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The effects of manual therapy or exercise therapy or both in people with hip osteoarthritis: a systematic review and meta-analysis

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Abstract

Objective: To determine whether manual therapy or exercise therapy or both is beneficial for people with hip osteoarthritis in terms of reduced pain, improved physical function and improved quality of life.

Methods: Databases such as Medline, AMED, EMBASE, CINAHL, SPORTSDiscus, PubMed, Cochrane Library, Web of Science, Physiotherapy Evidence Database, and SCOPUS were searched from their inception till September 2015. Two authors independently extracted and assessed the risk of bias in included studies. Standardised mean differences for outcome measures (pain, physical function and quality of life) were used to calculate effect sizes. The Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach was used for assessing the quality of the body of evidence for each outcome of interest.

Results: Seven trials (886 participants) that met the inclusion criteria were included in the meta-analysis. There was high quality evidence that exercise therapy was beneficial at post-treatment (pain-SMD-0.27,95%CI-0.5to-0.04;physical function-SMD-0.29,95%CI-0.47to-0.11) and follow-up (pain-SMD-0.24,95%CI- 0.41to-0.06; physical function-SMD-0.33,95%CI-0.5to-0.15). There was low quality evidence that manual therapy was beneficial at post-treatment (pain-SMD-0.71,95%CI-1.08to-0.33; physical function-SMD-0.71,95%CI-1.08to-0.33) and follow-up (pain-SMD-0.43,95%CI-0.8to-0.06; physical function-SMD-0.47,95%CI-0.84to-0.1). Low quality evidence indicated that combined treatment was beneficial at post-treatment (pain-SMD-0.43,95%CI-0.78to-0.08; physical function-SMD-0.38,95%CI-0.73to-0.04) but not at follow-up (pain-SMD0.25,95%CI-0.35to0.84; physical function-SMD0.09,95%CI-0.5to0.68). There was no effect of any interventions on quality of life.

Conclusion: An Exercise therapy intervention provides short-term as well as long-term benefits in terms of reduction in pain, and improvement in physical function among people with hip osteoarthritis. The observed magnitude of the treatment effect would be considered small to moderate.

Keywords

Hip pain, Physiotherapy, meta-analysis, Exercise, manipulation

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Introduction

Non-pharmacological and non-surgical interventions such as manual therapy and exercise therapy have been recommended as the first line option in the management of hip osteoarthritis.[1–3] Manual therapy can be defined as a specific 'hands-on' clinical approach used by a variety of health practitioners[4,5] to improve mobility of the joint capsule and its surrounding tissue, thereby reducing pain and improving physical function.[6,7] Despite its widespread use clinically, there is little scientific evidence to substantiate the effectiveness of manual therapy in reducing pain or improving function in hip osteoarthritis.[8] Although the National Institute for Health and Care Excellence (NICE) guidelines recommend manual therapy as a treatment option in hip osteoarthritis, the suggestion has been made based on the findings of just one clinical trial.[6]

Exercise therapy includes joint-specific exercise for range of motion, strengthening of muscles around the hip and general aerobic conditioning.[9,10] A number of studies have demonstrated the efficacy of exercise therapy in hip osteoarthritis.[11–16] The addition of manual therapy to exercise therapy (combined treatment) has also been considered as a promising approach to reduce the symptoms of mild to moderate hip osteoarthritis.[2] However, two recent clinical trials[17,18] have found no added benefits from combining the two interventions. This raises questions about the scientific rigor on which some clinical guidelines are based on.

A recent Cochrane review[16] concluded that land-based therapeutic exercise can reduce pain and improve physical function among people with symptomatic hip osteoarthritis. Another systematic review[19] concluded that a range of exercise therapy interventions (including water-based) and manual therapy in isolation or in combination produced beneficial effects in terms of decreasing pain and disability at short-term. However, these reviews have not included recently published studies[17,18] investigating the treatment outcomes for combined treatments in hip osteoarthritis. Further, the review[19] was not confined to hip osteoarthritis only studies. Therefore, the effects of combined treatments on hip osteoarthritis are still unknown. Therefore, the aim of this review is to update the level of evidence for exercise therapy, and to determine the evidence for treatment outcomes for manual therapy and combined treatments in patients with hip osteoarthritis. This systematic review aimed to answer the following question:

- Does exercise therapy alone or manual therapy alone or combined treatment reduce pain; improve physical function and quality of life in people with hip osteoarthritis?

Methods

This review has been reported based on Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[20] The review protocol was registered on the International Prospective Register of Systematic Reviews (PROSPERO). Randomized controlled trials or controlled clinical trials that involved adults with a clinical or radiological diagnosis of hip osteoarthritis (unilateral and/or bilateral), published in English language were included in this review. Studies that examined osteoarthritis in more than one joint were included when the hip specific data could be extracted. Age, gender and severity of illness were not restricted in this review. However pre and post hip arthroplasty surgery interventions were excluded.

Studies investigating the efficacy of manual therapy or exercise therapy or both as one of the interventions were included. The comparator (control) group could be an inert group (GP care, usual care, waiting list, patient education, etc). Exercise therapy including aquatic therapy should have been supervised. Studies that compared two different types of exercise programs, compared exercise therapy with manual therapy, and compared exercise therapy of varying intensity/frequency were excluded. Manual therapy should have been provided by a licensed manual therapist including physiotherapist, osteopath and chiropractor. Outcome measures of interest include pain and physical function, which belong to the core set of outcomes in osteoarthritis.[21] Quality of life was also an outcome measure of interest.

