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Published in:
British Journal of Sports Medicine

DOI:
10.1136/bjsports-2017-098429

Publication date:
2018

Document version
Publisher's PDF, also known as Version of record

Citation for pulished version (APA):
Thorlund, J. B., Juhl, C. B., Ingelsrud, L. H., & Skou, S. T. (2018). Risk factors, diagnosis and non-surgical treatment for meniscal tears: evidence and recommendations: a statement paper commissioned by the Danish Society of Sports Physical Therapy (DSSF). British Journal of Sports Medicine, 52(9), 557-565. DOI: 10.1136/bjsports-2017-098429

Risk factors, diagnosis and non-surgical treatment for meniscal tears: evidence and recommendations: a statement paper commissioned by the Danish Society of Sports Physical Therapy (DSSF)

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► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bjsports-2017-098429).

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Accepted 9 January 2018
Published Online First 2 February 2018

To cite: Thorlund JB, Juhl CB, Ingelsrud LH, *et al. Br J Sports Med* 2018;**52**:557–565.

ABSTRACT
This statement aimed at summarising and appraising the available evidence for risk factors, diagnostic tools and non-surgical treatments for patients with meniscal tears. We systematically searched electronic databases using a pragmatic search strategy approach. Included studies were synthesised quantitatively or qualitatively, as appropriate. Strength of evidence was determined according to the Grading of Recommendations Assessment Development and Evaluation framework. Low-quality evidence suggested that overweight (degenerative tears, k=3), male sex (k=4), contact and pivoting sports (k=2), and frequent occupational kneeling/squatting (k=3) were risk factors for meniscal tears. There was low to moderate quality evidence for low to high positive and negative predictive values, depending on the underlying prevalence of meniscal tears for four common diagnostic tests (k=15, n=2474). Seven trials investigated exercise versus surgery (k=2) or the effect of surgery in addition to exercise (k=5) for degenerative meniscal tears. There was moderate level of evidence for exercise improving self-reported pain (Effect Size (ES)–0.51, 95% CI −1.16 to 0.13) and function (ES −0.06, 95% CI −0.23 to 0.11) to the same extent as surgery, and improving muscle strength to a greater extent than surgery (ES −0.45, 95% CI −0.62 to −0.29). High-quality evidence showed no clinically relevant effect of surgery in addition to exercise on pain (ES 0.18, 95% 0.05 to 0.32) and function (ES, 0.13 95% CI −0.03 to 0.28) for patients with degenerative meniscal tears. No randomised trials comparing non-surgical treatments with surgery in patients younger than 40 years of age or patients with traumatic meniscal tears were identified. Diagnosis of meniscal tears is challenging as all clinical diagnostic tests have high risk of misclassification. Exercise therapy should be recommended as the treatment of choice for middle-aged and older patients with degenerative meniscal lesions. Evidence on the best treatment for young patients and patients with traumatic meniscal tears is lacking.

INTRODUCTION
Meniscal tears are common, and meniscal surgery is one of the most frequently performed orthopaedic procedures.[1] However, recent research evidence has seriously challenged the clinical dogma that surgery should be first-line treatment for patients aged 40 years or older who have meniscal tears.[2 3] The evidence suggests that other treatment modalities, particularly exercise therapy, should be considered as an alternative to surgery.[2 3]

Meniscal tears are typically categorised as traumatic or degenerative based on their aetiology. Traumatic tears are most often observed in young sports active individuals, and present as a tear to an otherwise healthy meniscus.[4] Degenerative lesions are more common in middle-aged and older individuals and considered to be an early sign of knee osteoarthritis.[5] Around 60%–70% of meniscal surgeries are performed in patients aged 40 years or older, suggesting that most surgically treated meniscal tears are likely of degenerative nature.[1 6]

Diagnosing a meniscal tear clinically is a challenge as several different diagnostic tests exist and the positive (PPV) and negative predictive values (NPV) of these tests depend on the prevalence of meniscal tears, which varies according to age.[7] A second challenge is to distinguish between traumatic and degenerative meniscal tears as there is no consensus on the exact definition of these tear types, which may require different treatments. Understanding the risk factors for meniscal tears may help to better understand what causes meniscal tears in different age groups and hence help distinguish between the two tear types.

Therefore, the aim of this statement, commissioned by the Danish Society of Sports Physical Therapy, was to determine the key risk factors for meniscal tears, assess the diagnostic value of different clinical tests used for the diagnosis of meniscal tears, and evaluate the role of non-surgical treatments for patients with traumatic and degenerative meniscal tears.

