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Ottawa Panel evidence-based clinical practice guidelines for therapeutic exercise in the management of hip osteoarthritis*

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Abstract

Objectives: The primary objective is to identify effective land-based therapeutic exercise interventions and provide evidence-based recommendations for managing hip osteoarthritis. A secondary objective is to develop an Ottawa Panel evidence-based clinical practice guideline for hip osteoarthritis.

Methods: The search strategy and modified selection criteria from a Cochrane review were used. Studies included hip osteoarthritis patients in comparative controlled trials with therapeutic exercise

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*The Ottawa Panel comprises of: 1) The Ottawa Methods Group (Co-authors : Brosseau to Marcotte inclusively)& 2) the Experts Panel (co-authors: Fransen to Longchamp)

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interventions. An Expert Panel arrived at a Delphi survey consensus to endorse the recommendations. The Ottawa Panel hierarchical alphabetical grading system (A, B, C+, C, D, D+, or D-) considered the study design (level I: randomized controlled trial and level II: controlled clinical trial), statistical significance ($p < 0.5$), and clinical importance ($\geqslant$15% improvement).

Results: Four high-quality studies were included, which demonstrated that variations of strength training, stretching, and flexibility exercises are generally effective for improving the management of hip osteoarthritis. Strength training exercises displayed the greatest improvements for pain (Grade A), disability (Grades A and C+), physical function (Grade A), stiffness (Grade A), and range of motion (Grade A) within a short time period (8–24 weeks). Stretching also greatly improved physical function (Grade A), and flexibility exercises improved pain (Grade A), range of motion (Grade A), physical function (Grade A), and stiffness (Grade C+).

Conclusion: The Ottawa Panel recommends land-based therapeutic exercise, notably strength training, for management of hip osteoarthritis in reducing pain, stiffness and self-reported disability, and improving physical function and range of motion.

Keywords

Therapeutic exercise, osteoarthritis, evidence-based clinical practice guideline, recommendations, rehabilitation, rheumatology, management, systematic review

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Target populations

These guidelines are primarily intended for health-care professionals and clinicians to improve their daily practice; however, those interested in managing their hip osteoarthritis through non-pharmacological methods may also benefit. Studies included in this evidence-based clinical practice guideline have determined the target population best suited for these guideline recommendations. Thus, the target patient population includes those who are between the ages of 55 and 70 years old, have experienced symptoms from three to nine years, have at least one hip affected, and are able to participate in a therapeutic exercise regime for a set period of time.

Introduction

Osteoarthritis, a chronic condition often owing to cartilage deterioration and changes in joint structure, is the most common type of arthritis[1,2] and is often diagnosed later in life.[2] Approximately 10% to 15% of senior adults (>60 years old) suffer from osteoarthritis worldwide and is predicted to grow to 130 million people by 2050.[3] Generally, there is a greater prevalence of osteoarthritis among women than men; however, there are additional risk factors associated with osteoarthritis development, including lack of physical activity, obesity, injury, and genetics.[3] Common signs and symptoms of osteoarthritis include persistent pain, morning stiffness, and decreased function, crepitus, restricted movement, and bony enlargement.[4,5]

Several high-quality clinical practice guidelines have recommended similar non-pharmacological interventions, however, these recommendations were determined through non-quantitative methodologies, were poorly disseminated, or are currently outdated.[6] Thus, there is great value in further exploring non-pharmacological interventions, such as therapeutic exercise, for the management of hip osteoarthritis. Therapeutic exercise involves a series of bodily movements that aim to improve physical function, impairments, and overall health status,[7] through the use of various aerobic, muscle-strengthening, balance, and flexibility exercises.[7] Although generally stated to deliver additional health benefits, the application of therapeutic exercise in hip osteoarthritis management has rarely been explored.

The primary objective of this guideline is to identify effective land-based therapeutic exercise interventions and provide stakeholders (both health-care professionals and patients with osteoarthritis of the hip) with updated, high-quality recommendations supporting the use of non-pharmacological interventions for managing hip osteoarthritis. The secondary objective is to develop Ottawa Panel guidelines on hip osteoarthritis management.

