



Original Research

Telemedicine in Arthroplasty Patients: Which Factors Are Associated With High Satisfaction?

Patawut Bovonratwet, MD ^{*}, Junho Song, BS, Scott M. LaValva, MD, Aaron Z. Chen, MD, Nathaniel T. Ondeck, MD, MHS, Jason L. Blevins, MD, Edwin P. Su, MD

The Adult Reconstruction and Joint Replacement Service, Hospital for Special Surgery, New York, NY, USA

ARTICLE INFO

Article history:

Received 14 August 2023

Received in revised form

27 October 2023

Accepted 4 November 2023

Available online xxx

Keywords:

Telemedicine

Hip and knee arthroplasty

Patient satisfaction

Predictor

Utilization rate

ABSTRACT

Background: During the initial coronavirus pandemic lockdown period, remote hip and knee arthroplasty care was heavily employed out of necessity. However, data on patient satisfaction with telemedicine specific to hip and knee arthroplasty patients remains unknown.

Methods: All patients who had a telemedicine visit in the hip and knee arthroplasty department and completed a telemedicine satisfaction survey at a specialty hospital from April 1, 2020, to December 31, 2020, were identified. Patient satisfaction with telemedicine, gauged through a series of questions, were analyzed and evaluated over time. Independent factors associated with high satisfaction, defined as the “Top Box” response to the survey question “Likelihood of your recommending our video visit service to others,” were identified.

Results: Overall, 29,003 patients who had an in-person or telemedicine visit in the hip and knee arthroplasty department during the study period were identified. During the initial coronavirus pandemic lockdown period, defined as April 1, 2020–May 31, 2020, rate of overall telemedicine utilization was approximately 84%. After the initial lockdown period, the rate of overall telemedicine utilization was approximately 8% of all visits per month. Average satisfaction scores for a series of 14 questions were consistently above 4.5 out of 5. Multivariable regression revealed younger age, particularly 18–64 years old, to be the only independent factor associated with high satisfaction with telemedicine. The rate of high satisfaction remained statistically similar throughout the study period ($P > .05$).

Conclusions: Patient satisfaction with telemedicine was consistently high in various domains and remained high throughout the study period, regardless of loosened pandemic restrictions. This technology will most likely continue to be utilized, but perhaps it should be targeted at patients younger than 65 years of age.

© 2023 The Authors. Published by Elsevier Inc. on behalf of The American Association of Hip and Knee Surgeons. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

The coronavirus disease 2019 (COVID-19) pandemic disrupted health-care systems globally. With widespread postponement and suspension of nonurgent surgery, total joint arthroplasty (TJA) case volume experienced a decline of approximately 47% in 2020 [1,2,3]. Furthermore, government-mandated efforts at physical distancing led to temporary closures of elective in-person clinics, prompting

alternative methods of health-care delivery [4]. This resulted in a dramatic acceleration in telemedicine utilization, and remote hip and knee arthroplasty care was heavily employed out of necessity [5].

Telemedicine served as an integral asset during the initial peak of the pandemic for reducing interpersonal viral transmission. However, given the numerous other advantages associated with telemedicine, this technology will likely continue to be implemented well beyond the initial peak pandemic period. Benefits of telemedicine include greater efficiency, lower health-care costs, and removal of geographical barriers to care [6,7,8]. In addition, prior studies have demonstrated high satisfaction rates with telemedicine, particularly among orthopaedic patients [9,10,11].

However, currently, there is a paucity of data on patient satisfaction with telemedicine specific to hip and knee arthroplasty

^{*} Corresponding author. The Adult Reconstruction and Joint Replacement Service, Hospital for Special Surgery, 535 East 70th Street, New York, NY 10021, USA. Tel.: +1 212 606 1466.

E-mail address: bovonratwetp@hss.edu

patients. Moreover, factors associated with high patient satisfaction within this population remain unknown. As telemedicine will continue to be utilized in the future, targeting this technology to those who will be most satisfied is essential for patient-centered care. Therefore, the purposes of this study were to determine patient satisfaction with telemedicine as well as factors associated with high satisfaction in a hip and knee arthroplasty patient population.

