

## Meta-Analysis

# International Knee Documentation Committee (IKDC) Is the Most Responsive Patient Reported Outcome Measure After Meniscal Surgery

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**Purpose:** To report the variability in outcome measures after meniscal surgery and to compare responsiveness between patient-reported outcome measures (PROMs). **Methods:** A systematic search of the PubMed/MEDLINE and Web of Science databases was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines. A total of 257 studies met inclusion criteria. Patient and study attributes were extracted, including pre- and postoperative means for PROMs. Of the studies that met inclusion criteria for responsiveness analysis (2+ PROMs reported, 1-year minimum follow-up; n = 172), we compared the responsiveness between PROM instruments using effect size and relative efficiency (RE) if a PROM could be compared with another in at least 10 articles. **Results:** In total, 18,612 patients (18,690 menisci, mean age = 38.6 years, mean body mass index = 26.3) were included in this study. Radiographic measures were reported in 167 (65.0%) studies, range of motion was reported in 53 (20.6%) studies, and 35 different PROM instruments were identified. The mean number of PROMs in each article was 3.6 and 83.8% reported 2 or more PROMs. The most used PROMs were Lysholm (74.5%) and IKDC (51.0%). IKDC was found to be more responsive than other PROMs, which include Lysholm (RE = 1.03), Tegner (RE = 3.90), and Knee Injury and Osteoarthritis Outcome Score (KOOS) Activities of Daily Living (ADL) (RE = 1.12). KOOS Quality of Life (QoL) was also more responsive than other PROMs, such as IKDC (RE = 1.45) and KOOS ADL (RE = 1.48). Lysholm was more responsive compared with KOOS QoL (RE = 1.14), KOOS ADL (RE = 1.96), and Tegner (RE = 3.53). **Conclusions:** Our study found that IKDC, KOOS QoL, and Lysholm were the most responsive PROMs. However, because of the previously reported risks of either floor effects (KOOS QoL) or ceiling effects (Lysholm), the IKDC may offer a more complete psychometric profile when quantifying outcomes after meniscus procedures. **Clinical Relevance:** To improve clinical outcomes, surgical decision-making, and research methodology, it is important to determine which PROMs are the most responsive after meniscal surgery.

The treatment of meniscal pathology is a rapidly expanding area in the field of orthopaedic surgery.<sup>1,2</sup> Despite expanding meniscal studies in the literature, a standardized, reliable metric to assess outcomes after meniscal procedures has not been established. Multiple patient-reported outcome measures

(PROMs) have been used to assess the efficacy of treatment<sup>3</sup>; however, the most effective measures remain unclear. Effective outcomes are needed to standardize the reporting of various meniscal pathologies to better assist not only patient satisfaction, but the surgeon's decision-making as well. The use of

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unnecessary PROMs can increase health care costs, time, and clinical inefficiency. The absence of guidelines on which pre- and postoperative outcomes to report also can lead to increased bias in the literature, as the variability of reporting methodology has not been quantified in a systematic manner and there are no comparisons performed between PROMs to determine responsiveness.<sup>4</sup> With the increase in systematic reviews seen in recent years,<sup>5</sup> more consistency in outcome reporting also would be beneficial.

The variability seen in PROM use is not unique to meniscal literature. Other studies on hip arthroscopy,<sup>4</sup> rotator cuffs,<sup>6</sup> and anterior cruciate ligament reconstruction (ACLR)<sup>7</sup> have demonstrated similar variability. As a result, this makes analysis of multiple studies difficult, limiting the ability to draw definitive conclusions from pooled data. With meniscal pathology being a common reason for surgery,<sup>8</sup> consistent reporting is critical to determine how to best follow these patients throughout their recovery. To identify patients at risk for inferior outcomes, pooled data from multiple studies are needed to assess risk; however, because of highly variable reporting measures, the ability to do so is limited. PROM instruments need to be compared within the same patient population before and after surgery to measure responsiveness.<sup>4</sup> Greater responsiveness allows for the ability to accurately detect change over time, which is the main purpose of PROMs.<sup>9,10</sup> Previous studies have been performed to determine the most responsive PROMs for common orthopaedic conditions, including hip arthroscopy<sup>4</sup> and patellar instability.<sup>11</sup>

The purposes of this systematic review were to report the variability in outcome measures after meniscal surgery and to compare responsiveness between PROMs. We hypothesized that the International Knee Documentation Committee (IKDC) would be the most responsive and commonly used PROM.

