Original Article

Approximately One Half of Patients Greater Than 40 Years Old Achieve Patient Acceptable Symptomatic State 6 Months After Arthroscopic Partial Meniscectomy

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Purpose: The purposes of this study were to 1) calculate the minimal clinically important difference (MCID) in a population of patients undergoing arthroscopic partial meniscectomy (APM) based on Knee Injury and Osteoarthritis Outcomes Scores (KOOS), 2) quantify the difference between the proportion of patients reaching MCID based on KOOS versus the proportion who considered surgery to be successful based on a "yes" answer to a patient acceptable symptom state (PASS) question, and 3) calculate the percentage of patients experiencing treatment failure (TF). **Methods:** A large, single-institution clinical database was queried for patients undergoing isolated APM (>40 years of age). Data were collected at regular time intervals, including KOOS and PASS outcome measures. Calculation of MCID using a distribution-based model was performed using preoperative KOOS scores as baseline. Comparison of the proportion of patients surpassing MCID was made to the proportion of patients answering "yes" to a tiered PASS question at 6 months after APM. Proportion of patients experiencing TF was calculated using patients who responded "no" to a PASS question and "yes" to a TF question. **Results:** Three-hundred and fourteen of 969 patients met inclusion criteria. At 6 months following APM, the percentage of patients meeting or exceeding the MCID for each respective KOOS subscore ranged from 64 to 72% compared to 48% who achieved a PASS ($P < .0001$ for each subscore). Fourteen percent of patients experienced TF. **Conclusions:** Six months after APM, approximately one half of the patients achieved a PASS and 15% experienced TF. The difference between achieving MCID based on each of the KOOS subscores and achieving success via PASS ranged from 16% to 24%. Thirty-eight percent of patients undergoing APM did not fit neatly into overt success or failure categorization. **Level of Evidence:** Level III, retrospective cohort study.

Introduction

Arthroscopic partial meniscectomy (APM) is one of the most common procedures performed in orthopaedic surgery and has long been regarded as reliable for improving patient pain levels and function.[1-6] Although APM has become a routine procedure for most arthroscopists, its application, particularly in patients >40 years of age (specifically among degenerative tearing in the presence of early arthritic changes), remains in question.[6-8] APM in patients over 40 years of age is typically reserved for those who have failed a course of nonoperative management (usually physical therapy), based on AAOS guidelines. However, even in these patients, its use continues to be debated.[9] Our study seeks to clarify and classify the degree of satisfaction patients undergoing APM experience.

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Patient satisfaction has become a more prevalent driver of healthcare decision making and expenditure. The availability of electronic methods to collect patient-reported outcome measures (PROMs) has facilitated the collection and analysis of large amounts of outcome data. However, the results can still be difficult to interpret and use for clinicians and patients alike. Although KOOS scores[10] may improve significantly, it may be difficult for patients and surgeons to interpret the value of this information without proper reference points. Measures such as minimal clinically important difference (MCID), the amount of improvement/change needed for it to be evident to the patient that change has occurred, as well as the proportion of patients who achieve this MCID after treatment have been used to inform conversations regarding results and expectations.[1,3,11-17] Critics of MCID as a proxy for success would suggest MCID simply allows for a noticed change following intervention, not necessarily "success," or "satisfaction."[18,19] Other helpful measures are patient-acceptable symptom state (PASS), which is calculated as the proportion of patients answering "yes" to a question posed regarding them having achieved a satisfactory functional state after treatment.[20,21] Finally, treatment failure (TF) is the proportion of patients responding "no" to a success question and "yes" to a failure question, as described by Ingelsrud and Roos.[20-23]

The purposes of this study were to 1) calculate the minimal clinically important difference (MCID) in a population of patients undergoing arthroscopic partial meniscectomy (APM) based on Knee Injury and Osteoarthritis Outcomes Scores (KOOS), 2) quantify the difference between the proportion of patients reaching MCID versus the proportion who considered surgery to be successful based on a "yes" answer to a PASS question and 3) calculate the percentage of patients experiencing treatment failure (TF). Our hypotheses were that a significantly higher proportion of patients would achieve MCID (based on KOOS) in comparison to PASS, and that ~10% of APM patients would suffer TF.

Methods

This study is an analysis of a large, single-institution clinical database of all patients undergoing APM from January 1, 2018, to May 17, 2021.

