

Role of physical therapy in management of knee osteoarthritis

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Purpose of review

The purposes of this review are to: (1) describe treatments that physical therapists may use to supplement exercise programs to enhance the benefit of rehabilitation, (2) discuss current research related to the mode of delivery of physical therapy treatment, and (3) identify characteristics from recent research that may influence the responsiveness of individuals with knee osteoarthritis to physical therapy.

Recent findings

Physical therapists provide a variety of interventions, such as manual therapy techniques, balance, coordination, and functional retraining techniques, knee taping techniques, electrical stimulation, and foot orthotics to assist in overcoming some of the barriers that make participation in exercise and physical activity difficult. Recent research implies that a number of factors may influence the responsiveness to physical therapy treatment for individuals with knee osteoarthritis. Factors such as the mode of treatment delivery, treatment compliance issues, mechanical characteristics such as joint laxity and malalignment, and radiographic severity are discussed.

Summary

Future studies are needed to improve our understanding of factors that can influence the responsiveness of patients with knee osteoarthritis to exercise and physical activity programs. The question may not be which mode of therapy works best, but rather, which patient and/or disease characteristics will tell us who will and who will not respond to a given mode of therapy.

Keywords

physical therapy, osteoarthritis, knee, exercise therapy

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Introduction

Regular participation in physical activity has been recognized for several years as being beneficial in the management of knee osteoarthritis (OA) [1–3••]. While there is agreement that exercise therapy can be helpful, the effect of exercise therapy on pain, quadriceps strength, and physical function appears to be small to moderate in most clinical trials [4–11]. These findings suggest that there are likely subgroups of individuals who continue to have pain, muscle weakness, and disability even after participating in an exercise therapy program. Individuals with knee OA must often overcome a variety of problems, such as joint pain, stiffness, limitations in motion, motor and sensory dysfunctions, and functional limitations that prevent them from participating in regular physical activity [3••]. Physical therapists can provide a variety of interventions to address barriers that may prevent individuals with knee OA from achieving maximum benefit from exercise or physical activity programs. The purposes of this review are to: (1) describe treatments that physical therapists may use to supplement exercise programs to enhance the benefit of rehabilitation, (2) discuss current research related to the mode of delivery of physical therapy treatment, and (3) identify characteristics from recent research that may influence the responsiveness of individuals with knee OA to physical therapy.

Physical therapy treatment options

Manual therapy techniques

In recent years, physical therapists have tested the effectiveness of exercise therapy programs that incorporate manual therapy techniques as a supplement to the exercises [12,13]. Manual therapy is the term used to describe passive movements that are applied by the physical therapist with the purpose of increasing joint motion or reducing joint stiffness. Techniques may include passive range of motion, passive accessory joint motions (*ie*, techniques to distract or glide one joint surface with respect to the opposite joint surface), muscle stretching techniques, or soft-tissue mobilization and massage techniques. Deyle *et al.* [12] conducted a randomized trial comparing the use of manual therapy techniques to the knee, hip, foot and ankle, and/or lumbar spine combined with exercises for lower-extremity strengthening, range of motion, and endurance to a group that received a placebo ultrasound treatment. The manual therapy techniques were selected based on the presence of limitations in active or passive joint motions in any or all of

the lower-extremity joints and the spine. Deyle *et al.* [12] reported significant improvements in pain, the 6-minute walk test, and self-reported function scores in the manual therapy plus exercise group compared with the control group after 8 treatments delivered over 4 weeks. Significant treatment effects remained present at a 1-year follow-up examination.

An important aspect of the treatment described by Deyle *et al.* [12] was that impairments that were present at other joints in addition to the knee were addressed. This emphasizes the need to evaluate and address a variety of problems that a patient with knee OA may have to optimize the response to treatment. Doing so may allow for longer-term results, supported in this study by sustained treatment effects over a 1-year period. However, what cannot be determined from this study's design is whether the general exercise program would have been as beneficial without the supplemental use of the manual therapy techniques. Future studies will need to be designed in a manner that clarifies whether or not there is added benefit in supplementing exercise therapy programs with manual therapy techniques.

