

Original Article

Despite Equivalent Clinical Outcomes, Patients Report Less Satisfaction With Telerehabilitation Versus Standard In-Office Rehabilitation After Arthroscopic Meniscectomy: A Randomized Controlled Trial

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Purpose: To evaluate functional outcomes and satisfaction in patients who underwent telerehabilitation (telerehab) compared with in-person rehabilitation after arthroscopic meniscectomy. **Methods:** A randomized-controlled trial was conducted including patients scheduled to undergo arthroscopic meniscectomy for meniscal injury by 1 of 5 fellowship-trained sports medicine surgeons between September 2020 and October 2021. Patients were randomized to receive telerehab, defined as exercises and stretches provided by trained physical therapists over a synchronous face-to-face video visit or in-person rehabilitation for their postoperative course. International Knee Documentation Committee Subjective Knee Form (IKDC) score and satisfaction metrics were collected at baseline and 3 months postoperatively. **Results:** Analysis was conducted on 60 patients with 3-month follow-up outcomes. There were no significant differences in IKDC scores between groups at baseline ($P = .211$) and 3 months' postoperatively ($P = .065$). Patients were more likely to report being satisfied with their rehabilitation group 73% vs. 100% ($P = .044$) if there were in the in-person group. Satisfaction differed significantly between the 2 groups at the end of their rehabilitation course, and only 64% of those in the telerehab group would elect to undergo telerehab again for future indications. Furthermore, they believed that future rehabilitation would benefit from a hybrid model. **Conclusions:** Telerehab showed no difference versus traditional in-person rehabilitation in terms of functional outcomes up to 3 months after arthroscopic meniscectomy. However, patients were less satisfied with telerehab. **Level of Evidence:** I, randomized controlled trial.

Telemedicine has gained attention in the past decade in response to rapidly ubiquitous video conferencing technology to provide for the remote care of patients.¹ Although innovative, telemedicine was not

commonly used until recently, when it was propelled to the forefront of health care following the outbreak of coronavirus disease 2019 (COVID-19).² The pandemic has created a unique situation that has led to expanding the telemedicine platform. Orthopaedics, which traditionally was based on in-person examination, surgeries, and postoperative in-person rehabilitation, recently has adopted telemedicine as an acceptable alternative for office visits as well as postoperative rehabilitation.³ Although the convenience for both patient and surgeon has made it clear that telemedicine is here to stay in a postpandemic landscape, the question remains how outcomes and patient satisfaction are affected by these changes. This is especially salient in postoperative rehabilitation, which is crucial to the patient's adequate recovery.

Telerehabilitation (telerehab) presents a unique challenge, given that physical therapy is built on manual

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The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received June 11, 2022; revised manuscript received December 22, 2022; accepted January 5, 2023.

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2666-061X/22735

<https://doi.org/10.1016/j.asmr.2023.01.006>

techniques and rehabilitation exercises that require tactile feedback to improve outcomes. Theoretically, the loss of this crucial facet of the rehabilitation process may jeopardize the effectiveness of rehabilitation. Alternatively, the convenience of telerehab may aid patient adherence to their prescribed program. There is a lack of orthopaedic literature investigating the question of telerehab, but the arthroplasty literature that has compared telerehab versus in-person rehabilitation has shown no difference between the 2 options in regard to functional metrics such as range of motion, balance, and strength.⁴⁻⁷ To date, there is minimal sports medicine literature on the difference between telerehab versus in-person rehabilitation. This presents a problem, given the growing number of those prescribing telerehab to accommodate patients during the COVID-19 pandemic, especially given the current uncertain climate regarding novel COVID-19 strains.⁸

The purpose of this study is to evaluate functional outcomes and satisfaction in patients who underwent telerehab compared with in-person rehabilitation after arthroscopic meniscectomy. By focusing on a standardized arthroscopic procedure such as meniscectomy, this study aims to lay the groundwork for future studies investigating telerehab outcomes. We hypothesized that functional outcomes following the cessation of rehabilitation would be the same, but satisfaction, and more specifically, the factors contributing to the patient's satisfaction with their assigned rehabilitation modality, would differ.