All patients over the age of 40 years undergoing isolated APM − CPT 29880/29881 (medial and/or lateral meniscectomy) during the above time period were identified. Those patients undergoing any additional procedure and those patients who did not respond to KOOS PROM's questionnaires within the time windows described below were excluded. Analysis was based on PROM's at the 6-month follow-up interval, and thus, patients who did not have available follow-up outcome measurement data at their 6-month interval were excluded. Demographic data were collected included age, body mass index, and gender. All operations were performed by orthopaedic surgeons fellowship-trained in sports medicine in a single orthopaedic group. Patients were indicated for APM if they had an MRI-identified meniscus tear that correlated with physical exam findings of meniscus tear (joint-line tenderness over the affected meniscus, pain with compression and rotation of the affected compartment, etc.), evidence of Kellgren-Lawrence grade <3 degenerative changes based on weight-bearing radiographs, and lack of satisfactory improvement after at least 3 months of nonoperative management. All radiographic measurements and physical examinations were performed by the eventual operative attending surgeon. APM was performed without concomitant chondral debridement.

All APM patients were questioned routinely as part of clinical outcome tracking at our institution, using the OBERD (Columbia, MO) clinical outcomes tracking software. Clinical outcomes (KOOS) were measured before (preoperatively to establish baseline) and at regular intervals after APM, including 2 weeks (14-21 days), 1 month (28-56 days), 3 months (70-98 days), 6 months (126-210 days), 1 year (252-420 days), and 2 years (504-840 days) postoperatively. Time windows to answer questionnaires were gradually widened as time from surgery increased to allow for maximal response rates. Prospectively collected patient outcome measures (KOOS), as well as responses to a question regarding satisfaction with current state (PASS) were analyzed. Preoperative KOOS scores were subtracted from 6-month postoperative score to quantify improvement. Patients were asked the following PASS question at each outcome timepoint, modeled based on previous literature: "Considering your function regarding the problem you're being treated for, and the length of time you've been undergoing treatment, do you feel that your current state is satisfactory? With function, you should take into account all activities during your daily life, sport and recreational activities, your level of pain and other symptoms, and also your related quality of life." Those patients answering "No" to the first PASS question were asked a follow-up question (Q2), "Would you consider your current state as being so unsatisfactory that you think the treatment is failing or has failed?" with the same answer selections (Fig 1). This tiered PASS question, wording, and method of establishing success ("yes" to Q1) and failure ("no" to Q1, "yes" to Q2) has been used in other arthroscopic knee surgery studies.[21,22]

Analysis included KOOS scores over time, PASS responses over time, and percentage of patients meeting MCID measures based on KOOS change (for each KOOS subscore) for each measured time interval.

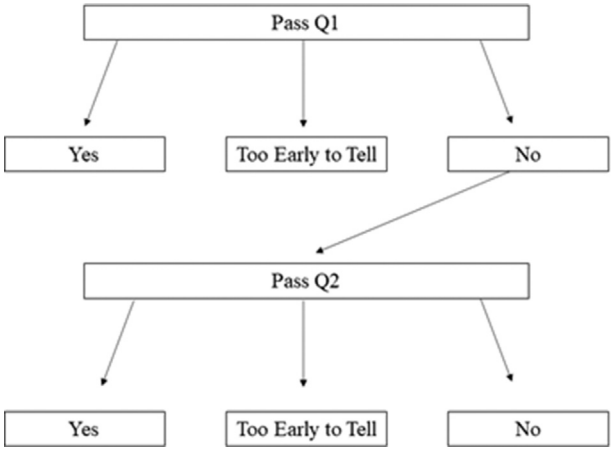

Fig 1. PASS question flowchart.

Proportion of patients who achieved MCID for each subscore were compared to proportions of patients who achieved satisfactory state ("yes" to PASS Q1). Analysis of the number of KOOS subscore MCID thresholds met compared to satisfactory state ("yes" to PASS Q1) was also performed. Finally, the proportion of patients who considered treatment to be a failure ("no" to PASS Q1, "yes" to PASS Q2) was calculated.

Institutional Review Board approval (IRB: STUDY00005039) for retrospective review of the above mentioned prospectively collected outcomes data was obtained.

