

## Exercise for Osteoarthritis of the Knee

Chung-Wei Christine Lin, Deborah Taylor, Sita M.A. Bierma-Zeinstra, Christopher G. Maher

<LEAP> highlights the findings and application of Cochrane reviews and other evidence pertinent to the practice of physical therapy. The Cochrane Library is a respected source of reliable evidence related to health care. Cochrane systematic reviews explore the evidence for and against the effectiveness and appropriateness of interventions—medications, surgery, education, nutrition, exercise—and the evidence for and against the use of diagnostic tests for specific conditions. Cochrane reviews are designed to facilitate the decisions of clinicians, patients, and others in health care by providing a careful review and interpretation of research studies published in the scientific literature.<sup>1</sup> Each article in this new PTJ series will summarize a Cochrane review or other scientific evidence resource on a single topic and will present clinical scenarios based on real patients to illustrate how the results of the review can be used to directly inform clinical decisions. This article focuses on a patient with moderate osteoarthritis in both knees. [Can exercise help this patient?](#)

Find <LEAP> Case #1 at <http://ptjournal.apta.org/cgi/content/full/90/1/9>.

Osteoarthritis (OA) is a joint disorder characterized by progressive degeneration of the articular cartilage, resulting in a loss of joint space and loss of marginal and central new bone formation. Structural abnormalities of all tissues in the joint—including the cartilage, subchondral bone, synovium, capsule, and ligaments—also may be present.<sup>2</sup> Pain and functional limitation are the main complaints in people with symptomatic OA. Worldwide, OA is one of the leading causes of disability, particularly in the elderly population,<sup>3,4</sup> and is most prevalent at the hip and knee. Osteoarthritis can be managed conservatively, and, in more severe cases, by joint replacement surgery. However, international guidelines recommend conservative treatments as first-line care for people with OA.<sup>5-8</sup> These treatments include medications, exercise, education, and weight loss.

Exercise is used to address specific problems experienced by people with knee OA. These problems include reduced joint range of motion, lower-limb muscle strength,<sup>9</sup> and aerobic fitness<sup>10</sup> at the level of body function and activity limitation<sup>11</sup> and reduced quality of life<sup>12,13</sup> at a global level of health. Fransen and McConnell<sup>14</sup> conducted a Cochrane systematic review to evaluate the benefits of exercise for knee OA on 2 outcomes: pain and physical function (Tab. 1).

### Take-Home Message

Thirty-two randomized or quasi-randomized controlled trials comparing land-based exercises with a nonexercise intervention were included in this Cochrane review,<sup>14</sup> and the pooled results showed a small benefit for exercise in reducing pain and improving physical function. Because studies in the review varied widely in the mode, content, and dosage of exercises provided, it was not possible to suggest an optimal exercise strategy. Most studies, however, provided an exercise program consisting of strengthening exercises with or without range of motion or aerobic exercises. An indirect comparison of the different modes of exercise showed that lower-limb muscle strengthening, aerobic exercise, or a combination of both seemed to be equally effective for both pain and physical function.<sup>14,15</sup>

The Cochrane review had some limitations. Only studies published in English were included, and only data collected at the end of the treatment period were extracted; therefore, only short-term effects were presented. Randomized controlled trials published since the 2008 Cochrane review found similar posttreatment benefits in support of exercise.<sup>16-19</sup> In the studies that provided longer-term results (3 months or more), there was some indication that the benefits of exercise persisted.<sup>17,19</sup> However, a systematic review investigating the long-term benefits of exercise showed that exercise did not have a significant effect

