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Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee—the MOVE consensus

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Objectives. **Exercise is an effective and commonly prescribed intervention for lower limb osteoarthritis (OA). Many unanswered questions remain, however, concerning the practical delivery of exercise therapy. We have produced evidence-based recommendations to guide health-care practitioners.**
Methods. **A multidisciplinary guideline development group was formed from representatives of professional bodies to which OA is of relevance and other interested parties. Each participant contributed up to 10 propositions describing key clinical points regarding exercise therapy for OA of the hip or knee. Ten final recommendations were agreed by the Delphi technique. The research evidence for each was determined. A literature search was undertaken in the Medline, PubMed, EMBASE, PEDro, CINAHL and Cochrane databases. The methodological quality of each retrieved publication was assessed. Outcome data were abstracted and effect sizes calculated. The evidence for each recommendation was assessed and expert consensus highlighted by the allocation of two categories: (1) strength of evidence and (2) strength of recommendation.**
Results. **The first round of the Delphi process produced 123 propositions. This was reduced to 10 after four rounds. These related to aerobic and strengthening exercise, group versus home exercise, adherence, contraindications and predictors of response. The literature search identified 910 articles; 57 intervention trials relating to knee OA, 9 to hip OA and 73 to adherence. The evidence to support each proposition is presented.**
Conclusion. **These are the first recommendations for exercise in hip and knee OA to clearly differentiate research evidence and expert opinion. Gaps in the literature are identified and issues requiring further study highlighted.**

KEY WORDS: Knee osteoarthritis, Hip osteoarthritis, Exercise, Aerobic exercise, Strengthening exercise, Evidence-based recommendations.

Osteoarthritis (OA) is the most common cause of musculoskeletal pain and disability. Exercise is a commonly prescribed and effective treatment for patients with lower limb OA. Many questions remain, however, regarding the type and format of exercise that should be prescribed, predictors of response and adherence.

The American Institute of Medicine has defined clinical guidelines as 'systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical conditions' [1]. Guidelines for the management of OA of the knee and hip [2–4] recommend exercise therapy without addressing the issues described above. Existing guidelines for exercise in OA [5] are not site-specific and do not provide estimates of treatment effect or differentiate between expert opinion and evidence-based recommendations.

Our objectives were to produce evidence-based recommendations for the role of exercise in the management of hip and knee OA, differentiating research-based evidence from

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expert opinion, to guide health-care practitioners caring for patients with OA.

Methods

The guideline development group

Professional bodies to which knee and hip OA are of relevance were invited to participate in a multidisciplinary guideline development group concerning exercise therapy and OA of the hip and knee. Representatives suggested by the British Geriatric Society, British Society for Rheumatology, Chartered Society of Physiotherapy and Primary Care Rheumatology Society agreed to take part in addition to other interested parties. A committee was formed consisting of 20 experts in the field of OA (10 rheumatologists, four physiotherapists, two general practitioners, two experts from the field of evidence-based medicine, one medicine for the elderly physician and one health psychologist).

Opinion of the expert committee

Each committee member was asked to contribute up to 10 propositions describing key clinical points regarding the role of exercise as a therapy for OA of the hip or knee. The propositions from all experts were then collated and consensus regarding the propositions reached by the Delphi technique [6]. The propositions were returned to the participants who were asked to select the 10 most important propositions. These were collated and similar propositions combined. The procedure was repeated until 10 recommendations were agreed. Propositions were accepted automatically if selected by over two-thirds of participants in one Delphi round. After the third round, propositions that were selected by fewer than 25% of participants were rejected.

The evidence-base to support each recommendation was then determined.

Literature search

A systematic literature search was undertaken in the Medline, PubMed, EMBASE, PEDro, CINAHL and Cochrane databases covering the period 1966 to November 2003. Search terms used were 'exercise' and 'exercise therapy' combined with 'osteoarthritis, knee', 'osteoarthritis, hip' or 'adherence'. Search terms were exploded. Reference lists of identified studies were also searched. Studies of all designs were included including meta-analyses and systematic reviews, randomized controlled trials (RCTs), controlled trials and uncontrolled studies. Only English-language publications and full-length articles were included.

Assessment of methodological quality

Methodological quality was assessed by a single reviewer according to a validated scoring system [7]. This system scores the reporting of studies on 27 items leading to a maximum quality score (QS) of 28 (0–1 for 26 items, 0–2 for one item).