A bibliographic search was performed through the following databases: Medline, AMED, EMBASE, CINAHL, SPORTSDiscus, PubMed, Cochrane Library, Web of Science, Physiotherapy Evidence Database, and SCOPUS (from inception till September 2015). The search strategies used in subject-based databases are shown in supplementary Table 1. In addition, various trial registries such as the clinical trials.org, ISRCTN.org, Australia New Zealand clinical trial registry and International Clinical Trial Registry Platform were screened.

Articles obtained by the systematic search were exported and saved into reference management software (EndNote X7 Thomson Corporation, Dunedin, New Zealand) and duplicates were removed. Titles of the retrieved articles were screened for relevance according to the inclusion criteria. If a decision could not be made based on the title of the article, the abstract of that article was screened. The screening procedure was conducted independently by two reviewers. Any disagreements were resolved by discussion; a third reviewer was consulted if required.

Two reviewers collected data independently from included studies using a data collection form. The following were extracted: study characteristics, patient characteristics, description of experimental and control interventions, duration of follow-up, types of outcomes assessed and the results. Any disagreements were resolved by reaching a consensus. If a study reported more than one pain or functional outcome measure, preference was given to the Western Ontario and McMaster Universities Osteoarthritis Index as it has been widely used and validated instrument for assessing patients with hip osteoarthritis. The Cochrane Collaboration's tool for assessing risk of bias[22] was used by two authors independently to assess the risk of bias in the included studies. A study was considered to have low risk of bias if the random sequence generation, allocation concealment and incomplete outcome data domains were adequately met.

Meta-analyses were performed from the pooled data of included studies for two time points: post-treatment and follow-up. For the purpose of this review, post-treatment was defined as the measurement point immediately at the end of treatment and follow-up as the next measurement point after post-treatment. Mean and standard deviations for outcome measures were extracted into Review Manager (RevMan 5.3)[23] software to analyse the comparative data between each treatment effect. We extracted final scores rather than change scores as almost all studies (85%) had reported the former. All outcomes of interest were examined as a standardized mean difference (SMD) as different instruments were used across the studies. A random effects model was used whereby the overall effects are adjusted to include an estimate of the degree of variation or heterogeneity across studies. Chi-square and I^2 statistics were used to test for heterogeneity (25%, 50% and 75% representing low, moderate and high heterogeneity respectively). An effect size (Cohen's d; small – 0.2; medium – 0.5 and large – 0.8)[24] and a 95% confidence interval were calculated for each treatment comparison. The overall quality of the evidence (high, moderate, low and very low) was evaluated using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) system[25] (supplementary material Appendix -1).

Results

An initial search retrieved a total of 663 records. After removal of duplicates, 372 citations were screened. Of the 96 abstracts screened, 45 full-text articles were assessed for eligibility. A total of 7 trials[12,13,17,18,26–28] that met the inclusion criteria were included in the final review (Figure 1).

A total of 886 participants were examined in the trials. Sample size calculation was performed in all the studies based upon determining a minimally clinically relevant difference for one or more of the primary outcome measures. The countries in which the studies were done included Europe[12,13,18,26–28] and New Zealand.[17] Recruitment of samples varied widely and there was no gender bias in any of the studies. The interventions were delivered mainly by physiotherapists except for one study[27] in which the manual therapy intervention was provided by a chiropractor. The nature and frequency of interventions used were diverse and varied in all studies (see Table 1).

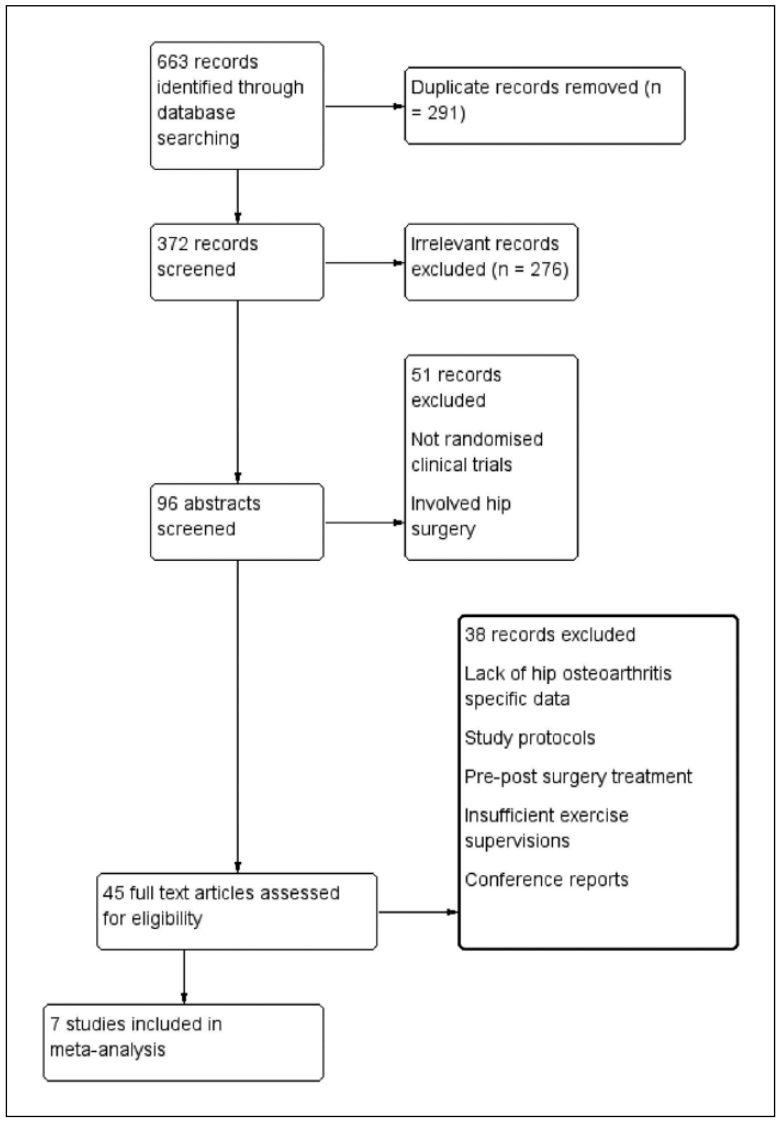

Figure 1. PRISMA flow diagram of included and excluded studies.

