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Arthroscopic meniscal surgery vs non-operative treatment for degenerative tears with mechanical symptoms: 5-year outcomes systematic review and meta-analysis of RCTs

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ABSTRACT

Introduction: The optimal management of degenerative meniscal tears with mechanical symptoms remains debated. This systematic review compares long-term outcomes of arthroscopic meniscal surgery (AMS) versus non-operative management.

Methods: A search of MEDLINE, Embase, Cochrane CENTRAL, Web of Science and ClinicalTrials.gov identified RCTs (2000–2024) with ≥5 years follow-up and meta-analyses were performed. Primary outcomes were patient-reported outcome measures (PROMs) measuring knee function, activity measures and meniscal evaluation (Lysholm Knee Scoring Scale, Tegner Activity Scale, International Knee Documentation Committee score (IKDC) and Western Ontario Meniscal Evaluation Tool (WOMET)); and general health and pain measures (European Quality of Life (EuroQoL) and Visual Analog Scale (VAS)). Secondary outcomes were Knee injury and Osteoarthritis Outcome Score (KOOS) and osteoarthritic progression rate. A prospective protocol was registered on PROSPERO (CRD42023427339).

Results: Six studies ($n = 1157$) met the inclusion criteria. Meta-analysis showed non-significant difference in knee function, activity and meniscal evaluation (Lysholm: $p = 0.07$; Tegner: $p = 1.00$; IKDC: $p = 0.46$; WOMET: $p = 0.77$) and small difference in general health and pain (EQ-5D: $p = 0.26$; EQ-VAS: $p < 0.00001$; VAS: $p = 0.16$). No significant differences were seen in KOOS ($p > 0.26$), but osteoarthritis progression was significantly higher in surgical group ($p < 0.0001$).

Conclusion: There is no significant difference between AMS and non-operative management in PROMS at 5-year follow-up period in activity or pain in patients with degenerative meniscal tears with mechanical symptoms. However, patients undergoing surgery show a significantly higher osteoarthritic progression rates long-term which is essential to consider for knee function and decision-making between the two treatment groups.

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1. Introduction

1.1. Rationale

Degenerative meniscal tears are highly prevalent in orthopaedic practice and commonly occur in both young, physically active individuals and elderly patients, demonstrating a bimodal age distribution.[1–4] Progressive meniscal degeneration not only contributes to significant knee pain but, also, markedly diminishes quality of life. In certain cases, this degeneration predisposes patients to osteoarthritis of the knee—the most prevalent joint disease worldwide—due to the structural compromise of the menisci.[5].

The treatment of degenerative meniscal tears remains contentious, with arthroscopic meniscal surgery (AMS) and non-operative management, representing the two principal approaches.[6] Some evidence suggests that non-operative treatment may be useful for patients, however, as the degeneration progresses, about a third of patients will require an operative intervention for pain relief and better function of the knee.[7]

Current clinical guidelines lack consensus on the optimal management strategy, particularly in cases involving degenerative meniscal tears with mechanical symptoms.[8–10] Many evidence-based guidelines recommend against treating degenerative meniscal tears as well as accompanied osteoarthritis with AMS nonetheless, have inconsistent recommendations when these tears are accompanied by mechanical symptoms. Whilst the 2022 NICE guidelines followed by the NHS in the UK clinical practice states degenerative meniscal tears "may be hard to distinguish from the osteoarthritis which is commonly associated," it recommends against arthroscopic lavage and debridement for its treatment with no mention of meniscal tears other than diagnosis.[8,11] Contrastingly, the Australian Knee Society 2016 statement suggests arthroscopy may be necessary for meniscal tears with mechanical symptoms after non-operative treatment has initially been tried.[9] In addition to this, the American Academy of Orthopaedic Surgeons (AAOS) guidelines from 2022 made an unclear statement on arthroscopic partial meniscectomy particularly for symptomatic knee tears, labelling it under "moderate recommendation" of treatments.[10]

Existing evidence further complicates decision-making, with some studies advocating against AMS due to limited benefits in long-term outcomes, while others report comparable results between surgical and non-surgical approaches.[7,12] However, many of these studies have significant limitations, including short follow-up periods, heterogeneity in treatment definitions and a failure to adequately address the role of mechanical symptoms in clinical decision-making. Crucially, despite the central role that mechanical symptom-such as pain, clicking, locking, popping and catching-play in guiding surgical decision-making, many studies fail to clearly differentiate between patients who present with these symptoms and those who do not. This lack of stratification undermines the ability of current literature to resolve the controversy over appropriate management in cases where mechanical symptoms are a prominent feature.

Previous systematic reviews by Brignardello-Petersen et al. (2017)[12] and O'Connor et al. (2022)[13] highlighted limited benefits of knee arthroscopic surgery for degenerative knee disease (degenerative meniscal tear with osteoarthritis) and recommended strongly against operating on such patients.[12,14] However, O'Connor et al.[13] included non-randomised controlled trials, as opposed to keeping only the highest form of evidence whilst, Brignardello-Petersen et al.[12] reports results which show an accumulation of evidence from observational studies[12] and outcomes only for up to three months post-surgery, potentially impeding their quality of bias control and limited long-term insight. In addition to this, all studies in O'Connor et al.'s review[13] were included without any restriction to publication date which may not meet current clinical practice standards considering significant advancements in day-to-day patient care, assessment and surgical techniques in Orthopaedics as a specialty, as reported by Rodham et al.[15] In contrast to this, Lee et al.[16] advocated for no difference in outcome between both interventions for treating degenerative meniscal tears in a meta-analysis focusing on patients aged 40 years and older thus, focused on patients undergoing surgery at a particular age, rather than providing a more comprehensive picture of evidence across different age groups given the bimodal distribution in age mentioned earlier for degenerative tears of the meniscus. A recent review by Meng et al.[17] reported no significant long-term differences in pain, function, activity levels or quality of life between arthroscopic partial meniscectomy and exercise-based therapy. However, their analysis was limited to this specific AMS procedure, failing to consider other surgical approaches for degenerative meniscal tears. Crucially, the review did not address mechanical symptoms such as locking or catching of the knee, which are pivotal in determining the need for surgical intervention. Furthermore, none of these reviews—despite their relevance—appropriately examine whether the presence or absence of mechanical symptoms modifies outcomes, which is critical to individualising treatment plans and informing clinical guidelines.

This gap in the literature remains problematic, as it fails to address the exact clinical dilemma that continues to divide guideline committees and practicing surgeons alike. With no mention of mechanical symptoms experienced by patients as an inclusion criteria, which plays a vital part in considering surgery as an option in any of these reviews, the applicability of the research conducted may be hindered due to failing to integrate essential real-life clinical practice considerations.

1.2. Objectives

In response to this gap, this systematic review and meta-analysis aims to provide an up-to-date evidence available to compare five-year long term effects of AMS to non-operative management in patients with advanced degenerative meniscal tears using only randomised controlled trials (RCTs). Importantly, this analysis recognises and responds to the urgent need to distinguish patient outcomes based on the presence or absence of mechanical symptoms. Unlike previous reviews, this analysis includes a broader range of clinically relevant outcomes, i.e. patient-reported outcomes measures, knee function scores and osteoarthritic rates, presented in a structured and methodical manner to enhance clinical applicability and decision-making.

2. Methods

- **Protocol and registration**

The protocol of this systematic review was registered on the International Register of Systematic Reviews (PROSPERO) on February 19, 2024 (registration number: CRD42024514025).

- **Eligibility criteria**

Only randomised, or quasi-randomized, studies with a follow-up period of 5 years/60 months or more, published between January 2000 and May 2024 were included.

- **Information sources**

Data were searched and collected up to May 29, 2024 from MEDLINE, Embase, Cochrane Central Register of Controlled Trails (CENTRAL) and Web of Science by two independent reviewers (NZ and JT). Once un-blinded, any dispute was resolved by a third author or escalated to all authors, if required. We also searched ClinicalTrials.gov (www.clinicaltrials.gov) for ongoing studies, using the terms 'arthroscopic' or 'arthroscopy' or 'degenerative meniscal tear' or 'meniscal degeneration' on May 29, 2024. No studies that were ongoing were found.

- **Search**

Search strategy (Appendix A) and PRISMA checklist has been included (Appendix B).

- **Study selection**

The pre-determined inclusion and exclusion criteria used to select studies relevant for this review is shown in Table 1 below using the PICOS framework (Population, Intervention, Comparator, Outcomes, and Study Selection).

- **Data collection process**

Articles identified from the aforementioned databases were imported into Rayyan[21] (data screening tool for Systematic Reviews) to filter out duplicated articles and selection of data according to inclusion and exclusion criteria which were predetermined. Selected data was then extracted onto pre-defined spreadsheet that was reviewed by additional author (SR) for table analysis.

Table 1
Inclusion and exclusion criteria as per the PICOS framework.

