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The conundrum of mechanical knee symptoms – signifying feature of a meniscal tear?

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ABSTRACT

Background: Mechanical knee symptoms are often considered important for the decision to perform knee arthroscopy on the suspicion of a meniscal tear. We investigated if presence of a meniscal tear at knee arthroscopy in adults is associated with presence of pre-operative self-reported mechanical knee symptoms.

Methods: We used data from Knee Arthroscopy Cohort Southern Denmark (KACS). KACS consists of patients aged 18 years or older referred to knee arthroscopy on the suspicion of a meniscal tear at 4 recruiting hospitals between February 1st 2013 and January 31st 2015. Of 1259 invited patients, 908 (72%) replied to the baseline questionnaire. With ninety-one patients excluded, the study sample consisted of 641 and 176 patients with and without a meniscal tear confirmed at surgery, respectively. Exposure was meniscal tear as determined by the knee surgeon during arthroscopy. Main outcomes were pre-operative mechanical knee symptoms defined as self-reported catching/locking or self-reported inability to straighten knee fully.

Results: 55% of all patients reported symptoms of catching/locking and 47% were unable to straighten their knee fully. Pre-operative mechanical symptoms were equally prevalent in patients with and without a meniscal tear (prevalence ratio catching/locking 0.89 95% CI 0.77 to 1.03 and inability to straighten knee fully, prevalence ratio 1.02 95% CI 0.84 to 1.23).

Interpretation: Patient-reported mechanical symptoms were equally common irrespective of presence or absence of a meniscal tear in patients undergoing arthroscopy for suspicion of a meniscal tear. Our findings suggest that mechanical knee symptoms have a limited value when considering indication for meniscal surgery.
What are the findings?

- More than half of patients with a meniscal tear self-report mechanical knee symptoms of catching and/or locking prior to their arthroscopic meniscal surgery.
- Mechanical symptoms were equally common among patients not having a meniscal tear at arthroscopy.

How might it impact on clinical practice in the future?

- Mechanical symptoms are not necessarily specific for a meniscal tear but appear to be associated with knee problems in general.
- Clinicians should be cautious to conclude, even in the presence of a meniscal tear confirmed by MRI, that the patient-reported mechanical symptoms are attributable to the meniscal tear.
INTRODUCTION

Arthroscopic partial meniscectomy (APM) is one of the most common orthopedic surgical procedures, with more than 700,000 annual procedures performed in the US alone.1 Based on the currently available evidence, statement and clinical guidelines generally recommend against the use of APM for degenerative meniscal tears.2-6 However, in the presence of ‘mechanical knee symptoms’ and a tear confirmed by magnetic resonance imaging (MRI), APM is frequently recommended.2 3 6

Mechanical knee symptoms, i.e. the patient’s sensation of catching and/or locking, are frequent among patients presenting in the clinic and often lead to the suspicion of a meniscal tear. However, patients with other knee pathologies such as osteoarthritis, anterior cruciate ligament (ACL) injury and synovial inflammation also experience mechanical symptoms.7-10

The assumption that APM is effective in relieving mechanical symptoms for patients with meniscal tear rests on the plausible assumption that such symptoms are truly caused by the meniscal tear per se, i.e. damaged meniscal tissue being trapped within the knee joint. However, a recent trial subgroup analysis on patients with preoperative mechanical symptoms suggested no difference in outcome between middle-aged and older patients with degenerative meniscal tears randomized to APM or a placebo APM intervention.11 12 These results question the proposed subgroup effect of APM among patients with mechanical symptoms. The presence of such symptoms among patients with other knee joint pathologies further question the premise that such symptoms are specific to a meniscal tear.

To better understand the relationship between meniscal tears and mechanical knee symptoms we investigated if presence of a meniscal tear at knee arthroscopy was associated with presence of self-reported pre-operative mechanical symptoms in adult patients undergoing knee arthroscopy for suspicion of a meniscal tear.
METHODS

We followed the strengthening the reporting of observational studies in epidemiology (STROBE) guideline for the reporting of this study.13

Patients

We included adult patients from the Knee Arthroscopy Cohort Southern Denmark (KACS) (ClinicalTrials.gov identifier NCT01871272.).14 In addition, we also included the patients who replied to the baseline questionnaire but had no meniscal tear at knee arthroscopy (which were excluded and not followed up in the KACS cohort). Patients were consecutively recruited at 4 public hospitals in Denmark between February 1st 2013 and January 31st 2014, and at 1 of the 4 hospitals in the period from February 1st 2014 to January 31st 2015.

