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Complementary Therapies for Osteoarthritis: Are They Effective?

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Abstract

Increasing interest has focused on complementary management modalities, including Tai chi, acupuncture, yoga, and massage therapy as treatments for osteoarthritis (OA). This review article synthesizes evidence from randomized controlled trials (RCTs) and systematic reviews (SRs) that examined one or more of the above as treatments for OA. Medline, PubMed, and CINAHL databases were searched to identify English-language articles employing an RCT design or that conducted a SR of published studies and presented data on symptom or functional outcomes. Two authors independently abstracted relevant information (e.g., study sample, intervention characteristics, treatment effects, safety data). Retained articles (N=29) included those that evaluated tai chi (8 RCTs; 2 SRs); acupuncture (11 RCTs; 4 SRs); yoga (2 RCTs); and massage therapy (2 RCTs). Available evidence indicates that Tai chi, acupuncture, yoga, and massage therapy are safe for use by individuals with OA. Positive short-term (6 months or less) effects in the form of reduced pain and improved self-reported physical functioning were found for all 4 treatments. Limited information exists regarding the relative effectiveness of the therapies (e.g., yoga vs. Tai chi vs. acupuncture), as well as treatment effects in persons with joint involvement besides the knee and in distinct (e.g., older vs. younger adults, persons with mild vs. moderate vs. advanced disease) patient subgroups. Complementary therapies can reduce pain and improve function in adults with OA. Research is needed to evaluate long-term benefits of the treatments, as well as their relative effects among diverse patient subgroups.

Keywords

Complementary therapy; osteoarthritis; pain; physical function

Osteoarthritis (OA) constitutes a significant public health problem (Centers for Disease Control and Prevention, 2001, 2006). Approximately 50 million adults in the U.S. have arthritis (with OA being the most common), including half of all individuals over the age of 65 (Centers for Disease Control and Prevention, 2001). OA contributes to substantial disability (Centers for Disease Control and Prevention, 2006), often producing deleterious

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effects on individuals' physical activity and quality of life (Centers for Disease Control and Prevention, 2006; Shih, Hootman, Kruger, & Helmick, 2006).

Treatment is directed at control of pain and joint swelling, with a goal of minimizing functional impairment. Analgesic medications constitute the most commonly prescribed therapy by healthcare providers (Sarzi-Puttini et al., 2005), and commonly employed treatment by patients with OA (Barry, Gill, Kerns, & Reid, 2005). However, cost issues, patient concerns regarding analgesic related adverse effects, and difficulty prescribing many analgesics to patients with common chronic conditions (e.g., those with congestive heart failure, hypertension, or who are on chronic anti-coagulant therapy), constitute significant limitations to this treatment approach (Sale, Gignac, & Hawker, 2006; Solomon et al., 2010). Nonpharmacologic treatments in the form of patient education, exercise, weight loss, and physical therapy are recommended and can provide substantial benefit (American College of Rheumatology Subcommittee on Osteoarthritis Guidelines, 2000), but are underutilized (Austrian, Kerns, & Reid, 2005). Surgery (arthroplasty) is typically considered and can be effective for patients with severe symptomatic disease who have failed to respond to customary therapies (Ibrahim, 2010). However, many older adults (particularly older minorities) forego joint replacement thereby limiting the reach of arthroplasty (Ibrahim, 2010).

Prior research has demonstrated that a growing number of adults with OA employ complementary treatments (e.g., massage, relaxation techniques) in an effort to manage OA-related symptoms (Herman, Allen, Hunt, Prasad, & Brady, 2004). Reasons for this trend remain inadequately defined, but likely include limited symptom relief from conventional therapies, as well as a belief that complementary treatments are free from adverse effects (Vitetta, Cicuttini, & Sali, 2008). However, the efficacy and safety of these interventions remain poorly defined.

This review seeks to synthesize existing evidence regarding the efficacy and safety of four complementary methods for managing OA: Tai chi, acupuncture, yoga, and massage. These four modalities were selected for review because of a growing evidence base regarding their use, accessibility (e.g., most communities offer tai chi and yoga classes/programs), and in the case of acupuncture, published guidelines recommending its use (Jordan et al., 2003; Zhang et al., 2008).

Methods

Medline, PubMed, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases (01/95–04/11) were searched using *tai chi*, *acupuncture*, *yoga*, and *massage* as *Mesh* terms. Additional search terms included randomized controlled trial, systematic review and osteoarthritis. Identified abstracts were reviewed in detail using the following inclusion criteria: 1) article published in English, 2) enrolled adults with osteoarthritis, 3) employed a randomized controlled trial (RCT) systematic review or meta-analytic design, and 4) reported outcomes on relevant endpoints, e.g., symptom relief or functional ability. The reference lists of retained articles were also reviewed to identify additional studies for review. Two investigators independently abstracted information from articles meeting the above criteria, including characteristics of the study population and intervention, estimates of treatment effect and safety data. Discrepancies in the abstraction process were resolved by discussion.