PICOS Framework	Inclusion Criteria	Exclusion Criteria
Population	- Patients of any age with degenerative meniscal tear presenting with mechanical symptoms (i.e. pain, swelling, clicking, catching and locking)	- Any patients with acute and/or traumatic meniscal tear - Inflammatory knee pathology
Intervention	- Any arthroscopic meniscal surgery (including but not limited to arthroscopic meniscectomy, arthroscopic debridement, arthroscopic meniscal repair)	- Any open procedures to treat meniscal tear - Revision procedures - Placebo surgery - Arthroscopic joint lavage
Comparator	- Any non-surgical management aiming to manage the condition conservatively (including but not limited to exercise therapy or physiotherapy regime, analgesia, intraarticular steroids, platelet-rich plasma) - Any placebo surgery procedure used as a control (due to being the comparison which is least prone to bias)	- Any surgical intervention to treat meniscal tear
Outcomes	Primary outcome: - Patient-reported outcomes measures (PROMs): • Lysholm Knee Scoring Scale • Tegner Activity Scale • International Knee Documentation Committee (IKDC) • Western Ontario Meniscal Evaluation Tool (WOMET) • Visual Analog Scale scores • European Quality of Life-EuroQol (i.e. EQ-5D & EQ-VAS) Secondary outcomes: • Knee injury and Osteoarthritis Outcome Score (KOOS) • Osteoarthritis rates (based on radiographic imaging-Kellgren–Lawrence or Ahlback classification)	- Any objectives which are not mentioned as primary or secondary outcomes.
Study Selection	- Only randomised, or quasi-randomized, studies - Studies with a follow-up period of 5 years/60 months or more - Data published between January 2000 and May 2024 - Articles of any language provided that an English translation is available at the time of the search.	- Reviews, non-randomised cohort or case-control studies, demographic studies, anatomical/cadaveric/biomechanical studies, case reports, editorials, commentaries, letters, guidelines, protocols, conference abstracts, and unpublished studies will be excluded - RCTs published before January 2000 and after March 2024.

- **Data items**

The following domains are included in the PICOS framework, which was utilized to organize the research question of interest for the systematic review:

Population- Patients of any age diagnosed with degenerative meniscal tear presenting with mechanical symptoms (i.e. pain, swelling, clicking, catching and locking). Mechanical symptoms were defined as patient-reported locking, catching, clicking, pain or swelling related to the meniscus. This is consistent with the previous definitions used in the literature and the included RCTs.

Intervention- Arthroscopic meniscal surgery (use of small incisions and arthroscope to repair, remove or reconstruct the meniscus of the knee, e.g. arthroscopic partial meniscectomy and arthroscopic debridement).

Comparator- Non-operative management (any non-surgical intervention to manage degeneration of the knee, such as exercise therapy or physiotherapy regime, analgesia and intraarticular injections).

Outcome- Patient-reported outcomes measures (PROMs) (Lysholm Knee Scoring Scale, Tegner Activity Scale, VAS scores, Quality of Life (QOL) score, EuroQol, IKDC, WOMET).

Study type- Systematic Review & Meta-Analysis.

- **Risk of bias in individual studies**

The overall quality of outcome after each study was extracted from the RCTs was assessed via the Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) tool.

- **Summary measures**

This data included continuous measures (means and standard deviations) and binary/dichotomous outcomes (event rates):

- Continuous measures: Means and standard deviations for IKDC, Lysholm Knee Scoring Scale, Tegner Activity Scale, EQ-5D, EQ-VAS, VAS-activity, VAS-rest, WOMET and KOOS.
- Binary/Dichotomous outcomes: Event counts for osteoarthritic progression rates.

The following outcomes were combined together to measure **primary aim** of the study quantitatively into forest plots:

1) **Knee Function, Activity Measures and Meniscal Evaluation-** IKDC, Lysholm Knee Scoring Scale, Tegner Activity Scale and WOMET
2) **General Health and Pain Measures:** EQ-5D, EQ-VAS, VAS-activity, VAS-rest

The following were combined in order to measure **secondary aim** of the study quantitatively into forest plots:

3) **Knee-specific Outcomes- Knee Injury and Osteoarthritis Outcome Score (KOOS):** KOOS-pain, KOOS-ADL, KOOS-QoL, KOOS-sports/recreation, KOOS-symptoms
4) Osteoarthritic Progression Rates

- **Synthesis of results**

All tabulated data from primary and secondary outcomes were synthesized on RevMan Web by Cochrane to summarise outcomes and pool effect sizes across studies using statistical methods (i.e. random effects models).

Microsoft Excel Version 16.86 and Microsoft® Word were used to create all the tables for data collection, making the data visualisation more practical. Meta-analysis done on any results were presented into forest plot graphs to provide clear visual representation of the results from individual studies and their overall effect sizes.

- **Risk of bias across studies**

Risk of bias was assessed for all included studies via the Cochrane Risk of Bias 2.0 tool (RoB 2 tool 26) for RCTs.

- **Additional analyses**

The quantitative data analysis involved the use of RevMan Web software based on arm-level data that were divided into either continuous or dichotomous/binary outcomes, which were then combined accordingly (see above). Meta-analyses were conducted to compare intervention (arthroscopic meniscal surgery) and control group (non-operative treatment) across the primary and secondary objectives. Forest plots were generated to visualize the effect sizes and confidence intervals. Random-effects models were employed based on the level of heterogeneity.

Effect Size were calculated as mean differences (MD) for continuous data and risk ratios (RR) or odds ratios (OR) for binary/dichotomous data, with corresponding 95 % confidence intervals (CIs).

Depending on heterogeneity, either fixed-effects or random-effects models were used. The I^2 statistic and chi-square test for heterogeneity guided this choice.

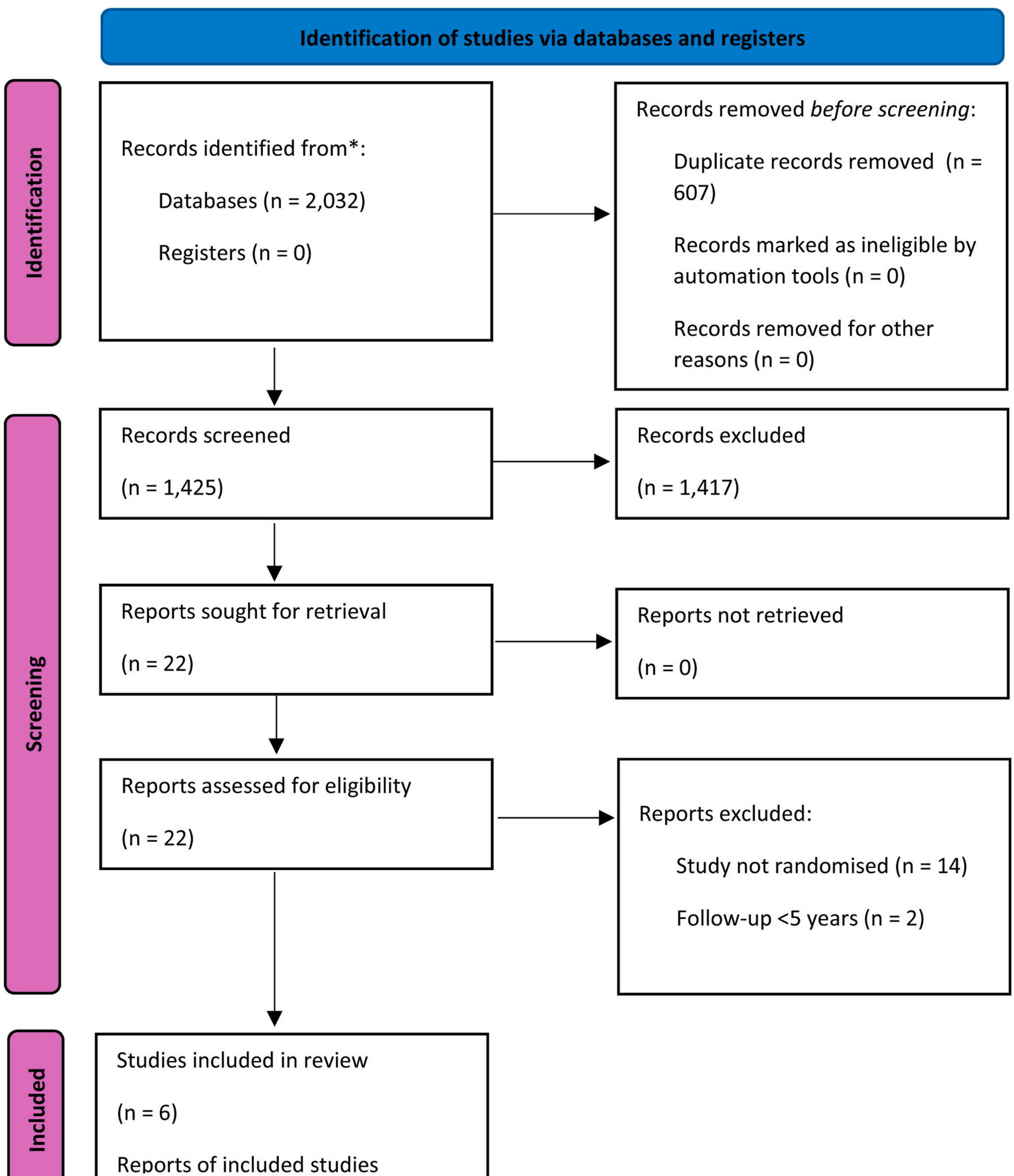

Fig. 1. PRISMA Chart flow diagram of all included studies. All papers from previous systematic reviews were included thus, no new references were required to be added.