Balance, agility, and functional re-training techniques

In addition to exercises that improve lower-extremity strength, range of motion, and cardiovascular endurance, it is now being recommended that exercise therapy programs also include techniques to improve balance and coordination, and provide patients with an opportunity to practice various skills that they will likely encounter during normal daily activities [3••,14•]. These additional activities are believed to enhance confidence and skill in performing higher-level physical activity, which in turn, may provide patients with the appropriate tools for regular participation in physical activity. Hurley and Scott [15] examined a protocol that used simple balance board exercises and practice of transfer techniques in conjunction with standard exercise therapy in 60 patients with knee OA, compared with a control group that did not receive exercise. The exercise group demonstrated improvements in strength, muscle activation, joint position sense, and both physical performance and self-report measures of function, which were maintained over a 6-month follow-up period [15]. Fitzgerald *et al.* [14•] described a case report in which agility training techniques (quick stops and starts, changes in direction, etc.) and a series of balance and perturbation training techniques (tilt board and roller board techniques) were used in conjunction with range of motion and strengthening exercises for an elderly female with bilateral knee OA who complained of knee instability. After 12 treatment sessions, the patient no longer complained of knee instability and was able to return to walking, tennis, and golf. Further study is needed to determine if the addition of agility, coordination, and balance activities to exercise

programs can enhance the ability of individuals with knee OA to return to higher levels of physical activity and maintain these levels of activity, above and beyond that which can be expected from standard exercise therapy programs.

Knee taping techniques

Patellofemoral taping techniques are frequently used in knee rehabilitation programs. It has been recommended that these techniques be used to supplement exercise for individuals with knee OA to reduce pain during exercise and functional activities [2]. The taping techniques are relatively simple to apply and can be taught to patients for self-management purposes. Recently, a single-blind, randomized controlled trial was performed to determine the effectiveness of patellofemoral taping for relieving knee pain and improving self-reported measures of physical function and general wellness [16•]. Subjects were randomly assigned to receive the taping treatment, receive a placebo taping treatment, or to receive no taping. The tape was worn continuously over a 3-week period, with reapplication of the tape performed weekly. The treatment period was 3 weeks, with an additional 3-week follow-up period. Concomitant treatments that were administered to subjects were not described. A relatively large effect for the taping group compared with the control group was achieved for knee pain (effect size = 1.00 to 1.19) and the physical function score for the WOMAC (0.83). The taping group was 7 times more likely to have a reduction in pain compared with the no tape group. The placebo taping group was 4.5 times more likely to have a reduction in pain compared with the no tape group. Although there appears to be a placebo effect in applying tape to the knee, the therapeutic tape provided an effect above the level of placebo in this study [16•]. Approximately 30% of subjects in the taping group did not have patellofemoral involvement yet the taping appeared to reduce their symptoms. This may indicate patellofemoral taping has a general effect on reducing knee pain. The mechanism for pain modulation using taping is not known at this time.

Transcutaneous electrical nerve stimulation

Physical therapists use a variety of transcutaneous electrical nerve stimulation (TENS) applications to reduce or alleviate pain for individuals with knee OA [17,18•]. TENS may be used in conjunction with exercise or physical activity to reduce pain during the activities, or may be used as a stand-alone treatment for pain. Osiri *et al.* [18•] performed a recent meta-analysis of literature concerning the use of TENS for knee pain in individuals with knee OA. Studies were included if they were randomized clinical trials, included only subjects with knee OA, used any type of TENS treatment for pain including acupuncture-like TENS (AL-TENS), and used pain relief as a primary outcome measure. Other outcome measures such as self-reported measures of function, physical

performance tests, strength and range of motion, etc. were also used in analyses if available. There were 7 studies included in this review, three rated as high quality and four rated as low quality. Based on the meta-analysis, Osiri *et al.* concluded (1) higher-quality studies showed an effect whereas lower-quality studies did not, (2) greater effects were apparent when high-intensity burst modes and AL-TENS were used compared to when high-frequency TENS was used, (3) repeated use of TENS was more effective than a single treatment, and (4) TENS was more effective than placebo when it was used for a duration of 4 weeks or greater. Use of TENS for less than 4 weeks was no more effective than placebo. There were no adverse effects reported in these studies.

