Critical review

Land-based exercise in the management of hip osteoarthritis: a critical review

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Abstract

Introduction
An estimated 1.5 million people in the United Kingdom have osteoarthritis of the hip; a number expected to rise with the increasingly ageing population. The importance of exercise in the conservative management of hip osteoarthritis is acknowledged. However, to date there has been little hip joint-specific exercise research. Recently published trials afford the opportunity of reviewing the evidence for exercise for patients with specific hip joint arthritis. This review aims to critique and summarise the available literature regarding the role of exercise in the conservative management of hip osteoarthritis.

Materials and Methods
AMED, CINAHL, EMBASE, MEDLINE, PUBMED, COCHRANE library and PEDro title and abstract searches (2000–2013) were performed to locate articles. The key search terms used were hip osteoarthritis, hip joint degenerative pathology, exercise therapy, physiotherapy and physical therapy.

Results
Seven studies were identified and included; six randomised clinical trials and one clinical trial. The study characteristics, including participants, interventions, outcomes and summarised findings are presented. Approaches to randomisation, allocation concealment, blind outcome assessment, sample size, attrition and interventions are outlined and discussed. Many studies were underpowered, with moderate to high attrition rates and short follow-up times. There is some evidence that exercise is beneficial, in terms of function, pain and performance in the short term.

Conclusion
As with previous research, this review indicates that exercise may be beneficial to patients in the short term. The growing number of trials evaluating the use of exercise in the conservative management of hip osteoarthritis suggests the possibility for a full systematic review with meta-analyses. Further high quality, adequately powered trials are needed and further research regarding dosage, intensity, timing and content is required. Future trials need to include long-term follow-up and allow for attrition rates of 20%–30% in study sample size calculations.

Introduction
It is estimated that over 1.5 million people in the United Kingdom, and up to 10.1% of the European population have osteoarthritis (OA) of the hip joint OA1,2. The hip is the second most common large joint affected by OA3 and, given that the prevalence of long-term musculoskeletal conditions such as OA are increasing4, these numbers are expected to continue to rise. Between 5% and 9% of the UK population have radiographic changes consistent with hip OA5. However, there is no simple definitive test for OA. Radiographic findings relate poorly to self-reported pain, function, muscle power and disability; there is an unexplained lack of correlation between disease severity and the level of reported disability and pain, and the source and causes of pain are complex and not well understood6.

The core nature of exercise as a treatment for OA has been re-emphasised in this year’s updated National Institute for Health and Care Excellence OA and European League Against Rheumatism (EULAR) guidelines5,7. The relative ease of application, unlikelyhood of adverse effects and comparatively low cost of exercise have contributed to these recommendations. Nevertheless, the evidence underpinning recommendations for the use of exercise in the conservative management of hip OA is limited in both quantity and quality. Research regarding exercise often involves participants with lower limb OA6–11. The inclusion of both hip and knee OA can make it difficult to detect joint-specific effects and to determine which specific exercises/exercise types are effective in the management hip OA; thus, the evidence level for patients with hip OA alone is low15–16. There is also a lack of detailed recommendations regarding dosage, intensity and mode of exercise for people with OA of the hip.

New clinical studies have been published, including the Exercise and Manual Physiotherapy Arthritis Research Trial11, which are too recent to be included in updated guidelines and which afford the opportunity to update the existing evidence. This review aims to present and critique recent research investigating exercise therapy in participants with OA of the hip, and to discuss the findings and consequent clinical implications for the conservative management of OA of the hip. The identification of areas requiring further research is also included.

