

Treatment Recommendations for Suspected Scapholunate Ligament Pathology

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Abstract

Keywords

- scapholunate ligament
- wrist arthroscopy
- Geissler grade
- tenodesis
- capsulodesis
- direct repair

Background The diagnosis and treatment of scapholunate interosseous ligament (SLIL) pathology is debated and notably variable. This study assessed the influence of diagnostic arthroscopy on treatment recommendations and the interobserver reliability of the arthroscopic classification of SLIL pathology.

Methods The influence of diagnostic arthroscopy on treatment recommendations and the reliability of the arthroscopic classification of SLIL pathology were tested in a survey-based experiment. Seventy-seven surgeons evaluated 16 scenarios of people with wrist pain with variation in symptoms, scaphoid shift, time of symptom onset, and MRI appearance of the SLIL. Participants were randomized to view or not to view diagnostic wrist arthroscopy. Factors associated with recommendation for repair, capsulodesis, or tenodesis were analyzed.

Results Viewing arthroscopic videos was associated with both offering surgery and a more reconstructive option. Other factors independently associated with recommendation for surgery included greater pain intensity and activity intolerance, women surgeons, an asymmetric scaphoid shift, and a recent onset of symptoms. The interobserver reliability of SLIL classification was slight.

Conclusions Diagnostic arthroscopy leads to more surgery, and more invasive surgery, in spite of unreliable assessment of pathology.

Clinical Relevance This points to the need to measure the potential benefits and harms of diagnostic wrist arthroscopy among people with wrist pain and no clear diagnosis on interview, examination, and radiographs.

Level of Evidence Not applicable.

* For The Science of Variation Group members, please refer to
► **Appendix A.**

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Rupture of the scapholunate interosseous ligament (SLIL) is one of the less common injuries that can result from a fall onto an outstretched hand. The proposed mechanism is direct axial compression with the wrist in extension, ulnar deviation, and intercarpal supination.¹ It is relatively unusual to diagnose SLIL rupture acutely. More typically, patients accommodate symptoms for a longer period of time or seek care after another event for which radiographs are obtained and the preexisting pathology is identified.^{2–4} Patients with a complete rupture of the SLIL may experience episodic pain. Eventually, they may develop persistent pain related to subsequent osteoarthritis which, in turn, is related to malalignment.⁵ Lesser degrees of SLIL pathology have a less clear relationship to symptoms and arthrosis.

Options for the evaluation of suspected ligament injuries of the wrist include examination maneuvers (such as the scaphoid shift test), radiological examinations such as radiographs (including a clenched fist view), CT, MRI, cineradiography, and diagnostic wrist arthroscopy.^{6,7} The potential benefit and potential harm associated with each of these diagnostic tests is relatively untested. The arthroscopic grading of SLIL pathology reported by Geissler and colleagues is used by some surgeons to direct treatment recommendations.^{3,8} Some surgeons consider diagnostic arthroscopy to be the reference standard in the evaluation of SLIL pathology, a position which may contribute to greater use of diagnostic surgery with unclear potential for benefit. For instance, one review of a series of diagnostic wrist arthroscopies reported a very low yield of diagnoses: 80% had no pathological findings or mild synovitis, much of the specific pathophysiology diagnosed were either debatable, potential variations, or likely age-related, and some lesions may have been iatrogenic.⁹ Subsequent surgery was offered to only 12% of patients, and much of it had questionable value.

