Rehabilitation Interventions for Pain and Disability in Osteoarthritis
A review of interventions including exercise, manual techniques, and assistive devices.

Maura Daly Iversen

OVERVIEW: Osteoarthritis (OA) results in progressive destruction of articular cartilage and bone at the joint margins, leading to impairments extending far beyond the synovial joint. Rehabilitation interventions that target specific impairments and activity restrictions can help restore independence and promote healthy living. Such interventions include exercise, physical modalities (ice, heat, ultrasonography), manual techniques (mobilization and manipulation), and assistive devices. The predominance of evidence on the effects of rehabilitation interventions for knee and hip OA suggests that they afford modest pain relief, reduced disability, and improved function. Research is needed to identify the modes of exercise and the effective doses for relief of symptoms and functional limitations.

KEYWORDS: exercise, osteoarthritis, rehabilitation

Symptomatic osteoarthritis (OA) is the most prevalent joint disease in the United States, occurring in roughly 10% of men and 13% of women ages 60 and older. It's the second most common cause of work-related disability in men over age 50 and frequently involves the large weight-bearing joints and the hands (the distal and proximal interphalangeals and the thumb carpometacarpal). OA is most often localized, but it has systemic features, and rehabilitation requires a comprehensive, patient-centered approach.

Rehabilitation for symptomatic OA targets impairment and restriction of activities and may be useful in modifying OA risk factors. Typical signs and symptoms include pain, joint swelling, joint stiffness upon waking and after prolonged inactivity, crepitus, loss of range of motion, and bony deformity. Possible impairments that limit activity include reduced grip strength and difficulties with transfer, imbalance, walking, and stair climbing, and these can lead to an inability to remain employed and engage in social activities. The magnitude of such restrictions in people with knee OA, for example, equals that found in people with heart disease, congestive heart failure, and chronic obstructive pulmonary disease.2 Rehabilitation interventions include exercise, manual therapies such as mobilization and manipulation, physical modalities such as application of heat and ice, splinting and bracing, orthotics, assistive devices, ergonomic modifications, and education (see Figure 1). While these do address the impairments and limitations, the evidence supporting their use is inconclusive.

I searched several databases—MEDLINE, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), the Cochrane Database of Systematic Reviews, and the Physiotherapy Evidence Database (PEDro)—using the terms hip osteoarthritis and knee osteoarthritis combined with randomized controlled trials and systematic reviews of exercise (aerobic, strengthening, flexibility), plus systematic reviews of splints, modalities, and heat-cold therapy. I restricted the search to articles published between 2000 and March 2011.

Exercise is the most studied intervention and appears to provide modest benefits with respect to pain, function, and disability. Clinical practice guidelines and professional society guidelines have been developed based on expert opinion and a synthesis of the literature.3–10 All identify exercise as a main component of OA management (see Table 13–5,7,9–12). Some of the guidelines also support the use of assistive devices, orthotics, and self-management strategies.1,2

In this paper, I focus predominantly on studies examining the effectiveness of rehabilitation interventions in people with hip and knee OA and synthesize the evidence when possible. In the section on manual therapy, I expand the review to include studies on OA of the
spine. And although there are few studies examining hand OA, I include a section on that as well.

**The Evidence For Exercise**

Biomechanical factors such as joint misalignment play a role in the development and progression of OA. Other risk factors, such as muscle weakness, impaired motor control, and diminished physical fitness, are modifiable with exercise. The evidence for the use of exercise in the management of symptomatic OA has evolved over the past two decades and includes clinical trials of several types of physical activities.

Data from large randomized, controlled trials (RCTs) and systematic reviews of the literature indicate that exercise provides small to modest benefits (effect sizes ranging from 0.2 to 0.4) for pain relief, improved function, and reduced disability.10,13-19 However, details on the frequency, intensity, duration, and type of exercise (aerobic, flexibility, dynamic or static strengthening, balance activities) are not always specified.20 Helmark and colleagues reported that in a group of women with knee OA, exercise increased both intraarticular and perisynovial concentrations of interleukin-10, an antiinflammatory cytokine that protects chondrocytes (cartilage cells) and may be responsible for the benefits for OA seen with exercise.21