Methods

The Ottawa Panel

The Ottawa Panel develops evidence-based clinical practice guidelines using: (1) a systematic review following Cochrane Collaboration methodology; (2) calculations of the clinical importance of an intervention based on the minimal clinically important difference of common validated osteoarthritis outcomes; (3) the Ottawa Panel grading system for recommendations;[8] and (4) an Expert Panel of health professionals who review and approve the final guideline recommendations. These components have been used in the previous Ottawa Panel and Philadelphia Panel clinical practice guidelines.

The Ottawa Panel is comprised of the Ottawa Methods Group (LB,GAW,AP,CMAS,ICAG,KTA, LL,GDA,SC,JT,RM) and the Expert Panel (MF,GHM,GPK,JPR,MMLC,SB,LL,LML,GL). The Ottawa Methods Group is responsible for developing a draft of the guideline, whereas the Expert Panel (nine health professionals with clinical expertise in rheumatology, exercise physiology, physiotherapy, etc.) reviewed the evidence tables within the draft guideline and answered the electronic Delphi questionnaire. A flow diagram of the guideline development process can be found in the supplementary file, available online.

Endorsing the recommendations

All experts completed the Delphi questionnaire, which asked whether they agreed with the recommendations, found them to be clear, considered the literature search to be relevant and comprehensive, as well as found the guidelines to be applicable to the specified target audience. Delphi rounds continued until experts reached a consensus (approved guideline recommendations) of $\geqslant$80% or until the law of diminishing returns was observed.[9]

Systematic review

The systematic literature search was taken from a recently updated Cochrane review on exercise for hip osteoarthritis (from inception to February 2013).[10] This systematic review underwent Cochrane peer review, thus search results were considered to be of high quality. The selection criteria of the systematic review were modified to consider studies with participants primarily having hip osteoarthritis ('signal' joint; used to characterize patient's disease) and consider all outcomes according to the objectives of the Ottawa Panel guideline. Studies that actively recruited participants with both hip and knee osteoarthritis were excluded, since collected data corresponding to participants with only/primarily hip osteoarthritis would not be easily identifiable. The Ottawa Methods Group then extracted the data directly from included studies to consider additional outcomes and calculate the relative differences and clinical importance required to determine intervention grades and risk of bias. The modified selection criteria from Fransen et al.[10] can be found within the supplementary file, available online.

The search strategy was performed in five databases and two trial registries. An additional literature search (from March 2013 to May 2015) was conducted to retrieve new eligible publications. For additional information on the systematic review process (e.g. methodology and search terms) see Fransen et al.[10]

Methodological quality of included studies

The Physiotherapy Evidence database (PEDro) scale score (10-point scale) was recorded for each article to assess the methodological evidence for therapeutic exercise. One challenge facing studies with therapeutic exercise interventions is blinding, which the PEDro scale takes into consideration.[11] This guideline will use a cut-off of five out of 10 to ensure only moderate to high quality articles are assessed.[12]

Outcomes

All measured outcomes within the studies were included as long as they used a validated outcome measure recognized by Outcome Measures for Rheumatoid Arthritis Clinical Trials (OMERACT),[13] or supported through external validation and reliability studies. The following outcomes were excluded: psychosocial outcomes, body mass index (BMI) owing to its low level of validity,[14] and the Physical Activity Scale for the Elderly (PASE) as it specifically targets participants aged ⩾65 years.[15] Differing recommendations for outcomes assessed by more than one outcome measure were possible; therefore this guideline presented outcome measure characteristics to support and encourage informed decision-making. Outcomes measured immediately after intervention completion were considered end of treatment. Outcomes measured after a period of time when no intervention was administered, were considered follow-up (retention effect). For a comparison between primary and secondary outcome measures for included studies, see Appendix 1, available online.

Statistical analysis

Data analysis was performed using RevMan (version 5.3).[16] The mean, standard deviation, and sample size were taken from the included studies to calculate the mean difference for continuous outcome measurements. Furthermore, statistics were used to create the figures following the Cochrane Collaboration methodology.[10] This guideline considered a clinically important improvement to be present when the relative difference between the intervention and control group is ⩾15%.[8,17–19] Clinical improvement is determined based on calculations of the absolute benefit and relative difference in change from baseline. The calculated difference of the improvement in the treatment group and control group provided the absolute benefit. The relative difference is calculated as the quotient of the absolute benefit and the baseline mean (of each group).[18]

