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ORIGINAL ARTICLE

Home-based exercise therapy in patients with ankylosing spondylitis: effects on pain, mobility, disease activity, quality of life, and respiratory functions

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Abstract The home-based exercise therapy recommended to the patients with ankylosing spondylitis (AS) is a simply applicable and cheap method. The aim of this study was to investigate the effects of home-based exercise therapy on pain, mobility, function, disease activity, quality of life, and respiratory functions in patients with AS. Eighty patients diagnosed with AS according to the modified New York criteria were included in the study. Home-based exercise program including range of motion, stretching, strengthening, posture, and respiratory exercises was practically demonstrated by a physiotherapist. A training and exercise manual booklet was given to all patients. Patients following home-based exercise program five times a week at least 30 min per session (exercise group) for 3 months were compared with those exercising less than five times a week (control group). Visual analog scale pain (VASp) values at baseline were significantly higher in the exercise group. The exercise group showed improvements in VASp, tragus–wall distance, morning stiffness, finger–floor distance, modified Schober's test, chest expansion, the Bath Ankylosing Spondylitis Disease Activity Index, the Bath Ankylosing Spondylitis Functional Index, Ankylosing Spondylitis Quality of Life Questionnaire (ASQoL), forced expiratory volume in first second, and forced vital capacity at third month. There was significant difference in ASQoL scores between the two groups in favor of the exercise group at third month. Regular home-based exercise therapy should be a part of main therapy in patients with AS. Physicians should recommend that patients with AS do exercise at least five times a week at least 30 min per session.

Keywords Ankylosing spondylitis · Exercise · Home based · Joint mobility · Pain · Pulmonary functions · Quality of life

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Introduction

Ankylosing spondylitis (AS) is a rheumatic and most frequently recorded disease with unknown etiology among seronegative spondyloarthropathies [1]. Primarily, it affects the mobility of vertebral column and joints and causes physical disability. Inflammation and pain in the vertebral column and joints result in a decrease in the physical activity and in fatigue, sleep disorder, depression, anxiety, and stress [2]. Depending on the decrease in the rib cage mobility, respiratory function disorder of restrictive type has commonly been reported [3]. Current management strategies should focus on decreasing pain, maintaining physical activity, and efforts to improve psychosocial health aspects for increasing quality of life in patients suffering from AS [4].

The main treatments for AS have been supportive, consisting of administration of nonsteroidal anti-inflammatory drugs (NSAID), tumor necrosis factor (TNF) inhibitors, and physical

therapy [5, 6]. Physical therapy is of critical importance in sustaining and increasing mobility, physical condition, and strength [7–9]. Hydrotherapy may have beneficial effects on reducing the pressure and pain within joints; however, it is difficult to maintain the involvement of patients in these kinds of programs on a regular basis [10]. Home exercise therapy is of great importance in patients with AS in terms of maintaining a normal life and for the success of long-term treatment [11]. The optimal exercise program for patients with AS can still not be determined [12]. The aim of this study was to investigate the effects of home-based exercise therapy on pain, mobility, function, disease activity, quality of life, and respiratory functions in patients with AS.

Materials and methods

Eighty patients diagnosed with AS according to the modified New York criteria were included in the study. They were recruited from the Physical Medicine and Rehabilitation Outpatient Clinic of Istanbul Training and Research Hospital, between dates of May 2007 and April 2008. In addition to their demographic characteristics [age, gender, height, weight, body mass index (BMI, kg/m^2), and educational level], the patients were also questioned for duration of symptoms, time of diagnosis, history of uveitis, smoking, and drug usage [NSAID, disease-modifying antirheumatic drugs (DMARDs)]. Presence of peripheral arthritis and Bath Ankylosing Spondylitis Radiology Index (BASRI) scores were recorded. Exclusion criteria were the presence of prosthesis, hypertension, cardiovascular disease, chronic obstructive pulmonary disease, and poster-oanterior chest X-ray abnormalities. All individuals gave informed consent in accordance with the Helsinki Declaration of 1975.

