Physical Therapist Interventions Versus or Combined With Surgical Treatment in Nontraumatic Degenerative Meniscal Pathology: A Systematic Review and Network Meta-Analysis

Running Head: Nontraumatic Degenerative Meniscal Pathology

Article Type: Review

TOC Category: Musculoskeletal

Submitted Date: March 9, 2023

Revised Date: September 5, 2023

Accepted Date: December 18, 2023

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Keywords: Knee; Physical Therapy Modalities; Meniscectomy; Network Meta-Analysis

ABSTRACT

Objective. This study aimed to synthesize the evidence from randomized clinical trials (RCTs) in people with nontraumatic degenerative meniscal pathology, comparing physical therapist interventions versus or combined with arthroscopic partial meniscectomy (APM).

Methods. Seven electronic databases were searched. Methodological quality was evaluated using the Physiotherapy Evidence Database scale. Data synthesis was performed with random-effects network meta-analysis, and results were summarized using the standardized mean differences.

Results. From 2103 studies, 10 RCTs comprising 1411 individuals were included. Ninety percent of the selected RCTs were classified as good quality according to the Physiotherapy Evidence Database scale. All interventions (physical therapist interventions, APM, and APM plus physical therapist interventions) showed reduced pain and physical impairments at 3 months follow-up. However, when a physical therapist intervention was included, greater reductions in pain at rest (APM versus physical therapist interventions: 0.73 [95% CI = 0.20 to 1.26]; APM versus APM plus physical therapist interventions: 0.59 [95% CI = 0.15 to 1.03]) and greater increases in the strength of knee extensor muscles (APM versus physical therapist interventions: 0.44 [95% CI = 0.07 to 0.80]; APM versus APM plus physical therapist interventions: 0.73 [95% CI = 0.29 to 1.16]) were observed at 3 months. In contrast, no differences were found between treatments beyond 3 months.

Conclusions. Physical therapist interventions based on exercise programs demonstrate superior short-term outcomes in pain reduction and knee extensor strength compared to surgical treatment.

Impact. For nontraumatic degenerative meniscal pathology, conservative treatment utilizing a physical therapist intervention approach should be prioritized as the first choice over surgical treatment. It offers comparable or superior short-term pain reduction and strength improvements, with a lower risk of side effects. In cases where surgery is deemed necessary, including postsurgical physical therapist interventions are highly recommended to enhance muscle strength and alleviate pain.

INTRODUCTION

Meniscal tear injuries are characterized as detached fragments of the meniscus and have an annual incidence rate of 172 per 100,000 individuals [1]. Typical symptoms include localized pain, functional and strength loss, joint impingement, and palpable clicking [2]. Meniscal injuries can be classified as either traumatic, which are more prevalent among young individuals, or degenerative, which are associated with aging [3]. Degenerative meniscal pathology affects approximately 35% of people older than 50 years, and its prevalence tends to rise with advancing age [4]. In this regard, the World Health Organization has projected that the proportion of elderly population will double from 11% to 22% between 2000 and 2050 [5]. This demographic shift is expected to result in a direct increase in degenerative pathologies and subsequently contribute to an indirect rise in healthcare expenditure [5]. Although certain European countries have experienced a decrease in the surgical rate for meniscal injuries over the past decade [6,7], the United States still witnesses an estimated 4 million surgeries annually, incurring a substantial cost of over $4 billion per year [8,9].

There are currently 2 main surgical procedures for meniscal tears: arthroscopic partial meniscectomy (APM) and meniscal reconstruction [10]. Meniscal repair has provided better results in patients under 35 years of age injured by traumatic causes [11], although APM is the most common surgical option in all other adults [4]. On the other hand, physical therapist interventions are the conservative treatment for the rehabilitation of people with degenerative meniscal injury [12]. The main therapeutic goal of physical therapist interventions is to enhance the strength of knee extensor and flexor muscles and improve functional performance by performing strength training and functional exercise [13]. Furthermore, another conservative approach consisting of intraarticular cortisone or

hyaluronic acid injections can also be provided periodically, for short-term relief of severe pain and facilitate the rehabilitation process [14].

APM and physical therapist interventions are considered effective interventions for managing pain and physical impairments in patients with degenerative meniscal injury [10]. Previous systematic reviews and meta-analyses have compared physical therapist treatment versus APM [15,16] or combined with APM [17-19], yielding varied and inconclusive findings regarding the superior treatment option. However, it is essential to mention that some of these studies combined patients with degenerative and traumatic meniscal injuries [16,18] or did not consider the coexistence of severe osteoarthritis [15,17] or anterior cruciate ligament injury [19] as an eligibility criterion. Importantly, none of them conducted a network meta-analysis (NMA) allowing simultaneous comparison between all possible treatment combinations. Therefore, taking into account the latest scientific research, a crucial step is to explore the treatment options or combinations that yield the best outcomes for patients with degenerative meniscal injury.

This systematic review and NMA aimed to synthesize the evidence from randomized clinical trials on knee pain, knee-related symptoms, and knee physical impairments, comparing physical therapist interventions versus APM, physical therapist interventions versus APM combined with physical therapist interventions, or APM versus APM combined with physical therapist interventions.

METHODS

STUDY DESIGN

This systematic review of the available scientific evidence analyzing the effectiveness of physical therapist interventions versus or combined with surgical treatment in people with degenerative meniscal pathology has been conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[20] and the extension for Network Meta-Analyses (PRISMA-NMA) [21]. The protocol for the systematic review and NMA was registered in the International Prospective Register of Systematic Reviews (PROSPERO) database under the number CRD42022320415.

DATA SOURCES AND SEARCHES

Seven databases (Web of Science, PubMed, Scopus, Rehabilitation & Sports Medicine Source, SPORTDiscus with Full Text, Cochrane Library, and Physiotherapy Evidence Database [PEDro]) were searched in triplicate by 3 authors (D.S.-C., J.T.-M., and P.B.-L.) from inception to November 15, 2022. The specific search strategy for each database is presented in Supplementary Material 1. PICOS search tool was used to design the search strategy [22]: Population: adults with degenerative meniscal pathology; Intervention and Comparator: physical therapist interventions and surgical treatments; Outcome: outcome variables related to pain, knee-related symptoms and physical impairments; and Study type: randomized controlled clinical trial design. Additionally, in order to avoid the loss of potentially eligible studies, an exhaustive review of the references of the selected full-text articles was carried out.

ELIGIBILITY CRITERIA

Type of studies

Only randomized controlled clinical trials in humans, published in English or Spanish within the last 15 years (ie, 2006 onward), and available in full text were included. Follow-up and secondary studies of an original trial were considered during the data extraction process but excluded from the total number of articles finally selected.

Type of participants

Studies of adults older than 35 years and diagnosed with nontraumatic degenerative meniscal pathology were included. Studies of participants who had simultaneous anterior cruciate ligament injury or were diagnosed with level 4 knee osteoarthritis on the Kellgren-Lawrence scale were excluded because of the presence of concomitant conditions. The Kellgren-Lawrence scale assesses the level of osteoarthritis from 0, if no signs are present, to 4, referring to a severe level of osteoarthritis [23].

