RESEARCH ARTICLE

Surgeon Personal Factors Associated with Care Strategies in Musculoskeletal Telehealth

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Abstract

Background: Most surgeons used, or are currently using telehealth during the SARS-CoV-2 (COVID-19) pandemic. We studied surgeon personal factors associated with relative use of telehealth during the worldwide height of the pandemic.
Questions/Purposes: (1) Are there any personal factors/characteristics associated with use and utilization of telehealth? (2) What are surgeon's perspectives/ opinions with regard to use of telehealth for five common upper extremity conditions in terms of future prospects and viability?

Methods: Hand and upper extremity surgeons in the Science of Variation Group (SOVG) were invited to participate in a web-based survey. The first part of the survey focused on surgeon characteristics and work preferences. The second part focused on care strategies during the pandemic and utilization of telehealth. The final part of the survey addressed the care of five common upper extremity conditions during the pandemic.

Results: Ninety percent of surgeons used telehealth during the first few months of the pandemic, but only 20% of visits were virtual. A greater percentage of telehealth visits compared to office visits was independently associated with a policy of only seeing people with emergencies in person (RC: 0.64; CI 95%: 0.21 to 1.1; *P<0.01*). Surgeons found it difficult to reproduce most parts of the physical examination on video, but relatively easy to make a diagnosis, with both ratings associated with less belief that the physical exam is essential. Comfort in offering surgery by video visit was associated with having young children, preference for remote meetings, and less belief that the physical exam is essential.

Conclusion: Utilization of, and comfort with, telehealth is related to personal factors and preferences, acceptance of a more limited physical examination in particular. Utilization of early adopters and training to increase comfort with the probabilistic aspects of medicine could facilitate incorporation of telehealth into standard practice.

Level of evidence: N/a

Keywords: Handsurgery, Orthopaedic surgery, Telehealth, Telemedicine

Introduction

Telehealth is the utilization of telecommunications technology to provide care directly to patients at a distance (1). Telehealth has the potential to improve health by improving access to care and inspiring agency and self-care (2). The SARS-CoV-2 (COVID-19) pandemic led to wide use of telehealth: the vast majority of physicians report using it to some extent and many are considering making it a part of their practice going forward (3–5).

Nevertheless, both patients and clinicians have

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expressed reservations about telehealth, most relating to the quality of medical care, adequate relationships, and technical issues (6). Gauging surgeons' opinions about telehealth may help identify opportunities to improve the way we deliver care through telehealth. In addition, identifying diseases for which telehealth may be a viable method of definitive care, and identification of people that will benefit from in-person care can inform the redesign of healthcare strategies and increase the value of care (7). Previous research regarding telehealth has focused on clinical outcomes, satisfaction and cost-effectiveness.(12) We address factors associated with surgeon confidence in, and affinity with telehealth (8-11).

An international collaborative of hand surgeons completed a survey about personal factors, communication preferences, incorporation of telehealth into their practice during the COVID-19 pandemic, and comfort using telehealth. We tested the primary null hypothesis that there are no factors associated with percentage of telehealth visits (compared to office visits). Additionally, we tested the secondary null hypotheses that there are no factors associated with various logistics regarding telehealth (e.g. ease of diagnosis and performing a physical exam, thoughts on viability of telehealth for triage) and the impact of the pandemic on their practice.

Materials and Methods

Study Design and Setting

With approval from our Institutional Review Board, we invited hand and upper extremity surgeon members of the Science of Variation Group (SOVG) to participate in a web-based survey. SurveyMonkey (Palo Alto, CA, USA) was used to create a questionnaire gauging surgeons' preferences and habits regarding telehealth during the pandemic (Appendix 1). The survey consisted of three parts. The first set of questions assessing surgeon personality and work style. The second set of questions inquired about the impact of the pandemic on resource utilization (e.g. MRI, radiographs, and surgery). In the third set of questions, five common upper extremity conditions were used to gauge surgeon comfort with making each diagnosis and performing a physical exam, and the viability of incorporating telehealth going forward.

All surgeon members of the SOVG were invited to partake in this web-based experiment. The SOVG is an international collaborative of orthopedic, plastic, and general surgeons, participating in monthly surveys that study reliability and variation in care. There are no financial incentives other than group authorship and collective use of the research mechanisms. Since there is only a small subset that actively participates in surveys and because even active participants only respond to surveys within their own subspecialty, it is not feasible to calculate a meaningful response rate. SOVG studies are experiments done by survey. Something is either randomized or correlated. Because we measure relationships and influences, not rates, it is less important that the population of participants is representative of all surgeons that may treat a given condition. The key to a survey-based experiment is adequate variation within the surveyed participants. Given that we typically address areas of debate and variation in practice, there is usually wide variation in beliefs and choices amongst our participants. Given the size of the group and the variations in training and geography, it is likely that the breadth of opinion within the SOVG is representative and the breadth of opinion among hand surgeons in general, and is therefore adequate for survey-based experiments. The variation documented in prior SOVG studies supports that supposition(13–15). Furthermore, we believe the associations we document are interesting and likely to be identified in different populations, largely because they reflect human tendencies that are likely to apply across genders, specialties, practice sites, email work style, and willingness to participate in research.

We periodically make efforts to expand and diversify (and anyone reading this is welcome to join, please see the link in the Appendix) but most participants in SOVG are white, men, and academics from the United States or Europe. This is likely in part because we have largely recruited from our home countries and among our colleagues, in part because we work in English, but mostly because these are the people that respond to emails and are willing to give us 15 minutes of their time each month, partly because they support research and perhaps partly in friendship. This group may or may not represent the average hand surgeon in these regions.

The SOVG email list includes people that never participate and may include unmonitored accounts. There is a core group of people that participate regularly or periodically and that group can shift and evolve. For the 409 emails in the upper extremity subset of SOVG we looked at the last 5 studies and 119 of the 210 people (57%) that participated in at least one study, participated in the current study (Appendix 2). The demographics of the participants and non-participants are similar. People may choose not to participate in some surveys. For instance, some hand and wrist surgeons also treat shoulder and elbow problems and the converse is also true, but some surgeons only treat one region. Since we cannot know the nuances of each surgeon's expertise, we let them decide whether the survey is appropriate for them.

