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Mechanical symptoms as an indication for knee arthroscopy in patients with degenerative meniscus tear: a prospective cohort study

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SUMMARY

Objective: According to prevailing consensus, patients with mechanical symptoms are those considered to most likely benefit from arthroscopic surgery. The aim of this study was to determine the value of using patients' pre-operative self-reports of mechanical symptoms as a justification surgery in patients with degenerative meniscus tear/knee disease.
Design: Pragmatic prospective cohort of 900 consecutive patients with symptomatic degenerative knee disease and meniscus tear undergoing arthroscopic partial meniscectomy (APM) was collected from one public orthopedic referral center specialized in arthroscopic surgery during 2007–2011. The patients' subjective satisfaction, self-rated improvement, change in Western Ontario Meniscal Evaluation Tool (WOMET) score, and patients' ratings of the knee using a numerical rating scale (NRS) was assessed at 1 year postoperatively. Multivariable regression models, adjusted for possible confounders and intermediates, were used to compare the outcomes in those with and without preoperative mechanical symptoms.
Results: The proportion of patients satisfied with their knee 12 months after arthroscopy was significantly lower among those with preoperative mechanical symptoms than among those without (61% vs 75%, multivariable adjusted risk ratio [RR] 0.84; 95% confidence interval [CI] 0.76, 0.92). Similarly, the proportion reporting improvement was lower (RR 0.91; 95% CI 0.85, 0.97). No statistically significant difference was found in change in WOMET or NRS between the two groups. Of those with preoperative mechanical symptoms, 47% reported persistent symptoms at 12 months postoperatively.
Conclusions: Our observational data contradicts the current tenet of using patients' self-report of mechanical symptoms as a justification for performing arthroscopic surgery on patients with degenerative meniscus tear.

Introduction

Osteoarthritis (OA) of the knee or degenerative knee disease, with associated joint pain and reduced physical function, is the most frequent cause of musculoskeletal disability in the developed world[1]. The use of knee arthroscopy to treat degenerative knee disease is common worldwide[2]. The surgery typically comprises of knee lavage, debridement and most importantly, in a case of torn meniscus, partial meniscectomy. One million knee arthroscopies, 700,000 of them involving the meniscus, are performed annually in the United States (US) alone, making this one of the most common surgical procedures[3]. Of these, 70% are carried out in patients aged >45 years, i.e., patients typically with a degenerative knee disease[3].

Numerous organizations, including the American Academy of Orthopaedic Surgeons (AAOS)[4], the National Institute for Health and Clinical Excellence (NICE)[5] and the Osteoarthritis Research Society International (OARSI)[6] have taken a stand of recommending against performing knee arthroscopy on patients with established knee OA. However, these guidelines still leave an option for

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arthroscopic surgery for patients with a diagnosis of meniscus tear[5,6] or refrain from any recommendations for such patients[4]. An obvious change in arthroscopic practice has ensued: decline in the incidence of debridements or lavages for knee OA has been compensated for by a commensurate increase in the incidence of meniscal surgeries (meniscectomies)[7–10].

Recently published high-quality RCTs challenge even the indications of meniscus surgery, as they have consistently shown that in patients with a degenerative meniscus tear and mild or no OA, arthroscopic partial meniscectomy (APM) does not provide a better outcome than physical therapy or sham surgery[11,12]. Despite this, the advocates of knee arthroscopy argue that there are subgroups of patients "likely to benefit from APM", patients with so-called "mechanical symptoms" (sensations of knee catching or locking) being the most obvious candidates[13–16]. For example, in a recently published survey among orthopaedic surgeons in the US, mechanical symptoms was not even included because the researchers considered that there would be virtual unanimity among orthopaedic surgeons that these patients require surgery[17].

The assertion that patients with mechanical symptoms represent a subgroup with favourable response to APM is plausible. Knee catching or locking is currently believed to result from a mechanical blocking mechanism in the knee — a piece of the joint structure lodging between the articular surfaces. And because degenerative meniscus tears are very common pathologic alterations found by arthroscopy in the knee joints of patients with degenerative knee disease, trimming the torn meniscus should improve the apparent mechanical derangement. However, the actual evidence to support such strategy is lacking.

We hypothesized that if mechanical symptoms do indeed constitute a valid indication for knee arthroscopy, then we should be able to show that patients with mechanical symptoms benefit from APM more than those without these symptoms.

Methods

Study sample

As a part of our ongoing initiative to study the efficacy of APM in patients with degenerative knee disease[18], all patients undergoing knee arthroscopy at a single orthopaedic institution between January 2007 and December 2011 were asked to take part in a prospective follow-up (so called pragmatic cohort design). During the entire 5-year sampling period, all 22 surgeons had complete independence over indications for knee arthroscopy, preoperative imaging, and procedures deemed necessary at arthroscopy. The research group was only responsible for the execution of the follow-up of the patients. From an overall cohort of 2090 surgeries, for this analysis, we selected those with a clearly non-traumatic onset of symptoms and an arthroscopically verified meniscus tear requiring partial meniscectomy (900 patients/932 surgical procedures, Fig. 1). The protocol was approved by the Institutional Review Board of Pirkanmaa Hospital District (R06157) and has been described in detail elsewhere[18].