Quantitative assessment of treatment effect

Outcomes of interest were identified by the Delphi process and relevant data were abstracted (e.g. pain, self-reported disability, health status, muscle strength). The mean and distribution for baseline, endpoint and difference (endpoint minus baseline) were recorded for each outcome measure in addition to the number of subjects in each treatment arm. Where sufficient data were provided, the effect size (ES) [8] for the difference between exercise and control groups was calculated.

TABLE 1. Categories of evidence and strength of recommendation [9]

Categories of evidence	1A: Meta-analysis of RCT
	1B: At least one RCT
	2A: At least one CT without randomization
	2B: At least one type of quasi-experimental study
	3: Descriptive studies (comparative, correlation, case–control)
	4: Expert committee reports/opinions and/or clinical opinion of respected authorities
Strength of recommendation	A: Directly based on category 1 evidence
	B: Directly based on category 2 evidence or extrapolated recommendation from category 1 evidence
	C: Directly based on category 3 evidence or extrapolated recommendation from category 1 or 2 evidence
	D: Directly based on category 4 evidence or extrapolated recommendation from category 1, 2 or 3 evidence

RCT = randomized controlled trial, CT = controlled trial.

Categories of evidence/strength of recommendation (Table 1)

The evidence from each study was then categorized according to study design. The strength of recommendation for each of the final 10 propositions was allocated by the committee based on the level of evidence available [9].

Results

The Delphi process

Eighteen of the experts participated in the Delphi process and the first round returned 123 propositions which were sent back to participants. Seventy-two propositions were returned following the second round and similar propositions were combined. Forty-seven propositions were sent out for the third round and two of these were accepted as final recommendations, having been selected by over two-thirds of the participants. After the third round, propositions selected by fewer than 25% were rejected, leaving 13 propositions, six of which had been accepted as final recommendations. Following the fourth round, eight propositions selected by over two-thirds of the panel and two further propositions selected by over half of the panel made up the 10 final recommendations.

Literature search

One hundred and fifty-nine articles relating to exercise therapy for hip or knee OA were identified by the literature search. There were three systematic reviews of exercise for OA of the hip or knee, 57 intervention trials relating to knee OA and nine relating to hip OA. Eight hundred and two articles were identified by the search for articles relating to adherence and exercise, including 73 articles relating to interventions to increase adherence.

The propositions

These are considered in no particular order.

1. Both strengthening and aerobic exercise can reduce pain and improve function and health status in patients with knee and hip OA. Both aerobic and strengthening exercises are effective for knee OA. Three RCTs of aerobic walking have shown

TABLE 2. Evidence to support proposition 1: number of RCTs, QS and ES

			Positive studies			Negative studies	
		Outcome measure	No of RCTs	QS	ES	No of RCTs	QS
Aerobic exercise	Knee OA	Pain	3 [10–12]	15, 20, 19	0.70, 0.53, 0.44	1 [13]	18
		Disability	2 [11, 12]	20, 19	0.37, 0.76	0	
		Health status	0			2 [10, 12]	15, 19
	Hip or knee OA	Pain	0			2 [31, 32]	15, 14
		Disability	0			2 [31, 32]	15, 14
		Health status	0			2 [31, 32]	15, 14
Strengthening exercise	Knee OA	Pain	16 [11, 15–28]	Median 18, range 12–23	Median 0.52, range 0.1–2.97	1 [29]	21
		Disability	8 [11, 18–22, 26, 27]	Median 20, range 12–23	Median 0.41, range 0.19–0.63	2 [15, 29]	22, 21
		Health status	1 [18]	20	0.41	2 [20, 29]	17, 21
	Hip or knee OA	Pain	2 [33, 34]	23, 20	0.22, 0.73	0	
		Disability	0			1 [34]	20
		Health status	0			0	

a reduction in pain [10–12], and improvement in function is reported in two of these [11, 12]. One small RCT failed to show an improvement in pain [13]. Improvement in health status was not demonstrated [10, 12]. Stationary cycling has also been shown to reduce pain from knee OA (QS 15) [14].

Sixteen RCTs have shown strengthening exercise to reduce pain in knee OA [11, 15–28]. Eight of these studies also demonstrated improvement in function [11, 18–22, 26, 27] and one improvement in health status [18]. In contrast, a small number of RCTs did not show improvement in pain [29], function [15, 29] or health status [20, 29] when compared with control. These studies did not share common features distinguishing them from RCTs demonstrating efficacy of strengthening exercise.