- **PRISMA Guidelines**

The Cochrane Handbook of Systematic Reviews of Interventions criteria and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to conduct the systematic review.[18–20]

3. Results

- **Study selection**

Overall, 6 RCTs were included in this systematic review after adhering to a rigorous search process and selection criteria.[2,22–26] Additionally, two of these primary studies[24,25] had multiple associated papers that were also assessed[27,28] which provided supplementary data and insights relevant to them.

- **Study characteristics**

The search identified 2032 records from multiple studies from which 607 duplicates were removed. After screening 1425 records, we retrieved 22 studies for full-text screening. The results of the search process are shown above in a PRISMA Chart in Fig. 1.

All included studies were published in English language/had English translation available. The overarching aim for all studies were to compare AMS with one form of conservation treatment (i.e. physical therapy/PT or placebo surgery) for degenerative meniscal tears with mechanical symptoms with a follow-up period of 5 years or more.

It is important to note that not all studies explicitly defined "mechanical symptoms" in their inclusion criteria. Herrlin et al.[2] included patients based on pain as a mechanical symptom in the inclusion criteria. Katz et al.[25,27] did not explicitly list mechanical symptoms in the inclusion criteria, but their results and discussion clarify that pain and functional impairment were primary drivers for surgical intervention. Sonesson et al.[26] and Noorduyn et al.[22] similarly do not mention mechanical symptoms in their methods but, were able to identify a subset of patients with mechanical symptoms. Sihvonen et al.[23] mentioned inclusion of patients with "knee symptoms," encompassing mechanical symptoms, while Berg et al.[24,28] registered their trial with the inclusion criteria of "symptomatic degenerative meniscal tears," indicating the likely presence of mechanical symptoms in their population.

All studies had a follow-up period of 60 months for both treatment groups. All studies had AMS as the intervention and non-operative treatment in form of either PT (5/6 studies) or placebo surgery (1/6 studies) as the control.

A total of 1157 participants were included in the 6 trials, of which 585 underwent AMS and 572 underwent non-operative treatment. The

Table 2
Characteristics Table of all included RCTs; NR= Not reported.

	Study ID (Author, Country and year of publication)	Type of study	Recruitment Period (Years)	Technique		Number of patients		Mean age (SD)		Mean Follow-up Duration (months)		Patient Reported Outcomes Measures
				Intervention	Control	Intervention (M/F)	Control (M/F)	Intervention	Control	Intervention	Control	
1	Herrlin et al. 2012 Sweden	RCT	Between 2003 and 2005	Arthroscopic Surgery +8 weeks' PT	PT x2/ week for 8 weeks	47 (28/19)	49 (30/ 19)	54 (5.0)	56 (5.8)	60	60	1. KOOS 2. Lysholm 3. Tegner Activity 4. VAS 5.OA Rate
2	Katz et al. (METEOR) 2019 USA	RCT	NR	Arthroscopic surgery + 6 weeks' PT	PT x2/ week for 6 weeks	174 (75/99)	177 (75/ 102)	58.6 (7.9)	57.2 (6.7)	60	60	1. KOOS
	Katz et al. (METEOR) 2023 USA	RCT	NR	Arthroscopic surgery + 6 weeks' PT	PT x5/ week for 6 weeks	100 (40/60)	42 (16/ 26)	59.3 (8.3)	58.6 (6.0)	60	60	1.KOOS 2. OA rate
3	Sonnesson et al. 2020 Sweden	RCT	between 2010 and 2012	Arthroscopic surgery +12 weeks' PT	PT x2/ week for 12 weeks	85 (43/42)	61 (39/ 22)	55 (5)	54 (6)	60	60	1.KOOS 2.EuroQol 3.OA rate
4	Berg et al. 2020 Norway	RCT	October 2009 through September 2012	Arthroscopic surgery +12 weeks' PT	PT x2–3/ week for 12 weeks	70 (43/27)	70 (43/ 27)	50.2 (6.4)	50.3 (6.2)	60	60	1.KOOS 2.OA rate
	Berg et al. 2022 Norway	RCT	October 2009 through September 2012	Arthroscopic surgery +12 weeks' PT	PT x2–3/ week for 12 weeks	70 (43/27)	(43/27)	50.2 (6.4)	48.9 (6.3)	60	60	1.KOOS 2.OA rate
5	Sihnoven et al. (FIDELITY) 2020 Finland	RCT	December 2007 through January 2012	Arthroscopic surgery + 6 weeks' PT	Placebo surgery	70 (42/28)	76 (47/ 29)	52.1 (6.9)	52.0 (7.2)	60	60	1.WOMET 2.Lysholm 3.VAS 4.OA rate
6	Noorduyn et al. (ESCAPE) 2022 Netherlands	RCT	July 12, 2013, and November 5, 2015	Arthroscopic surgery + 8 weeks' PT	PT x2/ week for 8 weeks	139 (66/73)	139 (68/71)	57.6 (6.5)	57.3 (6.8)	60	60	1.IKDC 2.OA rate 3.VAS 4.KOOS 5.EuroQol 6. Adverse Events & Additional Surgery

summary of all characteristics of all studies including patient demographics (i.e. age, sex, etc.), length and technique of treatment group and main outcomes are shown below in Table 2.

- **Risk of bias within studies**

All RCTs were assessed for risk of bias using Cochrane Risk of Bias 2.0 tool (RoB 2 tool 26) which comprises of 5 domains and an overall judgement. A summary of risk of bias for each included RCT in outlined in detail in Fig. 2. Moreover, Fig. 3 presents an overall summary, outlining risks in low, some concerns and high in proportions.

- **Results of individual studies**

The primary outcomes measured in this systematic review are as follows, including the scales used by each study:

1) Knee Function, Activity Measures and Meniscal Evaluation:
   - IKDC (1/6 studies, 278/1157 participants)
   - Lysholm Knee Scoring Scale (2/6 studies, 242/1157 participants)
   - Tegner Activity Scale (1/6 studies, 96/1157 participants)
   - WOMET (1/6 studies, 146/1157 participants)
2) General Health and Pain Measures
   - EQ-5D (2/6 studies, 424/1157 participants)
   - EQ-VAS (1/6 studies, 146/1157 participants)
   - VAS-activity (3/6 studies, 520/1157 participants)
   - VAS-rest (1/6 studies, 96/1157 participants)

The secondary outcomes measured in this systematic review are as follows, including the scales used by each study:

1) Knee-specific outcomes- Knee Injury and Osteoarthritis Outcome Score (KOOS):
   - KOOS-pain (5/6 studies, 1011/1157 participants)
   - KOOS-ADL (3/6 studies, 382/1157 participants)
   - KOOS-QoL (3/6 studies, 382/1157 participants)
   - KOOS-sports/recreation (3/6 studies, 382/1157 participants)
   - KOOS-symptoms (3/6 studies, 382/1157 participants)

- **Synthesis of results**

Descriptive Statistics and Meta-Analysis for Primary Outcomes-Arthroscopic Surgery (Intervention) vs Non-operative Management (Control): Knee Function, Activity Measures and Meniscal Evaluation. All reported results on knee function, activity measures and meniscal evaluation are outlined and shown graphically on Fig. 4 (see Appendix C for full descriptive statistics), all of which did not show any significant difference between both groups.

