



Cite as: DAWIDOWICZ, Marcel, KUCHARSKI, Kacper, MAJDA, Antoni, ALEKSANDROWICZ, Hanna, KAMOSIŃSKA, Anna, LASKE, Alicja, SOWA, Martyna, SITKO, Natalia, MAKOWSKA, Paulina, KOWAL, Adam, GONTARCZYK, Joanna and PAJĄK, Julia. Management of Degenerative Meniscus Injury: Surgical vs Conservative approach. Journal of Education, Health and Sport. 2026;92:72365. <https://doi.org/10.12775/JEHS.2026.92.72365>

ARTICLE TIMELINE

Received: 22.05.2026 Revised: 25.05.2026
Accepted: 26.05.2026 Published: 10.06.2026

INDEXING & EVALUATION

MEiN points: 40 Unique ID: 201159
Disciplines: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).

The journal has been awarded 40 points in the parametric evaluation by the Polish Ministry of Higher Education and Science (Annex to the announcement of 05.01.2024, No. 32318). Unique Journal Identifier: 201159. Scientific disciplines: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).

Punkty Ministerialne z 2019 – aktualny rok 40 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu). © The Authors 2026.

OPEN ACCESS · CC BY-NC-SA 4.0 This article is published with open access under the License Open Journal Systems of Nicolaus Copernicus University in Toruń, Poland, and is distributed under the terms of the Creative Commons Attribution Non-commercial Share Alike License <http://creativecommons.org/licenses/by-nc-sa/4.0/>, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the work is properly cited. The authors declare no conflict of interest regarding the publication of this paper.

Management of Degenerative Meniscus Injury: Surgical vs Conservative approach

Marcel Dawidowicz, ORCID: 0009-0000-5297-3507

E-mail: mardawidowicz@int.pl

1 Lower Silesian Centre for Oncology, Pulmonology and Haematology, plac Hirszfelda 12,
53-413 Wrocław, Poland

Kacper Kucharski, ORCID: 0009-0004-5709-8974

E-mail: kacper.kucharski1129@gmail.com

Jan Mikulicz-Radecki University Clinical Hospital, Borowska 213, 50-556 Wrocław, Poland

Antoni Majda, ORCID: 0009-0006-4357-513X

E-mail: antekmajda99@gmail.com

Provincial Specialist Hospital in Wrocław, Kamińskiego 73a, 51-124 Wrocław, Poland

Hanna Aleksandrowicz, ORCID: 0009-0006-3686-3942

E-mail: hania.aleks24@gmail.com

1 Lower Silesian Centre for Oncology, Pulmonology and Haematology, plac Hirszfelda 12,
53-413 Wrocław, Poland

Anna Kamosińska, ORCID: 0009-0005-0718-2112

E-mail: anna.kamosinska@interia.pl

4th Military Clinical Hospital with Polyclinic, Independent Care Institution, Weigla 5, 53-114 Wrocław, Poland

Alicja Laske, ORCID: 0009-0000-3690-4659

E-mail: laske.a.j@gmail.com

4th Military Clinical Hospital with Polyclinic, Independent Public Health Care Centre, Weigla 5 50-981 Wrocław, Poland

Martyna Sowa, ORCID: 0009-0003-7152-5787

E-mail: martynasowa34@gmail.com

Independent Public Healthcare Facility in Bochnia "District Hospital", Krakowska 31 32-700 Bochnia, Poland

Natalia Sitko, ORCID: 0009-0002-4128-134X

E-mail: nataliaasitko@gmail.com

Lower Silesian Specialist Hospital T. Marciniak – Emergency Medicine Center, Fieldorfa 2, 54-049 Wrocław, Poland

Paulina Makowska, ORCID: 0009-0009-1279-5422

E-mail: paulinamakowska615@gmail.com

Voivodeship Specialist Hospital in Wrocław, Kamińskiego 73a, 51-124 Wrocław, Poland

Adam Kowal, ORCID: 0009-0007-7779-598X

E-mail: adamkowal581@o2.pl

Jan Mikulicz Radecki University Clinical Hospital, Borowska 213, 50-556 Wrocław, Poland

Joanna Gontarczyk, ORCID: 0009-0002-7512-8853

E-mail: joanna.gontarczyk0@gmail.com

Jan Mikulicz-Radecki University Clinical Hospital, Borowska 213, 50-556 Wrocław, Poland

Julia Pająk, ORCID: 0009-0007-0882-9365

E-mail: julia.pajak@onet.eu

4th Military Clinical Hospital with Polyclinic, Independent Care Institution, Weigla 5, 53-114 Wrocław, Poland

Abstract

Objective: This review aims to compare surgical and conservative treatment methods for degenerative meniscus injuries.

Methods: A literature search was conducted in PubMed, Scopus, Web of Science, and the Cochrane Library to identify randomized controlled trials published from 2012 onwards. Eligible studies evaluated adult patients with degenerative meniscal tears confirmed by magnetic resonance imaging or radiographs, comparing surgical interventions with non-operative treatments.

Results: Evidence from high-quality trials indicates that conservative approaches are comparable to surgical interventions in improving long-term patient-reported outcomes. While arthroscopic partial meniscectomy (APM) yields significant initial clinical improvements, it offers no meaningful long-term advantage over structured physical therapy. Placebo-controlled trials demonstrate that the perceived therapeutic benefits of APM are predominantly due to the non-specific effects of the surgical act itself rather than the removal of damaged tissue. Conversely, APM exposes the knee to accelerated degenerative changes, including an increased risk of radiographic osteoarthritis progression and a five-fold higher likelihood of ultimately requiring a total knee replacement. Furthermore, patients who crossover from physical therapy to delayed surgery due to unsatisfactory results do not achieve superior functional outcomes compared to those who remain in conservative management.

Conclusion: Current clinical guidelines advocate for at least three months of structured physical therapy as the primary, first-line treatment for degenerative meniscal lesions. Adopting a conservative approach maximizes patient benefit, prioritizes the preservation of the meniscus, and supports long-term joint longevity.