## Methods

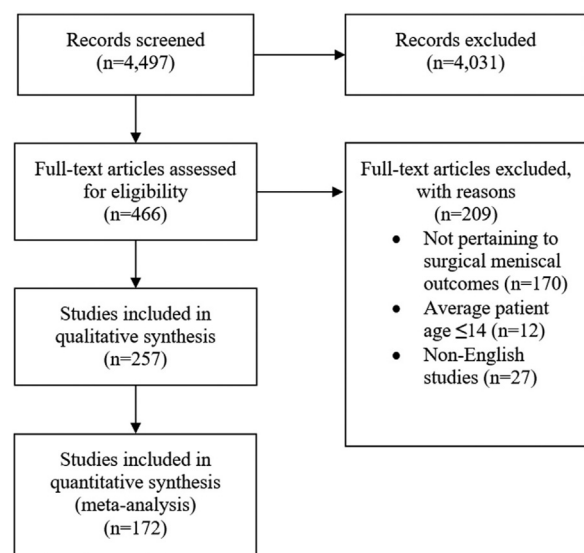
This project did not require review by the institutional review board. A comprehensive literature review by 2 authors (A.K. and L.S.) was conducted in PubMed/MEDLINE and Web of Science databases using the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines to identify all articles referring to meniscal repair published between January 1989 and April 2022. The key words “meniscal,” “menisci,” “patient reported outcomes,” “PROs,” and “outcomes” were used to identify articles. Cross-referencing was performed to identify articles that were potentially missed. Inclusion criteria were both English-language publications, as well as any study examining subjective and/or objective clinical outcomes after meniscal surgery for any presenting pathology. Exclusion criteria included systematic reviews, meta-analyses,

nonhuman subject testing, nonmeniscal studies, multiligament studies, studies in pediatric patients with an average age  $\leq 14$  years, and foreign-language publications (Fig 1).

Information extracted from each article included year and journal of publication, number of patients, number of knees, Level of Evidence, mean patient demographics, mean follow-up, and pathology treated. Outcome measures documented were as follows: range of motion, revision rate, PROMs, and patient satisfaction. Pre- and postoperative means and standard deviations of PROMs from all studies that used 1 or more PROMs were recorded. From these articles, we were able to compare responsiveness between the PROM instruments via calculating the effect size and relative efficiency if a PROM could be compared with another in at least 10 articles. A previously published methodology was used to evaluate responsiveness.<sup>4,11</sup> Effect size measures the change from pre- to postoperative scores while also accounting for variability within a specific PROM tool. An effect size between 0.2 and 0.49 is described as small, those between 0.5 and 0.79 are moderate, and those greater than or equal to 0.8 are large. Relative efficiency was then calculated to compare responsiveness between 2 individual PROM instruments used in the same study and population of patients. A relative efficiency value of  $<1$  signals that the first patient-reported outcome has less responsiveness than the other tool, and a value  $>1$  indicates that the first PROM has greater responsiveness.<sup>4</sup>

## Quality Assessment

Each article included in this study was assigned a level of evidence based on the Oxford Centre for Evidence-



**Fig 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram.

Based Medicine. The Methodological Index for Non-randomized Studies tool<sup>12</sup> was used to evaluate the quality of nonrandomized studies. The ideal global score is 16 for noncomparative studies and 24 for comparative studies.<sup>13</sup> The Modified Coleman Methodology<sup>14</sup> score as used to assess randomized studies. It uses a scoring system between 0 and 100, where 100 indicates a high-quality study without chances, bias, and other confounding factors.<sup>15</sup> Both these measures have been used in previous literature.<sup>11</sup>

## Results

We identified 257 studies that met inclusion criteria. These articles included 18,612 patients (18,690 menisci, mean age = 38.6 years, mean body mass index = 26.3). The mean number of menisci per article was 65.2 (range, 4-1,090 menisci). The mean follow-up was 48.5 months (range, 2-240 months). A total of 167 of 257 studies (65.0%) reported radiographic measures. The Kellgren–Lawrence classification (53/167) and meniscal extrusion (in millimeters) (37/167) were the most commonly reported variables. Range of motion was reported in 53 of 257 studies (20.6%), with the overall mean duration between the onset of symptoms and surgery being 16.3 months (range, 0.8-72 months). There were 104 articles (40.5%) that reported revision arthroscopy. The mean Methodological Index for Non-Randomized Studies score was 12.3 and the mean Coleman score was 65.2 (Table 1). The median Level of Evidence was III, with 55 of 257 (21.4%) being classified as Level I or II evidence (Fig 2). *The Knee Surgery, Sports Traumatology, Arthroscopy* journal had the greatest number of Level I and II studies. Journals that published the greatest number of articles are reported in Table 2.