Two studies[2,23] reported Lysholm Knee Scoring Scale, favouring

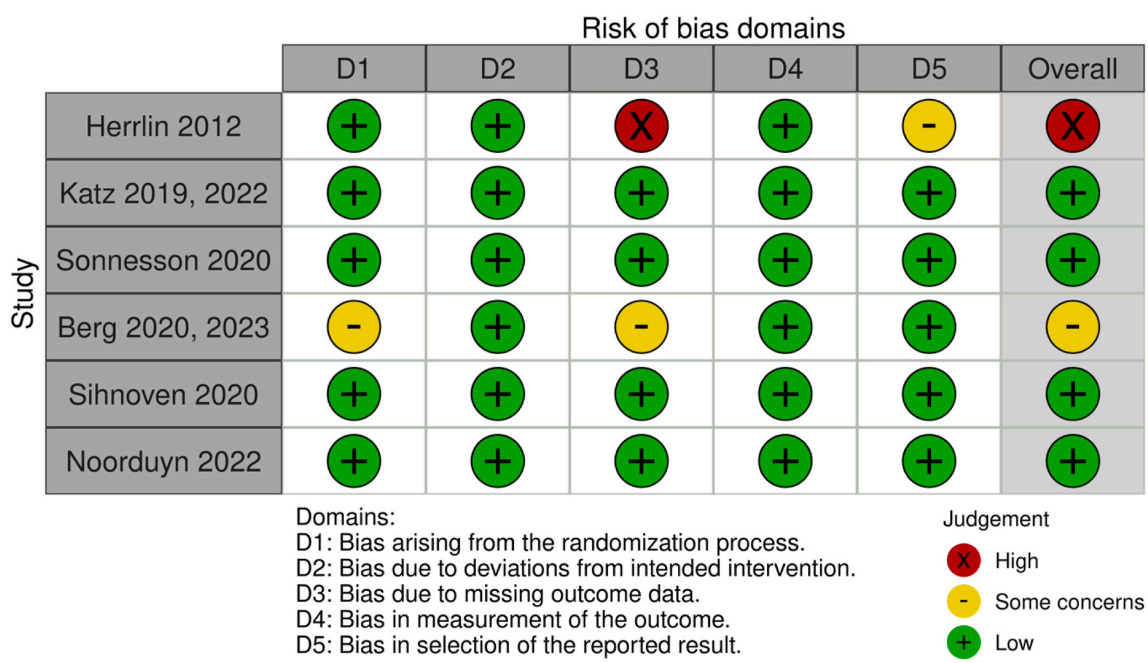

Fig. 2. Cochrane Risk of Bias (RoB2) Traffic Light Plot: Summary of all included trials.

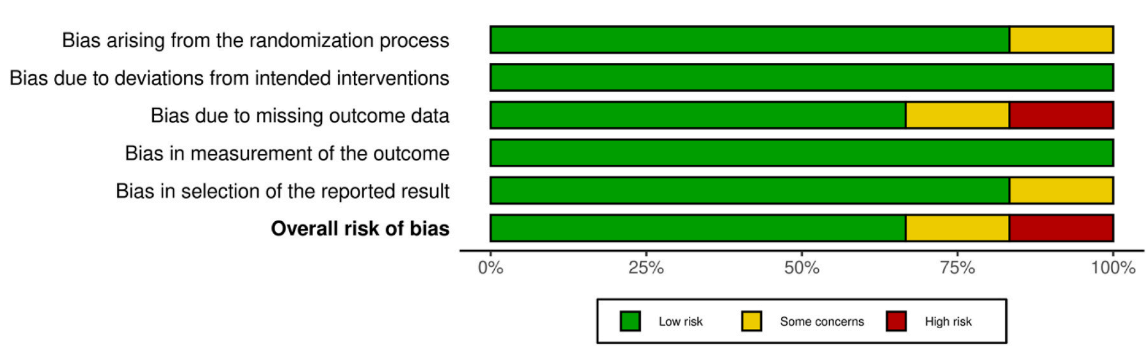

Fig. 3. Cochrane Risk of Bias (RoB2) Summary Plot: Graph of all included studies.

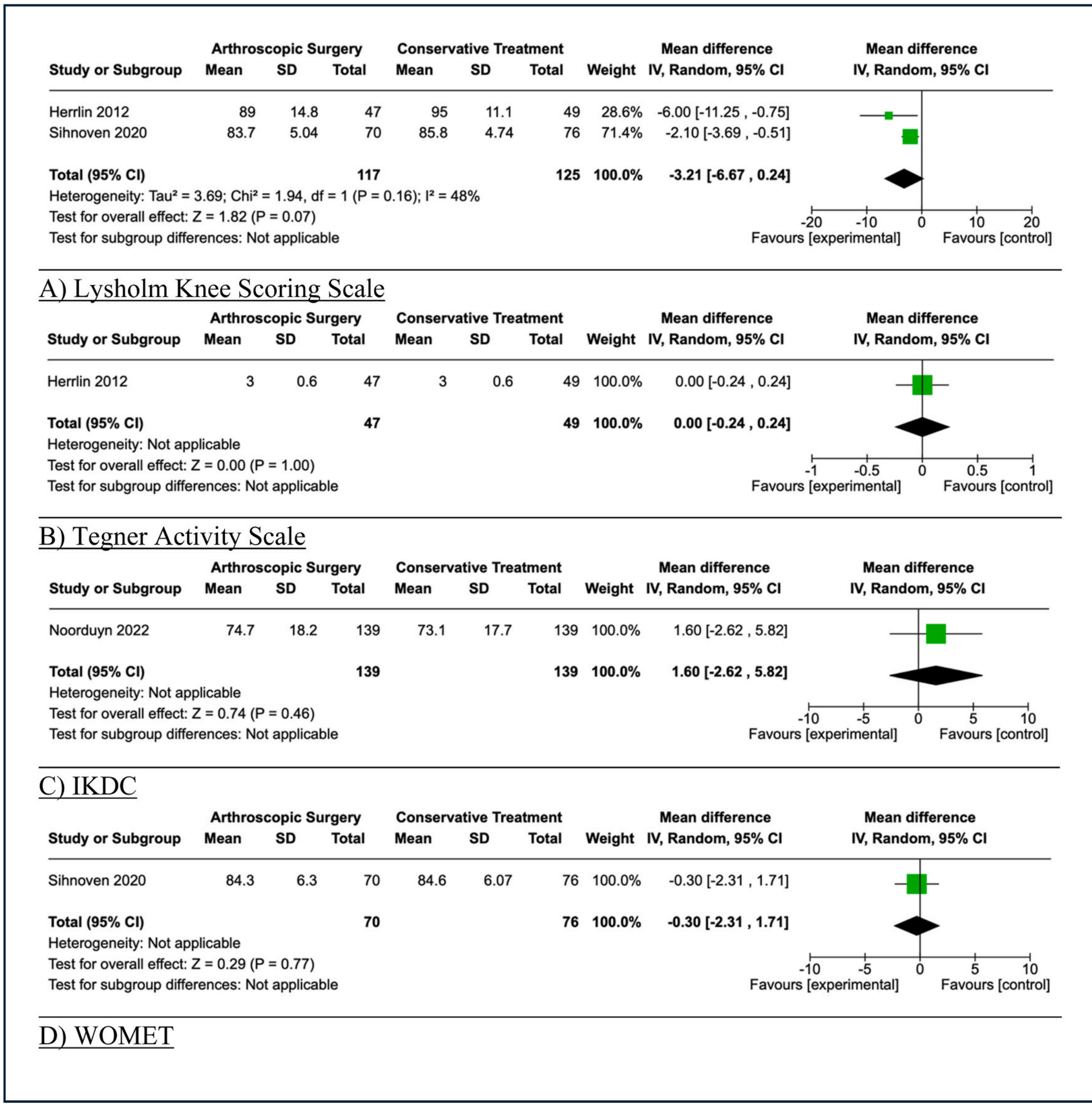

Fig. 4. Meta-analysis showing Forest Plots of Knee Function, Activity Measures and Meniscal Evaluation: 1) Lysholm Knee Scoring Scale 2) Tegner Activity Scale 3) IKDC 4) WOMET.

arthroscopic surgery over non-operative treatment (MD -3.21). However, this difference is not statistically significant (CI -6.67 to 0.24, P-value 0.07). There was moderate heterogeneity (I^2 = 48 %) and quality of evidence is low as per GRADE (Table 3).

Only one study[2] reported Tegner Activity Scale showing no significant difference between both groups (MD 0.00, CI -0.24 to 0.24, P-value 1.00).

One study[22] reported IKDC in favour of non-operative treatment (MD 1.60) with non-significance between both groups (CI -2.62 to 5.82, P-value 0.46).

WOMET was reported by one study[23] which showed no significant difference between both treatment groups either (MD -0.30, CI -2.31 to 1.71, P-value 0.77).

Descriptive Statistics and Meta-Analysis for Primary Outcomes-Arthroscopic Surgery (Intervention) vs Non-operative Management (Control): General Health & Pain Measures.

PROMs outlined in Fig. 5 reported results on general health and pain measures between the surgical and non-operative treatment group (see Appendix D for full descriptive statistics).

Two studies[22,26] reported subscales of EuroQol. EQ-5D showed in favour of AMS group (MD -0.03) however, no significant difference was seen with the control group (CI -0.08 to 0.02, P-value 0.26). There was substantial heterogeneity (I^2 = 87 %) and GRADE quality of evidence is high (Table 3).

Other subscale of EuroQoL, EQ-VAS, reported by one study,[26] reveals a significant difference (CI -4.97 to 4.03, P-value <0.00001) between both treatment groups, favouring surgery group (MD -4.50).

Three studies[2,22,23] reported VAS scores and found no statistical significance substantial for both subscales, VAS-activity (CI -0.43 to 0.07, P-value 0.16) and VAS-rest (CI -0.30 to 0.30, P-value 1.00). There was no heterogeneity (I^2 = 0 %) between the studies for VAS-activity) and GRADE quality of evidence is low to moderate (Table 3).

Descriptive Statistics and Meta-Analysis for Secondary Outcomes-Arthroscopic Surgery (Intervention) vs Non-operative Management (Control): Knee-specific outcomes & Osteoarthritic Progression Rates.