It is known that wrist pain is common and can exist without measurable pathology. For instance, young adults with lax ligaments can experience ongoing wrist and anterior knee pain in healthy and structurally sound joints.^{10,11} In the circumstance of a low prevalence of pathology such as SLIL rupture, even highly specific and sensitive diagnostic tests can be misleading (Bayes' theorem). Furthermore, there is likely some variation in wrist ligaments and other structures, which likely increases with age, expanding the base rate of accommodated pathology which, in turn, magnifies the influence of false positive tests and unreliability, thereby increasing the potential for misdiagnosis and unhelpful treatment.^{12,13}

To learn more about the role of diagnostic wrist arthroscopy in the evaluation of pain, we performed a survey-based experiment to study the primary null hypothesis that there is no variation in recommended treatment for patients with suspected SLIL pathology between surgeons who view videos of diagnostic wrist arthroscopy and those who do not, accounting for surgeon and patient characteristics. Secondly, we addressed the interobserver variability of the classification of SLIL pathology according to Geissler and colleagues as well as factors associated with recommendations for specific surgeries.

Methods

This study was reviewed and approved by the Institutional Review Board.

An email invitation was sent to members of the Science of Variation group (SOVG) with a link to an online survey-based (SurveyMonkey; Palo Alto) experiment about patients seeking care for wrist pain. SOVG studies are experiments conducted by survey. Something is either randomized or correlated. Because we measure relationships and influences, not rates, the key is adequate variation within the surveyed participants rather than participation rate. Given that we typically address areas of debate and variation in practice, there is usually a wide variation in training, beliefs, and choices among our participants. For hand and wrist topics, we tend to have approximately 65 to 80 participants.

Participating surgeons reviewed 16 patient scenarios which contained information about: 1) pain intensity and magnitude of activity intolerance ("the pain is mild and occasional with minimal interference with work and hobbies" or "the pain is substantial and interfering with work and hobbies"), 2) time since onset and potential relatedness to injury ("symptoms started more than a year ago and not clearly related to a specific event" or "symptoms started within a few months and after a fall on an outstretched arm"), 3) scaphoid shift test ("physical examination shows an [either asymmetric or symmetric] scaphoid shift test") and 4) radiological information ("an MRI scan demonstrates a signal change in the scapholunate ligament" or "a normal scapholunate ligament").

All participants read a patient scenario. Half were also randomized to view video recordings of midcarpal and radiocarpal arthroscopic evaluation of the SLIL ligament.

Sixteen consecutive videos of wrist arthroscopy in people with a working diagnosis of SLIL insufficiency were obtained from one surgeon's practice. Every year, 120 to 140 patients seek care for suspected SLIL pathology from this surgeon. Approximately 40 to 50 (35%) undergo diagnostic arthroscopy and approximately 30 to 40 (27% of the total and 75% of those having arthroscopy) undergo a reconstructive procedure. All videos were randomly assigned to a patient scenario.

Participants were asked whether they would recommend reconstructive surgery, and if yes, to pick the treatment closest to what they would advise: direct SLIL repair, capsulodesis, or tenodesis.

Additionally, all surgeons viewing arthroscopic videos were asked to grade the SLIL pathology, according to the Geissler classification (► **Table 1**).⁸ The following explanatory surgeon characteristics were obtained: sex, years of independent practice, supervision of trainees, and region of practice.

Participant Characteristics

In total, 88 members of the SOVG initiated the survey and 77 completed it. Thirty-four (44%) participants viewed arthroscopic videos and 43 (56%) only reviewed the patient scenario, and the groups were comparable (► **Table 2**). The

Table 1 Geissler classification

Grade	Description
I	Attenuation/hemorrhage of SLIL as seen from the radiocarpal joint. No incongruency of carpal alignment in the midcarpal space.
II	Attenuation/hemorrhage of SLIL as seen from the radiocarpal joint. Incongruency/step-off as seen from midcarpal space. A slight gap (less than width of a probe) between carpals may be present.
III	Incongruency/step-off of carpal alignment is seen in both the radiocarpal and midcarpal spaces. The probe may be passed through the gap between carpals.
IV	Incongruency/step-off of carpal alignment is seen in both the radiocarpal and midcarpal spaces. Gross instability with manipulation is noted. A 2.7-mm arthroscope may be passed through the gap between carpals.

concept of response rate is not relevant, since the SOVG participants email list is not filtered or updated, and not all SOVG members treat hand and wrist problems. The sample may or may not be representative of the average hand specialist, but the randomization and statistical analysis otherwise make monitoring relative participation less important. There is sufficient variation among participating surgeons to make the experiment informative and likely applicable to most surgeons.

