



Original research

Association of specific meniscal pathologies and other structural pathologies with self-reported mechanical symptoms: A cross-sectional study of 566 patients undergoing meniscal surgery

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ABSTRACT

Objectives: We explored associations between specific meniscal pathologies and other concurrent structural knee pathologies with presence of self-reported mechanical symptoms in patients undergoing meniscal surgery.

Design: Cross-sectional study.

Methods: We included patients undergoing surgery for a meniscal tear from Knee Arthroscopy Cohort Southern Denmark (KACS). Pre-surgery, patients completed online questionnaires including self-reported presence of mechanical symptoms. At arthroscopy, surgeons recorded information about specific meniscal pathologies and other concurrent structural knee pathologies. Relative risks (RR) were estimated to assess associations between specific meniscal pathologies and other structural knee pathologies with preoperative mechanical symptoms from multivariable logistic regression.

Results: 566 of 641 patients (mean age 48.6[SD 12.9] years, 57% men) with complete data were included. 386 (68%) patients reported mechanical symptoms of knee catching/locking and/or extension deficit. Most evaluated joint pathologies were not associated with mechanical symptoms of any kind with RRs close to 1.0. Meniscal tears involving both the posterior and anterior horn (n = 22) were associated with knee catching/locking (RR: 1.49[95%CI: 1.15–1.93]), and a tear in both menisci (n = 49) was associated with extension deficit of the knee (RR: 1.32[95%CI: 1.01–1.73]). A partial (n = 29) and total ACL rupture (n = 37) were each associated with extension deficit (RR: 1.83[95%CI: 1.47–2.28] and RR: 1.44[95%CI: 1.05–1.98], respectively).

Conclusions: Limited associations between specific meniscal pathology and other concurrent knee joint pathologies with presence of self-reported mechanical symptoms were found in patients undergoing meniscal surgery. The findings question the clinical importance of mechanical symptoms as an indicator for arthroscopy for specific meniscal tears with the specific aim to relieve such symptoms.

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1. Introduction

Meniscal tears are common in the general population¹ and arthroscopic meniscal surgery is frequently performed with the intention to treat symptoms considered to be caused by meniscal tears.^{2–4} Although no clear consensus exists regarding indications

for arthroscopic meniscal surgery,⁵ the presence of “mechanical symptoms” (i.e. the sensation of catching and/or locking of the knee) is considered an important and often pivotal indication.^{6,7}

A recent observational study of 900 patients undergoing arthroscopic partial meniscectomy (APM) for degenerative meniscal tears reported mechanical symptoms *not* to be relieved at the 12-months follow-up in nearly half of patients reporting mechanical symptoms prior to surgery.⁸ Furthermore, a secondary analysis of a randomized trial found no added benefit of APM over a sham APM procedure in relieving self-reported mechanical symptoms

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in patients with degenerative tears.⁹ These results challenge the common tenet that the mechanical symptoms are caused by meniscal tissue being trapped between the articular surfaces and that removal or trimming of a torn meniscus would resolve such symptoms.^{5,6,10}

Nonetheless, some meniscal tears (i.e. vertical and longitudinal–vertical tears) are typically considered to be unstable,¹¹ where the torn part of the meniscus may get stuck causing the knee to catch or lock. This is less likely for other tear types such as horizontal cleavage tears.¹² Hence, it is conceivable that some, but not all meniscal tear types, may cause mechanical symptoms.

Meniscal tears often present in combination with other knee pathologies, including synovial inflammation,¹³ cartilage lesions and knee osteoarthritis (OA),¹⁴ that have been reported to be associated with knee symptoms including mechanical symptoms.^{8,15} Thus, other factors than the meniscal tear per se are also potential candidates to cause mechanical symptoms.

We aimed to explore the possible association between specific meniscal pathologies (i.e. tear type, location, size, etc.) and other concurrent structural knee joint pathologies with preoperative self-reported mechanical symptoms in patients undergoing arthroscopic meniscal surgery.