**Land-based exercise** is the most studied form. A recent Cochrane review summarized the data from 32 RCTs involving almost 3,800 people with symptoms of knee OA of varying duration.1 Subjects were allocated to a group participating in land-based exercise of varying modes, durations, and intensities or to a nonexercise group. A mix of forms of exercise (such as aerobic, strengthening, flexibility) was employed, but aquatic exercise programs were not included. Subjects in the exercise group demonstrated small but clinically relevant short-term benefits in pain (standardized mean difference [SMD], 0.40; 95% CI, 0.30–0.50) and in physical function (SMD, 0.37; 95% CI, 0.25–0.49). Subgroup analyses indicated that exercise programs for quadriceps and lower-limb strengthening (weight training or the use of resistance bands, for example) provided small but significant self-reported benefits in function and pain. General strengthening and aerobic programs were less effective. Regarding exercise dosage, the authors divided the study data into supervised sessions of 12 or more or less than 12, regardless of program duration, and found that 12 or more supervised sessions yielded greater benefit. The format of treatment delivery (individual, home visits by a nurse or physical therapist, or supervised group classes) did not alter the effects of the intervention. Results varied according to whether the exercise was supervised and the number of program contacts. No analysis was conducted to determine whether patient demographics (such as race or sex) affected outcomes. The authors noted, however, that the benefits gained from exercise were comparable with those reported for nonsteroidal antiinflammatory drugs.

Fransen and colleagues conducted a similar systematic review of five RCTs of land-based exercise for people with hip OA.16 They found only small effects for pain and none for function. It’s important to note that only one of the five studies contained a sample with only hip OA; the others included subjects with hip or knee OA or both. Due to the limited data, subanalyses were not conducted.

**Aquatic exercise, or hydrotherapy,** is performed in water, which promotes muscle relaxation and facilitates movement by making use of water’s physical properties—buoyancy, adherence, and temperature adjustability. Buoyancy helps support body weight and unload joints. Water molecules adhering to one another and to the skin provide resistance when exercising. The recommended water temperature is 83°F to 88°F.22 Water exercises may consist of any mode of exercise (aerobic, stretching, strengthening, and range of motion). Bartels and colleagues synthesized data from six clinical trials of short-term (approximately three months long) aquatic exercise for hip or knee OA.13 Data were analyzed from 800 subjects randomly assigned to an aquatic exercise group, a land-based exercise group, or a control group. The results suggested that hydrotherapy has small to moderate short-term effects on function (SMD,
Physical Modalities

Physical modalities use physical energy to achieve therapeutic effects and are employed as adjunctive treatments to prepare for manual therapy, exercise, and gait-training activities. Physical modalities include a vast array of interventions, including thermotherapy, electrotherapy, pressure, and light therapy.

Thermotherapy is the most common of these. Defined as the use of heat or cold as a treatment, it alters skin and soft-tissue temperature by using radiation (infrared light) or conduction (hot packs, paraffin, water). Superficial heat is believed to increase the pain threshold, reduce muscle spasm, and relieve pain by acting on free nerve endings. Cold therapy may be applied using a variety of techniques, including ice packs, ice massage, cold baths, and vapocoolant sprays. Cold therapy decreases pain and inflammation by constricting blood flow in superficial and intraarticular tissues and slowing nerve conduction.

In a meta-analysis of three RCTs of thermotherapy for people with knee OA, 179 patients with physician-diagnosed disease (some with X-ray confirmation) received cold or ice packs with or without ice massage, hot packs, or no treatment. All subjects took medications as prescribed. The primary outcomes examined were pain relief, decreased swelling, improved range of motion, and better function. One of the studies found that, compared with no treatment, 20 minutes of ice massage five days a week for three weeks had a clinically important benefit for quadriceps strength (29% relative difference) and produced small gains in knee range of motion (8% relative difference) and functional status (11% relative difference). The studies were not of high quality and the therapy was administered for varying amounts of time, but in all three studies improvements were found in range of motion, function, and knee muscle strength. Cold appeared to reduce swelling but not pain. More rigorous research is needed.

Therapeutic ultrasonography uses sound waves to produce deep-tissue heating. (There are nonthermal effects as well, but these effects are not usually used therapeutically for musculoskeletal disorders.) Administered by a licensed provider, it reduces pain and maximizes function. The sound waves are absorbed in tissues having high collagen content, so in areas where bony surfaces are prominent, a pulsed rather than continuous mode should be used to avoid damaging tissues (pulsed ultrasonography reduces the risk of burning by administering the sound waves in small bursts). Heating occurs primarily at tissue interfaces (such as bone and soft tissue), although sound waves may penetrate 7 to 8 cm of fat. There have been few high-quality clinical trials examining the benefits of ultrasonography in rehabilitation. Rutjes and colleagues conducted a