## <LEAP> Case #2 Exercise for Osteoarthritis of the Knee

**Table 1.**  
Exercise for Osteoarthritis of the Knee: Cochrane Review Results<sup>14</sup>

<p>&gt; 32 randomized and quasi-randomized controlled trials were included, providing data on 3,616 participants for pain and 3,719 participants for self-reported physical function.</p>	
<p>&gt; Participants in the studies fulfilled the American College of Rheumatology diagnostic criteria for knee osteoarthritis or had self-reported knee pain and were recruited from the community, general practice clinics, or rheumatology, orthopedic, or physical therapy outpatient clinics.</p>	
<p>&gt; Studies compared land-based exercise with any nonexercise intervention (most commonly, no treatment/waiting list or education sessions). Exercise programs varied widely in the mode of delivery (eg, individual vs group), content, and dosage. Twenty studies included strengthening exercises, and 9 studies included aerobic exercises in the exercise program.</p>	
<p>&gt; Only data from the most immediate assessment after the treatment period were reported. Overall, exercise had a small benefit in reducing pain and improving physical function.</p>	
Pain	<p>There was a small and statistically significant benefit toward exercise (standardized mean difference<sup>a</sup>=0.40, 95% confidence interval=0.30–0.50). The most common measure for pain was the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) pain subscale (15 studies), followed by the visual analog scale (9 studies).</p>
Self-reported physical function	<p>There was a small and statistically significant benefit toward exercise (standardized mean difference<sup>a</sup>=0.37, 95% confidence interval=0.25–0.49). The most common measure for physical function was the WOMAC subscale for physical function (17 studies).</p>
<p>&gt; In general, mode of delivery, content, and dosage of exercises did not influence outcomes, except that a higher number of contact sessions between clinicians and patients increased the size of the treatment effect.</p>	
<p>&gt; Studies with more rigorous trial design (eg, blinded outcome assessment, larger sample size) produced smaller, though still statistically significant, treatment effects.</p>	

<sup>a</sup>The standardized mean difference is the difference in mean outcome between groups divided by the standard deviation of the outcome.<sup>23</sup> As a guide, a standardized mean difference of 0.2 represents a small effect, 0.5 a moderate effect, and 0.8 a large effect.<sup>24</sup>

on pain or physical function after 6 months, except when booster sessions were implemented.<sup>20</sup>

### <LEAP> Case #2: Exercise for Osteoarthritis of the Knee

#### Can exercise help this patient?

Mr S is a 55-year-old man with a 3-year history of progressively increasing bilateral knee pain, left worse than right. During the

past 3 months, he was in a sedentary job, his weight increased by more than 10 kg, and his symptoms increased significantly. Mr S reported left knee pain as being 6 out of 10 on the visual analog scale (Tab. 2), and he was using a walking stick to walk any distance. He had minimal symptoms at night, stiffness that resolved after about 15 minutes in the morning, and symptoms that worsened as the day went on. His pain was

exacerbated by walking more than 15 minutes or on hills and by long periods of sitting. Mr S found relief by using a walking stick, moving his knees when sitting, and taking regular doses of a nonsteroidal anti-inflammatory drug and paracetamol. Mr S's radiographic films showed a decreased medial knee joint height with osteophyte formation. Overall, his presentation was consistent with moderate knee OA.

Mr S was working full time, sitting at a desk for most of the day, and reported that he was managing his daily activities (eg, shopping, gardening) with slight difficulty. On the Patient-Specific Functional Scale<sup>21</sup> (/10), where a score of 0 was “unable to perform activity” and 10 was “able to perform activity at the same level as before,” he identified 3 activities that he had difficulties with: walking on a flat surface, walking on hills, and sitting (Tab. 2). Mr S had no limitations in knee range of motion; however, there was pain at end-range flexion on the

**Table 2.**  
Mr S's Progress Before and After an Exercise Program, Contrasted With the Minimal Clinically Important Difference of Each Scale<sup>a</sup>

	Minimal Clinically Important Difference	Before Exercise	After Exercise
Pain (visual analog scale, /10)	2 <sup>22</sup>		
Worst pain		6	3
Self-reported physical function (Patient-Specific Functional Scale, /10) <sup>b</sup>	>1.5 <sup>21</sup>		
Walking on flat surface		5	8
Walking on hills		4	7
Sitting		6	9

<sup>a</sup> Mr S had moderate osteoarthritis in the left knee.

<sup>b</sup> A higher score denotes better physical function.

left. Knee extension was slightly weaker on the left. He also had calf and hamstring muscle tightness that was worse on the left than on the right.

### How did the results of the Cochrane systematic review apply to Mr S?

Exercise is recommended as part of the first-line care for OA, and results of the Cochrane review support the use of exercise. Mr S himself stated that he had no regular exercise routine, and his goal was to be shown an appropriate exercise regimen that would help him improve his ability to walk and decrease his pain.

Mr S started on an exercise program that included quadriceps and gluteal muscle strengthening exercises and calf and hamstring muscle stretches. The dose for the strengthening and stretching exercises was established based on examination findings, and the exercises were progressed to more challenging functional exercises with increased

resistance as he improved. These exercises included sit-to-stand exercises, step exercises with emphasis on good lower-limb alignment, and resisted gluteus medius muscle exercises in a standing position with a blue Thera-Band.\* After 4 weeks, he was able to commence a progressively paced walking program, starting with 20 minutes on alternate days. If there was no increase in his symptoms, Mr S was instructed to increase the walk by 5 minutes at a time until he was comfortably managing 45 minutes. He also had borrowed a stationary bicycle and was encouraged to use it for up to 20 minutes 3 times a week. In conjunction, at his first treatment, Mr S was given education on OA and the importance of self-management strategies (exercise, pacing, and weight loss).