Knee arthroscopy

Knee arthroscopy was carried out using anterolateral and anteromedial portals and a standard 4 mm arthroscope. Arthroscopic evaluation included recording of the presence of intra-articular pathology (meniscus tears, loose bodies and characterization of chondral lesions of both tibiofemoral and patellofemoral chondral surfaces). Intraoperatively, cartilage degeneration of all three knee compartments was graded by the operating surgeon using a modification of the International Cartilage Repair Society

(ICRS) system[19], the assessment basing only on the depth (but not size) of the lesion(s). These intraoperative findings on cartilage degeneration were then converted into three category grading (no changes, early OA, or OA) (For details, see Table II). Following diagnostic arthroscopy, the procedures deemed necessary by the operating surgeon were carried out. The joint was then carefully irrigated and evacuated. No knee immobilizer was used postoperatively, and range-of-motion exercises and gait were allowed as tolerated, except for patients undergoing microfracture ($n = 25$, 2.7% of the entire cohort).

Outcome measures

All patients completed a questionnaire that was used to document information on their knee status and presence of mechanical symptoms preoperatively and at 12-month follow-up. Four outcomes were used to assess different aspects of the outcome after surgery, including a query eliciting patients' subjective satisfaction and perceptions on possible improvement (both only 12 months postoperatively), a disease-specific health-related quality of life instrument Western Ontario Meniscal Evaluation Tool (WOMET), and a simple numerical rating scale (NRS) for knee pain. However, no single primary outcome was defined as a priori.

In addition to these queries carried out preoperatively and 12 months after surgery, a sub-group of 482 consecutive patients (all patients undergoing surgery in 2007 and 2008, 487 procedures) also responded to the question about mechanical symptoms at two and 6 months postoperatively to provide information on the possible fluctuation of these symptoms.

Patient satisfaction

Patients' global assessment of satisfaction with their knee 12 months after arthroscopy was elicited using the following question: "How satisfied are you with your knee at present?" on a 5-point Likert scale (Supplementary Table 1.1). As before[20], the responses "Very satisfied" or "Satisfied" were categorized as satisfied, while responses "Neither satisfied nor dissatisfied", "Dissatisfied" and "Very dissatisfied" were categorized as dissatisfied.

Self-rated improvement

We also elicited patients' opinions on the success of arthroscopy using a standard global impression of change question: "How do you rate your knee now, 12 months after arthroscopy?" on a 5-point Likert scale (Supplementary Table 1.2). Similarly to satisfaction, the responses "Much better" and "Better" were considered to indicate improvement, while responses "Unchanged", "Worse" or "Much worse" were deemed not improved.

The WOMET

WOMET is a disease-specific tool designed to evaluate health related quality of life (HRQoL) in patients with meniscal pathology[21] and was recently validated for patients with degenerative meniscus tear[22]. Scores range from 0 to 100, with 0 indicating the worst possible situation and 100 the best. If there were 1–3 items missing, we substituted the missing value(s) with the average value for the answered items according to the protocol described previously for the Western Ontario and McMaster Universities Index (WOMAC)[23], a similar outcome tool for established knee OA. This procedure was carried out for 55 and 21 surgeries at the preoperative and 12-month follow up assessment points respectively. If more than three items were missing, total score was not calculated and was defined as missing. However, for the analyses, this data
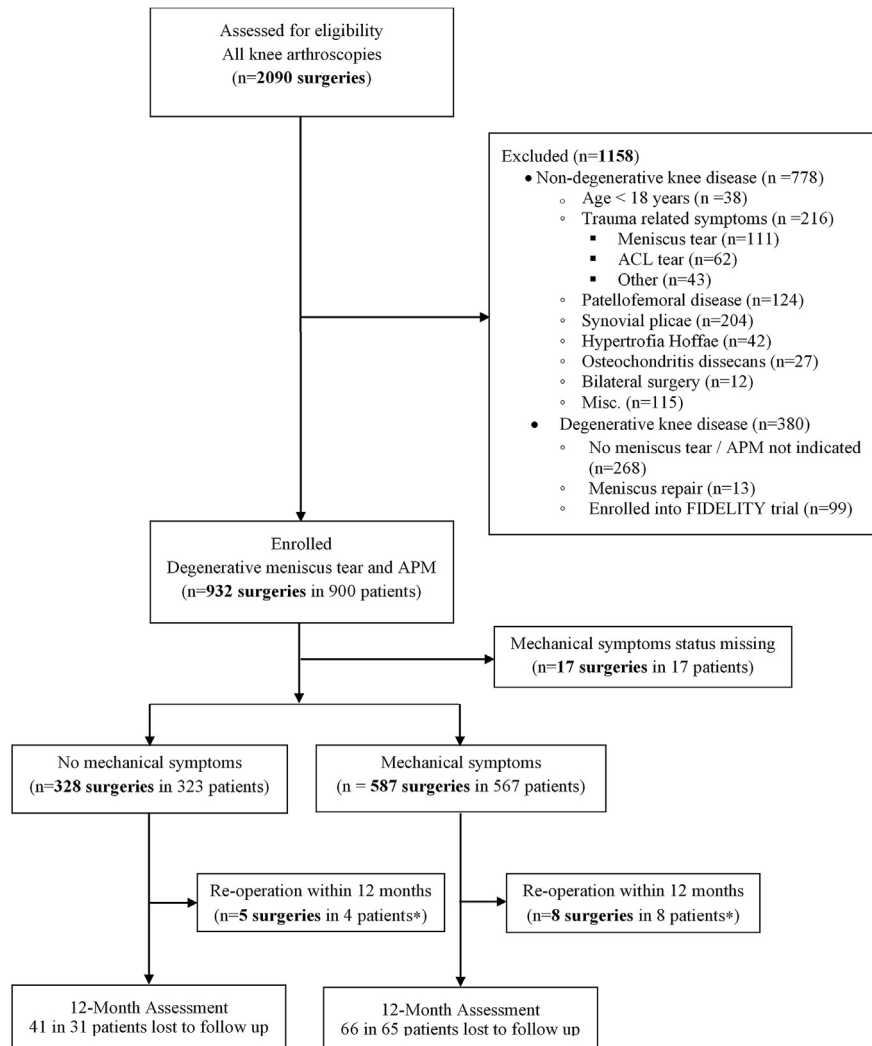
Fig. 1. Study flow chart. Flow chart of study participants in the cohort.