Surgeon characteristics

A total of 119 surgeons completed the survey [Table 1]. The majority of surgeons practice in the US (67%) and the vast majority used telehealth during the pandemic (90%), but most visits remained in-office (58-92%).

Questions

The first set of questions was designed to gauge general preferences and to collect surgeon characteristics. We asked participants about their preferred meeting type (remote or in person), contact style (phone calls or emails), workspace (home vs. office), type of conference (in-person vs self-directed or webinar), personality type (indicated on a Numeric Rating Scale [NRS], ranging from introverted to extroverted), whether they have small

children at home, how important they rate the hands-on (physical examination) part of a visit, and whether they enjoy their commute (NRS).

The next set of questions focused on work during the pandemic. Participants were asked whether they used telehealth, whether their in-person practice was limited to emergencies only, and their estimated percentage of in-office vs. telehealth visits. The final part of the survey addressed the care of five common upper extremity conditions: enthesopathy of the origin of the extensor carpi radialis brevis (ECRB; tennis elbow), trapeziometacarpal (TMC) arthrosis, carpal tunnel syndrome (CTS), trigger digit, and bumps (e.g. ganglion cysts). For each diagnosis, surgeons were asked about the viability of telehealth: the ease of making the diagnosis on video, the ease of reproducing the physical examination, the use of diagnostic tests, referrals to formal therapy, use of injections, and whether they felt comfortable offering surgery through telehealth. Surgeons were also asked whether--if they were not allowed to operate on these conditions for the next 6 months-- patients might adapt to their symptoms, whether patients would get better and decline surgery, and whether they anticipate a large backlog of surgical procedures.

Table 1. Surgeon characteristics

Variable	Number (%)
Total number of surgeons	119
Men	116 (98%)
Location of practice	
United States	79 (67%)
Europe	22 (19%)
Other	17 (14%)
Years in practice	
0-5	32 (28%)
6-10	26 (22%)
11-20	32 (28%)
21-30	26 (22%)
Supervising trainees	92 (79%)
Currently have young children	51 (43%)
Preference for remote meetings (vs. in-person)	15 (13%)
Preference for e-mail (vs. phone calls)	63 (53%)
Preference for working at home (vs. the office)	82 (69%)
Preference for webinars (vs. in-person conferences)	54 (45%)
Variable	**Mean (range)**
Self-reported personality (-50=introvert, 50=extrovert)	0 (-31 to 23)
Hands on physical exam is essential (-50=completely disagree, 50=completely agree)	35 (20 to 45)
Enjoyable commute (-50=dread it, 50=enjoy it)	1 (0 to 23)
During the COVID-19 pandemic...	
Using telemedicine	106 (90%)
Percentage of telemedicine consults (vs. in-office)	20% (8% to 42%)
In person visits only for urgent problems	24 (20%)

Continuous variables as median (interquartile range [IQR]); discrete variables as number (percentage). (-50 = minimal agreement, 0 = neutral, 50 = maximum agreement)

Statistical analyses

Continuous variables were reported as median (interquartile range) and categorical variables as numbers and percentages. In bivariate analysis, we sought factors associated with use of telehealth (yes or no), only seeing patients with emergencies (yes or no), and the percentage of telehealth visits. We also sought factors associated with the agreement statement that video visits are a viable method for triage in the future (yes or no), ease of reproducing the physical exam on video (-50 = very difficult to 50 = very easy), surgeon comfort making a diagnosis on video (-50 = very uncomfortable to 50 = very comfortable), comfort offering surgery based on a video visit alone (-50 = very uncomfortable to 50 = very comfortable), regularly using corticosteroids before the pandemic (% of patients that would receive an injection), and agreement of missing corticosteroids during the pandemic (-50 = completely disagree to 50 = completely agree). Finally, we sought factors associated with the effect of telehealth on the frequency of 1) surgery, 2) radiographs, and 3) MRI's. We accounted for the following independent variables: gender, location of practice, years in practice, subspecialty, supervising trainees, having young children, personality type (introverted vs extroverted), indicating the physical exam is essential, enjoying the commute, and surgeon preference for 1) remote meetings, 2) e-mail, 3) working from home, 4) webinars. For the primary null hypothesis, all variables with $P < 0.10$ were moved to multivariable negative binomial regression analysis. Regression coefficients (RC), 95% Confidence Intervals (95% CI), standard errors, and P values were reported. All P values below 0.05 were considered statistically significant.

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Results

Ninety percent of surgeons used telehealth during the pandemic, and use was associated with surgeons based in the US and fewer than 21 years in practice [Appendix 3]. Only 20% of visits were conducted via telehealth, and a greater percentage of telehealth visits was associated with only seeing patients with emergencies in person and less belief that a hands-on physical exam is essential in developing rapport [Appendix 3]. In multivariable analysis, a greater percentage of telehealth visits was independently associated with only seeing emergencies in person (RC: 0.64; CI 95%: 0.21 to 1.1; *P<0.01*) [Table 2].

Table 2. Bivariate analysis of factors associated with the use of telemedicine

Categorical variables	Percentage of telemedicine visits	*P value*	Using telemedicine		*P value*	Viability of video triage before office visit		*P value*
			Yes	No		Yes	No	
Gender		0.9			0.2			0.999
Men	20 (8-42)		104 (90%)	11 (9.6%)		71 (61%)	45 (39%)	
Women	19 (14-23)		1 (50%)	1 (50%)		1 (50%)	1 (50%)	
Location of practice		0.32			**0.031**			0.37
United States	20 (10-35)		74 (95%)	4 (5.1%)		46 (58%)	33 (42%)	
Europe	19 (5-50)		17 (77%)	5 (23%)		13 (59%)	9 (41%)	
Other	33 (14-50)		14 (82%)	3 (18%)		13 (76%)	4 (24%)	
Years in practice		0.45			**0.044**			0.068
0-5	21 (8.5-34)		28 (88%)	4 (12%)		15 (47%)	17 (53%)	
10-Jun	28 (10-54)		25 (96%)	1 (3.8%)		21 (81%)	5 (19%)	
20-Nov	20 (9-33)		31 (97%)	1 (3.1%)		20 (63%)	12 (37%)	
21-30	14 (5-40)		19 (76%)	6 (24%)		15 (58%)	11 (42%)	
Supervising trainees		0.49			0.27			0.24
Yes	20 (10-40)		83 (91%)	8 (8.8%)		59 (64%)	33 (36%)	
No	14 (6-50)		20 (83%)	4 (17%)		12 (50%)	12 (50%)	
Currently have young children		0.86			>0.99			**0.004**
Yes	21 (10-40)		46 (90%)	5 (9.8%)		39 (76%)	12 (24%)	
No	20 (6-50)		60 (90%)	7 (10%)		34 (50%)	34 (50%)	
Preference for remote meetings		0.5			0.36			0.999
Yes	23 (10-50)		15 (100%)	0 (0%)		9 (60%)	6 (40%)	
No	20 (7-42)		91 (88%)	12 (12%)		64 (62%)	40 (38%)	