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Materials and Methods

A comprehensive search of literature relating to exercise for the conservative management of people with OA of the hip was undertaken (LD). AMED, CINAHL, EMBASE, MEDLINE, PUBMED, COCHRANE library and PEDro title and abstract searches were performed in May–July 2013 to locate articles. The key search terms used were hip OA, hip joint degenerative pathology, exercise therapy, physiotherapy and physical therapy. Date limits were set to the years 2000–2013 as this review aims to inform current practice rather than provide a historical overview. The search limits requested English language articles relating to humans. The reference lists of identified articles were checked to identify further articles. Clinical studies with land-based exercise interventions for the conservative management of hip OA were included. Studies involving multimodal approaches (e.g., exercises plus a weight management programme) to the treatment (with exercise being only one component of a larger pragmatic intervention package) and studies where participants had either hip or knee OA were excluded if it was impossible to evaluate individual package/joint affected components. Since this review is regarding conservative management, studies relating to pre- or post-operative arthroplasty care were also excluded. Data extraction and assessment of quality were independently performed by two reviewers (LD and CML) and then discussed. Using the Centre for Evidence-Based Medicine 2011 levels of evidence criteria17, each study identified for inclusion was also rated independently.

Results

A total number of 243 abstracts (after removal of duplicates) were screened. Seven studies (total number of participants = 655) are included in the review15,16,18–22; one study has currently only been published in article form, hence limited information regarding quality is provided22. Six randomised clinical trials15,16,18–21 and one clinical trial22 met the inclusion criteria for the review. The study characteristics, including participants, interventions, outcomes and summarised findings are presented in Table 1 in order of publication date to provide a sequential narrative. The 2011 levels of evidence scores ranged from 2 to 3(Table 1). Review findings regarding study quality are presented below.

Sample size

Sample sizes ranged from 3218 to 13116. Most studies included appropriate sample size calculations15,16,19–21 but adequate sample size was not always achieved or maintained15,16,19,20. One study used a sample based on convenience with no formal sample size calculations18 and no details were available for one study22.

Randomisation and allocation concealment

Most studies clearly presented their approach to randomisation. The limited information available from Uesugi et al.22 states their study is a ‘clinical trial’ but does not specify whether the study is randomised and, given their group size variation, this cannot be assumed. Several studies used stratification, one stratified radiographic severity by Kellgren–Lawrence score19, another by both gender and age21. Approaches to randomisation included using a random number table18, computer-generated randomised numbers/lists16,20, permuted blocks (block size n = 6) independently prepared and implemented via numbered, non-transparent sealed envelopes19 and computer-generated blocked randomisation15,21.

Unlike randomisation, many studies did not mention allocation concealment18,19,20,22. One study reports that allocation concealment was maintained until completion of baseline and education sessions (common to both groups)15 and another group allocation that was communicated via email to the treating physiotherapists after randomisation16.

Blind outcome assessment

The majority of studies included blind outcome assessment15,16,19–21. Information regarding blinding is not included in the abstract by Uesugi et al.22 and one study did not blind the assessment of outcomes18.

Interventions

Tak et al.30 compared exercise versus control group, and French et al.16 used a modified cross-over design to enable controls to be included in the trial prior to receiving exercise or exercise and manual therapy interventions. Overall though, few studies compared intervention with control groups. Juhakoski et al.21 gave all participants an instructional lecture prior to participants receiving the intervention or usual care. Uesugi et al.22 compared two types of home exercise programmes with one group using an exercise DVD and the other group using usual home exercise instruction documents. Haslem18 compared six sessions of acupuncture (detailed fully) with three sessions of five exercises and an advice sheet (not provided in the paper) over a six-week period. Two trials compared individual supervised exercise programmes, incorporating daily home exercise programmes, with manual therapy16,18. One study concluded both interventions to be beneficial with manual therapy being more beneficial, especially in the short term although this tailed off over time.19 The authors of this study also queried whether the dose of exercise therapy was suboptimal. The other study found that, apart from increased patient satisfaction, manual therapy as an adjunct to exercise provided no further benefit to patients16. In this study, both interventions...
provided patient benefit compared with control. Finally, Fernandes et al.\textsuperscript{16} compared an education and exercise programme with education alone. Outcomes for these studies are presented in Table 1.