All the patients were individually trained on the disease, and preventive measures for the disease were explained. Home-based exercise program including range of motion exercises of the cervical, thoracic and lumbar spine, stretching, strengthening, posture, and respiratory exercises was practically demonstrated by a physiotherapist to all of them at baseline. Moreover, a training and exercise manual booklet was given to all the patients.

Evaluations were performed by the same clinician before and at third month of the treatment. The patients fulfilled a questionaire including the number of days per week that they exercised and the duration of each exercise session. According to the study of Uhrin et al. [5], patients following home-based exercise program five times a week at least 30 min per session (exercise group) were compared with those exercising less than five times a week (control group).

Evaluation parameters were as follows:

Severity of pain was evaluated using the 0–10 mm visual analog scale (VASp). Period of morning stiffness was questioned in per minute. Spinal mobility was evaluated using modified Schober's test (MST). Chest expansion, finger–floor distance (FFD), and tragus–wall distance (TWD) were measured. BASRI, Bath Ankylosing Spondylitis Functional Index (BASFI) [13], Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) [14], and Ankylosing Spondylitis Quality of Life Questionnaire (ASQoL) [15] scales were filled.

Pulmonary function tests (PFTs) were performed on all patients prior to and at third month of the treatment. PFTs were carried out using an ergospirometer device of Koko Legend Spirometer. The device was calibrated prior to each test. After a detailed explanation for the respiratory maneuvers was given to every patient, dynamic tests were conducted. Forced expiratory volume in first second (FEV1), forced vital capacity (FVC), and FEV1/FVC were recorded. Three breathing patterns were defined: obstructive pattern (FEV1/FVC <80%), restrictive pattern (decrease FVC <80% and FEV1 with a normal FEV1/FVC ratio), and normal pattern (FVC >80% and FEV1/FVC >80%).

Of 80 subjects, 14 subjects were excluded from the study: 10 because they did not come to control visit and 4 because of changes in their DMARDs medication during these 3 months. Sixty-six patients completed the study.

Statistical analysis was performed with SPSS 10.0 for windows. Descriptive data were presented as mean ±standard deviation (SD). Demographic and clinical characteristics were compared using the chi-square test. Independent samples t test or Mann–Whitney U test was used for the comparison of the two groups. Wilcoxon's signed rank test or paired t test was used to analyze the differences between baseline and third month values. A p value less than 0.05 was considered as statistically significant.

Results

Sixty-six patients completed the study. Of 66 patients, 34 subjects following home-based exercise program five times a week at least 30 min per session were taken as the exercise group. The rest of the patients (32 subjects) who were exercising less than five times a week were included in the control group. Of the patients in the control group, 25 (78%) subjects were exercising less than two times a week and 7 (22%) were exercising two or three times a week, but not on a regular basis.

Demographic characteristics and clinical parameters of the exercise and the control groups are presented in Table 1. No statistically significant differences were found between

Table 1 Demographic characteristics and clinical parameters of the patients

	Exercise group (n=34)	Control group (n=32)	p value
Age (years), (mean±SD)	34.35±9.48	35.75±6.71	>0.05
Gender (M/F)	25/9	27/5	>0.05
BMI (mean±SD)	25.55±4.04	27.30±4.09	>0.05
Duration of symptoms (months), (mean±SD)	106.06±118.94	98,97±71.74	>0.05
Time of diagnosis (months), (mean±SD)	45.85±68.84	45.22±42.51	>0.05
BASRI score (mean±SD)	8.09±2.56	8.97±2.25	>0.05
Smoking status, n (%)	21 (61.8)	24 (75)	>0.05
History of uveitis, n (%)	6 (17.6)	3 (9.4)	>0.05
Peripheral arthritis, n (%)	5 (14.7)	4 (12.5)	>0.05
DMARDs usage, n (%)	19 (55.8)	17(53.0)	>0.05