Keywords: Degenerative Meniscus Injury, surgical approach, Arthroscopic Partial Meniscectomy, physical therapy, conservative approach

1. Introduction

The human meniscus is a crucial fibrocartilaginous structure responsible for load distribution and stress reduction, which is essential for maintaining knee joint homeostasis [1,2,3]. The most common injuries of the knee are meniscal lesions, often manifesting as significant pain and functional deficiency of the knee, which negatively influence the quality of life for a considerable patient population [4]. These injuries can be divided based on their etiology into traumatic tears, usually associated with acute incidents in younger, active populations, and degenerative meniscal lesions (DMLs), native to age-related changes in the fibrocartilage tissue [4,5,6]. High prevalence of asymptomatic tears and frequent coexistence of osteoarthritis (OA) in middle-aged and elderly patients make identification of the exact origin of symptoms a major diagnostic challenge [7,8].

Surgical resection of meniscal tears used to be the dominant treatment option throughout history. In the 1970s clinical observations revealed a connection between the loss of meniscal tissue and joint space narrowing, as well as accelerated cartilage degeneration, which marked the end of total meniscectomy as a gold standard [9,10]. This understanding generated a paradigm shift towards meniscal preservation and the widespread endorsement of arthroscopic partial meniscectomy (APM), which goal is to resect only the unstable fragments while preserving a stable rim of healthy tissue [9,11]. Today, arthroscopic procedures of the meniscus are one of the most frequently performed orthopedic operations worldwide, with millions of cases conducted each year [12,13]. However, the clinical efficacy of APM has become a topic of intense debate in modern orthopedic surgery despite its popularity and ubiquity.

The superiority of surgical intervention over non-operative management for degenerative lesions has been increasingly challenged by recent high-quality evidence, including numerous randomized controlled trials and systematic reviews [14,15,16]. Most systematic reviews acknowledge that in middle-aged patients with DMLs, surgery grants no meaningful long-term improvement in pain or function when compared to exercise therapy or placebo [14,16,17]. While some studies report small, short-term benefits in functionality following surgery, these advantages typically decline within six months to two years, often resulting in outcomes

comparable to supervised physical therapy programs [17,18,19]. Furthermore, the potential for symptomatic relief of surgery cannot be taken into consideration without its risk of exacerbating joint inflammation, future OA predisposition and aggravation of the psychological status of the patient [20,21].

On the contrary, the management of specific injury types, such as meniscal root tears, presents a different clinical trajectory. These injuries are biomechanically equivalent to a total meniscectomy due to meniscus losing its ability of converting axial loads into hoop stresses, leading to accelerated joint degeneration [22,23]. In such cases, surgical repair using the transtibial pull-out technique has shown promising outcomes in recovering knee stability and preventing the afterward progression towards total knee arthroplasty [17,24]. This emphasizes the necessity of a tailored approach to meniscal pathologies, where patient age, activity level, tear morphology, and the degree of articular degeneration impacts the choice between conservative and surgical management [17,20].

Research objective: comparison of surgical and conservative treatment methods of degenerative meniscus injury.

2. Epidemiology, prevalence and risk factors of degenerative meniscus injury.

Degenerative meniscal lesions represent a progressive failure of the meniscal fibrocartilage, typically resulting from repetitive regular forces impacting an age-worn tissue rather than a single traumatic event [5,19]. In contrary to acute traumatic tears, DMLs develop gradually and are frequently considered as an indication of early knee joint senescence [25,26].

2.1 Epidemiology and Occurrence

DMLs are highly common in the middle-aged and elderly populations [8,27]. Estimates suggest a general prevalence of approximately 12% to 14%, with an annual incidence of around 61 cases per 100,000 individuals [6]. Some studies report that meniscal tears can be found in one out of every four (25%) knees of middle aged patients [8]. The frequency of such lesions seems to increase in correlation with age - population-based studies utilizing magnetic resonance imaging (MRI) have indicated that 35% of individuals over the age of 50 show evidence of meniscal tears. However, two-thirds of them did not develop any related symptoms [8]. In symptomatic patients, the prevalence of meniscal damage reaches 91%, while 76% of

asymptomatic age-matched controls also exhibit comparable injury [28]. The peak onset for men is generally between 41 and 50 years, while women show a peak onset between 61 and 70 years [6].

2.2 Risk Factors

The etiology of DMLs is multifactorial, involving both non-modifiable and modifiable risk factors [29].

Non-Modifiable Risk Factors: advanced age is the primary driver, due to decreased meniscal cellularity and tissue homeostasis alterations [30]. Moreover, sex is also a significant determinant of DMLs, as men exhibit an incidence rate 2,5 times higher than women [29]. In addition, specific anatomical variations, such as a biconcave tibial plateau, a discoid meniscus, or inherent ligamentous laxity further increase the risk of developing meniscal failure [31].

Modifiable Risk Factors: obesity and a high body mass index (BMI) are critical contributors, as they accelerate the degradation and increase focal stress of meniscal tissue [17,31]. Occupational and sports-related activities involving mechanical overload, specifically: prolonged squatting, kneeling, stair climbing and carrying of heavy weights are strongly correlated with an increased risk of damaging the meniscus [31].

2.3 Pathophysiology Context

Knee osteoarthritis (OA) is intrinsically linked with DMLs. Meniscal injuries can be found in over 75% of patients with symptomatic OA [9]. These lesions are increasingly recognized as a "pre-radiographic" sign of OA: failure of the meniscus disrupts the axial load conversion, thereby advancing cartilage breakdown and joint space narrowing [23,32,33,34]. Therefore, we cannot treat DML as an isolated mechanical defect, as it often reflects an impaired joint microenvironment [15].

3. Methodology

3.1 Study design

This study is a systematic review of randomized controlled trials (RCTs) evaluating surgical and conservative treatment options for degenerative meniscus injury.

3.2 Study eligibility

Randomized controlled trials evaluating surgical or conservative treatment strategies for degenerative meniscus injury in adult patients were eligible for inclusion. Studies, published from 2012 onwards, were required to enroll adults diagnosed with degenerative meniscal tears confirmed by magnetic resonance imaging (MRI) or radiograph and/or with typical meniscal symptoms. Trials including idiopathic cases as well as patients with associated systemic conditions were taken into consideration.