was handled identically to other missing data according to a procedure specified in the statistical methods section.

NRS

Patients were also asked to self-rate their knee with the following question: "How do you rate your knee at the moment?" on a 0 to 10 NRS, where 10 represents a completely normal knee and 0 denotes an extremely troublesome knee. This scale has been validated for patients with knee and hip OA[24].

Presence of mechanical symptoms

The presence of mechanical symptoms was assessed using the locking domain of the Lysholm knee score[25] with a minor modification (extension) to be applicable as a patient-administered question (Supplementary Table 1.3). In brief, the patients were asked to choose one of the five possible responses that best reflected the status of their knee: (1) no locking or catching, (2) catching sensations but no locking, (3) occasional locking, (4) frequent locking, or (5) locked at present. The Lysholm knee score[25] is a condition-specific outcome measure and has been validated for patients with meniscus injury[26]. Participants' responses were primarily classified into two groups; those reporting no mechanical symptoms (response 1 in the Lysholm knee score locking domain) vs those reporting mechanical symptoms (responses 2–5).

The test-retest reliability of the 'locking' question was determined in a sample of 40 patients (mean age 56 years [range 28–73]; 17 female and 23 male). The question was administered twice within a 2-week interval, as this time interval has been shown to provide the most reliable estimate of test-retest ability[27]. Thirty-three of the 40 patients gave identical assessments at the two visits (five differed by one category, and two by two categories), giving a reliability of $K = 0.72$ (95% confidence interval [95% CI] 0.50, 0.95) for the dichotomized responses options (no symptoms vs any symptoms) and $K = 0.75$ (95% CI 0.56, 0.89) for the full five-item discrimination, as defined by the Kappa statistics according to Landis and Koch[28].

Table I
Demographical and clinical characteristics of patients at baseline

	Preoperative mechanical symptoms	
	No (*n* = 328)*	Yes (*n* = 587)*
Age (years)	51.9 (12.5)	52.5 (11.6)
Sex (female)	126 (38%)	302 (51%)
BMI (kg/m²)	27.4 (4.2)	27.7 (4.2)
Duration of symptoms (months) (IQR)	12 (6, 24)	12 (6, 24)
Radiological OA (%)†	49 (15%)	139 (24%)
WOMET score‡	54.7 (17.2)	41.7 (18.5)
Numerical Rating Scale (NRS)**	4.8 (1.8)	4.3 (1.9)

Data are presented as means (SD), number of patients (%) or median (IQR).

* 17 persons had baseline mechanical symptoms status missing; 15 persons have missing BMI, 63 persons had missing duration of symptoms, 185 persons have missing radiological OA, 32 persons had missing WOMET baseline score, and 10 persons had missing NRS.

† Using the Kellgren and Lawrence grading system for which grade 0 denotes no abnormalities, and grade 1 minor degenerative changes (doubtful narrowing of the joint space or possible osteophytic lipping) meaning no knee OA; and grade 2 (definite narrowing of the joint space and definite osteophytes), grade 3 (marked narrowing of the joint space and definite osteophytes) and grade 4 (gross loss of joint space with sclerosis and cysts, marked deformity and large osteophytes) in either tibiofemoral compartment meaning knee OA. Of participants included in the analyses, images were missing in 69 (21.0%) of those with no mechanical symptoms and 114 (19.4%) of those with mechanical symptoms.