Material and methods

Patient population and telemedicine utilization

All patients who had an in-person or telemedicine visit in the hip and knee arthroplasty department at an urban tertiary specialty hospital from April 1, 2020, to December 31, 2020, were identified. Initial peak coronavirus pandemic lockdown period was defined as from April 1, 2020, to May 31, 2020, based on daily case volumes at the authors' institution location as well as the most restrictive social distancing policies. Data on the rate of COVID-19-related hospitalized cases per 100,000 people were obtained from New York City Health COVID-19 data [12]. Visits were categorized as either an in-person or telemedicine visit. In addition, visits were also categorized as either new patient or follow-up. For patients who had a telemedicine visit, patient characteristics such as gender, age, body mass index, insurance type, American Society of Anesthesiologists classification, number of past medical history diagnoses, primary diagnosis, and distance from their home address to the main hospital were extracted.

Patient satisfaction

A random subset of patients who had a telemedicine visit during the study period were sent a telemedicine patient satisfaction survey. The patient survey contained 14 questions, which are shown in Table 1. Possible responses to these questions include a scale of 1-5, in which 1 is the lowest possible rating and 5 is the highest. Top box response was defined as a rating of 5. In the current study, high patient satisfaction was defined as "Top Box" response to the survey question "Likelihood of your recommending our video visit service to others".

Statistical analysis

Statistical significance was set at $P < .05$. All statistical analyses were 2-tailed and performed using STATA version 13 (StataCorp LP, College Station, TX).

Descriptive statistics including means with standard deviations and percentages were computed for patient characteristics in

Table 1
Patient survey questions.

Question
Ease of arranging your video visit
Ease of contacting us
Concern the care provider showed for your questions or worries
Explanations the care provider gave you about your problem or condition
Care provider's efforts to include you in decisions about your care
Care provider's discussion of any proposed treatment
Your confidence in the care provider
Friendliness and courtesy of the care provider
Likelihood of your recommending this care provider to others
Ease of talking with the care provider over the video connection
How well the video connection worked during your video visit
How well the audio connection worked during your video visit
How well the video visit staff worked together to care for you
Likelihood of your recommending our video visit service to others

Table 2. Percentage of telemedicine visits by month throughout the study period was computed. Percentage of high patient satisfaction, defined as "Top Box" response to the survey question "Likelihood of your recommending our video visit service to others," by month throughout the study period was also computed.

High patient satisfaction was tested for association with each of the aforementioned patient characteristics using Poisson regression with robust error variance [13] (multivariable analysis). The final multivariable model was selected using a backward stepwise approach, where all perioperative variables in Table 2 were initially included in the model and variables with the highest P values were eliminated one by one until only variables with $P < .05$ remained in the model. Patient characteristics that remain in the model represent independent associations with high patient satisfaction after a telemedicine visit.

Results

Patient population

Overall, 29,003 patients who had an in-person or telemedicine visit in the hip and knee arthroplasty department during the study period were identified. Of these, 3617 patients (12.5%) had a

Table 2
Patient population.

Characteristic	Number	Percent
Total	790	100.0%
Age (years, average 65.2 ± 10.0)		
18 - 54	101	12.8%
55 - 59	100	12.7%
60 - 64	142	18.0%
65 - 69	168	21.3%
70 - 74	157	19.9%
≥75	122	15.4%
Gender		
Male	338	42.8%
Female	452	57.2%
Body mass index (kg/m ² , average 28.5 ± 5.5)		
18 - 24	158	20.0%
25 - 29	205	25.9%
30 - 34	119	15.1%
≥35	71	9.0%
Insurance		
Private	356	45.1%
Medicare	332	42.0%
Other	102	12.9%
American Society of Anesthesiologists classification (ASA)		
1	15	1.9%
2	427	54.1%
≥3	89	11.3%
Number of past medical history diagnoses		
0-2	127	16.1%
3	57	7.2%
4	68	8.6%
≥5	528	66.8%
Distance from home to main hospital (miles, average 118.6 ± 311.6)		
0 - 9	176	22.3%
10 - 29	277	35.1%
30 - 49	132	16.7%
≥50	199	25.2%
Primary diagnosis		
Osteoarthritis of the hip	126	15.9%
Osteoarthritis of the knee	153	19.4%
Hip/knee pain, effusion, or bursitis	61	7.7%
Periprosthetic fracture	22	2.8%
Aftercare of joint replacement	311	39.4%
Visit type		
New patient visit	154	19.5%
Follow-up visit	636	80.5%