The general KACS cohort inclusion criteria were: ≥18 years of age, referred for knee arthroscopy on suspicion of a meniscus tear by an orthopaedic surgeon (i.e. based on clinical examination, injury history and MRI if considered necessary), able to read and understand Danish and having an email address.

Exclusion criteria were: No meniscal tear at knee arthroscopy (this specific criteria were dropped for the present study), previous or planned ACL or posterior cruciate ligament (PCL) reconstruction surgery in either knee, fracture(s) to the lower extremities within the last 6 months prior to recruitment or not able to reply to the questionnaire because of mental impairment.

All study patients provided written informed consent but The Regional Scientific Ethics Committee of Southern Denmark waived the need for ethical approval after reviewing the outline of KACS.14

Data collection
Information about cohort participants and symptoms was self-reported by patients using online questionnaires approximately 1 week before surgery. Surgeons were blinded to all information collected from these online questionnaires. Self-reported knee symptoms were assessed using the Knee injury and Osteoarthritis Outcome Score (KOOS). The KOOS consists of 5 subscales covering pain, symptoms, function during daily activities (ADL), sport and recreational function (Sport/Rec) and quality of life (QOL). Each KOOS subscale ranges from 0-100 points with 0 representing extreme knee problems and 100 representing no knee problems and was designed for patients in the continuum from knee injury to osteoarthritis.15-17

Symptom onset was assessed with the question “How did the knee pain/problems for which you are now having surgery develop (choose the answer that best matches your situation)”, with the response options; “The pain/problems have slowly evolved over time”, “As a result of a specific incident (i.e. kneeling, sliding and/or twisting of the knee or the like, i.e. semi-traumatic onset)”, or “As a result of a violent incident (i.e. during sports, a crash, collision or the like, i.e. traumatic onset)”.

Main outcomes

Patient-reported mechanical symptoms (i.e. the sensation of knee catching and/or locking) were assessed using the single item from the KOOS symptom subscale:15 “Thinking of your knee symptoms during the last week - Does your knee catch or lock when moving?” with 5-item Likert scale response options ranging from ‘never’ to ‘always’. Patients were categorized as having mechanical symptoms unless replying ‘never’ to this question. In addition, patient-reported inability to straighten the knee fully (i.e. ‘extension deficit’) was assessed using the KOOS symptom subscale item: “Thinking of your knee symptoms during the last week - Can you straighten your
knee fully?” with response options ranging from ‘always’ to ‘never’. Patients were categorized as having extension deficit unless replying ‘always’ to this question.

*Exposure*

The operating surgeon collected information about presence or absence of a meniscal tear at knee arthroscopy. This information was collected together with information about other knee pathology using a modified version of the International Society of Arthroscopy, Knee Surgery and Orthopedic Sports Medicine (ISAKOS) classification of meniscal tears\(^\text{18}\) including cartilage lesion scoring using the International Cartilage Repair System (ICRS) grading system.\(^\text{19}\) ISAKOS and ICRS forms were only completed for those *with* a meniscal tear at surgery, as these patients were followed in the cohort. For this study we sought additional information about synovitis, ACL status for both patients *with* and *without* a meniscal tear. In addition, we collected information about degree of cartilage defects and type of surgical procedure performed for those *without* a meniscal tear from surgery reports.

*Statistical analysis*

Descriptive statistics are reported as means and standard deviations (SD), or numbers with percentages. Difference between groups was assessed by Chi\(^2\)-test or Students unpaired t-test as appropriate. Prevalence ratios with 95% confidence intervals were estimated from logistic regressions using the method described by Norton et al.,\(^\text{20}\) with age, sex and body mass index as covariates in the adjusted model. As meniscal tear types most likely to cause mechanical symptoms are typically more common among younger patients we also stratified analyses into patients aged 40 years or younger and older than 40 years of age, respectively. Sensitivity analyses with different cut-offs for presence/absence of mechanical symptoms were performed. That is, defining presence
of mechanical symptoms as only those patients with frequent/severe symptoms (i.e. catching/locking ‘often’ or ‘always’ and inability to straighten knee fully ‘rare’ or ‘never’). Also, we performed separate sensitivity analysis on the association of large longitudinal tears involving at least 2 of 3 adjacent sub regions (anterior horn, body, and posterior horn) only with mechanical symptoms. Stata 15.0 and a two-tailed significance level of 0.05 were used for all statistical analyses.