‡ The WOMET. WOMET contains sixteen items addressing three domains: nine items addressing physical symptoms; four items addressing disabilities due to sports, recreation, work and lifestyle and three items addressing emotions. The percentage of normal score is used, and accordingly, 100 (%) represents the best possible score and 0 (%) represents the worst possible score.

** NRS of the knee (0–10, 10 representing the best possible score).

Statistical methods

The exposure of interest in all analyses was the presence of mechanical symptoms at baseline. First we used Poisson regression with robust standard errors in the analysis of patient satisfaction and improvement and linear regression for analysis of change in WOMET score and NRS. We adjusted all analyses by potential confounding or effect modifying factors, i.e., age, sex, body mass index (BMI), if having radiographic OA (Kellgren–Lawrence grade 2 or more)[29], surgeon experience (less than 100 procedures, 100–500 procedures and more than 500 procedures), location of the tear (medial, lateral or both), chondral degeneration (none, early OA, OA)[30] and whether or not a chondral procedure, in addition to APM, was performed. In our primary model we used chained equations to multiply impute the missing data. The variables included in the imputation model were age, sex, if chondral procedure was performed (yes/no), resection size (less or more than 30% of the meniscal tissue volume) and location of the tear (medial, lateral or both) (variables fully observed), mechanical symptoms at baseline and 12-month follow-up, if improved, if satisfied, if having radiographic OA (imputed with a logit model), WOMET score and NRS at baseline (imputed with truncated linear regression model), chondral degeneration and surgeon experience (imputed with ordinal logistic model), logarithm of symptom duration, BMI, change in WOMET score and change in NRS (imputed with linear regression model). The numbers of missing data for each variable and time point are presented in the Supplementary material (Table 2). We created 30 imputed datasets and the imputation results were inspected visually by comparing the distributions of imputed and observed values. In the analyses we used robust standard errors (Hubert/White/sandwich estimate) as 3% of the included patients were operated on more than once (most often in the other knee). As part of a sensitivity analysis, we also report the results from the complete case analysis, i.e., without multiple imputation. Finally, we provided crude descriptive statistics of the occurrence of

Table II
Results of the poisson regression analysis, multiple imputed data

Variable	Satisfaction at 12 month RR (95% CI)	Improvement at 12 month RR (95% CI)
Mechanical symptoms at baseline	0.84 (0.76–0.92)	0.91 (0.85–0.97)
Age (years)	1.01 (1.00–1.01)	1.00 (1.00–1.00)
Sex (male)	1.00 (0.90–1.11)	0.97 (0.91–1.04)
Radiological OA*	0.83 (0.71–0.98)	0.91 (0.83–1.01)
Surgeon exp ≤100	1.00	1.00
Surgeon exp 100–500	1.04 (0.93–1.16)	0.97 (0.90–1.04)
Surgeon exp ≥500	1.10 (0.92–1.31)	0.97 (0.85–1.10)
Medial tear	1.00	1.00
Lateral tear	0.99 (0.85–1.16)	0.96 (0.87–1.06)
Tear on both menisci	0.95 (0.80–1.12)	0.96 (0.86–1.07)
Chondral deg none†	1.00	1.00
Chondral deg early†	0.98 (0.86–1.13)	1.00 (0.92–1.09)
Chondral deg OA†	0.78 (0.66–0.93)	0.91 (0.82–1.01)
Chondral procedure‡	1.03 (0.91–1.16)	1.00 (0.92–1.08)
BMI (kg/m²)	0.99 (0.98–1.00)	0.99 (0.99–1.00)

Data are presented as RRs with 95% CIs.

* Using the Kellgren and Lawrence grading system for which grade 0 denotes no abnormalities, and grade 1 minor degenerative changes (doubtful narrowing of the joint space or possible osteophytic lipping) meaning no knee OA; and grade 2 (definite narrowing of the joint space and definite osteophytes), grade 3 (marked narrowing of the joint space and definite osteophytes) and grade 4 (gross loss of joint space with sclerosis and cysts, marked deformity and large osteophytes) meaning knee OA.

† Chondral lesions were first graded at arthroscopy according to ICRS classification[19] (0 = none; 1 = superficial/softening; 2 = <50% of the cartilage thickness; 3 = through the entire cartilage thickness; 4 = extension into subchondral bone). Patients were then divided into three groups according to the severity of chondral degeneration as follows: None or mild = max. grade 1 lesion in one compartment; Degenerative changes = grade 1 lesion in at least two compartments or a single grade 2 lesion; Osteoarthritic = grade 3 or 4 lesion in one compartment.