Results

Twenty nine articles met inclusion criteria (23 RCTs and 6 SRs) and were retained for review. The following section is organized by treatment to include a brief description of each intervention (i.e., tai chi, acupuncture, yoga, and massage therapy), evidence regarding its efficacy and safety, and a summary of the evidence along with questions that remain unanswered regarding each treatment. Table 1 provides a brief summary of each article to include information regarding the characteristics of the study population, intensity and duration of the interventions and associated results.

Tai chi

Program description—Tai chi is a Chinese mind-body exercise that combines gentle movement, meditation and deep breathing and is most often taught and practiced in a group-based format. Tai chi classes are usually one hour in duration and are held once or twice a week. Classes begin with gentle warm-up and breathing exercises or a meditation, continue with practice of specific movements, and end with a directed cool-down.

Evidence base—Eight RCTs (Brismee et al., 2007; Fransen, Nairn, Winstanley, Lam, & Edmonds, 2007; Hartman et al., 2000; H. J. Lee et al., 2009; Ni, Song, Yu, Huang, & Lin, 2010; Song, Lee, Lam, & Bae, 2003; Song, Roberts, Lee, Lam, & Bae, 2010; Wang et al., 2009), and 2 SRs (Kang, Lee, Posadzki, & Ernst, 2011; M. S. Lee, Pittler, & Ernst, 2008) were identified that examined the effects of tai chi on OA-relevant outcomes. The studies employed group-based tai chi programs that met from once a week to 4 times a week and ranged in length from 8 to 24 weeks. In most cases, tai chi interventions were compared with an attention control or usual care arm. Participants were primarily women with knee OA who reported non-Hispanic white or Asian race/ethnicity. When compared with controls, significant improvements in quality of life (Fransen et al., 2007; H. J. Lee et al., 2009; Song et al., 2003; Wang et al., 2009), self-reported physical function (Brismee et al., 2007; Fransen et al., 2007; Ni et al., 2010; Wang et al., 2009), and joint stiffness (Brismee et al., 2007; Ni et al., 2010; Song et al., 2003) were reported for participants receiving treatment, as well as improvements in pain (Brismee et al., 2007; Ni et al., 2010; Song et al., 2003; Wang et al., 2009), fear of falling (Song et al., 2010), balance (Song et al., 2003) and performance-based measures of physical function, including gait speed (H. J. Lee et al., 2009; Ni et al., 2010) and timed chair stands (Wang et al., 2009). In the only study (Fransen et al., 2007) that compared tai chi to another exercise program (hydrotherapy), both programs led to comparable improvements in self-reported physical functioning and pain level. With one exception (Wang et al., 2009), studies measured short-term (i.e., 8 to 24 weeks) outcomes. Wang et al. (2009) evaluated the effects of tai chi (vs. an attention control arm) at 12, 24, and 48 weeks. Significant treatment effects were observed at 12 weeks for pain reduction and improvement in self-reported physical function, but these effects declined at both 24 and 48 weeks. However, significant improvements in self-efficacy and depressive symptom scores were present at 12 weeks and persisted at 24 and 48-weeks in the treatment arm. One systematic review (Kang et al., 2011) included a meta-analysis which showed that tai chi has favorable effects on pain, self-reported physical function, and joint stiffness among adults with OA. Only three studies (Brismee et al., 2007; Fransen et al., 2007; Ni et al., 2010) reported safety data, no significant adverse effects were reported from participating in a tai chi program.

Summary of evidence and unanswered questions—Available evidence indicates that tai chi is safe, can be feasibly administered to adults with OA, and can lead to improvements in salient outcomes, including pain, stiffness, quality of life and physical functioning. Most studies assessed short-term treatment effects and were limited by

homogenous study populations. Only one study examined (Wang et al., 2009) outcomes beyond six months. The effects of tai chi relative to other complementary treatments (e.g., acupuncture, yoga) are unknown and its effectiveness relative to customary exercise programs remains inadequately defined. The efficacy of tai chi among minority elders (e.g., Hispanic and African American), as well as its effect on different types of OA (e.g., hip, spine) and in different age groups (e.g., those over 75 versus younger adults) also remains unknown.

Acupuncture

Program description—Acupuncture is a wellness therapy originating in traditional Chinese medicine. Acupuncture practice uses small thin needles manipulated by hand to puncture the body at specific anatomical points. Puncturing these points is thought to unblock natural energy flow pathways called meridians. Acupuncture is practiced by health professionals certified and licensed to practice in each state. Acupressure, which is similar to acupuncture, employs directed pressure to unblock the body's natural meridians and can be self-administered.