### Table 1. Guidelines on the Use of Rehabilitation Interventions for Knee or Hip Osteoarthritis (OA)

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>American College of Rheumatology²⁻⁵</td>
<td>• Aerobic, range-of-motion, and muscle-strengthening exercises along with physical and occupational therapy</td>
</tr>
<tr>
<td>Centers for Disease Control and Prevention¹¹</td>
<td>• 150 minutes of moderate-intensity aerobic activity per week OR 75 minutes of vigorous-intensity aerobic activity per week</td>
</tr>
<tr>
<td>European League Against Rheumatism (EULAR)⁷</td>
<td>• Strengthening exercises on 2 or more days per week</td>
</tr>
<tr>
<td>National Health Service¹²</td>
<td>• Balance work on 3 days per week, if at risk for falling</td>
</tr>
<tr>
<td>Osteoarthritis Research Society International¹⁰</td>
<td>• Regular exercise along with pharmacologic therapy, although the best exercise regimen has not been determined</td>
</tr>
<tr>
<td></td>
<td>• Activity and exercise, which should include stretching, strengthening, and general aerobic fitness; manipulation and stretching should be used as adjunctive therapies for hip OA</td>
</tr>
<tr>
<td></td>
<td>• Patients with symptomatic hip or knee OA should be referred to a physical therapist for evaluation and instruction in exercise and encouraged to engage in regular aerobic, strengthening, and range-of-motion exercises. Water exercises are encouraged for knee and hip OA.</td>
</tr>
<tr>
<td></td>
<td>• Canes are recommended, as appropriate, with instruction in their use in the contralateral hand. Frames or wheeled walkers are best for those with bilateral OA.</td>
</tr>
<tr>
<td></td>
<td>• With mild-to-moderate varus or valgus instability, a knee brace can relieve pain, enhance stability, and lessen the risk of falling.</td>
</tr>
<tr>
<td></td>
<td>• Patients with hip or knee OA should receive advice on footwear.</td>
</tr>
<tr>
<td></td>
<td>• Thermal modalities may relieve hip and knee OA symptoms.</td>
</tr>
<tr>
<td></td>
<td>• Transcutaneous electrical nerve stimulation can provide short-term pain relief in some cases of hip or knee OA.</td>
</tr>
<tr>
<td></td>
<td>• Acupuncture may relieve knee OA symptoms.</td>
</tr>
</tbody>
</table>
systematic review of five RCTs or quasi-RCTs that compared therapeutic ultrasonography with a sham intervention or no intervention in patients with knee OA. Data from 341 patients were synthesized. Two trials evaluated pulsed ultrasound, two evaluated continuous, and one both pulsed and continuous ultrasound. The outcomes examined included pain, physical function, and disability (as determined using the Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC]). The intervention groups experienced improvements in self-reported pain measured on a visual analog scale (SMD, −1.2 cm; 95% CI, −1.9 to −0.6) and in function (SMD, −1.3 units on the 1-to-10 WOMAC disability scale; 95% CI, −3 to 0.3). No adverse events were reported. The authors noted that there was a high degree of heterogeneity among the trials for the outcome of function (88%).

Electrical stimulation. Research suggests that pulsed electrical stimulation might assist in the development of cartilage, and it has long been used as an adjunctive therapy to address pain and ultimately improve function. Hulme and colleagues conducted a systematic review of three RCTs and controlled clinical trials that compared pulsed electromagnetic fields or direct electrical stimulation with placebo in 259 patients with knee OA. Both forms of electrical stimulation were included in the review because they act by the same mechanism. The primary outcome examined was pain, and secondary outcomes included physical function, joint imaging, patient global function, and stiffness, among others. The authors concluded that electrical stimulation therapy produced small to moderate statistically significant effects on all outcomes (SMD, −0.59 to −0.91), with clinical benefit ranging from 13% to 23% over placebo. With the exception of knee pain, these benefits did not meet the requirement for clinical significance as defined by Felson of a 20% improvement in four of six measures. The limited number of studies, the fact that the same research team conducted two of the three trials, and the varied application of the modality limit the conclusions that can be made. Further research is warranted.

Manual Therapy And Manipulation

Manual therapy and manipulation, performed by licensed professionals, involve the low- or high-velocity, small- or large-amplitude passive movement of joints. Such movements trigger mechanoreceptors in joints and are often followed by stretching or exercise to gain and maintain the full benefit of the movement. A low-velocity, small-amplitude mobilization consists of a small movement of the joint with gentle pressure. A large-amplitude mobilization is performed by applying greater force and generating more movement. Most of the studies evaluating manual therapy and manipulation are case series and observational studies. Few RCTs have been conducted, and most of them include studies using comparison groups. Thus, no meta-analyses of manual therapy exist. A few recent literature reviews have summarized the data from studies of manual therapy for hip and knee OA and for lumbar spinal stenosis (LSS). French and colleagues summarized the results of four RCTs of manual therapy for persons with hip or knee OA and focused on its impact on pain relief and function. Three of the four trials included patients with knee OA. Only one study examined long-term outcomes. One study compared manual therapy with no treatment, another compared manual therapy with placebo, and two used a comparison group. The authors noted the high risk of bias in three of the four studies and suggested with caution that manual therapy might yield better results than exercise for persons with OA.

