Effect of Active Hand Exercise and Wax Bath Treatment in Rheumatoid Arthritis Patients

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The effect of active hand exercise and warm wax treatment was evaluated in 52 rheumatoid arthritis patients randomized into four groups: (1) both exercise and wax bath, (2) exercise only, (3) wax bath only, and (4) controls. Treatment was given three times a week for 4 weeks. Deficits in flexion and extension in digits II–V bilaterally, grip function, grip strength, pain, and stiffness were measured before and after the treatment period. The control group was measured at corresponding times. Wax bath treatment followed by active hand exercise resulted in significant improvements of range of motion (ROM) and grip function. Active hand exercise alone reduced stiffness and pain with nonresisted motion and increased ROM. Wax bath alone had no significant effect.

Finger and wrist joints are involved in most patients with rheumatoid arthritis (RA) [1]. Hand dysfunction is thus a frequent cause of disability in this disease [2] and a major concern in rheumatology care. The standard physical treatment is active hand exercise, combined with local application of heat and splinting [3, 4]. However, the rationale for many therapeutic approaches to hand training has been questioned [5].

Few studies on the outcome of treatments aimed at improving hand function are available [6]. The only reported controlled trial of wax bath treatment and exercise showed little benefit to the RA patients of this treatment [7]. In another trial combining exercise with wax bath treatment, an improvement in grip strength and articular index equivalent to that achieved with other physical treatments was found [8].

The aim of the present study was to evaluate the effects in RA patients of active hand exercise and wax bath treatment alone and in combination in a randomized controlled trial.

PATIENTS AND METHODS

Patients

The patients were selected from a questionnaire survey including all 705 seropositive RA patients of the Sahlgren University Hospital, Gothenburg, who had been either inpatients or outpatients of the Department of Rheumatology between January 1987 and June 1988. The questions concerned age, duration of the disease, activities of daily living (ADL) function, and interest in occupational and/or physical therapy. Eighty-nine percent answered the questionnaire.

The criteria for inclusion in this study were the following: resident in the city of Gothenburg, age not older than 70 years, duration of the disease 6 to 10 years, functional class I–II [9], and hand problems defined as decreased ROM and/or grip strength. Excluding seropositive RA patients with other diagnoses, 103 patients fulfilled the criteria. They were invited to participate, and 65 of them responded positively.
Thirteen patients dropped out before the start of the study because of other treatments, change of their work schedule, or other social reasons. The remaining 52 RA patients, 33 women and 19 men, between the ages of 29 and 69 years (mean for women 51.8; mean for men, 56.3) completed the study. The mean duration of the disease for the women was 7.7 and for the men, 7.5 years. Medications were not changed, and no intra-articular injections were given during the 2 months before or during the study. No significant differences were found between the four groups regarding age, sex, functional class, or disease duration.

The Research Ethics Committee of the University of Gothenburg approved the study.

Treatments

Wax-bath Treatment  Both hands were slowly dipped five times into a 47 to 50°C wax bath, then wrapped in paper and fitted in quilt mittens, in which they were kept for 20 minutes.

Hand Exercise  A standard written program including eight different movements according to Flatt [10] (flexion, extension and radial deviation of fingers, dorsal flexion, palmar flexion and ulnar deviation of wrists, opposition and abduction of thumbs) was followed and repeated five times during each session. Rotation, flexion, and abduction movements of shoulders were added to the hand exercise program. Soft exercise dough made from flour, water, salt, and liquid paraffin was used by the patients to obtain a slight resistance to facilitate the performance of exercises. The exercise program took about 20 minutes to carry out.

Outcome Measurements

Range of motion (ROM) was measured bilaterally as (1) flexion deficits of digits II–V as the distance in millimeters from the distal palmar crease to the distal point of the digits, and (2) extension deficits of digits II–V with the back of the hand resisting supinated on a table and the forearms outside the table [11]. The distance between the table and the distal point on the nail-bed of the extended fingers was recorded in millimeters. Patients were allowed to compensate supination difficulties by leaning the body and/or adduct the arm.