Evidence base—Eleven RCTs (Berman et al., 2004; Berman et al., 1999; Christensen et al., 1992; Foster et al., 2007; Ng, Leung, & Poon, 2003; Sangdee et al., 2002; Takeda & Wessel, 1994; Tukmachi, Jubb, Dempsey, & Jones, 2004; Vas et al., 2004; Witt et al., 2005; Yurtkuran, Alp, Konur, Ozcakil, & Bingol, 2007) and 4 SRs (Kwon, Pittler, & Ernst, 2006; Manheimer et al., 2010; Manheimer, Linde, Lao, Bouter, & Berman, 2007; Selfe & Taylor, 2008) were identified and reviewed that examined the effects of acupuncture on knee, hip, or hand OA. Acupuncture techniques included deep needle stimulation both with and without electrical needle stimulation. The number of acupuncture points stimulated per session varied across studies, ranging from a low of 2 to a high of 8 (Selfe & Taylor, 2008). The number of treatments administered also varied (median number administered = 10), while treatment duration ranged from 2 to 26 weeks (Kwon et al., 2006). In most cases, acupuncture was compared with a sham, wait-list control, or usual care group. Participants were primarily older women with knee OA; race/ethnicity data were infrequently reported (Manheimer et al., 2007). Four SRs were identified and reported positive treatment effects associated with acupuncture, the effects (most notably pain reduction and improved physical functioning) were strongest when comparing acupuncture to wait-list control groups (Kwon et al., 2006; Manheimer et al., 2010; Manheimer et al., 2007; Selfe & Taylor, 2008). In the most recent and rigorously conducted SR, Manheimer et al. (2010) synthesized results from 11 trials involving approximately 3,500 participants (most had knee OA). This meta-analysis revealed that acupuncture produced statistically significant (but not clinically meaningful) effects on pain and physical function when compared to sham acupuncture. Finally, Foster et al. (2007) examined the additive effects of acupuncture on an exercise-based physiotherapy program; individuals who received both interventions did not have superior outcomes relative to those who received the exercise based physiotherapy program alone.

Most studies found little difference between the number of adverse events occurring in acupuncture and control groups (Manheimer et al., 2010; Selfe & Taylor, 2008). One review (Manheimer et al., 2010) estimated the risk of a serious adverse event from treatment to be 0.05 per 10,000 treatments.

Summary of evidence and unanswered questions—Existing evidence indicates that acupuncture is a safe intervention for patients with OA. Treatment effects, however, vary as a function of type of control group employed. Several studies have reported reduced pain and improved physical function associated with acupuncture using wait-list control groups; less robust effects have been observed when a sham acupuncture was employed as a

reference condition. Studies to date have focused largely on persons with knee OA. The effects of acupuncture relative to other complementary treatments (e.g., tai chi, yoga) are unknown, as are the long-term effects of therapy (i.e., greater than 6 months). The efficacy of acupuncture in minority elders and in different age groups (e.g., those over 75 versus younger adults) also remains unknown.

Yoga

Program description—Yoga combines exercise practice with relaxation and meditation techniques. While a variety of yoga programs exist, common elements across all programs include use of stretching, breathing, and relaxation exercises. Some programs include specific attention to body postures and poses. Yoga programs typically focus on building strength, enhancing flexibility and promoting relaxation through regular yoga exercise practice. Programs are delivered by certified instructors and can be administered to an individual or to groups.

Evidence base—Two RCTs (Garfinkel, Schumacher, Husain, Levy, & Reshetar, 1994; Haaz, 2010) were identified that examined the effects of yoga on persons with OA. Garfinkel et al. (1994) randomized 17 participants with hand OA to a treatment group that received instruction in (and supervised practice of) specific yoga techniques or usual care. A certified instructor led the group-based program that consisted of 8 weekly sessions lasting 60 minutes each. Participant ages ranged from 52 to 79. As compared with usual care, participants receiving yoga demonstrated significant reductions in hand tenderness, range of motion and hand pain with activity at the 10-week follow-up assessment.

Haas (2010) randomized 75 participants with OA or rheumatoid arthritis to an 8-week standard yoga program that had been modified for use by persons with arthritis or to a wait-list control condition. Yoga classes were held twice a week (lasting 60 minutes each), and participants were asked to practice the exercises for an additional 60 minutes at home each week. Participants had a mean age of 52 years, were mostly female (96%) and non-Hispanic white (55%). Between group comparisons over the 8-week study period revealed significant improvements in pain, physical health, flexibility, balance, and depressive symptomatology in the yoga group. No treatment-related adverse events were reported in either study.

Summary of evidence and unanswered questions—Existing evidence (although limited) suggests that yoga programs can be feasibly delivered to adults with OA, are safe, and have beneficial short-term effects. The long-term efficacy and safety of yoga programs as a treatment for persons with OA remain undefined. The effects of yoga relative to other complementary treatments (e.g., tai chi, acupuncture) or to conventional therapies remain unknown. The efficacy of this therapy among minority elders, its effects on different types of OA (e.g., hip, knee) and different age groups (e.g., those over 75 versus younger adults) also remains unknown.

Massage Therapy

Program description—A wide variety of therapeutic massage techniques are currently practiced, including trigger-point, Swedish, and neuromuscular massage. While massage delivery techniques often vary (e.g., use of palm of hand versus fingers only), common elements include direct physical contact and manipulation of tender muscle groups, as well as muscles judged to be in spasm. Some massage techniques also incorporate balancing energy fields by compression of specific ‘meridians.’