Studies were excluded if they were non-randomized, designed as observational, case reports, narrative reviews, conference abstracts, or if they focused exclusively on diagnostic methods or anatomical aspects without evaluation of treatment effects.

3.3 Data collection: Information sources and strategy of search

A literature search was conducted in PubMed, Scopus, Web of Science, and the Cochrane Library (CENTRAL). Search terms related to degenerative meniscus injury and its treatment were used. Studies published from 2012 onwards were considered eligible in order to focus on contemporary treatment strategies and clinical practice. The search was limited to studies involving adult human participants. Reference lists of relevant review articles were screened to identify additional eligible trials.

3.4 Study selection and data extraction

Titles and abstracts were screened for eligibility, followed by full-text assessment of potentially relevant articles. Study selection was performed by three reviewers, with disagreements resolved by discussion. Data were extracted using a standardized approach, including study characteristics, participant demographics, intervention and comparator details, follow-up duration, and reported outcomes.

4. Results

4.1 Characteristics of Included Trials

The randomized controlled trials evaluating surgical versus non-surgical interventions for degenerative meniscal tears were primarily conducted and recruited participants between 2007 and 2015. The study populations typically targeted middle-aged and older adults, with age ranges typically ranging between 35 to 70 years. Participants generally presented with unilateral, non-traumatic knee pain that had persisted for various durations depending on a particular study: from at least one month [35] up to more than three months [36,37,38,39,40]. While the majority of trials focused on patients without obstructive symptoms, some studies [32,37,38,41,42] specifically included patients who had previously failed at least three months of supervised conservative therapy before enrollment. In most studies the diagnosis was confirmed by magnetic resonance imaging (MRI) to verify the presence of a degenerative meniscal tear, often defined as an intrameniscal linear signal penetrating one or both surfaces. Moreover, baseline radiographic assessment was used to group patients based on the degree of ongoing osteoarthritis, with inclusion generally limited to those with Kellgren-Lawrence (KL) grades of 0 to 2 or 3. Sample sizes ranged from a small pilot study of 17 patients to large multi-center trials, with the ESCAPE trial randomizing 321 patients and the MeTeOR trial randomizing 351 patients. The trials documented outcomes over varying time scopes, with short-term assessments at 3 to 12 months and long-term follow-ups reaching 2, 5, and 10 years. The primary outcomes reported across these trials can be categorized as follows:

Patient-Reported Outcome Measures (PROMs): Subjective knee function and pain were evaluated using validated scales, including: the Knee Injury and Osteoarthritis Outcome Score (KOOS), the International Knee Documentation Committee (IKDC) Subjective Knee Form, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the Western Ontario Meniscal Evaluation Tool (WOMET) [21,32,35,36,38,39,40,41,42].

Structural and Radiographic Outcomes: Longitudinal changes in joint space narrowing and osteophyte formation were evaluated using the Kellgren-Lawrence (KL) classification and the Osteoarthritis Research Society International (OARSI) atlas sum score [32,36,38,40,42].

Functional and Objective Tests: Thigh muscle strength (isokinetic quadriceps and hamstrings strength) and physical performance tests, such as hop tests and chair stand tests, served as objective measures of recovery [21,38,41,42].

Mental Health and Quality of Life: Secondary measures included health-related quality of life (SF-36 or EQ-5D) and assessments of anxiety and depression (HAD scale) [21,32,37,38,40,41].

Table 1: summarizes the key characteristics of the randomized controlled trials (RCTs) evaluating surgical versus non-surgical interventions for degenerative meniscal tears, as documented in the provided sources.

Trials	Injury Characteristics	Treatment Groups	Sample Size (N)	Follow-up Duration
MeTeOR [35]	Symptomatic meniscal tear with mild-to-moderate knee OA (KL grades 0-3).	1. Arthroscopic partial meniscectomy (APM) + postoperative PT 2. Standardized physical therapy (PT).	351 participants (174 APM, 177 PT).	6 and 12 months
ESCAPE [39,40]	Nonobstructive (no locking) MRI-confirmed degenerative meniscal tear.	1. APM 2. PT protocol (16 sessions over 8 weeks).	321 participants (159 APM, 162 PT).	3, 6, 12, and 24 months; 5 years.
FIDELITY [36]	MRI-verified degenerative medial meniscus tear, symptoms >3 months, no clinical OA signs.	1. APM 2. Placebo surgery (diagnostic arthroscopy).	146 participants (70 APM, 76 Placebo).	2, 6, 12, 24, 36, 48, and 60 months (5 years).
OMEX, Kise et al.[32,41,42]	Unilateral non-traumatic medial degenerative tear (MRI-verified), KL grade <2.	1. APM 2. Supervised exercise therapy (12-week neuromuscular program).	140 participants (70 APM, 70 Exercise).	3, 12, 24 months; 5 and 10 years.

Gauffin et al., Sonesson et al. [37,38]	Middle-aged patients with meniscal symptoms, KL grade 0, failed prior primary care PT.	1. Knee arthroscopy (mostly APM) + exercise program 2. Structured exercise program alone.	150 participants (75 per group).	3, 12 months; 3, 5, and 10 years.
Østerås et al. [21]	MRI-verified degenerative meniscus injury, knee pain >3 months.	1. Medical Exercise Therapy (36 treatments/3 months) 2. Arthroscopic surgery (meniscectomy).	17 participants (9 MET, 8 surgery).	3 months.
Vermesan et al. [43]	Nontraumatic symptomatic medial compartment degenerative lesions (MRI-verified), early OA.	1. Arthroscopic debridement/meniscectomy 2. Intra-articular corticosteroid injection.	120 cases/114 patients (60 cases per group).	1 month and 1 year.

4.2 Results of surgical treatment (APM)

Arthroscopic partial meniscectomy usually leads to significant pain reduction, improves function, and quality of life compared to preoperative status [21,38,39,40]. Some studies observed a statistically significant advantage for APM when compared with exercise over exercise alone at the one-year follow-up [37,38]. However, this distinction often diminishes over longer periods of time, with no noteworthy differences in pain or knee function reported at 5-year and 10-year intervals in multiple cohorts [32,36,38,40,42]. Moreover, it has been reported that APM is associated with a slightly higher risk of radiographic knee OA progression and joint space narrowing when compared to non-surgical or placebo groups in certain trials [36,38]. Furthermore, an "as-treated" analysis of the MeTeOR trial suggested that APM-treated patients have a five-fold increased risk of ultimately requiring a total knee replacement in contrast to those managed with PT alone [35].