2. Methods

We used an exploratory cross-sectional design and followed the STrengthening the Reporting of OBServational studies in Epidemiology (STROBE) guideline¹⁶ to report this study.

This study included patients from Knee Arthroscopy Cohort Southern Denmark (KACS)¹⁷ with baseline assessment of patient-reported mechanical symptoms and a verified meniscal tear at surgery. The KACS cohort consecutively included and prospectively followed patients undergoing arthroscopy for a meniscal tear who were recruited at 4 public hospitals in Denmark between February 1st 2013 and January 31st 2014 and also at 1 of the initial 4 hospitals in the period from February 1st 2014 to January 31st 2015.

The inclusion criteria were: ≥ 18 years of age, assigned for knee arthroscopy on suspicion of a meniscal tear by an orthopedic surgeon (i.e. based on clinical examination, history of injury, and MRI if available), able to understand Danish, and having an e-mail address. The exclusion criteria were: no meniscal tear at surgery, previous or planned anterior or posterior cruciate ligament (ACL or PCL) reconstruction surgery in either knee, fracture(s) in lower extremities within 6 months before recruitment, or not able to reply to the questionnaire because of mental impairment. All patients provided written informed consent to participate in the study. The Regional Scientific Ethics Committee of Southern Denmark waived the need for ethical approval after reviewing the outline of KACS.¹⁷

Information about presence of patient-perceived mechanical symptoms was collected using online questionnaires at a median of 7 (IQR 3–10) days before surgery. The mechanical symptoms of interest were presence of knee catching and/or locking, and extension deficit of the knee (i.e. inability to straighten the knee fully), which were assessed using two single items from the Knee Injury and Osteoarthritis Outcome Score (KOOS) symptom subscale¹⁸: “Does your knee catch or lock when moving?” and “Can you straighten your knee fully?”, respectively. Both questions were preceded by the phrase: “Thinking of your knee symptoms during the last week”. Response options were: [1] “never”, [2] “rarely”, [3] “sometimes”, [4] “often” and [5] “always”. Patients were categorized as having catching and/or locking if not replying ‘never’ and having extension deficit if not replying ‘always’. In addition, patients were asked about their pre-injury level of participation in leisure activities using the question: “To what extent did you

participate in leisure activities before your knee problems?” with response options ranging from: “no household work” to “sport at competitive level” on a 7-point Likert scale.

Information about meniscal pathology and cartilage status was reported by the operating surgeon at arthroscopy using a modified version of the International Society of Arthroscopy, Knee Surgery and Orthopedic Sports Medicine (ISAKOS) classification of meniscal tears¹⁹ including cartilage lesion scoring using the International Cartilage Repair System (ICRS) grading system.²⁰ Additional information on structural knee pathology (i.e. ACL status and presence of synovitis) at arthroscopy was extracted from the patients’ surgery reports. Information registered by surgeons in the modified ISAKOS questionnaire was transferred from paper format to electronic format using automated forms processing. This method has been validated as an alternative to double entry of data.²¹

The following meniscal pathology variables were included in the analyses: tear location (medial and/or lateral), tear depth (partial or complete), circumferential location of tear (red or white zone, i.e. zone 3 or zone 1–2 in ISAKOS, respectively), radial location of tear (posterior/posterior–mid body, mid body, anterior/anterior–mid body or all/posterior + anterior), length of tear (in cm), meniscal tissue quality (degenerative, non-degenerative or undetermined) and tear pattern (unstable, i.e. longitudinal–vertical or vertical flap tears, or stable, i.e. horizontal, radial, complex or root tears). If more than one tear type was present, these were categorized as unstable if at least one of them was either longitudinal–vertical or vertical flap tear. Other structural knee joint pathologies included in the analyses were: cartilage grade for the medial, lateral and patellofemoral compartment, respectively (scored from 0 to 4 with 0 being normal cartilage and 4 severe cartilage lesions), surgeon assessed knee joint laxity in anesthesia (no laxity, slight or pronounced laxity), presence of plica, ACL status (intact, partial rupture or total rupture) and inflammation/synovitis (none, irritation/redness, light, moderate or severe). As presence of synovitis was generally well described in surgery reports missing descriptions of synovitis were considered as no synovitis present.

