

Recommendations for the Treatment of Knee Osteoarthritis, Using Various Therapy Techniques, Based on Categorizations of a Literature Review

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ABSTRACT

Purpose: This literature review is to evaluate current research articles pertinent to physical therapy treatment of osteoarthritis (OA) of the knee. Osteoarthritis of the knee is an increasingly common diagnosis, with a prognosis that can lead to loss in an individual's functional abilities. Literature on the subject of OA and its physical therapy treatment is vast and current, however, obtaining and analyzing it can be time consuming and costly to a Physical Therapist. The primary aim of this paper is to review current trends for treatment of OA of the knee, and to compare each intervention for effectiveness. This article provides a systematic categorization as well as recommendations for physical therapists based on current (1996 or sooner) literature.

Methods: Twenty-two articles were located using various online databases, critically analyzed, and categorized using Sackett's levels of evidence. Recommendations for the treatment of OA of the knee by a physical therapist were then made.

Results: Two grade A recommendations, 5 grade B recommendation, and 2 grade C recommendations were made from the categorization of the articles. This article also contains recommendations outside the scope of a therapist's practice, which a physical therapist could consider when treating a patient with knee osteoarthritis. Further research recommendations are also provided.

Key Words: knee osteoarthritis, physical therapy, treatment, literature review

INTRODUCTION

Osteoarthritis (OA) is a disease characterized by the breakdown of articular joint cartilage, and often causes severe pain and disability.¹⁻⁴ In particular, the knee joint is most commonly affected, with more than 30% of adults over 60 years of age experiencing functional limitations, such as inability to perform Activities of Daily Living (ADL) or Instrumental Activities of Daily Living (IADL) due to OA of the knee.^{3,5,6} With the decrease in function an individual's quality of life is susceptible to deterioration. By 2020, the number of people with functional limitations due to OA

of the knee is expected to rise to 11.6 million.³ Currently, health care costs related to OA of the knee are \$60 billion per year.³

There are multiple interventions to treat OA of the knee. Current popular methods of treatment include, but are not limited to physical therapy based on practice pattern 4E; as well as nonsteroidal anti-inflammatory drugs (NSAIDs), surgery, and knee capsule injections, which are commonly followed by physical therapy. It should be noted, however, that NSAIDs though frequently prescribed, often have significant side effects.^{2,5,7-9} Arthroscopic surgery has not been shown to have a major role in the management of OA of the knee.³ Similarly, knee capsule injections have been shown to be equal to arthroscopy in effective management of the disorder.⁷ Exercise-based interventions are extensive, and include pool-based strengthening exercise, muscular strengthening, stretching, cardiovascular programs, and mechanical unloading.^{10,11} Modalities include, but are not limited to, knee bracing, heat, ice massage, cold packs, ultrasound, acupuncture, and taping.

Because the risk of disability due to OA of the knee is greater than that due to any other medical condition in aging adults,¹¹ it is essential for physical therapists to have a thorough understanding of different treatment methods, if they wish to make an impact in the reduction of this risk. Due to a lack of systematic reviews on the effectiveness of physical therapy management of OA of the knee, as well as the conflicting evidence about modalities, the primary aim of this paper is to review current trends for treatment of OA of the knee, and to compare the effectiveness of each intervention. This article explores various methods of treating OA of the knee and makes recommendations for physical therapy management of the disorder.

METHODS

Several common databases and search engines that the authors were familiar with were used for this review, including PubMed, EBSCO, The Cochrane Library, and Google Scholar.¹²⁻¹⁵ Articles included were written in English, peer-reviewed, and published from 1996 to 2007. Key search words and phrases for the physical therapy treatment of knee osteoarthritis included "physical therapy or physiotherapy," "knee osteoarthritis," and "management or treatment." Only studies that included a control group or presented a case report (ie, having true experimental design) of physical therapy management of knee osteoarthritis were included. Two additional articles evaluating acupuncture were also included, because they had sufficient scientific rigor, level of evidence, and close connection with rehabilitation. Previously conducted review articles on the subject of physical therapy management of knee osteoarthritis were excluded.