METHODS
This statement is divided into three domains: (1) risk factors, (2) diagnosis and (3) non-surgical treatments. We employed a pragmatic systematic approach to identify literature for the three domains. Where possible, we prioritised quantitative data synthesis. Otherwise, we used a qualitative approach. To account for potential differences between traumatic and degenerative tears, where possible we either (1) report separate results for traumatic and degenerative meniscal tears, or (2) refer to either young individuals (anticipating a large proportion of traumatic tears) or middle-aged and older individuals (ie, 40 years or older, anticipating the majority to have degenerative lesions). In

the case that neither approach was possible, we report general results for 'meniscal tears'.

Domain 1: risk factors

Search

Systematic searches were conducted on Medline and Embase by a systematic review expert (CBJ) (online supplementary table 1). The pragmatic search was designed to identify the most recent systematic review on risk factors for meniscal tears from which all individual studies were included. Additional searches for studies on risk factors for meniscal tears were performed from the latest search date in the systematic review up to 26 May 2017.

Selection

We screened and selected all studies that reported separate data for risk of meniscal tears. We included all studies from the most recent systematic review identified in the search and supplemented with additional studies identified up to the search date.

Appraisal

Two authors independently assessed risk of bias (LHI and CBJ) using the AMSTAR tool[8] for systematic reviews and the Scottish Intercollegiate Guidelines Network-50[9] for observational studies, as appropriate. Two authors independently extracted data (JBT and CBJ). Two authors (LHI and CBJ) reached consensus on the quality of evidence for each risk factor according to the Grading of Recommendations Assessment Development and Evaluation (GRADE) framework.[10]

Domain 2: diagnostic tests

A variety of clinical tests have been applied in the diagnosis of a meniscal tear.[11] The diagnostic utility of these has recently been assessed during the development of the Danish national clinical guideline for meniscal pathology published by the Danish Health Authority.[12] The same diagnostic tests were included in this statement as these are some of the most commonly used clinical diagnostic tests used to detect meniscal tears. The following were the tests evaluated in this statement paper:

1. assessment of joint line tenderness medially and laterally
2. McMurray's test
3. Thessaly's test (both with 5° and 20° knee flexion)
4. Apley's test.

Search

We used the systematic searches conducted as part of the preparation of the Danish national clinical guideline for meniscal pathology[12] in our pragmatic search (conducted on 30 May 2017). Medline, Embase, Cochrane Library and Physiotherapy Evidence Database (PEDro) were searched for systematic reviews, while Medline and Embase were searched for original data papers, limited to publications in English, Danish, Norwegian or Swedish from 2005 to 2017 (online supplementary table 2).

Selection

Studies using arthroscopy as comparator and including patients above 15 years of age with a clinical history and symptoms consistent with meniscal tear were included. Studies primarily including patients with a diagnosis of osteoarthritis or concomitant ligament injury, larger cartilage defects, meniscal root tears or congenital anomalies in the meniscus were excluded.

Appraisal

Two authors independently assessed risk of bias (LHI and CBJ) using the QUADAS tool.[13] One author (STS) extracted the data, which were then quality-checked by another author (CBJ). Two authors (LHI and CBJ) reached consensus on the quality of evidence for each diagnostic test according to the GRADE framework.[10]

Domain 3: non-surgical treatments

This domain was divided into two subsections: exercise therapy and passive treatments.

Exercise therapy

Search

We used the systematic searches conducted as part of the preparation of the Danish national clinical guideline for meniscal pathology in our pragmatic search (conducted on 28 May 2017).[12] Medline, Embase, Cochrane Library and PEDro were searched for systematic reviews and randomised trials limited to publications in English, Danish, Norwegian or Swedish from 2005 to 2015 (online supplementary table 3).

Selection

We included studies on patients aged 15 years or older with clinical history and symptoms consistent with a meniscal tear. Studies primarily including patients with concomitant ligament injury, large cartilage defects, meniscal root tears or congenital anomalies in the meniscus were excluded. As the Danish national clinical guidelines included only studies comparing non-surgical and surgical treatment of meniscal tears, we omitted the search term 'Surgery' to ensure we identified all randomised trials of exercise therapy as treatment of meniscal tears.

Appraisal

Two authors independently assessed risk of bias (LHI and CBJ) using The Cochrane Collaboration's risk of bias assessment tool.[14] Two authors independently extracted data (STS and CBJ). Two authors (LHI and CBJ) reached consensus on the quality of evidence for each treatment according to the GRADE framework.[10] Data from the primary endpoint of the studies were included in meta-analyses. If the studies did not define the primary endpoint, the endpoint with the longest follow-up was chosen.

Passive treatments

Search

Medline, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL) database, Cochrane Central Register of Controlled Trials and Web of Science were systematically searched (on 26 June 2017) for randomised trials on therapeutic ultrasound, laser therapy or shockwave therapy as treatment for meniscal tears (online supplementary table 4).

