



Physical Therapy Approaches in Ankylosing Spondylitis: A Systematic Review

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ABSTRACT

Background: Ankylosing spondylitis (AS) is a chronic, progressive, inflammatory disorder that mainly affects the axial skeleton with aseptic inflammation of synovial tissue, spinal ligaments, intervertebral discs and facet joints. The purpose of this review is to describe the effectiveness of different physical therapy approaches in patients with AS.

Method: This review followed PRISMA guidelines. A search was conducted in electronic databases Google Scholar, PubMed, and Cochrane. Publications were included if the study group included patients with a diagnosis of AS according to the classification system described in the New York criteria.

Results: A total of 6 clinical trials and 4 reviews were included in this review. One trial (n=1) had no intervention, most studies (n=4) and all the reviews (n=4) compared a variation in type of exercises, such as aerobic exercise, Pilates, swimming, one trial (n=1) was a follow-up evaluation.

Conclusions: The results of this review show that different types of treatment programs improve areas related to the physical health of patients with AS such as pain intensity, mobility, functionality, muscle strength, balance, fatigue, anxiety, depression. The most significant improvement in pain across all research data is noted after aquatic therapy. Supervised physiotherapy is more effective than usual care in improving disease activity, functional capacity and pain in patients with AS.

KEY WORDS: Ankylosing Spondylitis, Aquatic Therapy, Exercise, Quality of life.

INTRODUCTION

Ankylosing spondylitis (AS) is a chronic immune-mediated inflammatory disease, it is a form of arthritis characterized by an autoimmune and genetic etiology, included in the group of chronic inflammatory, autoimmune, and diseases [1]. Over time, because of the fusion of some small bones, the spine can become less flexible and result in a hunched forward posture [2]. The estimated prevalence in Caucasian European populations is 0.1 to 1.2% and the male to female ratio is approximately 2–3:1 [3-4]. The incidence ranges from 0.5 to 14 per 100,000 people per year, depending on the country [5]. The male–female ratio, around 3:1, shows that it is more common among men than women [6].

The progression of AS is strongest in the first 10 years of the disease but it is also clear that the disease keeps on being active for further decades [7]. It is clinically characterized by pain and stiffness of the back and sacroiliac joints and is often associated with peripheral arthritis, enthesitis and acute anterior uveitis [9]. AS leads to varying degrees of pain, reduced spinal mobility, and limitations in physical function. The main clinical manifestations of AS are back pain and progressive spinal rigidity, as well as inflammation of the hips, shoulders, peripheral joints, and fingers/toes [10]. Furthermore, inflammatory skin conditions, inflammatory bowel disease, enthesitis, and anterior uveitis can also be present [11].

The management of AS aims to improve and maintain spinal flexibility and normal posture, relieve symptoms, decrease functional limitations, and reduce complications [12]. Physiotherapy is considered important to maintain or improve spinal mobility and fitness and to reduce pain, and is included in recently published evidence-based recommendations for the management of AS [13]. According to the updated recommendations for AS in 2011 from ASAS and EULAR, a combination of non-pharmacological and pharmacological treatments has been suggested to reduce patients' discomfort [14]. The purpose of this review is to describe the effectiveness of different physical therapy approaches in patients with AS.



METHODS

Study Design and Strategy: The results are presented as per the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) reporting guideline (supporting checklist/diagram) [15]. A search was conducted at three electronic databases: Scholar, PubMed, and Cochrane, for randomized studies that compare the effectiveness and potential improvement of functional limitations, quality of life and pain management in patients with AS. The strategy followed includes the study and analysis of systematic reviews and post-analysis, randomized controlled trials and clinical trials found in valid databases.

Inclusion Criteria: Studies were identified in English by using the following keywords: Ankylosing Spondylitis, Physical Therapy, Chronic Pain, Exercise Therapy, Quality of life, Epidemiology. Publications were included if the study group included patients with a diagnosis of AS according to the classification system described in the New York criteria.