Thirty-five different PROM instruments were identified in this study. The mean number of PROMs in each study was 3.6 (range, 1-13), and 217 of 257 (84.4%)

used 2 or more PROMs. The most used PROM was the Lysholm Score (n = 193, 75.1%), followed by IKDC (n = 132, 51.4%), Tegner Activity Scale (n = 111, 43.2%), Knee Injury and Osteoarthritis Outcome Score (KOOS) Pain (n = 79, 30.7%), KOOS Sport and Recreation (Sport/Recreation) (n = 75, 29.2%), KOOS Quality of Life (QoL) (n = 75, 29.2%), KOOS Symptoms (n = 75, 29.2%), and visual analog scale (n = 67, 26.1%) (Table 3). A total of 66 of 257 articles (25.7%) reported patient satisfaction.

From the full set of 257 articles, 172 articles were identified that met inclusion criteria for responsiveness analyses (used 2 or more PROMs, minimum follow-up time was 1 year, and both pre- and postoperative means and standard deviations were reported). The majority of articles used either Lysholm or IKDC with additional PROMs. The 3 PROMs with the greatest positive effect sizes were IKDC (1.94), KOOS Overall (1.64) and KOOS QoL (1.62) (Table 4). The 3 PROMs with the highest relative efficiencies were IKDC, Knee Injury and Osteoarthritis Outcome Score Quality of Life, and Lysholm (Table 5).

## Discussion

The most important finding of this study was that the IKDC, KOOS QoL, and Lysholm were the most responsive instruments when compared with other PROMs used to assess outcomes after meniscal procedures. The Lysholm was the most commonly used instrument.

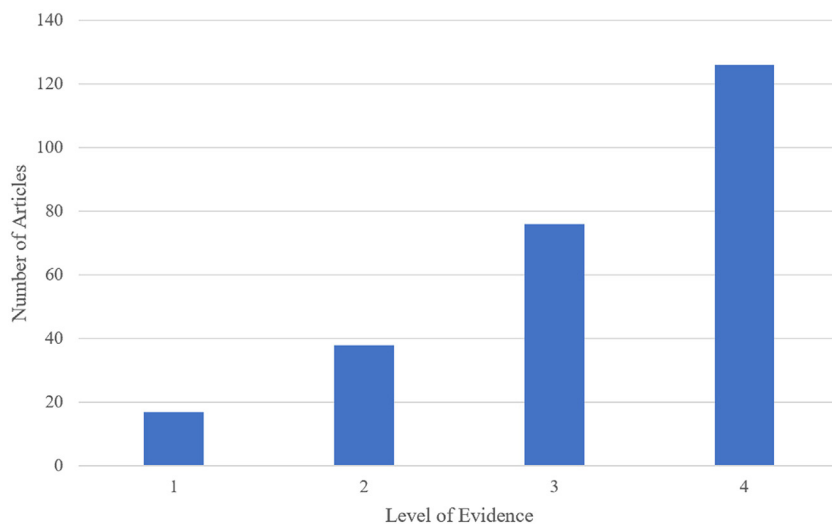
With the knee being a very common site of injury, outcome measures have been developed and validated to measure patient status postsurgery.<sup>16</sup> The IKDC was used in 132 of 257 studies (51%), which was originally developed as a knee-specific outcome measure of patient symptoms, sport activity, and function for multiple knee pathologies. It consists of 18 questions to measure pain, stiffness, swelling, joint locking, joint instability, and the ability to perform activities of daily living.<sup>17</sup> It has been validated several times in previous studies,<sup>3,17-19</sup> and its wide usability has allowed it to be a common staple of international orthopaedic literature.<sup>16</sup> Crawford et al.<sup>20</sup> assessed the floor and ceiling effects of IKDC in meniscal injuries, finding the overall score (0-100) has both a 0% floor effect and 0% ceiling effect. Floor and ceiling effects are defined as the proportion of respondents that score the lowest (floor) or highest (ceiling) score on a questionnaire.<sup>21</sup> For example, having a 0% floor effect means that no respondent scored the lowest possible score on a questionnaire. There was an acceptable test–retest reliability with an interclass correlation of 0.95.<sup>20</sup> Similar to our study, they found a large effect size (2.11) and large response mean (1.5).<sup>20</sup> Ha et al.<sup>22</sup> assessed IKDC scores in meniscal allograft transplant outcomes with patient satisfaction, finding that IKDC

**Table 1.** Characteristics of Included Studies

Characteristics	Results (Range)	Studies Reporting (%)
No. of patients	64.6 (4-1,090)	257 (100)
No. of menisci	65.2 (4-1,090)	257 (100)
Mean age, y	38.6 (14.9-75)	249 (97)
Mean BMI*	26.3	150 (58)
Mean follow-up, mo	48.5 (2-240)	251 (98)
Mean duration of symptoms, mo	16.3 (0.8-72)	82 (32)
Reported radiographic variables	–	167 (65)
Reported range of motion	–	53 (21)
Reported revision arthroscopy	–	104 (40)
Mean MINORS score	12.3	240
Mean Coleman score	65.2	17

BMI, body mass index; MINORS, Methodological Index for Non-Randomized Studies.