To determine the recommendation grades, the level (e.g. randomized controlled trials (RCTs) are level I, controlled clinical trials (CCTs) are level II) and strength (statistical significance and clinical importance) of the evidence were taken into consideration.[18] Positive recommendations received grade A (RCT), B (CCT or observational), or C+ (RCT, CCT, or observational) because they all display clinical importance (⩾15%), with only grade C+ not being statistically significant. Grade C and D recommendations occur when there is no clinical importance (<15%). Grade D favours the control, while Grade C favours neither intervention nor control. Both Grade D+ and D- are clinically important favouring the control, however Grade D- is statistically significant, whereas a Grade D+ is not statistically significant. Specific information regarding the Ottawa Panel grading system can be found in Table 1. See Figure 1 for a sample graph of a graded intervention.

Results

Literature search

The systematic literature search conducted by Fransen et al.[10] found 562 potential records retrieved from five databases: MEDLINE, EMBASE (Ovid), PEDro, CINAHL (EBSCOhost), and Cochrane Library; as well as two trial registries: ClinicalTrials.gov and the World Health Organization (WHO) trials portal. Two additional records were found during our supplementary literature search. Once duplicates were removed, a total of 525 eligible articles were screened,[10] with 479 articles excluded based on the title and/or abstract (Figure 2).

According to the selection criteria, four full-text articles were included and 42 articles were excluded for the following reasons (Figure 2): absence of non-exercise or appropriate control group in 12 trials; secondary or supplementary analysis (of previously published RCTs) in seven trials; absence of land-based exercise group in five trials; assesses both hip and knee osteoarthritis in five trials such that the specific effect of hip osteoarthritis could not be isolated; educational interventions only in three trials; not an appropriate intervention in two trials; surgical implications in two trials; only abstract available in two trials; not

Table 1. Ottawa Panel evidence-based clinical practice guideline grading system.

	Clinical importance	Statistical significance	Study design
Grade A* (strongly recommended**)	⩾15%	$p < 0.05$	RCT (single or meta-analysis)
Grade B* (recommended**)	⩾15%	$p < 0.05$	CCT or observational (single or meta-analysis)
Grade C+* (use suggested**)	⩾15%	Not significant	RCT or CCT or observational (single or meta-analysis)
Grade C* (neutral**)	<15 %	Unimportant	Any study design
Grade D* (neutral**)	<15 % (favours control)	Unimportant	Any study design
Grade D+* (use not suggested**)	⩾15% (favours control)	Not significant	RCT or CCT or observational (single or meta-analysis)
Grade D-* (strongly not recommended**)	⩾15% (favours control)	$p < 0.05$ (favours control)	Well-designed RCT with >100 patients (if <100 patients becomes a grade D)

Both Ottawa Panel alphabetical grading* and nominal grading systems** are presented in this table.
RCT: randomized control trial; CCT: controlled clinical trial.
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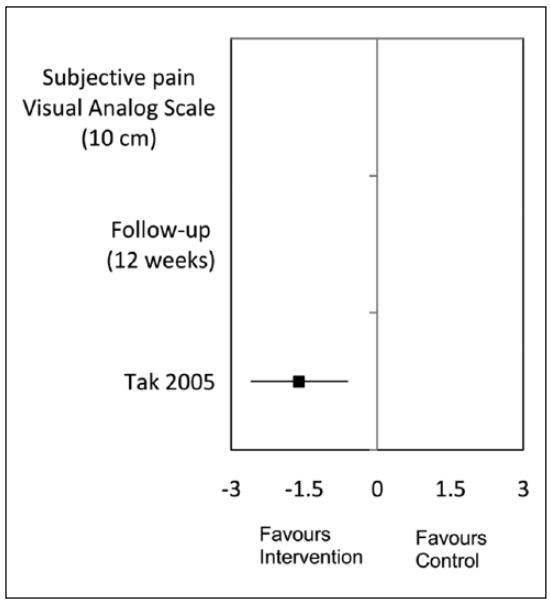

Figure 1. Example graph: Supervised group strength training with unsupervised home exercise group vs. control group: subjective pain (visual analogue scale).

an RCT in one trial; unspecified location of osteoarthritis in one trial; multi-modal intervention in one trial; and insufficient statistical data in one trial. See Appendix 2 (available online) for characteristics of excluded studies.

