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Original Article

Clinical Outcome Measures in Arthroscopic Meniscectomy: Clinician *versus* Patient Completed Knee Scores

Medidas de desfechos clínicos na meniscectomia artroscópica: Pontuações de joelho segundo médicos e pacientes

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Abstract

Objective The aim of the present study was to investigate the difference between clinician-completed and patient-completed outcome scores in detecting improvement following arthroscopic meniscectomy in patients with meniscal tears of the knee.

Methods Thirty-four patients with meniscal tears were prospectively assessed using 9 clinical outcome measures. The five clinician-completed knee scores included the Tegner Activity Score, the Lysholm Knee Score, the Cincinnati Knee Score, the International Knee Documentation Committee (IKDC) Examination Knee Score, and the Tapper and Hoover Meniscal Grading Score. The four patient-completed knee scores included the IKDC Subjective Knee Score, the Knee Outcome Survey – Activities of Daily Living Scale (KOS-ADLS), the Short Form-12 Item Health Survey (SF-12), and the Knee Injury and Osteoarthritis Outcome Score (KOOS). Twenty-nine of the 34 patients underwent an arthroscopic meniscectomy and were reassessed with all 9 outcome scores upon their follow-up review.

Results A significant longitudinal improvement was observed in 4 of the 5 clinician-completed scores (Tegner [$p < 0.001$], Lysholm [$p = 0.004$], Cincinnati [$p = 0.002$] and Tapper and Hoover [$p < 0.001$], but not in the IKDC Examination [$p = 0.332$]. However,

Keywords
- meniscus
- meniscectomy
- patient reported outcome measures
- Lysholm knee score

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the IKDC Subjective score ($p = 0.021$) was the only patient-completed score to demonstrate significant improvement postoperatively.

Conclusion Overall, clinician-completed scoring systems were found to be inconsistent with those of patient-completed instruments. The mode of administering outcome measures can have a significant influence on the outcome results both for research and for clinical practice. A combination of both a clinician-completed with a patient-completed instrument may be a more balanced approach to assessing and quantifying meniscus tears and the outcome following arthroscopic meniscectomy.

Resumo

Objetivo O objetivo do presente estudo foi investigar a diferença entre instrumentos de desfechos preenchidos por médicos e pacientes na detecção de melhora após a meniscectomia artroscópica para tratamento de rupturas de menisco.

Métodos Trinta e quatro pacientes com rupturas de menisco foram avaliados de forma prospectiva usando 9 medidas de desfechos clínicos. Os cinco instrumentos de avaliação de joelho respondidos por médicos foram o Escore de Atividade de Tegner, o Escore de Joelho de Lysholm, o Escore de Joelho de Cincinnati, o Escore de Exame do Joelho do International Knee Documentation Committee (IKDC, na sigla em inglês) e o Escore de Classificação do Menisco de Tapper e Hoover. Os quatro instrumentos de avaliação do joelho respondidos por pacientes foram o Escore Subjetivo do Joelho do IKDC, a Pesquisa de Desfecho de Joelho – Escala de Atividades de Vida Diária (KOS-ADLS, na sigla em inglês), o Formulário Curto de Pesquisa em Saúde de 12 Itens (SF-12, na sigla em inglês) e o Escore de Desfecho de Osteoartrite e Lesões no Joelho (KOOS, na sigla em inglês). Vinte e nove dos 34 pacientes foram submetidos a uma meniscectomia artroscópica e reavaliados com todos os 9 instrumentos na sua consulta de acompanhamento.

Resultados Uma melhora longitudinal significativa foi observada em 4 dos 5 instrumentos respondidos por médicos (Tegner [$p < 0{,}001$], Lysholm [$p = 0{,}004$], Cincinnati [$p = 0{,}002$] e Tapper e Hoover [$p < 0{,}001$], mas não no IKDC [$p = 0{,}332$]). Por outro lado, o Escore Subjetivo do Joelho do IKDC ($p = 0{,}021$) foi o único instrumento respondido por pacientes a demonstrar melhora pós-operatória significativa.

Conclusão De modo geral, os instrumentos respondidos por médicos foram considerados inconsistentes em relação àqueles respondidos por pacientes. O modo de administração dos instrumentos pode ter influência significativa nos resultados, tanto para fins de pesquisa quanto para a prática clínica. A combinação de um instrumento respondido pelo médico com um instrumento respondido pelo paciente pode ser uma abordagem mais equilibrada para a avaliação e a quantificação das rupturas do menisco e do desfecho após a meniscectomia artroscópica.