Statistical Analysis

Discrete variables were reported as number and percentage, p values < 0.05 were considered significant.

The paired t -test was used to compare the difference in the likelihood of recommendation for surgery. Values range

Table 2 Baseline surgeon characteristics

Variables	With arthroscopy	Without arthroscopy
Participating surgeons	34 (44%)	43 (56%)
Sex		
Women	7 (21%)	2 (4.7%)
Men	27 (79%)	41 (95%)
Years of independent practice		
0–10	18 (53%)	22 (51%)
> 10	16 (47%)	21 (49%)
Supervision to trainees		
Yes	31 (91%)	33 (77%)
No	3 (8.8%)	10 (23%)
Region of practice		
North America	15 (44%)	26 (60%)
Other	19 (56%)	17 (40%)

Note: Discrete variables presented as number (percentage).

from 0 to 1, with 0 indicating that for none of the cases the surgeon recommended surgery, and 1 indicating that for all of the cases, the surgeon recommended surgery. Values are based on the four dichotomous clinical characteristics which are presented and equally divided over the 16 cases, like the symmetric scaphoid shift test ($n=8$) versus asymmetric scaphoid shift test surgery ($n=8$).

We created an overall likelihood of recommending surgery score for each surgeon averaging all 16 scenarios and performed a two paired t -test, using likelihoods per patient characteristic of recommending surgery for all cases per surgeon (0–1).

To assess factors independently associated with recommending surgery including viewing arthroscopy and surgeon characteristics, a multilevel multivariable logistic regression was performed.

To determine interobserver variability, Cohen's kappa was used. The kappa value reflects the degree to which observers agree, considering the chance that observers agree at random. Perfect agreement is represented by a kappa of 1.00; agreement solely by chance would equate to a kappa of 0.00 and total disagreement is represented by a kappa of -1.00 . Values between 0.01 to 0.20 represent none to a slight agreement, 0.21 to 0.40 represent fair agreement, 0.41 to 0.60 represent moderate agreement, 0.61 to 0.80 represent substantial agreement, and 0.81 to 1.00 represent almost perfect agreement.¹⁴ To study the surgeon characteristics associated with the interobserver agreement, the differences were observed by comparing the 95% confidence interval of the kappa values per subgroup. To assess factors associated with the type of surgery recommended, a multinomial logistic regression was used.

Results

Accounting for potential confounding using multivariable analysis, the following factors were independently associated with recommending operative treatment (**► Appendix Table A1**; **► Table 3**): greater pain intensity and magnitude of activity intolerance (OR 10; 95% CI, 3.5–30; $p < 0.001$); viewing an arthroscopic video (OR 6.9; 95% CI, 2.8–18; $p < 0.001$), women surgeons (OR 4.6; 95% CI, 1.24–17.4; $p = 0.02$); asymmetric scaphoid shift (OR 4.0; 95% CI, 1.4–11; $p = 0.01$); and more recent onset of symptoms after a fall (OR 3.3; 95% CI, 1.1–9.4, $p = 0.03$).

There was slight interobserver reliability of the Geissler classification on video inspection ($\kappa = 0.18$; 95% CI, 0.11–0.26; **► Table 4**). No surgeon characteristics were associated with interobserver reliability.