Type of interventions

Studies were selected if participants were divided into a conservative treatment group based on physical therapist interventions, a surgical treatment group, or a combination of both treatments. Studies that included placebo surgery versus or combined with physical therapist treatment were excluded.

Type of outcome measures

Studies measuring any outcome variable related to pain, knee-related symptoms, and physical impairment, regardless of the type of scale used, were selected. Short-term effects were considered those shorter than 6 months and medium-term effects were considered those between 6 and 24 months.

STUDY SELECTION

The article selection process was carried out by 2 researchers independently (D.S.-C. and J.T.-M.), with the help of a third researcher (A.B.-E.), who mediated to reach a consensus in case of discrepancies after full-text screening. All articles retrieved from the different databases were introduced into EndNote software, and duplicates were removed. The studies were initially screened by reviewing the titles and abstracts, and subsequently, the full text of the articles was read.

DATA EXTRACTION AND QUALITY ASSESSMENT

Two authors (D.S.-C. and J.T.-M.) independently performed qualitative and quantitative data extraction using a standardized table in Microsoft Excel (Microsoft Corp, Redmond, WA, USA). The quantitative extraction included: first author and year of publication, treatment arm, name of variable (ie, test or scale used to measure outcome variables), number of participants, time point of measurement, and arm-level final value score (mean and SD). When it was not possible to extract the required data from the manuscript, up to 3 attempts over a period of 4 weeks were made to contact original study authors via email to request these data. When necessary, values expressed by median and other measures of dispersion were converted to mean and SD using established formulae [24].

The methodological quality of the selected studies was assessed independently by 2 researchers (D.S.-C. and J.T.-M.) using the PEDro scale [25], consulting a third researcher (A.B.-E.) to obtain consensus in case of any discrepancies. The PEDro scale scores 11 items, where 1 point is scored if the article meets the criterion and 0 point is scored if it does not. Item 1 assesses external validity, items 2 to 9 assess internal validity, and items 10 and 11 assess the interpretability of the results. The maximum score is 10 points (item 1 is not considered in the final score). Articles scoring at least 6 of 10 are considered good

quality; those scoring 4 and 5 of 10 are considered fair quality, and articles scoring <4 of 10 are considered poor quality.[26]

DATA SYNTHESIS AND ANALYSIS

Random-effects NMA within frequentist setting was conducted for connected networks [27]. A full design-by-treatment interaction random-effects model (global χ^2 test) was used to assess the presence of global inconsistency [28]. Then, a consistency model was fit if the null hypothesis of inconsistency parameters being equal to 0 was not rejected. Furthermore, network inconsistency was evaluated by analyzing the between-studies heterogeneity (ie, variation in treatment effects between studies) based on the magnitude of the heterogeneity variance parameter (τ^2) [28] and the presence of incoherence (ie, variation between direct and indirect sources of evidence) based on the node-splitting method [29]. Results were summarized using the standardized mean differences (SMDs). SMDs were categorized as small (≥0.2), medium (≥0.5), and large (≥0.8) [30]. The uncertainty of all estimates was expressed with their 95% CIs.

When direct comparisons between treatment arms were available, SMDs estimated by the Hedges *g* were pooled with a random-effects meta-analysis following a restricted maximum likelihood estimation [31]. Additionally, to analyze the change from baseline for each treatment arm, independent of whether direct comparisons were available or not, a random-effects meta-analysis following a restricted maximum likelihood estimation was calculated by pooling the SMDs estimated by the Hedges *g* from the baseline [32].

All analyses were performed using Stata V.16.1 (StataCorp, College Station, TX, USA) with the *mvmeta* command and *network graphs* package.

ROLE OF THE FUNDING SOURCE: The funders did not have any role in this study.

RESULTS

STUDY SELECTION

From 2103 studies obtained after the initial search, 967 studies were screened by title and abstract after removing duplicates. Forty-five studies were screened by full text reading, of which 35 were excluded. In particular, 17 were not randomized clinical trials, 8 did not meet all inclusion criteria, and 1 study did not involve physical therapist interventions. Furthermore, 9 studies analyzed similar samples through follow-up or consisted of secondary analyses of original articles. In these 9 cases, relevant information was extracted according to the objective of the review, but they were not considered as independent studies. The list of studies excluded after full-text screening is presented in Supplementary Material 2. No additional records were found within the reference list of the reviewed full-text articles. Finally, 10 independent studies were included in the systematic review and NMA. The study selection process is shown in Figure 1.

CHARACTERISTICS OF CLINICAL TRIALS

Table 1 shows the main characteristics of the studies selected. The follow-up ranged from 3 to 60 months. Regarding treatment comparisons, 4 studies compared physical therapist interventions versus APM [33-36], 4 studies compared physical therapist interventions versus APM plus physical therapist interventions [37-40], and 2 studies compared APM versus APM plus physical therapist interventions [41,42].

The selected studies comprised a total of 1411 participants. The study with the smallest sample size included 17 participants [35], and the largest sample accounted for 330 participants [38]. The mean age ranged from 42 to 59 years, with 41% of participants being women, and the mean body mass index ranged from 25.0 to 30.0. Furthermore, regarding

the classification of participants according to the degree of osteoarthritis using the Kellgren-Lawrence scale, all studies classified participants as having grades 0 to 3, except in 3 trials that did not report this information [35,37,42]. However, the 2 studies by Østerås et al excluded participants as having grade 3 or 4 on the Kellgren-Lawrence scale [35,42]. Likewise, Herrlin et al excluded individuals presenting obliteration of the joint space, in accordance with the Ahlbäck classification of knee osteoarthritis [37].

Participants underwent different rehabilitation treatments lasting for 1 to 3 months, performing 2 or 3 physical therapist sessions per week of 30 to 60 minutes. The sessions included a variety of strengthening, cardiovascular, proprioception, flexibility, and mobility exercises. On the other hand, the surgical treatment was APM in all cases. Additionally, only 2 studies considered a recent episode of intraarticular injections as an exclusion criterion [33,38].

The postintervention assessments consisted of 1,[35,39,41] 2,[33,37,42] 3,[34,38] or even 4[36,40] follow-up measurements using different measurement instruments to assess the main variables. Knee-related pain was evaluated using the visual analog scale (VAS). Self-reported knee symptoms were measured using the Knee Injury and Osteoarthritis Outcome Score (KOOS), the Western Ontario and McMaster Universities Osteoarthritis Index, the Subjective Knee Form of the International Knee Documentation Committee, the Lysholm Knee Scoring Scale, and the Tegner Activity Scale. Physical impairments were assessed through range of motion and dynamometry of the quadriceps and hamstring muscles. In addition, anecdotally, some studies also assessed other outcome measures such as quality of life, levels of physical activity, need for total knee replacement, presence of adverse effects, economic costs, and patient satisfaction, among others.

