The Cochrane Review of Physiotherapy Interventions for Ankylosing Spondylitis

HANNE DAGFINRUD, TORE K. KVIEN, and KÅRE B. HAGEN

ABSTRACT. Objective. To update the Cochrane review on the effectiveness of physiotherapy interventions in the management of ankylosing spondylitis (AS).

Methods. All randomized studies available in systematic searches (electronic databases, contact with authors, reference lists) up to February 2004 were included. Two reviewers independently selected trials for inclusion, assessed the validity of included trials, and extracted data. Investigators were contacted to obtain missing information.

Results. Six trials with a total of 561 participants were included. Two trials compared individualized home exercise programs with no intervention. Low quality evidence for effects in favor of the home exercise program was found in physical function and spinal mobility [absolute benefit 10.3 cm on fingertip to floor distance; relative percentage difference (RPD) 37%]). Further, the trials showed low quality evidence for no group differences in pain. Three trials compared supervised group physiotherapy with an individualized home exercise program. 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.

Conclusion. The current best available evidence suggests that physiotherapy is beneficial for people with AS. However, it is still not clear which treatment protocol should be recommended in the management of AS. (J Rheumatol 2005;32:1899–906)

Key Indexing Terms:
ANKYLOSING SPONDYLITIS
SYSTEMATIC REVIEW
PHYSIOTHERAPY
RANDOMIZED CONTROLLED TRIAL

Ankylosing spondylitis (AS) is a chronic, progressive, inflammatory disease predominantly affecting young men and women. The disorder mainly affects the axial skeleton and the sacroiliac joints, with an aseptic inflammation of synovial tissue, the spinal ligaments, intervertebral discs, and facet joints. The sacroiliac joint involvement is often regarded as the hallmark of the disease, and the presence of radiographic sacroiliitis is considered obligatory for classification of AS according to both the original and the modified New York criteria1,2. Some patients also experience peripheral joint involvement and extraarticular manifestations like acute anterior uveitis and cardiac problems. AS is found worldwide, but more often in Caucasians than in other races. The prevalence is most frequently reported to be 0.1% to 0.2%3-5. Clinically, the disease is more commonly seen in men, with a 2–3:1 male to female ratio3,5-7. The etiology of AS is unclear8-10.

The most active disease phase is between the ages of 20 and 50 years, and patients with AS experience various degrees of functional limitations. The main clinical characteristics are pain, stiffness, reduced spinal mobility, and reduced energy. Physiotherapy is therefore recognized as being an important part of the management program in AS. The main goals are to maintain the patient’s maximal potential movement, prevent postural deformities, improve muscle strength and fitness, and relieve pain11-18. Further, advice and education about the condition are important factors, enabling patients to manage the disease better and to seek assistance at the appropriate time19.

The previous review included data from 3 randomized controlled trials (RCT). The results indicated a positive effect of physiotherapy interventions for patients with AS,
but the few studies, examining a small range of modalities, represented limited evidence. Recently, 3 more RCT have been conducted, and the purpose of this updated review was to assess the effectiveness of various physiotherapy interventions in the management of patients with AS.

The following main comparisons were made: (1) physiotherapy versus other interventions (including no intervention); and (2) comparison of different modalities or applications of physiotherapy.

MATERIALS AND METHODS
Criteria for considering studies for this review
Studies. Randomized or quasi-randomized controlled studies examining the effectiveness of physiotherapy in AS were evaluated.
Participants. Men and women with the diagnosis of AS according to the classification system described in the modified New York criteria. Trials were excluded if the diagnostic criteria were unclear or were not met.
Interventions. Studies were included if the interventions were any physiotherapy modality considered relevant in the management of AS. If interventions were included, they had to be similar in the comparison groups. Relevant physiotherapy modalities included: supervised and unsupervised exercises, training, manual therapy, massage, hydrotherapy, electrotherapy, acupuncture, and patient information and educational programs.
Outcome measures. As designated by the Assessment of the AS (ASAS) Working Group, the main outcomes of interest were pain, stiffness, spinal mobility, physical function, and patient global assessment. Other relevant outcome measures were also considered.
Search strategy for identification of studies. Relevant studies were identified by searching the Cochrane Central Register of Controlled Trials (CENTRAL), AMED, Medline, Embase, CINAHL and PEDro (up to February 2004), with no language restrictions.