Delphi results

Of the 13 experts who received the first round of the Delphi questionnaire, 69.2% responded (nine out of 13). Questions one to four had a high level of consensus. There was a level of indecision for questions five (clear guidelines) and six (guideline application), while questions two (clear target audience) and four (clear selection criteria) had the greatest level of disagreement. In part two, six questions (out of 12; 7B, 7C, 8E, 8F, 9H, 9I) received ⩾80% consensus in agreement with questions corresponding to specific intervention recommendations. Although a response rate of 100% (nine out of nine) was achieved in the second Delphi round, a consensus was not reached for any part one questions. All part two questions, except 7A, 8D, and 10L, had achieved ⩾80% consensus agreement. A consensus was reached for four part one questions and all part two questions once the third Delphi round was completed. The two part one questions that received moderate consensus (44%–56%) were addressed through appropriate manuscript improvements.

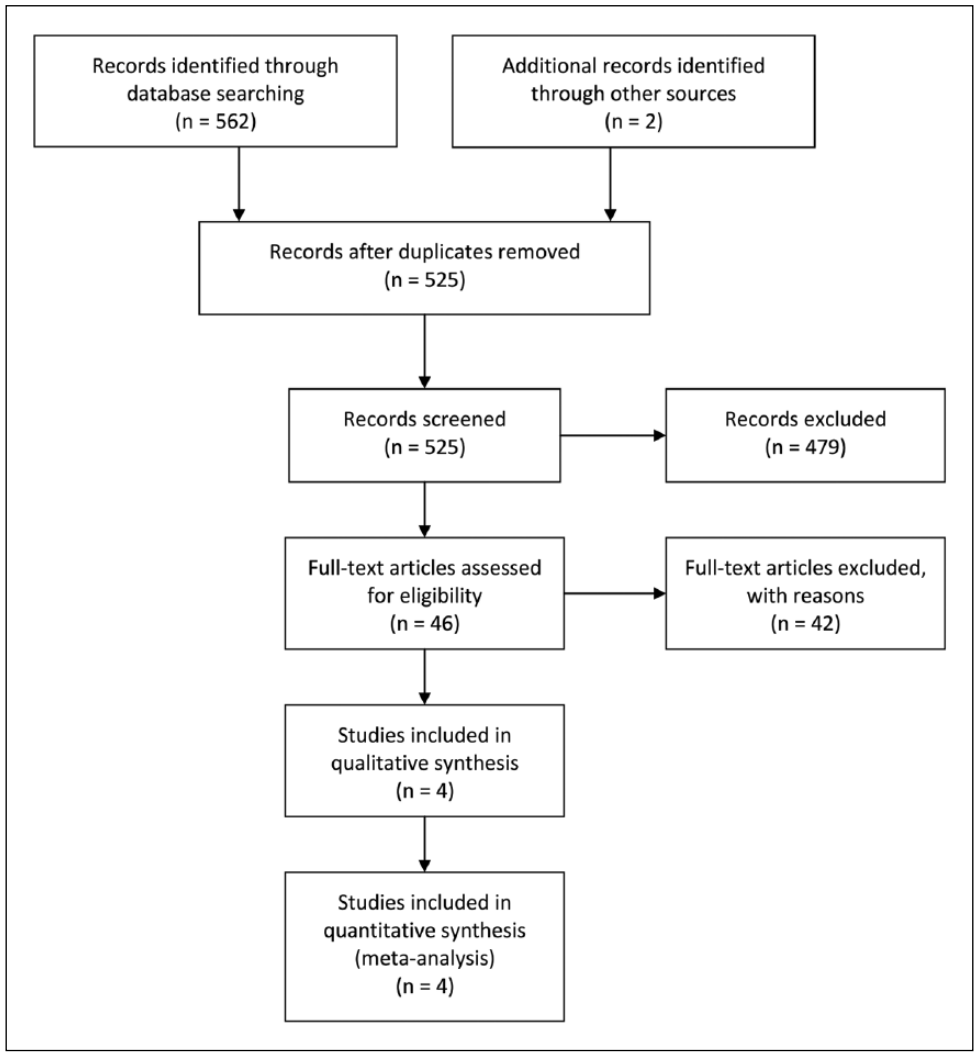

Figure 2. PRISMA flow diagram.