Continuous variables as median (interquartile range [IQR]). Bold indicates statistical significance, $P < 0.05$. Comfort level: - 50 = uncomfortable, to 50 = comfortable. Difficulty: -50 = very difficult, to 50 = very easy

Table 2. Bivariate analysis of factors associated with the use of telemedicine

Categorical variables	Percentage of telemedicine visits	*P value*	Using telemedicine		*P value*	Viability of video triage before office visit		*P value*
			Yes	No		Yes	No	
Preference for e-mail		0.71			0.22			0.45
Yes	20 (7-40)		59 (94%)	4 (6.3%)		41 (65%)	22 (35%)	
No	20 (10-50)		47 (85%)	8 (15%)		32 (57%)	24 (43%)	
Preference for working at home		0.38			0.51			0.22
Yes	20 (8-36)		74 (91%)	7 (8.6%)		47 (57%)	35 (43%)	
No	20 (10-50)		32 (86%)	5 (14%)		26 (70%)	11 (30%)	
Preference for webinars		0.41			>0.99			0.71
Yes	20 (6-40)		48 (91%)	5 (9.4%)		32 (59%)	22 (41%)	
No	20 (10-50)		58 (89%)	7 (11%)		41 (63%)	24 (37%)	
Only seeing patients with emergencies		**0.001**			0.066			0.999

Table 2. Continued

Yes	46 (22-70)		19 (79%)	5 (21%)		15 (63%)	9 (37%)	
No	18 (7-33)		87 (93%)	7 (7.4%)		58 (61%)	37 (39%)	
Continuous variables	**Spearman rank correlation**	***P* value**	**Using telemedicine**			**Viability of video triage before office visit**		***P* value**
			Yes	**No**		**Yes**	**No**	
Extroverted personality	-0.017	0.86	50 (29-75)	46 (28-54)	0.31	50 (29-71)	51 (30-81)	0.3
Physical exam is essential	-0.3	**0.001**	82 (70-93)	92(84-100)	0.071	81 (69-90)	88(77-100)	**0.019**
Enjoyable commute	-0.017	0.86	51 (50-73)	55 (50-70)	0.52	53 (50-70)	50 (50-75)	0.52

Continuous variables as median (interquartile range [IQR]). **Bold** indicates statistical significance, $P < 0.05$. Comfort level: - 50 = uncomfortable, to 50 = comfortable. Difficulty: -50 = very difficult, to 50 = very easy

Table 2. Continued

Categorical variables	**Surgeon comfort making a diagnosis on video**	***P value***	**Comfort offering surgery based on a video visit alone**	***P value***	**Ease of reproducing the physical exam on video**	***P value***
Gender		0.087		0.72		0.11
Men	13 (-1 to 27)		-20 (-39 to 6)		-8 ± 19	
Women	-13 (-22 to 3)		-12 (-21 to -3)		-29 ± 2.1	
Location of practice		0.059		0.87		0.053
United States	16 (2 to 29)		-29 (-40 to 7)		-6 ± 19	
Europe	3 (-19 to 19)		-20 (-34 to 11)		-17 ± 19	
Other	9 (-3 to 21)		-23 (-39 to -3)		-9 ± 14	
Years in practice		**0.019**		0.59		0.069
0-5	7 (-4 to 15)		-17 (-38 to 9)		-13 ± 19	
6-10	17 (3 to 29)		-18 (-33 to 2)		-4 ± 14	
11-20	19 (10 to 30)		-26 (-48 to 2)		-3 ± 20	
21-30	6 (-13 to 24)		-23 (-48 to 9)		-12 ± 20	
Supervising trainees		0.8		0.99		0.73
Yes	12 (-2 to 27)		-20 (-40 to 6)		-8 ± 19	
No	16 (-1 to 26)		-29 (-34 to 2)		-9 ± 19	
Currently have young children		0.17		**0.021**		0.091
Yes	13 (2 to 29)		-23 (-31 to 11)		-5 ± 17	
No	12 (-7 to 24)		-27 (-43 to -1)		-21 ± 20	
Preference for remote meetings		0.067		**0.027**		0.28
Yes	20 (11 to 29)		5 (-23 to 19)		-3 ± 14	
No	11 (-3 to 25)		-21 (-41 to 3)		-9 ± 19	

Continuous variables as median (interquartile range [IQR]). Bold indicates statistical significance, P < 0.05. Comfort level: - 50 = uncomfortable, to 50 = comfortable. Difficulty: -50 = very difficult, to 50 = very easy

Table 2. Bivariate analysis of factors associated with the use of telemedicine

Categorical variables	*P value*	Surgeon comfort making a diagnosis on video	*P value*	Comfort offering surgery based on a video visit alone	*P value*	Ease of reproducing the physical exam on video	*P value*
Preference for e-mail	0.45		0.11		0.35		0.31
Yes		17 (2 to 28)		-15 (-38 to 9)		-7 ± 18	
No		10 (-6 to 25)		-21 (-40 to -3)		-10 ± 20	
Preference for working at home	0.22		0.89		0.32		0.21
Yes		14 (-2 to 25)		-20 (-42 to 5)		-10 ± 18	
No		10 (-3 to 28)		-13 (-35 to 6)		-5 ± 20	
Preference for webinars	0.71		0.75		0.24		0.91
Yes		15 (-3 to 29)		-14 (-39 to 11)		-8 ± 21	
No		11 (-2 to 24)		-11 (-39 to 0)		-8 ± 17	
Only seeing patients with emergencies	0.999		0.065		0.76		0.24
Yes		8 (-9 to 17)		-18 (-45 to 11)		-12 ± 19	
No		15 (1 to 29)		-20 (-38 to 5)		-7 ± 19	
Continuous variables	***P* value**	**Spearman rank correlation**	***P value***	**Spearman rank correlation**	***P value***	**Spearman rank correlation**	***P value***
Extroverted personality	0.3	0.032	0.73	-0.0001	0.999	-0.039	0.68
Physical exam is essential	**0.019**	-0.39	**<0.001**	-0.48	**<0.001**	-0.29	**0.001**
Enjoyable commute	0.52	0.081	0.38	<0.0001	0.999	0.13	0.17