The search strategy recommended in the Cochrane Collaboration Handbook was used. The reference lists of retrieved studies were scanned to identify additional relevant trials, and authors of relevant studies were contacted.
Methods of the review. Trials included in the review were independently selected by the 2 reviewers (HD and KBH) using a standard form that had been pilot-tested.
Methodological quality. Internal validity was independently assessed by 2 reviewers (HD and KBH) using the criteria described in the Cochrane Collaboration Reviewers’ Handbook. The criteria included assessment of the following: concealment of allocation, use or control with cointerventions, use of intention-to-treat analysis and losses to followup, outcome assessment, and blinding of patients. These 5 criteria were rated as “met,” “unclear,” or “not met.” The operationalization of the 5 methodological quality criteria is presented in Table 1. Disagreement was easily resolved by discussion. Blinding of providers is clearly not possible, so the outcome criteria focus upon blinding of assessors and patients. However, the included trials compared exercises and educational programs in different settings, and blinding of patients was therefore rated as not met in these trials. An overall assessment of internal validity was based on a summary of these 5 criteria: low risk of bias means that 4 to 5 criteria were met; moderate risk of bias means that 3 criteria were met; and high risk of bias means that less than 3 criteria were met (Appendix).

Finally, the quality of evidence was assessed according to a recently developed systematic and explicit method. To indicate the extent to which one can be confident that an estimate of effect is correct, judgments about the quality of evidence were made for each comparison and outcome. These judgments considered study design (RCT, quasi-RCT, or observational study), study quality (detailed study design and execution), consistency of results (similarity of estimates of effect across studies), and directness (the extent to which people, interventions, and outcome measures are similar to those of interest). The following definitions in grading the quality of evidence for each outcome were used.

High: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate: Further research is likely to have an important influence on our confidence in the estimate of effect and may change the estimate.
Low: Further research is very likely to have an important influence on our confidence in the estimate of effect and may change the estimate.
Very low: Any estimate of effect is very uncertain.

In addition, there are some considerations that can lower or raise the quality of evidence that were not employed in this review.

Data extraction and analyses
Data were independently extracted by 2 reviewers (KBH and HD) using a pilot-tested data extraction form. Disagreement was resolved by discussion.

If the articles did not provide sufficient information for methodological assessment or necessary data for statistical analyses, letters were sent to investigators to collect missing data. Six letters were sent and 4 of the authors replied to our request. Two provided additional information regarding methodological quality and 2 provided additional data for statistical analyses.

For Main comparison 1 (physiotherapy interventions versus other interventions or no intervention), the preplanned stratified analyses were: Trials comparing home programs of therapeutic exercises and disease education with no intervention.

For Main comparison 2 (different modalities or applications of physiotherapy), the preplanned stratified analyses were:
(1) trials comparing home exercise regimes with supervised, inpatient or outpatient group physiotherapy (including hydrotherapy);
(2) trials comparing inpatient spa-exercise therapy with supervised, weekly group physiotherapy.

Where possible, weighted mean differences (WMD) with corresponding 95% confidence intervals (CI) were calculated. Both random effect models and fixed effect models were employed. For studies not providing sufficient data, qualitative analyses were undertaken. In one trial, 2 intervention arms were considered clinically similar and were therefore combined for analytical purposes.

Clinical relevance
In order to improve the clinical relevance of the review, absolute benefit and relative percentage differences (RPD) were calculated, if possible, for statistically significant differences. Absolute benefit was calculated as the improvement in the treatment group less the improvement in the control group using the original units. RPD was calculated as the absolute benefit divided by the baseline mean in the control group. According to the Philadelphia Panel, an improvement at 15% relative to a control group was considered clinically relevant.