‡ Patient undergoing an additional chondral procedure (vs partial meniscectomy alone).

mechanical symptoms during the study time frame. All estimates are presented with their 95% CIs. Statistical analysis was performed using Stata (version 13, StataCorp LP).

Results

Cohort characteristics

The mean (SD) age of participants was 52 (12) years and 439 (47%) were female (Table I). Of the 932 surgical procedures included (on 900 patients), in 328 (36%) patients reported not having mechanical symptoms preoperatively while in 587 (64%) they reported having mechanical symptoms (Table I and Fig. 1). Data on mechanical symptoms was missing for 17 (2%) at baseline and 120 (13%) at 12-month follow-up. Those with preoperative mechanical symptoms were more often women, had a higher prevalence of radiographic OA, and lower preoperative WOMET and NRS scores than those reporting no preoperative mechanical symptoms (Table I). The findings at arthroscopy confirmed the higher prevalence of chondral degeneration but also somewhat more frequent lateral meniscus tears in the patients with preoperative mechanical symptoms. The two groups were similar with respect to the surgical procedures performed (Supplementary Table 3). Thirteen reoperations were carried out in 11 patients within 12 months. All these patients were excluded from the analysis. In addition, one of these 11 patients had surgery on both the right and left knee on separate occasions during the 60 month study period (experiencing mechanical symptoms in one knee and not having mechanical symptoms on the other, thus being included primarily in both groups). This patient then later had to have a reoperation on one knee, which resulted in exclusion (Fig. 1).

Self-rated patient satisfaction

At the primary outcome assessment point (12 months postoperatively), 61% of patients reporting preoperative mechanical symptoms were satisfied compared to 75% of those reporting no mechanical symptoms (adjusted risk ratio [RR] 0.84 [95% CI 0.76, 0.92]) (Table II). We performed a crude sensitivity analysis assuming a "best case" scenario, i.e., among those with missing satisfaction value we classified all those reporting no mechanical symptoms as "dissatisfied", and all those reporting mechanical symptoms as "satisfied". We found that patients reporting mechanical symptoms would not have been more satisfied with the surgery than those reporting no mechanical symptoms (percentage of satisfied patients 65% in both groups). Beside mechanical symptoms, both radiographic and arthroscopically verified OA were also found to be negatively associated with patient satisfaction (adjusted RR 0.83 [95% CI 0.71, 0.98] and 0.78 [95% CI 0.66, 0.93] respectively) (Table II).

Self-rated improvement

Seventy-nine per cent (79%) of patients with preoperative mechanical symptoms compared to 88% of those without mechanical symptoms (adjusted RR 0.91 [95% CI 0.85, 0.97]) considered themselves "improved". Radiographic evidence of OA (adjusted RR 0.91 [95% CI 0.83, 1.01]) had a tendency to be negatively associated with patient self-rated improvement (Table II).

WOMET score

The mean (SD) change in WOMET score was similar between patients with and without preoperative mechanical symptoms, 26.3 (25.5) and 24.0 (22.4), respectively. Mechanical symptoms were not statistically significantly associated with the change (adjusted difference 2.79 [95% CI −0.79, 6.37]). However, radiographic OA, male sex, and arthroscopically verified cartilage degeneration (OA) were all significantly associated with lesser degree of improvement as measured with WOMET (Table III and Fig. 2).

NRS score

The mean (SD) change in NRS score was 2.3 (2.5) in patients with preoperative mechanical symptoms and 2.6 (2.5) in those without. The difference was not statistically significant (adjusted difference −0.08 [95% CI −0.45, 0.28]). Older patients had a tendency for greater change (Table III).

Sensitivity analyses

The results from the corresponding multivariate analysis of subjects with complete data sets were similar to the results obtained from multiple imputed data (Supplementary Tables 4 and 5).

Alleviation of mechanical symptoms by typical procedures performed at arthroscopy

Of the 513 cases reporting mechanical symptoms preoperatively (with complete follow-up for mechanical symptoms), 243 (47%) reported symptoms persisting 12 months after surgery. Accordingly, the 12-month success rate of arthroscopic surgery in alleviating mechanical symptoms was 53% of those with complete follow-up. The corresponding number for the whole cohort (multiple imputed data) was 52% (95% CI 49%, 56%). Moreover, of those reporting no mechanical symptoms preoperatively ($n = 282$), there were 32 (11%) who reported mechanical symptoms at 12-month follow-up. In addition, in a sub-group of 482 patients (with 487 procedures) whose symptoms were documented at four time points (preoperatively and at 2, 6, and 12 months postoperatively), considerable intra-individual fluctuation was observed in the reported presence of mechanical symptoms among 339 with complete data: of those with preoperative mechanical symptoms, only 33% reported complete alleviation (absence) of mechanical symptoms over the course of 12-month follow-up. Further, there were 22% (26/118) who reported no mechanical symptoms preoperatively but reported these symptoms at one point or another during the 12-month follow-up (Fig. 3).