Continuous variables as median (interquartile range [IQR]). **Bold** indicates statistical significance, $P < 0.05$. Comfort level: - 50 = uncomfortable, to 50 = comfortable. Difficulty: -50 = very difficult, to 50 = very easy

Most surgeons found it difficult to reproduce most parts of the physical exam on video, with some variation by diagnosis, but they felt relatively confident making the diagnosis (Appendix 4). The condition deemed easiest to diagnose via video was a trigger finger (median score of 33 on a scale from -50 = very difficult to 50 = very easy) and the most difficult were bumps and trapeziometacarpal arthrosis (median score of 5) [Appendix 4]. More than 75% of surgeons indicated that a video consultation prior to an office visit is a viable option in the future for each diagnosis [Appendix 4].

Greater agreement that a video triage is a viable approach prior to an in-person appointment was associated with surgeons who have young children and less belief that a hands-on physical exam is essential [Appendix 3]. Greater ease in reproducing the physical exam on video was associated with less belief that the hands-on physical exam is essential. [Appendix 3]. Greater comfort making a diagnosis on video was associated with lower belief that the physical exam is essential and 6-20 years in practice [Appendix 3].

When using telehealth, surgeons used imaging at a

Table 3. Multivariable negative binomial regression analysis of factors associated with the percentage of telemedicine visits (vs. in-office visits)

Variables	Regression coefficient (95% Confidence Interval)	Standard error	*P value*	Pseudo R^2
				0.011
Only seeing patients with emergencies				
No	*reference value*			
Yes	0.64 (0.21 to 1.1)	0.22	**0.004**	
Physical exam is essential	-0.0096 (-0.020 to 0.00074)	0.0053	0.069	

Bold indicates statistical significance, *P < 0.05*.

Table 4. Orthopedic hand and upper limb care via telemedicine for five common hand illnesses

	Lateral epicondylitis	Trigger digit	Carpal tunnel syndrome	TMC arthritis	Hand or wrist bump
Variable (relative use -50 = much less to 50 = much more)					
What was the relative use of the following during the pandemic					
-Surgery	-16 (-35 to 0)	-9 (-28 to 0)	-13 (-38 to 0)	-22(-42 to -4)	-16 (-34 to 0)
-Radiographs	-4 (-21 to 0)			-6 (-24 to 0)	
-MRI	0 (-14 to 1)			-1 (-25 to 0)	
Variable	**Count (%)**	**Count (%)**	**Count (%)**	**Count (%)**	**Count (%)**
Viability of video triage before office visit (y/n)	97 (84%)	91 (81%)	88 (77%)	85 (76%)	83 (75%)
If surgeons are not allowed to operate on this condition for six months:					
-Patients will adapt to their conditions (y/n)	78 (67%)	22 (19%)	16 (14%)	33 (29%)	49 (44%)
-Patients will get better and not need surgery (y/n)	66 (59%)	32 (28%)	20 (18%)	48 (43%)	56 (50%)
-There will be a backlog of procedures (y/n)	42 (36%)	98 (87%)	101 (89%)	77 (69%)	57 (51%)
Regularly using corticosteroid injection before the pandemic (y/n)	44 (38%)	105 (93%)	49 (43%)	74 (66%)	
Do you teach exercises, send a hand-out, or direct people to online resources? (y/n)	98 (84%)			82 (73%)	
Variable	**Mean % (range)**	**Mean % (range)**	**Mean % (range)**	**Mean % (range)**	**Mean % (range)**
Online resources, options and handouts are sufficient? (Agree/completely agree)	56% (35% to 76%)			50% (27% to 67%)	

Continuous variables as median (interquartile range [IQR]); discrete variables as number (percentage). ECRB= Extensor Carpi Radialis Brevis [muscle]; EMG= Electromyography; TMC= Trapeziometacarpal; MCP= Metacarpal phalangeal [joint]. Difficulty score: -50 = very difficult to 0 = neutral, to 50 = very easy. Agreement score: -50 = completely disagree, to 0 = neutral, to 50 = completely agree. Relative use: -50 = much less, to 0 = same, to 50 = much more.

Table 4. continued: Orthopedic hand and upper limb care via telemedicine for five common hand illnesses

	Lateral epicondylitis	Trigger digit	Carpal tunnel syndrome	TMC arthritis	Hand or wrist bump
Variable Agreement score (-50 = completely disagree to 50 = completely agree)	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**
Easy to diagnose in a video visit	20 (0 to 32)	33 (18 to 45)	17 (-7 to 30)	5 (-10 to 27)	5 (-12 to 27)
Missing steroid injection during pandemic	-17 (-48 to 13)	30 (12 to 43)	-14 (-43 to 13)	18 (-22 to 34)	
Missing formal Physical therapy referral during pandemic	0 (-28 to 28)				
Missing EMG to get to the diagnosis			0 (-19 to 19)		
Miss aspiration during pandemic					-20 (-40 to 15)
Comfort offering surgery based on a video visit alone	-30 (-49 to -2)	0 (-35 to 35)	-21 (-48 to 20)	-28 (-48 to -6)	-19 (-45 to 13)
Difficulty in reproducing the physical exam (- 50 = very difficult, 50 = very easy)					
-Tenderness at ECRB origin	1 (-20 to 27)				
-Testing for pain with: resisted wrist extension, pain with maximum wrist flexion	0 (-24 to 20)				
-Palpation of the A1-pulley nodule		-21 (-43 to 13)			

Table 4. Continued			
-Visualization of uneven digit movement	27 (13 to 40)		
-Sensory examination		-26 (-42 to -9)	
-Tinel test		-22 (-42 to -2)	
-Phalen test		15 (-13 to 34)	
-Palmar abduction strength		-29 (-43 to -14)	
-MCP hyperextension			16 (-8 to 32)
-Grind test			-26 (-43 to -10)
-Characterizing the bump			-14 (-33 to 13)

Continuous variables as median (interquartile range [IQR]); discrete variables as number (percentage). ECRB= Extensor Carpi Radialis Brevis [muscle]; EMG= Electromyography; TMC= Trapeziometacarpal; MCP= Metacarpal phalangeal [joint]. Difficulty score: -50 = very difficult to 0 = neutral, to 50 = very easy. Agreement score: -50 = completely disagree, to 0 = neutral, to 50 = completely agree. Relative use: -50 = much less, to 0 = same, to 50 = much more.