The risk of bias was analysed for all individual studies (supplementary Figure). All included studies met our risk of bias criteria and were considered to have a low risk of bias. In one study[12] the drop-out rate in the long term was 33% and it is unclear how the authors handled 'incomplete data'. Other potential source of bias including publication bias was not identified. A summary of findings table was also created to summarise the overall quality of evidence using GRADE (Table 2 and Table 3 and supplementary Table 2).

Data were extracted from six studies[12,13,17,18,26,28] that compared the effectiveness of exercise therapy with control (supplementary Table 2) and provided post treatment effects on 613 participants with hip osteoarthritis (Figure 2). For the outcome of pain, there was high quality evidence of significant difference (SMD −0.27, 95% CI−0.5 to−0.04)

Table 1. Characteristics of included studies.

Author and year	Study design participant characteristics	Groups intervention	Outcome measure(s)	Follow-up	Results
Abott et al. [17]	2X2 factorial RCT. Subjects with hip (*n*=93) or knee OA (*n* = 113). Diagnosis of OA hip based on ACR criteria.	**Group-1: Usual care group.** 51 Participants received usual GP care. **Group-2: MT group.** 54 participants received 9 individual MT treatment sessions of 50-minutes duration. **Group 3: ET group.** 51 participants received 9 individual ET treatment sessions of 50-minutes duration. **Group-4: ET + MT group.** 50 participants received 9 individual sessions of combination (ET + MT) treatment of 50 minutes duration.	**Primary:** WOMAC Score. **Secondary:** 15 secondary outcome measures including depression, adverse events overall health status to name a few.	Baseline 9 weeks 6 months 1 year 2 years	Manual physiotherapy provided benefits over usual care that was sustained to 1 year. Exercise physiotherapy also provided physical performance benefits over usual care. There was no added benefit from a combination of the two therapies.
Fernandes et al. [12]	RCT. A total 109 participants with radiographic and symptomatic hip OA.	**Group-1: PE plus SE group.** 55 participants received education and supervised exercise. The exercise program consisted of 26 different exercises including warm-up, strengthening exercises, functional exercises and flexibility exercises. **Group-2: PE group.** 54 participants received hip OA specific education.	**Primary:** Pain subscale of WOMAC index with VAS (WOMAC pain). **Secondary:** Stiffness and physical function subscales of the WOMAC with VAS (WOMAC stiffness and WOMAC physical function), the HRQOL SF-36v2 and the modified Norwegian version of PASE.	Baseline 4 months 10 months 16 months	No significant differences in pain reduction over time between PE+SE vs. PE alone. Adding SE to PE may improve physical function.
French et al. [18]	Multicenter, 3 group parallel arm RCT. A total of 131 participants with hip OA randomized into one of the three groups.	**Group-1: MT + ET group** 43 participants received 6 to 8 individual 45-minute physiotherapy session over an 8- week period which included 30-minutes of ET and 15- minutes of MT. **Group-2: ET only group.** 45 Participants received 6 to 8 individual 30 minute physiotherapy session over 8 weeks, which included flexibility and strength training exercises. **Group-3: Waiting list control.** Participants in the control group remained in the physiotherapy waiting list for 9 weeks after which they were re-randomized into either ET or ET + MT group.	**Primary:** Physical function subscale of WOMAC Index. Secondary: Sit to stand test. 50- Foot walk test. Active hip ROM measured by goniometer. NRS. SF- 36 Questionnaire. Medication Quantification Scale. HADS. Physiotherapy outpatient Survey.	Baseline 9 weeks 18 weeks	No significant difference was found between the ET and ET +MT groups in the majority of the outcomes at 9 or 18 weeks. However, patient satisfaction was higher in the ET+ MT group.

(Continued)

Table 1. (Continued)

