THE JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE
Volume 11, Number 4, 2005, pp. 689–693

Iyengar Yoga for Treating Symptoms of Osteoarthritis of the Knees: A Pilot Study

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ABSTRACT

Objectives: The American College of Rheumatology (ACR) Guidelines for the medical management of osteoarthritis (OA) emphasize the use of nonpharmacologic interventions including exercise. Implementation of an exercise program can be difficult for patients, and little is known about the benefits of alternative therapies such as yoga. The aim of this pilot study was to assess the feasibility of using yoga in the tradition of B.K.S. Iyengar to treat the symptoms of osteoarthritis of the knee.

Design: Participants were instructed in modified Iyengar yoga postures during 90-minute classes once weekly for 8 weeks.

Subjects: Participants met ACR criteria for osteoarthritis of the knee and completed a medical history and physical examination, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Arthritis Impact Measurement Scale 2 (AIMS2), Patient Global Assessment (GA) by Visual Analog Scale (VAS), Physician GA by VAS, and 50-foot Walk Time before and following an 8-week course of yoga instruction. Eleven (11) subjects enrolled, nine completed at least one session and seven (six of whom were obese) had data from pre- and post-course time points available for analysis.

Results: Statistically significant reductions in WOMAC Pain, WOMAC Physical Function, and AIMS2 Affect were observed when participants' status were compared to their pre-course status. WOMAC Stiffness, AIMS2 Symptoms, Social and Role, Physician GA, and Patient GA measured trends in improvement of symptoms. No adverse events from treatment were reported.

Conclusions: This pilot study suggests that yoga may provide a feasible treatment option for previously yoga-naive, obese patients >50 years of age and offers potential reductions in pain and disability caused by knee OA. Future studies should compare yoga to other nonpharmacologic interventions for knee OA, such as patient education or quadriceps-strengthening exercises.

INTRODUCTION

Osteoarthritis (OA) is the most common form of arthritis and a leading cause of disability in the United States.[1] The incidence of OA increases with age and will represent an increasingly significant problem for the aging U.S. population.[1] Symptoms of osteoarthritis of the knees include morning stiffness, gelling after periods of inactivity, and pain. As the disease progresses, cartilage is lost and joints may become enlarged and more limited in their range of motion. Limitations in motion may be caused by cartilage destruction, as well as spasm of surrounding muscles and loss of flexibility of surrounding soft tissues such as those of tendons and ligaments. As there are no disease-modifying agents available for OA, the standard care of patients with osteoarthritis of the knees is aimed at reducing

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pain and improving the functioning of the knees by focusing on the surrounding tissues through exercise or external support.

Although management of osteoarthritis typically includes the use of medications, pharmacologic agents can be associated with numerous potential side effects and variable efficacy. Emphasis has been placed on measures that can be used along with or in place of prescription medications. Recent practice guidelines have reflected recognition that exercise, including both aerobic and strengthening, as well as range of motion, are essential elements of any treatment program for osteoarthritis of the knees.[2] Physicians and other health care professionals treating individuals with osteoarthritis need to provide these patients with viable options to accomplish their exercise goals. This can include exploration of alternative therapies for the management of chronic pain.[3] Although significant attention has focused on stretching and strengthening the quadriceps muscles for reducing symptoms of knee OA,[4–7] yoga is one of several practices that have the potential to be effective in OA as well.[3,8] Although yogic philosophy addresses numerous aspects of well-being that might have an effect on health and disease, the use of the physical postures, or *asanas*, can be used as a form of exercise. Yoga improves both flexibility and strength and could theoretically be beneficial to some musculoskeletal problems. The use of the Iyengar approach to hatha yoga emphasizes strength, flexibility, and relaxation, with particular attention to alignment of body structures (e.g., the relationship of the distal to the proximal extremities and the extremities to the spine and torso).[9,10] Iyengar yoga is distinguished from the many forms of yoga currently advocated by its focus that it can be practiced by all; that part of the way in which it is accessible to all is through the use of props that help the practitioner to achieve appropriate and precise positioning; and that it emphasizes the importance of the proper sequence of postures as important to their successful completion. This study assessed the feasibility and safety of using yoga as a treatment for the symptoms and disability resulting from osteoarthritis of the knee.