Another review recently performed by my colleagues and me evaluated the quality of 11 studies that used manual therapy alone or with exercise to manage symptoms in patients ages 40 to 80 years old with diagnosed mild-to-moderate LSS. Seven studies were summarized; two were classified as being of high quality, two as moderate quality, and three as low quality. Most of the studies evaluated the results of manual therapy combined with exercise, and all reported small to modest effects for pain, disability, and function. We concluded that aerobic exercise combined with flexibility and strengthening exercise and manipulation could be more effective than either exercise or manual therapy alone.

Self-Management

Education, relaxation techniques, weight loss, stress reduction, motivation, and social support can help patients manage their symptoms, adhere to treatment regimens, and live with the consequences of a chronic condition. These interventions can be delivered in a variety of formats (online or in groups, for example). A recent analysis I conducted with my colleagues summarized the data from eight studies that examined self-management for people with OA. Most of the studies enrolled subjects with hip or knee OA or both. The interventions varied—most group interventions took place in 12 hours spread over a six-week period, while individual interventions lasted one hour—and examined pain and function as outcomes, although some also assessed health knowledge, care use, and self-efficacy; mood and fatigue were infrequently assessed. Overall, only half of the studies found significant long-term (12 months or more) improvements in function and pain; two noted significant improvements in self-efficacy, and one reported improved mood. Group interventions appeared to have greater impact on outcomes than individual sessions did.

The most effective interventions consisted of standardized group sessions, including six weeks of supervised exercise, led by trained people and using either cognitive behavioral therapy or theoretical behavioral approaches. [Editor’s note: See “Strategies to Support Self-Management in Osteoarthritis” in this supplement.]

Interventions For Hand OA

Although I found that interventions for hand OA are the least studied, one recent, well-designed systematic review was conducted by Ye and colleagues. They reviewed RCTs, quasi-RCTs, and crossover trials that compared a rehabilitation intervention with a control group, usual care, or no treatment and reported on at least one
of three outcomes: pain, hand function, and other measures of hand impairment. Studies were rated for quality using the PEDro scale—an 11-item scale used to assess the internal validity of a trial. Six studies met the eligibility criteria and were deemed to be of higher quality (PEDro score of more than 6). Of the 10 studies included, three evaluated exercise, two looked at laser and heat therapy, and one studied splints, massage, and acupuncture. One study assessing the use of a night splint demonstrated a large benefit at 12 months for pain, function, strength, and range of motion. Exercise showed no beneficial effects for function and a slight benefit for strength. Low-level laser therapy appeared to provide some gains in range of motion. No interventions improved stiffness. The authors concluded that growing evidence supports the use of some interventions for hand OA, but further research is needed.

Summary

The benefits of exercise for the management of OA, particularly knee OA, are evident. Regardless of mode, delivery, or duration, exercise demonstrates small to moderate positive effects for pain relief, function, and disability. Most studies of exercise in OA involve the knee; substantially fewer exist for OA of the hip, spine, or hand. Limited evidence supports the use of other rehabilitation interventions (such as physical modalities and manual therapy), although work in this area is growing. Given the paucity of studies, it has not been possible to determine which populations (based on sex, race, or ethnicity, for example) benefit the most from rehabilitation. Nor have rigorous cost-effectiveness studies been undertaken.

Uhlig and colleagues commented on the scarcity of economic analyses on rehabilitative interventions for the full spectrum of arthritic conditions. Aspects of the design of studies of nonpharmacologic methods, such as the inability to use a control group and limitations in outcome measures, affect the quality of data and our ability to synthesize them systematically. Recent systematic reviews attempted to document the benefits of exercise and identify the dosage that yields the greatest benefits, but more rigorous study is needed. In the meantime, it’s clear that exercise is as effective as nonsteroidal antiinflammatory drugs in managing many OA symptoms while having fewer risks.

Given the heterogeneity of the exercise programs studied, I recommend viewing exercise as we do medications: each mode has its benefits and risks. As the evidence supporting the use of exercise expands, we may become better able to fully address the question of which mode of exercise, and at what frequency, intensity, and duration, is best for helping our patients with OA.

REFERENCES

21. Helmer IC, et al. Exercise increases interleukin-10 levels both intraarticularly and peri-synovially in...

For 49 additional continuing nursing education articles on evidence-based practice, go to nursingcenter.com/ce.