n number of cases, *SD* standard deviation, *BMI* body mass index, *DMARD* disease-modifying antirheumatic drugs, *BASRI* Bath Ankylosing Spondylitis Radiology Index

groups in the demographic characteristics (p>0.05). Breathing patterns of the groups were shown in Table 2. There was no significant difference between groups with regard to breathing patterns (p>0.05). The differences in the values of VASp, morning stiffness, chest expansion, modified Schober's test, finger–floor distance, tragus–wall distance, BASFI, BASDAI, and ASQoL between baseline and at third month have been listed in Table 3. No statistically significant difference except VASp values was found between groups at baseline (p>0.05). VASp values at baseline were significantly higher in the exercise group (p =0.021), whereas no statistically significant difference was found between the two groups at third month (p=0.786).

A statistically significant improvement was observed in the values of VASp, TWD, BASFI, BASDAI, MST, chest expansion, FFD, and ASQoL in the exercise group at third month. MST and chest expansion, morning stiffness, FFD, and ASQoL scores were significantly worse in the control group at third month (p<0.05), but the values of VASp, TWD, BASFI, and BASDAI remained unchanged.

The results of PFTs were shown in Table 4. No statistically significant difference regarding PFTs values was found between groups at baseline (p>0.05). While there was significant decrease in all the pulmonary function parameters in the control group, the exercise group showed significant improvements in FEV1 and FVC (p<0.001). Although there were significant changes with regard to PFTs in both group at third month, the differences between groups were not at the level of significance (p<0.05).

There was no statistically significant difference except ASQoL scores between the two groups at third month (p> 0.05). A statistically significant difference in ASQoL scores between the two groups was found in favor of the exercise group (p=0.04).

Discussion

AS is among the chronic rheumatic disorders causing considerable loss of abilities in the long term. The main aim of regular exercise is to prevent mobility restriction and disease progression [16]. Our study showed that performing home-based exercises on a regular basis provided significant improvements in all the clinical and functional parameters and pulmonary functions in the exercise group, but the only significant difference between the exercise and the control group was found in ASQoL scores in favor of the exercise group at third month.

Most of the AS patients do not exercise regularly, and their compliance declines in the long term [17]. In our study, we did not group patients as a control group at baseline. All the patients were individually trained on the disease and the importance of exercises, but almost half of them did not do exercises regularly. In a prospective longitudinal study, Uhrin et al. concluded that unsupervised recreational exercise and back exercises were effective in improving pain severity and functional disability in patients with AS, but benefits were seen only

Table 2 Breathing patterns of the groups

		Exercise group, n (%)	Control group, n (%)	Total, n (%)	p value
Breathing patterns	Normal	25 (73.5)	25 (78.1)	50 (75.7)	>0.05
	Restrictive	6 (17.6)	4 (12.5)	10 (15.1)	>0.05
	Obstructive	3 (8.8)	3 (9.4)	6 (9.09)	>0.05

Table 3 Baseline and third month results of VAS, morning stiffness, chest expansion, MST, FFD, TWD, BASFI, BASDAI, and ASQoL of the patients

	Exercise group			Control group		
	Baseline	At third month	*p* value	Baseline	At third month	*p* value
VASp	5.1±2.1	4.1±2.0*	<0.001	3.9±2.3**	3.9±2.0	>0.05
Morning stiffness	55.15±70.94	39.11±65.86*	<0.001	32.66±32.40	38.59±34.43***	0.005
Chest expansion	3.94±1.24	4.39±1.22*	<0.001	4.05±1.62	3.89±1.55***	0.039
MST	3.68±1.55	4.14±1.50*	<0.001	3.86±1.80	3.56±1.64*	<0.001
FFD	16.35±13.04	13.94±12.44*	<0.001	16.44±15.97	17.68±16.14*	<0.001
TWD (cm)	14.35±3.65	13.55±3.44*	<0.001	13.13±2.8	13.37±2.75	>0.05
BASFI	2.54±2.26	2.05±2.14*	<0.001	2.90±2.30	2.99±2.26	>0.05
BASDAI	4.44±2.07	3.77±1.98*	<0.001	3.98±2.19	4.07±2.21	>0.05
ASQoL	9.56±5.21	7.29±4.6*	<0.001	9.34±5.97	9.96±6.1**, ***	0.01