Methods

Study Design

This study received approval from our institutional review board, and all patients provided written consent to participate. This study was registered on clinicaltrials.gov (Clinical Trials #NCT04644640). All patients undergoing arthroscopic meniscectomy between the ages of 18 and 60 years at our institution were considered for participation. Patients were excluded if they were pregnant, had previous surgery of the affected limb, had any medical comorbidities precluding them from complying with rehabilitation, or had a concomitant cartilage procedure.

Randomization

Overall, 30 patients each were recruited for the telerehab and in-person rehabilitation groups, for a total of 60 patients, from September 2020 to October 2021. Patients who met eligibility were enrolled and randomly allocated to a subject group. Randomization was performed 1:1 via a computer-generated algorithm and conducted by an investigator not involved in the procedure. The surgeons were blinded to the rehabilitation group to which each patient was assigned. Group

1 underwent rehabilitation in person and group 2 solely received the rehabilitation through telemedicine. In the event of loss to follow-up, a new patient was recruited following this randomization model—they were not immediately recruited to whichever arm experienced dropout. Upon consent and recruitment into this study, demographic variables were abstracted from the patients' chart. These variables included age, sex, and body mass index (BMI). Preoperative radiographs were assessed for the Kellgren–Lawrence (KL) grade. Finally, intraoperative findings were used to calculate cartilage damage of the affected menisci.

Surgical Technique and Rehabilitation

All surgeons in the study were sports medicine fellowship-trained surgeons practicing in an academic medical center. Patients undergoing the study received general anesthesia as well as an adductor canal regional nerve block. By the end of the first postoperative week, patients were instructed to begin a structured physical therapy course for arthroscopic meniscectomy.

The rehabilitation protocol was standardized among the participating physicians and included weight-bearing as tolerated, and the goals and exercises did not differ across rehabilitation modalities. In phase 1 of rehabilitation (weeks 0-2), crutches were used in the first 48 postoperative hours with progression to weight-bearing as tolerated. Range of motion was prioritized with a goal of immediate full range of motion. Therapeutic exercises involving quadriceps and hamstring activation, range of motion, and swelling-controlling modalities were initiated immediately after the procedure. In phase 2 of rehabilitation (weeks 2-4), the patient was expected to be weight-bearing with range of motion again prioritized to preserve their full range of motion. Strengthening of the quadriceps and hamstring was again conducted with the use of the patient's own body weight. In phase 3 of rehabilitation (weeks 4-6), strengthening of the thigh and leg muscles was advanced to using weights in addition to the patient's body weight as tolerated. A return to athletic activity at surgeon and therapist' discretion also was encouraged.

Outcomes Evaluated

A survey comprising validated questionnaires to ascertain the patients' functional outcomes and satisfaction was sent over e-mail via the RedCap (Research Electronic Data Capture) system to ensure anonymity. Our primary outcome measures included the International Knee Documentation Committee Subjective score (IKDC) to encapsulate functional and pain metrics. Outcomes were assessed at the 3-month postoperative time point to coincide with the cessation of the patient's assigned rehabilitation modality. All patients were clinically assessed at routine postoperative

Table 1. Demographic Information

| n | In-Person | Tele-Rehab | P Value |
|------------------------|-------------|-------------|---------|
| | n = 31 | n = 29 | |
| Age, mean (SD) | 45.0 (13.7) | 50.2 (15.0) | .164 |
| Sex (%) | | | |
| Female | 9 (29) | 15 (52) | .073 |
| Male | 22 (71) | 14 (48) | |
| BMI, mean (SD) | 29.0 (7.5) | 29.2 (5.6) | .911 |
| KL grade, median (IQR) | 1 (1-2) | 1 (1-3) | .629 |

BMI, body mass index; IQR, interquartile range; KL, Kellgren–Lawrence; SD, standard deviation.

follow-ups by their respective surgeon and senior authors (G.G., M.J.A., E.J.S., L.M.J., and K.A.C.). Patients were also evaluated by board-certified physical therapists at the same academic center where they received their physical therapy.