Selection

To be included, the passive treatment should have constituted at least 80% of the treatment or be an add-on to another treatment.

Appraisal

Two authors independently assessed risk of bias (LHI and CBJ) using The Cochrane Collaboration's risk of bias assessment tool.[14] Two authors independently extracted data (STS and CBJ). Two authors (LHI and CBJ) reached consensus on the quality of evidence for each treatment according to the GRADE framework.[10] Data from the primary endpoint of the studies were included in meta-analyses. If the studies did not define the primary endpoint, the endpoint with the longest follow-up was chosen.

Data synthesis

We used the GRADE framework[10] to rate the overall quality of evidence across studies for specific outcomes relating to risk factors, diagnostic tests and treatments. Quality of evidence was graded as high, moderate, low or very low. When the evidence was based on randomised studies, the starting level of evidence was 'high', and could be downgraded due to study limitations (ie, risk of bias), inconsistency (ie, the heterogeneity of results across studies), indirectness (ie, the generalisability of the findings to the target population), imprecision of the estimates and the risk of small study bias. When the evidence was based on observational studies, the starting level was 'low', and could be upgraded if a dose–response relationship was present or the effect was large, or downgraded due to study limitations, inconsistency (ie, the heterogeneity of results across studies), indirectness (ie, the generalisability of the findings to the target population), imprecision of the estimates and the risk of small study bias.

Diagnostic tests

We estimated the PPV and NPV from raw data:

$$\text{Positive predictive value} = \frac{\text{True negative}}{(\text{True negative} + \text{False positive})}$$

$$\text{Negative predictive value} = \frac{\text{True negative}}{(\text{True negative} + \text{False negative})}$$

or from sensitivity and specificity:

$$\text{Positive predictive value} = \frac{\mathit{Prevalence} \times \mathit{Specificity}}{\text{Prevalence} \times \text{Specificity} + ((1 - \text{Specificity}) \times (1 - \text{Prevalence}))}$$

$$\text{Negative predictive value} = \frac{\mathit{Specificity} \times (1 - \mathit{Prevalence})}{(\mathit{Specificity} \times (1 - \mathit{Prevalence})) + ((1 - \mathit{Sensitivity}) \times \mathit{Prevalence})}$$

The PPV describes the proportion of patients with a positive test who have a meniscal tear (true positive). The NPV describes the proportion of patients with a negative test who do not have a meniscal tear (true negative). The PPV and NPV were classified as high if >0.85, moderate if 0.70–0.85 and low if <0.70.

Treatments

We pooled data using the STATA V.14.0 software package and estimated the standardised mean difference (also known as Cohen's *d*) based on the difference between the mean score of the intervention and the comparison groups divided by the pooled SD of the final score. Cohen's *d* slightly overestimates the effect size in small studies, and a correction factor was applied to convert the effect size to Hedges' g.[15] We used a random-effects meta-analysis to estimate the combined effect size and the between-study variance. Heterogeneity was examined with the *Q*-tests and calculated as the I^2 statistic.[16 17]

RESULTS

Domain 1: risk factors

The search identified a systematic review and meta-analysis on risk factors for meniscal tears from 2013.[18] In addition, we identified 232 potentially eligible studies, and of these 20 individual studies contributed with data on risk factors for meniscal tears. It was decided not to rely on the meta-analyses in the identified systematic review[18] as these were calculated as ORs based on few studies with frequent events; this inflates ORs and overestimates the importance of the investigated risk factors.[19]

From the 20 studies we identified 8 potential risk factors: overweight (k=3)[7 20 21]; sex (k=4)[7 22–24]; age (k=5)[7 21 23–25]; trauma type (k=2)[26 27]; sports participation (k=3)[20 28 29]; time from ACL injury to reconstruction (k=9)[30–38]; generalised joint hypermobility (k=1)[20]; and occupational activity (k=3) (table 1).[20 25 28]

A detailed overview and synthesis of studies on risk factors is available in online supplementary table 5 and additional online supplementary materials. In brief, low-quality evidence supported that overweight and occupational activities such as frequent kneeling or squatting or work involving frequent stair climbing are risk factors for meniscal tears, and that male sex was associated with higher risk of degenerative meniscal tears. It was unclear whether age was a risk factor for meniscal tears. Low-quality evidence supported that sports-related traumatic meniscal tears are most common in contact sports or sports involving pivoting, whereas there was insufficient evidence to consider running a risk factor for meniscal injury (low-quality evidence). There was conflicting evidence whether increased time from ACL injury to ACL reconstruction was a risk factor for meniscal tears.

