at a much greater rate than their older counterparts. The same can be said for more specialized orthopedic surgeons. Although one might point to selection bias to explain this trend, it should be noted that the participants in our

study were each presented with the same exact clinical vignette to control for biases.

The point of this research is not to suggest one particular treatment regimen of nondisplaced scaphoid fractures, but to uncover the need to delineate a more uniform approach to treatment of this fracture. It can be taken from our study that there exist clear trends in how specific demographic groups choose to treat this common fracture. Whether these trends are the result of generational gaps or additional subspecialty training remain difficult to determine, but it is clear that there is a need to pursue a more consistent approach that benefits both the patients and the health care system as a whole.

Conflicts of interest

The authors have none to declare.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.jor.2016.06.020](https://doi.org/10.1016/j.jor.2016.06.020).

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