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Original Article

Tai Chi for Disease Activity and Flexibility in Patients with Ankylosing Spondylitis—A Controlled Clinical Trial

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We investigated the effects of *tai chi* on disease activity, flexibility and depression in patients with ankylosing spondylitis (AS). We allocated 40 patients to either a *tai chi* treatment group or a no-treatment control group. The *tai chi* group performed 60 min of *tai chi* twice weekly for eight consecutive weeks and 8 weeks of home-based *tai chi*, after which the group showed significant improvement in disease activity and flexibility compared to the control group. All outcome measures were significantly lower in the *tai chi* group than they were during pre-treatment, while they did not change in the control group. These findings suggest that *tai chi* can improve disease activity and flexibility for patients with AS. *Tai chi* is an easily accessible therapy for patients and, as such, may be an effective intervention for AS. However, we cannot completely discount the possibility that the placebo effect was responsible for the improvement.

Keywords: ankylosing spondylitis – disease activity – flexibility – *tai chi*

Introduction

Ankylosing spondylitis (AS) is a chronic inflammatory rheumatic disease that primarily affects the sacroiliac joint and spine, which causes physical outcomes such as reduced physical activity, fatigue, sleep disturbances and psychologic consequences such as depression, anxiety and stress (1–5). Because of its insidious nature, this condition's diagnosis may be delayed until the final stage of the disease (6). AS treatment aims to prevent the stiffness and flexion deformity that accompany the disease and to maintain a healthy physical and psychologic state for the patient (7).

First-line treatments for AS include physical exercise and the administration of non-steroidal anti-inflammatory drugs (NSAIDs) or anti-tumor necrosis factor (TNF) (6,8–10). Of many available treatments, physical exercise appears to benefit patients coping with the disease because activity provides opportunities to enhance their sense of control over its symptoms, especially pain and immobility (9,10).

Tai chi is a combination of physical exercise and relaxation techniques rooted in ancient Chinese philosophy and is used to enhance its practitioners' mental and physical health (11). Several previous studies have determined that *tai chi* is beneficial for balance control, flexibility, aerobic capacity, headache (12), improving immunity (13) and psychologic variables such as depressive symptoms (14), mood and anxiety (15). It also improves muscular strength and reduces the risk of falls in the elderly (16–18). *Tai chi* also has been determined to improve symptoms related to rheumatoid arthritis (RA) and osteoarthritis (19,20). Based on these findings, it is reasonable to assume that *tai chi* can help patients with AS. However, no studies have been conducted on the effect of *tai chi* exercise in AS patients. The present study clinically assesses *tai chi's* effects on disease activity, flexibility and depression in patients with AS.

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Methods

Patients

Patients with AS were recruited through bulletin board advertising to participate in an 8-week *tai chi* program at the University Medical Center's Rheumatism Center. Patients were eligible to participate in the program if they (i) were out-patients with no complications, (ii) could understand the content of questionnaires and experimental schedules, (iii) had no changes in their current prescription medication in the past 4 weeks, (iv) were classified as functional class II for AS according to the Modified NY, USA Criteria for AS and (v) had not experienced *tai chi*, *qigong* or other related relaxation training.

Sixty-one patients were eligible per our study's criteria. We randomly selected 40 subjects from among the volunteers and allocated them to either the *tai chi* group ($n = 20$) or the control group ($n = 20$). The study's dropout rates were 35 and 15% for the *tai chi* and control groups, respectively, so that both pre- and post-test data for 8 weeks of *tai chi* were available from 13 subjects in the tai chi group and 17 controls. The primary reasons for dropout in the *tai chi* group were that participants moved to another city (three subjects), had no time available to participate (two subjects) or were readmitted to the hospital (two subjects). The primary reason for dropout in the control group was failure to complete due to having no time available to participate (three subjects) (Fig. 1). We conducted additional analysis to compare the demographic and pre-test data for the dropouts to those of the remaining members of the *tai chi* and control groups, which revealed no significant differences.

