Willingness of Patients With Knee Osteoarthritis to Use Telemedicine Amid Sars-CoV-2 Outbreak

Tsuneari Takahashi, MD, PhD, Ryusuke Ae, MD, PhD, Kensuke Minami, MD, Meiwa Shibata, MD, Tatsuya Kubo, MD, Koki Kosami, MD, and Katsushi Takeshita, MD

Abstract
Background: There is no report yet on the application of telemedicine in orthopedic practice in Japan. With a focus on patients with KOA, we investigated the willingness of patients to use telemedicine by assessing factors such as the patient’s age, smartphone possession, hospital visiting time, and severity of KOA.

Methods: Data of patients who regularly consulted orthopedic surgeons at our institutions from April 2020 to June 2020 were retrospectively analyzed using an electronic medical database. The patients were diagnosed with KOA according to clinical and radiological findings, according to the Kellgren-Lawrence (KL) classification. Included were patients with KOA with KL classification above grade 2. All patients were asked: 1) whether they were willing to use telemedicine (Yes or No), 2) the reason why they answered Yes, 3) the reason why they answered No, 4) if they possessed a smartphone, 5) their numeric rating scale for pain at their last outpatient visit after the Sars-CoV-2 epidemic emerged, and 6) the time required for visiting hospital from their house. Patients were stratified into 2 groups depending on whether they answered Yes (Group Y) or No (group N). Comparisons between the groups concerning smartphone possession, NRS pain, hospital visiting times, and distribution of KL grade were made.

Results: Only 36.7% of the patients with KOA said they were willing to use telemedicine. The average age of group Y was significantly younger than that of group N (67.9 ± 9.1 vs 73.1 ± 8.0, P = 0.0026) and the cutoff age was 70.0 years. In addition, the rate of smartphone possession was significantly higher in group Y than in group N (82.5% vs 34.5%, P < 0.001). Hospital visit times and the severity of KOA did not differ between the groups.

Conclusion: Age is a barrier to the adoption of telemedicine.

Keywords
knee osteoarthritis, telemedicine, outpatient, Sars-CoV-2, outbreak

Submitted October 30, 2020. Revised November 18, 2020. Accepted November 19, 2020.

Introduction
Knee osteoarthritis (KOA) is a common musculoskeletal disease, with more than 25,000,000 patients aged over 40 diagnosed with radiographic KOA in Japan. Healthcare providers should pay attention to their patients who are experiencing changes in knee pain through KOA to help them prevent a decline in the patient’s ability to walk. Clinical scores for patients with KOA may worsen over time during the short term, indicating that they require effective treatment to avoid discomfort and further disability.

The outbreak of severe acute respiratory syndrome coronavirus 2 (Sars-CoV-2) is the third documented spillover of an animal coronavirus to humans, which has led to a severe epidemic. Sars-CoV-2 disease, COVID-19, may be more...
infectious than other severe acute respiratory syndromes. In addition, hospital-related transmission of the disease is of significant concern because of the reported presence of asymptomatic infection and the infection transmission in healthcare institutions. A past study reported that COVID-19 may be at its peak in terms of infectivity just before the onset of pneumonia and that in approximately half of COVID-19 cases, the secondary infected cases developed during the asymptomatic stage in index cases. Both patients and healthcare providers should therefore minimize the risk of infection at the medical facilities. With telemedicine, mild cases of COVID-19 can be provided with supportive care while minimizing their exposure to other patients who are critically ill. Furthermore, telemedicine may allow efficient screening of the patients while simultaneously avoiding the dissemination of viruses such as Sars-COV-2 or that of bacterial infections among patients, healthcare providers, and the community at large. Although the use of telemedicine has increased over the last 2-3 years, only a few patients have adopted it for orthopedic consultations. However, an American Orthopedic Association survey found that most orthopedic surgeons (60%) foresee the use of telemedicine for follow-up studies of patients who live remotely. In fact, some orthopedists (20%) use telemedicine for routine postoperative follow-up, while others (10%) believe that it can be used for supervised therapy. To the best of our knowledge, no past studies have investigated telemedicine in an orthopedic practice in Japan. Focusing on patients with KOA, this study investigated the willingness of patients to use telemedicine by assessing factors associated with the willingness.

Methods

Patient Selection

This study was approved by Clinical Research Ethics Committee of our institute (Receipt ID: 20-029). In this cross-sectional study, subjects were sampled from patients with KOA who regularly consulted the same orthopedic surgeon at the knee specialized outpatient department of our hospital and the affiliated hospitals located in the rural area. Of these patients, those who visited hospitals between April 2020 and June 2020 were interviewed about their views on using telemedicine as part of their treatment. All patients were questioned by the first author after their examination in the clinic. All patients were Japanese and hence there were no language barriers. We retrospectively reviewed these patients’ medical records.