RESULTS
We considered 43 studies for inclusion in this review. Thirty-three of them were excluded due to study design, the participants, the interventions, or the outcome measures. Two conference abstracts were considered potentially eligible, but full reports were not available. Eight published studies were RCT and investigated the effects of physiotherapy in the management of patients with AS. However, 2 of these were crossover or followup studies that did not provide independent results and they were consequently excluded from the review. Six studies with a total of 561 participants were included in this updated review, compared to 3 trials and 241 patients in the previous
version. The included studies were undertaken in Canada12, The Netherlands16, United Kingdom13,32, Austria, Germany and Netherlands24, and Turkey29. A description of the studies is presented in the Appendix.

The overall assessment of the methodological quality of the trials in this review was as follows: Two studies16,24 met 4 criteria of internal validity and were rated to have low risk of bias. Two studies12,29 met 3 criteria and were assessed to have moderate risk of bias; and 2 studies did not meet any of the criteria and were assessed to have high risk of bias13,32. The overall assessment and the assessments of each criterion are presented in the Appendix.

Comparisons
Main comparison 1: physiotherapy versus other treatment (including no treatment)
Two trials compared home exercise and educational programs with no intervention12,32. In one of the studies, 3 of the methodological quality criteria were met, and the study was assessed to have moderate risk of bias12. In one study, less than 3 methodological criteria were met, and the study was assessed to have high risk of bias32. The results are summarized in Table 2.

Pain. None of the included studies reported any clinically relevant differences in pain. We therefore conclude that there is low quality evidence for no group differences in pain reduction.

Stiffness. Stiffness was not measured in the studies, except one, where it was reported as part of the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI)33. No group differences were found on the BASDAI in the study of Sweeney, et al32.

Spinal mobility. Kraag, et al12 found a significant difference in fingertip-to-floor distance in favor of the home exercise program at 4 months (end of trial; RPD 37%). However, no significant difference was found in the Schober test (RPD 2.5%). Sweeney, et al32 did not measure spinal mobility. We conclude that there is low quality evidence for a positive effect of a home exercise program on some measures of spinal mobility.

Physical function. Physical function score was significantly better at end of trial in the experimental group than in the no-intervention group in the study of Kraag, et al12. Mean difference after treatment was about 4 points on a 33-point scale (p < 0.001, modified Toronto Activities of Daily Living Questionnaire). Sweeney, et al32 reported no significant group difference after treatment (at 6 months) on the Bath Ankylosing Spondylitis Functional Index (BASFI)34 (RPD 7.5%). In conclusion, there is low quality evidence for a treatment effect on self-reported physical function.

Patient global assessment. Patient global assessment was not measured in Kraag, et al12. Sweeney, et al reported no group differences on the Bath Ankylosing Spondylitis Patient Global Score (BAS-G)35. Thus, there is low quality of evidence for no difference between the groups on patient global assessment.

Main comparison 2: different modalities or applications of physiotherapy
A. Trials comparing supervised group physiotherapy (including hydrotherapy) with home exercise regimes.

Three trials were included in this comparison. One trial met all the methodological quality criteria, and was assessed to have low risk of bias16; one trial met 3 criteria and was assessed to have moderate risk of bias29; and one trial met less than 3 methodological quality criteria, and was assessed to have high risk of bias13. The results are summarized in Table 3.

Pain. Hidding, et al16 found no significant differences in pain between the groups (RPD 10%). Analay, et al measured
pain at rest and during activity and found no significant differences after treatment or after 3 months. Helliwell, et al combined pain and stiffness in one variable. The RPD was 48% immediately after treatment in favor of the supervised group. However, this study was assessed to have high risk of bias and the results were therefore given low weight. Six months after the intervention no significant differences were found. Thus, it is reasonable to state that there is moderate quality evidence for no difference in pain intensity between the groups.

Stiffness. No significant differences in stiffness were found after 9 months in Hidding, et al (RPD 8%). Analay, et al measured duration of morning stiffness in minutes. The authors reported statistically significant within-group improvement after treatment and after 3 months. However, between-group analyses showed no significant differences at the 2 measurement points. The quality of evidence for no group difference is therefore considered to be moderate.

Table 2. Results from individual studies in main comparison 1 (physiotherapy vs other treatment, including no treatment), trials comparing home exercise, and educational program with no treatment.