Subjects were informed about the nature of AS and the study procedures. We received approval for the study from the University Hospital's Institutional Review Board before we approached the subjects; all subjects provided written informed consent.

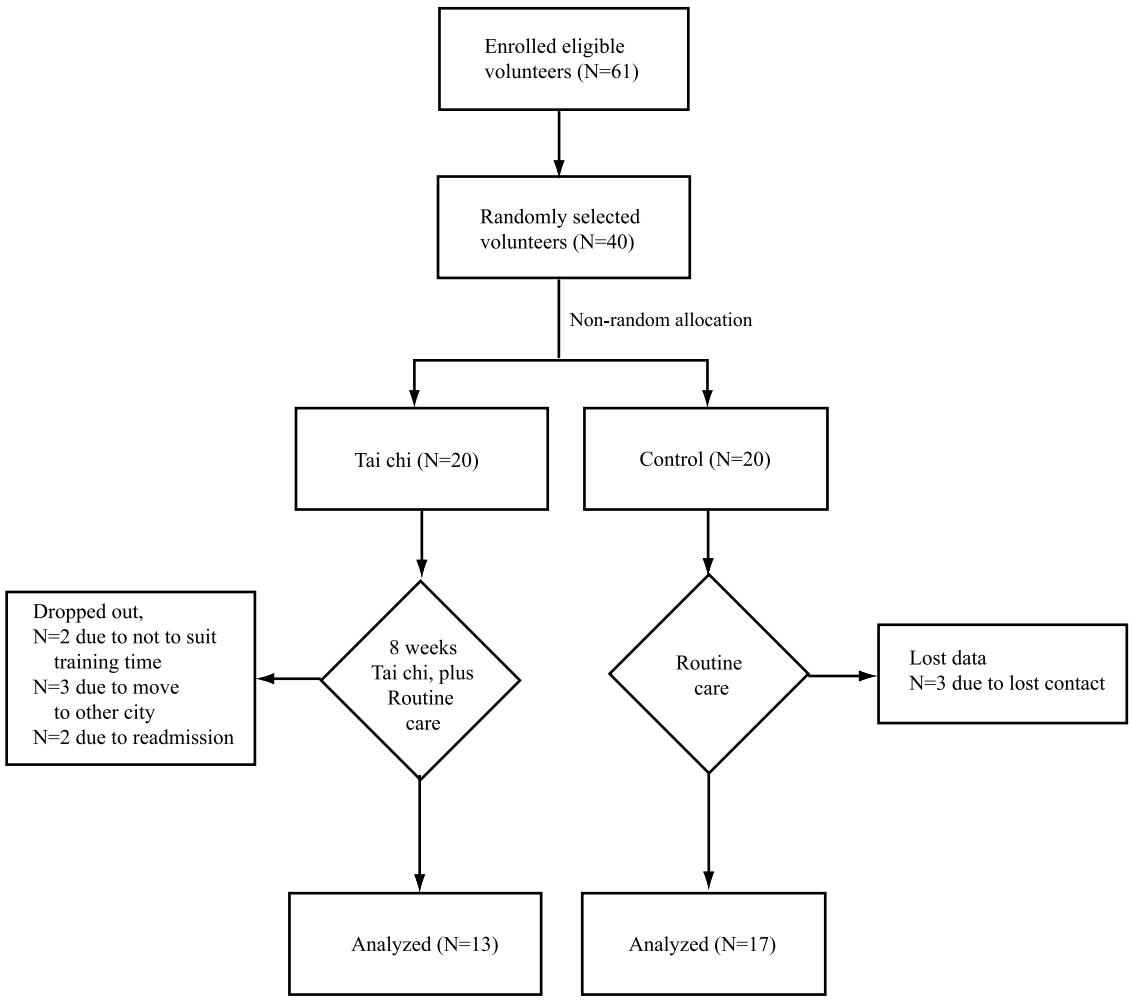

Figure 1. Diagram of study design showing the flow of participants.