Five first year physical therapy students evaluated the studies selected for inclusion. The student's goals were to identify and classify the studies according to their quality and adherence

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to scientific rigor. The quality of each study was determined by using the rating system of Sackett's 5 levels of evidence, which then allows for 3 grades of recommendations to be made.¹⁶ The procedural rigor of each study was graded according to the list of criteria created previously by Megens and Harris.¹⁷

Sackett's levels of evidence include 5 hierarchical categories: Studies classified at Level I studies are randomized controlled trials with a sample size of 100 or more subjects, with a low incidence of false-positive and false-negative errors. Level II studies consist of randomized, controlled trials with a sample size of less than 100 subjects, with a high incidence of false-positive and false-negative errors. Level III studies consist of nonrandomized, concurrent, cohort comparisons between subjects that did and did not receive treatment. Level IV studies consist of nonrandomized, historical cohort comparisons between current subjects, who did receive treatment and former subjects who did not receive treatment. Level V studies consist of case series without control¹⁶

The grades of recommendations will be assigned in the following manner: a grade A recommendation is supported by at least one level I study, a grade B recommendation is supported by at least one level II study, and a grade C recommendation is supported by any combination of levels III, IV, or V studies.^{16,17} The grading of the recommendations is based purely on the level of scientific study. Scientific studies with higher levels should be considered as having increased validity, and therefore should be considered weighted higher by a physical therapist as a treatment option.

The scientific rigor of each study was evaluated using the following 6 criteria developed by Megens and Harris: (1)

inclusion and exclusion criteria noted for the subjects and an operational definition of the clinical condition provided; (2) treatment methodology described adequately enough to allow replication; (3) outcome measures assessed for reliability; (4) validity of outcome measure's assessed; (5) blind assessment of outcome; and (6) accounting for attrition.¹⁷ Each study was assigned a "Y" for "yes" if it met the specific criteria and an "N" for "no" if it failed to meet the criteria. The scientific rigor is a broader spectrum of analysis of each article as compared to Sackett's levels of evidence and therefore gives the reader a more through inspection about specific aspects of each article. An increase in an article's scientific rigor should increase the confidence of the treating therapist in the validity of the article. Each article was independently evaluated by all 5 reviewers and graded according to Sackett's levels of evidence and Megens and Harris' criteria for scientific rigor to establish inter-rater reliability. Any discrepancies between rater's grades were decided by a round-table discussion over the articles. A rating was determined from the discussion or majority vote. Inter-rater reliability was determined using an Intraclass Correlation Coefficient (ICC). ICC measures association and agreement for more than two raters.

RESULTS

Twenty-two articles were found pertaining to physical therapy management of osteoarthritis of the knee. Fifteen of these articles met the inclusion criteria and were reviewed and evaluated according to Sackett's levels of evidence.¹⁶ A summary of the articles evaluated can be found in Table 1. The inter-rater

Table 1. Article Summary and Categorization According to Sackett's Levels of Evidence

Authors	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Berman et al.²	Randomized controlled clinical trial Level I	570 subjects Mean age 65.5	Group A (n=190) – Received true acupuncture treatment Group B (n=191)- Received control sham acupuncture treatment Group C (n=189) Received control education on OA self-management	Group A- 26 weeks Group B- 26 weeks Group C- 12 weeks	WOMAC, pain and function scores	Patients receiving true acupuncture. showed more improvement in function but less improvement in pain at 8 weeks and more improvement in both function and pain at 26 weeks than did the patients who received sham acupuncture.
Chuang et al.¹⁸	Randomized, controlled trail. Level II.	50 subjects. (8 male and 42 female), Age >50	Group A (n=25) – Initially, group A did not wear a neoprene sleeve while receiving a balance tests, then wore the sleeve to be retested Group B (n=25) – Performed the reverse procedure, receiving the sleeve first.	10 months	Static and dynamic balance testing using the Kines-thetic Ability Trainer 2000 instrument.	Both group A and group B showed significant improvements in static and dynamic balance testing when wearing a neoprene brace.
Deyle et al.⁵	Randomized, controlled clinical trial Level II	83 subjects with MD referred knee pain, Mean age of subjects 60	Group A (n=42)- received Manual therapy and exercise Group B (n=41)- Received placebo	8 sessions- twice weekly for 4 weeks	WOMAC and 6-minute walk test	Clinically and statistically significant improvements in 6-minute walk distance and WOMAC score at 4 and 8 weeks in treatment group.
De Jong et al.¹⁹	Concurrent Cohort Comparison Level V	40 Patients with hip or OA of the knee, Age >55	Group A (n=20) – Patients in knee OA health education program; Group B (n=20) – Patients in hip OA health information program	6 mos.	Questionnaires for pain, mobility, self-efficacy, and OA knowledge	The informational program was shown to have positive effects for osteoarthritis knowledge, pain, and patient self-efficacy.