4.3 Results of conservative treatment

Standard Physical Therapy

Standard physical therapy (PT), typically comprised of supervised exercises focused on muscle conditioning and coordination, has shown clear non-inferiority to APM in several large-scale trials. The MeTeOR trial reported that a standardized PT regimen resulted in an 18.5 point improvement in WOMAC physical function scores at six months, which is a result that did not significantly differ from the surgical group [35]. In addition, the ESCAPE study has disclosed that PT was comparable to APM over 24 months, with knee function improving by 20.4 points on the IKDC scale [39]. These functional improvements were sustained at a five-year follow-up, where PT remained non-inferior to surgery and showed corresponding rates of radiographic OA progression [40]. In spite of approximately 30% to 35% of PT-managed patients eventually opting for "delayed" surgery due to persistent symptoms, these patients did not ultimately gain superior functional outcomes when compared to the PT-only group [35,40].

Supervised Neuromuscular Training

Supervised Neuromuscular Training, focused on progressive strength and neuromuscular control, provides noticeable advantages in objective functional recovery. In the OMEX trial, participants undergoing a 12-week supervised exercise program achieved considerably greater improvements in thigh muscle strength (quadriceps and hamstrings) at 3 and 12 months compared to those undergoing only surgery [41]. While two-year patient reported outcomes (KOOS4) were almost identical between the exercise and surgery groups, the exercise group additionally avoided the initial decrease in muscle strength generally observed postoperatively [41]. Long-term follow-ups at 5 and 10 years confirmed that neuromuscular training results in clinical improvements and radiographic OA progression rates that correspond with APM [32,42].

Medical Exercise Therapy (MET)

Medical Exercise Therapy (MET) is a specific biopsychosocial approach aimed to modulate pain through the central nervous system by a high-repetition, high-dosage protocol [21]. A comparative pilot study found that MET was as effective as surgery in improving knee pain and daily function at three months follow-up [21]. Additionally, the MET group reported a significant reduction in symptoms of anxiety and depression on the Hospital Anxiety and Depression (HAD) scale, an advantage not observed in the surgical group [21]. This suggests

that the high-volume, supervised nature of MET may bring psychological benefits and strengthen self-efficacy in patients with chronic knee pain [21].

Intraarticular Corticosteroid Injection

Intraarticular corticosteroid injections serve as a pharmacological alternative for temporary symptom management, particularly when early OA is present [43]. In a randomized trial, steroid injections resulted in notable clinical improvement at one month for all participants, although the degree of relief was slightly lower than the result achieved by arthroscopic debridement [43]. In one year follow-up, 61% of patients in the injection group maintained their clinical improvement, compared to 79% in the surgical group [43]. In addition, around 16.7% of patients in the injection group required conversion to arthroscopy within the first year due to symptom recurrence [43].

Placebo Surgery

The effectiveness of the surgical act itself, independent of tissue removal, has been evaluated through placebo-controlled trials. The FIDELITY trial randomized patients to either APM or a diagnostic arthroscopy (sham surgery) and discovered that each group achieved considerable and sustained improvements in pain and knee function (WOMET and Lysholm scores) throughout five years [36]. Absence of a relevant difference between the actual meniscal resection and the placebo procedure indicates that the therapeutic benefit traditionally attributed to surgery is mainly related to non-specific effects of the surgical act rather than the removal of the damaged meniscus [36]. Furthermore, the placebo group expressed a slightly lower risk of radiographic OA progression in comparison to the APM group at five years [36].

4.4 Comparative Effectiveness and Crossover

The consensus among major trials, including: FIDELITY, MeTeOR, ESCAPE and OMEX, is that APM provides no clinically significant benefits over conservative management or placebo surgery [32,35,36,40,41]. Supervised neuromuscular training provides the additional benefit of superior muscle recovery, and high-dosage exercise therapy (MET) appears to offer distinct biopsychosocial advantages [21,41]. Moreover, the use of a sham-surgery control in the FIDELITY trial discovered that the resection of the damaged meniscus itself does not provide additional relief beyond the placebo effect of the surgical procedure [36]. While crossover from PT to surgery due to persisting symptoms occurs in approximately 19% to 35% of participants,

analysis informs that these delayed surgeries do not eventually result in superior functional status compared to remaining in the PT-only group [35,40,41]. Furthermore, the potential risk of accelerated joint degeneration following tissue removal and the effectiveness of conservative management make structured physical therapy the preferred initial treatment option in current clinical guidelines [38,40,42].

Table 2: synthesis of clinical outcomes for surgical and conservative management of degenerative meniscus injury

Treatment Modality	Short-term Symptom Improvement (3-12 Months)	Long-term Durability (2-10 Years)	Subsequent Need for Surgical Intervention
Arthroscopic Partial Meniscectomy (APM)	Significant reduction in pain and improvement in function (IKDC/WOMAC/KOOS) [35,40]. Some studies reported a statistically significant advantage over exercise alone at 12 months [37].	Long-term functional outcomes are generally comparable to non-surgical cohorts [38,40,42]. Associated with a slightly higher risk of radiographic OA progression in some trials [36,38].	Repeat arthroscopy required in approximately 3-10% of cases due to persistent symptoms [32,39,41]. Some analyses suggest a significantly higher risk of eventually requiring Total Knee Replacement (TKR) [36,38].
Standard Physical Therapy (PT)	Substantial clinical improvement in function, established as non-inferior to early surgery [35,39,40].	Functional parity with surgery is maintained through 5 years of follow-up. No significant differences in radiographic OA progression compared to surgical groups [40].	High crossover rate to "delayed" APM (29-35%) during the first 6-24 months due to persistent symptoms [35,39,40].
Supervised Neuromuscular Training	Significant functional improvement; demonstrated superiority over APM in restoring	Functional outcomes and radiographic OA development are comparable to surgical	Crossover rate to surgery reported at approximately 19-20%, with no additional functional benefit found for