Diagnosis of meniscal tears with clinical tests

In total 2579 studies were identified in the search. One systematic review[39] with 4 studies[40–43] and 11 additional studies[44–54] were included (online supplementary table 6). These 15 studies included 2474 patients. PPV and NPV for the different clinical tests and combinations of some of these are presented in tables 2 and 3. Since PPV and NPV depend on the prevalence of meniscal tears, which varies according to age,[7] results are presented for patients younger than 60 years of age (table 2) and patients older than 60 years of age (table 3).

Based on a prevalence of 19% of meniscal tears (primarily patients younger than 60 years of age; table 2), the median PPVs were 0.42, 0.84 and 0.23, respectively, for the

Table 1 Summary of evidence and evidence levels for risk factors for meniscal tear

Risk factor	Interpretation	Studies (n)	Quality of evidence
Overweight	Associated with increased risk	3	Low
Male sex	Associated with increased risk	4	Low
Age	Conflicting evidence	5	Low
Trauma type	Associated with increased risk	2	Low
Sports participation	Associated with increased risk	3	Low
Time from ACL injury to reconstruction	Conflicting evidence	9	Low
Generalised joint hypermobility	Associated with increased risk	1	Low
Occupational activity	Associated with increased risk	3	Low

Table 2 PPV and NPV of physical tests for meniscal tears with grading of quality of evidence in patients below 60 years of age

Test	Median (range)	High predictive value (pv≥0.85)	Moderate predictive value (0.84≥pv≥0.70)	Low predictive value (pv≤0.69)
Diagnosis in patients with knee pain and clinical suspicion of meniscal tear				
Joint line tenderness				
Medial+Lateral	PPV 0.23 (0.22–0.23)			Low
	NPV 0.87 (0.85 – 0.90)	Low		
Medial	PPV 0.42 (0.23–0.56)			Low
	NPV 0.93 (0.84– 0.98)	Low		
Lateral	PPV 0.84 (0.65–1.00)		Moderate	
	NPV 0.93 (0.87–0.99)	Moderate		
McMurray				
Medial + Lateral	PPV 0.37 (0.23– 0.47)			Very low
	NPV 0.86 (0.85–0.94)	Very low		
Medial	PPV 0.35 (0.20–0.65)			Very low
	NPV 0.88 (0.84–0.95)	Very low		
Lateral	PPV 0.52 (0.20–0.69)			Very low
	NPV 0.90 (0.84–0.94)	Very low		
Thessaly (20°)				
Medial+Lateral	PPV 0.57 (0.24–0.90)			Very low
	NPV 0.92 (0.86– 0.98)	Very low		
Medial	PPV 0.79 (0.21–0.87)		Very low	
	NPV 0.92 (0.84 – 0.97)	Very low		
Lateral	PPV 0.68 (0.20–0.84)			Very low
	NPV 0.95 (0.83–0.98)	Very low		
Thessaly (5°)				
Medial	PPV 0.23			Very low
	NPV 0.83		Very low	
Lateral	PPV 0.24			Very low
	NPV 0.82		Very low	
Apley				
Medial+Lateral	PPV 0.41			Very low
	NPV 0.95	Very low		
Medial	PPV 0.38 (0.28–0.58)			Very low
	NPV 0.90 (0.87–0.95)	Very low		
Lateral	PPV 0.47 (0.41–0.77)			Very low
	NPV 0.89 (0.86–0.95)	Very low		
McMurray and Thessaly (20°)				
Medial+Lateral	PPV 0.25			Very low
	NPV 0.85	Very low		
McMurray and joint line tenderness				
Medial	PPV 0.40			Very low
	NPV 0.99	Very low		
Lateral	PPV 0.75		Very low	
	NPV 0.98	Very low		
McMurray, joint line tenderness and Apley*				
Medial	PPV 0.40			Very low
	NPV 0.97	Very low		
Lateral	PPV 0.70		Very low	
	NPV 0.90	Very low		

PPVs and NPVs are calculated based on data from the systematic search for the Danish national clinical guideline for meniscal pathology,[12] and from an updated systematic search. The calculations are based on a prevalence of MRI-verified meniscal tears of 19% (women aged 50–59 years).[7] Since PPV and NPV are dependent on the prevalence of meniscal tears, and since the prevalence of MRI-verified meniscal tears varies according to gender and age, this table is primarily relevant for younger patients.
*Study by Ercin *et al*[45] was not included as the combination of tests in that study included additional tests.
NPV, negative predictive value; PPV, positive predictive value.

assessment of medial, lateral, and medial and lateral joint line tenderness combined, while the corresponding NPVs were 0.93, 0.93 and 0.87 (low to moderate quality evidence). Based on a prevalence of 56% of meniscal tears (primarily patients older than 60 years of age; table 3), the median PPVs were 0.79, 0.97 and 0.61, respectively, for the assessment of medial, lateral, and medial and lateral joint line tenderness combined, while the corresponding NPVs were 0.70, 0.70