Viewing arthroscopic videos motivated surgeons to recommend capsulodesis more often than direct repair (RR 0.52; 95% CI, 0.29–0.94; $p = 0.03$) and tenodesis over capsulodesis (RR 2.4; 95% CI, 1.3–4.2; $p = 0.004$; **► Table 5**) relative to surgeons who did not view videos. Surgeons from other regions than North America recommended significantly more capsulodesis than direct repair (RR 0.31; 95% CI, 0.18–0.55; $p \leq 0.001$). Giving supervision to trainees resulted in more recommendations for direct repair compared with

Table 3 Multilevel multivariable logistic regression analysis of factors associated with recommending surgery

Independent variables	Odds ratio	95% confidence interval	Standard error	p-Value
Arthroscopic video	6.9	2.8 to 18	3.3	< 0.001
Surgeon characteristics				
Women	4.6	1.24 to 17.4	0.15	0.02
> 10 years of independent practice	0.56	0.23 to 1.3	0.25	0.19
Giving supervision to trainees	0.75	0.23 to 2.5	0.46	0.63
Region other than North America	2.3	0.96 to 5.5	1.02	0.06
Patient characteristics				
Pain is substantial and interfering with work and hobbies	10	3.5 to 30	5.5	< 0.001
Symptoms started within a few months and after a fall on an outstretched arm	3.3	1.1 to 9.4	1.8	0.03
Asymmetric scaphoid shift test (Watson test)	4.0	1.4 to 11	2.2	0.01
MRI scan demonstrates a signal change in the scapholunate ligament	2.8	0.98 to 8.1	1.5	0.06

Note: Bold indicates statistically significant values.

Table 4 Interobserver reliability of the Geissler classification

	Kappa (κ)	95% confidence interval
Geissler classification	0.18	0.11 to 0.26
Surgeon characteristics		
Sex		
Women	0.13	-0.004 to 0.26
Men	0.19	0.12 to 0.26
Years of independent practice		
0-10	0.16	0.10 to 0.22
> 10	0.23	0.12 to 0.34
Giving supervision to trainees		
No	0.28	0.02 to 0.54
Yes	0.18	0.11 to 0.26
Region		
North America	0.15	0.07 to 0.22
Other	0.23	0.13 to 0.33

Note: Multirater kappa indicated by κ .

capsulodesis (RR 6.8; 95% CI, 2.6-18; $p \leq 0.001$). Recommending tenodesis over capsulodesis was also associated with supervision of trainees (RR 2.3; 95% CI, 1.1-5.0; $p = 0.03$; **Table 5**).

Discussion

The diagnosis and treatment of SLIL pathology is a subject of debate with substantial specialist-to-specialist variation in care.¹⁵⁻¹⁷ This study identified that viewing diagnostic wrist arthroscopy rather than clinical findings led to a significant increase in recommendation for surgery. Even though the

interpretation of SLIL pathology on arthroscopy was not reliable, viewing a video resulted in more frequent and more invasive treatment recommendations.

This study has several limitations. First, consecutive arthroscopic videos were collected from one hand surgeon. This surgeon's referral practice, assessment, and indications for diagnostic wrist arthroscopy may or may not be representative of the average surgeon. For the purposes of this experiment, it suffices that there was sufficient variation in pathology in the 16 videos. Second, all videos were randomly allocated to a fictional scenario. This might result in unlikely combinations. In our opinion, uncommon and even unlikely combinations are seen in practice and can be considered representative. Third, clinicians might consider unavailable information important. For practical statistical considerations, only four factors plus arthroscopy or no arthroscopy were studied. Using only four factors is a simplification of the clinical practice. Readers can consider this experiment as measuring the relative influence of these factors. Future experiments can address more and other factors felt to be important. Fourth, fewer surgeons randomized to review the arthroscopic videos completed in the survey. It is possible that reviewing videos involved more effort and people were less willing to invest that time, which could introduce some bias. In our opinion, a sufficient number of surgeons completed the survey, and the group had sufficient variation to allow the experiment to identify factors associated with the variation.