Author and year	Study design participant characteristics	Groups intervention	Outcome measure(s)	Follow-up	Results
Juhakoski et al. [26]	Prospective RCT. A total of 120 participants. Diagnosis of OA according to the clinical criteria of the ACR.	**Group-1: Standard GP care group.** 58 participants received standard GP care. **Group-2: Combined exercise and GP care group.** 60 participants received 12 supervised exercise therapy sessions at baseline and four booster sessions one year later along with standard GP care.	Pain and physical function subscale of the WOMAC index. Finnish- validated SF-36-item Health Survey RAND-36. Calculation of direct and indirect medical costs.	Baseline 3 months 12 months 24 months	No significant difference was found between the two groups at two-year follow-up.
Poulsen et al. [27]	RCT. A total of 118 participants with clinical and radiographic unilateral hip OA randomized into one of the three groups.	**Group-1: PE Group**. 39 participants received PE, comprising two individual and three group sessions. **Group-2: PE plus MT group.** 43 participant received PE plus MT twice a week for six weeks. **Group-3: MCI Group.** 36 participants received a pamphlet containing stretching program (5 to 10 minutes)	**Primary:** Pain measured by NRS. Secondary: HDOOS. Passive hip joint ROM.	Baseline 6 weeks 3 months 12 months	A combined intervention of MT and PE was superior compared to a MCI. PE alone was not superior to the MCI.
Tak et al.[13]	RCT. 109 participants randomly allocated to either the control group or experimental group. Diagnosis of OA hip based on ACR criteria.	**Group-1: ET group.** 55 participants received strengthening and health program, 1hour session per week for 8 weeks. Strength training using fitness equipment's with 2 levels of intensity: light and moderate; and a home exercise program **Group-2: Control group.** 54 participants received standard GP care.	**Outcome measures:** VAS for pain. Pain subscale of HHS Hip function measured by time to perform 4 functional tasks. Self-reported disability measured by Groningen Activity Restriction Scale Quality of life - QoL VAS. HRQOL.	Baseline 8 weeks 3 months	The exercise program had positive effects on pain and hip function post intervention and also at 3-month follow up when compared with 'standard GP' care.
Teirlinck et al. [28]	RCT. 203 participants randomly allocated to either the intervention group or the control group. Diagnosis of OA hip based on ACR criteria.	**Group 1: GP + ET.** 101 participants received GP care with additional ET. **Group 2: GP only.** 102 participants received only GP care.	**Primary:** Pain and physical disability as measured with the HDOOS. Secondary: Pain - NRS QoL – EQ5D.	Baseline 6 weeks 3 months 6 months 9 months 12 months	Significant benefits were found in participants in the GP+ET group compared with GP only group.

ACR: American College of Rheumatology; EQ5DL EuroQoL Scale; ET: Exercise therapy; GP: General Practitioner; HADS: Hospital Anxiety and Depression scale; HDOOS: Hip Disability and Osteoarthritis Outcome Score (HDOOS); HRQOL: Health related Quality of Life Questionnaire; MCI: Minimum Control Intervention; MT: manual therapy; NRS: Numeric Rating Scale; OA: Osteoarthritis; PASE: Physical Activity Score for Elderly; PE: Patient Education; QoL: Quality of Life; RCT: Randomised Controlled Trial; ROM: Range of Motion; SE: Supervised Exercise; SF: Short Form; VAS: Visual Analogue Scale; WOMAC :Western Ontario and McMaster Universities Osteoarthritis Index.

Table 2. Summary of findings (GRADE).

Manual therapy compared to Control for patients with hip osteoarthritis

Patient or population: Patients with hip osteoarthritis
Settings: Primary care, community, outpatient
Intervention: Manual therapy
Comparison: Control

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Control	**Manual therapy**				
Pain (post treat) Scale from: 0 to 10. Follow-up: 6 to 9 weeks	The mean pain (post treat) ranged across control groups from **5**	The mean pain (post treat) in the intervention groups was **0.71 standard deviations lower** (1.08 to 0.033 lower)[1]	–	117 (2 studies)	⊕⊕⊖⊖ **low**[2]	SMD −0.58 (−1.08 to −0.03)
Pain (follow-up) Scale from: 0 to 10. Follow-up: 3 to 6 months	The mean pain (follow-up) ranged across control groups from **6**	The mean pain (follow-up) in the intervention groups was **0.43 standard deviations lower** (0.8 to 0.06 lower)	–	116 (2 studies)	⊕⊕⊖⊖ **low**[2]	SMD −0.15 (–0.8 to − 0.06)
Physical function (post-treat) Scale from: 0 to 240. Follow-up: 6 to 9 weeks	The mean physical function ranged across control groups from **94**	The mean physical function in the intervention groups was **0.71 standard deviations lower** (1.08 to 0.33 lower)[3]	–	117 (2 studies)	⊕⊕⊖⊖ **low**[2]	SMD −0.48 (−1.08 to − 0.33)
Physical function (follow-up) Scale from: 0 to 240. Follow-up: 3 to 6 months	The mean physical function (follow-up) ranged across control groups from **64**	The mean physical function (follow-up) in the intervention groups was **0.47 standard deviations lower** (0.84 to 0.1 lower)	–	117 (2 studies)	⊕⊕⊖⊖ **low**[2]	SMD −0.26 (−0.84 to −0.1)

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
[1]Control group baseline mean (SD) was 5.1 (2.0) Poulsen et al (2013).[2] Total sample size < 200.[3] Control group baseline mean (SD) was 93.8 (52.8) Abbott et al (2013).
CI: Confidence interval.