Table 3 PPV and NPV of physical tests for meniscal tears with grading of quality of evidence in patients above 60 years of age

Test		High predictive value (pv≥0.85)	Moderate predictive value (0.84≥pv≥0.70)	Low predictive value (pv≤0.69)
	Median (range)			
Diagnosis in patients with knee pain and clinical suspicion of meniscal tear				
Joint line tenderness				
Medial+	PPV 0.61 (0.61–0.62)			Low
Lateral	NPV 0.56 (0.51–0.61)			Low
Medial	PPV 0.79 (0.62–0.87)		Low	
	NPV 0.70 (0.49–0.88)		Low	
Lateral	PPV 0.97 (0.91–1.00)	Moderate	Moderate	
	NPV 0.70 (0.56–0.94)			
McMurray				
Medial+	PPV 0.76 (0.62–0.83)		Very low	Very low
Lateral	NPV 0.54 (0.51–0.75)			
Medial	PPV 0.74 (0.58–0.91)		Very low	Very low
	NPV 0.57 (0.48–0.77)			
Lateral	PPV 0.86 (0.58–0.92)	Very low		Very low
	NPV 0.61 (0.48–0.73)			
Thessaly (20°)				
Medial+	PPV 0.81 (0.63–0.98)		Very low	
Lateral	NPV 0.71 (0.54–0.89)		Very low	
Medial	PPV 0.95 (0.60–0.97)	Very low		Very low
	NPV 0.69 (0.50–0.87)			
Lateral	PPV 0.92 (0.58–0.97)	Very low	Very low	
	NPV 0.79 (0.47–0.90)			
Thessaly (5°)				
Medial	PPV 0.62			Very low
	NPV 0.48			Very low
Lateral	PPV 0.64			Very low
	NPV 0.45			Very low
Apley				
Medial+	PPV 0.79		Very low	
Lateral	NPV 0.78		Very low	
Medial	PPV 0.76 (0.68–0.88)		Very low	Very low
	NPV 0.64 (0.55–0.79)			
Lateral	PPV 0.83 (0.79–0.95)	Very low		Very low
	NPV 0.60 (0.53–0.77)			
McMurray and Thessaly (20°)				
Medial+	PPV 0.64			Very low
Lateral	NPV 0.51			Very Low
McMurray and joint line tenderness				
Medial	PPV 0.78	Very low	Very low	
	NPV 0.96			
Lateral	PPV 0.94	Very low		
	NPV 0.89	Very low		
McMurray, joint line tenderness and Apley *				
Medial	PPV 0.78	Very low	Very low	
	NPV 0.86			
Lateral	PPV 0.93	Very low		Very low
	NPV 0.62			

PPVs and NPVs are calculated based on data from the systematic search for the Danish national clinical guideline for meniscal pathology,[12] and from an updated systematic search. The calculations are based on a prevalence of MRI-verified meniscal tears of 56% (men aged 70–90 years).[7] Since PPV and NPV are dependent on the prevalence of meniscal tears, and since the prevalence of MRI-verified meniscal tears varies according to gender and age, this table is primarily relevant for older patients.
*Study by Ercin *et al*[45] was not included as the combination of tests in that study included additional tests.
NPV, negative predictive value; PPV, positive predictive value.

and 0.56 (low to moderate quality evidence). Combinations of diagnostic tests (ie, those investigated in the included studies) did not improve the PPV or NPV and were only supported by very low-quality evidence (tables 2 and 3). In the diagnosis of a meniscal tear in patients above and below 60 years of age, there was very low-quality evidence with varying predictive values for using Thessaly's test at 5° and 20°, McMurray's test, Apley's test and for combinations of these tests. The evidence levels were generally downgraded to low or very low quality of evidence due to risk of bias, especially lack of blinding of reference test results; the studies included selected patients only; not all patients received both the index and reference test; and imprecision of study results.

Table 4 Treatment of meniscal tears in patients with primarily degenerative tears