Further measures collected at the same time point included questions aimed at gauging a patient's satisfaction. The patient was asked whether they were satisfied as a categorical variable, which was also quantified as a continuous variable from 0 to 10 (0 being completely unsatisfied and 10 being completely satisfied). To ask their satisfaction with their rehabilitation a different way, patients also selected whether they would undergo their assigned rehabilitation modality again as a categorical variable.

Drivers of satisfaction also were included on the survey for the telerehab group and included (1) whether the service was easy to implement; (2) whether the call quality with the physical therapist was optimal for their treatment; (3) whether the use of telerehab drove down the cost associated with their treatment, such as transportation, etc.; (4) whether using telerehab allowed the patient to attend more sessions; and (5) whether patients would prefer in the future a hybrid program consisting of initial in-person rehabilitation and later telerehab. The following questions were sent to patients in both the in-person and telerehab groups to assess differences and included: (6) whether patients were confident in performing the assigned exercise; (7) whether patients were confident in return to sport/daily activities; (8) whether patients had enough space at home for their exercises and equipment; and (9) whether patients had all of their questions answered. Patients were asked to respond to the aforementioned questions along a Likert scale (1: strongly disagree, 5: strongly agree).

Statistical Analysis

Statistical analysis was completed using GraphPad Prism 8.3 (GraphPad, La Jolla, CA). Descriptive statistics were reported for both continuous and categorical factors. Categorical variables were reported as prevalence with percentages, whereas continuous variables were

documented as a weighted mean with standard deviation. Fisher exact or χ^2 test was used to analyzed categorical variables. Data for continuous variables were tested for normality using the Shapiro–Wilk test. The independent or paired *t*-test for normally distributed variables, or the nonparametric Mann–Whitney *U* test or Wilcoxon signed-rank test was performed to compare continuous variables. Baseline scores and demographic variables were compared across the groups to control for confounding factors. A *P* of < .05 was considered to be statistically significant. Linear regression was performed with a dependent variable of satisfaction and covariates of age, BMI, sex, KL grade, cartilaginous damage, and in-person rehabilitation (binary variable).

An a priori power analysis was performed and the study was powered to achieve 80% power (1 – *b*) at the 0.05 significance level to assess for IKDC score, which disclosed a minimum of 25 patients in each group to detect clinical significance.

Results

Demographics

Overall, 60 patients were included in this randomized-controlled trial. Of this group, 49 patients were available for follow-up of 3 months (80%). All patients underwent arthroscopic meniscectomy. The patients were an average age of 47.5 (14.5), BMI of 29.1 (6.6), median KL grade of 1 (interquartile range 1-2). The cohort comprised 37 male and 23 female patients. The cohort studied was followed-up at a minimum of 3 months and comprised 31 patients receiving in-person rehabilitation and 29 patients receiving telerehab, thus comprising the 2 comparative groups. The demographic information of the patients in the 2 comparative groups is further illustrated in [Table 1](#) and demonstrates no statistically significant differences across groups. There was a loss to follow-up of 6 patients in the in-person group and 5 in the telerehab group at 3 months. None of the patients who enrolled in this randomized trial experienced any complications over the course of the participation to the date of their last clinical follow-up.

Analysis of Functional Outcomes at Baseline and 3 Months Across Groups

At baseline, IKDC was found to be similarly distributed across groups, with an average of 45.1 in the in-

Table 2. Functional Outcomes

| IKDC | In-Person | Tele-Rehab | P Value |
|----------|-------------|-------------|---------|
| Baseline | 45.1 (17.3) | 40.1 (12.0) | .211 |
| 3 months | 65 (17.8) | 54.8 (19.6) | .065 |

IKDC, International Knee Documentation Committee Subjective score.