Five studies[2,22,24–26] reported KOOS and found no statistically significant difference between surgery and control group for any KOOS subscales (p-value >0.26 or more), as shown in Fig. 6 (see Appendix E for full descriptive statistics). There was considerable heterogeneity seen in (I^2 = >98 %) and the GRADE quality of evidence is moderate/high

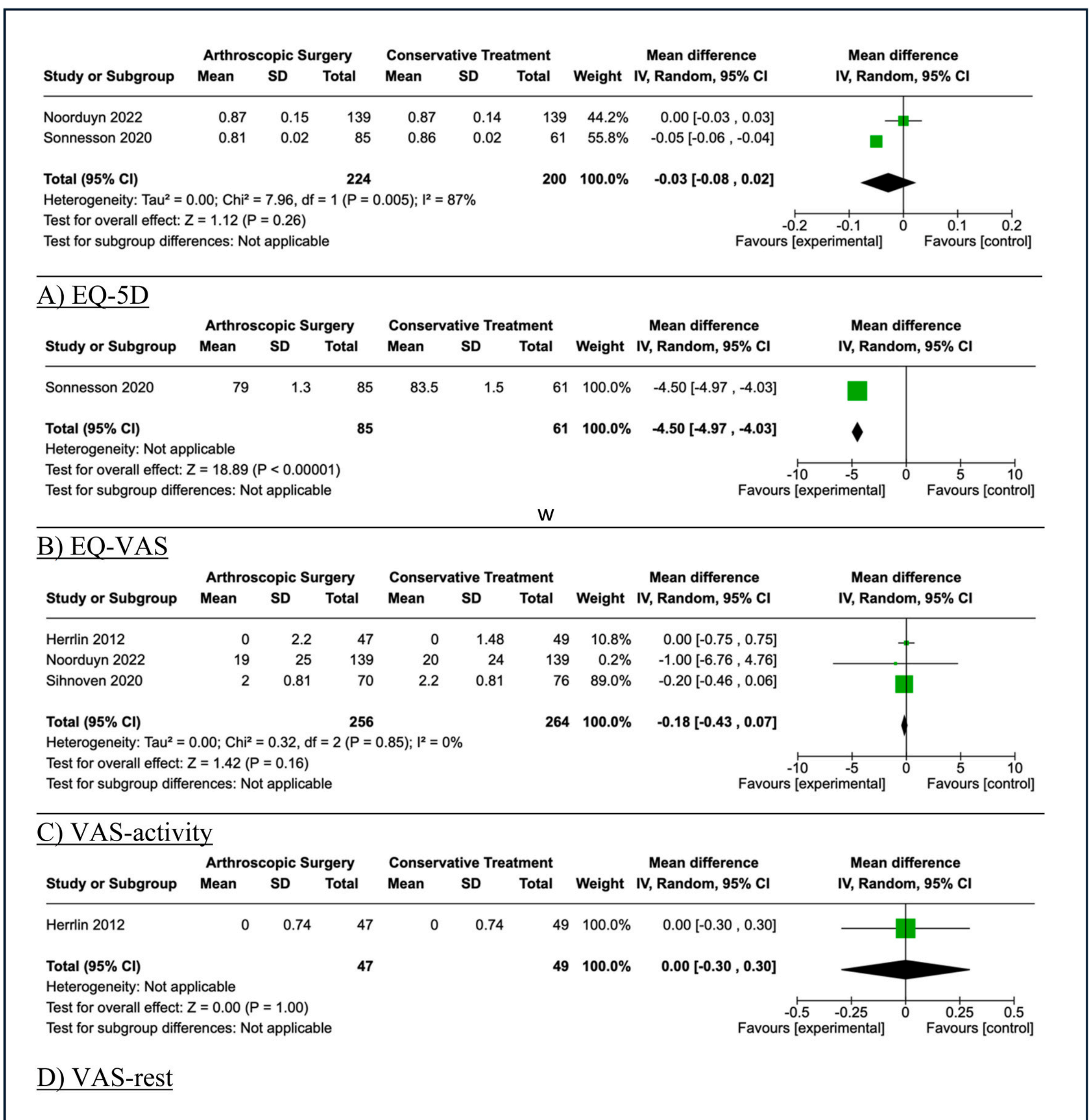

Fig. 5. Meta-analysis showing Forest Plots of General Health and Pain Measures: 1) EQ-5D 2) EQ-VAS 3) VAS-activity 4) VAS-rest.

Table 3
Summary of findings table for primary outcomes measured from the included RCTs.

Summary of findings: Primary Outcomes
Title: **Arthroscopic Meniscal Surgery vs Non-Operative Treatment for Degenerative Tears With Mechanical Symptoms: 5-Year Outcomes Systematic Review And Meta-Analysis of RCTs**
PICOS-
Patient or population: Patients with degenerative meniscal tears with mechanical symptoms
Intervention: Arthroscopic meniscal surgery
Comparison: Conservative treatment
Outcomes (Primary):
1) Knee Function, Activity Measures and Meniscal Evaluation- IKDC, Lysholm Knee Scoring Scale, Tegner Activity Scale and WOMET
2) General Health and Pain measures: EQ-5D, EQ-VAS, VAS-activity, VAS-rest
Study type: Systematic review and Meta-analysis

Outcomes	Anticipated absolute effects[e] (95 % CI)		Relative effect (95 % CI)	N of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with conservative treatment	Risk with Arthroscopic meniscal surgery				
EQ-5D	The mean EQ-5D was **0.84**	MD **0.03** lower (0.08 lower to 0.02 higher)	–	424 (2 RCTs)	++++ High	High quality RCTs. Minimal confounding bias.
EQ-VAS	The mean EQ-VAS was **83.5**	MD **4.5** lower (4.97 lower to 4.03 lower)	–	146 (1 RCT)	+++ Moderate[b]	High quality RCTs with consistent results however, bias not well controlled in one study with selection of reported results.
VAS-Activity	The mean VAS-Activity was **7.4**	MD **0.18** lower (0.43 lower to 0.07 higher)	–	520 (3 RCTs)	++ Low[b]	High quality RCTs reported however, some inconsistency between results.
VAS-Rest	The mean VAS-Rest was **0**	MD **0** (0.3 lower to 0.3 higher)	–	96 (1 RCT)	+++ Moderate[a]	Single study reporting results with some bias in selection of reported results even though RCT is of good quality.
IKDC	The mean IKDC was **73.1**	MD **1.6 higher** (2.62 lower to 5.82 higher)	–	278 (1 RCT)	++++ High	Single study reported with precise results and moderate sample size. High quality RCT.
LYSHOLM	The mean LYSHOLM was **90.4**	MD **3.21 lower** (6.67 lower to 0.24 higher)	–	242 (2 RCTs)	++ Low[c]	Although RCTs quality of high, some risk of bias within one study for selection of reported results.
TEGNER	The mean TEGNER was **3**	MD **0** (0.24 lower to 0.24 higher)	–	96 (1 RCT)	++ Low[a,d]	High quality RCTs with consistent results however, bias not well controlled in one study with selection of reported results.
WOMET	The mean WOMET was **84.6**	MD **0.3 lower** (2.31 lower to 1.71 higher)	–	146 (1 RCT)	+++ Moderate[d]	Single study reported with precise results and moderate sample size. High quality RCT.

CI: confidence interval; MD: mean difference; OR: odds ratio.
GRADE Working Group grades of evidence.
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate; the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited; the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate; the true effect is likely to be substantially different from the estimate of the effect.
Explanations:
[a] Single study with high imprecision and potential bias.
[b] Generally reliable but some inconsistency across studies.
[c] One study with some bias in selection of reported results.
[d] Single study but consistent and precise results.
[e] The risk in the intervention group (and its 95 % confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95 % CI).