Evidence base—Two RCTs (Perlman, Sabina, Williams, Njike, & Katz, 2006; Yip & Tam, 2008) were identified that examined the effects of massage on patients with knee OA.

Perlman et al. (2006) randomized 68 patients to a delayed intervention control group or twice weekly sessions of Swedish massage (weeks 1–4) and once weekly sessions (weeks 5–8), with each session lasting one hour. Participants included older adults (mean age = 68 years) who were mostly non-Hispanic white (85%) and female (78%). Significant improvements in level of pain, stiffness, and functioning were reported for the massage group at 8 and 16 weeks. Effect sizes ranged from 0.64 to 0.86, indicating moderate-to-large treatment effects. Yip and Tom (2008) randomized 59 adults with moderate-to-severe knee pain (most with a diagnosis of knee OA) to 1) six sessions of massage therapy with an aromatic oil (each session lasted about 30 minutes and was delivered by a nurse with training in aroma-massage over a 3-week period), 2) the same massage but without an aromatic oil, or 3) usual care. Participants were ages 60 or above and most (79%) were female. Significant reductions in level of pain, stiffness, and function were observed in the aroma-massage arm at 1 and 4 weeks relative to baseline. Between-group comparisons revealed significant effects for the active treatment relative to nonaromatic massage and control at one week, but these differences were not present at 4-weeks. No significant adverse effects were reported in either study.

Summary of evidence and unanswered questions—Available (although limited) evidence suggests that massage therapy 1) can be feasibly administered to older adults with knee OA, 2) is safe for use among patients with knee OA and 3) has short-term benefits. No study has examined the long-term safety or efficacy of this treatment approach, compared its effects to other complementary treatment modalities (e.g., yoga, tai chi) or examined its effects on other types of OA. The efficacy of this therapy among minority elders remains unknown.

Discussion

Available evidence suggests that tai chi, acupuncture, yoga and massage therapy are safe for use by persons with OA and may have beneficial effects. Many unanswered questions remain about their role as treatments for persons with OA. Studies are needed to determine the long-term effects (i.e., more than 6 months) of the therapies and their role in treating individuals with various types (e.g., multiple vs. single joint involvement) of OA. Head-to-head comparisons (e.g., tai chi vs. yoga) are needed to determine whether one or more of the modalities are superior to one another or to customary interventions, including physical therapy, analgesic medications or self-management pain programs. Disease duration is a potentially important moderating variable (e.g., are treatment effects greatest in persons mild, moderate or advanced disease?) and should be the focus of future research. Studies that determine treatment-related costs and potential cost savings (e.g., reduction in analgesic use) of the therapies are also needed. Finally, because of established disparities in pain management as a function of advancing age and race/ethnicity status (Green et al., 2003; Landi et al., 2001), research directed at understanding the role of these treatments in minority elder populations is particularly needed.

This review has several implications for nursing practice. Nurses can improve the quality of care delivered to patients with OA and other arthritis-related disorders by taking comprehensive pain management histories to include inquiring about all pharmacologic and nonpharmacologic strategies employed by patients to manage pain. Patients may be utilizing complementary therapies for OA; the health care team needs to be aware of the use, and effects, of these modalities as part of the treatment plan. Eliciting patients' attitudes and beliefs regarding the use of complementary therapies is helpful as well, as nurses may be able to knowledgeably educate patients about available nonpharmacologic treatments, patients can then discuss these options with their health care providers. Patients with OA (and caregivers when appropriate) should receive instruction from nurses about the risks and

benefits of specific complementary approaches as a means of managing OA-related pain. For example, functional limitations with mobility and balance may affect a patient's ability to safely participate in certain yoga and tai chi programs. Nurses can assess which patients may benefit from a modified program (for example chair yoga or chair tai chi), work with the patient and the provider in helping patients implement these complementary modalities to help manage pain.

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Table 1
Summary of studies examining the efficacy and safety of four complementary therapies for the treatment of osteoarthritis.