<table>
<thead>
<tr>
<th>Study</th>
<th>Treatment Group</th>
<th>Outcome (scale)</th>
<th>No. of Patients</th>
<th>Baseline Mean</th>
<th>End of Study Mean</th>
<th>Absolute Benefit</th>
<th>Relative Percentage Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweeney, 2002</td>
<td>Home SES, pain</td>
<td>75</td>
<td>6.49</td>
<td>6.80</td>
<td>0.13</td>
<td>2.1 (I)*</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Control (1–10*)</td>
<td>80</td>
<td>6.06</td>
<td>6.24</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweeney, 2002</td>
<td>Home BASDAI</td>
<td>75</td>
<td>3.9</td>
<td>3.65</td>
<td>–0.06</td>
<td>1.6 (W)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Control (0–100)</td>
<td>80</td>
<td>3.8</td>
<td>3.49</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kraag, 1994</td>
<td>Home FFD, cm</td>
<td>26</td>
<td>23.6</td>
<td>15.3</td>
<td>10.3</td>
<td>37 (I)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>27</td>
<td>27.5</td>
<td>29.5</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kraag, 1994</td>
<td>Home Schober test, cm</td>
<td>25</td>
<td>13.7</td>
<td>11.3</td>
<td>–0.3</td>
<td>2.3 (W)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>27</td>
<td>13.3</td>
<td>10.6</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweeney, 2002</td>
<td>Home BASFI</td>
<td>75</td>
<td>3.5</td>
<td>3.06</td>
<td>0.27</td>
<td>7.5 (I)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Control (0–100)</td>
<td>80</td>
<td>3.6</td>
<td>3.43</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweeney, 2002</td>
<td>Home BAS-G</td>
<td>75</td>
<td>4.0</td>
<td>3.60</td>
<td>0.31</td>
<td>8.4 (I)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Control (0–100)</td>
<td>80</td>
<td>3.7</td>
<td>3.61</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS: no statistically significant differences between groups; SES pain: Stanford Self-Efficacy Scale (* direction of scale not reported); BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; FFD: Fingertip-to-floor distance; BASFI: Bath Ankylosing Spondylitis Functional Index; BAS-G: Bath Ankylosing Spondylitis Patient Global Score; I: improvement; W: worsening.

Table 3. Results from individual studies in main comparison 2 (different modalities or applications of physiotherapy). Comparison 2A, trials comparing supervised group physiotherapy (including hydrotherapy) with home exercise regimes.

<table>
<thead>
<tr>
<th>Study</th>
<th>Treatment Group</th>
<th>Outcome (scale)</th>
<th>No. of Patients</th>
<th>Baseline Mean</th>
<th>End of Study Mean</th>
<th>Absolute Benefit</th>
<th>Relative Percentage Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analay, 2003</td>
<td>Supervised PT</td>
<td>Pain at rest</td>
<td>23</td>
<td>3.8</td>
<td>3.3</td>
<td>0.5</td>
<td>16 (I)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>(0-100)</td>
<td>22</td>
<td>3.1</td>
<td>3.1</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Analay, 2003</td>
<td>Supervised PT</td>
<td>Pain activity</td>
<td>23</td>
<td>4.5</td>
<td>4.2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>(0–100)</td>
<td>22</td>
<td>4.6</td>
<td>4.3</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Helliwell, 1996</td>
<td>Supervised PT</td>
<td>Pain and stiffness</td>
<td>15</td>
<td>8.1</td>
<td>4.1</td>
<td>3.9</td>
<td>48 (I)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>(0–200)</td>
<td>14</td>
<td>8.1</td>
<td>8.0</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Analay, 2003</td>
<td>Supervised PT</td>
<td>Morning stiffness, minutes</td>
<td>23</td>
<td>38.7</td>
<td>20.9</td>
<td>18.2</td>
<td>49.7 (I)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>(0–200)</td>
<td>22</td>
<td>36.6</td>
<td>37.0</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Helliwell, 1996</td>
<td>Supervised PT</td>
<td>Cervical rotation, degrees</td>
<td>15</td>
<td>95.3</td>
<td>112</td>
<td>14.9</td>
<td>17 (I)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>FFD, cm</td>
<td>14</td>
<td>88.8</td>
<td>90.6</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Analay, 2003</td>
<td>Supervised PT</td>
<td>TWD, cm</td>
<td>23</td>
<td>20.8</td>
<td>15.5</td>
<td>4.3</td>
<td>22.5 (I)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>TWD, cm</td>
<td>22</td>
<td>19.1</td>
<td>18.1</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Analay, 2003</td>
<td>Supervised PT</td>
<td>BASFI, cm</td>
<td>23</td>
<td>26.3</td>
<td>20.0</td>
<td>6.0</td>
<td>21.7 (I)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>BASFI, cm</td>
<td>22</td>
<td>27.6</td>
<td>27.3</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