All the studies reported improvements between baseline and the end of follow-up in both treatment arms for the main variables. However, several RCTs showed significant

differences between groups in specific outcomes, indicating the superiority of physical therapist interventions, both for physical therapist interventions versus APM or for the combination of physical therapist interventions plus APM versus APM [33,34,35,39,40,42]. Specifically, Yim et al, who compared a physical therapist intervention group versus an APM plus physical therapist intervention group in 2013, found that symptoms improvement was maintained longer in the physical therapist intervention group [40]. Østerås et al, who compared physical therapist interventions and APM in 2012, found better scores in the KOOS quality of life subscale (KOOS-QoL) at the 3-month follow-up in favor of the physical therapist interventions group [35]. Kise et al, who compared physical therapist interventions and APM in 2016, and Stensrud et al, who compared physical therapist interventions and APM plus physical therapist interventions in 2015, found greater improvements in muscle strength in the physical therapist interventions group.[34,39] Additionally, Başar et al, who compared physical therapist interventions and APM in 2021, found better results in the physical therapist interventions group in terms of range of motion.[33] Finally, Østerås et al, who compared APM and APM plus physical therapist interventions in 2014, found better improvements in favor of the AMP plus physical therapist interventions in all outcome measures, including knee pain and muscle strength [42].

METHODOLOGICAL QUALITY

The methodological quality of the included studies is presented in Supplementary Material 3. After assessment of the 10 studies selected by using the PEDro scale, 8 studies were considered good quality [33,34,36,38-42] and the remaining 2 studies were considered fair

quality [35,37]. Thus, the median score of the trials was 6.5 points, indicating good quality (ie, ≥6 points).

All studies performed random allocation of participants (item 2), included statistical comparisons between groups (item 10) and within-group points estimates and variability (item 11). However, none of the trials assessed conducted blinding of participants (item 5) or of the therapist delivering the treatment (item 6). Nevertheless, 4 studies informed about blinding of the assessor (item 7) [33,34,39,41].

Three studies did not conduct intention-to-treat analyses (item 9) [33,37,42] and 3 trials did not perform a concealed allocation process in their methodologies (item 3) [35,37,38]. In addition, 1 study did not comply with the principle of comparability between treatment groups at baseline (item 4) [35], and another study showed a ratio of losses to dropouts during the follow-up of higher to 15% (item 8) [33].

Figure 2 shows a bar graph summarizing the percentage of trials that met each individual quality criterion of the PEDro scale.

DATA SYNTHESIS

Five authors were contacted to retrieve additional information that could not be extracted from a total of 6 articles. Three of these 5 authors provided additional data corresponding to 4 articles. Data from each single study used in the NMA are presented in Supplementary Material 4.

The global chi-square test rejected the presence of global inconsistency for all outcome measures ($P \geq .05$). No between-studies heterogeneity was found (ie, $\tau^2 < 0.1$), and the P value after the node-splitting method rejected the presence of incoherence between direct and indirect estimates (ie, $P \geq .05$) for any of the outcome measures at the 3-month follow-up (Tab. 2). However, signs of between-studies heterogeneity for VAS

weight bearing at 6 months and incoherence between direct and indirect estimates of the KOOS pain subscale (KOOS-pain) at 12 months were observed (Tab. 2).

Table 2 presents a synthesizes of the network estimates for the VAS for weight bearing, VAS at rest, KOOS-pain, KOOS symptoms subscale, KOOS activities of daily living subscale, KOOS sport subscale, KOOS-QoL, and strength of knee extensor muscles at 3 months after intervention. Only for the VAS for weight bearing and for KOOS-pain was it possible to conduct an NMA at 6 and 24 months and at 12 months after intervention, respectively. Changes are expressed in SMDs.

For the VAS for weight bearing, no treatment differences were found at 3, 6, or 24 months. For the VAS at rest, higher reductions were observed at 3 months when a physical therapist intervention was included (APM versus physical therapist interventions: 0.73 [95% CI = 0.20 to 1.26]; APM versus APM plus physical therapist interventions: 0.59 [95% CI = 0.15 to 1.03]).

For KOOS-pain, higher score improvements were observed at 3 months in APM plus physical therapist interventions versus physical therapist interventions (0.23 [95% CI = 0.05 to 0.41]), but no differences between treatment groups were found at 12 months. For the other KOOS subdomains, no differences between treatment groups were found at 3 months.

Finally, higher indicators of the strength of knee extensor muscles were observed at 3 months when a physical therapist intervention was included (APM versus physical therapist interventions: 0.44 [95% CI = 0.07 to 0.80]; APM versus APM plus physical therapist interventions: 0.73 [95% CI = 0.29 to 1.16]).

Forest plots for direct comparisons between the treatment arms are presented in Supplementary Material 5. Significantly higher score improvements were observed at 3

months in KOOS-pain for physical therapist interventions compared to APM plus physical therapist interventions and in the knee extensor strength for physical therapist interventions and APM plus physical therapist interventions compared to APM.

Individual forest plots for each variable representing the change from baseline and grouped by treatment arms are presented in Supplementary Material 6. Physical therapist interventions showed significant improvements from baseline for all of the studied variables at all time points. However, APM did not show significant improvements from baseline for the VAS for weight bearing (Fig. 3), KOOS-QoL (Suppl. Mat. 7), and knee extensor strength (Fig. 4) at 3 months. Similarly, APM plus physical therapist interventions did not show significant improvements from baseline for the KOOS symptoms subscale (Suppl. Mat. 8), KOOS activities of daily living subscale (Suppl. Mat. 9), and KOOS-QoL (Suppl. Mat. 7) as well as knee extensor strength (Fig. 4) at 3 months.

DISCUSSION

This systematic review and NMA aimed to synthesize evidence from randomized clinical trials on knee pain, knee-related symptoms, and knee physical impairment, comparing physical therapist interventions versus APM, physical therapist interventions versus APM combined with physical therapist interventions, or APM versus APM combined with physical therapist interventions.

According to our findings at 3 months, conservative treatment based on physical therapist interventions for nontraumatic degenerative meniscal pathology appears to be a preferable option compared to surgical treatment (ie, APM), where physical therapist interventions seem to be more cost-effective than APM [43]. Although surgical treatment remains widely implemented in orthopedic healthcare services and is unlikely to change immediately [44], our findings emphasize the importance of accompanying surgical interventions with physical therapist interventions when surgery is necessary for the patient. This combined approach seems to enhance muscle strength, reduce pain, and should be considered in cases where surgical treatment is chosen as the primary option. Overall, these results are consistent with previous systematic reviews, which suggest that the combination of physical therapist interventions after surgery can effectively control pain and reduce physical impairments in the short term [18,19]. Nevertheless, Li et al reported better short-term results after arthroscopy, but when considering the follow-up data after 24 months, the combination with physical therapist interventions was identified as essential for reducing pain and increasing functionality [15].

Knee related pain.