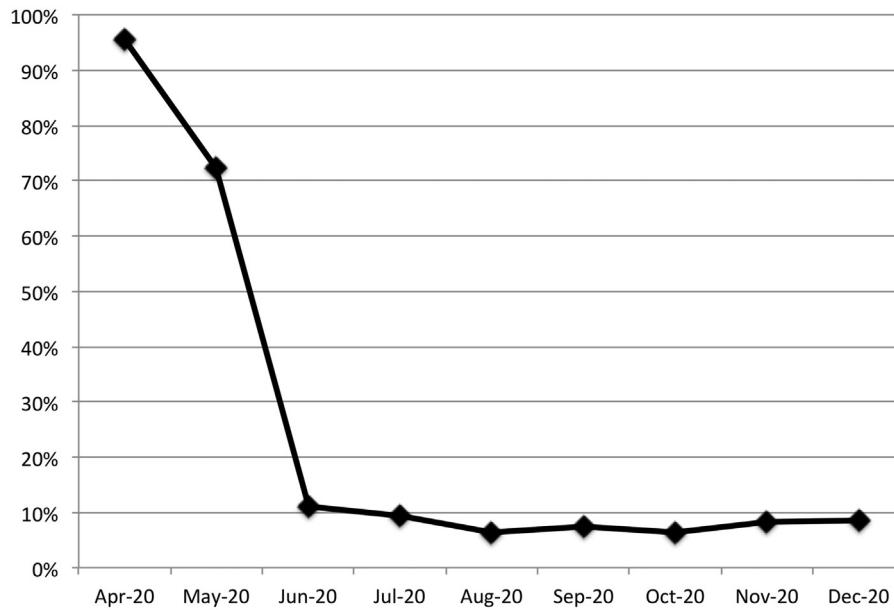


Figure 1. Percentage of telemedicine visits compared to overall visits per month.

telemedicine visit. Of these patients that had a telemedicine visit, 790 (21.8%) had patient satisfaction survey data available. For these 790 patients, average age was 65.2 years old, 42.8% were male, average body mass index was 28.5, and 45.1% had private insurance. Further, 54.1% of these patients had an American Society of Anesthesiologists score of 2, 66.8% of patients had ≥ 5 number of past medical history diagnoses, and the majority of visit diagnosis was aftercare of joint replacement at 39.4%. Finally, the average distance from the patient’s home address to the main hospital was 118.6 miles (Table 2).

Telemedicine utilization

During the initial peak pandemic lockdown period, defined as from April 2020 to May 2020, the average rate of telemedicine utilization was 84% (Fig. 1). After the initial lockdown period (June 1, 2020-December 31, 2020), the average rate of monthly telemedicine utilization was 8% (Fig. 1). Of the 790 patients that had a telemedicine and completed a patient satisfaction survey data, 154 (19.5%) had a new visit, while 636 (80.5%) had a follow-up visit.

Patient satisfaction

Average patient satisfaction scores for the series of 14 questions were consistently above 4.5 out of 5 (Table 2). The top 4 themes with the highest average satisfaction scores were (1) friendliness and courtesy of the care provider at 4.94, (2) your confidence in the care provider at 4.92, (3) concern the care provider showed for your questions or worries at 4.90, and (4) likelihood of your recommending this care provider to others at 4.90 (Table 3). Of the 790 patients that had a telemedicine and completed a patient satisfaction survey, 625 (79.1%) had a “Top Box” response to the survey question “Likelihood of your recommending our video visit service to others,” used as a proxy for high patient satisfaction with telemedicine. The rate of high satisfaction remained statistically similar throughout the study period ($P > .05$), despite easing of in-person visit restrictions (Fig. 2).