The finding that viewing videos of diagnostic arthroscopy led to more recommendation for surgery independent of surgeon and patient factors may reflect the influence of several well-known human cognitive biases (systematic errors in thinking) such as confirmation bias (giving greater weight to findings that support our belief), information bias (the tendency to seek information even when it cannot affect outcomes), prospect theory (the tendency to make riskier

Table 5 Multinomial logistic regression of factors associated with type of surgery

Dependent variables	Independent variables	Relative risk ratio	95% confidence interval	Standard error	p-Value
Direct repair compared to capsulodesis	Arthroscopic video	0.52	0.29 to 0.94	0.16	0.03
	Men	0.94	0.46 to 1.9	0.33	0.85
	> 10 years of independent practice	1.02	0.58 to 1.8	0.29	0.95
	Giving supervision to trainees	6.8	2.6 to 18	3.4	< 0.001
	Region other than North America	0.31	0.18 to 0.55	0.09	< 0.001
Tenodesis compared to capsulodesis	Arthroscopic video	2.4	1.3 to 4.2	0.70	0.004
	Men	0.74	0.40 to 1.4	0.23	0.34
	> 10 years of independent practice	0.66	0.39 to 1.1	0.18	0.12
	Giving supervision to trainees	2.3	1.1 to 5.0	0.92	0.03
	Region other than North America	1.1	0.65 to 1.9	0.30	0.72

Note: Bold indicates statistically significant values.

choices to avoid negative outcomes), and sunk cost effects (continuing a behavior as a result of previous invested resources; in this case, “we were willing to do surgery for diagnosis, we might as well keep going and do surgery for treatment”). There is evidence that surgeons are as prone to such biases as other humans, and that they may be no better at employing effective debiasing strategies to neutralize their influence.¹⁸

Some authors suggest that investigation of possible pathology is incomplete without wrist arthroscopy, while others point to evidence that nonspecific examination findings and reassuring radiographs are sufficient.^{9,19–21} Continuing the important consideration of cognitive bias, the proposition that diagnostic wrist arthroscopy is the reference standard could set up a framing heuristic that sets the level of acceptable uncertainty very low, which introduces the potential for iatrogenic, psychological, and financial harm. It is known that people experiencing notable symptoms can often be less accepting of uncertainty, or place inordinate hope on finding and fixing pathology.^{22,23} It would help to experimentally measure the following factors to evaluate the relative benefit of imaging and diagnostic surgery among people with nonspecific (reassuring exam and radiographs) ongoing wrist pain: reliability, accuracy, posttest changes in probability of diagnosis, and potential benefits and harms. It seems plausible that a simpler strategy using examination and radiographs alone will lead to greater health.

The finding that notable symptom intensity and magnitude of activity limitations had the strongest influence on the recommendation for surgery may reflect specialist unfamiliarity with the evidence of the notable influence of thoughts, emotions, and circumstances on human illness (biopsychosocial paradigm of human illness behavior) and the relative lack of correspondence of symptoms with objective pathology (biomedical model). More intense symptoms and relative incapability can signal musculoskeletal specialists to look for common misconceptions about symptoms as well as notable symptoms of stress and distress. This is an important step to

avoid misdiagnosing the illness and overutilizing potentially distracting and unhelpful reconstructive surgery.^{24–26}

The observation that video diagnosis of Geissler grade of pathology had slight interobserver reliability ($\kappa = 0.18$), independent of surgeon characteristics, is consistent with and even lower than a prior study measuring fair interobserver reliability ($\kappa = 0.34$) of three surgeons interpreting photographs and videos of wrist arthroscopy.^{27,28} The current study used a larger sample of surgeons and could therefore be considered more representative. The low reliability makes it difficult to support management strategies, based on these grades of pathology.

The observation that viewing an arthroscopic video was associated with moving up the reconstructive stepladder to more tenodesis compared with capsulodesis and more capsulodesis compared with direct repair reflects a strong influence of arthroscopy, which merits testing for potential benefits compared with potential harms. Do surgeons make recommendations that lead to better outcomes based on wrist arthroscopy or is wrist arthroscopy contributing to unhelpful tendencies to be more interventional and causing greater alteration of anatomy without measurable benefit?