Selection Process: Eligibility screening of the studies was conducted in a blinded standardized way by two independent reviewers (Ev.T. and G.G.). Titles and abstracts were screened using and duplicate articles were excluded. After screening titles and abstracts, full paper copies were retrieved. Full text screening was also performed blinded by the same reviewers (Ev.T. and G.G.). Disagreements between authors during any stage of the screening process were resolved by consulting a third reviewer (Em.T.). After the examination 5 clinical trials and 4 review that met the necessary criteria were selected (Table 1).

RESULTS

J. V. Viitanen et al. [16] studied the effect of physical therapy on the mobility of the HS in AS. The effectiveness of intensive inpatient physical therapy was retrospectively analyzed in 505 adult patients with AS. Eight different measures of thoracic and spine mobility were collected from the patients' medical records. Recovery in terms of the following measures was 7 to 37% when results after recovery were compared with those obtained before: thoracic flexibility (TLF) 15%; the Schober test 12.4%. Occiput to Wall Distance (OWD) 30.8%, Neck Rotation 22.6%, Chin to Chest Distance (CCD) 21.7%, Finger to Floor Distance (FFD) 36.6%, Chest Extension (CE) 31.370, vital capacity (VC) 7.4%. Changes in all measurements were statistically significant ($p < 0.001$). OWD, CE and FFD showed greater improvement. The mean increase in CE was approximately 1 cm in both sexes and the mean increase in VC 200 ml in men and 270 ml in women, indicating an improvement in respiratory capacity. Mobility in the majority of patients improved, although in 2 to 8% range of motion (ROM) worsened during the course. The study group included 362 men and 143 women aged 19 to 74 years, with a mean (SD) of 43.0 (9.6) years for men and 44.5 (9.8) years for women. Changes in all measurements were statistically significant ($p < 0.001$). Normal values for OWD, CCD, and FFD are 0 cm and cannot be improved with physical therapy. If these patients are excluded from the analysis, the changes are even greater. The normal values of all other measurements are not precisely known. Recovery ROM results are also expressed: Chin-to-chest distance (CCD) 21.7%, Chest extension (CE) 31.3%, Cervical rotation (CR) 22.6%, Toe-to-floor distance (FFD) 36.6%, occiput-to-wall distance (OWD) 30.8%, the Schober test 12.4%, thoracolumbar flexibility (TLF) 15% and vital capacity (VC) 7.4%. The majority of individual patients (50–90%) benefited from physical therapy as judged by the results of ROM measurements. However, the results of 2 to 8 percent of patients worsened. Mobility measurements showed that intensive physical therapy is helpful in AS and significantly reduces movement limitations in the spine and chest. All results improved significantly, up to 37 percent from those before rehabilitation. In 2012 Z. Gyurcsik et al. [17] study aimed at improving pain intensity, spinal stiffness and mobility during a controlled individualized physiotherapy program in AS. Of the 75 patients, 10 volunteered to undergo a complex exercise program twice a week for 3 months. The program included 1.5 hours of general postural retraining, spinal mobilization and pelvic, upper and lower extremity exercises, stretching with joint prevention strategies, and functional exercises. In AS, pain intensity recorded on a 10 cm VAS, BASFI, BASDAI, modified Schober index, chest expansion and occiput-wall distance showed a significant correlation with disease activity. The 3 months of physical therapy improved several subjective and functional parameters and significantly reduced pain intensity and spinal stiffness. The 3-month physical therapy improved several subjective and functional parameters, and markedly reduced pain intensity and spine stiffness. A complex, individualized physical therapy program can be helpful and should be instituted in patients with AS in order to maintain and increase spinal mobility, maintain functional capacity, and reduce pain and stiffness.