Stepwise multivariable regression revealed younger age, particularly 18-64 years old, to be the only independent factor

associated with high satisfaction with telemedicine (Table 4). Specifically, compared to those ≥ 75 years old, those 18-54 years old had relative risk (RR) = 1.32, 95% confidence interval (CI) = 1.07-1.63, of achieving high satisfaction; those 55-59 years old had RR = 1.36, 95% CI = 1.11-1.65, of achieving high satisfaction; and those 60-64 years old had RR = 1.25, 95% CI = 1.02-1.53, of achieving high satisfaction ($P = .018$) (Table 3).

Discussion

The current study aimed to evaluate patient satisfaction with telemedicine and the patient factors associated with high satisfaction in hip and knee arthroplasty patients. Our findings

Table 3
Average score for each telemedicine satisfaction survey question.

Question	Average score	SD
Ease of arranging your video visit	4.55	0.77
Ease of contacting us	4.54	0.77
Concern the care provider showed for your questions or worries	4.90	0.38
Explanations the care provider gave you about your problem or condition	4.88	0.42
Care provider’s efforts to include you in decisions about your care	4.87	0.43
Care provider’s discussion of any proposed treatment	4.84	0.46
Your confidence in the care provider	4.92	0.32
Friendliness and courtesy of the care provider	4.94	0.28
Likelihood of your recommending this care provider to others	4.90	0.39
Ease of talking with the care provider over the video connection	4.73	0.70
How well the video connection worked during your video visit	4.61	0.84
How well the audio connection worked during your video visit	4.63	0.81
How well the video visit staff worked together to care for you	4.81	0.52
Likelihood of your recommending our video visit service to others	4.69	0.77

Maximum score is out of 5.
SD, standard deviation.

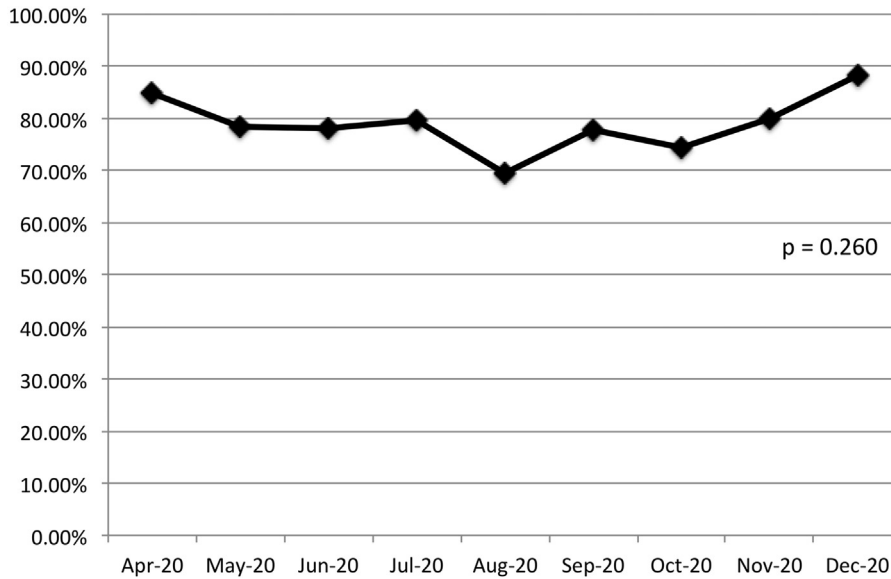


Figure 2. Percentage of "Top Box" response to the survey question "Likelihood of your recommending our video visit service to others" per month.

demonstrate that the rate of telemedicine utilization remained significant even after the initial pandemic lockdown period, at approximately 8% of all visits per month. Further, patient satisfaction with telemedicine was consistently high in various domains and remained high throughout the study period, regardless of loosened pandemic restrictions on in-person visits. Finally, patients aged <65 years of age were more likely to be highly satisfied with telemedicine.