Palavras-chave
- menisco
- meniscectomia
- medidas de resultados relatados pelo paciente
- escore de Lysholm para joelho

Introduction

Clinical outcome measures are important both in research and in clinical practice. It allows the clinician and the researcher to objectively quantify the severity of the disease or of the injury as they assess impairment and disability. They can also proportionally measure the outcome of interventions (i.e. surgery). The main strength of outcome scoring systems is that they take into account the experiences, preferences, and values of the patients. Outcome measures can help quantify the end results of clinical services that, in turn, can better inform policy makers and aid in difficult decisions concerning the rationing of finite healthcare resources. One such area that has come under recent scrutiny in the field of elective orthopedic surgery is that of the therapeutic efficacy of knee arthroscopy and meniscectomy in patients with meniscal tears.[1–4] Consequently, there have been national and international knee society guidelines produced by the British Association for Surgery of the Knee (BASK)[5] and the European Society for Sports Traumatology, Knee Surgery and Arthroscopy (ESSKA),[6] who advise surgery only for patients with meniscal tears that are still symptomatic following a minimum of 3 months of nonoperative treatment and absence of advanced arthritis. The findings of the present study pertain to this ongoing debate. Outcome measures have an

important role in all fields of medicine, data of which is often collated in established national audits, particularly in surgical specialties (for example, the National Joint Registry in the United Kingdom).[7]

The only specific outcome measure developed for the evaluation of meniscal injuries was the Tapper and Hoover Meniscal Grading Score,[8] in 1969. It was originally used to assess patients who had previously undergone a meniscectomy. This outcome measure takes the form of a classification system rather than the more traditional questionnaire format and is a clinician-completed instrument. It categorizes outcomes after meniscectomy into one of four grades: excellent, good, fair, and poor. Both the Lysholm knee score and the Tegner Activity scale have demonstrated acceptable psychometric performances in the assessment of patients with meniscal injuries.[9] Mintzer et al.[10] used the Lysholm score as one of their outcome measures to evaluate patients with meniscal tears who underwent meniscal repair surgery. The Knee Injury and Osteoarthritis Outcome Score (KOOS) outcome measure has also been rigorously tested in terms of validity, reliability, and responsiveness in patients with meniscal injuries and in their assessment after arthroscopic partial menisectomy.[11]

The Knee Outcome Survey - Activities of Daily Living Scale (KOS-ADLS) has been found to be scientifically robust in assessing patients before and after meniscal surgery.[12] As an adjunct to the Lysholm score, the Short Form - 36 Item Health Survey (SF-36) has been used to evaluate patients with meniscal tears and to determine the outcomes of arthroscopic partial menisectomy[13] and of meniscal repair.[10] Cole et al.[14] used the Short Form - 12 Item Health Survey (SF-12) in addition to several other disease-specific knee scores to evaluate the results of allograft meniscal transplantation in patients who had persisting symptoms of pain following previous meniscectomies. Koyonos et al.[15] conducted a double-blinded randomized trial to investigate the efficacy of intra-articular corticosteroid injections in patients with meniscal tears who underwent arthroscopic partial meniscectomy and were also found to have concurrent osteoarthritic changes in their knee at the time of surgery. They used the SF-12 in addition to several other disease-specific outcome measures to assess the results of their investigation.

The Cincinnati knee scoring system has been shown to have excellent validity, reliability, and responsiveness in the assessment of patients with a wide spectrum of knee pathologies, including meniscal tears.[16] The International Knee Documentation Committee (IKDC) subjective knee form has been shown to be a valid, reliable, and responsive measure in assessing patients with meniscal tears.[17,18] Both Mintzer et al.[10] and Pujol et al.[19] used the IKDC examination knee form to evaluate patients with meniscal injuries who underwent meniscal repair.

The availability and the use of a wide variety of instruments in assessing patients with meniscal tears has faced shortcomings. Studies that have used many knee scoring systems in evaluating patients with meniscal injuries[14,15] have revealed that different results were obtained between the different instruments used. This further emphasizes the lack of standardization that remains among the outcome measures in use today. This has prompted researchers to routinely use two or more clinical outcome measures when evaluating the results of their interventions under investigation. Therefore, comparing the results of studies that have investigated the same area but have used different outcome measures becomes fraught with limitations and difficulties.