Descriptive statistics are given as means and standard deviations (SD), median with interquartile range (IQR), or numbers with percentages as appropriate. Due to the exploratory nature of the study no power calculation was conducted. Only patients with complete data were included in all analyses, thus a drop out analysis describing the differences between patients with and without missing data was conducted.

Prior to analyses, all independent variables (i.e. meniscal and other structural knee joint pathologies) were investigated for collinearity by calculating variance inflation factors (VIFs). The level of collinearity was not considered problematic if mean VIF was ≤ 5 and individual VIFs were ≤ 10 .²² For each mechanical symptom (i.e. dependent variable) a logistic regression model was fitted including all meniscal and other structural knee joint pathology variables as independent variables. All models were analyzed unadjusted as well as adjusted for age, sex, BMI and previous meniscus surgery on index knee. Categorical and continuous variables were in all analyses handled as such with the exception of the two ordinal variables cartilage grade and synovitis, which were handled as continuous. As odds ratio does not equal risk ratios when the outcome is frequent (as is the case with mechanical symptoms in this study) risk ratios (RR) were estimated from the odds ratios using the method described by Norton et al.²³ Finally, residuals and leverage for all models were checked. To ease the interpretation of estimated associations an adjusted risk difference (RD) was derived for these using the method described by Norton et al.²³

To assess the robustness of the results, sensitivity analyses were conducted using alternative dichotomization of responses defining the presence of mechanical symptoms (i.e. present if option 3–5 for

the question concerning catching/locking and 1–3 for the question concerning ability to straighten knee fully).

As both degenerative meniscal tissue and a meniscal tear in the posterior part of the meniscus are associated with overall degenerative changes in the knee,¹ possible interaction between these two variables (i.e. tissue quality and radial location) was tested for each mechanical symptom.

Stata 14.2 was used for all statistical analyses and risk ratios are presented with 95% confidence intervals.

3. Results

Of the 641 patients included in KACS, 75 (12%) patients had missing surgery data and were therefore excluded, leaving 566 patients (each contributing one knee) for analyses (flowchart is presented in Supplementary Fig. 1). Patients with and without missing data for any of the variables listed in Table 1 were similar, except for degree of cartilage damage in the lateral knee compartment in which patients with missing data had less severe cartilage defects (Supplementary Table 1). The study sample included a majority of men, who were on average middle-aged and slightly overweight (Table 1). The majority of patients were sports active with one-third participating in recreational or competitive sport (Table 1).

The prevalence of knee catching and/or locking and extension deficit of the knee was 53% and 46%, respectively, while a total of 180 (32%) patients did not report any mechanical symptoms.

For the main analyses, no collinearity was detected between any of the independent variables included in the logistic regression models (mean VIF = 1.38, individual VIFs \leq 2.50), hence all variables were retained in all analyses. Also, examination of residuals and leverage did not reveal any obvious outliers as most residuals were within ± 0.2 and leverage < 0.2 . The few observations with larger residuals and leverage were checked for any abnormal values in data, but none were found, hence all observations were retained in the logistic models.

Most meniscal pathologies and other concurrent structural knee joint pathologies were not associated with presence of mechanical symptoms, with estimated RRs close to 1.0 (and not statistically significant). There were a few exceptions. Meniscal tears involving both the posterior and anterior horn (22/566 (4%)) (Table 1) were associated with knee catching and/or locking (RR: 1.49 [95%CI: 1.15;1.93]) (Table 2) with a corresponding adjusted risk difference of 0.25 [95%CI: 0.06;0.44]. Also, meniscal tears in both menisci (49/566 (9%)) and meniscal tears classified as unstable (i.e. longitudinal–vertical or vertical flap tears) (292/566 (52%)) were associated with extension deficit of the knee (Table 3), with adjusted risk differences of 0.14 [95%CI: -0.01 ;0.24] and 0.09 [95%CI: 0.01;0.18], respectively.