Table 3. Satisfaction Across Groups

| | In-Person | Tele-Rehab | <i>P</i> Value |
|--------------------------------------|------------|-------------|----------------|
| Satisfaction Satisfied | 89.9 (8.2) | 64.9 (35.3) | .022 |
| Yes | 100% | 73% | .044 |
| No | 0% | 27% | |
| Would elect for rehabilitation again | | | .012 |
| Yes | 100% | 64% | |
| No | 0% | 36% | |

person group and an average of 40.1 in the telerehab group ($P = .211$). This was observed along the recovery course, with averages at 3 months of 65 and 54.8 for in-person and telerehab groups, respectively ($P = .065$). These findings along with comparisons are further illustrated in [Table 2](#).

Analysis of Satisfaction With Allotted Rehabilitation Modality Across Groups

Despite functional outcomes that were not significantly different, there were appreciable differences in satisfaction across the treatment arms. Patients were more likely to report being satisfied with their physical therapy 73% versus 100% ($P = .044$) if they were in the in-person group. This is elaborated upon by statistical differences in continuous satisfaction metrics, with 89.2 versus 64.9 ($P = .021$) favoring the in-person group ([Table 3](#)). Finally, patients in the telerehab group were likely to indicate that they would undergo in-person rehabilitation if the need for rehabilitation arose again. Overall, 64% of the telerehab group indicated that they would undergo telerehab for future needs as compared with 100% of the in-person group ($P = .012$). When we controlled for covariates including age, BMI, KL grade, cartilage damage, sex, and rehabilitation modality, rehabilitation modality was the only variable shown to significantly affect satisfaction with the patient's rehabilitation. In-person rehabilitation was shown to be significantly associated with increased satisfaction with the patient's rehabilitation ($\beta = 37.32$; $P = .043$). The results from this regression are further provided in [Table 4](#). The R squared is 0.423.

Analysis of Factors Driving Satisfaction in Telemedicine Group

Overall, all patients agreed that telerehab was easy to implement (100%). Furthermore, the majority of patients stated that call quality was optimal for rehabilitation purposes (80%). Patients in the telehealth group reached consensus that remote care drove down the costs of their postoperative treatment, with 80% of patients stating that it was cheaper as the result of a multitude of factors. However, it did not allow for the attendance of more sessions, with patients being split on its true accommodability. Finally, most patients (74%) stated that future rehabilitation would benefit

from a hybrid program—of both telerehab and in-person rehabilitation. These findings are illustrated in [Figure 1](#).

Analysis of Factors Driving Confidence and Satisfaction Across Both Groups

Overall, there were no significant differences in confidence in the ability to do rehabilitation tasks—both ability to perform exercises correctly and availability of all necessary equipment and space to conduct activities—as well as confidence in return to sport and return to daily activity. Further, there were no significant differences between groups in how well their questions and concerns were addressed.

Discussion

The primary finding of this study is that, among patient undergoing arthroscopic partial meniscectomy, despite equivalent functional outcomes postoperatively in patients who underwent telemedicine rehabilitation and in-person rehabilitation, patients who underwent in-person rehabilitation were more likely to report a greater level of satisfaction. Even when we controlled for demographic variables along with osteoarthritic and cartilage damage insult, telerehab was found to be the only significant factor correlating with decreased patient satisfaction. Furthermore, only 64% of patients in the telerehab group indicated that they would pursue telerehab for future indications. It is notable that 27% of the patients in telerehab were left unsatisfied and 36% of the telerehab arm would elect not to use it again. Conversely, 100% of the in-person physical therapy arm was satisfied. Despite agreeing with the theorized advantages of telerehab like its convenience and cost-effectiveness, patients still reported that a hybrid model of telerehab and in-person rehabilitation would be preferable moving forward.