Clinical outcome scores can be broadly categorized into clinician-completed or patient-completed instruments. The aim of the present study was to compare the results of clinician-completed with patient-completed knee scores following arthroscopic partial meniscectomy to assess if there is a difference between the two methods of administering outcome measures.

Materials and Methods

The present study was granted full approval from the Research Ethics Committee and the Research Governance Committee. All subjects signed informed consent forms to participate. The present therapeutic study is a prospective longitudinal cohort study whose data was part of the doctorate thesis of the first author. A similar study using an entirely separate cohort of patients with anterior cruciate ligament tears has been previously published.[20] Some data points of the present study also served as data in the therapeutic arm of another case-control study submitted for publication.

A total of 50 subjects were recruited for the present study (based on the sample size calculation of the broader research from which this data is part of). ►**Table 1** shows the demographics of all participants. The included subjects were between 16 and 45 years old. The exclusion criteria consisted of meniscal repair procedures, concomitant ligamentous injury of the knee, major articular cartilage lesions of the knee, significant history of ankle or hip pathology, lumbar spine symptoms (including radiculopathy in either limb), neurological or vestibular disease, diabetes, regular use of opiate analgesics, and patients who had implanted metal work that was incompatible with magnetic resonance imaging (MRI) scanning.

The mean time from the injury to the clinic review was 63 weeks (standard deviation [SD] = 41). The diagnosis of an isolated meniscal tear in the presence of intact ligaments and cartilage was attained by clinical examination and MRI scan of the injured knee. These findings were confirmed at the

Table 1 Demographics of subjects

	Meniscus patients ($n = 50$)
Mean Age (years old) (SD)	34 (9)
Male: Female	37:13
Injured knee (Right:Left)	29:21
Mean height (m) (SD)	1.74 (0.1)
Mean weight (kg) (SD)	83.9 (18.6)
Mean BMI (kg/m^2) (SD)	27.6 (4.9)

Abbreviations: BMI, body mass index; SD, standard deviation.

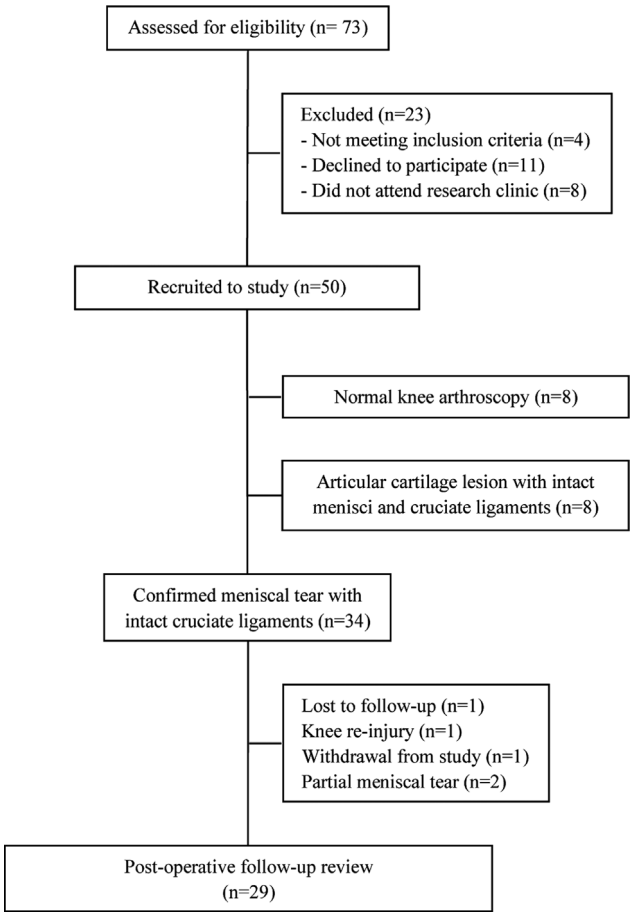

Fig. 1 Flow of subjects through the study.

time of knee arthroscopy for all patients. Clinical history and examination confirmed a normal contralateral knee. ►**Figure 1** illustrates the flow of patients in the Meniscus group through the study, and ►**Table 2** shows the mechanisms of injury. Out of the 34 patients with meniscal tears, 16 were found to have a medial meniscal tear, 17 had a lateral meniscal tear, and 1 patient had concurrent medial and lateral meniscal tears. Thirty-two of these patients underwent an arthroscopic partial meniscectomy. Two patients were found to have partial meniscal tears. One had a superior surface partial tear of the posterior horn of the medial meniscus and the other had a similar tear but of the lateral meniscus. Neither of these two patients underwent meniscectomy. Eight patients were found to have significant articular cartilage lesions (grade III/IV according to the modified Outerbridge scale)[21–25] in either the medial or the lateral tibiofemoral compartments or in the patellofemoral compartment. The mean time to follow-up was 13.4 weeks (SD = 3.8) postoperatively.