The only non-meniscal pathologies associated with mechanical symptoms were partial and total rupture of the ACL (29/566 (5%) and 37/566 (7%), respectively). Both were associated with extension deficit of the knee (RR: 1.83 [95%CI: 1.47;2.28] and 1.44 [95%CI: 1.05;1.98], respectively) (Table 3) with corresponding adjusted risk differences of 0.37 [95%CI: 0.20;0.54] and 0.20 [95%CI: -0.00 ;0.40], respectively.

No statistically significant interaction was found between meniscal tissue quality and radial location for any of the mechanical symptoms (data not shown).

In the sensitivity analysis, the association between having an unstable meniscal tear type with extension deficit of the knee was diminished and statistically insignificant (RR: 1.06 [95%CI: 0.79;1.44]). Remaining results from sensitivity analyses were very similar to the main analyses (see online Supplementary Table 2).

Table 1
Baseline patient characteristics.

Variables	N = 566	
		Range
Age, years (SD)	48.6 (12.9)	18–76
Sex, female, no. (%)	242 (43)	
BMI, kg/m ² (SD)	27.3 (4.3)	18.9–47.2
Previous surgery on index knee, no. (%)	101 (18)	
Participation in physical activity prior to injury, no. (%)		
Sport at competitive level	55 (10)	
Recreational sport	137 (24)	
Light sport	138 (24)	
Heavy household work	90 (16)	
Light household work	132 (23)	
Minimal household work	11 (2)	
No household work	3 (1)	
Knee catching/locking, no. (%)		
Never	265 (47)	
Rarely	91 (16)	
Sometimes	119 (21)	
Often	77 (14)	
Always	14 (2)	
Can extend knee fully, no. (%)		
Always	308 (54)	
Often	118 (21)	
Sometimes	64 (11)	
Rarely	26 (5)	
Never	50 (9)	
Tear location, no. (%)		
Medial	420 (74)	
Lateral	97 (17)	
Both	49 (9)	
Tear depth, no. (%)		
Partial	225 (40)	
Complete	341 (60)	
Tear pattern, no. (%)		
Longitudinal–vertical (bucket handle)	113 (20)	
Horizontal	38 (7)	
Radial	34 (6)	
Vertical flap	131 (23)	
Horizontal flap	30 (5)	
Complex	154 (27)	
Root tear	2 (1)	
More than one tear type	64 (11)	
Meniscal tissue quality, no. (%)		
Non-degenerative	232 (41)	
Degenerative	318 (56)	
Undetermined	16 (3)	
Length of tear, cm (SD)	1.7 (0.8)	0.2–5.0
Circumferential location, no. (%)		
Zone 1	166 (29)	
Zone 2	307 (54)	
Zone 3	93 (17)	
Radial location, no. (%)		
Posterior	375 (66)	
Posterior–mid body	94 (17)	
Mid body	50 (9)	
Anterior–mid body	8 (1)	
Anterior	17 (3)	
Posterior + anterior	2 (0)	
All	20 (4)	
Medial cartilage grade, no. (%)		
Grade 0	161 (28)	
Grade 1	137 (24)	
Grade 2	108 (19)	
Grade 3	123 (22)	
Grade 4	37 (7)	

Table 1 (Continued)