The current study found telemedicine utilization rate during the initial pandemic lockdown period to be 84%, which is consistent with the literature [14,15]. After the initial lockdown period, the average monthly telemedicine utilization rate was found to be 8% of all visits. This demonstrates that telemedicine is still significantly utilized even without the imperative of government restrictions preventing in-person visits. In a recent survey of 517 orthopaedic arthroplasty surgeons, 57% of respondents noted that they would continue to incorporate telemedicine into their practice after the pandemic [16]. Furthermore, the surveyed surgeons noted that they would feel more comfortable using telemedicine for routine follow-up visits, consistent with our finding that most of the telemedicine visits were for postoperative follow-up rather than new patient evaluations.

Our findings revealed high average patient satisfaction scores with telemedicine visits, and the high satisfaction rate remained statistically similar throughout the study period. High satisfaction with telemedicine among orthopaedic patients has been previously demonstrated in the literature [10,17,18,19]. Buvik et al. conducted a randomized controlled trial comparing orthopaedic patients who received video-based telemedicine vs those who had traditional in-

person visits [20]. Of the 389 patients included in this study, 99% of patients evaluated the consultation as "very satisfactory" or "satisfactory," and 86% of patients in the telemedicine group reported preferring video-assisted consultation as their next consultation. Kumar et al. similarly found a high patient satisfaction rate of 92% among patients at a single orthopaedic outpatient department, with only 7% of patients experiencing any difficulty with their telemedicine visit [11]. Although prior studies have shown high satisfaction with telemedicine among orthopaedic patients, our study is unique in highlighting these findings specifically within a hip and knee arthroplasty patient population. A potential contributing factor for such high patient satisfaction rates with telemedicine is that the COVID-19 pandemic prompted immediate systemic changes to overcome important challenges of telemedicine application, such as clinician awareness/hesitancy, technology installation, maintenance costs, and legal regulatory barriers [21]. The pandemic also accelerated efforts to increase the efficacy of telemedicine consultation, such as standardization of the telemedicine musculoskeletal physical examination [22,23,24]. Therefore, it is likely that the average patient satisfaction rate has considerably increased since the beginning of the pandemic, secondary to the more streamlined implementation of telemedicine.

To promote patient-centered care, surgeons should consider all factors that may potentially influence a patient's satisfaction level with telemedicine. The current study showed that younger age is an independent predictor of high satisfaction with telemedicine. Specifically, age of less than 65 years was significantly associated with higher satisfaction scores. Similarly, Giunta et al. reported that hip and knee arthroplasty patients less than 80 years of age were more satisfied with their telemedicine visit [25]. Omari et al. demonstrated that general orthopaedic patients younger than 65 years old were also significantly more likely to provide the "top box" response for satisfaction with telemedicine visits compared to older patients [9]. The inverse relationship between age and satisfaction with telemedicine may be related to navigating the telemedicine system on a smartphone or computer with audiovisual capabilities, which may be more difficult for some older patients less familiar with the technology. There is still room for improvement for modern telemedicine platforms in order to make this technology more user-friendly for a broader patient population.

Table 4
Independent risk factors for high satisfaction with telemedicine.

Characteristic	RR	95% CI	P-value ^a
Age			.018
18 - 54	1.32	1.07-1.63	
55 - 59	1.36	1.11-1.65	
60 - 64	1.25	1.02-1.53	
65 - 69	1.15	0.93-1.43	
70 - 74	1.20	0.97-1.48	
≥75	Ref.	-	

RR, relative risk; CI, confidence interval; Ref., reference.

^a Significant at $P < .05$.

Although age was the only significant predictor of high satisfaction with telemedicine in this study, prior studies have reported other associations as well. Abdulwahab et al. evaluated factors influencing patient satisfaction with telemedicine across a variety of specialties, including orthopaedic surgery, and found that female gender was significantly associated with higher satisfaction with telemedicine [10]. However, this study involved a highly heterogeneous patient sample with a wide variety of medical and surgical specialties, which likely influenced the results. In our analysis specific to TJA patients, gender was not found to be associated with high satisfaction with telemedicine.