In relation to the outcomes included in the study, the results showed the clinical significance of physical therapist interventions on reducing pain at rest. Both physical

therapist interventions and APM plus physical therapist interventions versus APM showed SMDs classified as a medium effect size, indicating the superiority of including exercise training in the treatment of patients with nontraumatic degenerative meniscus pathology. The analgesic effect might be influenced by the activation of the endogenous opioid system, which has one of its most important functions as reducing the intensity of pain [45]. On the other hand, physical activity modulates the local immune system, producing a greater number of antiinflammatory cytokines compared to inflammatory ones, in contrast to inactivity [46]. Another consequence of exercise is weight loss, which favors the reduction of pain by imposing less load [47], in this case, on the knee joint. Additionally, studies have investigated that adults who engage in regular physical activity have a lower sensitivity to pain [48].

Self-reported knee symptoms.

Regarding the KOOS, none of the subscales, except for activity limitations because of pain, showed differences between the groups at 3 months. Specifically, the pain subscale showed a small effect size in the group in which physical therapist interventions were performed after surgery compared to physical therapist interventions alone. However, no differences were observed between the groups at 12 months. Since a group of patients received surgical treatment, there might be some factors that can mediate the outcome, such as previous expectations related to surgery or a potential placebo effect. Although quantitative pain measures are vital to understanding pain management [49], they often overlook important attributes of the subjective experience, such as personal context and meaning, which can profoundly shape the experience [50]. On the other hand, the placebo effect refers to the reduction of symptoms caused by the psychosocial context, such as positive expectations, and not by the properties of the treatment itself [51].

Physical impairments.

Regarding the knee extensor strength, more favorable outcomes were observed when a physical therapist intervention was included. Specifically, small to moderate effect sizes were found, indicating the greatest and fastest recovery of quadriceps strength in the short term. Physical therapy programs have demonstrated their efficacy in various pathologies by incorporating strengthening and neuromuscular control exercises, leading to enhanced lower limb muscle strength and improved knee proprioception [52-54]. This finding emphasizes the importance of strengthening the muscles around the knee joint, which contributes to better mobility and increased ease in performing daily activities [55].

Physical therapist procedures based on exercise.

The physical therapist procedures used in the selected studies mainly consisted of active exercises performed by the patient. Although a detailed description of the progression of load, volume, and intensity was not available on a session-by-session basis in the studies, the common element in the training was a focus on neuromuscular and strengthening bodyweight exercises. Interestingly, studies that included cardiovascular or aerobic exercises did not show significant improvements compared to the alternative arm of treatment with APM [35-38,42.] In contrast, those studies where the core part of the physical therapist treatment was essentially based on neuromuscular and strengthening exercises showed greater benefits in favor of the physical therapist arm in terms of pain and physical impairments reductions [33,34,39,40]. It is known that strength training results in increased strength of the exercised muscles because of early neuromuscular adaptations and subsequent increases in muscle cross-sectional area and alterations in connective tissue stiffness when maintained over time [56]. Additionally, although aerobic exercise has the

ability to activate the cardiovascular system to a greater extent and has widely recognized benefits for pain management, strength training has also been shown to induce exercise-induced hypoalgesia [57]. Therefore, if there is limited time available for exercise sessions as part of physical therapist treatment, prioritizing neuromuscular and strengthening exercises at the core of the sessions may be more appropriate.

Methodological quality of the included studies.

As depicted in Supplementary Material 3, any study performed blinding of participants or therapists, and the evaluators were also not blinded in less than half of the studies (4/10). On the one hand, it does not seem possible or ethical to achieve blinding of surgeons and patients receiving APM for reasons inherent to the study designs and research questions. Blinding of therapists who administered exercise to patients also cannot be achieved, mainly if the exercise program was supervised or combined with other physical agents (eg, electrotherapy). A potential alternative to achieve pseudoblinding of therapists could be to report whether the therapists were outsiders to the clinical trial design and naïve to the research question. Whereas blinding of participant would involve an ethically questionable surgical simulation (pre-operative, anesthesia, incision, drainage, etc.) or an omission of the content of the physical therapist treatment prior to signing the informed consent form. On the other hand, blinding of the evaluator was only reported in 4 studies [33,34,39,41] by using, for example, sleeves to cover both knees and hide possible surgical scars. The rest of the studies [35-38,40,42] did not blind assessors, which was considered a substantial limitation even if part of the assessment was based on self-reported outcomes.

Overall, most studies avoided the presence of other biases and were classified as good quality. Nevertheless, it would be highly recommendable that future studies

contemplate blinding of the evaluator and include a follow-up period of at least 1 year. In addition, physical therapist interventions showed a lack of homogeneity in the exercise procedures, so it would be necessary to establish reproducible treatment protocols to avoid intervention bias. Moreover, the prior use of intraarticular injections should be recorded, and recent episodes should be considered as an exclusion criterion or a confounder.

Limitations

This NMA presents some limitations. Firstly, 2 of the included studies were classified as fair quality rather than good quality. Secondly, some baseline characteristics, such as pain intensity or physical impairment levels, as well as the timing and type of physical therapist interventions, varied across studies. However, no meta-regression or subgroup analyses were conducted to investigate their potential effects on the outcomes because of the small number of included studies. Last, the lack of homogeneity in the follow-up period among the included studies resulted in inconclusive results for outcomes beyond 3 months. Therefore, it is not possible to assume the superiority of either intervention in the medium or long term, and future studies will need to address this question as more research with longer follow-ups is generated.

Conclusions

Conservative treatment for nontraumatic degenerative meniscal pathology, based on a physical therapist intervention approach, should be considered a preferable option to surgical treatment. It has been shown to achieve superior moderate effects in pain and physical impairment outcomes in the short term, with lower risk of side effects. Nevertheless, in cases where surgery is deemed necessary, it is recommended that APM

be accompanied by physical therapist interventions to increase muscle strength and reduce knee pain.

Funding

A.B.-E., M.P.L.-R. and P.B.-L. are members of the research group MOTUS supported by "Gobierno de Aragón" (n. B60_23D).

Systematic Review Registration

The protocol for the systematic review and NMA was registered in the PROSPERO database (CRD42022320415).

Disclosure

The authors completed the ICMJE Form for Disclosure of Potential Conflicts of Interest and reported no conflicts of interest.

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Table 1.