\*BMI was most commonly reported as a mean; consequently, a range could not be determined due to incomplete data.



**Fig 2.** Level of Evidence of included studies.

outcome scores reflect patient satisfaction well before and after a multivariable logistic regression, whereas Lysholm only showed a significant association on univariate analysis.

The KOOS was developed in 1995 as an extension of the Western Ontario and McMaster Universities Arthritis Index (WOMAC) to assess short- and long-term symptoms in patients with knee injury and osteoarthritis. It is composed of 42 items in 5 subsections: Pain (9 items), Activities of Daily Living (17 items), Sport/Recreation (5 items), QoL (4 items), and other Symptoms (7 items).<sup>23</sup> Scores are then transformed to a scale of 0-100, with 100 being no knee problems. Overall scores are usually not reported, as it is more desirable to analyze the 5 separate subscales individually.<sup>23</sup> Van de Graaf et al.<sup>24</sup> assessed the reliability and validity of Dutch-language IKDC, KOOS, and WOMAC in patients with meniscal injuries. Cronbach alpha scores were 0.90, 0.72-0.95, and 0.84-0.95, with an intraclass correlation coefficient of 0.93, 0.84-0.89, and 0.77-0.89 respectively. Floor effects within the smallest

detectable difference from a minimum score was found for KOOS Sports/Recreation and QoL. Ceiling effects within the smallest detectable difference from the maximum score was found in KOOS Activities of Daily Living and WOMAC. They recommended IKDC to be used in assessing functional outcomes in patients with meniscal tears,<sup>24</sup> which is in line with the current meta-analysis results.

The most commonly used PROM in our study was Lysholm. It was originally designed to assess ligament

**Table 2.** Journals Most Frequently Publishing Outcome Studies After Meniscal Surgery and the Number of Level I and II Studies

Journals	No. of Studies	No. of Level I or II Studies
<i>Knee Surgery, Sports Traumatology, Arthroscopy</i>	50	10
<i>Arthroscopy</i>	45	5
<i>American Journal of Sports Medicine</i>	41	8
<i>Orthopaedic Journal of Sports Medicine</i>	12	2
<i>Knee</i>	10	3
<i>Journal of Orthopaedic Surgery (Hong Kong)</i>	6	0
<i>Orthopaedics &amp; Traumatology: Surgery &amp; Research</i>	6	2
<i>BMC Musculoskeletal Disorders</i>	5	0
<i>Journal of Knee Surgery</i>	4	1

**Table 3.** The Most Commonly Used Patient-Reported Outcome Measures

Patient-Reported Outcome Measure	No. of Articles (%)
Lysholm	193 (75.1)
International Knee Documentation Committee	132 (51.4)
Tegner Activity Scale	111 (43.2)
Knee Injury and Osteoarthritis Outcome Score – Pain	79 (30.7)
Knee Injury and Osteoarthritis Outcome Score – Sport and Recreation	75 (29.2)
Knee Injury and Osteoarthritis Outcome Score – Quality of Life	75 (29.2)
Knee Injury and Osteoarthritis Outcome Score – Symptoms	75 (29.2)
Visual analog scale	67 (26.1)
Knee Injury and Osteoarthritis Outcome Score – Activities of Daily Living	59 (23.0)
Knee Injury and Osteoarthritis Outcome Score – Overall	35 (13.6)
Western Ontario and McMaster Universities Osteoarthritis Index	21 (8.2)
Short Form-12 Physical Component Scale	13 (5.1)
Cincinnati Knee Rating System	12 (4.7)
Short Form-36	11 (4.3)
Short Form-12 Mental Component Scale	10 (3.9)
Hospital for Special Surgery Knee-Rating Scale	8 (3.1)
Western Ontario Meniscal Evaluation Tool	5 (1.9)