There are several important limitations that must be considered when interpreting the current study. The retrospective study design limits the level of evidence and the conclusions that can be drawn. Patients were not randomized to participate in telemedicine or in-person visits, and after loosening of mandated pandemic lockdown protocols, the decision to offer a telemedicine visit was solely at the discretion of the surgeons. This may have been predisposed to selection bias, as patients with more complicated postoperative courses may not have been offered a telemedicine option, leading to higher average satisfaction scores. Nevertheless, these findings show that, with appropriate patient selection, high patient satisfaction with telemedicine can be maintained even beyond the initial peak pandemic period. In addition, as previously noted, given that this study was conducted in an academic center located in a large metropolitan area, our results may not be generalizable to patient populations in more rural areas. Lastly, the purpose of follow-up telemedicine visits were not recorded as part of the questionnaire. Therefore, this variable could not be analyzed.

Conclusions

The rate of telemedicine utilization in hip and knee arthroplasty patients remains significant, at approximately 10% of all visits, even after the initial peak coronavirus pandemic period. In addition, patient satisfaction with telemedicine was consistently high in various domains and remained high throughout the study period, regardless of pandemic restrictions on in-person visits. This technology shows promise and will most likely continue to be utilized, but perhaps it should be mainly targeted at patients younger than 65 years of age. As postoperative patient satisfaction has been shown to correlate with patient-reported outcomes [26], appropriate patient selection for telemedicine to optimize satisfaction can potentially improve overall clinical outcomes following TJA.

Conflicts of interest

E. Su receives royalties from Kyocera Corporation, OrthAlign, and United Orthopedic Corporation; is a paid consultant for Smith and Nephew, OrthAlign, and United Orthopedic Corporation; has stock options in OrthAlign and HS2 LLC; receives research support from Smith and Nephew and United Orthopedic Corporation; receives other financial support from Kyocera Corporation; and is an editorial/governing board member of *Techniques in Orthopedics*. All other authors declare no potential conflicts of interest.

For full disclosure statements refer to <https://doi.org/10.1016/j.artd.2023.101285>.