The dosage of exercise interventions varied between group and individual exercises. Home exercise programmes were generally for a minimum duration of 30 min, frequency of exercises ranged from a maximum of daily to a minimum of two times weekly. Group exercise interventions lasted between 40 min and 1 h. Exercise groups generally had elements of warm up, strengthening and cool down. The type of exercises given were largely progressive from non-weight bearing to weight bearing with a focus on local hip muscles (isolated quadriceps, gluteus maximus, hamstrings and tensor fascia lata exercises). While some authors provided comprehensive details regarding exercise interventions (e.g. French et al.\textsuperscript{15}) it was generally difficult to precisely ascertain what was included in interventions, for example, what was included in cool down sections. Overall, the number of treatments ranged from a minimum of 6\textsuperscript{16} to a maximum of 17 (including one instruction session) treatments\textsuperscript{15}. Several studies also included advice about exercise and OA; Fernandes et al.\textsuperscript{15} included three 1-hour advice sessions while Juhakoski et al.\textsuperscript{21} included a 1-hour self-management session to all participants prior to randomisation. Unlike most studies, Juhakoski et al.\textsuperscript{21} did not individualise their exercise programmes for individual patients’ needs. The duration of interventions ranged from 5 weeks\textsuperscript{19} to one study including ‘booster’ or top-up sessions after one year\textsuperscript{21}.

Few studies reported adverse events known to be related to interventions. One study reported the withdrawal of a participant from an exercise intervention due to aggravation of pain\textsuperscript{15}. Another mentioned two withdrawals due to hip/back pain but does not specifically relate these to the intervention\textsuperscript{20}.

\textbf{Outcomes}

Frequently reported outcomes included pain and/or function subscales of the Western Ontario and McMaster Universities Arthritis Index (WOMAC)\textsuperscript{15,16,18,21}. Studies generally included function as an outcome; the Harris Hip Score\textsuperscript{15,20} and Oxford Hip Score\textsuperscript{22}. Pain visual analogue scores were also used\textsuperscript{20}. In addition, many performance and objective tests of function were included: walking\textsuperscript{15,19,22}, timed-up-and-go (TUG)\textsuperscript{20,22}, stair\textsuperscript{20}, toe reaching\textsuperscript{20}, one-legged stand\textsuperscript{22} and sit-to-stand\textsuperscript{16}. Measures of quality of life were included in six out of the seven studies; the SF-36\textsuperscript{15,16,19–21}, SF-8\textsuperscript{22}. As can be seen the SF-36/SF-8 has been most frequently used. Many additional outcomes, such as self-reported disability\textsuperscript{20}, physical activity\textsuperscript{15}, use of health care and costs incurred\textsuperscript{22} have been included in individual studies but not widely used (Table 1).

\textbf{Follow-up}

Follow-up was generally short term. One study used pre- and post-intervention follow-ups only\textsuperscript{22}. Other studies final follow-up times were generally between 2 and 6 months\textsuperscript{16,18,20}. The longest follow-up times from baseline were 16 months\textsuperscript{15} and 24 months\textsuperscript{22}; however, the latter included intervention booster sessions at 1 year (part way through follow-up).

\textbf{Attrition, compliance and adherence}

The calculation of dropout rates was possible/presented for seven out of the eight studies. With the exception of Juhakoski et al.\textsuperscript{21} (dropout rate 5.8%), drop out was generally moderate to high. Moderate dropout rates of 13.8\%\textsuperscript{20} and 14.5\%\textsuperscript{16} were reported rising to higher rates of 19.3\%\textsuperscript{19}, 25\%\textsuperscript{16} and 28.4\%\textsuperscript{15}.

Adherence/Compliance was not mentioned by Haslem\textsuperscript{16}. One study considered withdrawals as non-compliance\textsuperscript{19} but provided detailed adherence evidence regarding manual therapy ($n = 5$ or 10\% participants did not receive manipulations in each session) and exercise (only 61\% of participants were given home exercises). Tak et al.\textsuperscript{20} reported that 77\% of exercise group participants carried out their home exercise programme as intended and mean satisfaction with the programme scored 8/10. Fernandes et al.\textsuperscript{15} report all participants attended education sessions and, for exercise patients, a median of 20/24 sessions attended and a mean of 1.2/2 home exercise sessions was achieved. Fernandes et al.\textsuperscript{15} report 100\% attendance at the advice sessions, a median of 20 (out of a possible 24) attendance at session by the intervention group plus a mean of 1.6 exercise sessions per week during the intervention. Juhakoski et al.\textsuperscript{21} reported adherence to supervised exercise sessions was 86\% in year 1 and 58\% in year 2. Adherence to self-exercise programme peaked at 2.5/3 (months 0–3) and gently declined to 1.6/3 (18–24 months). French et al.\textsuperscript{16} reported mean exercise durations of 4.62 ± 0.91 for the exercise arm and 4.1 ± 0.6 for the exercise and manual therapy arm during the intervention but only 38/131 completed home exercise programme diaries were later returned by participants for analysis.