RESULTS

In total 641 (78%) of available 817 patients with a suspected meniscal tear had meniscal surgery (APM: n=600; repair: n=41) (Figure 1). A larger proportion of patients without a meniscal tear at surgery were women (p<0.001) and on average younger (p<0.001) than patients with meniscal tears. Self-reported symptom onset also seemed to differ between those with and without a meniscal tear (p=0.040) (Table 1). No difference in KOOS subscale scores prior to surgery were observed between groups, except for the symptoms subscale (p=0.017) (Table 1). Among patients without a meniscal tear, the most common procedures performed were synovectomy (n=83), cartilage debridement (n=72) and diagnostic arthroscopy only (n=46) (Supplementary table 1).

Fifty-five percent of the 817 patients reported symptoms of ‘catching/locking’ and 47% ‘extension deficit’. Among those with mechanical symptoms 75% had a meniscal tear, whereas 82% of those without mechanical symptoms had a tear. Mechanical knee symptoms were equally prevalent in patients with and without a meniscal tear (adjusted prevalence ratio 0.89 95% CI 0.77 to 1.03 for catching/locking and 1.02 95% CI 0.84 to 1.23 for extension deficit). Results of age-stratified analyses (Table 2) and sensitivity analyses using different cut-offs for presence/absence of mechanical symptoms (Supplementary Table 2) were essentially the same.
In the sensitivity analysis comparing presence of mechanical symptoms in the subgroup of patients with a large longitudinal tear (n=40) with patients without a meniscal tear, we found no difference in prevalence ratio for symptoms of catching/locking (adjusted prevalence ratio 0.98 95% CI 0.75 to 1.28), but extension deficit was more frequently reported among those with such meniscal tear (adjusted prevalence ratio 1.55 95% CI 1.24 to 1.94) (Table 3). Results were similar using other meniscal tears as the reference category (data not shown).

DISCUSSION

We found that mechanical knee symptoms were equally common, irrespective of presence or absence of a meniscal tear, among patients undergoing knee arthroscopy on suspicion of a meniscal tear. This was true for younger (18-40 years) as well as older patients (>40 years). Despite lack of evidence for a greater benefit of APM for patients with meniscal tears and mechanical symptoms among middle-aged and older patients,11 12 presence of mechanical symptoms is still considered an important component of the indication for meniscal surgery in both older and younger patients.2 3

In a Finnish cohort the investigators reported that 64% of approximately 900 middle-aged and older patients undergoing APM self-reported symptoms of catching/locking assessed by the Lysholm score,21 confirming that this is a common symptom.9 The higher prevalence of catching/locking compared to patients with a meniscal tear in the present study may be caused by use of different questionnaires to assess these symptoms and/or difference in the case mix of patients.

Our results suggest that clinicians should be very cautious to conclude, even in the presence of a meniscal tear confirmed by MRI, that the meniscal tear is the cause of the patient-reported mechanical symptoms. These symptoms are not necessarily specific for a meniscal tear.7 8 Indeed, other knee joint pathologies such as cartilage defects (indicative of osteoarthritis), synovitis and
ACL injury could also cause mechanical symptoms. However, in the present study these pathologies were generally less frequent and less severe in patients \textit{without} a meniscal tear than in patients \textit{with} a meniscal tear making it less likely that such pathologies explain the high prevalence of mechanical symptoms among those without a meniscal tear. Moreover, 26\% (n=46) of patients \textit{without} a meniscal tear had diagnostic arthroscopy as the only procedure reported in the surgery report, suggesting no relevant knee pathology and questioning the relationship between structural joint change and patient-reported mechanical symptoms.

We also investigated the association between ‘the ability to straighten the knee fully (i.e. extension deficit)’ and presence of a meniscal tear. Similar to the catching/locking symptom we found no association between this symptom and presence of a meniscal tear.

Some meniscal tear types, such as a large longitudinal tear, which is a tear parallel to the circumferentially-oriented collagen fibers which may form a ‘bucket handle’, are more likely to become displaced, and potentially cause mechanical symptoms.\textsuperscript{22} This tear type is strongly associated with acute knee trauma and therefore more prevalent in younger sports-active patients.\textsuperscript{23} Our age-stratified analysis did not indicate any association between meniscal tears (at large) and mechanical symptoms among patients aged 18-40 years. However, our sensitivity analysis specifically comparing only patients with large longitudinal tears with those without a meniscal tear yielded a higher prevalence of ‘extension deficit’ but not ‘catching/locking’ among those with a large longitudinal tear. This subgroup accounted for only 6\% of patients with a meniscal tear confirmed at surgery.