Inclusion was limited to patients with KOA aged >50 years who did not visit the clinic to get an injection or to sign up for surgery. These patients had been clinically diagnosed with KOA based on findings such as the loss of range of motion and radiological findings as per the Kellegren-Lawrence (KL) classification grades 2-4. No patients with KOA were aged <50 years and hence none were excluded.

Measurements

The demographic characteristics included age, sex, height, and weight, while pain was measured on the numeric rating scale (NRS) for pain, ranging from minimum (0) to maximum (100).

Patients were interviewed by the first author and asked the following: 1) whether they were willing to use telemedicine (Yes or No), 2) the reason why they answered Yes, 3) the reason why they answered No, 4) if they possessed a smartphone, 5) their NRS at their last outpatient visit after the Sars-CoV-2 outbreak, and 6) the time they needed to visit the hospital from their home. We classified the patients into 2 groups depending on whether they answered Yes (Group Y) to the first question or they answered No (group N).

Statistical Analysis

We compared the difference between groups Y and N according to age, smartphone possession, NRS pain, and time needed to visit the hospital, and calculated the KL grade distribution. Data are presented as mean and standard deviation. Comparisons between the groups were made for parametric clinical data using Student’s t-test. A receiver operating characteristic (ROC) curve was calculated to determine the cutoff value of numerical data for telemedicine. Chi-squared test and Fisher’s exact test were used to evaluate differences between the groups. All statistical analyses were performed using EZR software. A priori sample size calculation for primary outcome was performed, and the significance level was set at $P < 0.05$. The minimum sample size for $\alpha$ error $\leq 0.05$, $\beta$ error $\leq 0.20$, and effect size $= 0.8$ were calculated using G*Power 3.1 (Franz Paul, Kiel, Germany).

There were 40 patients in group Y and 69 in group N. A power analysis calculated $\alpha$ error of 0.05 and $\beta$ error of 0.02 (i.e., the power was 0.98).

Results

Only 36.7% of the patients said they were willing to use telemedicine. The reasons for response included: Concern over COVID-19 (67.5%), familiarity with internet-derived communication (12.5%), distance to the hospital (7.5%), and others (12.5%). The reasons why they were not willing to use telemedicine were: Unfamiliarity with internet-derived communication (62.3%), preference for face-to-face communication with medical doctors (31.9%), and others (5.8%) (Table 1). None of the responses mentioned cultural biases or language barriers as the reasons for not willing to use telemedicine. The average age of group Y was significantly younger than that of group N (67.9 ± 9.1 vs 73.1 ± 8.0, $P = 0.0026$) (Table 2) and the cutoff age from the ROC curve was 70.0 years old (Figure 1). The percentage of those willing to use telemedicine by age was recorded as 52.3% in their fifties and sixties category. On the other hand, the percentage was only 26.2% in their seventies and older category (Table 3). There was significant difference in percentages among the 2 age groups ($P = 0.0074$). In addition,
the rate of smartphone possession was significantly higher in group Y than that in group N (82.5% vs 34.8%, \( P < 0.001 \)). NRS (30.9 ± 21.9 vs 33.1 ± 24.0, \( P = 0.62 \)), time required to visit the hospital (27.0 ± 19.5 vs 25.6 ± 17.1, \( P = 0.69 \)), and severity of KOA (\( P = 0.33 \)) did not differ between the groups (Table 2.).

**Table 1.** Reasons for Adopting Telemedicine.

| The reasons to use telemedicine | Rate (\%) | The reasons not to use telemedicine | Rate (\%) |
|--------------------------------|-----------|-----------------------------------|-----------|
| Concern with COVID-19          | 67.5%     | Unfamiliar with internet derived communication | 62.3%     |
| Familiar with internet derived communication | 12.5% | Preference of face-to-face communication | 31.9% |
| Distance to hospitals          | 7.5%      | Others                             | 5.8%      |
| Others                         | 12.5%     |                                    |           |

**Table 2.** Comparisons Between Groups.

|                        | Group Y (n = 40) | Group N (n = 69) | P-value |
|------------------------|------------------|------------------|---------|
| Age                    | 67.9 ± 9.1       | 73.1 ± 8.0       | 0.0026  |
| Rate of smartphone possession | 33/40 (82.5%) | 24/69 (34.8%) | <0.001 |
| Numeric rating scale for pain | 30.9 ± 21.9 | 33.1 ± 24.0 | NS      |
| Time required to visit hospital | 27.0 ± 19.5 | 25.6 ± 17.1 | NS      |
| KL classification (Grade 2/3/4) | 15/11/14 | 24/12/33 | NS      |

Data are expressed as mean ± standard deviation.
NS: Not significant, KL: Kellgren-Lawrence.