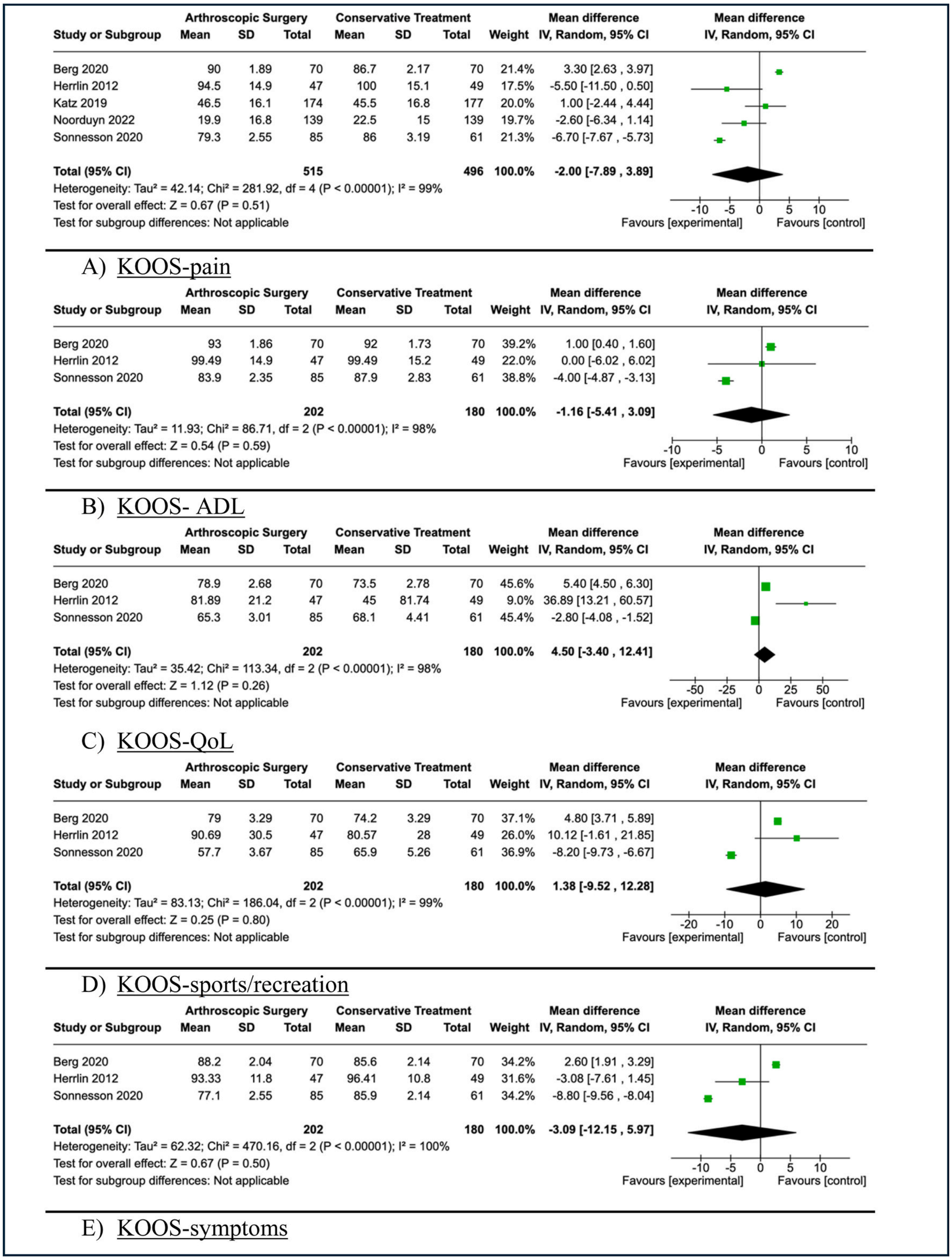

Fig. 6. Meta-analysis showing Forest Plots of Knee-specific Outcomes- KOOS: 1) KOOS-pain 2) KOOS-ADL 3) KOOS-QoL 4) KOOS-sports/recreation 5) KOOS-symptoms.

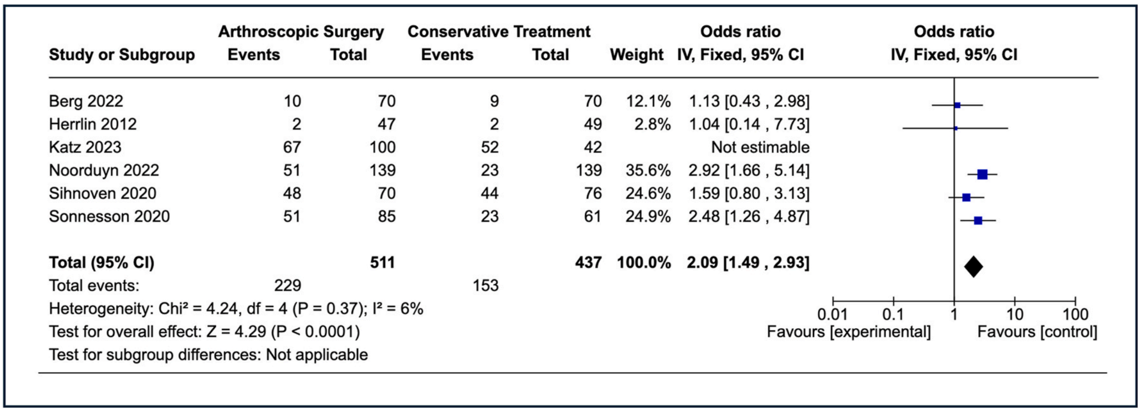

Fig. 7. Meta-analysis showing Forest Plots of Osteoarthritic Progression Rates.

Table 4
Summary of findings table for secondary outcomes measured from the included RCTs.

Summary of findings: Secondary Outcomes
Title: Arthroscopic Meniscal Surgery vs Non-Operative Treatment for Degenerative Tears With Mechanical Symptoms: 5-Year Outcomes Systematic Review And Meta-Analysis of RCTs
PICOS-
Patient or population: Patients with degenerative meniscal tears with mechanical symptoms
Intervention: Arthroscopic meniscal surgery
Comparison: Conservative treatment
Outcomes (Secondary):
1) Knee-specific Outcomes- Knee Injury and Osteoarthritis Outcome Score (KOOS): KOOS-pain, KOOS-ADL, KOOS-QoL, KOOS-sports/recreation, KOOS-symptoms
2) Osteoarthritic progression rates
Study type: Systematic review and Meta-analysis

Outcomes	Anticipated absolute effects[b] (95 %CI)		Relative effect (95 % CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with Conservative treatment	Risk with Arthroscopic meniscal surgery				
KOOS-pain	The mean KOOS-pain was **66.04**	MD **2 lower** (7.89 lower to 3.89 higher)	–	1011 (5 RCTs)	++++ High	High quality RCTs with consistent results and high population sample in total.
KOOS-ADL	The mean KOOS-ADL was **93.13**	MD **1.16 lower** (5.41 lower to 3.09 higher)	–	382 (3 RCTs)	+++ Moderate[a]	Although RCTs are of high quality, there is some inconsistency within results.
KOOS-QOL	The mean KOOS-QOL was **62.2**	MD **4.5 higher** (3.4 lower to 12.41 higher)	–	382 (3 RCTs)	++++ High	High quality RCTs with consistent results and moderate population sample in total.
KOOS-SPORT/ RECREATION	The mean KOOS-SPORT/ RECREATION was **73.6**	MD **1.38 higher** (9.52 lower to 12.28 higher)	–	382 (3 RCTs)	++++ High	High quality RCTs with consistent results and moderate population sample in total.
KOOS-SYMPTOMS	The mean KOOS-SYMPTOMS was **89.20**	MD **3.09 lower** (12.15 lower to 5.97 higher)	–	382 (3 RCTs)	++++ High	High quality RCTs with consistent results and moderate population sample in total.
OA rates	350 per 1000	**530 per 1000** (445–612)	OR 2.09 (1.49–2.93)	948 (6 RCTs)	++++ High	High quality RCTs with consistent results and high population sample in total.

CI: confidence interval; MD: mean difference; OR: odds ratio.
GRADE Working Group grades of evidence.
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate; the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited; the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate; the true effect is likely to be substantially different from the estimate of the effect.
Explanations:
[a] Generally reliable but some inconsistency across studies.
[b] The risk in the intervention group (and its 95 % confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95 % CI).

(Table 4) for all subscales of KOOS.

All six studies[2,22,23,26–28] reported osteoarthritic progression rates (Combined Odds ratio 2.09) in favour of non-operative treatment group and found a significant difference (OR 2.09, 95 % CI 1.49 to 2.93, P-value <0.0001) between both groups in results, as shown in Table 3 and Fig. 7. There was low heterogeneity between studies ($I^2 = 6$ %) and the quality of evidence is high (Table 4).

4. Discussion

- **Summary of evidence**

Overall, this systematic review and meta-analysis is the first to investigate compared five-year long-term outcomes between AMS and non-operative management for degenerative meniscal tears with mechanical symptoms, which addresses a recognised gap in the evidence base. This review synthesized data from six RCTs, comparing AMS with non-operative management for degenerative meniscal tears, all with a follow-up period of five years. This is the first review of its kind to include a specified 5 or more years of follow-up period and focusing on highest quality of evidence, offering a comprehensive long-term outcome of any treatment given. Moreover, this systematic review specifically included patients experiencing mechanical symptoms, a key factor in determining the AMS as an option for the patient. No other systematic review has explicitly addressed this aspect therefore, this specificity enhances the relevance and applicability of the findings, filling a critical gap in existing research. Furthermore, this study ensures the inclusion of only studies conducted from the year 2000 which puts greater emphasis on rigorous study design due to studies being likely to adhere to standardised treatments, ensuring that the data reflects up-to-date practice.

However, an important consideration that arose during this review is the heterogeneity in how mechanical symptoms were defined or reported across included studies. Only some trials explicitly identified mechanical symptoms as inclusion criteria. Others referred to more general terms like pain or symptomatic tears. While this review aimed to synthesise evidence regarding patients with mechanical symptoms, the lack of consistent inclusion criteria across trials presents a limitation in interpreting the outcomes exclusively for this population. Nonetheless, subset analyses in several studies did identify mechanical symptoms retrospectively, which partially addresses this gap and justifies their inclusion.