At U. Dundar et al. [18] randomized controlled trial the effect of water exercise on AS was examined. In more details the aim of this study was to compare the effectiveness of exercise interventions in water with exercises on land (exercise at home) in the



treatment of AS. The aquatic exercise program consisted of 20 sessions, 5 times a week for 4 weeks in a pool at 32–33°C. A total of 69 AS patients were included in this study. All patients in both groups were assessed for pain, spinal mobility, disease activity, disability, and quality of life pretreatment (week 0) and posttreatment (week 4 and week 12). We observed significant improvements in all parameters [pain score VAS, lumbar flexion/extension, modified Schober test, chest expansion, functional AS bathroom index, AS bathroom metrology index, AS bathroom disease activity index and SF-36] in both groups after treatment at week 4 and week 12 ($p < 0.05$). Comparison of percentage changes in parameters at both week 4 and week 12 relative to pre-treatment values showed that improvement in VAS ($p < 0.001$) and bodily pain ($p < 0.001$), general health ($p < 0.001$), vitality ($p < 0.001$), social functioning ($p < 0.001$), role limitations due to emotional problems ($p < 0.001$) and general mental health ($p < 0.001$) subscales of the SF-36 were better in the water exercise group. Water-based exercises produced better improvement in VAS pain score and physical pain, general health and social components of quality of life of AS patients compared to home exercise. Aquatic exercise can be considered as the initial part of an exercise therapy program for treating disabled patients with AS.

Y. Analay et al. [19] in 2003 conducted a research to compare the effectiveness on pain, functional and psychological status of an intensive group exercise program under the supervision of a physiotherapist and a home physiotherapy program in patients with AS. Both groups were evaluated and compared for pain, functional and psychological status before treatment, at the end of treatment and three months after treatment using a VAS for pain, Beck Depression Scale and Bath Ankylosing Spondylitis Functional Index (BASFI). Results from the remaining 45 showed more positive changes in the patients undertaking group exercise at six weeks and three months after treatment. Values showed a statistically significant difference in favor of group I. Group exercise in hospital may be more effective than home-based exercises at reducing impairment associated with ankylosing spondylitis. The results support that a multimodal supervised approach through exercises, physiotherapy, education, spa therapy and other non-pharmacological interventions help in the management of patients with AS. Supervised physical therapy is more effective than usual care in improving disease activity, functional capacity, and pain in patients with ankylosing spondylitis.

The first study of Kraag et al. [20] at 1990 study compared the effectiveness of a group exercise program lasting four months and home therapy at people with AS. Fifty-three patients with AS (were randomly allocated; 26 experimental patients received physiotherapy and disease education, 27 control patients received neither. The primary treatment outcome was change in spinal mobility measured at 4 months by fingertip-to-floor distance. Experimental patients had more improvement in fingertip-to-floor distance ($p < 0.004$) and in function ($p < 0.001$) than control patients. Physiotherapy with disease education is effective in the treatment of patients with AS.

Kraag's et al. follow-up study [21] reported on 22 control patients who received the previously withheld treatment and 24 experimental patients who received follow-up treatment as needed. Following treatment, fingertip-to-floor distance did not change in control patients ($P = 0.145$). Between 4 and 8 months, fingertip-to-floor distance did not change in experimental patients ($P = 0.143$); however, initial improvement achieved was maintained. The experimental group at 4 months was better than the control group at 8 months ($P = 0.038$). There was a significant decrease in fingertip-to-floor distance in the study group, but no significant difference in pains, occiput-to-wall distances and morning stiffness duration between the groups. The home physiotherapy treatment program must be delivered as rigorously as it was in the initial trial to be effective. The benefit from this treatment program can be maintained with very little intervention.

At H. Dagfinrud et al. [22] systematic review, that analyzed the physical therapy approaches for AS, the results showed low-quality evidence for effects in favor of the home exercise program was found in physical function and spinal mobility [absolute benefit of 10.3 cm from toe-to-floor distance; relative percentage difference (RPD) 37]. In addition, the trials showed low-quality evidence for non-group differences in pain. Three trials compared supervised group physiotherapy with an individualized home exercise program. Moderate-quality evidence of efficacy was found in patient global assessment and spinal mobility in favor of the control group. The trials showed moderate-quality evidence of no difference in pain intensity between groups. One trial compared a 3-week in-office exercise therapy followed by weekly outpatient group physiotherapy with weekly outpatient group physiotherapy alone. Moderate-quality evidence was found for effects on pain (absolute benefit 0.9 cm on visual analog scale, RPD 19%), physical function (absolute benefit 1 cm, RPD 24%) and overall patient assessment (absolute benefit 1.3 cm, RPD 19%). RPD 27%, in favor of combined bath-exercise therapy. Conclusion. The current best available evidence suggests that physiotherapy is beneficial for people with AS. However, it is still unclear which treatment protocol should be recommended for the management of AS.