Studies Included in the Systematic Review[a]

Study	Treatment Comparison	Follow-up (mo)	Participants				No. of Participants With the Indicated Kellgren-Lawrence Grade	Physical Therapist Intervention	Outcome Measures	Main Results
			No.	Age, y, Mean (SD)	% Women	BMI, Mean (SD)				

Başar et al[33] (2021)	APM vs PT	2 and 6	APM group: 48 PT group: 48	APM group: 48.4 (5.3) PT group: 50.9 (4.5)	APM group: 54 PT group: 60	APM group: 27.5 (2.7) PT group: 28.7 (2.2)	APM group: Grade 1 = 12 Grade 2 = 16 Grade 3 = 13 PT group: Grade 1 = 13 Grade 2 = 16 Grade 3 = 16	Duration of 2 mo: Month 1: TENS and pulsed US (3 sessions/wk) Months 1 and 2: progressive neuromuscular and strength exercises (3 sessions/wk)	Knee pain or physical impairment measures: VAS, ROM, WOMAC	VAS and WOMAC: APM and PT groups improved at 2 and 6 mo compared to baseline; no between-group differences at any time point ROM: the PT group improved at 2 and 6 mo compared to baseline; however, APM group got worse at 2 and 6 mo compared to baseline; better ROM in PT group than in APM group at 2 and 6 mo
Hall et al[41] (2015)	APM vs AP	3	APM group: 31	APM gr	APM gr	APM gr	APM group: Grade 0 = 12	Duration of 12 wk: Neuromuscular exercise program (8 sessions of 30–45 min) and home exercises (3 d/wk)	Knee pain or physical impairment measures:	KOOS, KEMS, and KFMS: no improvements within group and no between-group differences

	M plus PT		APM plus PT group: 31	oup: 43.2 APM plus PT group: 42.8	oup: 29 APM plus PT group: 25.8	oup: 26.6 APM plus PT group: 26.3	Grade 1 = 12 Grade 2 = 7 APM plus PT group: Grade 0 = 12 Grade 1 = 12 Grade 2 = 7		KOOS, isotonic KEMS and KFMS Other measures: 3D analysis, adverse effects	
Herrlin et al[37] (2007)	PT vs APM plus PT	2 and 6	PT group: 43 APM plus PT group: 47	PT group: 55	PT group: 37 AP	PT group: 26	N/A	Duration of 2 mo: Supervised: strength, endurance, flexibility, proprioception, and balance exercises (2 sessions/wk) Unsupervised at home: daily single-limb and step-down exercises	Knee pain or physical impairment measures: VAS, KOOS, LKSS, TAS	VAS, KOOS, LKSS, and TAS: PT and APM plus PT groups improved at 2 and 6 mo compared to baseline; no between-group differences at any time point

				(5.5) APM plus PT group: 54 (4.6)	Mplus PT group: 40	(3.3) APM plus PT group: 27 (3.9)				
Katz et al[38] (2013)	PT vs APM plus PT	3, 6, 12, 24, and 60	PT group: 169 APM plus PT group: 161	PT group: 57.8	PT group: 57 APM	PT group: 30	PT group: Grade 0 = 36 Grade 1 = 35 Grade 2 = 39	Duration of 6 wk: Cardiovascular, strengthening, and stretching exercises (1 or 2 sessions/wk) and home exercises	Knee pain or physical impairment measures: KOOS, WOMAC Other measures:	KOOS and WOMAC: PT and APM plus PT groups improved from month 6 onward compared to baseline; no between-group differences at any time point

				APM plus PT group: 59	plus PT group: 56	APM plus PT group: 30	Grade 3 = 39 APM plus PT group: Grade 0 = 34 Grade 1 = 26 Grade 2 = 37 Grade 3 = 45		QoL, adverse effects	
Kise et al[34] (2016)	APM vs PT	3, 6, 24, and 60	APM group: 70 PT group: 70	APM group: 48.9 (6.1) PT	APM group: 38 PT group: 38	APM group: 26 (3.7) PT gr	APM group: Grade 0 = 51 Grade 1 = 16 Grade 2 = 3 Grade 3 = 0 PT group: Grade 0 = 49	Duration of 2 mo: Progressive neuromuscular and strength exercises (2or 3 sessions/wk)	Knee pain or physical impairment measures: KOOS, isotonic KEMS and KFMS Other measures: PP tests, QoL	KOOS: no between-group differences at any time point KEMS and KFMS: better KEMS and KFMS results in PT group than in APM group at 3, 6, and 12 mo

Study	Treatment Comparison	Follow-up (mo)	Participants				No. of Participants With the Indicated Kellgren-Lawrence Grade	Physical Therapist Intervention	Outcome Measures	Main Results
			No.	Age, y, Mean (SD)	% Women	BMI, Mean (SD)				
				group: 50.2 (6.2)		oup: 26.4 (4.3)	Grade 1 = 18 Grade 2 = 2 Grade 3 = 1			

Study	Treatment Comparison	Follow-up (mo)	Participants				No. of Participants With the Indicated Kellgren-Lawrence Grade	Physical Therapist Intervention	Outcome Measures	Main Results
			No.	Age, y, Mean (SD)	% Women	BMI, Mean (SD)				
Østerås et al[35] (2012)	APM vs PT	3	APM group: 8 PT group: 9				N/A	Duration of 12 wk: Aerobic, coordination, strengthening, and pain reduction exercises (3 sessions/wk)	Knee pain or physical impairment measures: VAS, KOOS, 5RM KEMS Other measures: HADS	VAS, KOOS, and KEMS: PT and APM groups improved at month 3 compared to baseline; no between-group differences except for KOOS-QoL (better scores at 3 mo in PT group)

Study	Treatment Comparison	Follow-up (mo)	Participants				No. of Participants With the Indicated Kellgren-Lawrence Grade	Physical Therapist Intervention	Outcome Measures	Main Results
			No.	Age, y, Mean (SD)	% Women	BMI, Mean (SD)				
Osteras et al[42] (2014)	APM vs APM plus PT	3 and 12	APM group: 39 APM plus PT group: 38				N/A	Duration of 12 wk: Aerobic, coordination, strengthening, and functional exercises (3 sessions/wk)	Knee pain or physical impairment measures: VAS, KOOS, 5RM KEMS Other measures: HADS, PP test	VAS, KOOS, and KEMS: better results in APM plus PT group than in APM group at 3 and 12 mo

Stensrud et al[39] (2015)	PT vs APM plus PT	3	PT group: 40 APM plus PT group: 42	PT group: 49.2 (6.4) APM plus PT group: 54.9 (1	PT group: 32.5 APM plus PT group: 38	PT group: 26.9 (4.1) APM plus PT group: 26.3 (3	PT group: Grade 1 = 30 Grade 2 = 8 Grade 3 = 2 APM plus PT group: Grade 1 = 30 Grade 2 = 10 Grade 3 = 2	Duration of 3 mo: Progressive strength and neuromuscular exercises (2 or 3 sessions/wk of 60 min)	Knee pain or physical impairment measures: Isokinetic KEMS and KFMS Other measures: GRC, PP tests	KEMS and KFMS: better KEMS and KFMS results in PT group than in APM plus PT group at 3 mo