Outcome Measures

This study's outcome measures included the following: (i) disease activity (as the primary outcome measure) and (ii) finger to floor distance (FFD) and depression (as secondary outcome measures). Outcome measures were assessed by a nurse, who did not know the experimental protocol or the subjects' allocation, before and 8 weeks after the experiment.

Disease Activity

Disease activity the week prior to study admission was measured as a baseline reading using the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) (21), which includes six questions related to five symptoms during the past week: fatigue, spinal pain, joint pain, tenderness and morning stiffness. All items are scored on a 10 cm visual analogue scale (VAS), on which higher scores reflect greater disease activity. Analysis of this experiment indicated a high level of internal consistency (Cronbach's $\alpha = 0.94$).

Finger to Floor Distance (FFD)

FFD was measured with the patient bending forward maximally with knees straight. We used a ruler to assess flexibility by measuring the FFD. Two measurements were made and averaged.

Depression

The Center for Epidemiologic Studies Depression Scale (CES-D) was used to measure the subjects' depression level. The CES-D is a 20-item self-report questionnaire that has been used extensively for research purposes (22). It assesses the current level of depressive symptomatology over the past week and has been shown to possess good internal consistency ($\alpha = 0.85$ as reported by Radloff (22); $\alpha = 0.96$ in the present study). Participants indicate their level of endorsement of each item on a four-point scale ranging from 'rarely or none of the time (less than one day)' to 'all of the time (5–7 days)'.

Intervention

The intervention program used 21 movements based on *tai chi* for (RA) developed by Dr Paul Lam *et al.* (23). The *tai chi* for RA consisted of a warm-up exercise (10 min), 21 main movements (30 min) and a cool-down exercise (5 min). This study's warm-up and cool-down exercises involved stretching and relaxing the head, neck, upper and lower body and whole body. The exercises were not modified from original *tai chi* for the arthritis program.

The 21 basic *tai chi* movements involved commencement form, opening and closing hands, single whip, waving hands in the cloud, brush knee and twist step, playing the lute, stepping forward to deflect downward, parrying and punching, pushing the mountain, closing form and alternating sides for all previous motions (20).

Subjects in the *tai chi* group attended two group *tai chi* classes per week for 8 weeks, led by two instructors (the first two authors, ENL and YHK, who are certified as *tai chi* instructors and have 4 years of instruction experience). The instructors explained and demonstrated how the exercises should be performed and the subjects followed. A videotape was shown during the group session. We also individually instructed subjects in the appropriate movements. Six weeks were devoted to learning the *tai chi* routine, so the subjects were actually performing the routine competently for the last 2 weeks. A special guide book for home practice was produced, which contains pictures and written descriptions of the same exercise as the *tai chi* program. Subjects were asked to practice their exercises at home for repetition with the guide book (once daily for first 6 weeks and twice daily for last 2 weeks) and were telephoned by the researchers twice each week. Participants recorded the frequency and duration of their *tai chi* performance at home in their exercise log, which the instructors assessed during every weekly session (final compliance with home-based *tai chi* was 93.3% according to the exercise logs).

Subjects in both groups received standard drug treatments provided by the outpatient clinic. Control subjects received no other treatment and did not participate in any structured exercise programs during the study period. They were contacted by researchers twice weekly by telephone to confirm that they were not taking part in any other exercise activities and to provide impetus to keep them engaged in the study. Control group subjects who were interested in *tai chi* were provided with an exercise program after the study ended.

Results

No Differences in Baseline Homogeneity Between the Two Groups

Table 1 shows the demographic characteristics of subjects in the *tai chi* and control groups. The groups did not differ significantly according to age, gender, disease duration, marital status, religion, economic status or medication.

Group comparisons were made of outcome variables including BASDAI, FFD and depression to confirm homogeneity between the *tai chi* and control groups (Table 2). There were no significant differences between the two groups.

Adverse Events

No adverse effects associated with the practice of *tai chi* were reported by the participants.