Authors	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Deyle et al. ⁷	Level II	134 subjects with knee OA, Mean age of subjects 64	Group A (n=66) – Clinic treatment group that included exercise and manual therapy Group B (n=68) – Home exercise group	4 wk treatment; follow-up at 8 wks and 1 yr	WOMAC and 6 min walk	At 4 wks, patients in the clinical treatment group showed greater improvement in WOMAC scores than did the home exercise group. At 1 yr, patients in the clinical treatment group were more likely to be satisfied with their treatment and less likely to be using medication for pain management.
Fitzgerald et al. ²²	Case report, single subject Level V	73 yr old female subject, bilateral OA of the knee	LE stretching, strengthening exercise, perturbation training	6 wks (2 visits per week)	Knee range of motion, muscle strength, get up and go test, numeric pain scale, Activity of daily living, WOMAC	Subject reported reduced pain when walking. Gained ability to perform step-down past w/o pain. No longer felt a giving way of the knee after 5 th session.
Foley et al. ²³	Single Blind, Randomized controlled Trial Level II	105 total participants with clinical OA of hip or knee, Age of subjects >50	Group A (n = 35) - hydrotherapy Group B (n = 35) – gym Group C (n = 35) – control	6 wks	Muscle strength dynamometry, six minute walk test, WOMAC, Total drugs, SF-12 quality of life, Adelaide Activities Profile, Arthritis Self-Efficacy Scale	In gym, both quadriceps significantly better than control and hydrotherapy. Hydrotherapy increased left quadriceps only at follow up, compared to control. Hydrotherapy group was significantly different from control in distance walked and physical component of SF-12. The gym group was significantly different from control group for walk speed and self efficacy satisfaction. The compliance rates were similar in both gym and hydrotherapy. There was no difference in drug use between groups.
Hinman et al. ²⁰	Randomized controlled Level II	71 subjects with OA of the knee or symptomatic hip OA, Age of subjects >50	Group A (n=36) – Aquatic physical therapy Group B (n=35) - No aquatic physical therapy	6 wks	WOMAC, Physical activity scale for the elderly, Manual Muscle Test, Step Test, Timed up and go, six minute walk.	Intervention resulted in less pain and joint stiffness, greater physical function. Quality of life, and hip muscle strength.
Hinman et al. ¹⁰	Randomized single blind controlled trial Level II	87 patients with OA of the knee, Age of subjects >50	Therapeutic tape n=29, control tape n=29, no tape control n=29	3 wks	Reported pain measured by WOMAC, knee pain scale and the SF-36	The therapeutic tape group experienced a significantly greater reduction in pain and disability on most secondary outcomes than the no tape group. Although control tape achieved small beneficial effects, most differences were not significantly different from no tape.
Huang et al. ⁴	Randomized controlled trial; Level II	140 subjects with bilateral OA of the knee (Altman grade II) Mean age of subjects 65.4	Group A (n = 35) – Received isokinetic exercises Group B (n = 35) – Received isokinetic exercise and pulse ultrasound for periarticular soft tissue pain Group C (n = 35) – received isokinetic exercise, pulse ultrasound, and intraarticular hyaluronan therapy Group D (n = 35) – Control group	8 wk treatment 1 yr follow up	Effects of therapeutic effects measured by changes in Lequesne's index,ROM, peak muscle torques of knee flexion and extension, and ambulation speed	Groups A-C showed increased muscle torques and significantly reduced pain and disability after treatment and follow up. Groups B and C showed significant improvements in range of motion and ambulation speed after treatment. Group C showed greatest increase in walking speed and decrease in disability after treatment and follow up. Groups B and C had significant gains in muscle strength after treatment and at follow up.