PATIENTS AND METHODS

Patients were recruited from the community by advertisements placed around the campus of the University of Pennsylvania and in the outpatient medical and rheumatology practices at the University of Pennsylvania Medical Center. The presence of osteoarthritis of the knee was diagnosed using the Clinical Criteria for the Classification of Idiopathic Osteoarthritis (OA) of the Knee developed by the American College of Rheumatology.[11] These criteria do not require radiographic confirmation. Qualified participants were ≥50 years of age with symptomatic osteoarthritis in at least one knee for at least 6 months before study entry and were not currently participating in an exercise program. In addition, they had at least two of the following: stiffness <30 minutes; crepitus; bony tenderness; bony enlargement; or absence of palpable warmth. Subjects were excluded who had any of the following: symptoms of locking or instability; a corticosteroid injection in the symptomatic knee within 3 months of study entry; a hyaluronic acid injection in the symptomatic knee within 6 months of study entry; a history of knee surgery within the last 2 years or a joint replacement at any point; chronic use of a knee brace, cane, or walker; or a prior diagnosis of inflammatory arthritis. Patients were excluded who had significant medical comorbidities that might preclude participation. No changes in medication for arthritis symptoms were permitted during the trial. Patients signed an informed consent form before participation. The study was approved by the University of Pennsylvania Institutional Review Board.

Baseline data collection included medical history and a general and rheumatologic physical examination. Outcome measures were assessed for all subjects at study entry and after the 8-week yoga intervention. Outcome measures chosen were those recommended to be of value by the Osteoarthritis Research Society for interventions in OA.[12] These included the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC),[13] the Arthritis Impact Measurement Scale 2 (AIMS2) social and psychological subsets (Affect, Symptom, Social Interaction, Role),[14,15] the Patient Global Assessment (GA) by a 100-mm visual analog scale (VAS), and the Physician Global Assessment by a 100-mm visual analog scale.[12] The 50-foot walk time was also assessed.[12]

The yoga intervention consisted of 15 postures taken from *Light on Yoga*[9] and taught by a certified senior Iyengar yoga teacher (M.G.) over 8 weeks during weekly 1 and 1.5-hour sessions. Patients were required to attend five of the eight sessions as well as the preintervention and postintervention assessment visits to be included in the analysis. Patients were asked not to start other physical therapy interventions during the time that they participated in the study.

The sequence and adaptation of classical yoga postures (asanas) were designed by the instructor, based on the Iyengar method of hatha yoga. The Iyengar method takes into account both underlying anatomical structure and body alignment. Iyengar yoga allows for individual variation in the ability of participants and specifically includes the use of assistive devices such as blocks, belts, and blankets to support parts of the body while performing the asanas. Postures were performed in standing, sitting, and supine positions on standard yoga mats. The asanas are listed below, along with a brief description and the most commonly used props where applicable. All participants were encouraged to stretch as fully as possible while not exceeding the limits of their comfort and were encouraged to use props as needed.

The postures used included Tadasana (Mountain Pose; basic standing pose), Uttitha Trikonasana (Standing Extended Triangle Pose; stretch to the sides with arms and legs

spread), Virabhadrasana (Standing Lunge Pose; forward lunge with foot supported by block), Dandasana (Staff Pose; seated on floor with legs extended, arms stretched forward, seated on blanket), Supta Tadasana (Supine Mountain Pose; flex and extend legs at knees while lying flat, head supported by blanket), Supta Padangustasana (Supine Foot Pose; raising one leg at a time straight from floor using belt, head supported by blanket), Urdhva Hastasana (Standing Hand Pose; raising arms over head), Ardha Uttanasana (Standing Deliberate Stretch Pose; arms parallel to floor, touching wall, stretching arms and legs), Prasarita Padathanasana (Standing; bending from waist forward holding onto seat of chair) Baddha Konasana (Seated Restrained Angle Pose; legs flexed at knees, feet brought in close to body assisted by belt), Urdhva Prasarita Padasana (Supine Stretched Foot Pose; raising both legs from floor, propping them with feet flat on wall), Virasana (Warrior Pose; seated on blanket with knees flexed to the sides of the body, buttocks on bolster), Swastikasana (Seated Cross-Legged Pose; seated on blanket with knees flexed in cross-legged position), and Savasana (Supine Relaxation Pose; lying on floor, calves supported on seat of chair, head on blanket). Detailed descriptions and photographs can be obtained by referring to *Light on Yoga*.[9] Subjects were instructed at each session that no at home practice was required.