Our study has limitations. In this study symptoms of catching, locking and extension deficit were patient reported, which may not necessarily correspond to what the surgeon considers ‘mechanical’ of nature at the clinical examination when referring the patient to surgery. In the present study not all patients had a pre-operative MRI to confirm the clinical suspicion of a meniscal tear. Instead, the
operating surgeon confirmed presence or absence of a meniscal tear at arthroscopy, eliminating false positive meniscal tear findings on MRI. Patients’ age and sex distribution among those with a meniscal tear in the KACS cohort was similar to what has been reported for patients undergoing meniscal surgery in Denmark.24

In conclusion, we found patient reported mechanical symptoms to be equally common irrespective of presence or absence of a meniscal tear in patients undergoing arthroscopy for suspicion of a meniscal tear. Our findings highlight that mechanical symptoms are non-specific symptoms among patients with knee problems and causality with a meniscal tear is often questionable.

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Author contributions:
Concept and design: Thorlund, Pihl, Lohmander, Englund.
Acquisition, analysis and interpretation of data: Thorlund, Pihl, Nissen, Jørgensen, Fristed, Lohmander, Englund.
Drafting of the manuscript: Thorlund, Englund.
Critical revision of the manuscript for important intellectual content: Pihl, Nissen, Jørgensen, Fristed, Lohmander.
Approval of final submitted version of manuscript: All authors.
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Table 1: Characteristics of study sample, n=817.

<table>
<thead>
<tr>
<th></th>
<th>Patients with a meniscal tear (n=641)</th>
<th>Patients without a meniscal tear (n=176)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (SD)</td>
<td>49.2 (13.0)</td>
<td>41.6 (13.1)</td>
</tr>
<tr>
<td>Men/women, no. (%)</td>
<td>361/280 (56/44)</td>
<td>60/116 (34/66)</td>
</tr>
<tr>
<td>Body mass index, kg/m² (SD)</td>
<td>27.3 (4.4)</td>
<td>26.9 (5.2)</td>
</tr>
<tr>
<td>Symptom onset, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Slowly evolved over time</td>
<td>208 (32)</td>
<td>66 (38)</td>
</tr>
<tr>
<td>- Semi-traumatic</td>
<td>260 (41)</td>
<td>53 (30)</td>
</tr>
<tr>
<td>- Traumatic</td>
<td>173 (27)</td>
<td>57 (32)</td>
</tr>
<tr>
<td>KOOS scores (SD)b:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Pain</td>
<td>54.9 (18.5)</td>
<td>52.3 (18.9)</td>
</tr>
<tr>
<td>- Symptoms</td>
<td>60.0 (19.3)</td>
<td>56.0 (21.6)</td>
</tr>
<tr>
<td>- ADL function</td>
<td>63.6 (19.5)</td>
<td>61.7 (20.5)</td>
</tr>
<tr>
<td>- Sport/Rec function</td>
<td>26.3 (21.9)</td>
<td>24.0 (24.0)</td>
</tr>
<tr>
<td>- QOL</td>
<td>41.6 (15.4)</td>
<td>40.1 (16.1)</td>
</tr>
</tbody>
</table>

Abbreviations: ADL function, functional limitations during activities of daily livings; KOOS, Knee injury and Osteoarthritis Outcome Score; Sport/Rec function, functional limitations during sports and recreational activities; QOL, Quality of life.

a Semi-traumatic symptom onset was defined as ‘a result of a specific incident (i.e. kneeling, sliding, and/or twisting of the knee or the like)’, Traumatic onset was defined as ‘a result of a violent incident (i.e. during sports, a crash, or collision or the like)’.
b The KOOS subscale score ranges from 0 to 100, with 0 representing extreme knee problems and 100 representing no knee problems
Table 2: Prevalence of mechanical knee symptoms according to presence or absence of a meniscal tear at surgery.