Study characteristics

All four studies had a supervised component during the intervention, while two studies included an additional home exercise programme.[20,21] These studies were RCTs that included patients clinically diagnosed with hip osteoarthritis[20–23] and ⩾40 years old. One RCT investigated the effects of patient education with supervised therapeutic exercise compared with an education-only control group.[22] Another RCT examined the effects of a combined standardized exercise therapy and manual therapy programme, exercise therapy only, and a non-exercise control.[20] One RCT compared a supervised strength training and stretching exercise programme with general practitioner care to a general practitioner care-only control group.[23] One RCT compared supervised group strength training with unsupervised home exercises (Hop with a Hip programme) to a general practitioner care-only control group. The time of end of treatment and initial outcome measure assessment have been stated separately (in weeks) if inconsistencies were apparent.

Results of the included studies

Methodological quality (PEDro scores of included studies)

The PEDro scale, which avoids assigning a heavy weight on blinding, is commonly used to measure RCT and CCT methodological quality and bias.[11] According to the PEDro scale cut-off score (score ⩾5),[12] all four included studies were ranked as having methodologies of 'moderate to high quality'.[20–23] Scores for these studies ranged from 7–8 out of 10, therefore indicating that methodological parameters for blinding, randomization, statistical analysis, and data reporting were suitable.

Effectiveness of exercise therapy for the management of hip osteoarthritis

Supervised group strength training with unsupervised home exercises[21]

One level I RCT explored the effects of supervised group strength training ($n=45$) with unsupervised home exercises vs. a general practitioner care-only control group ($n=49$).[21] The supervised strength training programme focused primarily on equipment-based strength training exercises, such as the leg press and pull down, for one-hour weekly sessions over eight weeks. Lower extremity training was conducted at home during unsupervised sessions. Exercise intensity and fitness equipment difficulty were modified as the participant progressed through the programme. For additional information on study characteristics (e.g. population, intervention intensity, and frequency) see Appendices 3 and 4, available online. Additional evidence tables and figures can be found in the supplementary file, available online.

This study received a PEDro score rating of seven out of 10, indicating high quality methodology. The Ottawa Panel strongly recommends eight weeks of **supervised group strength training in conjunction with unsupervised home exercises** for hip osteoarthritis management for pain (observed; Harris Hip Score) following ⩾8 weeks and for pain (subjective; 10-cm visual analogue scale) and self-reported disability (Sickness Impact Profile physical) following ⩾ 20 weeks total.

Supervised group strength training and stretching exercises with general practitioner care[23]

One level I RCT investigated supervised group strength training and stretching exercises with general practitioner care ($n=60$) vs. a general practitioner care-only control ($n=58$).[23] This supervised programme included various muscle strength and stretching exercises taught during 45-minute weekly sessions for 12 sessions. General practitioner care consisted of normal care provided by the physician, including analgesics and physiotherapy. The direct effect of general practitioner care had not been evaluated seeing as both groups had access. For additional information on study characteristics (e.g. population, intervention intensity, and frequency) see Appendices 3 and 4. Additional evidence tables and figures can be found in the supplementary file, available online.

The PEDro score rating for this study was eight out of 10, indicating high quality methodology. The Ottawa Panel strongly recommends 12 weeks of **supervised group strength training and stretching exercises with general practitioner care** for hip osteoarthritis management for pain and suggests its use for physical function (Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) subscale)[24] following ⩾24 weeks total. The Ottawa Panel suggests the use of this intervention for hip osteoarthritis management of pain (WOMAC subscale),[24] which has the potential to improve or remain the same.

Supervised group low-load strength training and flexibility exercises[20]

One level I RCT explored the effects of a supervised group low-load strength training and flexibility exercise therapy programme ($n=45$) vs. a waitlist control ($n=43$).[20] The programme delivered six to eight supervised 30-minute sessions over the period of eight weeks, which showcased low-load exercises, functional, and non-weight-bearing

positions. A home-based exercise programme was incorporated into the intervention. Aerobic exercises (including walking and swimming activities) were also encouraged in order to supplement supervised sessions. For additional information on study characteristics (e.g. population, intervention intensity and frequency) see Appendices 3 and 4, available online. Additional evidence tables and figures can be found in the supplementary file, available online.

> This study received a PEDro rating score of eight out of 10, indicating high quality methodology. The Ottawa Panel strongly recommends eight weeks of **strength training and flexibility exercises** for hip osteoarthritis management of physical function (WOMAC subscale),[24] pain experienced during activities (numerical rating scale) and aggregated range of motion following ⩾8 weeks total.