\textbf{Discussion}

The review identified and included seven clinical trials meeting the review criteria. Studies were mostly comparative trials with few trials evaluating exercise interventions against control\textsuperscript{16,20}. As shown in Table 1, the review supports the use of exercise to improve function in the short term; WOMAC function scores improved in three studies\textsuperscript{15,16,22}. Comparisons between exercise and manual therapy lacked agreement. A comparison of exercise versus

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Table 1. Study characteristics for studies included in the review (N = 7)

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants (sample size)</th>
<th>Participants</th>
<th>Intervention</th>
<th>summarised main results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haslem et al.</td>
<td>18 hip OA (radiographic change) patients awaiting arthroplasty</td>
<td>32 (F = 13, M = 19; mean age 66 ± 7)</td>
<td>Group A: Six sessions acupuncture, group B: Three sessions exercise advice (advice sheet, five exercises given, checked and reviewed over 6 weeks)</td>
<td>Pain and function (modified WOMAC). Assessments: pre- and post-intervention pain (VAS) and function (HSS). Intervention (10–25 min duration) per session. Post-intervention improvement was similar: 83% manual and 50% exercise (OR 1.92 95% CI 1.30, 2.60) at 5 weeks (not collected after 5/52). Effects sizes greater for function but declined over time. SF-36 no differences in effect size for exercise at 5 weeks on physical functioning. Underpowered.</td>
</tr>
<tr>
<td>Blomqvist et al.</td>
<td>30 adults ≥ 55 with early to moderate hip OA</td>
<td>30 adults (F = 16, M = 14; mean age 67.4 ± 9.8)</td>
<td>Group A: Hip OA (ACR) + hip education; Group B: Education group</td>
<td>General improvement (6-point Likert scale); quality of life (SF-36v2), function (HSS), mobility (gait analysis, goniometry). Post-treatment improvement: 83% manual and 50% exercise (OR 1.92 95% CI 1.30, 2.60) at 5 weeks (not collected after 5/52). Effects sizes greater for function but declined over time. SF-36 no differences in effect size for exercise at 5 weeks on physical functioning. Underpowered.</td>
</tr>
<tr>
<td>Hoeksma et al.</td>
<td>109 adults aged between 60 and 85 with mild to moderate hip OA</td>
<td>109 adults &gt; 55 with early to moderate hip OA</td>
<td>Group A: Eight 1-hour weekly group hip ‘Hop with the Hip’. Eight 1-hour weekly group education and exercise</td>
<td>Significant differences between groups, favouring exercise, found for WOMAC function (45/55 exercise and 49/55 controls completed study). Significant differences in FAS (P = 0.031), SF (P = 0.046). Study was underpowered, possible trends for HHS (P = 0.08). Other outcomes = NS differences. Underpowered.</td>
</tr>
<tr>
<td>Fonnesen et al.</td>
<td>159 adults aged 40–80 mild to moderate hip OA</td>
<td>159 adults (F = 83, M = 76; mean age 69.9 ± 10.5)</td>
<td>Group A: Hip OA (ACR) + hip education; Group B: Education group</td>
<td>Significant differences between groups, favouring exercise, found for WOMAC function (45/55 exercise and 49/55 controls completed study). Significant differences in FAS (P = 0.031), SF (P = 0.046). Study was underpowered, possible trends for HHS (P = 0.08). Other outcomes = NS differences. Underpowered.</td>
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</table>