Author, Year Site, Design	Study Population Characteristics	Intervention Components/Control group	Study Duration	Main Results
Tai chi				
Brismee et al. (2007) Texas, USA, Randomized Controlled Trial (RCT)	41 adults with knee OA a. Tai chi group (n=22), mean age 70.8 b. Control group (n=19), mean age 68.8	a. Tai chi: Group-based 40 min sessions 3 times a week in weeks 0-6; home-based training weeks 7-12; no training weeks 13-18 b. Controls (attention): 40 min health lecture and discussion sessions 3 times a week in weeks 0-6	18 weeks; 12 weeks of tai chi; conducted follow-up evaluation 6 weeks later	Tai chi associated with significantly reduced overall pain and improved physical function at weeks 9 and 12, as well as improved maximum pain levels and stiffness compared to baseline at 12 weeks. Improvements were not sustained at 18-weeks
Fransen, Nairn, Winstanley, Lam & Edmonds (2007) Sydney, Australia, RCT	152 adults with chronic symptomatic hip or knee OA a. Hydrotherapy group (n=55), mean age 70.0 b. Tai chi group (n=56), mean age 70.8 c. Control group (n=41), mean age 69.6	a. Hydrotherapy: Classes for 1 hr twice a week in weeks 0-12 b. Tai chi: Classes for 1 hr twice a week in weeks 0-12 c. Controls (wait list):	24 weeks; 12 weeks of hydrotherapy or tai chi classes; conducted follow-up evaluation 12 weeks later	Both hydrotherapy and Tai Chi associated with significant improvements in pain and physical function at 12 and 24 weeks
Hartman et al. (2000) Boston, USA, RCT	33 adults with lower extremity OA a. Tai chi group (n=18), mean age 68.6 b. Control group (n=15), mean age 67.5	a. Tai chi: Classes for 1 hr twice a week in weeks 0-12 b. Controls (usual care):	12 weeks	Tai chi associated with significant improvements in arthritis self efficacy, general health satisfaction and level of tension compared to baseline
Lee et al. (2009) Seoul, Republic of Korea, RCT	44 adults with knee OA a. Tai chi group (n=29), mean age 70.2 b. Control group (n=15), mean age 66.9	a. Tai chi: Classes for 1 hr twice a week in weeks 0-8 b. Controls (wait list):	8 weeks	Tai Chi Qigong associated with significant improvements in health-related quality of life compared to controls at 8-weeks. Intervention group also showed significant improvements in pain and 6-minute walking test times compared to controls
Ni, Song, Yu, Huang, & Lin (2010) Guangzhou, China, RCT	35 Chinese women with knee OA a. Tai chi group (n=18), mean age 62.9 b. Control group (n=17), mean age 63.5.	a. Tai chi: Classes given 2 to 4 times a week in weeks 0-24 b. Controls (attention): Received 45 min once a week of wellness education and stretching exercise training in weeks 0-24	24 weeks	Tai chi associated with significantly improved pain, stiffness and physical function scores. Tai chi group also showed significant improvements in both 6-minute walk distance and stair climb times at 24-weeks compared to controls

Author, Year Site, Design	Study Population Characteristics	Intervention Components/Control group	Study Duration	Main Results
Song, Lee, Lam, & Bae (2003) Chon An, South Korea, RCT	43 women with OA a. Tai chi group (n=22), mean age 64.8 b. Control group (n=21), mean age 62.5	a. Tai chi: Classes for 20 min 3 times a week in weeks 0-2; classes once a week plus home-based 20 min tai chi exercise 3 times a week in weeks 3-12 b. Controls (usual care)	12 weeks	Tai chi associated with significantly improved pain and stiffness scores, physical functioning, as well as balance and abdominal strength at 12 weeks compared to controls
Song, Roberts, Lee, Lam, & Bae (2010) Daejeon, South Korea, RCT	65 women with OA a. Tai chi group (n=30), mean age 63.0 b. Control group (n=35), mean age 61.2	a. Tai chi: One hr classes twice a week in weeks 0-3; one hr classes once a week in weeks 4-24; home-based 20 min tai chi exercise a day in weeks 0-24 b. Controls: Self-help education program for 2 hrs a month weeks 0-24	24 weeks	Tai chi associated with significantly increased knee extensor muscle endurance and bone mineral density, as well as decreased fear of falling compared to controls. No between group differences were seen in knee flexor/extensor strength
Wang et al. (2009) Boston, USA, RCT	40 adults with tibiofemoral OA a. Tai chi group (n=20), mean age 63.0 b. Control group (n=20), mean age 68.0	a. Tai chi: One hour sessions twice a week in weeks 0-12 b. Controls (attention): One hr wellness education and stretching program classes twice a week in weeks 0-12	48 weeks: 12 weeks of tai chi classes; conducted follow-up evaluations at 12, 24 and 48 weeks	Tai chi associated with significantly improved pain, stiffness and physical function, depression and self efficacy scores at 12-weeks compared to controls. Depression and self-efficacy score changes remained significant at 24 and 48 weeks for intervention group
Kang, Lee, Posadzki, & Ernst (2011) Seoul, Republic of Korea, ^a Meta-analysis (MA)	9 RCTs examined effects of tai chi on adults with OA: 6 focused on those with knee OA while 3 focused on adults with either hip, knee or multiple joint OA	a. Tai chi interventions ranged from one hr classes twice a week in weeks 0-8 to one hr classes twice weekly in weeks 0-3, then weekly in weeks 4-24 b. Controls included attention controls, wait lists, routine care, self-help programs, hydrotherapy, and non-physical activities (e.g., bingo)	8 to 24 weeks	Meta analyses revealed that tai chi has favorable effects on pain and physical functioning when compared to diverse control groups. Positive pain reducing effects were not found for subjects with multiple-joint OA
Lee, Ptitler, & Ernst (2008) Exeter, UK, ^a Systematic review (SR)	12 clinical trials examined effects of tai chi on adults with OA: 5 RCTs and 7 non-randomized controlled clinical trials (CCTs)	a. Tai chi interventions ranged from one hour classes in weeks 0-8 to 50 minute classes 3 times weekly in weeks 0-24 b. Controls included routine care, attention controls, wait lists, self-help programs, hydrotherapy, aquatic exercise or non-physical activities (e.g., bingo)	8 to 24 weeks	Some but not all studies found that tai chi led to significant reductions in pain and improved physical function, balance, flexibility, and quality of life compared to diverse control conditions
Acupuncture				
Berman et al. (2004) Baltimore, USA, RCT	570 adults with knee OA a. True acupuncture group (n=190), mean age 65.2 b. Sham acupuncture control group (n=191), mean age 66.2	a. True acupuncture: Two treatments a week in weeks 0-8, one per week in weeks 9-10, one every other week in weeks 11-14, one per month weeks 15-26 b. Controls (sham acupuncture): Had combined insertion and non-insertion procedure given on same schedule as group a	26 weeks	Acupuncture associated with significant improvement in lower extremity function at 8, 14 and 26 weeks compared with sham controls. Participants in both true and sham acupuncture groups showed significant improvement