Statistical Analysis

Python version 3.7.3 (Beaverton, OR) was used for analysis. Initial analysis was performed by grouping whether or not the PASS question was answered "yes". The distribution method was used to calculate MCID, defining MCID for each KOOS subscore as equal to 1/2 the observed standard deviation of the baseline preoperative measurement.[24] Contingency tables were tabulated for the conditional counts and proportions of PASS, according to whether MCID was met for each subscore. A two-proportion z-test was calculated to test for significant differences in the proportion of patients meeting MCID versus patients responding "yes" to PASS questioning. Significance levels assume two-tailed testing and alpha = 0.05. PASS Q2 was further utilized to determine proportionality of the overall group that answered "yes" to Q2, indicating TF.

Results

Overall, 959 patients underwent isolated APM during the time period of the study, with a mean age of 56.8 ± 8.3 years (range: 40−83 years), and average BMI of 31.0 ± 6.3 (range 17.8 − 67.6). Fifty-eight percent of included patients were male. A total of 314 (32.7%) patients were included in the analysis at the 6-month follow-up period, based on having answered KOOS questions preoperatively, both KOOS and PASS questions at 6-month follow-up and having met the other inclusion criteria. Of excluded patients, mean BMI and age were not notably different from the overall population (BMI 31.2 ± 6.5 and age 56.6 ± 8.5 years).

KOOS and PASS scores were tracked over time intervals from −84 days (beginning of preoperative window) to 2 years after surgery; however, for the purposes of the present study, the data of interest were collected from the 6-month interval. KOOS subscores and PASS question responses showed no further improvement beyond 3 months following surgery (Figs 2 and 3). For consistency with previously published data, the 6-month interval was chosen for analysis.[3]

Mean preoperative KOOS scores for measures of daily living, pain, quality of life, sports, symptoms were as follows 52.5 (±20.3), 46.3 (±17.6), 24.2 (±18.0), 27.1 (±23.6), and 50.6 (±18.4). Mean 6-month postoperative scores for measures of daily living, pain, quality of life, sports, symptoms were as follows: 73.2 (±22.0), 68.9 (±22.1), 50.8 (±28.4), 51.3 (±29.8), 67.9 (±20.5) (Figs 2 and 3).

MCID scoring calculations, using the distribution-based formula, and the "6-month postoperative" data were analyzed for each KOOS subscore. The calculated MCID based on standard deviation of preoperative KOOS scores was 10.2 for daily living, 8.8 for pain, 9.0 for quality of life, 11.8 for sports, and 9.2 for symptoms. The percentage of patients meeting or exceeding the MCID for each respective KOOS subscore at 6 months postoperatively was 68.8%, 72.3%, 70.4%, 64.3%, and 67.8%. PASS responses to Q1 were 47.8% "yes," 15.3% "too early to tell" and 36.9% "no." Of patients that were asked PASS Q2 (116 patients), 37.1% answered "yes" (current state indicates treatment failure), 27.6% indicated "too early to tell," and 35.3% answered "no." Grouping the responses together, ∼48% considered the APM a success, ∼25% thought it was too early to determine success versus failure, ∼13% thought it was not successful but also not a failure, and ∼14% thought it was a failure.

When compared using two proportion z-test analysis, for each of the five KOOS subscores, a significantly higher proportion of patients achieved at least the MCID in comparison to the proportion answering "yes" to the PASS Q1 question ($P < .0001$). In total, 138 patients surpassed MCID for all 5 KOOS criteria. Of these, notably, 37 (26.8%) patients still suggested it was either "too early to tell" or were not completely satisfied (PASS Q1 "too early to tell" or "no") (Fig 4). However, only 1 patient that surpassed all 5 KOOS MCID thresholds fell into the TF category (PASS Q2 "yes").

Discussion

We found that a significantly lower proportion of patients at 6 months post-APM achieved a PASS