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### Table 1 (Continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Design and level of quality</th>
<th>Participants (sample size)</th>
<th>Intervention</th>
<th>Main outcome measures</th>
<th>Summary of findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jobsakop et al.</td>
<td>RCT Level 2</td>
<td>120 adults aged 55–80 mild RA</td>
<td>All patients had 1-h instructional lecture. Exercise group: 12 weekly group sessions (warm-up, stretching, duration in 3/12-4 2–3× per week home exercise programme). Assessments: 0, 3, 6, 12, 18, 24 months.</td>
<td>Pain and function (WOMAC). Use and health care system costs, NSAID and medication use 6, 12, 18 months.</td>
<td>Overall exercise = significantly less non-NS for pain, RAND-36, performance measures, NSAID use 6, 12, 18 months. Significance within group changes: DVD group TUG (P = 0.001), one-legged stand (P = 0.001), hip abductor strength (P = 0.001), knee extension–flexion (P = 0.02). From exercise group: Muscle volume improvement was significant within the group. Increase in muscle volume was observed after 12 weeks of DVD intervention (P = 0.001). After the 12-week intervention, both the exercise and control groups had significant improvements in WOMAC physical function and physical disability. The exercise group had a greater improvement than the control group in WOMAC physical function and physical disability (P &lt; 0.001). The exercise group also had a greater improvement in physical function than the control group (P &lt; 0.001) and in physical disability (P = 0.001). No significant changes were observed in the control group.</td>
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manual therapy found that, while both groups improved, the manual therapy arm patients improved most in terms of function and walking speed although this improvement declined over time. Recently, French et al. compared exercise with exercise plus manual therapy, finding that both groups improved WOMAC function scores. This study found no additional benefit from manual therapy for patients’ liking manual therapy. A very small study comparing exercise with acupuncture found greater improvement in WOMAC pain and function scores for acupuncture; however, this study included six sessions of acupuncture versus three sessions teaching five exercises and the latter does not seem to include optimal exercise treatment. Further support for the use of exercise to help pain is provided by Tak et al. and Uesugi et al. and these studies also suggest that exercise can improve performance measures such as TUG, walking speed, hip abductor strength and one-legged stand. Key components of study quality, the limitations of the review and its clinical implications will be discussed.

Sample size and attrition
Most studies included sample size calculations (not included or reported by Haslem and Uesugi et al.) but failed to meet them due to under-recruitment or attrition. This is demonstrated by Tak et al. who identified possible trends which may have been demonstrated if they had been adequately powered and retained their original required sample. However, Juukoski et al. retained 153/158 participants over 2 years, demonstrating that loss to follow-up is not inevitable for this patient group. Loss to follow-up was also influenced by trial lists’ decision making regarding whether patients undergoing arthroplasty during follow-up are included or withdrawn. Hoeksm et al. calculated their sample size but stopped recruitment early, due to a less than expected drop out rate. Subsequent loss to follow-up however lead to a lessening of power; also, 18 participants underwent arthroplasty (necessitating per protocol analyses in addition to their intention to treat approach). Hip arthroplasty during follow-up was also the main cause (55%) of drop out for Fernandes et al. Arthroplasty needs careful consideration in hip OA trials; in one study, patients with severe symptoms requiring surgery had higher mean pain scores than non-surgery patients and were excluded from data analyses. Some studies, for example, Tak et al. deliberately excluded patients awaiting arthroplasty, but disease progression and surgery is difficult to predict and three participants underwent hip/knee surgery during follow-up. Another study’s inclusion criteria specified the recruitment of patients awaiting arthroplasty. Decisions regarding whether to exclude people expecting to undergo surgery and how to deal with people undergoing arthroplasty during follow-up (in terms of data analyses and impact on study sample size) need to be considered during protocol development. Drop out ranged from 5.8% to 28.4%, with rates generally towards the higher end of range. Sample size calculations often included low numbers of 10% for expected attrition and this review suggests that the inclusion of higher attrition rates, within sample size calculations of around 25%–30%, should be considered for exercise studies including people with hip OA.