RESULTS

Eleven subjects enrolled and nine attended at least one session. Seven attended at least five classes and had data from pre- and postcourse time points available for analysis. Because of an unrelated illness (pneumonia), one subject withdrew; another was unable to accommodate the class into her work schedule. No participant had previously practiced yoga. The seven women who completed the trial had a mean age of 58.6 (range, 50–68) years and a mean body mass index (BMI) of 35.6 calculated by formula on the basis of their height and weight (range, 28.7–39.1; obesity, BMI > 30). This study used a within-subject repeated-measures design. For each of the outcome measures, percent change from baseline was calculated as follows:

$$\text{Percent change from baseline} = \frac{\text{Final value} - \text{Baseline value}}{\text{Baseline Value}} \times 100\%$$

A negative percent change from baseline represented an improvement in OA symptoms. A Shapiro-Wilkins Goodness of Fit Test was performed for each distribution. Absolute changes in outcomes measured were also calculated and gave similar results. A paired *t* test was performed for each measure comparing the absolute change/percent change from baseline to a hypothesized percent change of zero (null hypothesis). For all significantly non-normal distributions, a nonparametric, signed rank test was performed. The following measures had significantly non-normal distributions: WOMAC Pain, WOMAC Physical Function, and Patient GA.

Compared with their status before taking the yoga classes, participants had statistically significant improvements in their levels of pain and disability measured by the WOMACs Pain and Physical Function Subscales (Table 1). WOMAC Pain declined 46.7% ($p = 0.04$) and WOMAC Physical Function fell 39.1% ($p = 0.04$). WOMAC Stiffness declined 39.0%, but this was not statistically significant ($p = 0.06$). Only one participant had an increase in WOMAC Pain or WOMAC Stiffness. This subject experienced a personal tragedy between the last yoga class and the follow-up assessment, and it is likely that her mental distress under these circumstances may have had a significant bearing on her outcome measures. The AIMS2 showed few changes over this time period for this intervention (Table 2). Only the AIMS2 Affect Component showed a statistically significant improvement at 23.2% ($p = 0.002$). A large but nonsignificant improvement in AIMS2 Symptoms (36.5% improvement; $p = 0.1$) was noted. Improvements in Physician Global Assessment (29.5% improvement; $p = 0.2$) and in Patient GA (24.1% improvement; $p = 0.2$) were observed but did not reach statistical significance (Table 3). The 50-foot walk time was unchanged. No participant reported experiencing an adverse event.

DISCUSSION

In this study, a sequence of asanas based on the teachings of B.K.S. Iyengar was used specifically as an intervention to treat knee OA symptoms. The results presented suggest that a supervised 8-week course of yoga can be beneficial in reducing pain and disability and improving affect in symptomatic knee OA patients. Stiffness was less clearly affected. There were also significant improvements in the AIMS2 psychologic subscale. Psychologic factors have been previously demonstrated to have an impact on pain perception in OA.[16,17] Physician and patient global assessments

Table 1. Change in Western Ontario and McMaster (WOMAC) Universities' Index Scores Before and After Yoga Intervention

WOMAC subscale	*% Change*	*% Change SD*	*p*
Pain	**−46.7**	±53.2	**0.04**[a]
Physical function	**−39.1**	±44.0	**0.04**[a]
Stiffness	−39.0	±55.4	0.06[b]

SD, standard deviation.
[a]Signed rank test.
[b]Student's *t* Test.
Note: Bolded items show statistically significant results.

Table 2. Change in Arthritis Impact Measurement Scales 2 (AIMS2) Scores Before and After Yoga Intervention

AIMS2 component	*% Change*	*% Change SD*	*p*
Affect	**−23.2**	±13.5	**0.002**[a]
Symptoms	−36.5	±65.9	0.1[b]
Social	−2.2	±38.9	0.6[b]
Role	−37.3	±100.6	0.8[b]

SD, standard deviation.
[a]Signed rank test.
[b]*t* Test.