Author, Year Site, Design	Study Population Characteristics	Intervention Components/Control group	Study Duration	Main Results
	c. Control group (n=189), mean age 65.1	c. Controls (attention): Six two-hr educational self-management sessions in weeks 0–12		in pain compared to baseline at week 26
Berman et al. (1999) Baltimore, USA, RCT	73 adults with knee OA a. Acupuncture (n=36), mean age 65.7 b. Control group (n=37), mean age 65.5	a. Acupuncture: Twice a group week treatment during weeks 0–8 b. Controls (usual care):	12 weeks; 8 weeks of acupuncture; conducted follow-up evaluation 4 weeks later	Acupuncture associated with significant improvements in disability, pain, and physical function compared to controls at 4 and 8 weeks. Effects diminished at 12 weeks
Christensen et al. (1992) Nykøbing-Falster, Denmark, RCT	29 adults with knee OA awaiting arthroplasty, median age 69.2 a. Acupuncture group (n=14) b. Control group (n=15)	In 1 st part of study: a. Acupuncture: in weeks 1–3 Treatments twice a week b. Controls: No treatment weeks 1–9; acupuncture treatment twice a week in weeks 9–11 In 2 nd part of study: 17 subjects from both groups continued with acupuncture 3 or 4 times a week in weeks 23–24 (if needed) and once a month in weeks 25–49 (if needed)	49 weeks: 1 st part: Weeks 1–17 2 nd part: Weeks 18–49	Acupuncture associated with significant reductions in analgesic consumption and pain as well as improved physical functioning compared to baseline; improvements were maintained from 17 to 49 weeks
Foster et al. (2007) Midlands, UK, RCT	352 adults with knee OA a. True acupuncture group (n=117), mean age 63.1 b. Non-penetrating acupuncture control group (n=119), mean age 62.8 c. Advice and exercise control group (n=116), mean age 63.8	a. True acupuncture: Received acupuncture plus advice and exercise treatment delivered up to 6 treatment sessions for 3 weeks b. Non-penetrating acupuncture controls: Received non-penetrating acupuncture plus advice and exercise treatments up to 6 sessions over 3 weeks c. Advice and exercise controls: Received advice leaflet on knee OA and exercise individualized using PhysioTools 30 min 6 sessions over 6 weeks	52 weeks; conducted follow-up evaluations at 2, 6, 26, and 52 weeks	Acupuncture was not associated with significant reductions in pain compared to exercise/educational control groups at 6 months. Non-penetrating acupuncture participants experienced slightly improved pain compared to exercise/educational controls at 6 weeks
Ng, Leung, & Poon (2003) Hong Kong, China, RCT	24 adults with knee OA a. Electroacupuncture (EA) group (n=8), mean age 84.4 b. Transcutaneous electrical nerve stimulation (TENS) group (n=8), mean age 85.9 c. Control group (n=8), mean age 85.0	a. EA: Received 8 sessions of 20 min of low frequency EA (2 Hz) in weeks 0–2 b. TENS: Received 8 sessions of 20 min of low frequency TENS (2 Hz) and pulse width of 200-μs treatment in weeks 0–2 c. Controls: Received usual care and general education in weeks 0–2	4 weeks; 2 week intervention period; conducted follow-up evaluation 2 weeks later	Both electroacupuncture and TENS associated with significantly reduced pain (relative to baseline) at post-intervention and at 2-week follow-up. Electroacupuncture also associated with significant improvement in timed-up-and-go test scores at 2 (but not 4) weeks
Sangdee et al. (2002) Chiang Mai, Thailand, RCT	193 adults with knee OA a. Combined group (n=49), mean age 61.8	a. Combined: Received true EA and diclofenac in weeks 0–4	4 weeks	Electroacupuncture (true EA + placebo diclofenac) associated with strongest treatment effects, including significantly improved