### How well do the outcomes of the intervention provided to Mr S match those suggested in the systematic review?

After 8 weeks of strengthening, stretching, and progressive walking and bicycle exercises, Mr S reported a decrease in his pain. His physical function improved. The decrease in pain on the visual analog scale and improvement in physical function on the Patient-Specific Functional Scale were greater than the minimal clinically important difference for each scale<sup>21,22</sup> (Tab. 2). Mr S reported that he was now able to walk for almost an hour before needing to rest and rarely needed to use his walking stick.

### Can you apply the results of the Cochrane systematic review to your own patients?

The findings of the Cochrane review apply well to Mr S. He had specific deficits that could be addressed with exercise, he was keen for an exercise program to improve his deteriorating condition, and he subsequently benefited from the program. As a person who is middle aged and has moderate symptoms compounded by lifestyle factors (eg, sedentary lifestyle, increasing weight), Mr S is not atypical of the patients with OA seen by physical therapists. Therefore, benefits from exercise can be expected from most patients who follow an exercise program. The Cochrane review shows that variations in the delivery, content, and dosage do not influence outcomes, except that a higher number of contact sessions leads to greater effects, meaning that physical therapists can adapt the exercises to the individual patient (eg, home vs gym-based programs, strengthening exercises vs aerobic exercises vs tai chi).

### What can be advised based on the results of this systematic review?

Patients with knee OA often experience pain and problems in activities involving the lower limb (eg, walking) or prolonged positioning (eg, sitting), as well as stiffness after a night's sleep. Exercise can target these specific deficits. Knee OA also is a potentially deteriorating condition without a curative treatment. Therefore, patients with knee OA are likely to benefit from exercise in managing this long-term condition. It is the physical therapist's role to prescribe appropriate exercises to suit a patient's goals, lifestyle, and overall health condition and ensure that the exercise program is pro-



©2010, Fotosearch, LLC. All rights reserved.

\* The Hygenic Corporation. 1245 Home Ave, Akron, OH 44310.

gressive and challenging in order to deliver benefits.

The benefits of exercise are contingent on a patient's adherence to the exercise program. Evidence to date shows that, although exercise has short-term benefits in reducing pain and improving physical function, these benefits may not persist in the long term without adherence to the exercise program. Therefore, strategies to increase long-term adherence to exercise, such as adding in booster sessions, may be necessary to maximize the benefits of exercise for people with knee OA.

C.-W.C. Lin, PT, PhD, is Research Fellow, Musculoskeletal Division, The George Institute for International Health and Sydney Medical School, The University of Sydney, PO Box M201, Missenden Rd, Sydney, New South Wales 2050, Australia.

D. Taylor, PT, BAppSc(Phy), is Senior Musculoskeletal Physiotherapist, Physiotherapy Department, Royal North Shore Hospital, Pacific Highway, St Leonards, New South Wales 2065, Australia.

S.M.A. Bierma-Zeinstra, PhD, is Associate Professor, Department of General Practice, Erasmus MC University Medical Center, PO Box 2040, 3000 CA, Rotterdam, the Netherlands.

C.G. Maher, PT, PhD, is Director, Musculoskeletal Division, The George Institute for International Health and Professor, Sydney Medical School, The University of Sydney, PO Box M201, Missenden Rd, Sydney, New South Wales 2050, Australia. Address all correspondence to Dr Maher at: cmaher@george.org.au.

Dr Lin and Dr Maher are funded by the National Health and Medical Research Council, Australia.