Foot orthoses

Foot orthoses are sometimes used by physical therapists to indirectly offset faulty mechanics that may place harmful stress on the knee. Lateral wedge shoe inserts for individuals with medial compartment knee OA have been found to be useful in reducing pain and improving function [19,20]. Recently, Kerrigan *et al.* [21•] reported that a 5° wedge could reduce the varus moment at the knee in 15 subjects with medial compartment knee OA. The theory is that the lateral wedge encourages valgus loading on the knee, countering the varus moment, thereby reducing medial knee compartment stress. Lateral wedge shoe inserts seemed to be more effective for individuals with minimal to moderate degrees of OA. Individuals with more severe OA or malalignments may not always respond favorably to this intervention [19].

Mode of treatment delivery

Increasing concern over rising healthcare costs has prompted greater interest in cost-effective modes for delivering physical therapy services and rehabilitative care for individuals with knee OA. Fransen *et al.* [13] compared physical therapy treatment effectiveness between patients who received individually supervised physical therapy and patients who received group physical therapy. The group program included a variety of lower-extremity strengthening and stretching exercises, and stationary cycling for endurance. The individualized program was similar in terms of exercise therapy, but several patients also received physical agent modalities. Patients in the individualized therapy group received an average of seven 30-minute treatment sessions over an 8-week period. Subjects in group therapy were prescribed sixteen 1-hour sessions at 2 sessions per week for 8 weeks. Both groups demonstrated moderate treatment effects for improving pain and function, and small effects for health-related quality of life. There were no statistically significant differences between treatment groups; however, the values for standard response means on most outcome variables tended to favor the group therapy mode. A *post hoc* power calculation indicated that there was an inadequate sample size to achieve statistical sig-

nificance in this study. The group treatments appeared to be more resource-friendly in that group treatments average 2.7 hours of one-on-one patient to therapist care compared with 3.5 hours for the individualized group. In addition, the equipment needs were considered to be equivalent for both groups.

Other investigators have studied the effectiveness of home-based exercise therapy programs [22–24]. Evcik and Sonel [22] compared a home-based, low-level quadriceps strengthening program to a home walking program and a control group over a 3-month period. Both the strengthening program and the walking program subjects made modest improvements in pain and self-report measures of function compared with the control group, but there were no significant differences between exercise groups on these variables. The walking group scored higher than the strength training group on health-related quality of life.

Baker *et al.* [23] examined the effectiveness of a partially supervised home-based progressive exercise program for knee OA patients compared with a control group that received education on nutrition. The exercise program described by Baker *et al.* [23] appeared to be more comprehensive and of greater intensity than that described by Evcik and Stone [22]. In addition, subjects received up to 12 supervised exercise sessions in the home over a 16-week period. There was a large effect for increasing muscle strength and moderate effects for reducing pain and improving physical performance and self-report measures of function. Adherence to the program was also reported as being relatively high (84%). This may be the result of increased supervision over the course of treatment. Although this approach involves one-on-one supervision, similar to what might be provided in an outpatient care facility, having the trainer or therapist go to the patient's home to supervise the exercise may be an alternative that requires less resources in terms of equipment. It may also allow patients to learn how to exercise in their own homes, which could improve self efficacy for participating in self-directed exercise and physical activity programs.

What is not yet clear is whether home-based programs are more or less effective than supervised, outpatient programs. While home-based programs can reduce pain and improve function, the effects appear to be moderate to small without supervision. Trials comparing supervised versus self-management programs are needed to clarify this issue. It should also be considered that there may be differential responses to supervised versus self management programs, dependent on a variety of patient characteristics, that could affect treatment responsiveness. Future studies should be designed to identify factors that might differentiate between responders to supervised programs and self-management programs.