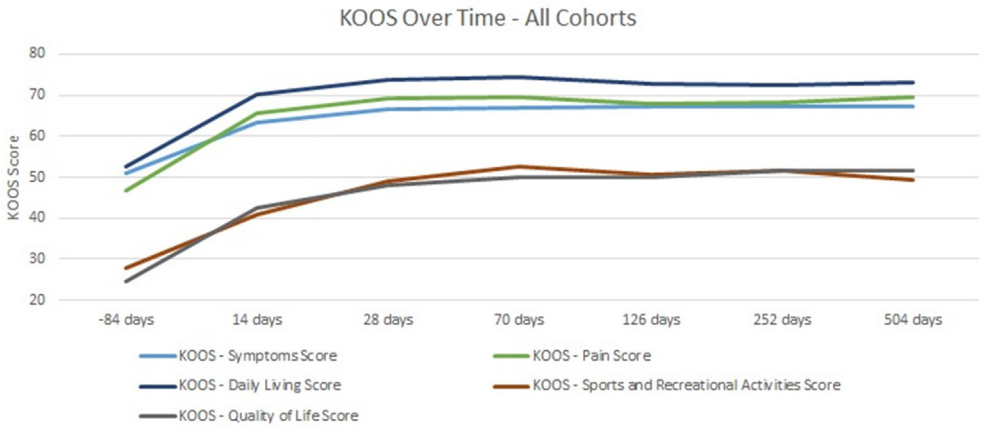

Fig 2. Individual KOOS Scores over time.

(48%) than MCID (64-72%) for any of the five KOOS subscores. This confirms that 15-25% of patients improved from APM, but not to a described acceptable state. Fourteen percent of patients analyzed considered their treatment to have failed, partially confirming the second hypothesis. The authors believe that these described MCID, PASS, and TF rates are easily understandable outcomes that can help patients and surgeons understand the range of results expected following APM. Specifically, a more granular discussion of expectations can be had between surgeon and patient based on these findings.

The current data set illustrates a potential mismatch between patient expectations and outcomes in patients over 40 undergoing APM. MCID should not be used as a proxy for treatment success. Instead, MCID simply identifies the change in a PROM score needed for the change to be perceived, rather than the change needed for "success," or "satisfaction".[18,19] If MCID and PASS are used to describe a diner who has requested that salt be added to their steak[18] (to paraphrase Rennard), MCID is the ability to barely tell that salt has been added, PASS is the diner being pleased with the amount of salt added. In recent studies of ACL reconstruction by Ingelsrud and Roos, ~90-95% of patients achieve MCID based on KOOS scoring, ~50-65% achieve PASS, and ~10% are TF.[21-23] Their results represent a similar disconnect between patients who improved in a statistically measurable amount and those who were satisfied with this improvement. For APM, ~60-70% meet MCID for functional and pain scores[17,25] and in a separate study, 67% achieve PASS.[3] However, these and other APM outcomes studies have been limited by use of a single, binary PASS question and a lack of directed queries regarding TF.

Only 48% of APM patients considered their treatment successful. Many would consider this to be disappointingly low. This is contrasted to 14% of patients who considered their treatment to be a failure. It could be tempting to dismiss these findings as not applicable to other surgeons and their patient populations. However, comparing the present population and results to other published APM and knee arthroscopy studies should provide reassurance that these results can be generalized. Dwyer et al.[15] reported PROMs in 110 patients 1 year after APM with average age of 54 years (they

Fig 3. PASS Q1 question "yes" responses over time by percentage of responders.

PASS Q1 Result	Not Yes	Yes	All
# KOOS MCID Met (out of 5)			
0	31	5	36
1	29	4	33
2	16	7	23
3	20	6	26
4	31	27	58
5	37	101	138
All	164	150	314

Fig 4. Frequency of KOOS meeting MCID versus PASS performance at 6 months.

included patients aged 18-70) with 57% males, and Gowd et al.[3] reported on 269 patients 6 months after APM with average age of 49 years (they included all ages) and average BMI of 30. Kenney et al.[26] reported PROMs in a knee arthroscopy population of 76 patients with average age of 49 years (they enrolled all patients over 18) with 53% males and BMI average of 30.5. The study population was 314 patients with average age of 57 years (we included only patients over the age of 40) with 58% males and BMI of 31. Demographically, this population is slightly older due to our inclusion criteria of age >40 and, otherwise, has a similar percentage of males and similar BMI. Second, the MCID results are similar to many studies of APM and knee arthroscopy.[1,3,15,17,25,26] KOOS subscore MCID values ranged from 8.5 to 15.6 in Gowd et al.'s work,[3] and 12.5-17.5 for Kenney et al.[26] MCIDs in the current study ranged from 8.8 to 11.8. Slight MCID value differences between our study and Kenney were likely due to the calculation method; Gowd et al.'s and our study used the distribution method, while Kenney et al. used an anchor-based method. Finally, the average postoperative improvement in KOOS subscores ranged from 7 to 32 in Dwyer,[15] 17-24 in Kenney, and 17-27 in our study. The overlap in demographics, MCID, and KOOS improvement between prior studies and the current study provides evidence that our PASS and TF results reflect what could be expected in other APM and knee arthroscopy studies if the patients had been queried as ours were, especially in the group over 40 years of age.