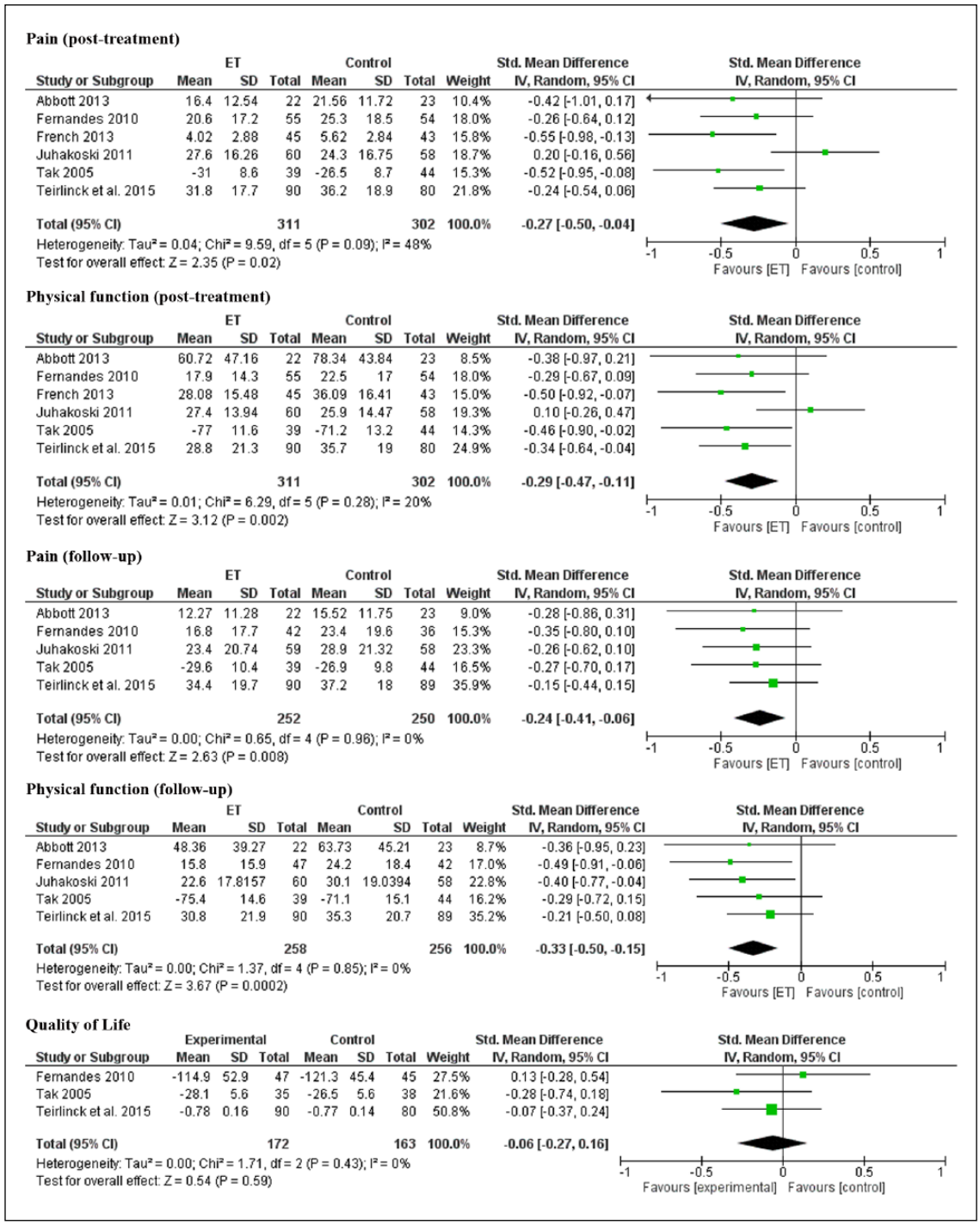

Figure 2. Pooled estimate effect of exercise therapy versus control for pain, physical function and quality of life at post-treatment and follow-up.

between exercise therapy and control. This effect size would be considered small to medium.[24] The demonstrated effect size translated to an improvement of pain of 5 points (95% CI 9 to 1) on a 0 to 100 scale compared with a control group. For the outcome of physical function, there was high quality evidence that exercise therapy was better than control (SMD −0.29, 95%CI−0.47to−0.11). This effect size would be considered small to medium.[24] This effect size translated to an improvement of physical function of 8 points (95% CI 12 to 3) on a 0 to 100 scale compared with a control group.

There was high quality evidence from five studies[12,13,17,26,28] (502 participants) that exercise therapy was better than control at follow-up for the outcome of pain (SMD −0.24, 95%CI−0.41to−0.06). This effect size would be considered small to medium. [24] The demonstrated effect size translated to an improvement of pain of 5 points (95% CI 9 to 1) on a 0 to 100 scale compared with a control group. High quality evidence from five studies[12,13,17,26,28] (514 participants) indicate that exercise therapy was better than control for the outcome of physical function at follow-up (SMD −0.33,95%CI−0.5to−0.15). This effect size would be considered small to medium.[24] This effect size translated to an improvement of physical function of 8 points (95% CI 12 to 4) on a 0 to 100 scale compared with a control group.

Three included studies[12,13,28] provided post treatment effects on quality of life on 335 participants with hip osteoarthritis. No significant difference was detected (SMD −0.06, 95%CI−0.27to0.16).

Data were extracted from two studies[17,27] that compared the effectiveness of manual therapy with control (supplementary Table 2) and provided post treatment effects on 117 participants with hip osteoarthritis (Figure 3). For the outcome of pain there was low quality evidence that manual therapy was better (SMD −0.71, 95% CI−1.08to−0.03) compared to control. This effect size would be considered medium to large.[24] For the outcome of physical function, there was a low quality evidence that manual therapy was better (SMD −0.71, 95%CI−1.08to−0.33) compared to control. This effect size would be considered medium to large.[24]

There was a low quality evidence from 2 studies[17,27] (116 participants) that manual therapy was better (SMD −0.43, 95%CI−0.8to−0.06) to control at follow-up. This effect size would be considered medium.[24] There was also a low quality evidence from 2 studies[17,27] (117 participants) that manual therapy was better (SMD-0.47, 95%CI-0.84to-0.1) compared to control at follow-up. This effect size would be considered medium.[24] Quality of life was not reported in either of the manual therapy studies.