This distinction is critically important because mechanical symptoms—when properly defined—are one of the few clinical factors for which current guidelines allow some discretion regarding AMS. As noted in the introduction, while many guidelines advise against surgery for degenerative meniscal tears, they often make an exception or lack clarity when mechanical symptoms are present. This underscores the clinical relevance of accurately capturing and reporting mechanical symptoms in research, as they remain a common indication for surgical referral. Without consistent reporting of these symptoms, the external validity of RCT findings to real-world decision-making is compromised.

4.1. Primary outcome: PROMs

The meta-analysis of the patient-reported outcomes (IKDC, Lysholm, Tegner, and WOMET scores) showed no significant differences were found between both treatment groups in improving on knee function, activity measures and meniscal evaluation. This is keeping with the most recent review by O'Connor et al. who also reported no significant difference in functionality and activity between AMS and non-operative treatment.[13] This may be due to the nature of degenerative meniscal tears, which often occur due to age-related changes rather than acute trauma.[29] Thus, in such cases, surgery may not address the underlying issue or may not significantly improve the knee's overall function or pain as the surrounding knee tissue may show inflammation and pain despite the degenerative meniscus being treated. Jarett et al.[30] suggests that increased strengthening of knee muscles and cruciate ligaments as a result of physical therapy reduces mechanical symptoms in patients, showing similar results to partial meniscectomies and therefore, may explain the findings of this review.[31] Given the similar outcomes between AMS and non-operative treatment, the choice of treatment should be based on patient preferences, specific symptoms and activity levels. Future studies should investigate specific subgroups (e.g. age, activity level, type of meniscal tear) which could provide more tailored insights between both types of treatment.

4.2. Primary outcome: General Health & Pain Measures

Whilst VAS-rest, VAS-activity and EQ-5D might not have shown significant differences, the EQ-VAS highlighted a significantly better improvement in overall health perceived by patients following surgery compared to non-operative treatment. This is a new, significant finding that was not reported by O'Connor et al.[13] or in the series of systematic reviews by Brignardello-Petersen et al.[12] The EQ-VAS reflects upon the patient's overall perception of their health status thereby, demonstrating that surgery has provided a noticeable improvement in the patient's overall well-being or how they perceive their health, compared to the more specific or focused measures like VAS-rest or VAS-activity. The discrepancy suggests that different measures can capture different dimensions of the impact of treatment, and the EQ-VAS might be particularly sensitive to overall changes in health perception. Ultimately, a combination of quantitative and qualitative research methods for future research is suggested to investigate this further and provide a holistic view of treatment effects to help bridge the gap between numerical data and patient experiences.

4.3. Secondary outcome: knee-specific outcomes

The knee-specific outcomes measured by this systematic review and meta-analysis showed non-significance between the AMS group compared to non-operative treatment group. This is similar to a review done by Meng et al.[17] which showed that no significant difference in knee-specific outcome either nevertheless, their review focused on APM thus, not taking other type of AMS into account for degenerative meniscal tears, such as debridement or repair. Furthermore, the possible reasons behind this result seems ambiguously reported by Meng et al.[17] as well as O'Connor et al.[13] who further reports less certainty on applicability of results. This may be due to the variability in patient population, causing high heterogeneity between studies which reported KOOS. Due to the inherent nature of subjectiveness, KOOS rely on patients' perceptions of pain, function, and quality of life thus, patient expectations and psychological factors can influence these scores. This may further be impacted through the inclusion of broad range of patients with varying ages, activity levels, and comorbidities. Future studies may benefit from more objective measure of knee-specific outcome, e. g, through measure of clinical movement and rotation of the knee to further add onto this result.

4.4. Secondary outcome: osteoarthritic progression rates

The outcome of osteoarthritic progression rate was reported by the largest number of studies (6/6) included in this review with some trials reporting separate papers from the studies solely outlining osteoarthritic rates.[27,28] Additionally, a total of 948 participants (511 in the AMS group and 437 in the Non-operative Treatment group) makes it the largest dataset among the outcomes examined with a substantial sample size. The measure of osteoarthritic progression rates in this review was based on studies that reported objective radiographic imaging, specifically the Kellgren–Lawrence and Ahlback classifications. This approach significantly strengthens the reliability of the reported results, as it ensures a high level of objectivity and consistency in assessing osteoarthritic progression. The use of these standardized, well-established radiographic criteria minimizes subjectivity and enhances the accuracy of the findings and conclusions drawn in this review.

A potential reason for why osteoarthritic rates showed an increase in 5 years' time despite patients undergoing surgery may be due to the nature of degenerative meniscal tears which typically occurs in context of knee osteoarthritis. This means that the underlying degeneration and inflammation of the joint can cause ongoing symptoms irrespective of whether the torn meniscal tissue is removed or repaired. As surgery introduces new trauma to the knee, this can cause additional inflammation and delay recovery. Whilst previous systematic reviews on this showed results demonstrating immediate post-surgical period might involve pain and swelling, the long term follow-up period in this review reflects on surgery potentially offsetting any benefits through removal of the torn meniscal tissue. Therefore, the intriguing trend perceived of heightened risk of osteoarthritis progression within the surgical group indicates the necessity for extended probe and refined clinical direction of treatment choice should be based on this factor. Ultimately, future research can focus on this potential link between specific surgical technique in AMS and the biomechanics of what may cause this higher progression of osteoarthritis.

4.5. Discussion of results against current knowledge in literature & included study characteristics

The study years of publication encompassed from 2012 to 2022, ensuring the findings are highly relevant to current clinical practices unlike O'Connor et al. and Brignardello-Petersen et al.[12,13] Additionally, this review incorporates two new and updated studies[22,26] that were also not included in the previous systematic review by O'Connor et al.,[13] adding further onto the current literature.

The inclusion of data from trials conducted globally including in Sweden, USA, Netherlands, Finland and Norway enhances generalisability of the results across diverse populations. Furthermore, this review focused on high-quality RCTs with standardized outcomes that were all robustly measured using meta-analysis for statistical significance unlike O'Connor et al.,[13] increasing internal validity and giving more reliable reporting of results.

Studies included in this review compare AMS with placebo or physical therapy in form of non-operative management. Although, O'Conner et al. reports mainly placebo surgery as a comparator to AMS, the results show an accumulation of evidence from studies which mostly had other non-operative managements as opposed to placebo surgery, questioning the discrepancy between their aim and findings. This review establishes a clear comparison between placebo surgery and AMS which answers a critical therapeutic element of surgery in question and shows that any significant differences seen after surgery is in fact not attributed to the placebo effect of patient anticipation.

The use of standardized outcomes, all of which were eligible for meta-analysis, increase the validity and objectivity of the results reported in this study. to Meng et al.[17] conducted a systematic review and meta-analysis comparing APM to exercise therapy which reported no difference in knee function and osteoarthritic progression rates between both groups in 5 years' period, aligning with the findings from this review. Nonetheless, additional broad-range of clinically relevant outcome measures in this review as well as focus on AMS and non-operative management broadly rather than sub-types of the group, as opposed to Meng et al., means more comprehensive reporting of results.

The inclusion of prospective registration of the review protocol ensures transparency in the research process of this review, reducing the risk of selective reporting and publication bias and strengthening the reliability in contributing to the advancement of evidence-based practice.

- **Limitations**

Due to the nature of this systematic review which seeks to look at long-term outcomes at a follow-up period of 5 years or more, participants in the studies may be lost during this time period of follow-up thus, creating a gap in the data available. As the use of this raw data is mandatory in systematic reviews, this may result in missing or unaccounted data from studies, potentially impacting the data analysis. Therefore, to tackle this issue, for any missing data, relevant authors from the study were contacted. In occasions no correspondence is possible with the authors, such data were omitted from this review.

Only six RCTs met the inclusion criteria, which restricts the statistical power and external validity of the meta-analysis. Significant heterogeneity was observed across several outcomes, particularly in KOOS subscales. This may reflect differences in study designs, patient populations, treatment protocols, follow-up durations, or definitions of mechanical symptoms.

Furthermore, not all studies clearly defined or stratified mechanical symptoms. As these symptoms are often key indicators for surgery, inconsistent definitions across studies may limit clinical applicability and the internal validity of findings.

Further studies could also do sub-group analyses to focus on specific demographic of population, e.g. age difference, to explore this more. Although the small number of studies limits subgroup analysis power.

5. Conclusion

Overall, this review found that patients with degenerative meniscal tears with mechanical symptoms who undergo AMS will not significantly improve in PROMs in 5 year's period in comparison to non-operative management. However, non-operative treatment shows a significantly less osteoarthritic progression in 5 years' period in comparison to AMS. These findings strongly suggest that the management approach for degenerative meniscal tears should be tailored based on the patient's osteoarthritis status. The data indicates that AMS may be associated with a higher rate of osteoarthritic progression compared to non-operative treatment, suggesting that surgery could accelerate the degenerative process within the knee joint. This finding has significant clinical implications, as it underscores the need for clinicians to carefully consider the long-term impact of surgical interventions, particularly in patients with pre-existing osteoarthritis.

