

Telemedicine in the Evaluation and Management of Neurosurgical Spine Patients

Questionnaire Assessment of 346 Consecutive Patients

Alexander C.M. Greven, BS, Beau M. McGinley, BS, Ndeye F. Guisse, BS, Lynessa J. McGee, BS, Sarah Pirkle, BS, James G. Malcolm, MD, PhD, Gerald E. Rodts, MD, Daniel Refai, MD, and Matthew F. Gary, MD

Study Design. Retrospective questionnaire study of all patients seen via telemedicine during the COVID-19 pandemic at a large academic institution.

Objective. This aim of this study was to compare patient satisfaction of telemedicine clinic to in-person visits; to evaluate the preference for telemedicine to in-person visits; to assess patients' willingness to proceed with major surgery and/or a minor procedure based on a telemedicine visit alone.

Summary of Background Data. One study showed promising utility of mobile health applications for spine patients. No studies have investigated telemedicine in the evaluation and management of spine patients.

Methods. An 11-part questionnaire was developed to assess the attitudes toward telemedicine for all patients seen within a 7-week period during the COVID-19 crisis. Patients were called by phone to participate in the survey. χ^2 and the Wilcoxon Rank-Sum Test were performed to determine significance.

Results. Ninety-five percent were "satisfied" or "very satisfied" with their telemedicine visit, with 62% stating it was "the same" or "better" than previous in-person appointments. Patients saved a median of 105 minutes by using telemedicine compared to in-person visits. Fifty-two percent of patients have to take off work for in-person visits, compared to 7% for telemedicine. Thirty-seven percent preferred telemedicine to in-person visits. Patients who preferred telemedicine had significantly longer patient-reported in-person visit times (score mean of 171) compared to patients who preferred in-person visits (score mean of 137, $P=0.0007$). Thirty-seven percent of patients would proceed with

surgery and 73% would proceed with a minor procedure based on a telemedicine visit alone.

Conclusion. Telemedicine can increase access to specialty care for patients with prolonged travel time to in-person visits and decrease the socioeconomic burden for both patients and hospital systems. The high satisfaction with telemedicine and willingness to proceed with surgery suggest that remote visits may be useful for both routine management and initial surgical evaluation for spine surgery candidates.

Key words: COVID-19, evaluation, management, neurosurgery, remote medicine, spinal pathology, spine surgery, surgery, telehealth, telemedicine.

Level of Evidence: 3

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With the spread of the novel coronavirus 2019 (COVID-19), clinics around the world are utilizing telemedicine in an effort to keep up with patient demand and slow the spread of the virus. The process of rapidly implementing spine telemedicine services in the context of a changing regulatory landscape and global pandemic has been detailed in a recent publication about the benefits and limitations of telemedicine during COVID.¹ Otherwise, the neurosurgical literature on telemedicine is sparse and primarily relates to routine follow-up care,² economic benefit of remote visits for patients,³ and the usefulness of telemedicine for triaging neurotrauma in rural, resource-poor areas.⁴ The literature on telemedicine in spine surgery is even more sparse, limited to the evaluation of mobile applications for increasing medication and protocol adherence.⁵ Thus, the COVID-19 pandemic provides a unique opportunity to investigate the utility of telemedicine in both the evaluation and management of spine pathology. During normal times, patients who would not feel comfortable with telemedicine would opt to be seen in clinic only. This would skew any pre-COVID analysis of patient experiences and satisfaction in favor of telemedicine. Since all

From the Emory University School of Medicine, Atlanta, GA.

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Address correspondence and reprint requests to Matthew F. Gary, MD, Department of Neurosurgery, Emory University Medical Center, 1365 Clifton Road, Atlanta, GA 30322; E-mail: mfgary@emory.edu

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spine patients at our institution were required to be seen via telemedicine from March 23 to May 8, we can better generalize how patients perceive telemedicine.

Objective

The purpose of this study was to evaluate the satisfaction, socioeconomic benefit, and feasibility of utilizing telemedicine in both the evaluation and management of spinal pathology. The primary objective was to compare patient satisfaction of the newly implemented telemedicine clinic to satisfaction with previous in-person visits. The secondary objective was to evaluate what percentage of patients preferred telemedicine to traditional in-person visits, and what the differences were between these two groups. To compare, we looked at age, sex, new (initial surgical evaluation) *versus* established (either post-op or routine follow-up), length of telemedicine and in-person visits, the need to take off work, and the need for assistance to travel to in-person visits. The tertiary goal was to assess whether patients would feel comfortable proceeding with major surgery and/or a minor procedure (*i.e.*, injection) based off a telemedicine visit alone. The differences between the group that would proceed with surgery *versus* the group that would not were also analyzed.