	Large effect	Moderate effect	Small or no effect
Exercise			
Patient-reported pain			
No difference between arthroscopic knee surgery and exercise Effect size (95% CI; I^2): −0.51 (−1.16 to 0.13; 0.0%); 2 studies (n=157)[58 62]			Moderate-quality evidence
Small effect from arthroscopic knee surgery in addition to exercise compared with exercise alone Effect size (95% CI; I^2): 0.18 (0.05 to 0.32; 0.0%); 5 studies (n=893)[3]			High-quality evidence
Patient-reported function			
No difference between arthroscopic knee surgery and exercise Effect size (95% CI): −0.06 (−0.23 to 0.11); 1 study (n=140)[62]			Moderate-quality evidence
No difference between arthroscopic knee surgery in addition to exercise compared with exercise alone Effect size (95% CI; I^2): 0.13 (−0.03 to 0.28; 7.8%); 4 studies (n=785)[3]			High-quality evidence
Muscle strength			
Moderate effect from exercise compared with arthroscopic knee surgery (peak torque for isokinetic knee extension) Effect size (95% CI): −0.45 (−0.62 to −0.29); 1 study (n=140)[62]		Moderate-quality evidence	
No difference between arthroscopic knee surgery and exercise (5 repetition maximum measured with a leg extension bench) Effect size (95% CI): −0.28 (−0.80 to 0.24); 1 study (n=17*)[58]			Low-quality evidence
Functional performance			
No difference between arthroscopic knee surgery and exercise (number of knee bends on one leg in 30 s) Effect size (95% CI): −0.08 (−0.25 to 0.09); 1 study (n=140)[62]			Moderate-quality evidence
Passive physiotherapy treatments			
Patient-reported pain			
Large effect from low-level laser therapy compared with placebo Effect size (95% CI): −9.07 (−10.78 to −7.38); 1 study (n=64†)[65]	Low-quality evidence		
Pain, function and clinical findings (Lysholm score)			
Large effect from low-level laser therapy compared with placebo Effect size (95% CI): −1.28 (−1.82 to −0.74); 1 study (n=64†)[65]	Low-quality evidence		

If the effect size is negative it is in favour of the treatment (exercise or laser). If it is positive it is in favour of the control treatment (surgery, surgery+exercise or placebo).
*Due to lack of blinding and a low sample size, the quality of the evidence was downgraded one level.
†Due to lack of description of blinding of the physiotherapist and the fact that the trial was not registered until after the data collection had been completed, the quality of the evidence was downgraded one level.

Treatment

The final search for exercise therapy treatment and passive treatments for meniscal tears yielded 8898 and 39 studies, respectively. No randomised trials investigating the effect from exercise or passive physiotherapy treatments compared with surgery or one type of non-surgical treatment versus another in younger patients or patients with a traumatic meniscal tear were identified.

Exercise therapy

Seven randomised trials, published in 10 papers,[55–64] were included. Two studies reported in three papers compared exercise therapy head-to-head with arthroscopic knee surgery.[58 62 63] Five studies reported in seven papers investigated the effect of arthroscopic knee surgery in addition to exercise therapy (in some cases combined with other non-surgical treatments) compared with exercise alone.[55–57 59–61 64] All studies primarily included patients with degenerative meniscal lesions (online supplementary table 7).

In studies comparing exercise therapy with arthroscopic knee surgery, moderate-quality evidence supported no difference between interventions for self-reported pain and function and functional performance (maximum number of one-legged knee bends in 30 s) (table 4).[58 62] Also, moderate-quality evidence was found for greater improvements in knee extensor peak torque with exercise therapy compared with arthroscopic surgery (ES −0.45, 95% CI −0.62 to −0.29).[62] However, no difference was observed between exercise therapy and surgery in a small study (n=17) for five repetition maximum in a leg extension bench.[58] Due to lack of blinding in both studies[58 62] and a low sample size,[58] the quality of evidence was downgraded from high to moderate.

There was high-quality evidence for no additional clinically relevant benefit from arthroscopic knee surgery in addition to exercise therapy compared with exercise therapy alone on self-reported pain (ES 0.18, 95% CI 0.05 to 0.32). The observed statistically significant effect corresponded to an additional effect of surgery of 3 mm on a 0–100 mm Visual Analogue Scale, which was not considered clinically relevant (table 4).[3] There was high level of evidence that there was no additional effect from arthroscopic knee surgery in addition to exercise therapy compared with exercise therapy alone on self-reported function (ES 0.13, 95% CI −0.03 to 0.28) (table 4).[3]

Passive physiotherapy treatments

There was low-quality evidence that low-level laser therapy may decrease pain and increase functional level in patients with degenerative meniscal lesions (table 4).[65] The evidence was based on one randomised trial, which was downgraded due to lack of description of blinding of the physiotherapist and because the trial was not registered until after data collection had been completed.

DISCUSSION

The following sections discuss some of the most important findings within the three domains and also highlight some of the limitations for the reader to take into account when using this statement.

Risk factors

The overall quality of evidence for risk factors for meniscal tears was low, as most studies did not sufficiently adjust for confounders and/or blinded assessment of outcomes.