Data were extracted from two studies (Table 3)[17,18] (132 participants) that compared the effects of combined treatment with control at post treatment (Figure 4). There was low quality evidence that combined treatment was better than control for pain (SMD-0.43,95%CI- 0.78to-0.08) and physical function (SMD −0.38,95%CI− 0.73to−0.04). These effect sizes would be considered small to medium.[24]

There was a low quality evidence from 1 study[17] (44 participants) of no difference in effect of combined treatment compared to control at follow-up in terms of pain (SMD 0.25,95%CI- 0.35to0.84) and physical function (SMD 0.09,95%CI-0.5to0.68). One study (86 participants) 1[8] reported that combined treatment was not better than control in improving quality of life at post-treatment (SMD −0.17, 95% CI −0.59to0.25).

Discussion

For the primary outcomes (pain and physical function), there is high quality evidence that exercise therapy is better than control at post-treatment and at follow-up. There is insufficient evidence to determine the effect of exercise therapy on quality of life among people with hip osteoarthritis. Our review found low quality evidence that manual therapy is better than control for primary outcomes (pain and physical function) at post-treatment and at follow-up. Low quality evidence indicates that combined treatment is better than control for primary outcomes (pain and physical function) at post-treatment but not at follow-up.

The results of our meta-analysis suggests that exercise therapy is beneficial in terms of reduced pain and improved physical function in hip osteoarthritis population, both at post-treatment and

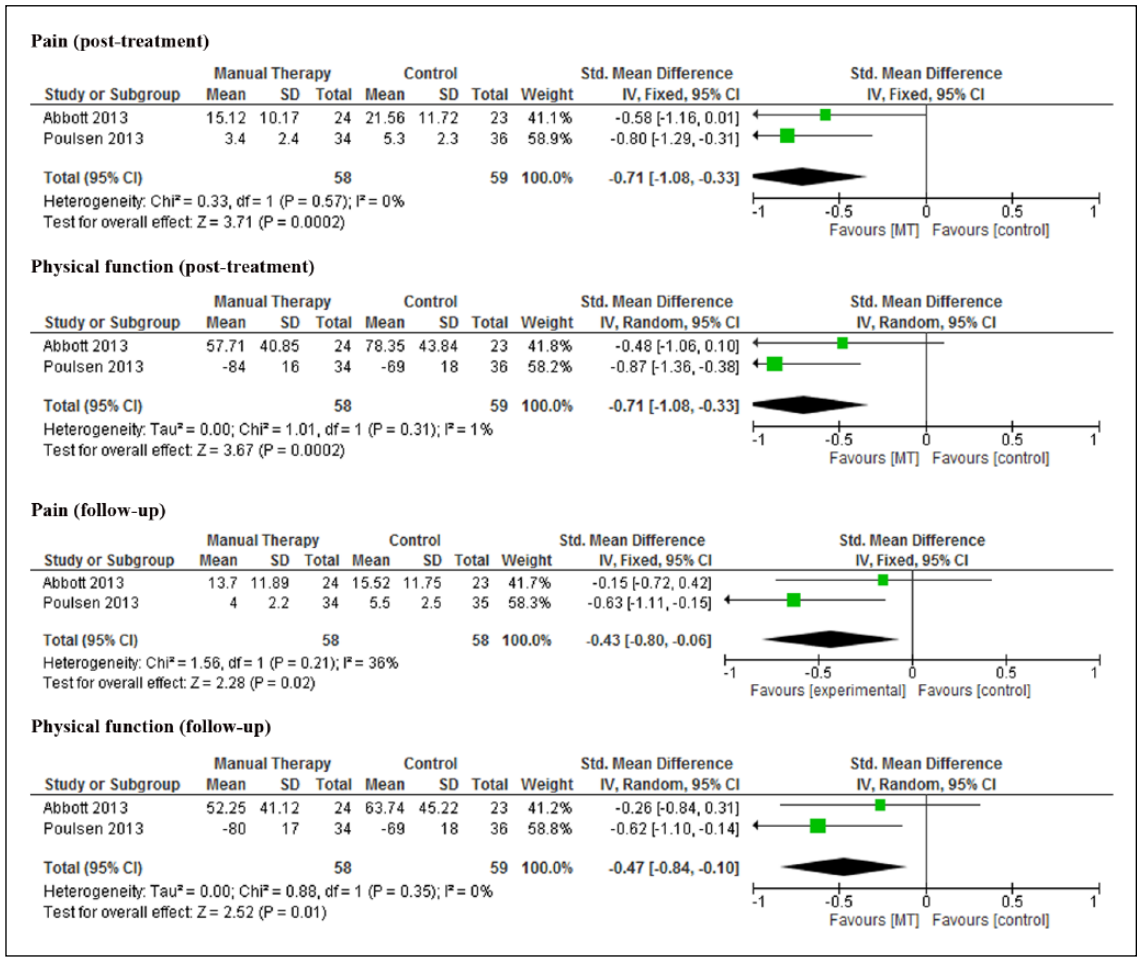

Figure 3. Pooled estimate effect of manual therapy versus control for pain and physical function at post-treatment and follow-up.

follow-up. Exercise intervention may potentially play a significant role in disease-related factors such as impaired muscle function and fitness by improving muscle function, increasing joint range of motion, reducing pain and increasing walking ability.[13,29] Our findings are consistent with those reported in two previous meta-analyses.[14,15] The effect size for pain and physical function reported in our study is similar to that of a recent Cochrane review; pain (SMD −0.33, CI95% −0.84to0.17) and physical function (SMD −0.3, CI95%–0.54to−0.05). These findings are partly in disagreement with a systematic review,[19] which found insufficient evidence for exercise therapy in reducing pain. While we included only hip osteoarthritis studies, those authors have included studies of osteoarthritis affecting other joints as well, which could explain the difference in the findings.