Table 3. Change in Global Assessments (GA) Before and After Yoga Intervention

GA	*% Change*	*% Change SD*	*p*
Patient	−24.1	±62.3	0.2[a]
Physician	−29.5	±79.3	0.2[a]

SD, standard deviation.
[a]Signed rank test.

improved after the yoga intervention as well, although these changes did not reach statistical significance. The 50 (50)–foot walk time was unaffected and appeared to be an insensitive reflection of the improvements in pain and functioning noted. The intervention was safe, with no injuries experienced by participants.

The mechanisms by which yoga may be of benefit in treating symptoms of knee OA are not known, but possibilities are suggested by prior studies. These mechanisms include improvements in cardiovascular fitness, enhanced diaphragmatic breathing, strength, flexibility, and/or improvements in body awareness and in positioning the body in space at rest and during motion. Although yoga may merit further study into its cellular and physiologic effects, these have not yet been explored.

Some studies have suggested that cardiovascular fitness may be improved by yoga. Raju and colleagues compared physiologic parameters in two groups of elite athletes.[18] Both groups significantly reduced oxygen consumption at rest after exercise. The experimental group (daily supervised pranayama for 2 years) also improved oxygen consumption per unit work after exercise testing and had lower resting blood lactate levels, suggesting enhanced aerobic benefits. A second study of six healthy female volunteers had similar findings,[19] but both of these studies included participants that were likely to be considerably more physically fit than the average patient with symptomatic osteoarthritis of the knee.

A third study used a group of participants who may be more comparable to the subjects in our study.[20] It assessed a group of 40 sedentary, elderly men and women as they underwent a 6-week program of either exercycle-based or yoga-based training. Both interventions resulted in a reduction in heart rate and an increase in oxygen consumption after exercise, but the yoga practitioners experienced an increase in baroreflex sensitivity, reflecting an improvement in vascular tone. In the current study cardiorespiratory efficiency was not assessed, and it is unknown whether changes in these parameters would have had any correlation with pain symptoms.

Strength and flexibility have rarely been assessed as outcome measures of yoga interventions. One pranayama technique on grip strength was assessed in a group of 130 teenagers attending a residential Indian yoga camp.[21] The effect of a 10-week program of yoga on symptoms of hand OA were studied,[22] and reductions were found in tenderness of the finger joints and hand pain during activity, as well as an increase in range of motion. In a previous study of persons with carpal tunnel syndrome,[23] statistically significant improvements in grip strength and pain were found in the yoga intervention group. The yoga intervention used in this current study emphasized the positioning of the body at rest in supine and seated positions and in motion. Subjects reported that they had heightened awareness of how they were positioning their bodies in space after participation in the study. This, in turn, may have had an impact on the physical stress applied to different body parts and therefore the levels of pain experienced.

There are several limitations of this uncontrolled pilot study. First, the sample size was small. The study was not powered to assess adequately the magnitude of the effect of yoga on OA. However, the aim of this study was to test the feasibility and safety of using yoga to treat OA in a sample of the affected population who may have had difficulty committing to an exercise program in the past. These subjects were middle aged, obese, did not regularly exercise, and had not performed yoga asanas before. However, they were able to participate in the class and to show improvements in symptoms and functioning. Participants did not report any adverse events; this is especially important, as there may be concerns about the safety of yoga in patients not accustomed to physical activity. A second limitation of this study is that patients served as their own controls. Future studies should enroll larger numbers of subjects and should compare yoga to other time-intensive, nonpharmacologic interventions for osteoarthritis, such as patient education, quadriceps strengthening, walking, or swimming. It would be of interest to test physical parameters of functioning, such as those that are available in a gait analysis laboratory, and to identify subsets of individuals who would particularly benefit or for whom yoga might be inappropriate. Further work will be needed to address what the mechanisms might be through which yoga reduces symptoms of knee OA.

CONCLUSIONS

In summary, ACR management guidelines emphasize the importance of nonpharmacologic therapy of OA, and recent evidence supports exercise as a beneficial intervention. This pilot study suggests that yoga provides a safe and feasible

exercise option for previously yoga-naive, obese patients over ≥50 years of age and offers potential reductions in pain and disability caused by knee OA.