Overweight was found to be a risk factor for degenerative meniscal lesions (low-quality evidence). However, conflicting evidence was found for increasing age as a risk factor for meniscal tears. Englund *et al*[7] found a higher prevalence of meniscal tears with increasing age in a population of older individuals with and without knee osteoarthritis (57% women, mean age 62.3 years). These findings align well with the fact that register data indicate that the majority of patients undergoing meniscal surgery are patients older than 45 years.[6] In contrast, a study comparing risk of meniscal tears in floor layers and graphic designers did not observe increasing prevalence of meniscal tears with increasing age,[25] and a population-wide study using Swedish register data found that incidence of meniscal tears decreased after the age of 40 years in both men and women.[23] The reason for these different findings is unclear but may represent difference in the way data were sampled or registered.

Occupational activities such as frequent kneeling or squatting or work involving frequent stair climbing may increase the risk of meniscal tears (low-quality evidence), but the results for heavy lifting were conflicting (low-quality evidence), and there was insufficient evidence to consider running as a risk factor for meniscal injury (low-quality evidence).

Prolonged time from ACL injury to ACL reconstruction is often considered a risk factor for meniscal tears. However, results from the nine included studies were conflicting (low-quality evidence).

Domain 2: diagnostic tests for meniscal tears

Currently, there is no consensus on how to diagnose a meniscal tear *clinically*, often making it hard to differentiate a meniscal tear from other common knee disorders. We examined four common diagnostic tests.[12] The predictive value of the diagnostic tests varied according to the prevalence of meniscal tears in different age groups, and the quality of evidence was in general low or very low.

Assessment of joint line tenderness medially and laterally can be used to rule out a meniscal tear in patients below 60 years of age (high NPVs; low to moderate quality evidence) and to diagnose a lateral meniscal tear with lateral joint line tenderness (moderate to high PPV; low to moderate quality evidence). Since joint line tenderness is also common in other knee disorders (eg, osteoarthritis),[66] the test should be combined with the clinical history and symptoms when diagnosing meniscal tears. There are indications that Thessaly's test at 20° knee flexion, McMurray's test and Apley's test might be used to rule out a meniscal tear in patients below 60 years of age (high NPVs; very low-quality evidence). However, neither can be recommended as stand-alone tests to diagnose a meniscal tear because of moderate-to-low PPVs (very low-quality evidence).

Since only a few studies have combined several tests, no recommendation can be given when it comes to a specific combination of tests. The PPVs were higher with a higher prevalence of meniscal tears in the population, while NPVs were higher with a lower prevalence of meniscal tears.

Importance of tear type

Because none of the examined tests are suited as stand-alone tests to diagnose a meniscal tear, the diagnosis is typically given based on a combination of the medical history, physical examination and diagnostic imaging (if needed). Sudden or gradual onset of knee pain accompanied by a sensation of locking or catching of the knee, clicking, giving away, repeated swelling of the knee and pain/tenderness at the medial or lateral joint line are indicative of a meniscal tear, but the symptoms are also associated with other knee disorders, such as osteoarthritis.[66 67]

Thus, it is likely important to consider whether a tear is most likely to be of traumatic or degenerative origin when interpreting clinical tests. Traumatic meniscal tears are most frequently observed in younger, active individuals (below 40 years of age) following a high-energy trauma, for example, during sport,[11] whereas degenerative meniscal lesions are more frequent in individuals aged 40 years or older and are considered a part of the initial stage of knee osteoarthritis.[7 11 68] Different approaches to classify meniscal tears as traumatic or degenerative can be found in the literature. Some are based on symptom onset alone,[69] whereas others use a combination of age and symptom onset[70] as osteoarthritic changes and meniscal degeneration are linked to older age. Clearly, a 'gray zone' exists where it can be difficult to discern. Some would consider a patient aged 40 years or older with a meniscal tear caused by a minor trauma/incident, such a kneeling, sliding and/or twisting of the knee as having sustained a traumatic tear. Others would consider such a tear degenerative, as a healthy meniscus would be resistant to tears from such minor incidents.

Meniscal tear pattern has also been reported to differ between traumatic tears and degenerative meniscal lesions. Horizontal, complex and horizontal flap tears are usually considered to be of degenerative origin, whereas longitudinal-vertical tears are considered traumatic.[4] However, this distinction is less useful for the clinicians as specific tear pattern is typically first established at knee arthroscopy. To the authors' knowledge, no studies have validated the diagnostic accuracy of MRI for determining meniscal tear pattern. At present, there is no consensus on how to define traumatic and degenerative meniscal tears.