**Table 4.** Pooled Pre- and Postoperative Means and ES of PROMs

PROM	No. of Studies	No. of Menisci	Preoperative Score	Postoperative Score	ES
IKDC	66	3,261	46.7 ± 15.2	76.2 ± 18.3	1.94
KOOS Overall	10	912	43.1 ± 17.3	71.4 ± 20.8	1.64
KOOS QoL	31	2,110	32.8 ± 18.6	63.0 ± 24.5	1.62
Lysholm	100	5,025	55.8 ± 17.7	83.4 ± 16.1	1.56
KOOS Pain	33	2,168	54.9 ± 18.6	79.4 ± 17.8	1.32
KOOS Sport/Recreation	31	2,110	34.6 ± 23.8	61.7 ± 26.3	1.14
KOOS ADL	31	2,110	65.3 ± 20.3	86.2 ± 15.1	1.03
KOOS Symptoms	31	2,110	55.7 ± 19.0	74.5 ± 17.7	0.99
Tegner	38	1,654	3.6 ± 2.2	4.8 ± 2.1	0.57
VAS	35	2,010	5.4 ± 2.5	1.9 ± 1.9	-1.38

ADL, activities of daily living; ES, effect size; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; PROM, Patient-Reported Outcome Measure; QoL, Quality of Life; VAS, visual analog scale.

injuries in the knee,<sup>25</sup> such as ACLR,<sup>26</sup> but has since been used in multiple knee pathologies like chondral disorders<sup>25</sup> and meniscal injury.<sup>27</sup> The adaptation for multiple knee pathologies may be due to its familiarity with clinicians and researchers. Lysholm measures outcomes in 8 categories: limp, locking, pain, stair-climbing, support, instability, swelling, and squatting.<sup>25</sup> Like the IKDC, it has been validated in the past and has been shown to be reliable.<sup>25,28-30</sup> Ra et al.<sup>31</sup> compared the ceiling effects of Lysholm and IKDC in patients undergoing ACLR, finding no significant difference between IKDC subjective and Lysholm scores in terms of ceiling effects. However, there was a concern that the ceiling effect of Lysholm was greater than IKDC subjective score. The Lysholm was shown to be one of the most responsive instruments in the current results; however, the potential for ceiling effects minimizes enthusiasm for using the Lysholm to quantify outcomes after meniscal procedures when compared to the IKDC.

Outcome reporting in meniscal literature is highly variable and guidelines should be constructed on how to best measure outcomes, allowing for better interpretation of studies to draw conclusions. Although each PROM has its role in orthopaedic literature, the results of this systematic review showcase that IKDC, KOOS QoL, and Lysholm were the most responsive

instruments. However, because of the risks of either floor effects (KOOS QoL) or ceiling effects (Lysholm), the IKDC may offer a more complete psychometric profile when quantifying outcomes after meniscus procedures.

### Limitations

This study was not without limitations. We did not review the included studies for treatment efficacy, only to report and assess responsiveness of the PROM they used. Several articles were excluded from responsiveness analysis due to not meeting inclusion criteria for analysis. Even though not every article was included in responsiveness analysis, we believe that the inclusion criteria was important to preserve the integrity and validity of our study. Finally, only studies written in English were included in this review.

### Conclusions

Our study found that IKDC, KOOS QoL, and Lysholm were the most responsive PROMs. However, because of the previously reported risks of either floor effects (KOOS QoL) or ceiling effects (Lysholm), the IKDC may offer a more complete psychometric profile when quantifying outcomes after meniscus procedures.

**Table 5.** Relative Efficiency (Comparative Responsiveness) Between PROMs\*

	Lysholm	IKDC	Tegner	VAS	KOOS Pain	KOOS ADL	KOOS Symptoms	KOOS Sport/Recreation	KOOS QoL
Lysholm		1.03	0.28	0.79	0.70	0.51	0.41	0.38	0.88
IKDC	0.97		0.26	0.12	1.12	0.89	0.72	0.73	1.45
Tegner	3.53	3.90		1.49	—	—	—	—	—
VAS	1.27	8.36	0.67		1.00	0.69	0.72	0.84	1.15
KOOS Pain	1.44	0.89	—	1.00		0.74	0.60	0.65	1.07
KOOS ADL	1.96	1.12	—	1.46	1.34		0.87	0.89	1.48
KOOS Symptoms	2.47	1.38	—	1.39	1.67	1.15		1.10	1.83
KOOS Sport/Recreation	2.62	1.37	—	1.19	1.54	1.12	0.91		1.66
KOOS QoL	1.14	0.69	—	0.87	0.93	0.68	0.55	0.60	

ADL, Activities of Daily Living; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; PROM, patient-reported outcome measure; QoL, Quality of Life; VAS, visual analog scale.

\*Values >1 suggest that the PROM tool in the top row is more responsive than the corresponding PROM tool in the left column. A dash indicates that there were not 10 comparisons to be made between PROMs to calculate relative efficiency.

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