Factors that may influence responsiveness to treatment

Recent studies appear to suggest that there is a need to consider factors that may alter the responsiveness of patients with knee OA to exercise therapy and physical activity programs. Compliance with home exercise programs can influence long-term responsiveness to exercise therapy. van Baar *et al.* [25] reported a steady decline in beneficial treatment effects from the end of a 12-week exercise therapy program to a 9-month follow-up examination. The investigators suggested that: (1) providing periodic re-check or re-training programs over time or (2) keeping the time duration of the home exercise session to a reasonable limit (less than 30 minutes) might help improve compliance with independent exercise programs. Campbell *et al.* [26] performed a qualitative analysis of factors that influenced compliance with follow-up period home exercises in subjects who had undergone physical therapy for patellofemoral joint OA. Campbell *et al.* [26] reported that the “motivation to comply” was based on the following four factors: (1) willingness to incorporate exercise into one’s already busy lifestyle, (2) perceived severity of knee symptoms or disease (greater severity = greater compliance), (3) ideas about the causes of arthritis (*eg*, if subjects believe causative factors are unalterable they will not comply; if they believe they can have a personal impact on the disease, they will comply), and (4) perceived effectiveness of the intervention (if subjects do not believe the treatment will help, they will not comply). Campbell *et al.* [26] also recommended that periodic follow-ups with the physical therapist may improve compliance and allowing the patient to have input in planning the home program may help address barriers to compliance.

Recently, Sharma *et al.* [27•] reported that varus/valgus laxity and malalignment may influence the relationship between quadriceps strength and progression of tibiofemoral arthritis. Subjects who had greater quadriceps strength at baseline and exhibited greater laxity or malalignment were more likely to have radiographic progression of knee OA over an 18-month period than those who had less quadriceps strength and equivalent degrees of laxity and malalignment. Sharma *et al.* [27•] suggested that perhaps patients with knee OA who had higher degrees of laxity or malalignment may not respond favorably to quadriceps strengthening programs and that other interventions designed to enhance joint protection should be employed. A criticism of this suggestion, however, is that responsiveness to strengthening exercise was not actually observed in this study, nor was quadriceps strength reassessed at the 18-month follow-up [28•]. It is not certain that those subjects who were strong at baseline remained strong over the 18-month period. Nevertheless, the report does suggest the need to examine if mechanical factors such as laxity and malalignment do indeed alter the responsiveness to exercise.

The degree of radiographic severity of knee OA may also alter responsiveness to physical therapy. Fransen *et al.* [13] reported that the degree of joint space narrowing on radiographic examination at baseline modified responsiveness to exercise therapy. Subjects with greater narrowing of the joint space did not respond as well to exercise as those who had less severe changes [13]. Fransen *et al.* [13] stated that these findings may indicate that physical therapy should be initiated in the early stages of the disease to achieve maximum benefits, and that early screening and preventative exercise therapy programs may be a more cost-effective approach to management of knee OA over the long term.

Conclusion

Individuals with knee OA may have a variety of impairments and functional limitations that prevent them from participating in regular exercise and physical activity. Physical therapists can offer a variety of supplemental treatment approaches that may help patients overcome these barriers and enhance the overall effectiveness of exercise therapy programs. All of us who treat patients with knee OA must realize that a “one size fits all” approach to exercise and physical activity will likely continue to yield only modest benefits from these programs. Future studies are needed to improve our understanding of factors that can influence the responsiveness of patients with knee OA to exercise and physical activity programs. The question may not be which mode of therapy works best, but rather, which patient and/or disease characteristics will tell us who will and who will not respond to a given mode of therapy. When we understand the factors that can alter treatment responsiveness, we will be better able to develop strategies to address the variety of barriers that prevent our patients from improving their quality of life.

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- Of special interest
 - Of outstanding interest
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- A commentary to the previous reference [27]. The author does an elegant job of pointing out limitations with the conclusions drawn in the article by Sharma *et al.* and raises good questions for future study on this topic.