With those objections faced, we can focus on several novel findings. First, significantly more patients achieve MCID than a PASS after APM. This should be intuitive, as the data presented quantifies the difference as about 15-25% of patients being improved but not to their acceptable state. The gap between MCID and PASS is likely because MCID is a measure of the minimum positive impact noticeable to change outcome,[27] but also oversimplifies the complex association of patient expectations, attitudes, and patients considering a surgery as a "success," limiting generalizability.[28] MCID thresholds are designed to locate a point at which a patient begins to notice a treatment has been beneficial, but this is not equivalent to what a patient may consider to be a "successful" intervention.[27] Second, only about 50% of APM patients achieve a PASS. This seems low, but it is actually similar to that reported for ACL reconstruction when a similar approach to querying regarding PASS question is employed.[21-23] "Yes" answers to Q1 of the PASS question in this study may also be lower than those reported by Gowd et al.[3] (66%), because patients had the option to select "too early to tell" as a response to PASS Q1. It is interesting that although the KOOS scores plateaued at 3 months from surgery, 25% of patients still responded that it was "too early to tell" at 6 months after APM. Preoperative education about the time expected to reach full recovery after APM may help these patients. Third, nearly 15% experienced TF. Close analysis of this group may help us to identify predictors of TF and, thus, patients we should avoid offering APM, effectively further narrowing indications. Finally, there is a fairly large group of patients (38%) who are hiding in plain sight. They haven't achieved PASS, but they also haven't suffered failure. Some think it's too early to declare success or failure (25%)—those answering "too early to tell", and some are between success and failure (13%)—those answering "no" to Q1 and Q2. Although not the focus of our study, we found that many patients remain in this intermediary group even at longest duration of follow-up, well beyond the most optimistic duration of potential continued improvement from APM. This likely represents a shortcoming of MCID or other binary analyses. This continued anticipation of potential further improvement by patients in this group may be represent a failure of surgeons to accurately counsel patients on the timeframe of expected benefit of results which, based on the data, is between 3 and 6 months of surgery.

APM remains an important surgical intervention with significant merit, even in many patients >40 years, but it may benefit from contextualization to the patients to improve satisfaction rates. Moreover, patients for whom the surgery has been neither a success nor a failure exist. Perhaps with further intervention or preoperative counseling, a larger portion of these patients may define themselves as satisfied. Furthermore, we should continue to explore how to determine success following surgery and how to identify optimal surgical candidates. Lastly, we should continue to consider the ~1/3 of patients "hidden" by binary definition of success who have had some measures of success but

remain incompletely satisfied. We may see a significant increase in patient satisfaction with adjustment of expectations and more accurate assessment and targeting of this group, using a tiered PASS-type question moving forward. For patients considering APM after failure of nonoperative treatment, we tell them that two-thirds to three-fourths of them should feel improvement after surgery, half should be completely satisfied with their results of treatment, and 15% will believe that the treatment has failed. We hope that presentation of easily understandable results will lead to improved shared decision making.

Limitations

There are limitations to our study. Despite a large clinical database of patients, the study was retrospective. The study also had a large group of patients who did not respond to questionnaires at the timeframe of interest (6 month), and, thus, were excluded, potentially introducing selection bias. Additionally, the results are likely limited to the population of patients undergoing APM, rather than all knee pathology/surgical patients. No information was included regarding tear size, specifics of preoperative/postoperative management, tear characteristics, traumatic versus degenerative tearing, or medial/lateral meniscus injury. Additionally, a large age range was captured. Although outcome measures were collected prospectively, there is a largely heterogenous population of patients undergoing APM, including patients with and without chondral lesions, as well as patients of varying ages and activity levels, all of which can influence results.[29,30] Furthermore, the data collected, although from a large clinical database, are from a single institution in one geographical location and, thus, is subject to the potential bias of surgical indications and patient characteristics of the institution. It should also be noted that the data above is specific for patients over the age of 40, and likely does not represent the same type of results as the young, athletic APM population following an acute injury.

Conclusions

Six months after APM, approximately one-half of the patients achieved a PASS and 15% experienced TF. The difference between achieving MCID based on each of the KOOS subscores and achieving success via PASS ranged from 16% to 24%. Thirty-eight percent of patients undergoing APM did not fit neatly into overt success or failure categorization.

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