Table 2 Mechanism of injury ($n = 50$)

Cause of injury	*n* (%)	Cause of injury	*n* (%)
Spontaneous onset of symptoms	22 (44)	Soccer	5 (10)
Fall	10 (20)	Running	5 (10)
Minor trauma	6 (12)	Road traffic accident	2 (4)

A total of nine clinical outcome measures were used in the present study. Five were clinician-completed instruments and four were patient-completed instruments. These knee scores were chosen because they are the most used in the literature, except for the Tapper and Hoover Grading Score, which was included as it is the only outcome measure specifically developed to assess meniscal injuries. All clinical outcome measures have been validated for use in assessing patients with knee injuries. The clinician-completed knee scores were applied at the time of the attendance of the subjects to the research clinic. The patient-completed knee scores were mailed to the subjects ~ 7 days prior to their attendance to the research clinic. Therefore, the participants completed these outcome measures in their own time and provided a completely uninfluenced evaluation and perception of their functional knee impairment. All subjects were assessed with these outcome measures at baseline (preoperatively) and reassessed postoperatively (for the subjects who were followed-up after surgery).

Clinician-completed Knee Scores

The clinician-completed knee scores included:

- Tegner Activity Score[26]
- Lysholm Knee Score[26]
- Cincinnati Knee Score[27–29]
- International Knee Documentation Committee (IKDC) Examination Score[30,31]
- Tapper and Hoover Meniscal Grading Score[8] (T&H)

Patient-completed Knee Scores

The patient-completed knee scores included:

- International Knee Documentation Committee (IKDC) Subjective Knee Score[18,32]
- Knee Outcome Survey - Activities of Daily Living Scale[12] (KOS-ADLS)
- Short Form – 12 Item Health Survey[33] (SF-12)
- Knee Injury and Osteoarthritis Outcome Score[34,35] (KOOS)

Statistical Analysis

All continuous data variables displayed a normal distribution, as verified by both plotted histograms and by the Shapiro-Wilks test. The results were evaluated using the paired Student *t*-test for within group analyses of continuous variables. The results of both the IKDC Examination score and of the T&H score were categorical ordinal variables and the appropriate nonparametric statistical test (Wilcoxon signed ranks test) was used for their analysis. The level of statistical significance was set at $p < 0.05$. Statistical analysis was performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA).

Results

The results of the outcome measures of the Meniscus group (continuous variables) and of the longitudinal statistical analysis are displayed in ►**Table 3**. A significant longitudinal

Table 3 Comparison of knee outcome scores *pre*-operatively ($n = 34$) and *post*-operatively ($n = 29$)

	Pre-Operative	Post-Operative	*p*-value[1]	95% CI	Mean difference
	Mean (SD)	Mean (SD)			
Tegner	3.1 (1.2)	4.4 (1.3)	<0.001*	0.77 to 1.82	1.3
Lysholm	72.6 (21.7)	86.2 (12.2)	0.004*	4.72 to 22.40	13.6
Cincinnati	66.7 (23.9)	83.5 (16.4)	0.002*	6.82 to 26.74	16.8
IKDC Sub.	53.2 (19.3)	65.0 (21.0)	0.021*	1.93 to 21.65	11.8
KOS-ADLS	70.9 (18.5)	76.6 (17.8)	0.177	−2.73 to 14.10	5.7
SF−12 PCS	41.6 (10.9)	45.3 (9.1)	0.138	−1.26 to 8.63	3.7
SF−12 MCS	51.7 (11.4)	52.2 (11.8)	0.719	−2.47 to 3.52	0.5
KOOS					
Symptoms	65.6 (16.7)	73.7 (19.5)	0.050	0.01 to 16.33	8.2
Pain	65.6 (17.6)	74.2 (22.2)	0.090	−1.44 to 18.70	8.6
ADL	75.0 (20.7)	83.8 (18.5)	0.042*	0.35 to 17.29	8.8
Sp. & Rec.	47.9 (29.4)	59.1 (30.4)	0.092	−1.97 to 24.47	11.3
QOL	37.5 (22.0)	51.6 (25.6)	0.005*	4.70 to 23.43	14.1

Abbreviations: ADL, activities of daily living; CI, confidence interval; MCS, mental component summary; PCS, physical component summary; QOL, quality of life; SD, standard deviation; Sp. & Rec, sport and recreation.
*Statistically significant at < 0.05 level.
[1]Paired Student t-test analysis.