Discussion

Mechanical symptoms are quite universally considered a valid indication for arthroscopic surgery in patients with degenerative knee disease[14–17]. In accordance with this tenet, a large proportion of patients (64%) of this pragmatic cohort reported presence of mechanical symptoms preoperatively. However, in obvious contrast to the prevailing consensus and most guideline recommendations, our study indicates that a preoperative self-report of mechanical symptoms is actually associated with less favourable outcome of surgery than the absence of these symptoms. Further, half of the patients with preoperative mechanical symptoms still reported their presence 12 months after surgery.

Apart from our recently published secondary analysis of the sham-surgery controlled FIDELITY trial[31], we are aware of no prospective study specifically addressing the validity of preoperative mechanical symptoms as an indication for knee arthroscopy in patients with degenerative meniscus tear. In fact, the existing evidence on the issue is both scarce and quite contradictory. While there are some uncontrolled case series/cohort studies reporting that mechanical symptoms predict good outcome after knee arthroscopy[32–35], others have observed no effect[36,37]. Subgroup analyses of two recent RCTs comparing knee arthroscopy and conservative treatment to conservative treatment alone concluded that mechanical symptoms had no effect on the outcome of treatment (relief of knee symptoms/pain) in either patients with established knee OA[38] or middle-aged patients with meniscal symptoms and no radiographic OA[39]. Also, in a prospective prognostic study[37], neither the presence of meniscus tears nor mechanical symptoms had an effect on the outcome of arthroscopic debridement in 122 patients with OA of the knee. In this particular study, the strongest predictor of poor postoperative outcome (high pain scores) was the severity of cartilage lesions[37]. Interestingly, the knee OA was also found to be associated with (the existence of) mechanical symptoms in the present study. Finally, in a recent RCT comparing APM and non-operative management in patients with degenerative horizontal tear of the posterior horn of the medial meniscus and knee pain with mechanical symptoms, no difference was found between the two treatment arms[40].

Regarding our strengths, the study cohort was prospectively collected and the loss to follow-up was well within the limits considered acceptable (13% of enrolled patients). The demographics (mean age, gender distribution, percentage of meniscal resections vs repairs) of our pragmatic cohort (the effectiveness of interventions assessed in real-life routine practice conditions) to produce results that can be generalized and applied in routine practice[41] is highly similar to that of entire Finland and other published representative datasets around the world[38,42], suggesting high external validity for our findings. Further, 90% of the surgeries were carried out by orthopaedic consultants with ample experience in knee arthroscopy and our analyses suggested that the surgeons' experience was not associated with the outcome of arthroscopy.

Table III
Results of the linear regression analysis, multiple imputed data

Covariate	Change in WOMET (95% CI)	Change in NRS (95% CI)
Mechanical symptoms at baseline	2.79 (−0.79 to 6.37)	−0.08 (−0.45 to 0.28)
Age (years)	0.23 (0.06 to 0.39)	0.02 (0.00 to 0.03)
Sex (male)	−4.30 (−7.80 to −0.79)	−0.18 (−0.54 to 0.18)
Radiological OA*	−7.17 (−11.94 to −2.41)	−0.19 (−0.69 to 0.31)
Surgeon exp ≤100	0.00	0.00
Surgeon exp 100–500	2.10 (−1.54 to 5.74)	−0.11 (−0.48 to 0.26)
Surgeon exp ≥500	1.10 (−5.06 to 7.26)	−0.21 (−0.87 to 0.45)
Medial tear	0.00	0.00
Lateral tear	−1.81 (−6.65 to 3.02)	−0.10 (−0.58 to 0.39)
Tear on both menisci	−5.46 (−10.76 to −0.16)	−0.55 (−1.13 to 0.04)
Chondral deg none†	0.00	0.00
Chondral deg early†	1.25 (−3.62 to 6.13)	0.06 (−0.42 to 0.54)
Chondral deg OA†	−6.69 (−12.47 to −0.91)	−0.43 (−0.98 to 0.13)
Chondral procedure‡	2.87 (−0.99 to 6.73)	0.07 (−0.32 to 0.46)
BMI (kg/m²)	−0.16 (−0.59 to 0.27)	−0.01 (−0.05 to 0.03)

Data are presented as coefficients presented with 95% CIs. The change in scores is from baseline to 12 month follow-up.

* Using the Kellgren and Lawrence grading system for which grade 0 denotes no abnormalities, and grade 1 minor degenerative changes (doubtful narrowing of the joint space or possible osteophytic lipping) meaning no knee OA; and grade 2 (definite narrowing of the joint space and definite osteophytes), grade 3 (marked narrowing of the joint space and definite osteophytes) and grade 4 (gross loss of joint space with sclerosis and cysts, marked deformity and large osteophytes) meaning knee OA.