Supervised group strength training, functional, and flexibility exercises with patient education[22]

One level I RCT investigated the significance of supervised group strength training, functional, and flexibility exercises with patient education ($n=55$) vs. a patient education-only control ($n=54$).[22] The programme featured 26 different supervised strength training, functional, and flexibility exercises delivered twice a week, with unsupervised access to a gym facility the remaining weekdays for a total of 12 weeks. Both groups received patient education, therefore its direct effect on participants was not evaluated. For additional information on study characteristics (e.g. population, intervention intensity, and frequency) see Appendices 3 and 4, available online. Additional evidence tables and figures can be found in the supplementary file, available online.

> This study was rated eight out of 10 on the PEDro scale, indicating high quality methodology. The Ottawa Panel strongly recommends 12 weeks of **supervised group strength training, functional, and flexibility exercises** with patient education programme for hip osteoarthritis management and improvement of physical function (WOMAC subscale)[24] following ⩾40 weeks total. The Ottawa Panel suggests the use of this intervention for hip osteoarthritis management of pain and stiffness (WOMAC subscale),[24] which may improve or remain the same.

Discussion

Given the high quality of included studies (PEDro score ⩾5) and evidence-based recommendations determined, the Ottawa Panel approves the use of therapeutic exercise as an effective intervention for managing hip osteoarthritis. The four included studies outlined a total of 12 positive recommendations (nine for grade A and three for C+), 37 neutral recommendations (29 for grade C and eight for grade D), and one negative recommendation (one grade for D+) (Appendix 5, available online). Strength training with supplementary home-based low extremity training should be used to improve observed pain, subjective pain, and Sickness Impact Profile (physical aspect); however, it is necessary to perform one-hour sessions each week for at least eight weeks.[21] Group strength training and stretching exercises are useful for improving pain relief and physical function within a six-month period if twelve 45-minute sessions are performed for 12 weeks.[23] Low-load strength training and flexibility exercises performed six to eight times for 30 minutes over eight weeks, while accommodating individual tolerance levels, are recommended for improving physical function, pain with activity, and aggregated range of motion.[20] Patient education (three sessions) in conjunction with strength training, functional, and flexibility exercises at least two times a week has been shown to be effective for improving pain, physical function, and stiffness when performed for ⩾10 months.[22]

Comparisons with previous clinical practice guidelines

Past evidence-based clinical practice guidelines have provided general recommendations (no grades; cardiovascular/resistance therapeutic exercise) for patients with hip osteoarthritis,[25] recommended land-based exercise for those experiencing hip osteoarthritis at a level B (i.e. Good evidence:

evidence acquired can reliably be used in most situations to direct practice)[26] and recommended flexibility, strength training, and endurance exercises at a level B (i.e. Moderate evidence: one high-quality RCT or multiple lesser-quality RCTs, prospective, and diagnostic studies).[27]

The recommendations from the Ottawa Panel guidelines are largely in agreement with previous clinical practice guidelines; however assessed outcomes, the recommendation grading scale and its development, and study limitations between guidelines have been shown to differ. For example, it is common to find variations in grading scales used to assess evidence as is seen between existing guidelines that choose to employ either a numerical and/or alphabetical evaluation system.[6,26,27] These differences may impact the final conclusions clinicians and practitioners make. The Ottawa Panel guideline has incorporated a quantitative evidence-based method of determining statistical and clinical significance, with the addition of feedback from healthcare professionals and research experts in hip osteoarthritis, to create widely acceptable recommendations.

Physiological effects of therapeutic exercise on pain management

Therapeutic exercise can have beneficial effects on lower-limb osteoarthritis outcome measures when performed routinely and correctly,[28,29] which may suggest pain reduction for those with hip osteoarthritis as well. However, recent studies, which have further explored the use of therapeutic exercise as an osteoarthritis pain management tool, concluded that evidence is inconclusive and inadequate.[30,31] We speculate malfunctioning pain proprioception mechanisms, such as exercise induced analgesia, may explain the lack of significant evidence in support of reduced pain. If an endogenous mechanism that inhibits pain, like exercise induced analgesia, is dysfunctional, pain sensitivity could remain present or increase.[31] Generally, research on the effects of exercise-induced analgesia has suggested pain attenuation should be expected shortly after exercise. Galdino et al.[32] found that antinociception is produced with general resistance exercises, resulting in decreased pain. Based on this evidence, one may conclude that therapeutic exercise also has beneficial effects on osteoarthritis hip pain. The studies included in this guideline have shown that pain relief is variable and depends upon the type and total duration of therapeutic exercise performed.[20–23] The diverse array of evidence in support of therapeutic exercise as an effective intervention for osteoarthritis pain management suggests that future research should investigate more thoroughly the direct and indirect effects therapeutic exercise can have on the osteoarthritis hip population.