Data are expressed as means±standard deviation

VASp visual analog scale, *MST* modified Schober's test, *FFD* finger–floor distance, *TWD* tragus–wall distance, *BASFI* Bath Ankylosing Spondylitis Disease Activity Index, *BASDAI* Bath Ankylosing Spondylitis Functional Index, *ASQoL* Ankylosing Spondilytis Quality of Life Questionnaire

*$p<0.001$ within groups; **$p<0.05$ between groups; ***$p<0.05$ within groups

in periods with more than 30 min per day of exercise or periods in which back exercises were performed at least 5 days per week. [5]. In another study, it is reported that the AS patients who performed moderate exercise (2–4 h per week) had improved function and lower disease activity, and they suggested that there is an optimum duration for exercise performed over a weekly period, and consistency, rather than quantity, is of most importance [8]. Considering these studies, we compared patients following home-based exercise program five times a week at least 30 min per session along 3 months (exercise group) with those exercising less than five times a week (control group).

Continuity of patients with exercise program was higher when they noticed the positive effects of the exercises. Falkenbach reported in a cross-sectional study that patients with AS who were less disabled were less willing to exercise [16]. In another study investigating the effect of group training in patients with arthritis, it was determined that the patients feeling well discontinued performing exercises and those of suffering severe symptoms kept performing exercises [18]. In our study, VASp values in the exercise group at baseline were significantly higher compared to the control group and we considered this case as an important factor for patients leading them to perform exercises on a regular basis. Pain level is an important variable affecting quality of life. In a review for physiotherapy interventions in patients with AS, low quality of evidence for a small pain reduction in favor of the individual exercise programs compared to no intervention was reported [19]. In a recent study evaluating the impact of two different home-based daily exercise progams in the patients with AS, significant improvements in VASp in the exercise group were reported [20]. In the present study, the significant difference for VASp values at baseline between groups was not shown at third month. However, there was significant decrease in VASp values in the exercise group after the treatment ($p<0.001$).

Table 4 Baseline and third month pulmonary function parameters of the patients

	Exercise group			Control group		
	Baseline	At third month	*p* value	Baseline	At third month	*p* value
FVC	3.72±0.97	3.96±0.99*	<0.001	4.07±0.80	3.98±0.78*	<0.001
FEV1	3.21±0.84	3.36±0.82*	<0.001	3.46±0.72	3.27±0.73*	<0.001
FEV1/FVC	85±5.72	85±6.07	>0.05	84±6.30	82±6.30*	<0.001

Data are expressed as means±standard deviation

FVC forced vital capacity, *FEV1* forced expiratory volume in first second

*$p<0.001$

Spinal mobility is one of outcome measures in physiotherapy for AS. There is no consensus on standard measurements for mobility assessment; different areas are selected for each study [17]. It is concluded that there is moderate-quality evidence for a positive effect of individual exercise programs, home based or supervised, on some measures of spinal mobility, when compared to a no-intervention group [19]. In a recent study, Karapolat and colleagues reported significant improvements both home-based and group-based exercise groups, and no significant differences were recognized between groups [17]. In the present study, spinal mobility was assessed by MST, chest expansion, FFD, and TWD. At the end of the study, a statistically significant improvement was observed in all of these parameters in the exercise group at third month, but there were no significant differences in these parameters between exercise and control groups.