In L. Gravaldi et al. [23] systematic review and post-analysis the effectiveness of physical therapy in patients with AS was examined. In more details, this study aimed to evaluate the safety and efficacy of non-pharmacological interventions under the supervision of a physical therapist in patients with AS. Post-analysis results showed that between supervised physiotherapy and usual care, the former was significantly associated with improvement in disease activity (standardized mean difference = -0.37, 95% CI, -0.64; -0.11; $p < 0.001$, $I^2 = 71.25\%$, $n = 629$) and functional capacity (standardized mean difference = -0.36, 95% CI, -0.61, -0.12, $p < 0.05$, $n = 629$). No statistically significant differences emerged when the interventions were compared with home exercise programs. Supervised physical therapy is more effective than usual care in improving disease activity, functional capacity, and pain in patients with ankylosing spondylitis. No significant improvements were found when supervised physical therapy and home exercise programs were compared.

Virginie Pécourneau et al. [24] analyzed the effectiveness of exercise programs in AS in a meta-analysis of randomized controlled trials (RCTs). Exercise programs were found to have greater benefits than no intervention in improving physical function and disease activity, especially in more recent studies involving patients receiving anti-TNF agents. Despite the heterogeneity of exercise programs and measures outcomes used in the trials included in this meta-analysis, its results support the potential benefits of exercise for improving disease activity and function in AS. New studies are needed to characterize the type, frequency, and duration of the best exercise programs, which should be more uniform. Although the use of anti-TNF has substantial effects on AS, the additional beneficial effects of standardized supervised exercise programs on pain, function, and quality of life should be investigated in further trials.

In 2014 E. Giannoti et al. [25] studied the effects of physical therapy in the management of patients with AS in the biological era. The results support a multimodal approach, including educational sessions, conducted in a group setting, supervised by a physical therapist, and followed by a home maintenance program. Spa exercise and the McKenzie, Heckscher, and Pilates methods appear promising in the rehabilitation of AS, but their efficacy should be further investigated in future randomized controlled trials (RCTs). When performed according to the American College of Sports Medicine guidelines, cardiovascular training has been shown to be safe and effective and should be included in AS rehabilitation protocols. Exercise plays an important role in the biologic era as it is now applied to stabilized patients, ultimately leading to better management of AS by physical therapists and rheumatologists.

Table 1. Studies included in the review.

Authors	Sample	Intervention	Results
Viitanen et al. 1992	505	None	Recovery in terms of the following measures was 7 to 37% when results after rehabilitation were compared to those taken before: thoracolumbar flexibility (TLF) 15%, the Schober test 12.4%, occiput to wall distance (OWD) 30.8%, cervical rotation 22.6%, chin to chest distance (CCD) 21.7%, finger to floor distance (FFD) 36.6%, chest expansion (CE) 31.3%, vital capacity (VC) 7.4%. Changes in all measures were statistically significant (p less than 0.001). OWD, CE and FFD showed greatest improvement. The average increase in CE was about 1 cm in both sexes and the average increase in VC200 ml in men and 270 ml in women, which indicates improvement in ventilatory capacity. Mobility in the majority of patients improved, though in 2 to 8% range of motion (ROM) deteriorated during the course.