Study	Treatment Comparison	Follow-up (mo)	Participants				No. of Participants With the Indicated Kellgren-Lawrence Grade	Physical Therapist Intervention	Outcome Measures	Main Results
			No.	Age, y, Mean (SD)	% Women	BMI, Mean (SD)				
				0.3)		.6)				

van de Graaf et al[36] (2018)	APM vs PT	3, 6, 12, 24, and 60	PT group: 161 APM group: 158	PT group: 57.3 (6.8) APM group: 57.6 (6.5)	PT group: 50 APM group: 51	PT group: < 25 for 33% and > 30 for 26% APMgr	PT group: Grade 0 = 16 Grade 1 = 81 Grade 2 = 59 Grade 3 = 5 APM group: Grade 0 = 19 Grade 1 = 85 Grade 2 = 48 Grade 3 = 6	Duration of 2 mo: Cardiovascular, coordination/balance, and closed kinetic chain strength exercises (16 sessions of 30 min)	Knee pain or physical impairment measures: VAS, IKDC, TAS Other measures: QoL	VAS, IKDC, and TAS: PT and APM groups improved at month 3 onward compared to baseline; no between-group differences at any time point

						oup:<25for35%and>30for19%				

Yim et al[40] (2013)	PT vs APM plus PT	3, 6, 12, and 24	PT group: 52 APM plus PT group: 50	PT group: 57.6 (11.0) APM plus PT group: 54.9 (1	PT group: 77 APM plus PT group: 82	PT group: 26.4 (1.9) APM plus PT group: 25.0 (2	PT group: Grade 0 = 35 Grade 1 = 17 APM plus PT group: Grade 0 = 39 Grade 1 = 11	Duration of 11 wk: Weeks 1–3: supervised strength, endurance, and flexibility exercise (3 sessions/wk of 60 min) Weeks 4–11: daily unsupervised isotonic and isometric home exercises	Knee pain or physical impairment measures: VAS, LKSS, TAS Other measures: Satisfaction	VAS: higher pain reductions at month 6 in PT group but no between-group differences at month 24 LKSS and TAS: PT and APM plus PT groups improved at month 3 onward compared to baseline; no between-group differences at any time point

Study	Treatment Comparison	Follow-up (mo)	Participants				No. of Participants With the Indicated Kellgren-Lawrence Grade	Physical Therapist Intervention	Outcome Measures	Main Results
			No.	Age, y, Mean (SD)	% Women	BMI, Mean (SD)				
				0.3)		.5)				

[a]3D = 3-dimensional; 5RM = 5-repetition maximum; APM = arthroscopic partial meniscectomy; BMI = body mass index; GRC = Global Rating of Change; HADS = Hospital Anxiety and Depression Scale; IKDC = Subjective Knee Form of the International Knee Documentation Committee;

KEMS = knee extension muscle strength; KFMS = knee flexion muscle strength; KOOS = Knee Injury and Osteoarthritis Outcome Score; KOOS-QoL = KOOS quality of life subscale; LKSS = Lysholm Knee Scoring Scale; N/A = not available; PP = physical performance; PT = physical therapy; QoL = quality of life; ROM = range of motion; TAS = Tegner Activity Scale; TENS = transcutaneous electrical nerve stimulation; US = ultrasound; VAS = visual analog scale; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

Table 2.

League Table With Standardized Mean Differences (SMDs), 95% CIs, and Network Inconsistency Statistics[a]

Outcome Measure and Comparator 1 vs Comparator 2	SMD	95% CI	Network Inconsistency	
			Heterogeneity (τ^2)	Incoherence (*P*)
VAS for weight bearing at 3 mo			<0.001	.992
APM vs physical therapist interventions	−0.07	−0.12 to 0.27		
APM vs APM plus physical therapist interventions	−0.26	−0.61 to 0.09		
Physical therapist interventions vs APM plus physical therapist interventions	0.19	−0.10 to 0.47		
VAS for weight bearing at 6 mo			0.315	.984
APM vs physical therapist interventions	−0.04	−0.54 to 0.45		
APM vs APM physical therapist interventions	−0.46	−1.18 to 0.27		
Physical therapist interventions vs APM plus physical therapist interventions	0.41	−0.11 to 0.94		
VAS for weight bearing at 24 mo			<0.001	.999
APM vs physical therapist interventions	−0.23	−0.48 to 0.02		
APM vs APM physical therapist interventions	−0.16	−0.54 to 0.21		
Physical therapist interventions vs APM plus physical therapist interventions	−0.07	−0.35 to 0.22		
VAS at rest at 3 mo			0.019	.655
APM vs physical therapist interventions	**0.73**	**0.20 to 1.26**		
APM vs APM plus physical therapist interventions	**0.59**	**0.15 to 1.03**		
Physical therapist interventions vs APM plus physical therapist interventions	0.14	−0.24 to 0.53		
KOOS pain subscale at 3 mo			<0.001	.322
APM vs physical therapist interventions	0.18	−0.07 to 0.44		
APM vs APM plus physical therapist interventions	−0.05	−0.30 to 0.21		

Physical therapist interventions vs APM plus physical therapist interventions	0.23	0.05 to 0.41		
KOOS pain subscale at 12 mo			<0.001	<.001
APM vs physical therapist interventions	0.03	−1.35 to 1.42		
APM vs APM plus physical therapist interventions	−0.46	−1.86 to 0.94		
Physical therapist interventions vs APM plus physical therapist interventions	0.49	−0.88 to 1.87		
KOOS symptoms subscale at 3 mo			0.031	.082
APM vs physical therapist interventions	0.10	−0.50 to 0.69		
APM vs APM plus physical therapist interventions	0.01	−0.62 to 0.64		
Physical therapist interventions vs APM plus physical therapist interventions	0.08	−0.52 to 0.69		
KOOS ADL subscale at 3 mo			0.007	.451
APM vs physical therapist interventions	0.15	−0.15 to 0.46		
APM vs APM plus physical therapist interventions	0.04	−0.33 to 0.41		
Physical therapist interventions vs APM plus physical therapist interventions	0.11	−0.23 to 0.45		
KOOS sport subscale at 3 mo			0.018	.381
APM vs physical therapist interventions	−0.01	−0.32 to 0.29		
APM vs APM plus physical therapist interventions	0.07	−0.30 to 0.44		
Physical therapist interventions vs APM plus physical therapist interventions	−0.09	−0.43 to 0.26		
KOOS QoL subscale at 3 mo			0.010	.271
APM vs physical therapist interventions	0.34	−0.02 to 0.71		
APM vs APM plus physical therapist interventions	0.09	−0.33 to 0.52		
Physical therapist interventions vs APM plus physical therapist interventions	0.25	−0.13 to 0.63		
Knee extensor strength at 3 mo			<0.001	.051
APM vs physical therapist interventions	0.44	0.07 to 0.80		
APM vs APM plus physical therapist interventions	0.73	0.29 to 1.16		
Physical therapist interventions vs APM plus physical therapist interventions	−0.29	−0.86 to 0.28		

[a]A positive SMD indicated a better outcome of comparator 2 over comparator 1. ADL = activities of daily living; APM = arthroscopic partial meniscectomy; KOOS = Knee Injury and Osteoarthritis Outcome Score; QoL = quality of life; VAS = visual analog scale.