Table 4 Comparison of Tegner activity scores preoperatively ($n = 34$) and postoperatively ($n = 29$) with preinjury score (mean 5.7; SD =1.3)

	p-value[1]	95%CI	Mean difference
Tegner preinjury versus preoperative	< 0.001*	2.0–3.29	2.6
Tegner preinjury versus postoperative	0.001*	0.68–2.32	1.3

Abbreviation: CI, confidence interval.
*Statistically significant at < 0.05 level.
[1]Paired student's t-test analysis.

improvement was observed in the clinician-completed knee scores, including the Tegner, Lysholm, and Cincinnati scores. In contrast, the only patient-completed knee score to demonstrate a significant longitudinal improvement postoperatively was the IKDC subjective score. ►**Table 4** shows that there was a significant difference between the mean preoperative Tegner score compared with its preinjury score. Although there was a significant improvement of the Tegner score following surgery (►**Table 3**), the patients in the Meniscus group had still not returned to their preinjury level of activities at the time of follow-up, as a significant difference remained in this respect. ►**Figures 2** and **3** show the longitudinal statistical analysis of both the IKDC Examination and the Tapper and Hoover Meniscal Grading scores (respectively). Both are clinician-completed instruments. There was a significant improvement of the Tapper and Hoover Meniscal Grading score following meniscectomy. However, this was not the case with the IKDC Examination score.

Discussion

The results of the present study revealed a significant improvement in four of the five clinician-completed outcome scores (except for the IKDC examination score) following arthroscopic partial meniscectomy. However, the IKDC subjective score was the only patient-completed knee score to demonstrate a significant longitudinal improvement.

An interesting finding was the observation of a statistically significant improvement of the IKDC subjective score, but of no significant improvement in the IKDC examination knee score. A significant improvement in the Tapper and Hoover Meniscal grading system was also noted, in contrast with the more elaborate IKDC examination knee score. This could be explained by the fact that the latter scoring system was originally devised to assess knee ligament injuries with a major emphasis on ligament laxity testing[31] rather than specifically relating to symptoms pertinent to meniscal tears, as is the case with the Tapper and Hoover system.[8] The IKDC subjective score[17,18] was designed to encapsulate a broader range of knee pathologies than the IKDC examination score, which could explain why the former knee score was found to be more responsive in this respect. It was noted that the only 2 statistically significant subgroups of the KOOS score were activities of daily living ($p = 0.042$) and quality of life ($p = 0.005$). The former result was of borderline statistical significance and may represent a Type I statistical error considering the results of the other KOOS subgroups. The latter result may be a reflection either of lifestyle activity modifications or simply of the patients being acceptant of their symptoms and persevering with their normal day-to-day activities, nonetheless.

It can be seen that, overall, there is an inconsistency between clinician-completed and patient-completed clinical