Limitations

Limitations of the Ottawa Panel evidence-based clinical practice guideline

One limitation to this Ottawa Panel guideline involves discrepancies concerning the timing of outcome assessment (last day of intervention delivery vs. day of actual outcome assessment) within included studies. Two studies performed an outcome assessment one week after the intervention was terminated,[20,21] whereas another study assessed outcomes immediately after intervention completion[23] and four weeks after intervention completion.[22] Studies displaying a lapse of time between the final intervention session and actual end of treatment outcome assessment may inaccurately reflect the intervention effect. This Ottawa Panel guideline refers to the first outcome measure assessment as the study end of treatment assessment, contrary to its identification as a follow-up assessment within the trial.

It is important to note that the following outcomes have produced conflicting recommendations: observed pain,[21] subjective pain,[21] aggregated range of motion,[20] and FABER range of motion.[20] Additionally, the following outcome measures have only indicated an improvement at follow-up: pain subjective,[21] Sickness Impact Profile Physical,[21] WOMAC Pain,[23] WOMAC Physical Function,[22,23] and WOMAC Stiffness.[22] It is highly recommended that clinicians consult Appendix 6 (available online) to discern which outcome measure and corresponding recommendation is most

appropriate for their patient. The outcome measures that received conflicting recommendations may be best explained by varying methods of test administration. For example, pain-measured subjectively may be influenced by participant bias. Furthermore, clinical discretion is advised for differing recommendations seen at end of treatment and follow-up assessment periods. Possible explanations for these variations include the imprecision of self-reporting, often influenced by seasonal, time of day, and mood confounders. Additionally, stronger recommendations at follow-up may indicate certain interventions elicit a long-term effect for specific outcome measures, as was the case for pain (subjective; 10-cm visual analogue scale),[21] Sickness Impact Profile Physical,[21] physical function (WOMAC; 0–100)[22], and stiffness (WOMAC; 0–100).[22]

Limitations of the primary included studies

One study included additional booster intervention sessions between scheduled follow-up assessments, which may have positively influenced data taken at the 18- and 24-month follow-up assessment, therefore only data from 12 weeks end of treatment and 12 weeks follow-up (24 weeks from baseline) were considered in this guideline. Additionally, one study incorporated a crossover design after end of treatment outcome measures were assessed,[20] therefore, only data taken at the nine-week end of treatment assessment were used for recommendation development in this guideline. It was also noted within the same study that an estimated adjustment of the marginal mean for baseline values was used owing to heterogeneity seen in baseline characteristics between the two groups.[23] In order to avoid introducing selection bias, this guideline also used the adjusted mean values calculated in this primary study to determine recommendations.

Conclusion

The Ottawa Panel found convincing evidence supporting the use of therapeutic exercise for hip osteoarthritis management, especially for those who have 55 and 70 years, minimum three to nine years of active symptoms, minimum one hip affected, and the capacity to exercise. Based on the evidence from four high-quality RCTs, strength training, functional, stretching, and flexibility-based therapeutic exercise can be expected to provide average to great improvements in self-reported disability, pain (observed and subjective), stiffness, aggregated range of motion, and physical function. It is recommended that therapeutic exercise interventions be supplemented with individualized medical advice and treatment in order to ensure safety and maximal benefit. Lastly, it would be interesting to explore the long-term effects of therapeutic exercise on hip osteoarthritis to determine if management of hip osteoarthritis with therapeutic exercise can provide significant lifelong improvements.

Clinical messages

- Therapeutic exercise, especially strength training, can greatly improve pain, disability, physical function, stiffness, and range of motion for hip osteoarthritis patients.
- Flexibility exercises have shown great improvements for pain, range of motion, physical function, and stiffness.
- Further research is required to determine the long-term effects of therapeutic exercise on management of hip osteoarthritis

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