<table>
<thead>
<tr>
<th>Symptom present</th>
<th>Yes, n (%)</th>
<th>No, n (%)</th>
<th>Crude (95% CI)</th>
<th>Adjusted (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CATCHING OR LOCKING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients (n=817)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meniscal tear present</td>
<td>340 (53)</td>
<td>301 (47)</td>
<td>0.83 (0.73 to 0.95)</td>
<td>0.89 (0.77 to 1.03)</td>
</tr>
<tr>
<td>No meniscal tear</td>
<td>112 (64)</td>
<td>64 (36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients ≤40 years (n=235)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meniscal tear present</td>
<td>89 (59)</td>
<td>61 (41)</td>
<td>0.93 (0.76 to 1.15)</td>
<td>1.00 (0.80 to 1.25)</td>
</tr>
<tr>
<td>No meniscal tear</td>
<td>54 (64)</td>
<td>31 (36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients &gt;40 years (n=582)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meniscal tear present</td>
<td>251 (51)</td>
<td>240 (49)</td>
<td>0.80 (0.67 to 0.96)</td>
<td>0.83 (0.69 to 1.00)</td>
</tr>
<tr>
<td>No meniscal tear</td>
<td>58 (64)</td>
<td>33 (36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EXTENSION DECIFIT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients (n=817)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meniscal tear present</td>
<td>292 (46)</td>
<td>349 (54)</td>
<td>0.91 (0.77 to 1.08)</td>
<td>1.02 (0.84 to 1.23)</td>
</tr>
<tr>
<td>No meniscal tear</td>
<td>88 (50)</td>
<td>88 (50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients ≤40 years (n=235)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meniscal tear present</td>
<td>82 (55)</td>
<td>68 (45)</td>
<td>1.13 (0.87 to 1.48)</td>
<td>1.26 (0.95 to 1.66)</td>
</tr>
<tr>
<td>No meniscal tear</td>
<td>41 (52)</td>
<td>44 (48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients &gt;40 years (n=582)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meniscal tear present</td>
<td>210 (43)</td>
<td>281 (57)</td>
<td>0.83 (0.66 to 1.04)</td>
<td>0.87 (0.69 to 1.10)</td>
</tr>
<tr>
<td>No meniscal tear</td>
<td>47 (52)</td>
<td>44 (48)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a* The prevalence ratio was calculated as the proportion of patients with mechanical symptoms among those with a meniscal tear divided by the corresponding proportion among patients without a meniscal tear.

*b* Adjusted for age, sex and body mass index.
Table 3: Sensitivity analyses of prevalence of mechanical knee symptoms according to presence of a large longitudinal tear\(^a\) or absence of a meniscal tear at surgery.

<table>
<thead>
<tr>
<th>Symptom present</th>
<th>Prevalence ratio(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes, n (%)</td>
</tr>
<tr>
<td><strong>CATCHING OR LOCKING</strong></td>
<td></td>
</tr>
<tr>
<td>All patients (n=216)</td>
<td></td>
</tr>
<tr>
<td>Large longitudinal tear</td>
<td>24 (60)</td>
</tr>
<tr>
<td>No meniscal tear</td>
<td>112 (64)</td>
</tr>
<tr>
<td><strong>EXTENSION DECIFIT</strong></td>
<td></td>
</tr>
<tr>
<td>All patients (n=216)</td>
<td></td>
</tr>
<tr>
<td>Large longitudinal tear</td>
<td>30 (75)</td>
</tr>
<tr>
<td>No meniscal tear</td>
<td>88 (50)</td>
</tr>
</tbody>
</table>

\(^a\) Large longitudinal tear was defined as a complete longitudinal-vertical tear (i.e. extending all the way through the meniscus tissue parallel to the circumferentially-oriented collagen fibers) involving at least two regions of the meniscus (i.e. posterior horn + body, anterior horn + body or entire meniscus), as reported by the surgeon at arthroscopy.

\(^b\) The prevalence ratio was calculated as the proportion of patients with mechanical symptoms among those with a meniscal tear divided by the corresponding proportion among patients without a meniscal tear.

\(^c\) Adjusted for age, sex and body mass index.
FIGURES

Figure 1: Study flow-chart

Participants invited to KACS cohort, n=1259

Excluded, did not fit inclusion criteria (n=138):
- Previous ACL or PCL surgery, n=112
- Fracture on lower extremities less than six months before surgery, n=5
- No email address, n=18
- Did not understand Danish, n=2
- Not mentally able to reply, n=1
Excluded, other reasons (n=213):
- No time to participate, n=8
- No reason, n=50
- No reply prior to surgery, n=155

Replied to baseline questionnaire, n=908

Excluded (n=70):
- Surgery cancelled, n=51
- Rescheduled to surgery at other hospital, n=19

Surgery, n=838

Excluded, n=15
- ACL reconstruction at surgery, n=15

Excluded, n=6
- Missing data, misclassified by surgeon as 'no tear', n=6

Participants with meniscal tear, n=641

Participants without meniscal tear, n=176