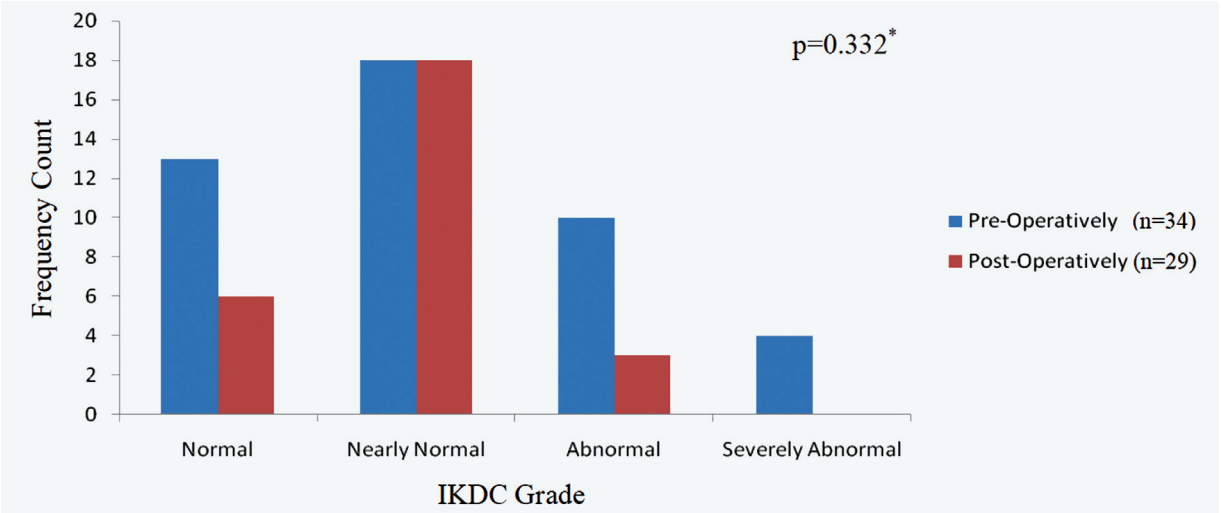

Fig. 2 Comparison of IKDC Examination scores (frequency counts) of the Meniscus patients before and after meniscectomy. *Wilcoxon signed ranks test analysis.

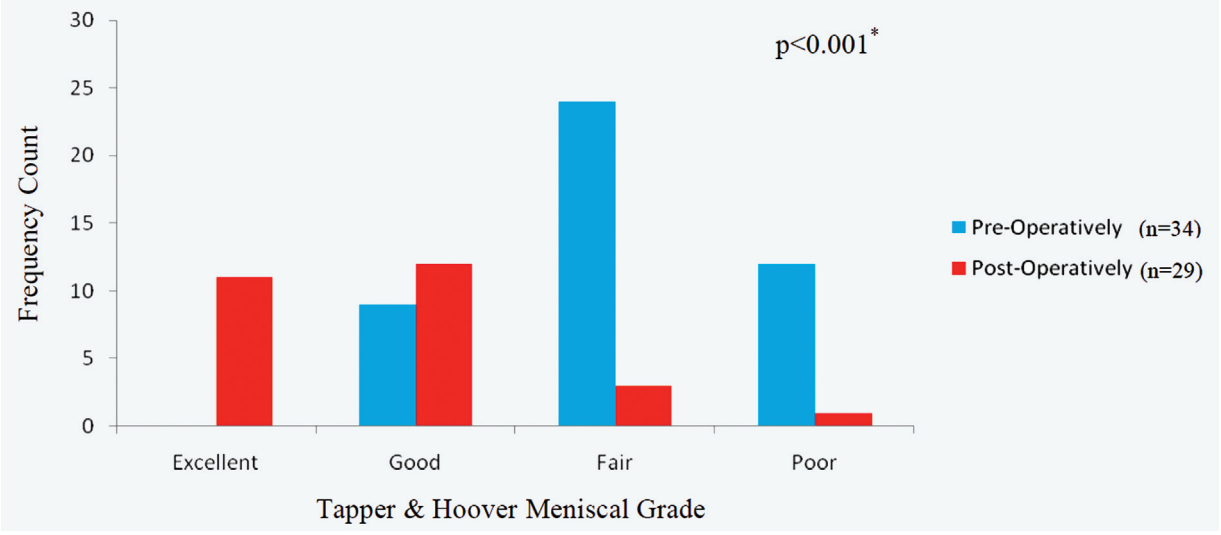

Fig. 3 Comparison of Tapper and Hoover Meniscal Grading scores (frequency counts) of the Meniscus patients before and after meniscectomy. *Wilcoxon signed ranks test analysis.

outcome measures in the assessment of patients with meniscal injuries following partial meniscectomy. The discordance observed between these two outcome measure techniques can be explained by the potential influence of interviewer bias, which could lead the surgeon to unconsciously underrate any unfavorable answers from the patient. Similarly, the patients themselves may be less inclined to admit to an unfavorable response in a face-to-face consultation. Patient-completed instruments could, therefore, be a better indication of the degree of functional impairment of the knee following meniscal injury and surgery. A significant improvement was found in the Tegner activity score when comparing the preoperative with the post-operative findings. However, a significant difference was also demonstrated when comparing the results postoperatively with the preinjury scores, implying that the patients in the Meniscal group had still not fully recovered and returned to their original level of activity 3 months after arthroscopic partial meniscectomy. This finding was surprising, as the patients in the Meniscal group were not subjected to the same stringent rehabilitation program and activity restrictions as those to which patients following anterior cruciate ligament reconstruction surgery are subjected. The follow-up period of 3 months may account for this result and could also have influenced the limited responsiveness of the patient-completed knee scores following surgical intervention. Therefore, a statistically significant result for the longitudinal analysis of the patient-completed outcome measures in the Meniscal group may had been found had the follow-up period been longer. However, a significant improvement was

demonstrated in terms of the clinician-completed outcome measures within the same follow-up period. Another patient factor that could influence the results includes the potential of limited understanding of the questions asked and, therefore, of limited compliance in answering patient-completed instruments.