Although telehealth capabilities have been in development for many years, they were only fully implemented in orthopedic practices at the start of the COVID-19 pandemic lockdown. At this time, they were used to provide the full spectrum of orthopaedic care visits from initial consultations to postoperative and long-term follow-up visits.^{7,9-17} Several studies

Table 4. Regression for Variables Affecting Satisfaction With Postoperative Rehabilitation

| | β | 95% CI | <i>P</i> Value |
|--------------------------|---------|------------------|----------------|
| Age | 0.339 | −0.9201 to 1.599 | .565 |
| Sex | −7.037 | −40.99 to 26.91 | .657 |
| BMI | −0.1002 | −2.203 to 2.003 | .918 |
| KL grade | 3.502 | −14.18 to 21.19 | .671 |
| Cartilage damage | −4.903 | −15.38 to 5.578 | .325 |
| In-person rehabilitation | 37.32 | 1.379 to 73.26 | .043 |

BMI, body mass index; CI, confidence interval; KL, Kellgren–Lawrence.

Drivers of Satisfaction in the Telerehab Group

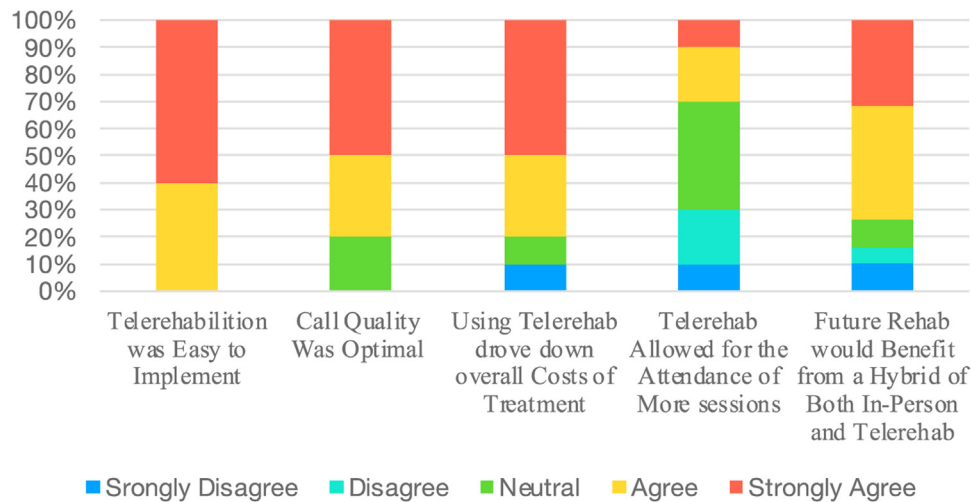


Fig 1. Illustrated are the drivers of patient satisfaction the telerehab group.

have shown that telemedicine enables patients to attend visits that were otherwise inaccessible to them due to lack of transportation or time off from work for example.^{10,18,19} Further, previous studies have shown widespread patient^{15,16,20,21} and surgeon²² satisfaction with telemedicine and plans for its continued use in practice. These findings and the burgeoning need for resilient healthcare infrastructure that promotes social distancing given continued COVID-19 variants and related uncertainty beg the question of how, if at all, important aspects of orthopedic care like postoperative rehabilitation can be made virtual. Given that successful telerehab requires not only patient and physician satisfaction but also equivalent or superior functional outcomes compared to in-person rehabilitation, our study findings are an important step towards successfully operationalizing telerehab into orthopedic practice.

Meniscectomies are known to be fairly low risk and complexity, in comparison to other arthroscopic procedures, and subsequently necessitate a similarly uncomplicated postoperative rehabilitation course.²³ At our institution, a typical postoperative course includes 6 weeks of rehabilitation that focuses primarily on immediate full range of motion, early full weight-bearing, and full painless range of motion, with supplemental quadriceps and hamstring strengthening. Complex equipment and tactile support may not be required for rehabilitation from meniscectomy and thus supports the present study findings, which suggests that there are no significant differences in functional outcomes across rehabilitation modalities. This however poses the question whether similar functional outcomes in the 2 different rehabilitation modalities will persist with more complex arthroscopic surgeries. Of the 6 existing orthopaedic studies—all in hip and knee