Authors	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Hurley and Scott²⁴	Randomized controlled clinical trial Level II	81 subjects with OA of the knee Mean age of Subjects 61.5	Group A (n=44) – Performed exercise regime only Group B (n=21) – Did not perform exercises Group C (n=16) – Members of control group who performed exercise regime after control period ended	Group A- 2 sessions per wk for 5 wks Group B- 12 wks Group C- 2 sessions per wk for 5 wks after original 12 wk session	Sit to stand transfer, stepping on and off a low block, unilateral balance on balance board	Patients who performed the exercise regime displayed improvement in quadriceps motor strength, sensory function and reduced disability; Patients who had treatment delayed showed no difference in anthropometrics from patients who received treatment immediately.
McCarthy et al.²⁵	Randomized, time series with control. Level I	214 subjects with radiologically confirmed OA of the knee Age of subjects 63-94	Group A (n = 103) – Allocated to home exercise group Group B (n = 111) - Allocated to class exercise group	6 mo and 12 mo	Aggregate locomotor function, Stair ascent and descent time, Sit to Stand Transfer, Visual analog pain scale, WOMAC	Patients for class-based group demonstrated significantly greater improvement in locomotor function and decrease in walking pain than the home-based group at 12-months follow-up.
Sangdee et al.²⁸	Randomized, single-blind, placebo controlled trial Level II	186 subjects with OA of the knee Age of subjects >40	Placebo n=47, Diclofenac n=49, EA(electroacupuncture) n=48 and combined n=49	4 wks	visual analog scale (VAS), WOMAC, Lequesne's functional index, 50 feet-walk time, and the orthopedist's and patient's opinion of change	EA is significantly more effective than placebo and diclofenac in the symptomatic treatment of OA of the knee in some circumstances. However, the combination of EA and diclofenac treatment was no more effective than EA treatment alone.
Thorstensson et al.²⁶	Randomized Control group Level II	61 subjects with OA grade III, age of subjects 35-65	Bi-weekly one hour, high intensity exercise program n=30, control group n=31.	6 wks	KOOS subscale quality of life, Åstrand's bicycle-ergometer test. Rising on one leg, from sitting on lowest possible height One-leg hop. Lateral step-up One-leg semi squatting. Heel-raising on one leg	A six-week high-intensive exercise program had no effect on pain or function in middle-aged patients with moderate to severe radiographic OA of the knee. Some effect was seen on quality of life in the exercise group compared to the control group.
Van Baar et al.²⁷	Randomized single blind clinical trial. Level II	201 total subjects, 183 completed the trial Age of subjects 40-85	Group A (n = 99) – Exercise group: Received treatment from their practitioner, patient education and drug treatment, and received exercise treatment from physiotherapist in primary care Group B (n = 102) – Control group: Received treatment from their practitioner, patient education	12 wks treatment 24 wks follow up	Outcome measures were pain, drug use (NSADs) and observed disability.	At 24 weeks exercise treatment was associated with small to moderate effect on pain during past week. At 36 weeks no difference were found between groups.

reliability for grading the articles according to Sackett's levels of evidence was ICC(3,1)=.93.

Studies included in this review either evaluated or described procedures or tools used in PT procedural interventions of OA of the knee. Four studies dealt with analysis or development of a tool to treat knee OA.¹⁸⁻²¹ Ten studies evaluated the effects of exercise programs.^{4,5,7,20,22-27} Two studies evaluated the use of acupuncture.^{2,28}

A variety of techniques in physical therapy management of knee osteoarthritis were included in the articles presented in this study. Studies differed in research design, level of evidence, and type of intervention. The research design distribution of

the articles consisted of the following: 13 studies^{2,4,5,7,10,18,20,23-28} were randomized, controlled clinical trials, 2 studies were case studies,^{19,22} and one was a nonrandomized convenience sample trial.²¹

In order to determine the weight of evidence, articles were evaluated according to Sackett's levels of evidence. The results of this analysis produced 2 level I trials,^{2,25} 12 level II trials,^{4,5,7,10,18,20,21,23-28} and 2 level V trials.^{19,22} Studies were classified as level I or II trials based on randomization, presence of a control group and number of participants in each group. Level III and IV studies were nonrandomized cohort trials with or

without a control group. Level V studies consisted of case studies or observational studies.

Grades of recommendation were developed based on these levels of evidence. Grade A recommendations were made according to level I results, Grade B recommendations were made according to level II studies and Grade C recommendations were made according to level III, IV, and V results.

Grade A Recommendations:

1. Class based exercise is more effective than home based exercise to decrease the pain associated with OA of the knee.²⁵
2. True or electro acupuncture has been shown to relieve pain in patients with OA of the knee when compared to patients that received placebo or “sham” acupuncture.^{2,28}

Grade B Recommendations:

1. Mechanical unloading using a Zuni Exercise System of patients with OA of the knee may not help with pain reduction.²¹
2. The use of a neoprene brace and/or therapeutic tape on patients with OA of the knee may help reduce pain and regain function.^{10,18}
3. Patients that are treated in a clinic or classroom setting benefit more from exercise and manual therapy, than those patients given instructions for home based exercise.^{25,27}
4. Aquatic or hydrotherapy has positive effects on the strengthening of patients with OA of the knee.^{20,23}
5. Manual therapy and exercise is shown to increase quadriceps strength, while decreasing disability.^{4,5,7,26}

Grade C Recommendations:

1. An evidence-based exercise and health education program to inform patients of OA is useful in patient comprehension of the disease.¹⁹
2. Stretching, strengthening exercise, and perturbations are all useful interventions for aging adults with OA of the knee.²²