Table 1. Demographic characteristics of subjects

	Tai chi ($n=13$)	Control ($n=17$)	t or χ^2	P
Age (years, mean ± SD)	35.2 ± 11.5	34.9 ± 12.9	0.60	0.95
Gender (M/F)	10/3	15/2	0.68	0.41
Disease duration (years, mean ± SD)	2.9 ± 1.0	2.7 ± 1.1	0.57	0.57
Marital status (Yes/No)	5/8	9/8	0.62	0.43
Religion (Yes/No)	10/3	7/10	3.83	0.07
Economic status (Middle/Low)	7/6	14/3	2.85	0.12
Medication (Yes/No)	12/1	17/0	1.35	0.25

Table 2. Homogeneity test on outcomes between the groups

Outcome measures	*Tai chi* ($n=13$)	Control ($n=17$)	t	P
BASDAI	27.5 ± 11.3	20.1 ± 13.3	1.61	0.12
FFD (cm)	16.0 ± 14.1	9.1 ± 13.1	1.39	0.18
Depression	21.9 ± 13.8	16.3 ± 13.3	1.12	0.27

Values are expressed as mean ± SD.
BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; FFD: finger to floor distance.

Tai Chi Improves BASDAI, FFD and Depression

Fig. 2 shows the change in outcome measures between the pre- and post-test scores (post-test – pre-test) and an unpaired group test was conducted to assess *tai chi's* effects on AS symptoms. By the 8-week study's endpoint, BASDAI had improved significantly compared to the control group (intergroup difference, $P<0.05$). FFD in the *tai chi* group also differed significantly from that of the control group ($P<0.05$). No significant intergroup differences were seen in depression scores.

Compared to the change scores from the pre-test data, the *tai chi* group exhibited negative scores in their BASDAI, FFD and depression scores of −7.38 (SD 13.02), −4.56 (SD 2.74) and −5.86 (SD 8.10), respectively; while the control group had more BASDAI (0.35, SD 6.77) and FFD (1.84, SD 10.58) or reduced depression (−2.12, SD 8.57).

Discussion

This preliminary controlled clinical trial was conducted to investigate the efficacy of *tai chi* exercise in patients with AS. Subjects in the active treatment group showed greater improvement in disease activity and flexibility after 8 weeks than controls. This result supports previous findings that *tai chi* benefits flexibility and disease activity in different conditions (11,16,18,20). The results of the