NS: no statistically significant differences between groups; FFD: Fingertip-to-floor distance; TWD: Tragus-wall distance; BASFI: Bath Ankylosing Spondylitis Functional Index; I: improvement; W: worsening.
(lumbar flexion)\textsuperscript{13,29} showed no significant differences, but Analay, \textit{et al}\textsuperscript{29} found a significant difference in Schober score at 3 months (RPD 18%).

Further, no difference in cervical rotation was found in Hellwell, \textit{et al}\textsuperscript{13}; and Analay, \textit{et al}\textsuperscript{29} found no difference between the groups on fingertip-to-floor distance or tragus-to-wall distance. In conclusion, the quality of evidence for small differences on some measures of spinal mobility is considered to be moderate.

\textbf{Physical function.} No significant differences in self-reported physical function measured after intervention were found in the study of Hidding\textsuperscript{16} (RPD 7%) or in the study of Analay\textsuperscript{29} (RPD 22%) (Table 3). The quality of evidence is moderate.

\textbf{Patient global assessment.} The supervised group reported significantly better scores on the patient global assessment after the 9-month intervention period in the study of Hidding, \textit{et al}\textsuperscript{16} [mean change difference 1.46 cm (10 cm scale); 95% CI 1.05 to 1.87]. Relative difference was not calculated due to insufficient reporting of baseline data. Patient global assessment was not measured in the 2 other studies\textsuperscript{13,29}. The quality of evidence for a difference in favor of group physiotherapy is considered to be moderate.

\section*{Main comparison 2 – different modalities or applications of physiotherapy}

\subsection*{B. Trials comparing the effectiveness of spa therapy with weekly group physiotherapy}

One study was included, meeting all the methodological quality criteria and assessed as having low risk of bias\textsuperscript{24}. The 2 spa-exercise interventions took place at 2 different spa resorts, but the therapy programs were standardized for both spa resorts. The 2 interventions were therefore considered clinically similar, and they were combined to perform as one group in this review (intervention group: IG), which was compared to weekly group physiotherapy alone (control group: CG). The authors expressed the primary outcomes (BASFI, BAS-G, pain intensity, and morning stiffness) as a pooled index of change (PIC). Both the pooled index and the individual variables were reported. The results are summarized in Table 4.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|l|l|l|}
\hline
Study & Treatment Group & Outcome (scale) & No. of Patients & Baseline Mean & End of Study Mean & Absolute Benefit & Relative Percentage Difference \\
\hline
Van Tubergen, & Spa exercise & Pain (0–10) & 80 & 4.6 & 3.6 & 0.9 & 19 (I) \\
2001 & Control & & 40 & 4.8 & 4.7 & & \\
Van Tubergen, & Spa exercise & BASFI & 80 & 4.6 & 3.6 & 1.0 & 24 (I) \\
2001 & Control & (0–10) & 40 & 4.2 & 4.2 & & \\
Van Tubergen, & Spa exercise & BAS-G & 80 & 5.3 & 3.7 & 1.3 & 26.5 (I) \\
2001 & Control & (0–10) & 40 & 4.9 & 4.6 & & \\
\hline
\end{tabular}
\caption{Results from individual studies in main comparison 2 (different modalities or applications of physiotherapy). Comparison 2B, trials comparing the effects of spa therapy with weekly group physiotherapy.}
\end{table}

\text{BASFI: Bath Ankylosing Spondylitis Functional Index; BAS-G: Bath Ankylosing Spondylitis Patient Global Score; I: improvement.}

\textbf{Pain.} Significant effects of the spa-exercise intervention were found regarding pain 1 and 4 months after start of the 3-week intervention (RPD 19%). It may be reasonable to conclude that there is moderate quality evidence for a clinically relevant effect of the spa-exercise intervention on pain.