Table 5. Bivariate analysis of factors associated with practice characteristics during the COVID-19 pandemic

Categorical variables	Only seeing patients with emergencies		*P value*	Regularly using corticosteroids before pandemic (Relative use)	*P value*	Missing steroid injection during pandemic (Agreement)	*P value*
	Yes	No					
Gender			>0.999		0.32		0.47
Men	23 (20%)	93 (80%)		7 ± 27		-2 ± 23	
Women	0 (0%)	2 (100%)		-12 ± 53		-13± 35	
Location of practice			0.2		**0.008**		0.05
United States	12 (15%)	67 (85%)		12 ± 28		0 ± 24	
Europe	7 (32%)	15 (68%)		-7 ± 23		-12 ± 21	
Other	4 (24%)	13 (76%)		0 ± 25		1 ± 17	
Years in practice			0.33		0.49		0.88
0-5	7 (22%)	25 (78%)		1 ± 25		-3 ± 21	
6-10	4 (15%)	22 (85%)		6 ± 22		0 ± 18	
20-Nov	4 (13%)	28 (87%)		12 ± 32		-3 ± 26	
21-30	8 (31%)	18 (69%)		10 ± 30		1 ± 25	
Supervising trainees			**0.041**		0.52		0.28
Yes	22 (24%)	70 (76%)		6 ± 29		3 ± 17	
No	1 (4.2%)	23 (96%)		10 ± 21		-2 ± 24	
Currently have young children			0.82		0.46		0.99
Yes	11 (22%)	40 (78%)		9 ± 28		-2 ± 21	
No	13 (19%)	55 (81%)		6 ± 28		-2 ± 24	
Preference for remote meetings			0.3		0.24		0.25
Yes	1 (6.7%)	14 (93%)		15 ± 18		5 ± 14	
No	23 (22%)	81 (78%)		6 ± 29		-3 ± 24	

Continuous variables as mean ± standard deviation or median (interquartile range [IQR]) **Bold** indicates statistical significance, $P < 0.05$**.** Agreement score: -50 = completely disagree, to 0 = neutral, to 50 = completely agree. Frequency/Relative use: -50 = much less, to 0 = same, to 50 = much more

Table 5. Continued

Categorical variables	Only seeing patients with emergencies		*P value*	Regularly using corticosteroids before pandemic (Relative use)	*P value*	Missing steroid injection during pandemic (Agreement)	*P value*
	Yes	No					
Preference for e-mail			0.5		0.32		0.9
Yes	11 (17%)	52 (83%)		10 ± 24		-2 ± 19	
No	13 (23%)	43 (77%)		4 ± 31		-2 ± 26	
Preference for working at home			0.09		0.13		0.12
Yes	13 (16%)	69 (84%)		5 ± 28		-4 ± 24	
No	11 (30%)	26 (70%)		13 ± 25		3 ± 19	
Preference for webinars			0.25		0.94		0.47
Yes	8 (15%)	46 (85%)		7 ± 27		-3 ± 21	
No	16 (25%)	49 (75%)		7 ± 28		0 ± 24	
Only seeing patients with emergencies			.		0.22		0.34
Yes	.	.		1 ± 28		-6 ± 25	
No	.	.		9 ± 27		-1 ± 22	
Continuous variables	**Only seeing patients with emergencies**		***P value***	**Regularly using corticosteroids before pandemic**	***P value***	**Missing corticosteroids during pandemic**	***P value***
	Yes	**No**					
Extroverted personality	41 (25-64)	51 (30-75)	0.16	0.16	0.08	0.14	0.13
Physical exam is essential	84 (73-95)	86 (70-95)	0.95	0.017	0.86	0.088	0.34
Enjoyable commute	51 (41-64)	53 (50-76)	0.25	0.16	0.075	0.27	**0.003**

Continuous variables as mean ± standard deviation or median (interquartile range [IQR]) **Bold** indicates statistical significance, $P < 0.05$. Agreement score: -50 = completely disagree, to 0 = neutral, to 50 = completely agree. Frequency/Relative use: -50 = much less, to 0 = same, to 50 = much more

Table 5. continued: Bivariate analysis of factors associated with practice characteristics during the COVID-19 pandemic

Categorical variables	Frequency of Radiographs telemedicine	*P value*	Frequency of MRI telemedicine	*P value*	Frequency of Surgery telemedicine	*P value*
Gender		0.68		0.88		0.56
Men	-10 (-25 to 0)		-3 (-21 to 0)		-9 (-22 to 5)	
Women	-16 (-32 to 0)		-15 (-30 to 1)		-5 (-25 to 16)	
Location of practice		**0.002**		0.89		0.42
United States	-16 (-26 to 0)		-1 (-21 to 0)		-13 (-37 to 15)	
Europe	-7 (-14 to 0)		-12 (-22 to 0)		-9 (-32 to 4)	
Other	0 (-1 to 2)		-2 (-20 to 0)		-4 (-21 to 10)	
Years in practice		0.6		0.9		0.54
0-5	-13 (-28 to -1)		-10(-19 to 0)		-15 (-32 to 7)	
6-10	-9 (-22 to 0)		-5 (-21 to 1)		-5 (-19 to 6)	
11-20	-10 (-25 to 0)		-6 (-22 to 0)		-9(-43 to 1)	