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	<p>b. EA group (n=48), mean age 65.1</p> <p>c. Diclofenac group (n=49), mean age 62.1</p> <p>d. Placebo group (n=47), mean age 62.7</p>	<p>b. EA: Received true EA and placebo diclofenac in weeks 0–4</p> <p>c. Diclofenac: Received diclofenac and placebo EA in weeks 0–4</p> <p>d. Placebo: Received placebo diclofenac and Placebo EA in weeks 0–4 Placebo or diclofenac tablets prescribed 3 times a day</p> <p>True EA or placebo EA performed 3 times a week in weeks 0–4</p>		pain and function scores compared to placebo group (placebo diclofenac and placebo EA)
Takeda & Wessel (1994) Alberta, Canada, RCT	<p>40 adults with knee OA</p> <p>a. Acupuncture group (n=20), mean age 63.0</p> <p>b. Control group (n=20), mean age 60.2</p>	<p>a. Acupuncture: 3 times a week in weeks 0–3</p> <p>b. Controls: Received sham (placebo) acupuncture 3 times in weeks 0–3</p>	3 weeks	Both true and sham acupuncture associated with significant improvement in pain intensity, stiffness and overall function
Tukmachi, Jubb, Dempsey, & Jones (2004) Birmingham, UK, RCT	<p>30 adults with knee OA</p> <p>a. Combined group (n=10), mean age 60.0</p> <p>b. Acupuncture group (n=10), mean age 61.0</p> <p>c. Control group (n=10), mean age 61.0</p>	<p>a. Combined: Received acupuncture twice a week along with continued use of analgesics in weeks 0–5</p> <p>b. Acupuncture: Received only acupuncture treatment twice a week in weeks 0–5</p> <p>c. Controls: Received analgesic medication only in weeks 0–5; received acupuncture twice a week with continued use of analgesics in weeks 6–10</p>	10 weeks; 5 weeks of intervention; conducted follow-up evaluations at 9 weeks for combined and acupuncture group and at 10 weeks for controls	Acupuncture only, acupuncture + oral analgesics and acupuncture following oral analgesics were all associated with significant improvements in pain and stiffness scores
Vas et al. (2004) Dos Hermanas, Spain, RCT	<p>97 adults with knee OA</p> <p>a. Acupuncture group (n=48), mean age 65.7</p> <p>b. Control group (n=49), mean age 68.4</p>	<p>a. Acupuncture: Received true acupuncture in weeks 0–12 and diclofenac 50mg 3 times a day; participants instructed to reduce diclofenac dose if symptoms improved in weeks 0–12</p> <p>b. Controls: Received placebo acupuncture in weeks 0–12 and diclofenac in same regimen as acupuncture group</p>	13 weeks; 12 week intervention period; conducted follow-up evaluation at 1 week after treatment ended	Acupuncture associated with significantly improved functional activity, decreased pain levels, and decreased use of diclofenac compared to controls. Intervention group also showed significant (and positive) changes in physical capability and psychological functioning compared to controls
Witt et al. (2005)	<p>294 adults with knee OA</p> <p>a. Acupuncture group (n=149), mean age 64.5</p> <p>b. Minimal acupuncture control group (n=75), mean age 63.4</p> <p>c. Wait list control group (n=70), mean age 63.6</p>	<p>a. Acupuncture: Received semi-standardized 30 min treatments twice a week in weeks 0–4; once a week in weeks 5–8</p> <p>b. Minimal acupuncture controls: Received 30 min treatments (at non-acupuncture points) twice a week in weeks 0–4; once a week in weeks 5–8</p> <p>c. Control (wait list): Received no intervention in weeks 0–8; 30 min duration 12 acupuncture</p>	52 weeks; 8 week intervention period; follow-up evaluations conducted at 8, 26 and 52 weeks	Acupuncture associated with significantly improved pain, stiffness and physical functioning, as well as physical health and disability immediately post-intervention compared to those who received minimal or no acupuncture treatment. Between group differences were not maintained at 26 or 52 weeks