\textbf{Stiffness.} Stiffness was measured as duration (minutes) of morning stiffness. Significant differences between the spa-exercise groups and the control group were not found. Thus, the quality of evidence for no group differences is moderate.

\textbf{Spinal mobility.} Spinal mobility was not measured in this study.

\section*{DISCUSSION}

The results of this review showed that patients with AS had some beneficial effects from individualized home exercise programs compared to no intervention. Further, supervised group physiotherapy programs were better than individualized home exercise regimes, and a 3-week combined spa-exercise intervention was better than weekly group physiotherapy alone. Six studies met the inclusion criteria of this review, with a total of 561 patients with AS. Two of the studies were assessed to have low risk of bias, 2 studies were assessed to have moderate, and 2 to have high risk of bias. Patients or providers were not blinded in the included trials.
Nearly all the studies in this review included more than 70% men in the participant groups. Among the exclusion criteria were patients using disease modifying antirheumatic drugs, patients with peripheral joint involvement, severe comorbidity, and diagnosis of AS more than 20 years ago. Thus, the applicability of the results to women and patients severely affected with AS may be limited.

The main goal of the 6 trials in this review was to study the effectiveness of physiotherapy in the management of AS. However, the interventions were often poorly described, so that the exact content of the programs remained partly unclear, and the external validity was thereby unclear. Another problem related to the external validity was the somewhat unusual interventions in some of the included trials, such as treatment programs in spa resorts. Although the spa-exercise intervention showed favorable cost-effectiveness and cost-utility ratios compared to self-exercising and group-exercising, spa resorts are not readily available in many parts of the world and the generalizability of the results may therefore be limited.

The included studies measured spinal mobility with different methods and for different parts of the spinal column. The varying results may indicate that mobilizing exercises have to be specifically designed for each part of the column, and a general effect of exercising on spinal mobility is not to be expected. Further, measures of spinal extension range of motion are lacking in the included studies, and future trials should aspire to include more specific spinal mobility movements and measurements.

Compared to the previous version of this review (not published in a paper journal), 2 substantial changes have been made. First, 3 new studies with a total of 320 patients have been included. Second, the clinical relevance of the effect sizes and the quality of evidence has been assessed according to systematic and explicit methods. These changes have reinforced the tendency toward positive effects of physiotherapy in terms of exercise programs in the management of AS. A new high quality study is added in this update, showing good results of combined spa-exercise therapy. Another study with moderate methodological quality indicates positive results, although not statistically significant, of intensive group physiotherapy compared to home exercises.

The trials included in this review compared therapeutic exercises applied in group settings to exercises performed individually. Thus, the comparisons may provide information on the effect of the group setting rather than the effect of the specific content of the exercise programs. That the patients who participated in the groups (both inpatients and outpatients) improved more than the patients who did exercises on their own may be ascribed partly to the contribution of nonphysical factors, such as mutual encouragement, increased motivation, and exchange of experiences with fellow sufferers. These are important factors for the total well-being of the AS patients, but does not give evidence to identify the most appropriate and effective exercise program.

The random allocation of patients in physiotherapy studies may lead to reduced effectiveness of the interventions. Physiotherapy interventions are often time-consuming and compliance is dependent on highly motivated patients. Hellwell, et al addressed this problem in their study, considering that the large number of dropouts may have been due to lack of motivation and a time-consuming treatment program that the patients had not chosen. With use of intention-to-treat analyses, the high degree of noncompliance will influence the treatment effects negatively. To avoid noncompliance or poor recruitment, physiotherapy researchers may have a tendency to compare active and quite similar interventions. Significant differences of clinically relevant treatment effects may therefore be hard to obtain.

The trials included in this review compared different active interventions, and blinding of the participants was therefore not considered as a methodological quality criterion. Blinding of providers and patients is regarded as very difficult in physiotherapy studies. However, lack of blinding weakens the methodological quality of trials and should therefore be used if possible, for example in electrotherapy modalities, and possibly by means of different kinds of attention placebos.