Therefore, the way a knee scoring system is administered in the clinical or research setting is important, as it can have a significant influence on the end results. Accordingly, the combined use of a clinician-completed and a patient-completed clinical outcome measure may be the more robust assessment format when conducting studies regarding meniscal injuries. The recommended clinician-completed outcome measure for use in the clinical practice, based on the results of the present study, is the Tapper and Hoover Meniscal Grading System, due to its ease of use and responsiveness following partial meniscectomy. The recommended patient-completed outcome measure is the IKDC subjective knee score, as it was the only patient-completed scoring system found to be responsive following meniscal surgery.

The limitations of the present study include the lack of radiological evaluation of overall lower limb alignment, which could have been beneficial to detect the influence of any varus or valgus deformities on outcome scores in the context of meniscal tears and can be considered by future researchers. Furthermore, the inclusion of a higher number of patients would allow for a meaningful subgroup comparison of outcome data between medial and lateral meniscal tears.

Conclusion

Overall, the longitudinal results of the clinician-completed outcome measures were found to be inconsistent with those of the patient-completed instruments. A combination of both a clinician-completed and a patient-completed instrument may be a more balanced approach to assessing and quantifying meniscus tears and the outcome following arthroscopic meniscectomy.

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Conflict of Interests
The authors have no conflict of interests to declare.

References

1 Kise NJ, Risberg MA, Stensrud S, Ranstam J, Engebretsen L, Roos EM. Exercise therapy versus arthroscopic partial meniscectomy for degenerative meniscal tear in middle aged patients: randomised controlled trial with two year follow-up. BMJ 2016;354: i3740
2 Sihvonen R, Paavola M, Malmivaara A, et al. Arthroscopic partial meniscectomy for a degenerative meniscus tear: a 5 year follow-up of the placebo-surgery controlled FIDELITY (Finnish Degenerative Meniscus Lesion Study) trial. Br J Sports Med 2020;54(22): 1332–1339
3 Sihvonen R, Paavola M, Malmivaara A, et al. Arthroscopic partial meniscectomy versus sham surgery for a degenerative meniscal tear. N Engl J Med 2013;369(26):2515–2524
4 Thorlund JB, Juhl CB, Roos EM, Lohmander LS. Arthroscopic surgery for degenerative knee: systematic review and meta-analysis of benefits and harms. BMJ 2015;350:h2747
5 Abram SGF, Beard DJ, Price AJBASK Meniscal Working Group. Arthroscopic meniscal surgery: a national society treatment guideline and consensus statement. Bone Joint J 2019;101-B (06):652–659
6 Beaufils P, Becker R, Kopf S, et al. Surgical management of degenerative meniscus lesions: the 2016 ESSKA meniscus consensus. Knee Surg Sports Traumatol Arthrosc 2017;25(02): 335–346
7 The National Joint Registry - Patient Reported Outcome Measures Available from: https://www.njrcentre.org.uk/njrcentre/Research/NJR-PROMs
8 Tapper EM, Hoover NW. Late results after meniscectomy. J Bone Joint Surg Am 1969;51(03):517–526
9 Briggs KK, Kocher MS, Rodkey WG, Steadman JR. Reliability, validity, and responsiveness of the Lysholm knee score and Tegner activity scale for patients with meniscal injury of the knee. J Bone Joint Surg Am 2006;88(04):698–705
10 Mintzer CM, Richmond JC, Taylor J. Meniscal repair in the young athlete. Am J Sports Med 1998;26(05):630–633
11 Roos EM, Roos HP, Ekdahl C, Lohmander LS. Knee injury and Osteoarthritis Outcome Score (KOOS)–validation of a Swedish version. Scand J Med Sci Sports 1998;8(06):439–448
12 Irrgang JJ, Snyder-Mackler L, Wainner RS, Fu FH, Harner CD. Development of a patient-reported measure of function of the knee. J Bone Joint Surg Am 1998;80(08):1132–1145
13 Katz JN, Harris TM, Larson MG, et al. Predictors of functional outcomes after arthroscopic partial meniscectomy. J Rheumatol 1992;19(12):1938–1942
14 Cole BJ, Dennis MG, Lee SJ, et al. Prospective evaluation of allograft meniscus transplantation: a minimum 2-year follow-up. Am J Sports Med 2006;34(06):919–927
15 Koyonos L, Yanke AB, McNickle AG, et al. A randomized, prospective, double-blind study to investigate the effectiveness of adding DepoMedrol to a local anesthetic injection in postmeniscectomy patients with osteoarthritis of the knee. Am J Sports Med 2009;37 (06):1077–1082
16 Marx RG, Jones EC, Allen AA, et al. Reliability, validity, and responsiveness of four knee outcome scales for athletic patients. J Bone Joint Surg Am 2001;83(10):1459–1469
17 Anderson AF, Irrgang JJ, Kocher MS, Mann BJ, Harrast JJInternational Knee Documentation Committee. The International Knee Documentation Committee Subjective Knee Evaluation Form: normative data. Am J Sports Med 2006;34(01):128–135
18 Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the international knee documentation committee subjective knee form. Am J Sports Med 2001;29(05):600–613
19 Pujol N, Panarella L, Selmi TA, Neyret P, Fithian D, Beaufils P. Meniscal healing after meniscal repair: a CT arthrography assessment. Am J Sports Med 2008;36(08):1489–1495
20 Al-Dadah O, Shepstone L, Donell ST. Clinical outcome measures in anterior cruciate ligament reconstruction: Clinician vs patient completed knee scores. Surgeon 2021;19(06):e353–e360
21 Cameron ML, Briggs KK, Steadman JR. Reproducibility and reliability of the outerbridge classification for grading chondral lesions of the knee arthroscopically. Am J Sports Med 2003;31 (01):83–86
22 Curl WW, Krome J, Gordon ES, Rushing J, Smith BP, Poehling GG. Cartilage injuries: a review of 31,516 knee arthroscopies. Arthroscopy 1997;13(04):456–460