Other trial procedures
In general, studies clearly reported randomisation processes and stated the use of blind outcome assessment. Allocation concealment was frequently not mentioned; this does not necessarily mean that poor allocation concealment occurred, only that it has not been reported. Among a variety of outcome measures, the WOMAC was the most frequently used. Follow-up was generally short term and the lack of long-term follow-up means the effectiveness of exercise in the longer term for patients with hip OA remains unclear. Few studies experienced or reported adverse events; there may be a suggestion that a minority or participants undertaking exercise interventions experience increased pain but few details are given.

Content and clinical implications
Tak et al. prescribed a general lower limb strengthening programme. French et al. provide details regarding repetitions and sets of exercises and Fernandes et al. refer an earlier description of their exercise programme. Overall, however, insufficient details were reported in most studies, thus preventing replication of interventions. Clinically, hip strengthening exercises are prescribed if muscle strength deficits are found with the aim of improving/maintaining strength, mobility, function and pain. Treatment also aims to improve joint awareness, balance, cardiovascular fitness, quality of life and continued involvement in socialisation. The lack of replicable details and evidence regarding the dosage, intensity, duration and timing of interventions means it is difficult for clinicians to underpin their practice with evidence at this time. The review can offer the following information for clinicians: specific joint strengthening exercise, for at least 30 min, at least twice a week, may be beneficial for patients with hip OA. The main muscle groups targeted are hip abductors, hip extensors, quadriceps and calf muscles. Case studies and anecdotal evidence suggest that trunk stability also has a role to play in hip joint pathology. Functionally applicable exercises should be considered and exercises related to sensory motor components to hip joint may also be beneficial. Treatments should be individualised to patients and, apart from one study, review studies have utilised this approach. Exercises can
be progressed at all stages of the disease process; with participants accepting the risk of increased pain for a short duration during such progression. Uncertainty remains regarding whether individual or group exercise treatments are more effective for this patient group. The EULAR guidelines also emphasise the importance of including aerobic activities in OA management. It is known that adults with OA are significantly less likely to meet the levels of moderate or vigorous activities recommended for health than non-arthritis adults. While some interventions included aerobic exercise components during ‘warm-ups’, these components were not of sufficient duration to meet recommended guidelines. Increased aerobic fitness and function can be developed without increasing pain and, in line with current guidelines, advice and education highlighting a healthy lifestyle should be conveyed to all patients with OA. Some studies, such as Fernandes et al. and Tak et al., have incorporated advice into intervention trials. The review also highlights the need for long-term adherence to exercise since exercise benefits reduce as compliance to exercise declines. The investigation of innovative, technologically accessible and user-friendly means of encouraging engagement in exercise and OA management appears to be a further area of future research.

**Limitations**

This review aimed to update, critique and summarise the available knowledge regarding the role of exercise in the conservative management of this common clinical condition to benefit patients, clinicians and researchers. The review was restricted to English language papers only, due to no translation costs being available, and there may be additional non-English studies which would meet the inclusion criteria and add to the review’s findings. The focus of many of the studies included in this review was to investigate hip joint-specific interventions and exclusion criteria that often prevented people with knee OA or back pain from participation. While this approach usefully provides information regarding exercise in the management of hip OA, it may lessen the generalisability of findings since many patients experience multiple joint and site OA. The current review was not intended to be a definitive systematic review of this topic but has indicated that, with the increasing number of studies becoming available in this clinical area, a systematic review and meta-analyses are becoming possible.

**Conclusion**

Exercise can provide short-term benefit, in terms of function, pain and performance, to patients with hip OA. This review highlights the growing evidence around the use of exercise in the conservative management of hip OA. The improving quality and number of trials over time indicate that it is now becoming possible to undertake a full systematic review, with meta-analyses for outcomes such as WOMAC scores. The need for further high-quality, adequately powered trials remains. The review emphasises that further research regarding dosage, intensity, timing and content is required. Additionally, future trials need to include long-term follow-up of participants and to allow for attrition rates of 20%–30% in study sample size calculations in order for meaningful findings to be achieved.

**Abbreviations list**

OA, osteoarthritis; TUG, timed-up-and-go; WOMAC, Western Ontario and McMaster Universities Arthritis Index.

**References**