Table 5. Continued						
21-30	-24 (-22 to 0)		0 (-24 to 0)		-3 (-37 to 12)	
Supervising trainees		0.89		0.75		0.97
Yes	-7 (-20 to 0)		-3 (-22 to 0)		-9 (-32 to 6)	
No	-12 (-25 to 0)		-9 (-23 to 0)		-13 (-28 to 5)	
Currently have young children		0.85		0.84		0.23
Yes	-12 (-25 to 0)		-4 (-19 to 0)		-7 (-25 to 9)	
No	-8 (-24 to 0)		-2 (-22 to 0)		-13 (-35 to 3)	
Preference for remote meetings		0.74		**0.023**		**0.014**
Yes	-14 (-20 to 0)		0 (0 to 1)		6 (-13 to 12)	
No	-9 (-25 to 0)		-8 (-22 to 0)		-13 (-34 to 5)	
Preference for e-mail		0.96		0.13		0.4
Yes	-9 (-21 to 0)		0 (-14 to 0)		-6 (-32 to 9)	
No	-10 (-25 to 0)		-12 (-25 to 0)		-10 (-36 to 4)	

Continuous variables as mean ± standard deviation or median (interquartile range [IQR]) **Bold** indicates statistical significance, $P < 0.05$. Agreement score: -50 = completely disagree, to 0 = neutral, to 50 = completely agree. Frequency/Relative use: -50 = much less, to 0 = same, to 50 = much more

similar rate but offered surgery at a lower rate. The likelihood of ordering radiographs through telehealth was greater among surgeons based outside of the US. Likelihood of ordering MRI's through telehealth was greater for surgeons who preferred remote to in-person meetings [Appendix 5].

Greater corticosteroid injection use before the pandemic was associated with surgeons based in the US [Appendix 5]. Surgeons were relatively neutral about not being able to give steroid injections during the pandemic—perhaps because many still offered in-person appointments—and only "enjoyable commute to work" was associated with missing steroid injections.

Surgeons were most likely to feel comfortable offering surgery based on video alone if they have young children, prefer remote meetings, and have less belief that the

Table 5. continued: Bivariate analysis of factors associated with practice characteristics during the COVID-19 pandemic.

Categorical variables	**Frequency of Radiographs telemedicine**	***P value***	**Frequency of MRI telemedicine**	***P value***	**Frequency of Surgery telemedicine**	***P value***
Preference for working at home		0.47		0.38		0.98
Yes	-9 (-25 to 0)		-3 (-22 to 0)		-8 (-32 to 9)	
No	-10 (-22 to 0)		-1 (-18 to 1)		-11 (-29 to 4)	
Preference for webinars		0.78		0.94		0.08
Yes	-8 (-25 to 0)		0 (-20 to 0)		-3 (-25 to 12)	
No	-10 (-22 to 0)		-7(-22 to 0)		-11 (-36 to 2)	
Only seeing patients with emergencies		0.33		0.27		0.51
Yes	-12 (-29 to -2)		-10 (-25 to 0)		-6 (35 to 2)	
No	-9 (-22 to 0)		0 (-20 to 0)		-11 (-29 to 9)	
Continuous variables	**Spearman rank correlation**	***P value***	**Spearman rank correlation**	***P value***	**Spearman rank correlation**	***P value***
Extroverted personality	0.1	0.3	0.04	0.64	0.03	0.77
Physical exam is essential	0.038	0.68	-0.0096	0.92	-0.4	**<0.001**
Enjoyable commute	0.093	0.32	-0.14	0.12	-0.0098	0.92

Continuous variables as mean ± standard deviation or median (interquartile range [IQR]) **Bold** indicates statistical significance, $P < 0.05$. Agreement score: -50 = completely disagree, to 0 = neutral, to 50 = completely agree. Frequency/Relative use: -50 = much less, to 0 = same, to 50 = much more

physical exam is essential [Appendix 3]. The majority felt that the inability to operate on these common hand and upper extremity conditions for the next 6 months would result in a surgery backlog, with the exception of enthesopathy of the ECRB origin (36% agreed there would be a backlog) [Appendix 4].

Discussion

Since the start of the SARS-CoV-2 (COVID-19) pandemic, more orthopedic surgeons have used telehealth as part of their practice and will consider making it part of their routine going forward. The purpose of this study was to gauge surgeon opinions about telehealth and help identify opportunities for improving the way we deliver care through telehealth. On average, surgeons were comfortable with making a diagnosis on video and believed video evaluation to be a viable alternative to an office visit in the future. Variation in enthusiasm and comfort towards telehealth was determined by personal factors.

This study has several limitations to consider. First, most participants practice in Europe and the US, which might limit generalizability. Second, the participants were nearly all men, which we have had trouble remedying. If you are a woman surgeon reading this please contact us—we want all surgeons to participate and we crave diversity. Thirdly, we spent some time working on the wording of the items, but some may still have elements that are unclear or somewhat ambiguous, particularly for non-native English speakers. Fourthly, the survey occurred at the relative height of adjustments to the pandemic and feelings and utilization towards telehealth may differ now and in the future. Finally, our study used a large number of variables and comparisons, and since it was relatively exploratory, we made no statistical correction for multiple comparisons. It is notable that very few associations were identified and some, such as preference for remote meetings, are almost certainly spurious given the small number of people who had this preference.

The observation that use of, and comfort with telehealth was most associated with personal factors, is consistent with other lines of evidence demonstrating the influence of surgeon biases and preferences on variations in care (13, 16). The observation that attitudes towards the role of the physical examination in specialty care influence attitudes towards virtual care provides a good point of discussion. There is evidence that for many common conditions the interview alone can establish a high probability of a certain diagnosis and that the physical examination, and sometimes even medical diagnostic imaging, plays a mostly confirmatory role (17, 18). It may be that surgeons that are more comfortable with the probabilistic nature of diagnosis may feel more comfortable with a relatively high probability based on anamnesis and therefore less uncomfortable foregoing a largely confirmatory physical examination or having a more limited, video-based examination. One notable association that seems to reflect comfort with uncertainty is the correlation between comfort foregoing physical examination and comfort offering surgery via telehealth.

The data on the potential for accommodation or resolution of the problem, and the probability of a backlog suggests notable variation in the surgeon conceptions of these diseases. The confidence for resolution and no backlog was highest for enthesopathy of the ECRB origin, but by no means universal. Moreover, the confidence was relatively low for trapeziometacarpal arthrosis, while evidence supports considering this as a universal, and generally well-adapted disease (19–22). It would be interesting to study the percentage of people forced to delay surgery due to the pandemic that later decided to forego it altogether.

It is notable that surgeons, on average, miss the hands-on physical examination part of the visit when using telehealth and find it difficult to reproduce via video, but feel comfortable with video diagnosis of 5 common upper limb conditions. With more experience treating common upper extremity conditions, surgeon comfort is likely to continue increasing. Surgeons may develop and improve techniques for video examination with continued use and practice, and also get more comfortable with the probabilistic nature of diagnosis and relying on anamnesis.