	thigh muscle strength (quadriceps and hamstrings) at 3 and 12 months [41].	patients at 5 and 10 years [42].	those who switched [32,41,42].
Medical Exercise Therapy (MET)	Effective in improving knee pain and function; uniquely resulted in a significant reduction of anxiety and depression compared to surgical patients [21].	Not extensively evaluated over long-term durations in current pilot studies [21].	Not reported in the short-term pilot phase [21].
Intra-articular Corticosteroid Injections	Significant symptom relief at one month, though improvement was slightly less pronounced than in the arthroscopic debridement group [43].	61% of patients maintained clinical improvement at the 1-year follow-up [43].	Approximately 16.7% of patients required conversion to arthroscopy within the first year due to symptom recurrence [43].
Placebo (Sham) Surgery	Significant improvements in subjective pain and function, largely attributed to the profound placebo effect of the surgical act [36].	Functional and structural outcomes remain comparable to actual APM at 5 years [36].	Approximately 11-12% of patients reported symptoms severe enough to lead to unblinding and subsequent "rescue" APM [36].

5. Discussion

5.1 Conservative Treatment and Patient-Oriented Outcomes

Conservative approach is composed of a variety of procedures that consistently grant substantial symptomatic relief and functional gain. Standardized physical therapy focused on muscle

conditioning and coordination has been confirmed as equivalent to early surgery in large scale trials [35,39,40]. Particularly, the ESCAPE trial demonstrated that the functional benefits obtained through PT were maintained over a 5 year follow-up period [40]. Specialized exercise programs, such as supervised neuromuscular training, have shown clear objective benefits, such as significantly greater progress in quadriceps and hamstring strength compared to surgically treated patient cohorts at 3 and 12 months [41]. Moreover, high dosage medical exercise therapy (MET) uniquely addresses psychological comorbidities, providing a substantial reduction in symptoms of anxiety and depression that was not observed in surgery-treated patients [21]. Pharmacological treatment, such as intraarticular corticosteroid injections offer effective short term relief, although they are associated with a greater chance of eventual conversion to surgery as opposed to exercise-based protocols [43].

5.2 Surgical Treatment and Durability of Its Benefits

While APM provides rapid knee pain reduction and functionality improvement, longitudinal data indicate that these benefits lack long-term superiority over non-operative care [38,42]. Initial advantages of surgery reported by Sonesson et al. at one year were found to diminish over time, with functional similarity observed at 5 and 10 year follow-ups [38]. Essentially, the FIDELITY trial utilized a placebo surgery control to demonstrate that the benefit typically attributed to meniscal resection is mainly a result of the surgical act itself along with associated non-specific effects, rather than the actual resection of the damaged tissue [36]. Anatomically, the durability of surgical benefits is challenged by evidence of accelerated joint degeneration. APM has been linked with an increased risk of radiographic OA progression and joint space narrowing in the FIDELITY and MeTeOR studies [35,36]. Additionally, analysis of the MeTeOR trial indicated that patients treated with APM have a five times higher risk of ultimately requiring a total knee replacement in comparison to those managed conservatively [35].

5.3 Clinical Implications and Patient Benefit

Current clinical recommendations advocate for at least three months of structured, evidence-based physical therapy as the first-line treatment for patients with degenerative meniscal symptoms [25,38,42]. Approximately 65-80% of patients who respond well to non-operative care can avoid the unnecessary risk of surgery by following this approach [35,38,41]. For patients with unsatisfactory conservative treatment results, crossover to a delayed surgery

remains a viable option, occurring in 19% to 35% of trial participants [32,39,40]. However, analysis of crossover surgery cases indicates that they do not ultimately yield superior functional results when compared to remaining in the PT group, questioning the value of APM even for those with persistent symptoms [35,40]. Moreover, the presence of mechanical symptoms, often serving as a primary reason for surgery, has not been proven to predict better outcomes following APM compared to conservative care [36].

5.4 Limitations

The synthesis of results from meniscal injury trials is subject to several methodological challenges. The most notable limitation is the considerable crossover rate from non-surgical to surgical groups, which may lead to an underestimation of the potential structural harm of APM when analyzed using the intention-to-treat principle. Furthermore, blinding of participants and therapists is intrinsically difficult in exercise-based studies, making them more vulnerable to placebo and attention effects. Variation in initial joint status across trials (KL grades ranging from 0 to 3), as well as the diversity of physical therapy protocols (standard PT vs MET vs supervised neuromuscular training) complicates direct comparisons. Ultimately, the lower sensitivity of radiographs compared to MRI in detecting early cartilage changes may lead to an underestimation of structural progression in some long-term follow-ups.

5.5 Contribution of the Present Review

This review incorporates a thorough range of data from both functional and structural aspects, extending the analysis of treatment outcomes to long-term perspectives of 5 and 10 years. By distinguishing between diverse conservative models, it emphasizes the unique objective benefits of neuromuscular training and the biopsychosocial advantages of high-dosage exercise therapy. Ultimately, this review reinforces the clinical mandate for preservation of the meniscus and supports the adoption of structured exercise therapy as the preferred initial management strategy for the sake of maximizing patient benefit and joint longevity.

6. Conclusion

The body of evidence provided by high quality randomized controlled trials indicates that for the majority of middle-aged and older patients with degenerative meniscal lesions, a conservative approach is comparable to surgical intervention in improving patient-reported outcomes. Although both arthroscopic partial meniscectomy and structured physical therapy

yield considerable clinical improvements, surgical management provides no meaningful long-term advantage and may expose the knee joint to accelerated degenerative changes. Standardized PT has been confirmed as equivalent to early surgery in large-scale trials, with functional benefits maintained over a 5 year follow-up period. Furthermore, placebo-controlled trials demonstrate that the therapeutic benefit traditionally attributed to meniscal resection is predominantly a result of the surgical act itself and associated non-specific effects, rather than the removal of damaged tissue.