MATERIALS AND METHODS

Design

Due to the COVID-19 pandemic, the Emory Musculoskeletal Center saw patients via telemedicine from March 23rd to May 8th, 2020. During this time, all patients seen via telemedicine by three neurological spine surgeons (authors M.F.G., G.E.R., and D.R.) were called after their visit to participate in a telemedicine survey as part of a quality improvement project to obtain patient feedback and improve the Emory telemedicine experience. Later, Internal Review Board (IRB) approval was obtained in order to retrospectively access patient electronic medical records and publish findings based on this research. Patients who did not answer the phone were called up to three times on non-consecutive days. Patients who answered the phone but declined to participate were excluded, but were counted as a part of the total number of patients called. One patient was excluded due to the inability to speak English and lack of translator services available. This was the only patient that required translator services.

Telemedicine Survey

The telemedicine survey was an 11-part questionnaire designed by clinical staff to evaluate patient satisfaction with their recent telemedicine visit. A 5-point Likert scale was used to assess satisfaction, with responses ranging from “Extremely dissatisfied” to “Extremely satisfied.” Other questions addressed how their telemedicine visit compared to previous in-person visits, how much time their telemedicine visit took compared to in-person visits (including travel), whether they have to take off work or require

assistance for in-person visits, and whether they would have preferred an in-person or telemedicine visit for the appointment in question. Furthermore, patients were asked, hypothetically, if they would feel comfortable proceeding with surgery and/or a minor procedure (*i.e.*, injection) based on a telemedicine visit alone.

Telemedicine Platform + Scheduling

On March 13, 2020, Emory Healthcare transitioned all physicians to transition to remote care. Within 10 days, the first patient was seen via telemedicine by the Emory Musculoskeletal Center. Patients who had clinic visits scheduled were contacted and instructed to change their appointment to a telemedicine visit rather than postpone their appointment. The application Zoom (San Jose, CA), which had previously been used by the neurosurgery department for remote conferences, was the preferred method for conducting telemedicine due to its HIPAA compliance and familiarity of use. The application has features like “break-out rooms,” which allow telemedicine visits to closely mimic the workflow of an in-office clinic visit: complete with a waiting room, different examination rooms, and a common hub for providers. Telephone calls without video were used as a backup when audio-visual visits were not possible due to connectivity issues.

Days before the visit, patients were contacted with instructions regarding the process of downloading and installing the Zoom application. For new patients, specific directions were given on how to upload imaging done at outside facilities to the Emory system. A private Zoom link was sent to each patient that could be accessed at the time of their scheduled visit. Thirty minutes before the scheduled appointment, the medical assistant (MA) called the patients to obtain special consent for the telemedicine visit and gather information including patient identification, estimated height and weight, chief complaint, pain level and location, and current medications. The MA gave clear instructions to login or “check-in” at least 15 minutes before their appointment, to conduct the visit in a quiet room with good lighting, to wear clothes that are easily removed if a direct examination of the spine or extremity was needed, and to have someone else available to hold the camera, if possible, to facilitate capturing physical examination findings. The patient’s history was obtained by either a resident or advanced-practice provider (APP), followed by the physical examination and consultation with the neurological spine surgeon. Images were shared with the patient in real time by sharing the providers screen.

Statistical Analysis

Differences in categorical variables were assessed using the χ^2 or Fisher exact test, when frequency was <5 . Odds ratios were constructed from contingency tables. The Anderson-Darling test was used to assess normality of continuous data. The Wilcoxon Rank-Sum test was used to compare non-parametric continuous data. All tests were 2-sided, and P value <0.05 was considered statistically significant. All

TABLE 1. Patient Demographics.

	No. of Patients
Total called	464
Total responded	346 (75%)
Sex	
Male	164 (53%)
Female	182 (47%)
Age, y	
18–49	79 (23%)
50–64	119 (34%)
65+	148 (43%)
Physician relationship	
New	96 (28%)
Established	250 (72%)

analyses were performed using JMP Pro data analysis software version 15.1.0 (SAS Institute, Cary, NC).