† Chondral lesions were first graded at arthroscopy according to ICRS classification[19] (0 = none; 1 = superficial/softening; 2 = <50% of the cartilage thickness; 3 = through the entire cartilage thickness; 4 = extension into subchondral bone). Patients were then divided into three groups according to the severity of chondral degeneration as follows: None or mild = max. grade 1 lesion in one compartment; Degenerative changes = grade 1 lesion in at least two compartments or a single grade 2 lesion; Osteoarthritic = grade 3 or 4 lesion in one compartment.

‡ Patient undergoing an additional chondral procedure (vs partial meniscectomy alone).

Regarding limitations, the reliability of eliciting the presence of mechanical symptoms through a questionnaire is debatable. The definitions of the terms 'mechanical symptoms' or 'catching' and 'locking' are inherently somewhat vague, and accordingly, different individuals may comprehend these terms differently. However, we used expanded symptom definitions in our questionnaire, a policy that has recently been advocated[43]. The method used also showed relatively good repeatability in our test-retest analysis. Although it is indeed possible that there was heterogeneity between individuals' understanding of the concepts, our standardized questionnaire is at least as thorough as that used to elicit these symptoms in daily clinical practice. Finally, it is unlikely that the understanding of each individual changed during the study (or that the surgical intervention somehow altered this understanding), and accordingly, the risk of bias is as low as it can be in any analysis of subjective symptoms. Also, the definition of the concepts 'degenerative' or 'traumatic' in the context of meniscal injuries is arbitrary in nature. In this study, patients with a history of a more substantial event, such as falling from a chair, stairs or bicycle, or slipping on ice were considered to have experienced a 'trauma', and were subsequently excluded. However, although a traumatic tear morphology is commonly considered a favourable prognostic factor for arthroscopic knee surgery/partial meniscectomy, little evidence exists to support such assertion[44]. In fact, the outcome of patients with degenerative meniscus tear and traumatic onset of symptoms was recently reported to be no better than for those without a traumatic onset[45].

One may also argue that comparison of two groups discrepant with respect to mechanical symptoms is not valid, as the former has inferior preoperative knee status and higher prevalence of knee OA. However, theoretically the patients with mechanical symptoms thus had more room for improvement than patients with no preoperative mechanical symptoms. Despite this, the arthroscopy-induced improvement was not different in the two groups. In fact, the observed mean arthroscopy-induced improvements in the WOMET scores of the two groups of our pragmatic cohort (approximately 25 WOMET points) are virtually identical to the treatment benefit/ response observed in the sham-surgically treated patients in the FIDELITY trial[46]. However, our finding of more prevalent knee OA among the patients with mechanical symptoms is actually also one of the key findings of this study, as this data suggests that mechanical symptoms are actually attributable to general knee degeneration,
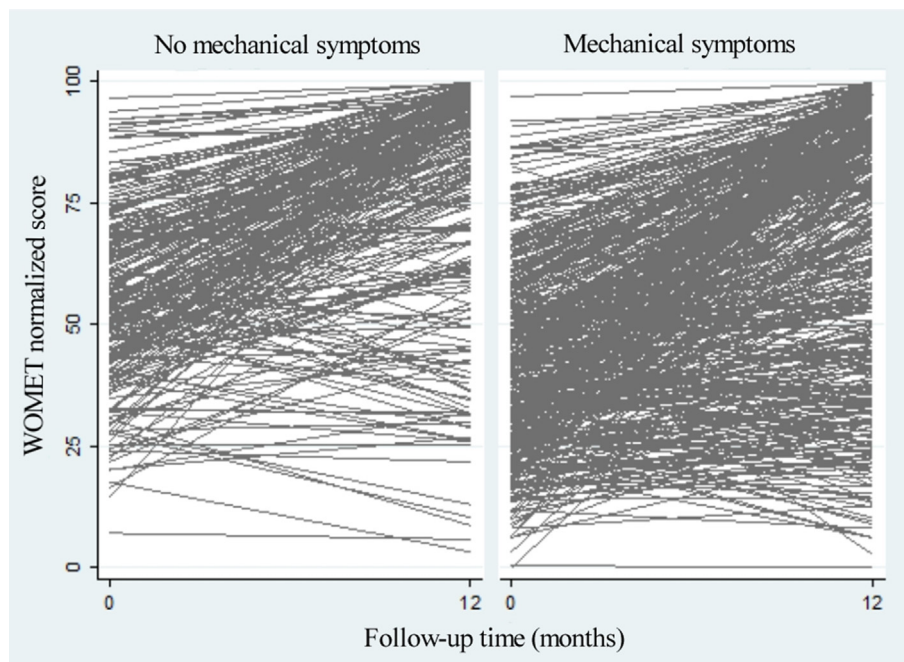