**Discussion**

This is the first study to clarify the factors that draw patients with KOA into using telemedicine in Japan, and it realized several important findings. First, only 36.7% of patients with KOA were willing to use telemedicine, even during the Sars-CoV-2 pandemic despite the absence of any cultural biases or language barriers in the use of telemedicine. Second, the average age of group Y was significantly younger than that of group N and cutoff age was 70.0 years old. Third, the rate of smartphone possession was significantly higher in group Y than that in group N. Fourth, latest knee NRS pain score, time required to visit the hospital, and severity of KOA (\( P = 0.33 \)) did not differ between the groups.

Fatal cases of COVID-19 in older age groups have been higher than in those in younger ones, and the median age at death has been recorded at 75.5 years old in Korea.\(^{15}\) Similar results by Richardson et al. described that the fatality rate was higher in patients aged \( \geq 70 \).\(^{16}\) Therefore, the Sars-Cov-2 epidemic and silent transmission might impact the health of aged patients with KOA.

Although there have been multiple reports about the use of telehealth in orthopedics,\(^{12}\) its uniform implementation and widespread availability remain lacking. Older age was a significant barrier for the adoption of telemedicine in our study. Hoque et al. described based on their survey for the adoption of telemedicine by elderly (age \( \geq 60 \)) from the capital city of Bangladesh that technology anxiety and resistance to change are significant negative factors,\(^{17}\) which conformed to our findings.

The rate of Smartphone possession among patients who were not willing to use telemedicine was significantly lower. Unfamiliarity with internet-derived communication and a preference for face-to-face communication with the medical doctors were the 2 most reported reasons for not preferring telemedicine in this study. Bennell et al. described that internet-delivered, physiotherapist-prescribed home exercise and pain-coping skills training improved pain and function in patients with chronic knee pain aged 50 and older, and this was seen to be sustained for at least 6 months.\(^{18}\) Therefore, we should develop a system for aged populations that is easy to handle and are interested to know if the implementation of telemedicine for patients with KOA is as effective as regular outpatient visits.

The factors of “time spent in visiting the hospital” and the severity of KOA did not affect whether patients were willing or not to use telemedicine in this study. This point may be explained by the fact that the hospitals were located in rural areas and all patients visited the hospitals from their home by car or on foot.

This study had several limitations. First, it was retrospective and conducted in several hospitals located in a same prefecture where the Sars-CoV-2 epidemic was relatively mild, so
potential biases in the results exist within our patient cohort. Second, we only analyzed patients with KOA of KL grade 2 to 4. Therefore, our results cannot be generalized for all patients with other musculoskeletal disorders. Third, separate KL grade analysis to look at whether patients wanted to use telemedicine was not performed. Fourth, patient-reported outcome measures, except for NRS, were not compared between the groups. Fourth, the patients who visited the clinic to get an injection were excluded from this study. Patients with KOA are often prescribed with intra-articular hyaluronic acid injections and outpatient physiotherapy in Japan. Injections cannot be administered over the telemedicine system and the concern about the continuity of outpatient services probably made the patients switch to self-assessed physiotherapy, which made them willing to use telemedicine. We hope these will be clarified in the future.

Above these limitations however, this study is the first to make a number of clarifications concerning the number of patients with KOA who are willing to use telemedicine during the Sars-CoV-2 outbreak and their age groups and hints at their adoption of technology.

In conclusion, the percentage of patients with KOA who were willing to use telemedicine was low, even during the Sars-CoV-2 outbreak. The early development of a novel telemedicine system that is easy for aged patients to handle is required. Thus, age is a barrier to the adoption of telemedicine.

Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authoredness, and/or publication of this article. Tsuneari Takahashi, MD, PhD, Ryusuke Ae MD, PhD, Kensuke Minami, MD, Meiwa Shibata MD, PhD, Tatsuya Kubo, MD, Koki Kosami, MD, and Katsushi Takeshita, MD, PhD. The authors have declared no financial conflicts of interest with respect to their authorships and/or publication of this work.

Funding
The author(s) received no financial support for the research, authoredness, and/or publication of this article.