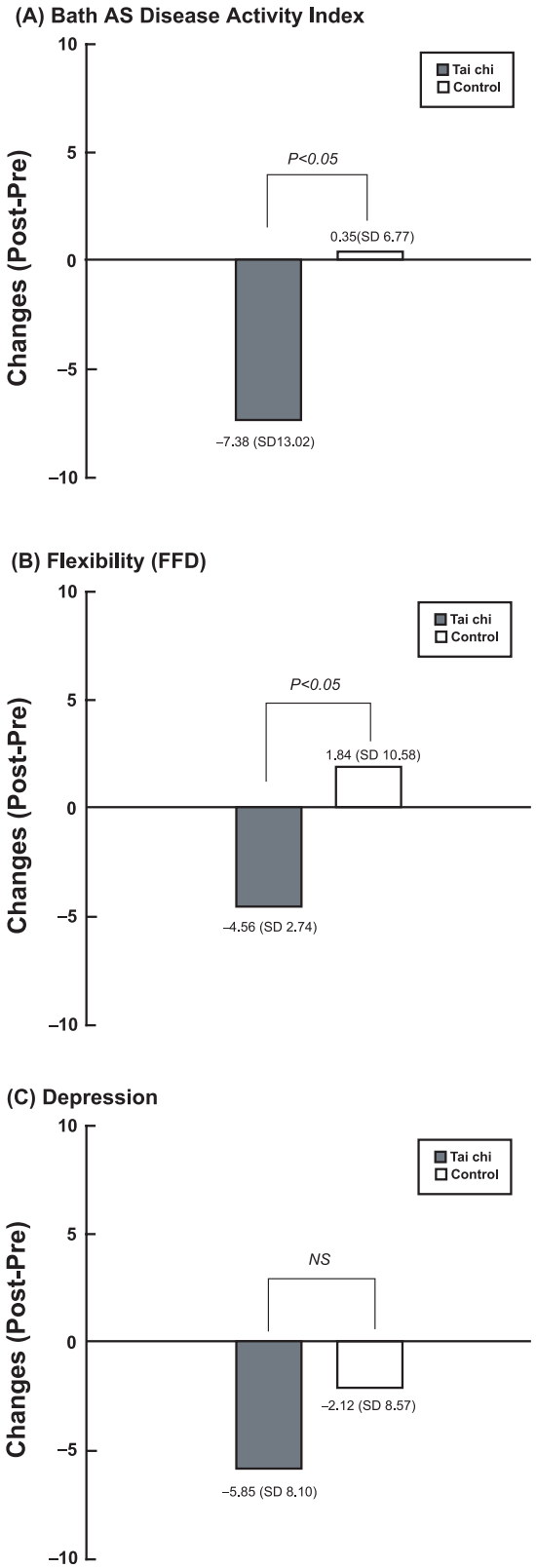

Figure 2. The changes (post-pre) of outcome measures including Bath Ankylosing Spondylitis (AS) Disease Activity Index, flexibility and depression between the pre- and post-tests. Values are expressed as mean (SD). FFD: finger to floor distance.

current study also suggest that *tai chi* may be used to treat symptoms of AS. This finding has not been previously reported.

The effect size (ES) in terms of disease activity (BASDAI) improvement was significant for the *tai chi* group versus the control group. Compared to previous studies, the ES of tai chi (0.60) was greater than that of home exercise (0.09) (24), conventional exercise (0.24) (25,26), global posture re-education (0.15) (25,26) and NSAIDs (0.55) (27).

FFD improvement was significant for the *tai chi* group versus the control group. The ES of *tai chi* (0.30) was greater than that of home exercise (0.1) (28), but group exercise (0.38) (28) and home-based exercise (0.39) (29) resulted in a higher ES than *tai chi*.

One-third of AS patients experienced depression related to pain (30). In our study, the depression level decreased (i.e., improved) more in the *tai chi* group than in the control group; however, the difference was not significant. These results are consistent with previous results. For example, Taylor-Piliae (15) reported no significant changes in depression level after six or 12 weeks of *tai chi*. Data from other studies also failed to find an effect on depression level of two or three times weekly *tai chi* for 12 weeks (31,32). However, an average of four times weekly tai chi for 18 weeks reduced depression level in osteoarthritic patients (33). We speculate that training time and duration seemed to relate to reducing depression level, but further studies are required to prove this.

Assuming that *tai chi* is a potentially useful treatment option for patients with AS, its possible mechanism of action may be of interest. When performed regularly, the physical exercise of *tai chi* (11) affects the cardiovascular and muscular systems, resulting in muscular adaptation and, ultimately, increased muscle strength. Physical activity can also improve joint stability and aid in reducing excess weight, effectively decreasing joint pain, increasing function and improving other symptoms related to AS (3,10,34–36).

This study has several limitations, including its small sample, high dropout rate and lack of an equivalent exercise control group to estimate the expectation effect. Moreover, we cannot completely confirm the absence of performance bias, such as complete separation of contact between the two groups, which may indicate a possible placebo effect in this study.

In conclusion, our results suggest that *tai chi* improves flexibility and positively influences levels of disease activity in AS patients. *Tai chi*, which is easily accessible to patients, may also be an effective intervention for AS. Further randomized studies, with more objective measures, larger samples, measurements after multiple sessions and long-term follow-up, are needed to verify *tai chi's* effects on patients' quality of life, pain, mobility, psychologic variables and physical functional improvement.

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