Z. Gyurcsik et al. 2012	75	The program included 1.5 h of general posture reeducation, manual mobilization of the spine, and pelvic-, upper-, and lower-extremity exercises, stretching with joint prevention strategies and functional exercises.	Pain intensity recorded on a 10-cm visual analog scale (VAS), BASFI, BASDAI, modified Schober index, chest expansion and occiput-to-wall distance values showed significant correlation with disease activity. The 3-month physical therapy improved several subjective and functional parameters, and markedly reduced pain intensity and spine stiffness.
U. Dundar et al. 2014	69	Randomly assigned to receive either home-based exercise or aquatic exercise treatment protocol. Home-based exercise program was demonstrated by a physiotherapist on one occasion and then, exercise manual booklet was given to all patients in this group. Aquatic exercise program consisted of 20 sessions, 5× per week for 4 weeks in a swimming pool at 32-33 °C.	Significant improvements for all parameters [pain score (VAS) visual analog scale, lumbar flexion/extension, modified Schober test, chest expansion, bath AS functional index, bath AS metrology index, bath AS disease activity index, and short form-36 (SF-36)] in both groups after treatment at week 4 and week 12 (p < 0.05). Comparison of the percentage changes of parameters both at week 4 and week 12 relative to pretreatment values showed that improvement in VAS (p < 0.001) and bodily pain (p < 0.001), general health (p < 0.001), vitality (p < 0.001), social functioning (p < 0.001), role limitations due to emotional problems (p < 0.001), and general mental health (p < 0.001) subparts of SF-36 were better in aquatic exercise group.
Y. Analay et al. 2003	51	Intensive group exercise under the supervision of a physical therapist and a home physical therapy program.	Results from the remaining 45 showed more positive changes in the patients undertaking group exercise at six weeks and three months after treatment. Values showed a statistically significant difference in favour of group I.
G Kraag et al. 1990	53	26 experimental patients received physiotherapy and disease education, 27 control patients received neither	Experimental patients had more improvement in fingertip-to-floor distance (p2 less than 0.004) and in function (p2 less than 0.001) than control patients.
G Kraag et al. 1990	46	This follow-up study reports on 22 control patients who received the previously withheld treatment and 24 experimental patients who received follow-up treatment as needed.	Following treatment, fingertip-to-floor distance did not change in control patients (P2 = 0.145). Between 4 and 8 months, fingertip-to-floor distance did not change in experimental patients (P2 = 0.143); however, initial improvement achieved was maintained. The experimental group at 4 months was better than the control group at 8 months (P2 = 0.038).



H. Dagfinrud 2005	6 clinical trials	Effectiveness of physiotherapy interventions	Moderate quality evidence for effectiveness was found in patient global assessment and spinal mobility in favor of the supervised group. The trials showed moderate quality evidence for no differences in pain intensity between the groups. One trial compared a 3-week inpatient spa-exercise therapy followed by weekly outpatient group physiotherapy with weekly outpatient group physiotherapy alone. Moderate quality evidence was found for effects in pain (absolute benefit 0.9 cm on visual analog scale; RPD 19%), physical function (absolute benefit 1 cm; RPD 24%), and patient global assessment (absolute benefit 1.3 cm; RPD 27%), in favor of the combined spa-exercise therapy.
L. Gravaldi, 2022	12 RCT	Non-pharmacological interventions supervised by a physiotherapist were compared with usual care or home-based exercise programmes	No statistically significant differences emerged when interventions were compared with home-based exercise programmes. Supervised physiotherapy is more effective than usual care in improving disease activity, functional capacity, and pain in patients with ankylosing spondylitis. No significant improvements emerged when supervised physiotherapy and home-based exercise programmes were compared.
Virginie Pécourneau, 2017	8 trials, a total of 331 patients with AS.	home exercise program (2/8), swimming (1/8), Pilates training (1/8) or supervised exercises (4/8)	Six trials showed a positive effect of exercise on the BASDAI. The overall 1 WMD (95% CI) was -0.90 (-1.52, -0.27) for BASDAI, with an index of heterogeneity (I^2) of 69% ($p=0.005$) in favor of exercise. All tests showed a positive effect of exercise on BASFI. The overall WMD (95% CI) was -0.72 (-1.03, -0.40) for BASFI, with an I^2 of 0% ($p<0.00001$) in favor of exercise. Four studies included patients on anti-TNF therapy. all showed a decrease in both BASDAI and BASFI with exercise. For BASDAI, the overall WMD (95% CI) was -1.37 (-1.90, -0.84) with an I^2 of 0% ($p<0.00001$). For BASFI, WMD (95% CI) was -0.81 (-1.25, -0.38) with I^2 0% ($p=0.0002$).
E. Giannoti, 2014	15 studies, a total of 1516 patients with AS	therapeutic exercise, spa treatment and correlation between physiotherapy and biological drugs, occupational therapy, manual therapy and physical therapy	Physiotherapy and biological drugs Study: BASDAI, BASFI, BASMI, BDI, MAF and SF-36 scores showed statistically significant improvements at T1 in EG ($p<0.05$) while the value remained unchanged in CG. Spa therapy, Significant reduction in BASMI score. normalized lung function in 3/6 patients with restrictive lung disorder after spa therapy.