Specific conservative treatment procedures also offer unique objective advantages. Supervised neuromuscular training yields significantly greater progress in quadriceps and hamstring strength compared to surgically treated cohorts at 3 and 12 months. Additionally, high-dosage medical exercise therapy uniquely addresses psychological comorbidities, providing a substantial reduction in symptoms of anxiety and depression that is not observed in surgery-treated patients. Conversely, APM is associated with an increased risk of radiographic osteoarthritis progression and a five-fold higher risk of ultimately requiring a total knee replacement compared to conservative management. Even among the 19% to 35% of participants who cross over to delayed surgery due to unsatisfactory results of PT, these procedures do not ultimately grant superior functional results compared to remaining in the PT group. Consequently, current clinical guidelines advocate for at least three months of structured physical therapy as the first-line treatment, supporting the intention of preserving the meniscus for joint longevity.

6.1 Directions for Future Research

To advance the understanding of degenerative meniscus injury management, future research should address several methodological challenges present in the current literature:

Handling Crossover Rates: The considerable crossover rate from non-surgical to surgical groups can lead to an underestimation of the potential structural harm of APM when analyzed using the intention-to-treat principle. Future studies need robust analytical methods to better evaluate the true impact of surgical crossover.

Standardization of Protocols and Cohorts: Direct comparisons are currently complicated due to the diversity of physical therapy protocols (standard PT, MET, supervised neuromuscular

training) and variations in initial joint status. Subsequent trials should standardize conservative regimens and stratify patients based on baseline degeneration.

Advanced Imaging in Follow-ups: The lower sensitivity of standard radiographs compared to MRI in detecting early cartilage changes may cause an underreporting of structural progression in long-term follow-ups. Future longitudinal studies should prioritize MRI to accurately track long-term joint space alterations and structural outcomes.

7. Author contribution

Conceptualization: Marcel Dawidowicz

Methodology: Marcel Dawidowicz

Formal analysis: Kacper Kucharski, Hanna Aleksandrowicz, Anna Kamosińska, Alicja Laske, Julia Pająk, Natalia Sitko, Joanna Gontarczyk

Investigation: Paulina Makowska, Joanna Gontarczyk, Julia Pająk, Adam Kowal, Martyna Sowa

Data curation: Antoni Majda, Natalia Sitko, Martyna Sowa, Paulina Makowska, Anna Kamosińska, Adam Kowal, Alicja Laske

Writing - original draft preparation: Marcel Dawidowicz, Kacper Kucharski, Antoni Majda, Natalia Sitko, Alicja Laske, Adam Kowal

Writing - review and editing: Marcel Dawidowicz, Hanna Aleksandrowicz, Anna Kamosińska, Martyna Sowa, Joanna Gontarczyk, Julia Pająk, Paulina Makowska

Visualization: Kacper Kucharski, Antoni Majda

Supervision: Marcel Dawidowicz

Project administration: Hanna Aleksandrowicz

All authors have read and agreed to the published version of the manuscript.

8. Funding statement

This research received no external funding.

9. Conflict of interest statement

The authors declare no conflicts of interest.

10. Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used Gemini by Google for the purpose of refining the academic English language of the manuscript in order to maintain clarity, consistency and adherence to scientific writing standards, as well as additional linguistic refinement in order to provide proper English grammar, style and clarity in the presentation of the results. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the substantive content of the publication.

References

1. Fithian, D. C., Kelly, M. A., & Mow, V. C. (1990). Material properties and structure-function relationships in the menisci. *Clinical orthopaedics and related research*, (252), 19–31.
2. Gecelter, R. C., Ilyaguyeva, Y., & Thompson, N. E. (2022). The menisci are not shock absorbers: A biomechanical and comparative perspective. *Anatomical record (Hoboken, N.J. : 2007)*, 305(5), 1051–1064. <https://doi.org/10.1002/ar.24752>
3. Zaffagnini, S., Di Paolo, S., Stefanelli, F., Dal Fabbro, G., Macchiarola, L., Lucidi, G. A., & Grassi, A. (2019). The biomechanical role of meniscal allograft transplantation and preliminary in-vivo kinematic evaluation. *Journal of experimental orthopaedics*, 6(1), 27. <https://doi.org/10.1186/s40634-019-0196-2>
4. Kopf, S., Beaufils, P., Hirschmann, M. T., Rotigliano, N., Ollivier, M., Pereira, H., Verdonk, R., Darabos, N., Ntagiopoulos, P., Dejour, D., Seil, R., & Becker, R. (2020). Management of traumatic meniscus tears: the 2019 ESSKA meniscus consensus. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA*, 28(4), 1177–1194. <https://doi.org/10.1007/s00167-020-05847-3>
5. Hough, A. J., Jr, & Webber, R. J. (1990). Pathology of the meniscus. *Clinical orthopaedics and related research*, (252), 32–40.