Figure Legend

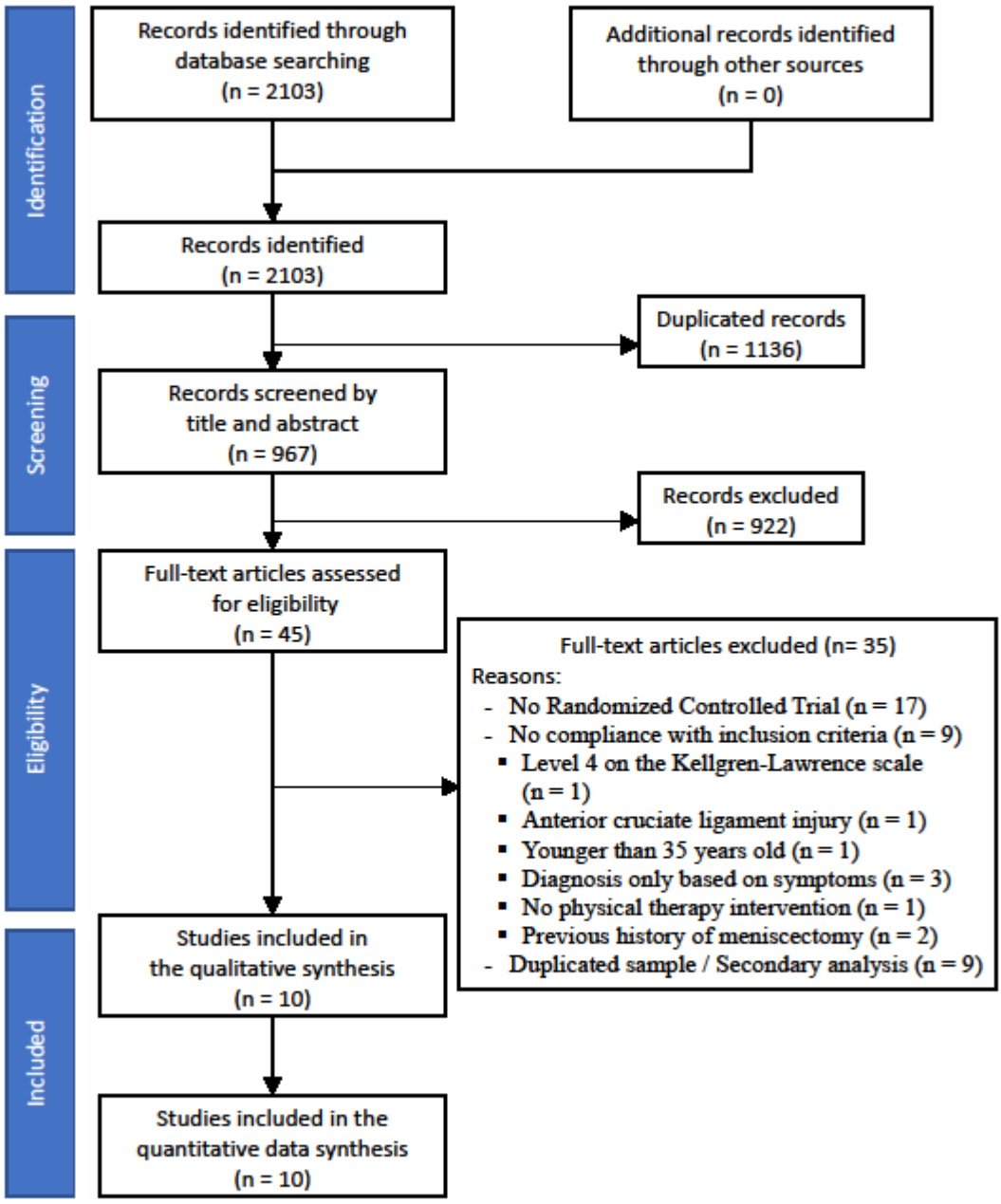

Figure 1. Flowchart of study phases according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

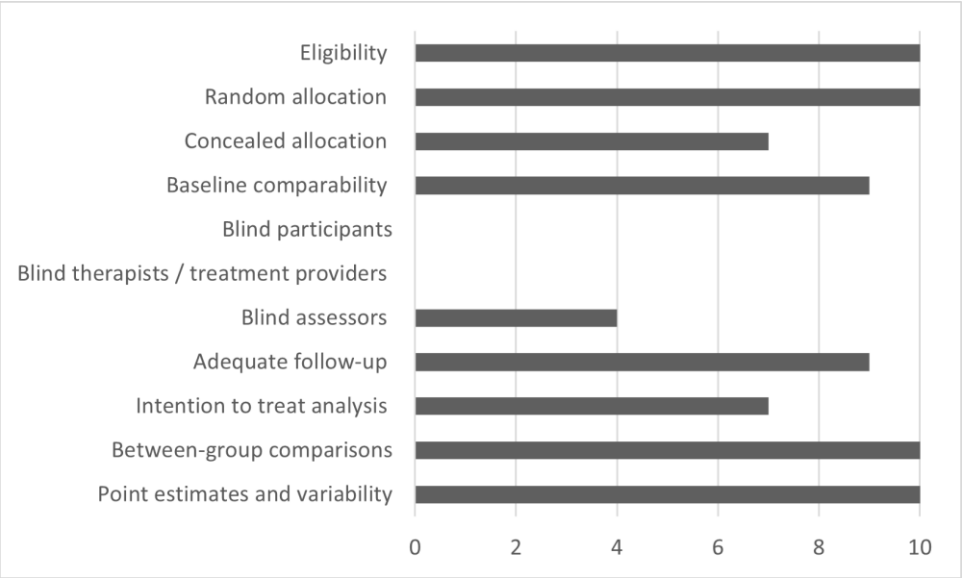

Figure 2. Bar graph representing the percentage of trials reporting information fulfilling each individual quality criterion of the Physiotherapy Evidence Database (PEDro) scale.