The assessment of daily vital function is of clinical importance because disability is one of the most important complaints in AS patients [21]. The BASFI index showed to be sensitive to demonstrate an improvement in the functional capacity in AS patients [22]. The improvement in BASFI scores with home-based exercise is reported in AS patients [11, 20, 23–25]. On the other hand, some researchers have not detected any difference between groups [17, 26, 27]. BASDAI is a self-administered questionnaire for assessing disease activity in patients with AS. They are conflicting results for the effects of the exercise on the BASDAI. Some investigators reported that exercises improved BASDAI, whereas others found that they did not [17, 20, 22, 23, 25]. We found statistically significant improvements both in BASFI and BASDAI in the exercise group, whereas they remained unchanged in the control group. However, these improvements were not at the level of significance between groups.

Because presence of various factors developed in the normal course of AS such as pain, movement restriction, functional loss and impaired well-being, the disease has negative effects on the quality of life [4]. Health-related quality of life (HRQoL) measures have been increasingly used to determine resource allocation strategies and treatment plans [28]. There should be an improvement in AS patients' quality of life in order to talk about the success of treatment [17]. Different HRQoL measures have been used in the previous studies, and exercise has been shown to be effective in improving the quality of life [17, 23, 27, 29]. In our study, we applied ASQoL scale which we considered to be more specific to AS and determined a significant decrease in ASQoL values in the exercise group than in the control group.

It is reported that psychological symptoms of patients with AS affect the quality of life, and this factor should be included in the assessment stages of the treatment success [17]. Exercise is effective for improving psychosocial status. In recent studies, the mean ASQoL scores were found higher in the subgroups with depression and anxiety than in subgroups without depression and anxiety [30]. In the present study, we did not evaluate the psychosocial status of the patients, so there is a possibility that psychosocial status affected continuity of patients with exercise program and the significant difference for ASQoL scale between two groups.

Pulmonary involvement is the most frequent extra-articular involvement in AS patients. There are few studies evaluating the effects of home-based exercises on pulmonary functions in AS patients. These studies compared different exercise modalities and reported that there were significant improvements in FEV1 and FVC in all exercise groups including home-based exercise group [20, 27]. Our results in the exercise group were similar to these studies. There was a significant decrease in all the pulmonary function parameters in the control group unlike the exercise group. Considering these findings, we observed that the regular exercise at least maintained the existing level of respiratory function.

In addition to thoracic involvement, pleuropulmonary involvement may also be an important factor in the development of respiratory function disorders [31]. In studies conducted to test this hypothesis, PFTs were also performed along with chest X-ray and high-resolution computed tomography (HRCT) in order to evaluate the pleuropulmonary involvement in patients with AS. Absence of any relationships between respiratory functions and pulmonary radiological findings was revealed and PFTs were found to be insensitive in determining the pulmonary interstitial changes. Thus, the idea regarding the fact that respiratory function disorder developed due to the mechanical problems related to thoracic involvement rather than due to pulmonary parenchymal inflammatory involvement emerged during the course of the disease was supported. This fact may explain why no significant changes in the chest expansion and dynamic respiratory function tests occurred between two groups in our study both before and after the treatment. Therefore, the application of HRCT is recommended in patients suspected with a disorder of restrictive type pulmonary involvement [32, 33].

This study is not a randomized controlled study, and the control group of the present study were the patients who did not participate in the exercise protocol at least five times a week. Most of the patients in the control group were exercising less than two times a week; however, they did not exercise on a regular basis. In a cross-sectional study, the reasons for lack of the exercises were reported as a waste of time, fatigue, and inflammation of symptoms [34].

Also in our study, most of the patients in the control group implied that they could not perform their exercises due to lack of time and considering these activities as a waste of time, and we also observed that these patients had no good drug compatibility.

In conclusion, regular home-based exercise therapy is an effective, low-priced, and easy applicable therapy in decreasing symptoms and improving quality of life and pulmonary functions in patients with AS and should be essentially included in the treatment of patients with AS.

Disclosures None.

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