Most surgeons see a future for telehealth, at least as a first step in triage before an office visit. This might contribute to evolutions in care strategies to incorporate greater use of telehealth and also leaves us better prepared for care during a pandemic.

In conclusion, despite differences in preference and comfort, most surgeons agreed on the viability of telehealth in the future for common hand conditions. We interpret our data as indicating that relative comfort with the probabilistic nature of medical care is associated with relatively comfort with telehealth. It may be that specific surgeons in a practice can be designated to provide telehealth according to their comfort and affinity with this new visit type. Furthermore, like all other skills, training for telehealth can be informed by the observation that comfort with uncertainty and probabilistic thinking may be important skills for clinicians to develop.

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Appendix 1.

SOVG COVID Study Telemedicine Survey: upper extremity surgeons

General Questions:
(dichotomous)

Are you someone who prefers to meet in person rather than remote (phone, email, video)?
In person meetings/ Remote

Are you someone who prefers phone calls or are you comfortable communicating via email?
Phone calls/ E-mails

Can you work at home or do you need to work in the office to avoid distractions?
I can work from home/ I need/prefer the office

Do you have small children at home?
Yes/ No

Do you prefer in-person conferences to more self-directed learning or webinars?
In-person conferences / self-directed or webinar

(sliders)

Are you more of an introvert or extrovert?
Introvert/ Extrovert

The hands-on part of a visit (physical examination) is an essential part of developing rapport (Completely agree, agree, neutral, disagree, completely disagree)

Do you enjoy your commute to and from work or dread it?
I enjoy it/ I don't mind it/ I dread it

During the pandemic:
(dichotomous)
Are you using telemedicine?
Yes/ No

Do you still see patients with common musculoskeletal problems in the office or only emergencies?
I still see common problems/ I only see emergencies

Does this include fractures? (dichotomous)
Yes/ No

(Sliders)
What percentage is in-office vs. video?
% in office visit/ % video

Specific Scenarios:
Category 1: Self-limiting enthesopathy and tendinopathy (lateral elbow enthesopathy [tennis elbow], medial elbow enthesopathy, de Quervain tendinopathy)

Lateral elbow enthesopathy
It is easy to make the diagnosis on video: (0=impossible 100=with great ease) (slider)

What parts of the exam do you find difficult to reproduce via video (check list)? (all sliders)
Tenderness at ECRB origin
(easy, fairly easy, same, slightly harder, very hard)

Testing for pain with: resisted wrist extension, pain with maximum wrist flexion
(easy, fairly easy, same, slightly harder, very hard).

Appendix 1. Continued

Did you regularly give steroid injections for this condition? Mark the percentage of your patients that would have a steroid injection: (0-100%)

I miss being able to do a steroid injection (slider)
(Completely agree, agree, neutral, disagree, completely disagree)

I miss the lack of in-person formal therapy to refer the patient to (slider)
(Completely agree, agree, neutral, disagree, completely disagree)

Do you teach exercises, send a hand-out, or direct people to online resources?
(yes-no) (dichotomous)
These options are good enough (slider)
(if yes= Completely agree, agree, same, disagree, completely disagree)

Do you order x-rays differently? (all slider)
(much less, slightly less, same, slightly more, much more)

Do you order MRI differently?
(much less, slightly less, same, slightly more, much more)

I feel comfortable offering surgery without an in person visit (Completely agree, agree, disagree, completely disagree)

Do you offer surgery differently through telemed? (slider)
(much less, slightly less, same, slightly more, much more)

If you are not allowed to operate on this condition for the next 6 months, do you think: (all dichotomous)

Many people will get better and decline?
Yes-no

Many people will not get better, but they will adapt and no longer be interested?
Yes-no

There will be a large back-log of procedures?
Yes-no

Is a video visit before an office visit a viable option in the future for this condition? (dichotomous)
(Yes, no)

Examination insertions for other category 1 diseases:
de Quervain tendinopathy

What parts of the exam do you find difficult to reproduce via video (check list)? (all sliders)
Finkelstein
(easy, fairly easy, same, slightly harder, very hard)

examination and palpation of 1st dorsal compartment
(easy, fairly easy, same, slightly harder, very hard)

Medial elbow enthesopathy

What parts of the exam do you find difficult to reproduce via video (check list)? (all sliders)
Tenderness at the flexor-pronator origin
(easy, fairly easy, same, slightly harder, very hard)

Testing for pain with: resisted wrist flexion, pain with maximum wrist extension
(easy, fairly easy, same, slightly harder, very hard).

Category 2 (degenerative) = age-appropriate and generally well adapted
(rotator cuff tendinopathy, TMC arthrosis)

Appendix 1. Continued

Specific disease: Rotator cuff tendinopathy

Is it easy to make the diagnosis on video? (slider)
0-100 (0=impossible 100=with great ease)

What parts of the exam do you find difficult to reproduce on video (sliders)?

Resisted external rotation in neutral with arms at side
(easy, fairly easy, same, slightly harder, very hard)

external rotation lag in the same position
(easy, fairly easy, same, slightly harder, very hard)

lift off test
(easy, fairly easy, same, slightly harder, very hard).

Did you regularly give steroid injections for this condition? Mark the percentage of your patients that would have a steroid injection:
(0-100%)

I miss being able to do a steroid injection (slider):
(Completely agree, agree, neutral, disagree, completely disagree)

I miss the lack of in-person formal therapy to refer the patient to (slider)?
(Completely agree, agree, neutral, disagree, completely disagree)

Do you teach exercises, send a hand-out, or direct people to online resources?
(yes-no) (dichotomous)
These options are good enough
(if yes= Completely agree, agree, neutral, disagree, completely disagree)

Do you order x-rays differently? (all sliders)
(much less, slightly less, same, slightly more, much more)

Do you order MRI differently?
(much less, slightly less, same, slightly more, much more)

I feel comfortable offering surgery without an in person visit (Completely agree, agree, disagree, completely disagree)

Do you offer surgery differently through telemed? (slider)
(much less, slightly less, same, slightly more, much more)

If you are not allowed to operate on this condition for the next 6 months, do you think: (all dichotomous)

Many people will get better and decline?
Yes-no

Many people will not get better, but they will adapt and no longer be interested?
Yes-no

There will be a large back-log of procedures?
Yes-no

Is a video visit before an office visit a viable option in the future for these conditions?
Rotator cuff:
yes/no

Specific Disease: TMC arthritis

Grind-test
(easy, fairly easy, same, slightly harder, very hard),

Appendix 1. Continued

evaluation of MP hyperextension
(easy, fairly easy, same, slightly harder, very hard)

Scenario category 3 (carpal tunnel and cubital tunnel syndrome) = slowly progressive and causes nerve damage without surgery.