ACKNOWLEDGMENT

This study was partially supported by the American College of Rheumatology Clinical Summer Preceptorship Program (W.M.).

REFERENCES

1. Peyron J, Altman R. The epidemiology of osteoarthritis. In: Moskowitz RW, Howell DS, Goldberg VM, et al, eds. Osteoarthritis Diagnosis and Medical/Surgical Management, 2nd Edition. Philadelphia: WB Saunders, 1992:15–37.
2. 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.
3. Kolasinski SL. The use of alternative therapies by patients with rheumatic diseases. J Clin Rheum 1999;5:1–2.
4. Hurley MV, Scott DL. Improvements in quadriceps sensorimotor function and disability of patients with knee osteoarthritis following a clinically practicable exercise regime. Br J Rheumatol 1998;37:1181–1187.
5. van Baar ME, Assendelft WJ, Dekker J, et al. Effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a systematic review of randomized clinical trials. Arthritis Rheum 1999;42:1361–1369.
6. Deyle GD, Henderson NE, Matekel RL, et al. Effectiveness of manual physical therapy and exercise in osteoarthritis of the knee. A randomized, controlled trial. Ann Intern Med 2000;132:173–181.
7. Maurer BT, Stern AG, Kinossian B, et al. Osteoarthritis of the knee: Isokinetic quadriceps exercise versus an educational intervention. Arch Phys Med Rehabil 1999;80:1293–1299.
8. Kolasinski SL. Yoga for degenerative joint disease. Altern Med Alert 2001;4:28–31.
9. Iyengar BKS. Light on Yoga. New York: Schocken Books, 1979.
10. Garfinkel M, Schumacher HR. Yoga. Rheum Dis Clin North Am 2000;26:125–131.
11. Altman R, Asch E, Bloch G, et al. Development of criteria for the classification and reporting of osteoarthritis: Classification of osteoarthritis of the knee. Arthritis Rheum 1986;29: 1039–1049.
12. Altman RD. Design and conduct of clinical trials in patients with osteoarthritis: recommendations from a task force of the Osteoarthritis Research Society. Osteoarthritis Cartilage 1996; 4:217–243.
13. Bellamy N, Buchanan WW, Goldsmith CH, et al. Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol 1988;15:1833–1840.
14. Meenan RF, Gertman PM, Mason JH. Measuring health status in arthritis. The Arthritis Impact Measurement Scales. Arthritis Rheum 1980;23:146–152.
15. Meenan RF, Gertman PM, Mason JH, Dunaif R. The Arthritis Impact Measurement Scales. Further investigations of a health status measure. Arthritis Rheum 1982;25:1048–1053.
16. van Baar ME, Dekker J, Lemmens JA, et al. Pain and disability in patients with osteoarthritis of hip or knee: The relationship with articular, kinesiological and psychological characteristics. J Rheumatol 1998;25:125–133.
17. Wolfe F. Determinants of WOMAC function, pain and stiffness scores: Evidence for the role of low back pain, symptom counts, fatigue and depression in osteoarthritis, rheumatoid arthritis and fibromyalgia. Rheumatology 1999;38:355–361.
18. Raju PS, Madhavi S, Prasad KV, Reddy MV, et al. Comparison of effects of yoga and physical exercise in athletes. Indian J Med Res 1994;100:8.
19. Raju, PS, Prasad KV, Venkata RY, et al. Influence of intensive yoga training on physiological changes in 6 adult women: A case report. J Altern Complement Med 1997;3:291–295.
20. Bowman AJ, Clayton RH, Murray A, et al. Effects of aerobic exercise training and yoga on the baroreflex in healthy elderly persons. Eur J Clin Invest 1997;27:443–449.
21. Raghuraj, P, Nagarathna R, Nagendra H, Telles S. Pranayama increases grip strength without lateralized effects. Indian J Physiol Pharmacol 1997;41:129–133.
22. Garfinkel MS, Schumacher HR Jr, Husain A, et al. Evaluation of a yoga based regimen for treatment of osteoarthritis of the hands. J Rheumatol 1994;21:2341–2343.
23. Garfinkel MS, Singhal A, Katz WA, et al. Yoga-based intervention for carpal tunnel syndrome. A randomized trial. JAMA 1998;280:1601–1603.

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