Our review findings suggests that manual therapy reduced pain and improve physical function at post-treatment and follow-up. Joint based manual therapy have a role in activating pain inhibitory cortical systems[30] and has been shown to be effective in reducing pain in hip osteoarthritis.[6] This is partly in agreement with that of a recent review.[19] While our meta-analysis found significant effect of

Table 3. Summary of Findings (GRADE).

Combined treatment compared to Control for patients with hip osteoarthritis

Patient or population: Patients with hip osteoarthritis
Settings: Primary care, community, outpatient
Intervention: Combined treatment
Comparison: Control

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Control	**Combined treatment**				
Pain (post treat) NRS (0 to 10). Scale from: 0 to 10. Follow-up: mean 9 weeks	The mean pain (post treat) ranged across control groups from **6** [1]	The mean pain (post treat) in the intervention groups was **0.43 standard deviations lower** (0.78 to 0.08 lower)	–	132 (2 studies)	⊕⊕⊖⊖ **low**[2]	SMD −0.43 (−0.78 to −0.08)
Pain (follow-up) WOMAC. Scale from: 0 to 240.	The mean pain (follow-up) ranged across control groups from **94**	The mean pain (follow-up) in the intervention groups was **0.25 standard deviations higher** (0.35 lower to 0.84 higher)	–	44 (1 study)	⊕⊕⊖⊖ **low**[3]	SMD 0.25 (−0.35 to 0.84)
Physical function (Post treat) WOMAC. Scale from: 0 to 100.	The mean physical function (post treat) ranged across control groups from **33** [4]	The mean physical function (post treat) in the intervention groups was **0.38 standard deviations lower** (0.73 to 0.04 lower)	–	130 (2 studies)	⊕⊕⊖⊖ **low**[2]	SMD −0.38 (−0.73 to −0.04)
Physical function (follow-up) WOMAC. Scale from: 0 to 240.	The mean physical function (follow-up) ranged across control groups from **64**	The mean physical function (follow-up) in the intervention groups was **0.09 standard deviations higher** (0.5 lower to 0.68 higher)	–	44 (1 study)	⊕⊕⊖⊖ **low**[3]	SMD 0.09 (−0.5 to 0.68)

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
[1]Control group baseline mean (SD) was 5.65 (2.46) French et al (2013).[2] Sample Size < 150.[3] Findings based on single study, samples size < 50.[4] Control group baseline mean (SD) was 36.09 (16.41) French et al (2013).
CI: Confidence interval.