The literature search identified only one RCT of aerobic exercise for hip OA, which found home exercise to be as effective as hydrotherapy, but there was no placebo arm (QS 18) [30]. One RCT of aerobic exercise in OA of the hip, knee or tarsal joints (and patients with rheumatoid arthritis) [31] and another including subjects with knee or hip OA [32] did not find any benefit on pain, function or health status.

No studies evaluating the effect of strengthening exercise for hip OA were identified by the literature search. Strengthening exercise has been shown to reduce pain in subjects with hip or knee OA [33, 34], but no improvement in self-reported disability was seen [34]. Neither of these studies states the proportion of subjects with hip OA and knee OA but one of them found no interaction between location of OA and outcome [34].

In summary, there is category 1B evidence to support this statement for knee OA but a paucity of evidence exists for hip OA (category 4 evidence). Quality scores and effect sizes are summarized in Table 2.

2. There are few contraindications to the prescription of strengthening or aerobic exercise in patients with hip or knee OA. There is no direct evidence concerning contraindications to exercise therapy for hip or knee OA. The British Association for Cardiac Rehabilitation has produced guidelines for exercise therapy [35] listing contraindications (Table 3), but the relevance of these to people with OA rather than cardiac disease is not known. Eleven of the studies of exercise for hip or knee OA discussed above list a history of cardiac disease as an exclusion criterion [11–14, 18, 20, 22, 27, 28, 30, 32]. A minority of intervention trials of exercise in hip or knee OA report adverse events in detail but the frequency of minor adverse events related to the intervention such as exacerbation of pain ranges from 0–11.8% [11, 22, 25–36]. Serious adverse events such as falls or fracture appear to be rare.

In summary, exercise appears to be a safe intervention and the number of contraindications is relatively few (category 4 evidence).

TABLE 3. British Association for Cardiac Rehabilitation contraindications to exercise therapy [35]

Hypertrophic obstructive cardiomyopathy
Significant aortic stenosis
Acute febrile illness
Viral infection
Acute myocarditis
Exercise-induced ventricular arrhythmia
Patients with unstable symptoms or conditions

3. Prescription of both general (aerobic fitness training) and local (strengthening) exercises is an essential, core aspect of management for every patient with hip or knee OA. There is no evidence from clinical trials addressing this proposition directly. Exercise is a core recommendation in all guidelines for the management of patients with hip or knee OA [2–4]. Although there is evidence from one RCT of the benefit of combining aerobic and strengthening exercises (QS 24; ES pain 0.29) [37], the recommendation that prescription of both general and local exercises is an essential, core aspect of management for every patient with hip or knee OA is based solely on expert consensus (category 4 evidence).

4. Exercise therapy for OA of the hip or knee should be individualized and patient-centred taking into account factors such as age, co-morbidity and overall mobility. This proposition represents the ideal standard of clinical practice. There is no evidence to support this statement, as clinical trials tend to recruit homogeneous populations to whom a standard intervention is delivered with little room for individualization of treatment. Many factors such as the patient's beliefs and experiences concerning OA, their expectations from their disease and its management, the requirements of the patient's daily routine and their co-morbid disease and its treatment should be considered when prescribing exercise therapy, particularly as these have implications for adherence [38]. Hence, the findings of clinical trials may not be generalizable to clinical practice.

This proposition has not been assessed in clinical trials but has clear face-validity (category 4 evidence).

5. To be effective, exercise programmes should include advice and education to promote a positive lifestyle change with an increase in physical activity. The literature search did not identify any studies addressing this proposition with reference to hip or knee OA, although many clinical trials in OA include education or advice as part of the exercise intervention. Evidence

from the general exercise literature suggests that advice and education delivered in the form of self-efficacy enhancing information (QS 16 16 16) [39–41], a group-mediated cognitive behavioural intervention (QS 21) [42], an exercise dosage prescription instrument (QS 26) [43], individually tailored exercise prescription (QS 14) [44] and one-to-one person-centred exercise consultation (QS 14 15) [45, 46] leads to increased physical activity. Motivational interviewing (QS 17) [47] has also been shown to increase physical activity but activity levels were not maintained at 1 yr. Relapse prevention and reinforcement interventions were not found to promote exercise adherence in one RCT (QS 13) [48].