ORCID iD
Tsuneari Takahashi, MD, PhD https://orcid.org/0000-0002-4198-6684
Koki Kosami, MD https://orcid.org/0000-0003-1050-2699

References
1. Yoshimura N, Muraki S, Nakamura K, et al. Epidemiology of the locomotive syndrome: The research on osteoarthritis/osteoporosis against disability study 2005-2015. Mod Rheumatol 2017;27:1-7. doi:10.1080/14397595.2016.1226471
2. Yoshimura N, Muraki S, Oka H, et al. Prevalence of knee osteoarthritis, lumbar spondylosis, and osteoporosis in Japanese men and women: the research on osteoarthritis/osteoporosis against disability study. J Bone Miner Metab 2009; 27:620-628. doi:10.1007/s00774-009-0080-8
3. Yamaguchi N, Takahashi T, Ueno T, et al. Pain deterioration within 1 year predicts future decline of walking ability: a 7-year prospective observational study of elderly female patients with knee osteoarthritis living in a rural district. Geriatr Orthop Surg Rehabil 2018;9:2151459318799855. doi:10.1177/2151459318799855
4. Gormeli G, Gormeli CA, Ataoglu B, et al. Multiple PRP injections are more effective than single injections and hyaluronic acid in knees with early osteoarthritis: a randomized, double-blind, placebo-controlled trial. Knee Surg Sports Traumatol Arthrosc 2017;25:958-965. doi:10.1007/s00167-015-3705-6
5. Gates B. Responding to covid-19—a once-in-a-century pandemic? N Engl J Med 2020;382(18):1677-1679. doi:10.1056/NEJMp2003762
6. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323(11): 1061-1069. doi:10.1001/jama.2020.1585
7. Arons MM, Hatfield KM, Reddy SC, et al. Presymptomatic sars-cov-2 infections and transmission in a skilled nursing facility. N Engl J Med 2020;382(22):2081-2090. doi:10.1056/NEJMoa2008457
8. Luo Y, Trevathan E, Qian Z, et al. Asymptomatic SARS-cov-2 infection in household contacts of a healthcare provider, Wuhan, China. Emerg Infect Dis 2020;26(8):1930-1933. doi:10.3201/eid2608.201016
9. He X, Lau EHY, Wu P, et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nat Med 2020;26(9):1491-1493. doi:10.1038/s41591-020-0869-5
10. Portnoy J, Waller M, Elliott T. Telemedicine in the Era of COVID-19. J Allergy Clin Immunol Pract 2020;8(5):1489-1491. doi:10.1016/j.jaip.2020.03.008
11. Machado RA, de Souza NL, Oliveira RM, Martelli Júnior H, Bonan PRF. Social media and telemedicine for oral diagnosis and counselling in the COVID-19 era. Oral Oncol 2020;105:104685. doi:10.1016/j.oraloncology.2020.104685
12. Wongworawat MD, Capistrant G, Stephenson JM. The opportunity awaits to lead orthopaedic telehealth innovation: AOA critical issues. J Bone Joint Surg Am. 2017;99(17):e93. doi:10.2106/JBJS.16.01095
13. Kohn MD, Sassoon AA, Fernando N. Classifications in brief: Kellgren-Lawrence classification of osteoarthritis. Clin Orthop Relat Res 2016;474(8):1886-1893. doi:10.1007/s11999-016-4732-4
14. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: visual analog scale for pain (VAS pain), numeric rating scale for pain (NRS pain), McGill pain questionnaire (MPQ), chronic pain scale for pain (NRS pain), McGill pain questionnaire (SF-MPQ), short-form McGill pain questionnaire (SF-MPQ), chronic pain scale for pain (CPGS), short-form 36 bodily pain scale (SF-36 BPS), and measure of intermittent and constant osteoarthritis pain (ICOAP). Arthritis Care Res (Hoboken). 2011;63(Suppl 11): S240-S252. doi:10.1002/acr.20543
15. Korean Society of Infectious D, Korea Centers for Disease C and Prevention. Analysis on 54 mortality cases of coronavirus disease 2019 in the republic of Korea from January 19 to march 10, 2020. J Korean Med Sci 2020;35:e132. doi:10.3346/jkms.2020.35.e132
16. Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with covid-19 in the New York City area. *JAMA* 2020;323(20):2052-2059. doi:10.1001/jama.2020.6775

17. Hoque R, Sorwar G. Understanding factors influencing the adoption of mhealth by the elderly: an extension of the UTAUT model. *Int J Med Inform.* 2017;101:75-84. 2017/03/30. doi:10.1016/j.ijmedinf.2017.02.002

18. Bennell KL, Nelligan R, Dobson F, et al. Effectiveness of an internet-delivered exercise and pain-coping skills training intervention for persons with chronic knee pain: a randomized trial. *Ann Intern Med* 2017;166(7):453-462. doi:10.7326/M16-1714