6. Johnson, J., Amin, M., Malmut, L. (2025). Meniscus injuries of the knee. *PM&R KnowledgeNow*, <https://now.aapmr.org/meniscus-injuries-of-the-knee/>.
7. Bottegoni, C., Dei Giudici, L., Salvemini, S., Chiurazzi, E., Bencivenga, R., & Gigante, A. (2016). Homologous platelet-rich plasma for the treatment of knee osteoarthritis in selected elderly patients: an open-label, uncontrolled, pilot study. *Therapeutic advances in musculoskeletal disease*, 8(2), 35–41. <https://doi.org/10.1177/1759720X16631188>
8. Englund, M., Guermazi, A., Gale, D., Hunter, D. J., Aliabadi, P., Clancy, M., & Felson, D. T. (2008). Incidental meniscal findings on knee MRI in middle-aged and elderly persons. *The New England journal of medicine*, 359(11), 1108–1115. <https://doi.org/10.1056/NEJMoa0800777>
9. Bhan K. (2020). Meniscal Tears: Current Understanding, Diagnosis, and Management. *Cureus*, 12(6), e8590. <https://doi.org/10.7759/cureus.8590>
10. FAIRBANK T. J. (1948). Knee joint changes after meniscectomy. *The Journal of bone and joint surgery. British volume*, 30B(4), 664–670.
11. Wilson, W., van Rietbergen, B., van Donkelaar, C. C., & Huiskes, R. (2003). Pathways of load-induced cartilage damage causing cartilage degeneration in the knee after meniscectomy. *Journal of biomechanics*, 36(6), 845–851. [https://doi.org/10.1016/s0021-9290\(03\)00004-6](https://doi.org/10.1016/s0021-9290(03)00004-6)
12. Cullen, K. A., Hall, M. J., & Golosinskiy, A. (2009). Ambulatory surgery in the United States, 2006. *National health statistics reports*, (11), 1–25.
13. Kim, S., Bosque, J., Meehan, J. P., Jamali, A., & Marder, R. (2011). Increase in outpatient knee arthroscopy in the United States: a comparison of National Surveys of Ambulatory Surgery, 1996 and 2006. *The Journal of bone and joint surgery. American volume*, 93(11), 994–1000. <https://doi.org/10.2106/JBJS.I.01618>
14. Rotini, M., Papalia, G., Setaro, N., Luciani, P., Marinelli, M., Specchia, N., & Gigante, A. (2023). Arthroscopic surgery or exercise therapy for degenerative meniscal lesions: a systematic review of systematic reviews. *Musculoskeletal surgery*, 107(2), 127–141. <https://doi.org/10.1007/s12306-022-00760-z>
15. Giuffrida, A., Di Bari, A., Falzone, E., Iacono, F., Kon, E., Marcacci, M., Gatti, R., & Di Matteo, B. (2020). Conservative vs. surgical approach for degenerative meniscal injuries: a systematic review of clinical evidence. *European review for medical and pharmacological sciences*, 24(6), 2874–2885. https://doi.org/10.26355/eurev_202003_20651
16. Lee, D. Y., Park, Y. J., Kim, H. J., Nam, D. C., Park, J. S., Song, S. Y., & Kang, D. G. (2018). Arthroscopic meniscal surgery versus conservative management in patients aged 40 years and older: a meta-analysis. *Archives of orthopaedic and trauma surgery*, 138(12), 1731–1739. <https://doi.org/10.1007/s00402-018-2991-0>
17. Elnewishy, A., Elsenosy, A. M., Nahas, S., Abdalla, M., Symeon, N., & Teama, H. (2024). A Systematic Review and Meta-Analysis of Medial Meniscus Root Tears: Is Surgery the Key to Better Outcomes?. *Cureus*, 16(12), e75199. <https://doi.org/10.7759/cureus.75199>
18. Khan, M., Evaniew, N., Bedi, A., Ayeni, O. R., & Bhandari, M. (2014). Arthroscopic surgery for degenerative tears of the meniscus: a systematic review and meta-analysis. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, 186(14), 1057–1064. <https://doi.org/10.1503/cmaj.140433>

19. Howell, R., Kumar, N. S., Patel, N., & Tom, J. (2014). Degenerative meniscus: Pathogenesis, diagnosis, and treatment options. *World journal of orthopedics*, 5(5), 597–602. <https://doi.org/10.5312/wjo.v5.i5.597>
20. Doral, M. N., Bilge, O., Huri, G., Turhan, E., & Verdonk, R. (2018). Modern treatment of meniscal tears. *EFORT open reviews*, 3(5), 260–268. <https://doi.org/10.1302/2058-5241.3.170067>
21. Østerås, H., Østerås, B., & Torstensen, T. A. (2012). Medical exercise therapy, and not arthroscopic surgery, resulted in decreased depression and anxiety in patients with degenerative meniscus injury. *Journal of bodywork and movement therapies*, 16(4), 456–463. <https://doi.org/10.1016/j.jbmt.2012.04.003>
22. LaPrade, R. F., Padalecki, J. R., Jansson, K., Smith, S., Dornan, G., Pierce, C., & Wijdicks, C. A. (2014). Biomechanical Consequences of a Complete Radial Tear Adjacent to the Medial Meniscus Posterior Root Attachment Site. *Orthopaedic Journal of Sports Medicine*, 2(1 Suppl), 2325967114S00004. <https://doi.org/10.1177/2325967114S00004>
23. LaPrade, R. F., LaPrade, C. M., & James, E. W. (2015). Recent advances in posterior meniscal root repair techniques. *The Journal of the American Academy of Orthopaedic Surgeons*, 23(2), 71–76. <https://doi.org/10.5435/JAAOS-D-14-00003>
24. Faucett, S. C., Geisler, B. P., Chahla, J., Krych, A. J., Kurzweil, P. R., Garner, A. M., Liu, S., LaPrade, R. F., & Pietzsch, J. B. (2019). Meniscus Root Repair vs Meniscectomy or Nonoperative Management to Prevent Knee Osteoarthritis After Medial Meniscus Root Tears: Clinical and Economic Effectiveness. *The American journal of sports medicine*, 47(3), 762–769. <https://doi.org/10.1177/0363546518755754>
25. Beaufils, P., Becker, R., Kopf, S., Englund, M., Verdonk, R., Ollivier, M., & Seil, R. (2017). Surgical management of degenerative meniscus lesions: the 2016 ESSKA meniscus consensus. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA*, 25(2), 335–346. <https://doi.org/10.1007/s00167-016-4407-4>
26. Englund M. (2009). The role of the meniscus in osteoarthritis genesis. *The Medical clinics of North America*, 93(1), 37–x. <https://doi.org/10.1016/j.mcna.2008.08.005>
27. Guermazi, A., Niu, J., Hayashi, D., Roemer, F. W., Englund, M., Neogi, T., Aliabadi, P., McLennan, C. E., & Felson, D. T. (2012). Prevalence of abnormalities in knees detected by MRI in adults without knee osteoarthritis: population based observational study (Framingham Osteoarthritis Study). *BMJ (Clinical research ed.)*, 345, e5339. <https://doi.org/10.1136/bmj.e5339>
28. Englund, M., Guermazi, A., & Lohmander, S. L. (2009). The role of the meniscus in knee osteoarthritis: a cause or consequence?. *Radiologic clinics of North America*, 47(4), 703–712. <https://doi.org/10.1016/j.rcl.2009.03.003>
29. Adams, B. G., Houston, M. N., & Cameron, K. L. (2021). The Epidemiology of Meniscus Injury. *Sports medicine and arthroscopy review*, 29(3), e24–e33. <https://doi.org/10.1097/JSA.0000000000000329>
30. Mesiha, M., Zurakowski, D., Soriano, J., Nielson, J. H., Zarins, B., & Murray, M. M. (2007). Pathologic characteristics of the torn human meniscus. *The American journal of sports medicine*, 35(1), 103–112. <https://doi.org/10.1177/0363546506293700>
31. Luvsannyam, E., Jain, M. S., Leitao, A. R., Maikawa, N., & Leitao, A. E. (2022). Meniscus Tear: Pathology, Incidence, and Management. *Cureus*, 14(5), e25121. <https://doi.org/10.7759/cureus.25121>