DISCUSSION

This review investigated the effects of different types of exercise in adults with AS. A total of 5 clinical trials and 4 reviews were included. In all the studies there was variation in the type of exercises, such as aerobic exercise, Pilates, swimming, etc. None of the studies analyzed the exercise regimen, but only a combination of therapeutic exercises, stretching and respiratory physical therapy. Most researches simply refer to the type of exercise and not a detailed analysis of it. Physiotherapy presented to be more effective than usual care in improving disease activity, functional capacity and pain in patients with AS. Supervision leads not only to improved technical performance, but also increased motivation, which ultimately has a positive effect on mood and quality of life, controlling fatigue and disease activity.

Various scales were used to measure patients' mobility, functionality and quality of life. In addition, a clinical examination and various laboratory tests were performed to assess the health of the patients. In the studies presented, specific scales for the diagnosis of ankylosing spondylitis were used, along with general assessment scales such as VAS (pain), HADS (headache, anxiety, depression) and HAQ (health assessment questionnaire). Patients were also clinically examined with tests such as BASFI (back pain



index), BASMI (buttock pain index) and BASDAI (chest pain index). Other clinical examinations and tests were also used such as: Modified Scober test, time up and go test, tragus to wall distance, fingers to floor distance, occiput to wall distance, intermalleolar distance and chest expansion, spirometry and laboratory tests.

The results of the present review come in agreement with the existing literature. In more details, van Tubergen review results [26] provide low-quality evidence for the beneficial effects of the exercise program compared with no intervention and moderate evidence for the benefits of supervised group physical therapy compared with individual home programs. A combined program of therapeutic exercise and group physical therapy was more effective than group physical therapy in the management of AS, and an experimental muscle chain exercise program may be better than conventional exercises.

Physical therapy is a tool that can reduce pain and improve a patient's overall health. These specific treatments include the local application of heat and cold through various instruments, from warm paraffin baths to electromagnetic waves and ultrasound. An example is given by the German authors Van den Bjerg et al. [27], Metzger et al. [28] and Albrecht et al. [29] that use a cold environment to treat the acute phases of rheumatic diseases. In the study by Samborski et al. [30] patients found better spinal mobility after cryotherapy and worsening after thermotherapy, highlighting the beneficial effects of cold. The use of TENS in people with AS appears to have reduced pain, even if scientific evidence for this has not been obtained. Yurtkuran et al. [31] advocated the importance of spa therapy in improving general well-being, reducing pain, and enhancing flexibility and functional movement.

CONCLUSION

The results of this review show that different types of treatment programs improve areas related to the physical health of patients with AS such as pain intensity, mobility, functionality, muscle strength, balance, fatigue, anxiety, depression. Despite the heterogeneity of exercise programs and outcome measures used in the trials included in this review, the results support the potential benefits of exercise in improving disease activity and function in AS. The most significant improvement in pain across all research data is noted after water exercises. Supervised physiotherapy is more effective than usual care in improving disease activity, functional capacity and pain in patients with AS. Regarding the respiratory function a significant improvement in oxygen intake and chest expansion was observed.

Trials investigating commonly used physiotherapy approaches, such as different practical techniques and specific education and information programs, are still lacking. It is very important in future studies to examine the effects of a specific type of exercise and not in combination with other methods. To improve practice and decision-making, it is important to conduct trials that examine different modes, frequency, intensity, duration and adherence to exercise programs.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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