In summary, there is category 1B evidence that advice and education can promote lifestyle change and increase physical activity but solely category 4 evidence that such techniques are required for exercise programmes to be effective.

6. Group exercise and home exercise are equally effective and patient preference should be considered. A meta-analysis of exercise for OA of hip or knee compared the effect of supervised group-based treatment and home programmes [49]. The mean effect sizes for self-reported pain were 0.47 for exercise classes and 0.28 for home programmes. Although these effect sizes would be considered medium and small, respectively, suggesting that exercise classes are more effective than home programmes, there was overlap of the 95% confidence intervals. Furthermore, exercise classes often involve a home component and home programmes may be partly supervised. The recommendation that patient preference should be considered has not been assessed in the literature but this has clear face validity and, where two modes are equally effective, represents ideal clinical practice. No RCTs list patient preference as a reason for drop-out.

In summary, there is category 1A evidence to support both group and home exercise with no clear evidence of superiority of one over the other on indirect comparison and therefore patient preference should be considered (category 4 evidence).

7. Adherence is the principal predictor of long-term outcome from exercise in patients with knee or hip OA. Using different measures, adherence has been shown to be an important predictor of outcome from exercise in five RCTs (QS median 20, range 11–23) [11, 21, 26, 50, 51]. One of these studies calculated effect sizes of 0.42, 0.34 and 0.16 for high-, medium- and low-adherence groups respectively [26]. Furthermore, two follow-up studies of previous RCTs (QS 16 18) have shown that by 12 and 9 months after the end of the intervention period, subjects' improvements had regressed to baseline [52, 53]. Whether adherence is the principal predictor of outcome is unknown as the small number of studies which have performed sub-group analyses of other potential predictors such as age, weight and severity of radiographic changes do not reach consistent findings [11, 18, 22, 54]. Similarly, it is not known whether long-term outcome is predicted by adherence, as the longest study of exercise is of only 2 yr duration [26]. There is, therefore, category 1B evidence supporting adherence as an important predictor of outcome but only category 4 evidence supporting it as the principal predictor.

8. Strategies to improve and maintain adherence should be adopted, e.g. long-term monitoring/review and inclusion of spouse/family in exercise. The literature search identified few studies addressing this proposition with reference to hip or knee OA. One study of subjects with OA or RA affecting weight-bearing joints showed that support from friends was associated with maintenance of exercise 9 months after completing an exercise programme but not after 18 months (QS13) [55].

In the general exercise literature, telephone contact (QS 19 10) [56, 57], personal trainers and financial incentives (QS 15) [58] have been shown to increase adoption of exercise programmes. Self-monitoring by means of a diary (QS 10 11) [57, 59], reinforcement by another individual (QS 11) [59], telephone and mail contact (QS 11) [60], and graphic feedback (QS 13) [61] increase maintenance. Married couples have been shown to attend an exercise programme more frequently if they attend with their spouse (QS 12) [62], and support from family and friends predicts maintenance of adherence (QS 15 11) [63, 64].

There is category 1B evidence to support this statement extrapolated from the general exercise literature but few studies of hip or knee OA have addressed this issue (category 4 evidence).

9. The effectiveness of exercise is independent of the presence or severity of radiographic findings. There is no direct evidence to support this proposition. Only one RCT of exercise has examined severity of radiographic findings as a predictor of response [18]. This study stratified according to medial knee joint space width and demonstrated significantly greater improvement in pain and function in subjects with less severe loss of medial joint space. Other radiographic features of OA have not been studied. This recommendation is not supported by current research evidence (category 4 evidence)

10. Improvements in muscle strength and proprioception gained from exercise programmes may reduce the progression of knee and hip OA. Evidence from RCTs confirms that exercise increases muscle strength (QS median 19, range 14–24; ES 9 studies, median 0.32, range 0.02–0.96) [11, 13, 15, 17–21, 23–26, 29, 30, 33, 34, 37] and one non-randomized controlled trial showed improvement in proprioception (QS 10, ES 0.21) [36]. Very few studies, however, have examined the effect on progression of knee and hip OA. One RCT found no change in radiographic features of knee OA after an 18-month exercise programme [11]. It has been suggested that greater quadriceps strength at baseline increases the likelihood of OA progression in malaligned or lax knees [65] but this cannot be extrapolated to improvements in strength achieved through an exercise intervention.