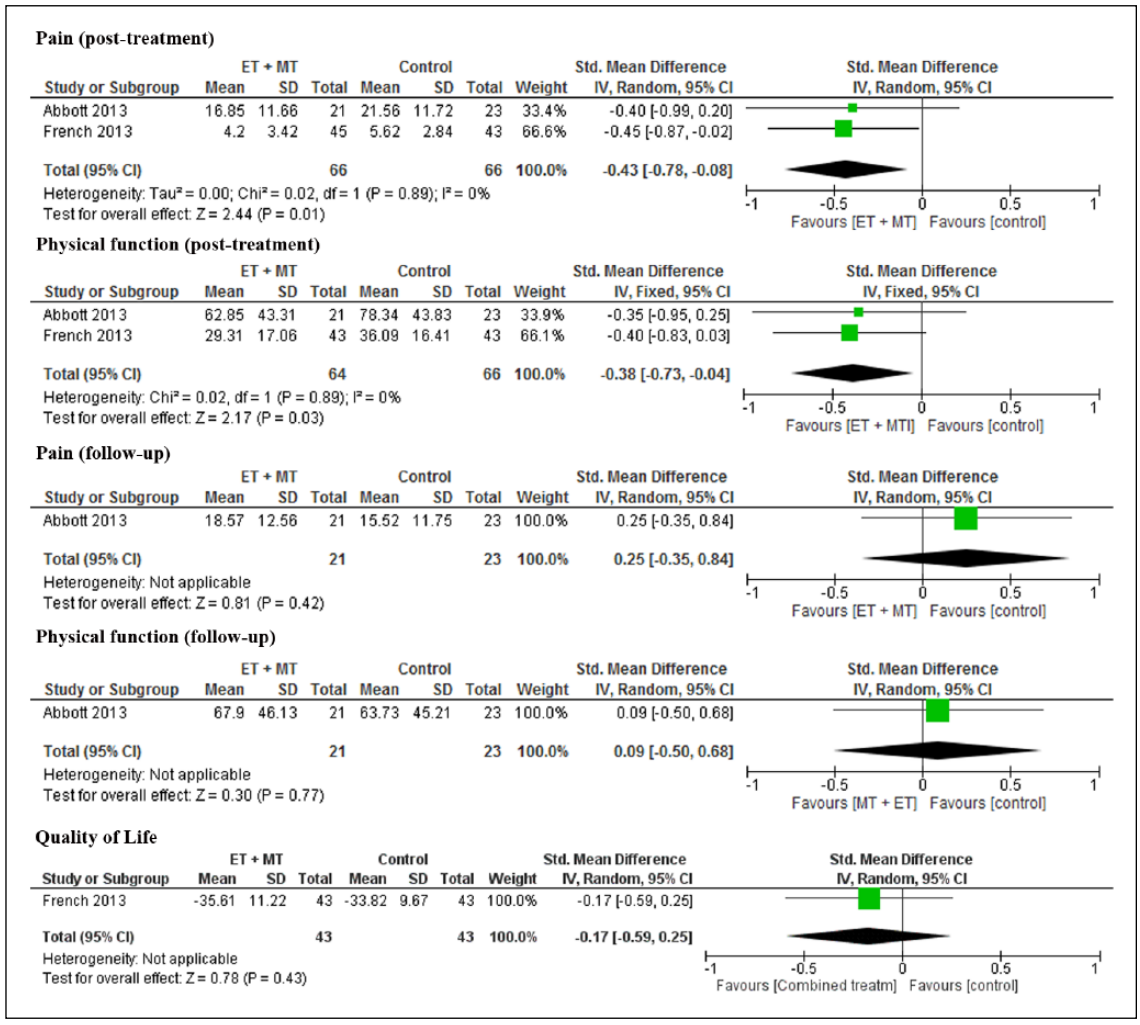

Figure 4. Pooled estimate effect of combined treatment versus control for pain, physical function and quality of life at post-treatment and follow-up.

manual therapy in pain and physical function in hip osteoarthritis at both post-treatment and follow-up; the review[19] reported only short term improvement in pain and physical function after manual therapy. A broad definition of manual therapy has been used in this review as there is a lack of clear description of what constitutes manual therapy.[31] This has led to different criteria for inclusion of studies in various systematic reviews,[31] which could explain the difference in findings. It is important to note that our review is up-to-date and has included recently published studies. The effectiveness of manual therapy; however, should be interpreted with caution as this is based on the significant benefits demonstrated by only one study.[27]

Combined treatment has been recommended by clinical guidelines in the management of hip osteoarthritis.[32] However, only one study[18] demonstrated significant benefit for pain at post treatment for combined treatment. It is interesting to note that combined treatment was not better than control for primary outcomes at follow-up. There could be

two reasons for lack of effect of combined treatment as reported in one of the studies:[17] (1) a significant antagonistic interaction between the two interventions and (2) it is probable that those in the combined therapy group spent less time on each intervention than did those who received only one intervention. The duration of active treatment is an important aspect of study design in clinical trials. Too short a treatment may not permit the full effect of an intervention to be manifested.[33] Therefore, the inequality in therapist contact time and subsequent effect on the therapeutic relationship may also have contributed to lack of sustained benefit from combined treatment.

The meta-analysis was hampered by three significant factors. Firstly, a significant issue centres on optimal treatment dosage. Exercise therapy dosage can differ greatly and encompasses the total number of sessions within a program, the frequency (number of sessions per week), duration (time length of session) and the intensity.[34] Information on exercise therapy dosage was inadequately reported in all the studies. Manual therapy dosage can also vary in terms of force, amplitude, rate, repetition and duration.[6,35] However, the commonly reported factors were frequency (total number of sessions) and duration (total number of weeks). The ideal dosage could not be determined when evaluating existing controlled trials. It is important to note that research into the optimal dosage of physical therapy in osteoarthritis has been minimal.[31,34] Therefore, pilot studies investigating the minimally effective dose as well as the optimal dose for any intervention (exercise therapy or manual therapy or combined) for the treatment of hip osteoarthritis should be undertaken before conducting a larger trial.

Secondly, the interventions were not standardised and were poorly controlled. Exercise therapy studies provided a spectrum of exercises making it hard to determine exactly what the participants did. In manual therapy trials, the types of techniques used were based on individual clinical presentation. In one study,[18] 22 different therapists provided the manual therapy intervention. Except for one study,[27] no study provided details on the experience of manual therapy providers, which is an important factor in non-pharmacological studies.[36] Furthermore, there were variations in the age and severity of patients included in the trials. This diverse spectrum of patients and exercise; and a lack of standardised treatment approach may have compromised study results. Large number of quality studies with various subgroups (e.g. disease severity, chronicity and age) are therefore required to make any strong recommendations about which groups benefit most from various interventions.

Thirdly, some studies in our review did not report adequate treatment characteristics to allow for replication. The need for studies to report treatment techniques and clinical parameters in a transparent and standardised way underpins the determination of best evidence.[37] Hence future trials may need reporting conventions such as those proposed in the Consolidated Standards of Reporting Trials (CONSORT) statement[38] for clinical trials, or the Standards for Reporting Interventions in Controlled Trials of Acupuncture (STRICTA) statement[39] for clinical trials of acupuncture specifically.

We expect minimal biases in extracting and reporting of data (two authors' independently extracted data and a third one was involved wherever necessary). An important limitation is the minimal number of trials that have explored the effectiveness of manual therapy and combined treatment against control in patients with hip osteoarthritis. This raises an important question of publication bias. Hence we maximised our efforts to include any studies published in the 'grey literature'. We decided not to rate down the risk of bias based on the item 'blinding of participants and practitioners' as patient practitioner blinding is impossible to achieve in manual therapy or exercise therapy related studies. This may potentially inflate the treatment effect sizes. One study[26] resulted in low to moderate heterogeneity. This study included patients with mild hip osteoarthritis who had relatively low baseline scores of pain and physical function. The low levels of baseline pain and disability may have led to limited improvement and non-significant differences between the two groups. Based on this review, no specific clinical recommendations regarding optimal treatment dosage for exercise or manual therapy could be made. Future clinical trials should investigate for the optimal treatment dose in patients subgroups based on osteoarthritis severity.

Clinical messages

- Exercise therapy intervention reduced pain and improved physical function in people with hip osteoarthritis.
- Manual therapy may be beneficial for people with hip osteoarthritis.
- Combined treatments may provide only short term benefits.
- No recommendations regarding optimal treatment dosage could be made for clinicians to incorporate.

Declaration of Conflicting Interests

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