References

- [1] Flemming S, Hankir M, Ernestus RI, Seyfried F, Germer CT, Meybohm P, et al. Surgery in times of COVID-19—recommendations for hospital and patient management. *Langenbecks Arch Surg* 2020;405:359–64.
- [2] Spinelli A, Pellino G. COVID-19 pandemic: perspectives on an unfolding crisis. *Br J Surg* 2020;107:785–7.
- [3] Heckmann ND, Bouz GJ, Piple AS, Chung BC, Wang JC, Mayfield CK, et al. Elective inpatient total joint arthroplasty case volume in the United States in 2020: Effects of the COVID-19 pandemic. *J Bone Joint Surg Am* 2022;104:e56.
- [4] Lanham NS, Bockelman KJ, McCriskin BJ. Telemedicine and orthopaedic surgery: the COVID-19 pandemic and our new normal. *JBJS Rev* 2020;8:e2000083.
- [5] Iyer S, Bovonratwet P, Samartzis D, Schoenfeld AJ, An HS, Awwad W, et al. Appropriate telemedicine utilization in spine surgery: results from a delphi study. *Spine (Phila Pa 1976)* 2022;47:583–90.
- [6] Buvik A, Bergmo TS, Bugge E, Smaabrekke A, Wilsaard T, Olsen JA. Cost-effectiveness of telemedicine in remote orthopedic consultations: randomized controlled trial. *J Med Internet Res* 2019;21:e11330.
- [7] Duchesne JC, Kyle A, Simmons J, Islam S, Schmieg Jr RE, Olivier J, et al. Impact of telemedicine upon rural trauma care. *J Trauma* 2008;64:92–8.
- [8] Craig J, Patterson V. Introduction to the practice of telemedicine. *J Telemed Telecare* 2005;11:3–9.
- [9] Omari AM, Antonacci CL, Zaifman J, Johal A, Conway J, Mahmoud Y, et al. Patient satisfaction with orthopedic telemedicine health visits during the COVID-19 pandemic. *Telemed J E Health* 2021;28:806–14.
- [10] Abdulwahab SA, Zedan HS. Factors affecting patient perceptions and satisfaction with telemedicine in outpatient clinics. *J Patient Exp* 2021;8:23743735211063780.
- [11] Kumar S, Kumar A, Kumar M, Kumar A, Arora R, Sehrawat R. Feasibility of telemedicine in maintaining follow-up of orthopaedic patients and their satisfaction: a preliminary study. *J Clin Orthop Trauma* 2020;11(Suppl 5):S704–10.
- [12] COVID-19: data. <https://nyc.gov/site/doh/covid/covid-19-data.page>. [Accessed 1 March 2022].
- [13] Bovonratwet P, Shen TS, Ast MP, Mayman DJ, Haas SB, Su EP. Reasons and risk factors for 30-day readmission after outpatient total knee arthroplasty: a review of 3015 cases. *J Arthroplasty* 2020;35:2451–7.
- [14] Parisien RL, Shin M, Constant M, Saltzman BM, Li X, Levine WN, et al. Telehealth utilization in response to the novel coronavirus (COVID-19) pandemic in orthopaedic surgery. *J Am Acad Orthop Surg* 2020;28:e487–92.
- [15] Krueger CA, Mont MA, Backstein DJ, Browne JA, Krebs VE, Mason JB, et al. COVID will End but telemedicine may be here to stay. *J Arthroplasty* 2021;36:789–90.
- [16] Kolin DA, Carroll KM, Plancher K, Cushner F. Perspective of attending physicians on the use of telemedicine in an outpatient arthroplasty setting during the COVID-19 pandemic. *HSS J* 2021;17:31–5.
- [17] Hanna G, Siddiqui B, Jernigan EA, Edobor-Osula F. Telemedicine for pediatric orthopedic visits: evaluating usability and satisfaction. *J Pediatr Orthop B* 2022;31:e75.
- [18] Chaudhry H, Nadeem S, Mundi R. How satisfied are patients and surgeons with telemedicine in orthopaedic care during the COVID-19 pandemic? A systematic review and meta-analysis. *Clin Orthop Relat Res* 2021;479:47–56.
- [19] Sinha N, Cornell M, Wheatley B, Munley N, Seeley M. Looking through a different lens: patient satisfaction with telemedicine in delivering pediatric Fracture care. *J Am Acad Orthop Surg Glob Res Rev* 2019;3:e100.
- [20] Buvik A, Bugge E, Knutsen G, Småabrekke A, Wilsaard T. Patient reported outcomes with remote orthopaedic consultations by telemedicine: a randomised controlled trial. *J Telemed Telecare* 2019;25:451–9.
- [21] Makhni MC, Riew GJ, Sumathipala MG. Telemedicine in orthopaedic surgery: challenges and opportunities. *J Bone Joint Surg Am* 2020;102:1109–15.
- [22] Wahezi SE, Duarte RA, Yerra S, Thomas MA, Pujar B, Sehgal N, et al. Telemedicine during COVID-19 and beyond: a practical guide and best practices multidisciplinary approach for the orthopedic and neurologic pain physical examination. *Pain Physician* 2020;23:S205–38.
- [23] Iyer S, Shafi K, Lovecchio F, Turner R, Albert TJ, Kim HJ, et al. The spine physical examination using telemedicine: strategies and best practices. *Global Spine J* 2022;12:8–14.
- [24] Laskowski ER, Johnson SE, Shelerud RA, Lee JA, Rabatin AE, Driscoll SW, et al. The telemedicine musculoskeletal examination. *Mayo Clin Proc* 2020;95:1715–31.
- [25] Giunta NM, Paladugu PS, Bernstein DN, Makhni MC, Chen AF. Telemedicine hip and knee arthroplasty experience during COVID-19. *J Arthroplasty* 2022;37:S814–818.e2.
- [26] Schroeder GD, Radcliff KE, Vaccaro AR, Murphy H, Sutton RM, Lurie JD, et al. Comparing patient-reported outcomes to patient satisfaction after a microdiscectomy for patient's with a lumbar disk herniation. *Clin Spine Surg* 2020;33:82–8.