arthroplasty—comparing outcomes after telerehab and in-person rehabilitation, 4 found that there were both groups saw improvements in Western Ontario and McMaster Universities Osteoarthritis scores across its functional components without significant between group differences.⁴⁻⁷ Further, one study reported superior patient-specific functional scale and Western Ontario and McMaster Universities Osteoarthritis stiffness subscale patient outcomes after telerehab.¹¹ This literature as well as our findings suggest that as the COVID-19 pandemic continues, sports medicine surgeons can confidently recommend telerehab as a modality that ensures equivalent outcomes for meniscectomy. Although further research is required comparing outcomes in more complex sports medicine procedures, it is possible that equivalent outcomes between telerehab and in-person rehabilitation groups be seen after complex arthroscopic procedures, as evidenced by the previous arthroplasty literature.

Notably, 2 of the aforementioned 6 studies found no difference in patient satisfaction when comparing telerehab to in-person rehabilitation.^{7,24} These findings are in contrast to current study findings, which show not only were patients who underwent in person rehabilitation more likely to be satisfied at all, but also, they were more likely to experience greater satisfaction levels than patients who underwent telerehab.

Through more detailed survey questions, a more nuanced understanding was gained regarding why patient satisfaction was significantly different. Known benefits of telemedicine rehabilitation were acknowledged by patients—a majority agreed on telerehab's ease of use, optimal call quality, and reduction of treatment costs. However, patients did not agree that telerehab allowed for attendance of more sessions.

Although our study did not investigate why, anecdotal evidence from patients suggests that a growing number of responsibilities at home attributable to the pandemic (e.g., childcare, homeschooling, working from home, etc.) took time away from patients' abilities to attend even virtual sessions. Other factors, including appropriate addressing of patients' questions and concerns, space for exercise and equipment, confidence in abilities to perform rehabilitation exercises correctly, and confidence in return to daily activities and sport, did not vary significantly.

The results of these studies illustrate no disparity in functional outcomes, but clear and distinct differences in several metrics of patient satisfaction across the 2 rehabilitation arms. In-depth questioning of patients did not reveal what drove dissatisfaction with telerehab in comparison with in-person rehabilitation. Interestingly, the psychosocial metrics evaluated such as confidence in performing the exercises and confidence in their knee returning to sports or daily activities showed no difference between the 2 groups. In the absence of disparities in functional outcomes and important metrics such as confidence in performing their required activities, telerehab does stand as a viable alternative to in-person rehabilitation. However, more studies are needed to investigate this satisfaction gap to improve patient satisfaction—or to illustrate that the lack of a personal touch is truly insurmountable.

Limitations

There were several limitations of our study. First, although all rehabilitation specialists were trained physical therapists, we did not assess rehabilitation providers' proficiency or experience with telerehab, which may in turn have influenced patients' rehabilitation experiences. Second, although there was no statistically significant difference in KL grades and cartilage defects in both groups, a large percentage of patients in had KL grade of 3 or 4, which may significantly negatively impact satisfaction. Heterogeneity of the physical therapists is a potential limitation of the study, but all physical therapy and assessment were performed by board-certified physical therapists following an identical rehabilitation protocol at the same academic center at which patients received their original procedure. Limited follow-up time can be seen as a limitation of this study, but was made to coincide with the cessation of their rehabilitation modalities and should still encapsulate their functional outcomes trajectory. Arthroscopic meniscectomy was specifically chosen as the authors believed this would be sufficient time to encapsulate the satisfaction of patients undergoing therapy for this indication. Patient-reported outcomes, such as the IKDC, provide limited information at this time point, but help to provide an additional dimension of subjective outcome measurements for this

study in addition to satisfaction. Three people in the telerehab group crossed over to the in-person group, and 1 person switched from the in-person to telerehab group during their rehabilitation course. All patients who switched rehabilitation modalities during the study duration were treated with intention-to-treat analysis. We were unable to achieve the a priori power analysis of 25 patients in each arm with a final follow-up of 49 participants.

Conclusions

Telerehab showed no difference versus traditional in-person rehabilitation in terms of functional outcomes up to 3 months after arthroscopic meniscectomy. However, patients were less satisfied with telerehab.

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