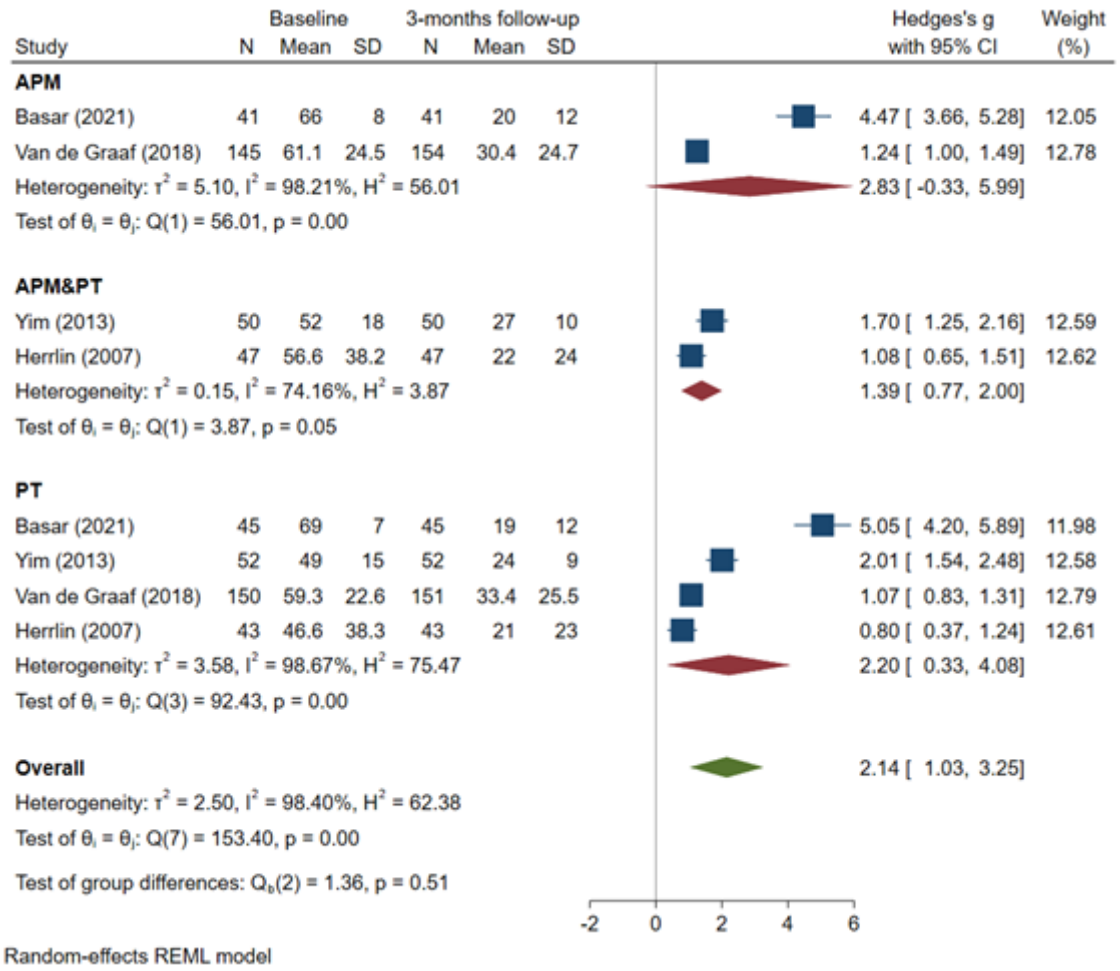

Figure 3. Forest plots grouped by treatment arms representing changes from baseline for visual analog scale for weight bearing at 3 mo. Positive Hedges *g* values indicated a better outcome at the 3-mo follow-up compared to baseline. APM = arthroscopic partial meniscectomy; PT = physical therapy; REML = restricted maximum likelihood.

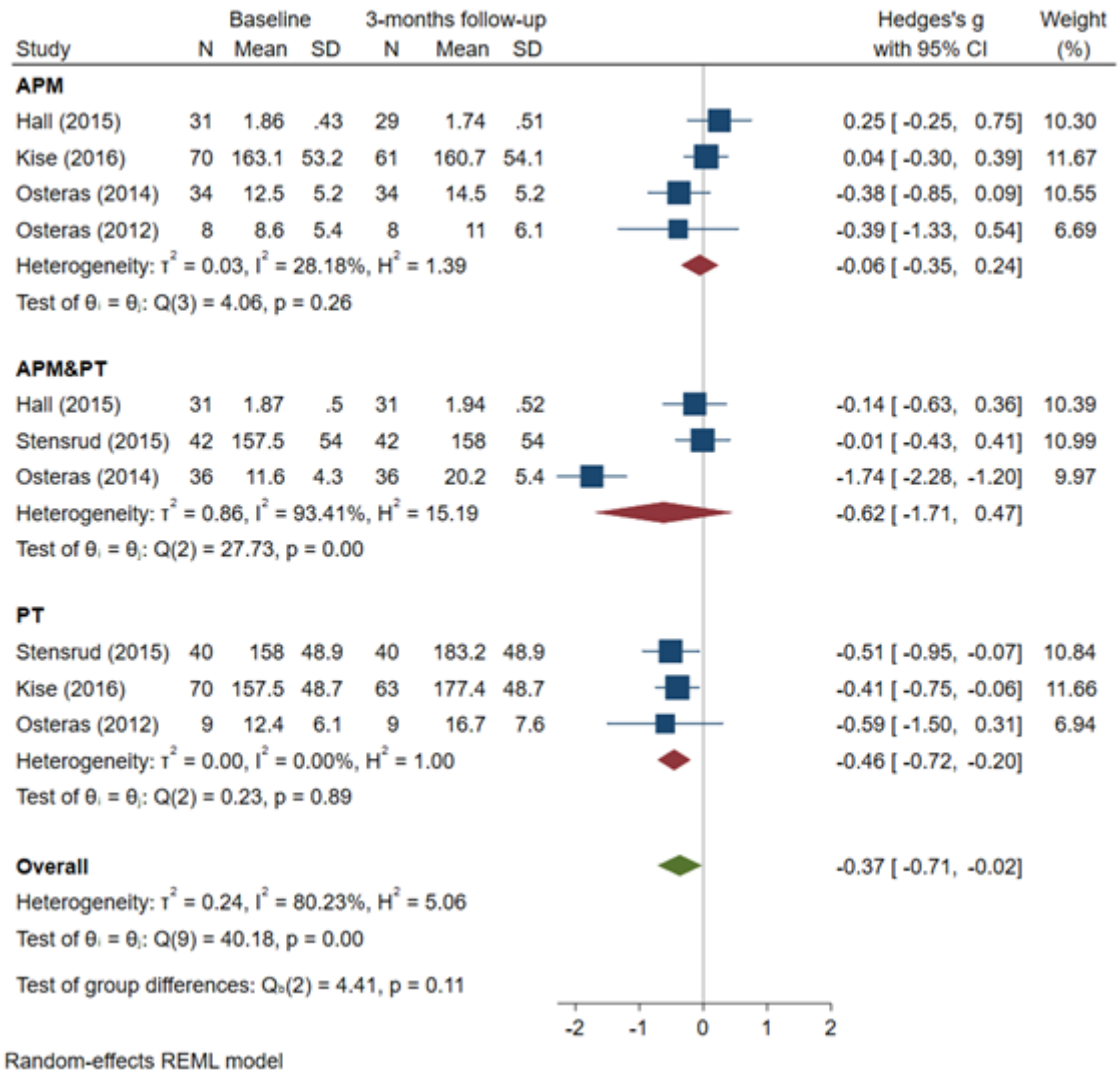

Figure 4. Forest plots grouped by treatment arms representing changes from baseline for knee extensor strength at 3 mo. Negative Hedges *g* values indicated a better outcome at the 3-mo follow-up compared to baseline. APM = arthroscopic partial meniscectomy; PT = physical therapy; REML = restricted maximum likelihood.