The proposition that improvements in strength and proprioception lead to reduced progression is based solely on expert opinion (category 4 evidence).

Category of evidence/strength of recommendation

The category of evidence and strength of recommendation for each proposition is summarized in Table 4.

Discussion

These are the first recommendations for exercise in the management of hip or knee OA to combine and differentiate both research evidence and expert opinion with key clinical statements derived by the Delphi technique [6]. They concur with existing traditional style expert guidelines [2–5] in emphasizing the convincing body of research evidence that supports the benefit of exercise for patients with hip or knee OA. They differ, however, in also considering related issues such as contraindications, adherence, predictors of response and the question of how best to deliver exercise as an intervention. Many of these questions, particularly with specific reference to OA, remain unanswered in the research literature.

There are numerous methods for producing clinical 'guidelines' and 'recommendations', and each has its strengths and weaknesses. There are several caveats to the methodology that we used. Firstly, a Delphi approach was used to minimize bias and ensure the validity of our recommendations. This relies upon the experts

TABLE 4. Propositions, category of evidence and strength of recommendation

Proposition	Category of evidence (1–4)	Strength of recommendation (A-D)
Both strengthening and aerobic exercise can reduce pain and improve function and health status in patients with knee and hip OA	Knee 1B Hip 4	A C (extrapolated from knee OA)
There are few contraindications to the prescription of strengthening or aerobic exercise in patients with hip or knee OA	4	C (extrapolated from adverse event data)
Prescription of both general (aerobic fitness training) and local (strengthening) exercises is an essential, core aspect of management for every patient with hip or knee OA	4	D
Exercise therapy for OA of the hip or knee should be individualized and patient-centred taking into account factors such as age, co-morbidity and overall mobility	4	D
To be effective, exercise programmes should include...	4	D
...advice and education to promote a positive lifestyle change with an increase in physical activity	1B	A
Group exercise and home exercise are equally effective...	1A	A
...and patient preference should be considered	4	D
Adherence is the principal predictor of long-term outcome from exercise in patients with knee or hip OA	4	D
Strategies to improve and maintain adherence should be adopted, e.g. long-term monitoring/review and inclusion of spouse/family in exercise	1B	A
The effectiveness of exercise is independent of the presence or severity of radiographic findings	4	Not recommended
Improvements in muscle strength and proprioception gained from exercise programmes may reduce the progression of knee and hip OA	4	D

involved and some may question whether the composition of our group contained the correct proportional representation of health professionals. Patients were not represented, and clearly recommendations need to be acceptable to patients if they are to have any clinical impact. It is possible that our literature search is incomplete. Although we attempted to overcome this by using multiple databases, only English-language publications were considered so that some research information would have been excluded. The categories of evidence relate to clinical research evidence, and the results of such clinical trials may not be generalizable to routine clinical practice and the complete spectrum of patients with OA. The method used to allocate strength of recommendation was directly related to the category of evidence and hence the research evidence. We feel that an alternative more flexible methodology that enabled experts to provide the strength of recommendation based on a combination of the research evidence and their own opinion and experience is desirable. The methodological quality of trials was also assessed, but we did not use this to weight the balance of evidence since the scoring systems relate more to presentation of data than to the quality and solidity of the study design and findings. Indeed we did not find quality scores to be of any help in the analysis and they may not be considered necessary in future similar recommendations.

The gaps in the available research evidence that were identified by the literature search highlight the need for future studies to address issues such as contraindications to exercise, predictors of response, increasing adherence and promoting physical activity, the role of exercise and muscle strength in progression and how best to deliver exercise as an intervention in subjects with hip or knee OA. Given that exercise is clearly of benefit in people with large joint OA, it is these more practical aspects of long-term exercise delivery and maintenance that now require attention. This set of recommendations is not meant to be a didactic or static guideline for management. Instead, we hope that it will act as a catalyst and focus of debate for health-care professionals who are involved with people who have hip or knee OA and raise the profile of exercise in the management plan of OA. The recommendations will need to be discussed and modified in the light of feedback and future research knowledge.

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Key messages

- These are the first evidence-based recommendations on exercise for knee and hip OA to differentiate research evidence and expert consensus.
- Gaps in our knowledge requiring further research are highlighted.
- Practical aspects related to the delivery of both aerobic and strengthening exercise are discussed.

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