23 Outerbridge RE. The etiology of chondromalacia patellae. J Bone Joint Surg Br 1961;43-B:752–757
24 Outerbridge RE, Dunlop JA. The problem of chondromalacia patellae. Clin Orthop Relat Res 1975;(110):177–196
25 Spindler KP, Warren TA, Callison JC Jr, Secic M, Fleisch SB, Wright RW. Clinical outcome at a minimum of five years after reconstruction of the anterior cruciate ligament. J Bone Joint Surg Am 2005;87(08):1673–1679
26 Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. Clin Orthop Relat Res 1985;(198):43–49
27 Bentley G, Biant LC, Carrington RW, et al. A prospective, randomised comparison of autologous chondrocyte implantation versus mosaicplasty for osteochondral defects in the knee. J Bone Joint Surg Br 2003;85(02):223–230
28 Noyes FR, Barber SD, Mangine RE. Bone-patellar ligament-bone and fascia lata allografts for reconstruction of the anterior cruciate ligament. J Bone Joint Surg Am 1990;72(08):1125–1136
29 Noyes FR, Barber SD, Mooar LA. A rationale for assessing sports activity levels and limitations in knee disorders. Clin Orthop Relat Res 1989;(246):238–249
30 Forms IKDC. The American Orthopaedic Society for Sports Medicine. 2000 Available from: http://www.sportsmed.org/tabs/research/ikdc.aspx
31 Hefti F, Müller W, Jakob RP, Stäubli HU. Evaluation of knee ligament injuries with the IKDC form. Knee Surg Sports Traumatol Arthrosc 1993;1(3-4):226–234
32 Irrgang JJ, Anderson AF. Development and validation of health-related quality of life measures for the knee. Clin Orthop Relat Res 2002;(402):95–109
33 Ware J Jr, Kosinski M, Keller SDA. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Med Care 1996;34(03):220–233
34 Roos EM, Lohmander LS. The Knee injury and Osteoarthritis Outcome Score (KOOS): from joint injury to osteoarthritis. Health Qual Life Outcomes 2003;1:64
35 Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)–development of a self-administered outcome measure. J Orthop Sports Phys Ther 1998;28(02):88–96