RESULTS

A total of 464 patients were seen via telemedicine and called to participate in the telemedicine survey. Three hundred and sixty-six patients answered the phone, of which 20 declined to participate. Nine were “busy,” eight said they had already completed the survey (upon review, they were referring to a different, unrelated survey from our study), and three “did not want to participate.” Thus, 346 patients (75%) participated in the survey. The mean patient age was 60 years (standard deviation 14). One hundred and eighty-two patients were female (53%) and 164 patients were male (47%). Two hundred and fifty patients were established (72%) and 96 patients were new (28%) (Table 1).

Ninety-five percent of patients were either “satisfied” (21%) or “very satisfied” (74%) with their telemedicine visit. Sixty-two percent of patients said that their telemedicine visit was either “the same” (39%) or “better” (23%) than previous in-person visits, with 91% of patients stating they would use telemedicine again in the future. The median amount of patient-reported time spent for the entire telemedicine visit was 20 minutes (range 3–120). The median amount of patient-reported time for a typical in-person visit, including travel to and from clinic, was 120 minutes (range 24–1440). The time of 1440 minutes was for a patient who drove from out of state and spent the night before the appointment, which was included in their travel time. Patients saved a median of 105 minutes (range: 30–1430)

using telemedicine compared to in-person appointments (Table 2). The 30-minute difference between telemedicine visit time and in-person time was from one patient who had a particularly long telemedicine visit time due to a number of technical and personal factors. Twenty-nine percent of patients normally require assistance to get to in-person visits. Fifty-two percent of employed patients have to take off work for in-person visits, compared to just 7% who take off work for telemedicine (Table 3).

Fifty-two percent of patients preferred in-person visits to telemedicine, 37% preferred telemedicine to in-person visits, and 11% had no preference. There were no statistically significant differences between these groups in sex, age, new *versus* established, need for assistance to get to in-person visits, or need to take off work for in-person visits. There was a significant difference between these groups in patient-reported time for a typical in-person visit. Patients who preferred telemedicine had significantly longer patient-reported in-person visit times (score mean of 171) compared to patients who preferred in-person visits (score mean of 137, $P = 0.0007$).

Thirty-seven percent of patients would feel comfortable proceeding with surgery and 73% of patients would feel comfortable proceeding with a minor procedure (*i.e.*, injection) based on a telemedicine visit alone. Patients who preferred in-person visits compared to telemedicine visits were less likely to feel comfortable proceeding with surgery based on a telemedicine visit alone (odds ratio [OR] = 0.47, 95% confidence interval [CI] 0.29–0.76). There was no significant difference in age between those who would proceed with surgery and those who would not, but there was a sex difference with women less likely to proceed with surgery based on a telemedicine visit alone compared to men (OR = 0.49, 95% CI 0.31–0.76). In addition, established patients were less likely to proceed with surgery based on a telemedicine visit compared to new patients (OR = 0.57, 95% CI 0.35–0.92).

DISCUSSION

Due to the rapid spread of COVID-19, industries across the country, including health care, were forced to convert to a remote style of working. The World Health Organization (WHO) declared the COVID-19 outbreak a pandemic on March 11, 2020. On March 13, Emory Healthcare made an institutional announcement to transition to remote consultation. Just 10 days later on March 23 the Emory

TABLE 2. Patient Reported Time

Questionnaire	Median (Min–Max)
How much time did the entirety of your telemedicine visit take including setup, waiting, and seeing the doctor?	
Time, min	20 (3–120)
How much time does a typical in-person visit take including traveling to clinic, seeing the doctor, and traveling home?	
Time, min	120 (24–1440)
Difference in time between telemedicine visit and typical in-person visit.	
Time, min	105 (–30–1440)