Variables	N = 566	Range	
Lateral cartilage grade, no. (%)			
Grade 0	231 (41)		
Grade 1	196 (35)		
Grade 2	86 (15)		
Grade 3	42 (7)		
Grade 4	11 (2)		
Patellofemoral cartilage grade, no. (%)			
Grade 0	208 (37)		
Grade 1	156 (28)		
Grade 2	91 (16)		
Grade 3	81 (14)		
Grade 4	30 (5)		
Plica, n (%)	234 (41)		
Knee joint stability, no. (%)			
No laxity	492 (87)		
Slight laxity	57 (10)		
Pronounced laxity	16 (3)		
Synovitis, no. (%)			
None	161 (29)		
Irritation/redness	194 (34)		
Light synovitis	112 (20)		
Moderate synovitis	69 (12)		
Severe synovitis	30 (5)		
ACL, no. (%)			
Intact	500 (88)		
Partial rupture (non-reconstructed)	29 (5)		
Total rupture (non-reconstructed)	37 (7)		

no.: number, SD: standard deviation, BMI: body mass index; ACL: anterior cruciate ligament.

Table 2
Logistic regression for association between meniscal pathology and other concurrent structural knee pathologies with presence of catching/locking of the knee. Risk ratios were estimated from the logistic regression using a method of Norton et al.²³

Variables	Catching/locking (n = 566)			
	Unadjusted RR	95% CI	Adjusted ^a RR	95% CI
Tear location (ref.: medial)				
Lateral	1.01	0.80–1.29	1.00	0.78–1.27
Both	0.90	0.66–1.23	0.91	0.67–1.24
Tear depth (ref.: partial)				
Complete	0.89	0.76–1.05	0.90	0.76–1.06
Tear pattern (ref.: stable)				
Unstable	1.04	0.89–1.23	1.04	0.88–1.22
Meniscal tissue quality (ref.: non-degenerative)				
Degenerative	1.00	0.82–1.21	1.04	0.85–1.27
Undetermined	0.55	0.26–1.16	0.57	0.27–1.21
Length of tear, cm	1.00	0.91–1.11	1.00	0.91–1.11
Circumferential location (ref.: white zone)				
Red zone	1.02	0.86–1.22	1.02	0.85–1.21
Radial location (ref.: posterior/posterior-mid body)				
Mid body	1.18	0.91–1.51	1.18	0.92–1.52
Anterior/anterior-mid body	1.31	0.95–1.79	1.31	0.95–1.79
All/posterior + anterior	1.47	1.13–1.92	1.49	1.15–1.93
Synovitis	0.96	0.90–1.02	0.96	0.90–1.02
ACL status (ref.: intact)				
Partial rupture (non-reconstructed)	0.83	0.52–1.32	0.82	0.51–1.30
Total rupture (non-reconstructed)	1.06	0.74–1.51	0.97	0.66–1.44
Plica	0.86	0.72–1.01	0.87	0.73–1.02
Knee joint laxity	0.96	0.70–1.30	0.98	0.73–1.33
Medial cartilage grade	1.09	0.98–1.20	1.09	0.99–1.21
Lateral cartilage grade	0.97	0.88–1.07	0.98	0.88–1.08
Patellofemoral cartilage grade	0.96	0.88–1.04	0.96	0.88–1.04

RR, relative risk; CI, confidence interval; ACL, anterior cruciate ligament.

^a Adjusted for age, sex, body mass index and previous surgery to the meniscus on the index knee.

4. Discussion

In this explorative study, most meniscal pathologies and other concurrent structural knee joint pathologies were found not to be associated with presence of any kind of mechanical symptoms in patients undergoing meniscal surgery. The few exceptions were meniscal tears involving both the posterior and anterior horn, tears in both menisci simultaneously, and partial and total rupture of the ACL, which were associated with increased risks of either presence of knee catching and/or locking or extension deficit of the knee. However, these structural pathologies were rare findings, hence only few cases of mechanical symptoms may be explained by the presence of these specific pathologies.

Presence of mechanical symptoms such as catching and/or locking in patients with a meniscal tear is considered an important indication for arthroscopic meniscal surgery,^{6,7} however not all patients undergoing meniscal surgery experience such symptoms. Previous studies including middle-aged and older patients undergoing arthroscopic meniscal surgery have reported the prevalence of catching and/or locking symptoms to be between 47% and 64%,^{8,9} which is in line with results in the present study (53%). This suggests that not all meniscal tears cause mechanical symptoms, and/or that other concurrent structural knee joint pathologies may be the cause of such symptoms and not the meniscal tear per se.