Publication bias is discussed as a problem when developing systematic reviews. Research has suggested that studies with positive results are more likely to be published than studies with negative results. Further, our literature search identified reports of 2 possibly eligible studies, published as conference abstracts, that did not provide sufficient data to be included. Due to the small number of included studies and insufficient data reporting, the possible extent of publication bias could not be explored further in this review.

No randomized trials investigating relevant physiotherapy interventions other than exercise programs were found through this systematic search strategy. Other commonly used physiotherapy interventions (e.g., different hands-on techniques such as manual therapy, electrotherapy, and information and education programs) should be investigated. Future trials should compare different treatment and exercise programs, and aspire to an accurate description of the content, dose and application of training and exercise programs, as well as duration and frequency of the interventions. Further, future trials should apply standardized, validated outcome measures suitable for assessing effects of physiotherapy interventions.

According to the current research evidence, we do not know which particular treatment protocol should be recommended in the management of AS.

This review identified and summarized data from all available RCT investigating the effects of physiotherapy in the management of AS. Due to a small number of partici-
pants, some of the studies may be underpowered and prone to bias due to baseline differences. Further, because of heterogeneous interventions and outcome measures, varying methodological quality, and deficient reporting of data in the included studies, the review does not provide strong evidence. However, systematic reviews also have the potential to identify areas of poor knowledge, leading to new hypotheses and constituting a valuable guide for further research. The tendency toward positive effects of physiotherapy in the management of AS calls for further research, and future trials should address other physiotherapy interventions commonly used in clinical practice.

ACKNOWLEDGMENT

Louise Falzon at the editorial office of the Cochrane Musculoskeletal Group conducted the literature searches for this updated version. The authors of the primary studies are acknowledged for their cooperation.

REFERENCES

# APPENDIX

The RCT included in this review.