TABLE 3. Patient Results

Questionnaire	No. of Patients
How satisfied were you with your visit?	
Very Satisfied	256 (74%)
Satisfied	73 (21%)
Somewhat satisfied	12 (3%)
Dissatisfied	5 (1%)
Compared to previous in-person visits with Dr. _____ or a comparable specialist, how would you compare your telemedicine visit?	
Much better	40 (12%)
Slightly better	38 (11%)
The same	135 (39%)
Slightly worse	90 (26%)
Much worse	7 (2%)
N/A (refused to answer)	36 (10%)
Would you use telemedicine for a visit in the future?	
Yes	315 (91%)
No	31 (9%)
N/A	0
For this particular visit (initial visit, follow-up) would you have preferred to have an in-person or a telemedicine visit?	
In-person	179 (52%)
Telemedicine	127 (37%)
No preference	39 (11%)
Do you normally require assistance to get to in-person visits?	
Yes	99 (29%)
No	244 (71%)
N/A (refused to answer)	2 (1%)
Did your telemedicine visit require you to take off of work?	
Yes	13 (4%)
No	171 (50%)
N/A (retired/not working)	159 (46%)
Do you normally have to take off work for in-person visits?	
Yes	95 (28%)
No	86 (25%)
N/A (retired/not working)	164 (48%)
Would you feel comfortable proceeding with surgery based on a telemedicine visit alone?	
Yes	127 (37%)
No	212 (62%)
N/A (refused to answer)	5 (1%)
Would you feel comfortable proceeding with a minor procedure (<i>i.e.</i> , injection) based on a telemedicine visit alone?	
Yes	251 (73%)
No	91 (26%)
N/A (refused to answer)	2 (1%)
N/A indicates not applicable.	

Musculoskeletal Center saw their first spine patients using a telemedicine platform.

Despite the rapid implementation of telemedicine services in a department and institution with no previous remote medical experience, patients reported a high level of satisfaction with their remote visits and openness to using telemedicine in the post-COVID future. Due to the lack

of coverage of health insurance for telemedicine visits before COVID, it is reasonable to believe that most, if not all, patients had never experienced telemedicine before. In fact, of the first 51 patients called, only five had previously had a telemedicine visit before. All five patients had their previous telemedicine visit during the COVID pandemic, after coverage regulations had been waived. In an effort to shorten our survey, we stopped asking whether patients had previously had a telemedicine visit. Given the unprecedented circumstance and the lack of previous telemedicine experience, there may have been low expectations of what is capable with a telemedicine visit which could have falsely elevated the satisfaction scores. However, a high percentage of patients (37%) actually preferred telemedicine to traditional in-person visits. Although telemedicine preference has been demonstrated before, it is generally discussed regarding primary care or nonsurgical specialties.⁶ In surgery, telemedicine preference has rarely been looked at, and has only been discussed in a small study with regard to routine follow-up appointments.⁷ In this previous small study, patients had to opt-in to agree to follow-up with telemedicine, which could have positively skewed the satisfaction rates. In our study, nearly 100% of the patient population was forced to use telemedicine due to the COVID pandemic, potentially allowing for a more accurate representation of patient attitudes about telemedicine. Our study shows that there is a significant number of spine patients who prefer telemedicine to in-person visits, and that this preference is independent of whether the visit is for post-op or routine follow-up (established patients) or an initial surgical evaluation (new patients). In addition, other factors like age of patient, which have previously been identified as a potential barrier to telemedicine adoption,⁸ show no correlation with telemedicine preference according to our dataset. This may be due to the preemptive measures taken by Emory Healthcare to facilitate ease of access through clear communication and step-by-step instructions on how to launch their telemedicine appointment.

Patients who had longer reported in-person visit times were more likely to prefer telemedicine. Since the patient-reported time for in-person visits includes travel time, this suggests that patients with longer travel times are more likely to prefer telemedicine. This is consistent with literature that patients who prefer remote visits most often cite convenience, travel, and time as the primary benefits.⁷ In a tertiary care center like Emory University, it is not uncommon for patients to travel hours for in-person visits, even spending the night in hotels. Thus, telemedicine has large implications for increasing the availability of surgical specialty care to rural populations. Furthermore, in a densely populated metropolitan area like Atlanta, travel times may be increased due to dense traffic and prohibitive for some patients seeking care. Thus, telemedicine has implications in benefitting urban patient populations as well. Since the typical in-person visit time was a patient-reported measure, another explanation for why patients with longer in-person visit times prefer telemedicine could be that patients with a

high perceived time burden of in-person visits, whether accurate or not, may prefer telemedicine over in-person visits.