Meniscal tear types such as longitudinal-vertical and vertical flap tears are generally considered to be unstable and thus more likely to cause catching and/or locking in the knee than other types of tears.¹¹ However, in the present study we did not find any association between *type* of meniscal tear and presence of knee catching and/or locking. Findings from previous studies are conflicting,^{24,25} with the only study finding an association between a specific type

Table 3

Logistic regression for association between meniscal pathology and other concurrent structural knee pathologies with extension deficit of the knee. Risk ratios were estimated from the logistic regression using a method of Norton et al.²³

Variables	Extension deficit (n = 566)			
	Unadjusted RR	95% CI	Adjusted ^a RR	95% CI
Tear location (ref.: medial)				
Lateral	1.06	0.80–1.40	1.04	0.79–1.38
Both	1.31	1.00–1.72	1.32	1.01–1.73
Tear depth (ref.: partial)				
Complete	0.98	0.80–1.18	0.98	0.81–1.19
Tear pattern (ref.: stable)				
Unstable	1.25	1.03–1.51	1.23	1.02–1.49
Meniscal tissue quality (ref.: non-degenerative)				
Degenerative	1.17	0.94–1.46	1.22	0.97–1.54
Undetermined	1.08	0.63–1.87	1.14	0.67–1.95
Length of tear, cm	0.97	0.87–1.08	0.97	0.87–1.08
Circumferential location (ref.: white zone)				
Red zone	1.07	0.88–1.30	1.07	0.88–1.31
Radial location (ref.: posterior/posterior-mid body)				
Mid body	1.07	0.78–1.47	1.07	0.78–1.47
Anterior/anterior-mid body	1.29	0.88–1.90	1.26	0.85–1.86
All/posterior + anterior	1.21	0.79–1.84	1.23	0.81–1.85
Synovitis	1.06	0.97–1.16	1.06	0.97–1.16
ACL status (ref.: intact)				
Partial rupture (non-reconstructed)	1.89	1.50–2.38	1.83	1.47–2.28
Total rupture (non-reconstructed)	1.59	1.18–2.15	1.44	1.05–1.98
Plica	0.99	0.82–1.19	1.00	0.83–1.20
Knee joint laxity	0.73	0.48–1.11	0.74	0.49–1.12
Medial cartilage grade	1.03	0.93–1.14	1.03	0.93–1.15
Lateral cartilage grade	0.92	0.82–1.02	0.93	0.83–1.04
Patellofemoral cartilage grade	1.00	0.91–1.11	1.00	0.90–1.11

RR, relative risk; CI, confidence interval; ACL, anterior cruciate ligament.

^a Adjusted for age, sex, body mass index and previous surgery to the meniscus on the index knee.

of meniscal tears (i.e. flap tears) and knee catching sensations being a very small case study with only 8 cases of flap tears and failing to adjust for other knee joint structures.²⁵

The only structural pathology found in the present study to be associated with prevalence of catching and/or locking was a meniscal tear involving both the posterior and anterior horn, although tears involving the mid and/or anterior part of the meniscus also tended to be associated with such symptoms. The association was not strong and is only partly supported by previous studies. A cross-sectional study involving 227 knees found no difference in prevalence of knee catching between meniscal tears located in the posterior part alone and those involving other parts of the meniscus,²⁴ whereas a case-control study reported knee catching to be more frequent in patients with a meniscal tear located in the middle part of the meniscus than tears in the posterior part alone.²⁵ In the present study, only 4% of patients had a meniscal tear involving both the posterior and anterior horn and 13% involving only the mid and/or anterior part, while as many as 53% reported knee catching and/or locking. The adjusted difference in prevalence of knee catching and/or locking between those with or without meniscal tears involving both the posterior and anterior horn, or mid and/or anterior part ranged between 9% and 25%. Thus, the association may only explain a negligible number of knee catching and/or locking cases among patients undergoing meniscal surgery. Similarly, having a meniscal tear in both menisci simultaneously was associated with extension deficit of the knee, but a tear in both menisci were only observed in 9% of patients, whereas the symptom was reported by more than half of all patients. Also, having a meniscal tear classified as unstable was observed to be associated with extension deficit of the knee. However, in sensitivity analyses the association for having an unstable tear with extension deficit