In conclusion, our experiments measured strong influences of wrist arthroscopy and symptom intensity on recommendations for reconstructive surgery and for more anatomy-altering surgery while showing that the interpretation of SLIL pathology was unreliable. These types of studies manifest the cognitive biases that affect the surgeon mind. Such cognitive biases are almost certainly a source of surgeon-to-surgeon variations in care for wrist pain and other conditions. To improve the quality of care, reduce unwarranted variation, and increase alignment with patient values and preferences, surgeons can anticipate such biases and incorporate debiasing tactics into their care strategies. For instance, surgeon awareness that a decision for diagnostic wrist arthroscopy creates a bias toward reconstructive surgery, regardless of the potential benefits or harms of that surgery, and even though what is seen on arthroscopy is unreliably interpreted, might alter the circumstances in

which diagnostic wrist arthroscopy is offered. Surgeons can also learn to anticipate common misconceptions as a component of notable symptom intensity and magnitude of activity intolerance and prepare for communication strategies that can help guide people to a more accurate understanding of their condition. These possibilities merit additional study.

Ethical Approval

Ethical approval for this study was waived by the daily board of the medical ethics committee Erasmus MC (MEC-2018-1351). This study was completed in accordance with the Helsinki Declaration as revised in 2013

Authors' Contributions

D.B., J.K., G.K., J.C., N.M., and D.R. contributed in the initial idea and design of the study, and in drafting and finalizing of the manuscript. They also provided the final approval.

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Conflict of Interest

None declared.

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Appendix A

Participating members of the SOVG

Adams J, Akabudike N, Aparid T, Bainbridge C, Bamberger H, Barreto C, Bauer A, Baxamusa T, Bedout R, Benhaim P, Brubacher J, Cagnone J, Calcagni M, Castillo A, Catalano L, Chen N, Chepla K, Cohen M, Colaris J, de Jong T, Debeij J, DeSilva G, Dwyer C, Escobar Luis Felipe N, Farr S, Fernandes C, Fischer T, Gilbert R, Gottschalk M, Grafe M, Guitton T, Hahn P, Hammert W, Henry S, Hofmeister E, Hyatt B, Ilyas A, Kakar S, Keijser L, Kemler M, Kennedy S, Kraan G, Lee K, McKee D, Metzger C, Miranda G, Mitchell S, Moreno-Serrano C, Muhl P, Nancollas M, Nappi J, Ortiz J, Palmer M, Paz L, Polatsch D, Raven E, Rizzo M, Rodner C, Sandoval J, Schep N, Siff T, Souer S, Spaans A, Staal H, Suarez F, Terrono A, van der Heijden B, van der Stok J, van Doorn J, Verstreken F, Walbeehm E, Watchmaker G, Weiss L, Wills B, Wint J, Zaidenberg E.

Table A1 Patient characteristics leading to recommending surgery

Variables	Recommending surgery	p-Value
Overall	0.30 ± 0.24	
Pain		
Pain is mild and occasional with minimal interference with work and hobbies	0.18 ± 0.21	< 0.001
Pain is substantial and interfering with work and hobbies	0.42 ± 0.33	
Symptoms		
Symptoms started more than a year ago and not clearly related to a specific event	0.25 ± 0.22	< 0.001
Symptoms started within a few months and after a fall on an outstretched arm	0.35 ± 0.29	
Watson test		
Symmetric scaphoid shift test (Watson test)	0.23 ± 0.22	< 0.001
Asymmetric scaphoid shift test (Watson test)	0.38 ± 0.29	
MRI		
MRI scan demonstrates a normal scapholunate ligament	0.25 ± 0.28	0.001
MRI scan demonstrates a signal change in the scapholunate ligament	0.35 ± 0.27	

Note: Bold indicates statistically significant. Recommendation for surgery from 0 indicating no surgery to 1 indicating surgery.