The studies were assessed according to Megens and Harris’ criteria for scientific rigor and the results are presented in Table 2. The inter-rater reliability for this classification was ICC(3,1) = .93. Overall, the evaluations revealed a moderately strong attention to scientific rigor. All the studies contained inclusion and exclusion criteria as well as operational definitions. Only one study¹⁹ did not include enough information for the procedure to be replicated. Many studies did not include blinding.^{3,9,18,19,21,22,24,25} or accounting for attrition.^{8,19,21} The reliability^{2,5,22,24} and validity^{2,24} of measures used in the study were sometimes absent as well.

DISCUSSION

After a thorough literature search and filtering of numerous articles on osteoarthritis of the knee, the usefulness of various physical therapy interventions in the treatment of OA of the knee were determined. Sackett’s levels of evidence offered a basis on which to categorize and assess various research articles, which led to numerous recommendations for physical therapy management of OA of the knee.

Megens and Harris’ criteria for scientific rigor were also used in this review to categorize the articles. According to the criteria (Table 2), very few articles reviewed met each of the scientific rigors and this should be noted when accepting any recommendations from these studies.

While the recommendations of this review are based on varying degrees of scientific levels, it should be noted that none of them should be accepted without caution. The significant clinical recommendations that can be made from this review include:

1. Use of either neoprene sleeves or therapeutic tape to supplement the bone loss in patients with knee osteoarthritis;
2. Patients that receive therapy in direct contact from the therapist have lower pain and better Western Ontario and McMaster Osteoarthritis Index (WOMAC) scores than those that are given a take home therapeutic plan;
3. Class based exercise with instruction from a physical therapist is more effective than a home based exercise program;
4. Aquatic or hydrotherapy can be very useful in the treatment of OA;
5. Manual therapy has the ability to decrease pain and increase strength in for aging adults with OA of the knee.

A trend that was noted while reading and classifying articles was that patients who received treatment from a physical therapist directly showed better WOMAC scores and had decreased pain when compared to individuals that received no treatment for their knee

Table 2. Scientific Rigor by Article According to Megens and Harris’ Criteria

Author(s)	Inclusion and Exclusion Criteria and Operational Definition	Intervention Can Be Replicated	Reliability of Outcome Measures Assessed	Validity of Outcome Measures Investigated	Blind Assessment of Outcome	Account for Attrition
Berman et al (2)	Y	Y	N	N	Y	Y
Chuang et al (18)	Y	Y	Y	Y	N	N
Dejong et al (19)	Y	N	Y	Y	N	N
Deyle et al (5)	Y	Y	Y	Y	Y	Y
Deyle et al (7)	Y	Y	N	Y	Y	Y
Fitzgerald et al (22)	Y	Y	N	Y	N	Y
Foley et al (23)	Y	Y	Y	Y	Y	Y
Hinman et al (20)	Y	Y	Y	Y	Y	Y
Hinman et al (10)	Y	Y	Y	Y	Y	Y
Huang et al (4)	Y	Y	Y	Y	Y	Y
Hurley et al (24)	Y	Y	N	N	N	Y
McCarthy et al (25)	Y	Y	Y	Y	N	Y
Sangdee et al (28)	Y	Y	Y	Y	Y	Y
Thorstensson et al (26)	Y	Y	Y	Y	Y	Y
Van Baar et al (27)	N	Y	Y	Y	Y	Y

osteoarthritis. Therefore, physical therapy is recommended to patients with OA of the knee in order to increase their functioning ability. Exercise is shown to be beneficial for patients suffering from OA of the knee, however, it is important that the program be designed properly. Two modalities were directly addressed in the studies reviewed. It should be noted that hot packs have been shown to be of little therapeutic value, while ultrasound, based on 2 studies, has shown contradicting evidence.^{4,7}

Additional studies about the usefulness of physical therapy interventions in the treatment of knee osteoarthritis are needed in order to further support the role of a physical therapist in the recovery and adaptability of patients with OA of the knee. Furthermore, most operational definitions used in these studies relied on physician and radiological diagnosis of knee osteoarthritis. While this is currently acceptable, in the spirit of APTA Vision 2020, there should be an operational definition in place for the physical therapist to objectively determine the presence or absence of knee osteoarthritis. Finally, the base of research needs to be expanded assessing the usefulness of tools, such as neoprene braces and therapeutic tape, in the physical therapist's treatment of OA of the knee based on the preliminary success of these tools.^{10,18}

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