Author, Year Site, Design	Study Population Characteristics	Intervention Components/Control group	Study Duration	Main Results
Berlin, Germany, RCT		sessions in weeks 9–16 in same frequency as acupuncture and minimal acupuncture group		
Yurikuran, Alp, Konur, Ozcakar & Bingol (2007) Bursa, Turkey, RCT	53 adults with knee OA a. Acupuncture group (n=27), mean age 51.8 b. Control group (n=26), mean age 53.5	a. Acupuncture: Received 20 min low-level laser therapy 5 times a week in weeks 0–2 b. Controls (placebo): Received 20 min placebo- laser therapy 5 times a week in weeks 0–2	12 weeks; 2 week intervention period; conducted follow-up evaluation at 12 weeks	Both laser and sham laser acupuncture associated with significant reductions in pain and improved 50 foot walk time compared to baseline scores
Kwon, Pittler, & Ernst (2006) Exeter, UK, ^a MA	18 RCTs examined effects of acupuncture on adults with peripheral joint OA (10 studied manual acupuncture and 8 electro-acupuncture)	a. Acupuncture treatments ranged from 20 min/session for 5 days weekly for 2 weeks to 8 weeks of treatment and additional follow-up for one year after intervention b. Controls included wait lists, sham acupuncture, and other active treatments such as TENS, physical therapy, ice massage, analgesic medications, exercise, and hydrotherapy	2 to 52 weeks	Meta-analyses of studies examining manual acupuncture revealed a significant treatment effect for pain reduction; excessive heterogeneity precluded a meta-analysis of studies examining electro-acupuncture
Manheimer, Linde, Lao, Bouter, & Berman (2007) Baltimore, USA, ^a MA	11 RCTs examined effects of acupuncture on adults with knee OA	a. Acupuncture treatments ranged from 3 weeks of intervention, with additional 6 weeks of follow-up to 23 sessions delivered over 26 weeks b. Controls ranged from sham acupuncture, usual care or waiting lists	9 to 26 weeks	Meta analyses revealed that acupuncture (i.e., active treatment vs. wait-list controls) is associated with clinically relevant reductions in pain and improvement in function; in subset of studies that compared active to sham acupuncture, no clinically relevant effects on pain or function were observed
Manheimer et al. (2010) Baltimore, USA, ^a MA	16 RCTs examined effects of acupuncture on adults with peripheral joint OA: 12 included only adults with knee OA, 3 included only adults with hip OA, and 1 included those with hip and/or knee OA	a. Acupuncture treatments ranged from 3 weeks of intervention, with additional 6 weeks of follow-up to 8 weeks of treatment and additional follow-up for one year after intervention b. Controls ranged from sham acupuncture, usual care or waiting lists	9 to 52 weeks	Meta analyses revealed that acupuncture (active treatment vs. sham control) is associated with significant (but not clinically relevant) improvement in pain and function. Acupuncture (active treatment vs. wait-list control) is associated with significant (and clinically relevant) improvement in pain and function
Selfe & Taylor (2008) Charlottesville, USA, ^a SR	10 RCTs examined effects of acupuncture on adults with knee OA	a. Acupuncture treatments ranged from 20 min/session for 5 days a week for 2 weeks to 12 sessions over 8 week and additional follow-up for one year after intervention b. Controls included sham acupuncture, wait lists, education, and other active treatments such as TENS and analgesic medications	2 to 52 weeks	Most studies (8 of 10) found that acupuncture was associated with significant reductions in pain compared with diverse controls; of the 6 studies that assessed physical function 5 found that active treatment was associated with significant improvement in this outcome

Author, Year Site, Design	Study Population Characteristics	Intervention Components/Control group	Study Duration	Main Results
Yoga				
Garfinkel, Schumacher, Husain, Levy, & Reshetar (1994) Philadelphia, USA, RCT	25 adults with hand OA a. Yoga group (n=19), b. Control group (n=11) Sample age ranged from 52 to 79 (5 control subjects received intervention in 2 nd phase of study)	a. Yoga: 60 min sessions once a week in weeks 1-9; b. Controls (wait list):	20 weeks; 8 weeks of tai chi with follow-up evaluation at week 10; in 2 nd phase of study wait list controls received intervention conducted	Yoga associated with significant improvements in finger tenderness in both hands, right-handed finger range of motion and hand pain during physical activity compared to controls
Haaz (2010) Baltimore, USA, RCT	75 adults with OA or RA a. Yoga group (n=40), mean age 49.2 b. Control group (n=35), mean age 55.9	a. Yoga: One hour classes twice a week and one hour once a week individual home practice in weeks 0-8 b. Controls (usual care):	8 weeks	Yoga associated with significant (and positive) changes in overall physical health, balance and physical functioning compared with controls
Massage				
Perlman, Sabina, Williams, Njike, & Katz (2006) New Jersey, USA, RCT	68 adults with knee OA a. Massage group (n=34), mean age 70.4 b. Control group (n=34), mean age 66.2	a. Standard Swedish massage: 1 hr session twice weekly in weeks 1-4, once a week sessions in weeks 5-8 b. Controls (usual care): in weeks 1-8 and standard Swedish massage 1 hr sessions on same schedule as group a in weeks 9-16	16 weeks; 8 week intervention period; conducted evaluation at 8 and 16 weeks	Massage therapy associated with significant improvements in pain, stiffness and physical function relative to controls. Massage group also showed significantly improved range of motion compared to controls
Yip & Tam (2008) Sydney, Australia, RCT	59 adults with knee OA a. Treatment massage group (n=21), mean age 73.3 b. Placebo massage group (n=20), mean age 72.9 c. Control group (n=18), mean age 74.4	a. Treatment: Six 30-35 min ginger and orange oil massage sessions delivered over 2-3 weeks b. Placebo: Six 30-35 min olive oil massage sessions delivered over 2-3 weeks c. Controls (usual care):	7 weeks; 3 week intervention period; conducted follow-up evaluations at 1 and 4 weeks after treatment ended	Ginger + orange oil massage associated with significant improvement in knee pain, stiffness and physical function. However, there were no significant differences reported in these values in between the massage groups (treatment vs. placebo, placebo vs. controls and treatment vs. controls)

^a Location shows the address of principal author and does not reflect the site where the studies were conducted.