Further research is required to identify potential patient subgroups that might benefit more from AMS and to explore alternative treatments that could mitigate osteoarthritic progression rate while providing effective symptom relief. Additionally, research should investigate the potential link between surgical techniques in AMS and the biomechanics contributing to osteoarthritic progression.

Declaration of patient consent form

Not applicable. This study is a systematic review and meta-analysis of previously published data and does not involve any direct patient recruitment, intervention, or individual patient-level data collection. Hence, patient consent was not required.

Guardian/Patient's consent

Not applicable. This study is a systematic review and meta-analysis of previously published data and does not involve any direct patient recruitment, intervention, or individual patient-level data collection. Hence, patient consent was not required.

Ethical approval

This systematic review and meta-analysis complies with ethical standards and did not require ethical approval.

Level of evidence

Level I, meta-analysis of randomised controlled trials.

Registration and protocol

The review protocol was prospective registered on PROSPERO, the International Prospective Register of Systematic Reviews (registration ID: CRD42024514025).

Authors' contribution

Nafisa Zilani (NZ): Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Validation, Writing – Original Draft, Writing – Review & Editing. Janice Tan (JT): Conceptualization, Methodology, Investigation, Data Curation, Writing – Review & Editing. Siddarth Raj (SR): Conceptualization, Methodology, Investigation, Data Curation, Validation, Writing – Review & Editing. Alexandros Maris (AM): Conceptualization, Methodology, Validation, Supervision, Writing – Review & Editing. Angelo V. Vasiliadis (AV): Writing – Review & Editing. Akash Patel (AP): Conceptualization, Methodology, Supervision, Project Administration.

Ethical statement

This systematic review and meta-analysis complies with ethical standards and did not require ethical approval.

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Declaration of competing interest

The authors declare no conflict of interest. This research did not receive any specific grant or funding from public, commercial or non-profit funding agencies.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jorep.2025.100809.

Data availability

All of the processed data have been included in the manuscript, tables and figures. Any further data are available upon request to the corresponding author.

References

1. Bhattacharyya T, Gale D, Dewire P, et al. The clinical importance of meniscal tears demonstrated by magnetic resonance imaging in osteoarthritis of the knee. *J Bone Joint Surg Am*. 2003;85(1):4–9.
2. Herrlin SV, Wange PO, Lapidus G, Hållander M, Werner S, Weidenhielm L. Is arthroscopic surgery beneficial in treating non-traumatic, degenerative medial meniscal tears? A five year follow-up. *Knee Surg Sports Traumatol Arthrosc*. 2013;21(2):358–364.
3. Baker BE, Peckham AC, Pupparo F, Sanborn JC. Review of meniscal injury and associated sports. *Am J Sports Med*. 1985;13(1):1–4.
4. Mather 3rd RC, Garrett WE, Cole BJ, et al. Cost-effectiveness analysis of the diagnosis of meniscus tears. *Am J Sports Med*. 2015;43(1):128–137.
5. Beaufils P, Becker R, Kopf S, et al. Surgical management of degenerative meniscus lesions: the 2016 ESSKA meniscus consensus. *Knee Surg Sports Traumatol Arthrosc*. 2017;25(2):335–346.
6. Pan H, Zhang P, Zhang Z, Yang Q. Arthroscopic partial meniscectomy combined with medical exercise therapy versus isolated medical exercise therapy for degenerative meniscal tear: a meta-analysis of randomized controlled trials. *Int J Surg*. 2020;79:222–232.
7. Doral MN, Bilge O, Huri G, Turhan E, Verdonk R. Modern treatment of meniscal tears. *EFORT Open Rev*. 2018;3(5):260–268.
8. NICE. Knee pain - assessment: non-traumatic causes 2022. Available from: https://cks.nice.org.uk/topics/knee-pain-assessment/diagnosis/non-traumatic-causes/; August 2022.
9. Society AK. Position statement from the Australian knee society on arthroscopic surgery of the knee, including reference to the presence of osteoarthritis or degenerative joint disease: updated October 2016. *Orthop J Sports Med*. 2017;5(9), 2325967117728677.
10. AAOS. Surgical management of osteoarthritis of the knee evidence-based clinical practice guideline. Available from: https://www.aaos.org/globalassets/quality-and-practice-resources/surgical-management-knee/smoak2cpg.pdf; 2022.
11. NICE. Osteoarthritis in over 16s: diagnosis and management 2022. Available from: https://www.nice.org.uk/guidance/ng226; 19 October 2022.
12. Brignardello-Petersen R, Guyatt GH, Buchbinder R, et al. Knee arthroscopy versus conservative management in patients with degenerative knee disease: a systematic review. *BMJ Open*. 2017;7(5), e016114.
13. O'Connor D, Johnston RV, Brignardello-Petersen R, et al. Arthroscopic surgery for degenerative knee disease (osteoarthritis including degenerative meniscal tears). *Cochrane Database Syst Rev*. 2022;(3).
14. Siemieniuk RAC, Harris IA, Agoritsas T, et al. Arthroscopic surgery for degenerative knee arthritis and meniscal tears: a clinical practice guideline. *BMJ*. 2017;357, j1982.
15. Rodham P, Giannoudis PV. Innovations in orthopaedic trauma: top advancements of the past two decades and predictions for the next two. *Injury*. 2022;53:S2–S7.
16. Lee DY, Park YJ, Kim HJ, et al. Arthroscopic meniscal surgery versus conservative management in patients aged 40 years and older: a meta-analysis. *Arch Orthop Trauma Surg*. 2018;138(12):1731–1739.
17. Meng J, Tang H, Xiao Y, et al. Long-term effects of exercise therapy versus arthroscopic partial meniscectomy for degenerative meniscal tear: a meta-analysis of randomized controlled trials. *Asian J Surg*. 2024;47(6):2566–2573.
18. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*. 2009;339, b2535.
19. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372, n71.
20. Higgins JTJ, Chandler J, Cumpston M, Li T, Page MJ, Welch VA, eds. *Cochrane Handbook for Systematic Reviews of Interventions*. Cochrane; 2023 [updated August 2023]. Available from: version 6.4. www.training.cochrane.org/handbook.
21. Ouzzani MHH, Fedorowicz Z, Elmagarmid A. Rayyan — a web and mobile app for systematic reviews. *Syst Rev*. 2016;5(210).
22. Noorduyn JCA, van de Graaf VA, Willigenburg NW, et al. Effect of physical therapy vs arthroscopic partial meniscectomy in people with degenerative meniscal tears: five-year Follow-up of the ESCAPE randomized clinical trial. *JAMA Netw Open*. 2022;5(7), e2220394.
23. Sihvonen R, Paavola M, Malmivaara A, et al. Arthroscopic partial meniscectomy for a degenerative meniscus tear: a 5 year follow-up of the placebo-surgery controlled FIDELITY (Finnish degenerative meniscus lesion study) trial. *Br J Sports Med*. 2020;54(22):1332–1339.
24. Berg B, Roos EM, Englund M, et al. Development of osteoarthritis in patients with degenerative meniscal tears treated with exercise therapy or surgery: a randomized controlled trial. *Osteoarthr Cartil*. 2020;28(7):897–906.
25. Katz JN, Shrestha S, Losina E, et al. Five-year outcome of operative and nonoperative management of meniscal tear in persons older than forty-five years. *Arthritis Rheumatol*. 2020;72(2):273–281.
26. Sonesson S, Kvist J, Yakob J, Hedevik H, Gauffin H. Knee arthroscopic surgery in middle-aged patients with meniscal symptoms: a 5-Year Follow-up of a prospective, randomized study. *Orthop J Sports Med*. 2020;8(1), 2325967119893920.
27. Katz JN, Collins JE, Brophy RH, et al. Radiographic changes five years after treatment of meniscal tear and osteoarthritic changes. *Arthritis Care Res*. 2023;77(3).
28. Berg B, Roos EM, Kise NJ, Engebretsen L, Holm I, Risberg MA. Muscle strength and osteoarthritis progression after surgery or exercise for degenerative meniscal tears: secondary analyses of a randomized trial. *Arthritis Care Res*. 2022;74(1):70–78.
29. Howell R, Kumar NS, Patel N, Tom J. Degenerative meniscus: pathogenesis, diagnosis, and treatment options. *World J Orthop*. 2014;5(5):597–602.
30. Jarrett JB, Sauereisen S. PURLs: when can exercise supplant surgery for degenerative meniscal tears? *J Fam Pract*. 2017;66(4):250–252.
31. Kise NJ, Risberg MA, Stensrud S, Ranstam J, Engebretsen L, Roos EM. Exercise therapy versus arthroscopic partial meniscectomy for degenerative meniscal tear in middle aged patients: randomised controlled trial with two year follow-up. *Bmj*. 2016;354, i3740.