32. Berg, B., Roos, E. M., Englund, M., Kise, N. J., Tiulpin, A., Saarakkala, S., Engebretsen, L., Eftang, C. N., Holm, I., & Risberg, M. A. (2020). Development of osteoarthritis in patients with degenerative meniscal tears treated with exercise therapy or surgery: a randomized controlled trial. *Osteoarthritis and cartilage*, 28(7), 897–906. <https://doi.org/10.1016/j.joca.2020.01.020>
33. Englund, M., Guermazi, A., Roemer, F. W., Aliabadi, P., Yang, M., Lewis, C. E., Torner, J., Nevitt, M. C., Sack, B., & Felson, D. T. (2009). Meniscal tear in knees without surgery and the development of radiographic osteoarthritis among middle-aged and elderly persons: The Multicenter Osteoarthritis Study. *Arthritis and rheumatism*, 60(3), 831–839. <https://doi.org/10.1002/art.24383>
34. LaPrade, C. M., Jansson, K. S., Dornan, G., Smith, S. D., Wijdicks, C. A., & LaPrade, R. F. (2014). Altered tibiofemoral contact mechanics due to lateral meniscus posterior horn root avulsions and radial tears can be restored with in situ pull-out suture repairs. *The Journal of bone and joint surgery. American volume*, 96(6), 471–479. <https://doi.org/10.2106/JBJS.L.01252>
35. Katz, J. N., Brophy, R. H., Chaisson, C. E., de Chaves, L., Cole, B. J., Dahm, D. L., Donnell-Fink, L. A., Guermazi, A., Haas, A. K., Jones, M. H., Levy, B. A., Mandl, L. A., Martin, S. D., Marx, R. G., Miniaci, A., Matava, M. J., Palmisano, J., Reinke, E. K., Richardson, B. E., Rome, B. N., ... Losina, E. (2013). Surgery versus physical therapy for a meniscal tear and osteoarthritis. *The New England journal of medicine*, 368(18), 1675–1684. <https://doi.org/10.1056/NEJMoa1301408>
36. Sihvonen, R., Paavola, M., Malmivaara, A., Itälä, A., Joukainen, A., Kalske, J., Nurmi, H., Kumm, J., Sillanpää, N., Kiekara, T., Turkiewicz, A., Toivonen, P., Englund, M., Taimela, S., Järvinen, T. L. N., & FIDELITY (Finnish Degenerative Meniscus Lesion Study) Investigators (2020). 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. *British journal of sports medicine*, 54(22), 1332–1339. <https://doi.org/10.1136/bjsports-2020-102813>
37. Gauffin, H., Tagesson, S., Meunier, A., Magnusson, H., & Kvist, J. (2014). Knee arthroscopic surgery is beneficial to middle-aged patients with meniscal symptoms: a prospective, randomised, single-blinded study. *Osteoarthritis and cartilage*, 22(11), 1808–1816. <https://doi.org/10.1016/j.joca.2014.07.017>
38. Sonesson, S., Springer, I., Yakob, J., Hedevik, H., Gauffin, H., & Kvist, J. (2024). Knee Arthroscopic Surgery in Middle-Aged Patients With Meniscal Symptoms: A 10-Year Follow-up of a Prospective, Randomized Controlled Trial. *The American journal of sports medicine*, 52(9), 2250–2259. <https://doi.org/10.1177/03635465241255653>
39. van de Graaf, V. A., Noorduyn, J. C. A., Willigenburg, N. W., Butter, I. K., de Gast, A., Mol, B. W., Saris, D. B. F., Twisk, J. W. R., Poolman, R. W., & ESCAPE Research Group (2018). Effect of Early Surgery vs Physical Therapy on Knee Function Among Patients With Nonobstructive Meniscal Tears: The ESCAPE Randomized Clinical Trial. *JAMA*, 320(13), 1328–1337. <https://doi.org/10.1001/jama.2018.13308>
40. Noorduyn, J. C. A., van de Graaf, V. A., Willigenburg, N. W., Scholten-Peeters, G. G. M., Kret, E. J., van Dijk, R. A., Buchbinder, R., Hawker, G. A., Coppeters, M. W., Poolman, R. W., & ESCAPE Research Group (2022). 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 network open*, 5(7), e2220394. <https://doi.org/10.1001/jamanetworkopen.2022.20394>

41. Kise, N. J., Risberg, M. A., Stensrud, S., Ranstam, J., Engebretsen, L., & Roos, E. M. (2016). Exercise therapy versus arthroscopic partial meniscectomy for degenerative meniscal tear in middle aged patients: randomised controlled trial with two year follow-up. *BMJ (Clinical research ed.)*, *354*, i3740. <https://doi.org/10.1136/bmj.i3740>
42. Berg, B., Roos, E. M., Englund, M., Kise, N. J., Engebretsen, L., Eftang, C. N., & Risberg, M. A. (2025). Arthroscopic partial meniscectomy versus exercise therapy for degenerative meniscal tears: 10-year follow-up of the OMEX randomised controlled trial. *British journal of sports medicine*, *59*(2), 91–98. <https://doi.org/10.1136/bjsports-2024-108644>
43. Vermesan, D., Prejbeanu, R., Laitin, S., Damian, G., Deleanu, B., Abbinante, A., Flace, P., & Cagiano, R. (2013). Arthroscopic debridement compared to intra-articular steroids in treating degenerative medial meniscal tears. *European review for medical and pharmacological sciences*, *17*(23), 3192–3196.