<table>
<thead>
<tr>
<th>Author (country)</th>
<th>Methodological quality</th>
<th>Participants</th>
<th>Interventions</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holcomb, 1996 (United Kingdom)</td>
<td>Concomitant of allocation: NOT MET</td>
<td>56 participants, mean age 38.9 years, 89% men, exclusion: New York criteria + one or more of the following features: Pain, stiffness or functional limitation last 3 months. Exclusion: Hip replacement, knee replacement, and pregnancy.</td>
<td>Group 1: A home exercise program directed at the key joints, peripheral joints, and the entire lower limb. The participants were encouraged to exercise for 30 minutes daily during the 12 months study period. Group 2: The home exercise program + supervised group physical therapy once a week over the 12 months study period. The group exercise program consisted of their physical therapy, an hour of aerobic activity, 1 hour of walking, and 1 hour of hydrotherapy.</td>
<td>1. Spinal mobility: Thera-Band ladder (fuller method), cervical traction. 2. Physical fitness: Max work capacity, bicycle ergometer. 3. Functioning or health status: Sicardi Impact Profile, Health Assessment Questionnaire for Spinal Arthritis. 4. Patient global assessment of well-being (VAS, 0-10). Points of assessment: baseline and 6 months after intervention.</td>
</tr>
<tr>
<td>Bieden, 1993 (Netherlands)</td>
<td>Concomitant of allocation: MFT, exclusion: New York criteria + one or more of the following features: Pain, stiffness or functional limitation last 3 months. Exclusion: Hip replacement, knee replacement, and pregnancy.</td>
<td>144 participants, age between 17 and 60 years, 76% men, exclusion: New York criteria + one or more of the following features: Pain, stiffness or functional limitation last 3 months. Exclusion: Hip replacement, knee replacement, and pregnancy.</td>
<td>Group 1: A home exercise program directed at the key joints, peripheral joints, and the entire lower limb. The participants were encouraged to exercise for 30 minutes daily during the 12 months study period. Group 2: The home exercise program + supervised group physical therapy once a week over the 12 months study period. The group exercise program consisted of their physical therapy, an hour of aerobic activity, 1 hour of hydrotherapy.</td>
<td>Spinal mobility: Theraband ladder (fuller method), cervical traction. Physical fitness: Max work capacity, bicycle ergometer. Functioning or health status: Sicardi Impact Profile, Health Assessment Questionnaire for Spinal Arthritis. Patient global assessment of well-being (VAS, 0-10). Points of assessment: baseline and 12 months after intervention.</td>
</tr>
<tr>
<td>Saltz, 2000 (Canada)</td>
<td>Concomitant of allocation: UNCLEAR</td>
<td>57 participants between 10-75 years, 79% men, the participants were divided into two age groups: 10-55 years (27) and 56-75 years (26). Exclusion: New York criteria + one or more of the following features: Pain, stiffness or functional limitation last 3 months. Exclusion: Hip replacement, knee replacement, and pregnancy.</td>
<td>Group 1: A home exercise program directed at the key joints, peripheral joints, and the entire lower limb. The participants were encouraged to exercise for 30 minutes daily during the 12 months study period. Group 2: The home exercise program + supervised group physical therapy once a week over the 12 months study period. The group exercise program consisted of their physical therapy, an hour of aerobic activity, 1 hour of hydrotherapy.</td>
<td>Spinal mobility: Thera-Band ladder (fuller method), cervical traction. Physical fitness: Max work capacity, bicycle ergometer. Functioning or health status: Sicardi Impact Profile, Health Assessment Questionnaire for Spinal Arthritis. Patient global assessment of well-being (VAS, 0-10). Points of assessment: baseline and 12 months after intervention.</td>
</tr>
<tr>
<td>Swaraj, 2002 (United Kingdom)</td>
<td>Concomitant of allocation: UNCLEAR</td>
<td>155 participants aged between 19-61 years, 67% men, exclusion: New York criteria + one or more of the following features: Pain, stiffness or functional limitation last 3 months. Exclusion: Hip replacement, knee replacement, and pregnancy.</td>
<td>Group 1: A home exercise program directed at the key joints, peripheral joints, and the entire lower limb. The participants were encouraged to exercise for 30 minutes daily during the 12 months study period. Group 2: The home exercise program + supervised group physical therapy once a week over the 12 months study period. The group exercise program consisted of their physical therapy, an hour of aerobic activity, 1 hour of hydrotherapy.</td>
<td>Spinal mobility: Thera-Band ladder (fuller method), cervical traction. Physical fitness: Max work capacity, bicycle ergometer. Functioning or health status: Sicardi Impact Profile, Health Assessment Questionnaire for Spinal Arthritis. Patient global assessment of well-being (VAS, 0-10). Points of assessment: baseline and after intervention (8 months).</td>
</tr>
<tr>
<td>van Tubergen 385 (The Netherlands, Germany and Austria)</td>
<td>Concomitant of allocation: MFT, exclusion: New York criteria + one or more of the following features: Pain, stiffness or functional limitation last 3 months. Exclusion: Hip replacement, knee replacement, and pregnancy.</td>
<td>120 participants (3 groups of 40). Group 1: 15% men, mean (SD) age 48 (10). Group 2: 20% men, mean (SD) age 45 (9). Group 3: 25% men, mean (SD) age 48 (13). Exclusion: New York criteria + one or more of the following features: Pain, stiffness or functional limitation last 3 months. Exclusion: Hip replacement, knee replacement, and pregnancy.</td>
<td>Group 1: A home exercise program directed at the key joints, peripheral joints, and the entire lower limb. The participants were encouraged to exercise for 30 minutes daily during the 12 months study period. Group 2: The home exercise program + supervised group physical therapy once a week over the 12 months study period. The group exercise program consisted of their physical therapy, an hour of aerobic activity, 1 hour of hydrotherapy.</td>
<td>Spinal mobility: Thera-Band ladder (fuller method), cervical traction. Physical fitness: Max work capacity, bicycle ergometer. Functioning or health status: Sicardi Impact Profile, Health Assessment Questionnaire for Spinal Arthritis. Patient global assessment of well-being (VAS, 0-10). Points of assessment: baseline and 12 months after intervention (6 months).</td>
</tr>
</tbody>
</table>

Personal non-commercial use only. The Journal of Rheumatology Copyright © 2005. All rights reserved.