The combination of in-person visits taking more time than telemedicine visits (median of 120 min *vs.* median of 20 min), requiring more patients to take off work compared to telemedicine visits (52% *vs.* 7%), and requiring assistance from either a family member, caretaker, or professional service to arrive at in-person visits suggests that there is a high socioeconomic burden on spine patients associated with in-person visits that telemedicine has the potential to address. Although not previously demonstrated with spine patients, this socioeconomic finding is consistent with neurosurgical literature that suggests telemedicine can save patients substantial travel time, travel cost, and time away from work.³ However, patients who needed to miss work or required assistance for in-person visits were not significantly more likely to prefer telemedicine. This was somewhat surprising, but is most likely because the perceived benefit of in-person visits outweighs these potential socioeconomic burdens, which may not be directly shouldered by the patient but rather insurance companies, caretaking loved ones, and so on.

As previously stated, telemedicine has the potential to decrease economic burden for patients. By transitioning a portion of all spine patients seen to telemedicine, remote consultation also has the potential for reducing the economic burden for hospital systems by decreasing the demand for electricity, patient parking, front desk staff, and waiting/examination room space. Additional studies on the economic implications of large-scale incorporation of telemedicine into clinic care are needed to investigate both patient and hospital costs.

Lastly, patients were assessed whether they would feel comfortable proceeding with surgery or a minor procedure, like an injection, based on a telemedicine visit alone. Not surprisingly, more patients would feel comfortable proceeding with an injection (73%) compared to major spine surgery (37%). Traditionally telemedicine has been used at the two extremes of surgical care: either urgent trauma—by triaging remote cases for a potential transfer to a better equipped hospital, or for routine follow-up care in low-risk surgery. Telemedicine has rarely been used for initial surgical evaluation outside of the context of surgical mission trips to developing countries, where telemedicine has been used to determine supplies needed and scheduling before the trip.⁹ Our data indicate that patients are open to proceeding with surgery based on a telemedicine visit alone and suggests that telemedicine may have a future role in initial evaluation for non-urgent and potentially semi-urgent spine procedures. Patients who felt comfortable proceeding with surgery based on a telemedicine visit were more likely to prefer telemedicine over traditional in-person visits, demonstrating an overall confidence in the capabilities of remote visits. The ability for the patient to share previous imaging with the surgeon may also play a role in the overall confidence of a telemedicine evaluation.

New patients were also more likely to proceed with surgery than established patients. This may be due to new patients having more severe problems with more associated pain, and a desire to move forward with a potentially curative operation without delay. Whereas established patients, most of which had already undergone surgery, were in less pain and thus less likely to favor surgery without a traditional in-person visit first. Although there was no sex difference in telemedicine preference, men were significantly more likely to proceed with surgery based on a telemedicine visit alone. In the author's own interpretation, this may be due to men being less risk-averse to the perceived risks of proceeding with surgery without an in-person visit. Ultimately, using telemedicine for presurgical evaluation will depend on the comfort level of both the patient and surgeon. It is imperative that a formal physical examination be done on the day of surgery in person when a patient is scheduled for surgery via telemedicine. Future research is indicated to investigate surgical outcomes of patients who, during this pandemic, have proceeded with surgery after an initial telemedicine evaluation. Investigating surgical outcomes and patient satisfaction ratings will provide insight to the safety and efficacy of telemedicine use for initial surgical evaluation.

Some additional limitations that have not been addressed include having a relatively small sample size of a specific Emory patient population which may make generalizing these findings difficult. Larger, multicenter studies should be conducted to address this. As previously mentioned, all visit times were patient-reported and retrospective, which leaves room for inaccurate estimation by patients of actual visit times. Future studies can mitigate this potential inaccuracy by documenting the time during the actual visit itself, which may give a more accurate result of how much time is saved using telemedicine. Third, our study has a lack of hard financial data to support the potential socioeconomic benefits of incorporating telemedicine into regular spine practice. Further studies with in-depth financial analysis should be performed to gain deeper insight into the financial implications of offering regular telemedicine visits in the post-COVID era.

CONCLUSION

Telemedicine has the potential to increase access to specialty care for patients with prolonged travel time to in-person visits and may decrease the socioeconomic burden of in-person visits for both patients and hospital systems. The high level of satisfaction with telemedicine and willingness to proceed with surgery also suggest that remote visits may be a useful tool for both routine management and initial surgical evaluation for spine surgery candidates.

➤ Key Points

- ❑ Telemedicine is a valuable tool for both evaluation and management of spinal pathology.

- Thirty-seven percent of patients prefer telemedicine to in-person visits.
- Patients are willing to undergo both major surgery and minor procedures based on a telemedicine visit alone.

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