of the knee was nearly absent, questioning the robustness of this association.

A partial or total ACL rupture was a rare finding among patients included in this study (12%) due to the exclusion of patients having had or with planned ACL/PCL reconstruction. Despite this, we found partial or total ACL rupture (without reconstruction) to be associated with knee extension deficit. This finding was consistent in both main and sensitivity analyses and is in line with a previous study reporting extension deficit of the knee being a common symptom among patients with an ACL rupture.²⁶

The limited associations between specific meniscal pathology and mechanical symptoms may in part explain the reported lack of effect of arthroscopic meniscal surgery for alleviating mechanical symptoms in middle-aged and older adults.^{8,9} As the strongest association with mechanical symptoms in patients undergoing arthroscopic meniscal surgery was found to be a non-meniscal pathology (i.e. partial and total ACL rupture), our findings question the importance of mechanical symptoms as an indication for arthroscopic surgery when clinical suspicion of presence of specific meniscal tears thought to cause such symptoms.

This study has some limitations. Although we used validated methods to collect information about knee joint pathology,^{19,20,27} misclassification of meniscal pathology and other knee joint pathologies may have occurred and potentially affected any association with mechanical symptoms. Meniscal tears were classified as either stable or unstable as previously described by Mordecai et al.¹¹ and as used in a previous study.²⁸ Some complex and root tears may however be unstable, but in the present study we were not able to distinguish different complex meniscal tear patterns, thus some tears may be misclassified as stable and potentially attenuate an association. Furthermore, the definition of

presence/absence of mechanical symptoms was an arbitrary cut-point and may have affected any association with structural pathologies, however sensitivity analyses with alternative cut-points were conducted to check the robustness of results and yielded similar estimates.

As we included a large number of variables in the analyses without any pre-defined hypotheses the risk of spurious findings is inherently increased. However, because all variables were included and retained regardless of their p-values, the significance level of 0.05 for each variable was maintained and data driven approaches, which are known to produce selection bias,²⁹ were avoided.

The strengths of this study are the size of the cohort and the prospectively consecutive inclusion of patients, the inclusion of several structural pathologies and mutually adjusting for these in all analyses. We believe the results are generalizable to the majority of patients undergoing arthroscopy for meniscal tears, though only a small proportion were active at competitive level. All patients included were assigned to arthroscopy on suspicion of a meniscal tear by the orthopedic surgeon responsible for their care, and furthermore, demographics of the included patients with regard to age and sex are very similar to what has been reported for patients undergoing meniscal surgery in Denmark² and the United States.³⁰

5. Conclusion

In this explorative study including primarily middle-aged patients, no strong associations between specific meniscal pathology and other concurrent knee joint pathologies with presence of self-reported mechanical symptoms were found. Our findings question the clinical importance and utility of mechanical symptoms in isolation to assert presence of specific meniscal pathology and thus as an indication for arthroscopic surgery for meniscal tears with certain features with the specific aim to relieve such symptoms.

Practical implications

- Considerable heterogeneity exists with regard to presence of self-reported mechanical symptoms in patients undergoing meniscal surgery.
- Only few and uncommon structural pathologies in patients with meniscal tears are associated with self-reported mechanical symptoms.
- Presence of self-reported mechanical symptoms has limited utility as an indicator for the presence of meniscal tears with certain features that are believed to be the cause of mechanical symptoms.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.jsams.2018.07.018>.

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