Fig. 2. **The pre- and post-operative WOMET scores.** The pre- and post-operative WOMET score for patients with complete data, by pre-operative mechanical symptoms status. Each line represents an individual trajectory.
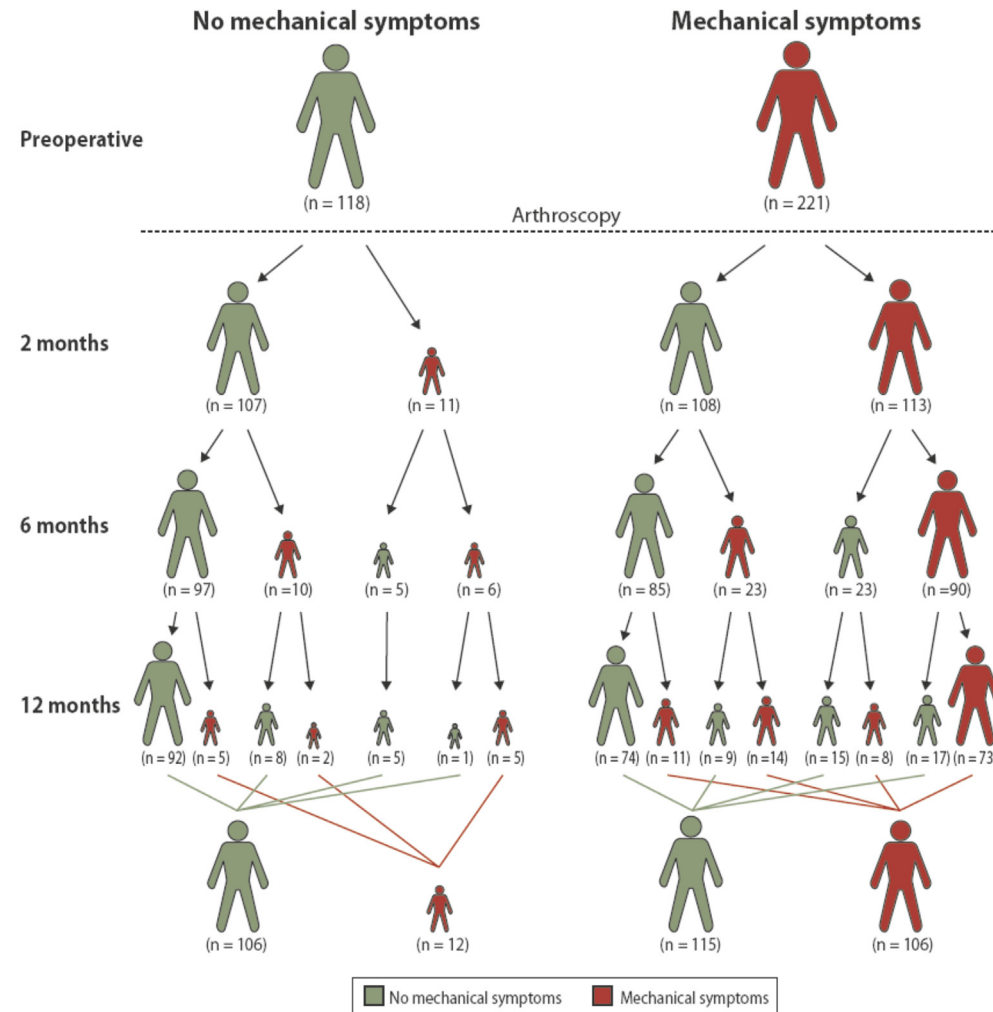
Fig. 3. Intra-individual fluctuation in the presence of mechanical symptoms during 12-month follow-up. The presence of mechanical symptoms was elicited preoperatively and then at 2, 6 and 12 months postoperatively for the subgroup 339 patients with complete data. Of the 221 patients reporting preoperative mechanical symptoms, 74 (33%) were symptom-free for the entire 12-month follow-up. Intra-individual fluctuation was observed during the follow-up period, particularly among the patients with preoperative mechanical symptoms but also among those with no preoperative mechanical symptoms. A green symbol denotes no mechanical symptoms and red denotes mechanical symptoms at the time of follow-up.

rather than a distinct lesion such as a degenerative meniscus tear. In our statistical analyses, the possible confounding effect of differences in the baseline characteristics was controlled for.

Finally, being a pragmatic study, we included all patients deemed in need of arthroscopic knee surgery by the surgeon in charge of their care and who underwent APM. Inherently, there is obvious heterogeneity with regards to such issues as indications for surgery, preoperative imaging, documentation of intraoperative findings, and interventions carried out at arthroscopy. For example, preoperative imaging was lacking in 20% participants, radiographs were not taken in a standardized manner and the grading of knee OA (both radiographic and intraoperative) was carried out by a single assessor, the arthroscopic grading of chondral lesions basing only on the depth, not size, of the lesion. While all this could have resulted in some non-differential misclassification of confounders, it obviously increases the external validity of the findings.

Conclusion

This study challenges the prevailing consensus that preoperative self-report of sensations of mechanical symptoms constitutes a valid indication for knee arthroscopy in patients with degenerative knee disease, as our results show that mechanical symptoms are actually associated with less favourable outcome of surgery.

Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.joca.2016.03.013.

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