DOI: 10.2522/ptj.20100084

## References

- 1 The Cochrane Library. Available at: <http://www3.interscience.wiley.com/cgi-bin/mrwhome/106568753/HOME>. Accessed December 8, 2009.
- 2 Felson DT, Lawrence RC, Dieppe PA, et al. Osteoarthritis: new insights, part 1: the disease and its risk factors. *Ann Intern Med*. 2000;133:635-646.
- 3 Guccione AA, Felson DT, Anderson JJ, et al. The effects of specific medical conditions on the functional limitations of elders in the Framingham study. *Am J Public Health*. 1994;84:351-358.
- 4 Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. *Bull World Health Organ*. 2003;81:646-656.
- 5 Zhang W, Moskowitz RW, Nuki G, et al. OARSI recommendations for the management of hip and knee osteoarthritis, part II: OARSI evidence-based, expert consensus guidelines. *Osteoarthritis Cartilage*. 2008;16:137-162.
- 6 Jordan KM, Arden NK, Doherty M, et al. EULAR Recommendations 2003: an evidence-based approach to the management of knee osteoarthritis: Report of a Task Force of the Standing Committee for International Clinical Studies Including Therapeutic Trials (ESCISIT). *Ann Rheum Dis*. 2003;62:1145-1155.
- 7 Conaghan PG, Dickson J, Grant RL. Care and management of osteoarthritis in adults: summary of NICE guidance. *BMJ*. 2008;336:502-503.
- 8 American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. Recommendations for the medical management of osteoarthritis of the hip and knee: 2000 update. *Arthritis Rheum*. 2000;43:1905-1915.
- 9 Fransen M, Crosbie J, Edmonds J. Isometric muscle force measurement for clinicians treating patients with osteoarthritis of the knee. *Arthritis Rheum*. 2003;49:29-35.
- 10 Philbin EF, Groff GD, Ries MD, Miller TE. Cardiovascular fitness and health in patients with end-stage osteoarthritis. *Arthritis Rheum*. 1995;38:799-805.
- 11 Fautrel B, Hilliquin P, Rozenberg S, et al. Impact of osteoarthritis: results of a nationwide survey of 10,000 patients consulting for OA. *Joint Bone Spine*. 2005;72:235-240.
- 12 Fitzgerald JD, Orav EJ, Lee TH, et al. Patient quality of life during the 12 months following joint replacement surgery. *Arthritis Rheum*. 2004;51:100-109.
- 13 Salaffi F, Carotti M, Stancati A, Grassi W. Health-related quality of life in older adults with symptomatic hip and knee osteoarthritis: a comparison with matched healthy controls. *Aging Clin Exp Res*. 2005;17:255-263.
- 14 Fransen M, McConnell S. Exercise for osteoarthritis of the knee. *Cochrane Database Syst Rev*. 2008;4:CD004376.
- 15 Roddy E, Zhang W, Doherty M. Aerobic walking or strengthening exercise for osteoarthritis of the knee? A systematic review. *Ann Rheum Dis*. 2005;64:544-548.
- 16 Jan M-H, Lin C-H, Lin Y-F, et al. Effects of weight-bearing versus nonweight-bearing exercise on function, walking speed, and position sense in participants with knee osteoarthritis: a randomized controlled trial. *Arch Phys Med Rehabil*. 2009;90:897-904.
- 17 Jenkinson CM, Doherty M, Avery AJ, et al. Effects of dietary intervention and quadriceps strengthening exercises on pain and function in overweight people with knee pain: randomised controlled trial. *BMJ*. 2009;339:b3170.
- 18 Lim B-W, Hinman RS, Wrigley TV, et al. Does knee malalignment mediate the effects of quadriceps strengthening on knee adduction moment, pain, and function in medial knee osteoarthritis? A randomized controlled trial. *Arthritis Rheum*. 2008;59:943-951.
- 19 Wang C, Schmid CH, Hibberd PL, et al. Tai chi is effective in treating knee osteoarthritis: a randomized controlled trial. *Arthritis Rheum*. 2009;61:1545-1553.
- 20 Pisters MF, Veenhof C, van Meeteren NL, et al. Long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a systematic review. *Arthritis Rheum*. 2007;57:1245-1253.
- 21 Chatman AB, Hyams SP, Neel JM, et al. The Patient-Specific Functional Scale: measurement properties in patients with knee dysfunction. *Phys Ther*. 1997;77:820-829.
- 22 Tubach F, Ravaud P, Baron G, et al. Evaluation of clinically relevant changes in patient reported outcomes in knee and hip osteoarthritis: the minimal clinically important improvement. *Ann Rheum Dis*. 2005;64:29-33.
- 23 Higgins JPT, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions, Version 5.0.2* [updated September 2009]. The Cochrane Collaboration. 2009. Available at: [www.cochrane-handbook.org](http://www.cochrane-handbook.org).
- 24 Cohen J. *Statistical Power Analysis in the Behavioral Sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates Inc; 1988.