Role of imaging in diagnosing a meniscal tear

Medical history and physical assessment are required for all patients with suspicion of a meniscal tear. Diagnostic imaging such as ultrasonography, MRI and weightbearing radiographs should not be used routinely. Although there are indications of a relatively high diagnostic accuracy of ultrasonography for diagnosing meniscal tears,[71] ultrasound is limited because of its inability to evaluate the entire meniscus and other intra-articular pathology.[12 72] Despite relatively high diagnostic accuracy,[73] MRI should not be used routinely to diagnose a meniscal tear,[12] as a previous study showed that 61% of subjects with a meniscal tear on MRI were asymptomatic during the previous month.[7] Finally, weightbearing radiographs should not be offered routinely, even in patients suspected of having both osteoarthritis and a meniscal tear. The degenerative meniscal lesion is an early sign of osteoarthritis[11 68] and radiographs are not necessary to diagnose osteoarthritis.[74] As only 1 in 200 radiographs of patients with symptomatic knee osteoarthritis in primary care results in a change in the initial treatment strategy,[75] and as the osteoarthritis severity at baseline is not associated with the improvements in pain from exercise[76] and other non-surgical treatment,[77] radiographs should only be offered if the clinical assessment cannot rule out serious pathology or if non-surgical treatment of sufficient dose and length does not improve symptoms.[3 62 75]

Based on the current evidence it is recommended to diagnose a meniscal tear based on a combination of the medical history, clinical tests/physical examination and diagnostic imaging (if needed). It is important to consider that knee pain accompanied by symptoms such as sensation of locking or catching of the knee, clicking, giving away and repeated knee swelling that are often associated with meniscal tears are also common symptoms for other knee disorders, such as osteoarthritis. If the symptoms occur acutely, the assessment should be repeated after a couple of weeks, dependent on the severity of the knee pain, as this will improve the accuracy of the diagnosis.[11]

Domain 3: treatment

Treatment of degenerative meniscal lesions should be non-surgical, with exercise therapy as the core component (moderate-quality evidence). There was no additional, clinically relevant effect of adding arthroscopic knee surgery to exercise therapy (high-quality evidence).[3] As a degenerative meniscal lesion is considered a component of knee osteoarthritis,[11 68] it seems reasonable to highlight the high-quality evidence supporting a moderate effect from exercise in reducing pain and improving function in patients with knee osteoarthritis,[76] underscoring the importance of exercise of sufficient dose and length as first-line treatment of this population.

Low-level laser therapy may be effective in improving symptoms (low-quality evidence),[65] but further confirmatory trials are needed before low-level laser therapy or other passive physiotherapy treatments can be recommended as a clinically relevant part of treatment for degenerative meniscal lesions.

There was no evidence from randomised trials to determine the best treatment (surgical or non-surgical) for patients younger than 40 years or with a traumatic tear. Findings from previous trials on treatment of meniscal tears in middle-aged or older patients with a degenerative meniscal lesion cannot be generalised to this population. Traditionally, younger patients or patients with a traumatic tear have been treated with meniscal repair or resection, and have been considered to have larger benefit of surgery compared with patients with degenerative lesions. However, patients with traumatic and degenerative tears up to 52 weeks have been reported to have similar improvements after arthroscopic partial meniscectomy, challenging this assumption.[70]

The recently developed Danish national clinical guideline for treatment of meniscal tears[12] recommends that patients with traumatic tears be offered exercise and other non-surgical treatments, unless the knee is locked (self-reported by the patient and confirmed by the clinician) (based on expert opinion). Knee locking is suspected to be caused by meniscal fragments or a displaced bucket handle tear.

Given the lack of evidence there is a need for high-quality randomised trials comparing surgical and non-surgical treatments of meniscal tears in younger patients and patients with a traumatic tear. Two such studies, one Dutch (identifier www.trialregister.nl no 17454) and one Danish,[78] are currently underway.

Limitations

The search strategy may have resulted in not identifying some older studies for all three domains, as we relied on the most recent systematic review, adding only additional studies from our full search from the search date in identified reviews.

No clear recommendations can be given regarding the best treatment for patients younger than 40 years of age or patients with traumatic tears as no evidence from trials was available. Also it is important to consider that the level of evidence was generally low for the risk factor and diagnosis domains.

Contributors All authors participated in the conception and design of the statement. All authors participated in various tasks regarding data collection (ie, literature searches, study screening, data extraction, data analysis and risk of bias assessment). JBT and STS made the first draft of the manuscript. All authors provided critical input on the manuscript and approved the final version of the paper.

Funding The study was commissioned and funded by the Danish Society of Sports Physical Therapy (DSSF). DSSF had no influence in designing, performing or writing the study and the decision on publishing the results. STS is supported by the Danish Council for Independent Research (DFF – 6110-00045) and the Lundbeck Foundation.

Competing interests STS is one of the founders of Good Life with osteoArthritis in Denmark (GLA:D). GLA:D is a non-profit initiative hosted at University of Southern Denmark. The remaining authors have no conflict of interests to declare.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement All data available upon reasonable request.

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