Specific Disease: CTS

Is it easy to make the diagnosis on video?
of 0-100 (0=impossible 100=with great ease)

What parts of the exam do you find difficult to reproduce on video (check list)?
CTS:
Sensory examination
(easy, fairly easy, same, slightly harder, very hard)

Tinel test
(easy, fairly easy, same, slightly harder, very hard)

Phalen test
(easy, fairly easy, same, slightly harder, very hard)

Palmar abduction strength
(easy, fairly easy, same, slightly harder, very hard)

I miss not being able to do an EMG to get to the diagnoses (all sliders)
(Completely agree, agree, neutral, disagree, completely disagree)

Did you regularly give steroid injections for this condition? Mark the percentage of your patients that would have a steroid injection: (0-100%)

I miss being able to do a steroid injection
(Completely agree, agree, neutral, disagree, completely disagree)

I feel comfortable offering surgery without an in person visit or EMG
(Completely agree, agree, neutral, disagree, completely disagree)

Do you offer surgery differently through telemed? (slider)
(much less, slightly less, same, slightly more, much more)

If you are not allowed to operate on this condition for the next 6 months, do you think: (all dichotomous)

Many people will get better and decline?
Yes-no

Many people will not get better, but they will adapt and no longer be interested?
Yes-no

There will be a large back-log of procedures?
Yes-no

Is a video visit before an office visit a viable option in the future for these conditions?
Yes/No

Specific Disease: Cubital tunnel syndrome:
Tinel test
(easy, fairly easy, same, slightly harder, very hard)

Elbow flexion test
(easy, fairly easy, same, slightly harder, very hard).

Appendix 1. Continued

Scenario category 4: (trigger digit) = annoying, can be long-standing, easily fixed with surgery, sometimes cured with injection.

Specific disease Trigger finger:

Is it easy to make the diagnosis on video? Slider 0-100 (0=impossible 10=with great ease)

What part of the exam do you find hardest to reproduce on video (check list)?

Palpation of: A1-pulley nodule
(easy, fairly easy, same, slightly harder, very hard)

Visualization of uneven digit movement
(easy, fairly easy, same, slightly harder, very hard)

Did you regularly give steroid injections for this condition? Mark the percentage of your patients that would have a steroid injection: (0-100%)

I miss being able to do a steroid injection (sliders)
(Completely agree, agree, neutral, disagree, completely disagree)

I feel comfortable offering surgery without an in person visit (Completely agree, agree, disagree, completely disagree)

Do you offer surgery differently through telemed? (slider)
(much less, slightly less, same, slightly more, much more)

If you are not allowed to operate on this condition for the next 6 months, do you think: (all dichotomous)

Many people will get better and decline?
Yes-no

Many people will not get better, but they will adapt and no longer be interested?
Yes-no

There will be a large back-log of procedures?
Yes-no

Is a video visit before an office visit a viable option in the future for these conditions?
Yes/no

Scenario category 5: Bumps

Common bumps (Ganglion cysts, giant cell tumor of tendon sheath)

Is it easy to make the diagnosis on video? of 0-100 (0=impossible 100=with great ease)

It is easy to make the diagnosis on video: (0=impossible 100=with great ease) (slider)

What part of the exam do you find hardest to reproduce on video (check list)?

Characterizing the bump
(easy, fairly easy, same, slightly harder, very hard)

I miss being able to do an aspiration
(Completely agree, agree, same, disagree, completely disagree)

I feel comfortable offering surgery without an in person visit
(Completely agree, agree, disagree, completely disagree)

Do you offer surgery differently through telemed than I would in person
(Completely agree, agree, disagree, completely disagree)

Appendix 1. Continued

If you are not allowed to operate on this condition for the next 6 months, do you think: (all dichotomous)

Many people will get better and decline?
Yes-no

Many people will not get better, but they will adapt and no longer be interested?
Yes-no

There will be a large back-log of procedures?
Yes-no

Is a video visit before an office visit a viable option in the future for these conditions?
Yes/no

Appendix 2. Characteristics of current participants, nonresponders, past participants, and never responders.

Variables	Current participants	Nonresponders†	Past participants‡	Never responders
N	119	290	106*	199
Men	116 (98%)	249 (89%)	173 (89%)	174 (90%)
Location of practice				
United States	79 (67%)	189 (67%)	127 (65%)	132 (68%)
Europe	22 (19%)	50 (18%)	37 (19%)	34 (18%)
Other	17 (14%)	42 (15%)	30 (15%)	28 (14%)
Years in practice				
0-5	32 (28%)	88 (31%)	62 (32%)	54 (28%)
6-10	26 (22%)	69 (25%)	44 (23%)	51 (26%)
11-20	32 (28%)	89 (32%)	56 (29%)	64 (33%)
21-30	26 (22%)	35 (12%)	32 (16%)	25 (13%)
Subspecialty				
Hand and/or wrist	87 (75%)	195 (69%)	143 (74%)	132 (68%)
Shoulder and elbow	24 (21%)	75 (27%)	42 (22%)	57 (29%)
Trauma	1 (0.86%)	3 (1.1%)	2 (1.0%)	1 (0.52%)
Other	4 (3.5%)	8 (2.9%)	7 (3.6%)	4 (2.1%)
Supervising trainees	92 (79%)	213 (76%)	154 (79%)	146 (75%)

Variables reported as number (percentage). * Mean. Range= 102 to 113. †All surgeons in the database who were e-mailed an invitation (n=409) and did not respond to the current survey. Data were missing for 9 participants.
‡ Participants who completed one or more surveys from 5 previous surveys that were sent to the upper extremity division of the Science of Variation Group. Data were missing for 10 participants.

Link to join/register for SOVG: https://www.surveymonkey.com/r/XD7FMN5