Grip function in the dominant hand was measured by the “Sollerman test” [12]. A total of seven different grips such as pulp-pinche, lateral-pinche, and diagonal-volar are combined within 20 different tasks included in this test (Figure 1). Performance is graded from 4 (best) to 0 (worst). Use of the correct grip and performance of the activity within 20 seconds rates 4 points. Because 40% of the grips in studied ADL situations focus on pinch grips, eight tasks from the Sollerman test performed with pulp-pinche and lateral-pinche grips were also chosen and added up separately to form the pinch function score. The maximum score was 32 points for pinch function and 80 points for the total grip function.

Grip strength bilaterally was measured in Newtons (N) by means of an electronic instrument. “Grippit” (AB Detektor, Gothenburg, Sweden) [13, 14]. This instrument records both maximal power and average power based on 20 registrations during a 10-second period. The size of the handle of this instrument remains constant during the test. The subjects were tested while sitting in a standard position with the elbow in 90° flexion and the wrist in a neutral position.

Pain with resisted motion in the dominant hand during performance of the grip function tests was measured on a 10-point scale for quantitative estimation [15] where 0 is described as “no pain” and 9 as “maximal pain.” Using this scale, the patients could immediately estimate pain without interrupting the test procedure. Pain was recorded for each subtest of grip function and a single mean score for each person was calculated.

Pain with nonresisted motion in both hands was measured on a 100-millimeter vertical visual analog scale (VAS) [16] from the lowest point defined as “no...
pain” to the highest point defined as “maximal pain” (as bad as it could be). Patients were asked to mark how much pain they had when moving their fingers on both hands without resistance. The distance from the lowest point to the mark was recorded in millimeters.

Stiffness of both hands was measured on a 0 to 100-mm vertical VAS-scale from the lowest point defined as “no stiffness” to the highest point defined as “maximal stiffness” (as bad as it could be). Patients were instructed to mark how stiff their fingers on both hands currently felt. The distance in millimeters from the lowest point to the mark was recorded.

Study Design
The patients were randomized into four groups using sequential allocation according to sex, age, duration of the disease, and/or previous hand surgery:

- Group I—wax bath treatment followed by active hand exercise
- Group II—active hand exercise only
- Group III—wax bath treatment only
- Group IV—control group

Patients were included in the regular treatment groups in the occupational therapy (OT) department three times a week for 4 weeks. The treatment, following a written instruction handed out to the patients, was supervised by an occupational therapist. Examinations were performed 2 to 5 days before and 2 to 5 days after the 4-week treatment period, and at the corresponding times in the control group. Individual patients were examined at the same hour of the day each time. Pain and stiffness were also evaluated before and after each treatment in groups I, II, and III. Two occupational therapists (B.D. and I.W.) did all measurements, the same therapist seeing the individual patient before and after treatment. Examinations were performed in a total of 30 to 40 minutes. The subjects were not told the measurement results during the study period.

Statistical Analysis
Wilcoxon signed-rank test was used for analysis of intragroup outcome. The Kruskal–Wallis method was applied to test for overall intergroup differences [17], and measurement showing significant differences was further analyzed for differences between individual groups by the Mann-Whitney U test [17]. A 2-tailed Mantel’s test was used to evaluate the overall effects of each treatment [18].

RESULTS
The mean scores of the outcome measures are given for the four groups at baseline and at the end of the treatment/control period in Table 1. No statistically significant differences of these variables were found between the groups at baseline. Group I (both treatments) improved significantly (p < 0.05) concerning the mobility of the nondonominate hand and the grip function test. Group II (exercise only) improved (p < 0.05) concerning flexion in the dominant hand and was the only group showing significantly (p < 0.05) reduced pain (with nonresisted motion) and stiffness. No significant influence of treatment was observed in group III (wax bath only), and in group IV (controls) no significant change occurred during the observation period. Significant pain relief was registered immediately after the treatment in group I (both treatments) (p < 0.01) and in group III (wax bath only) (p < 0.05), but not in group II (exercise only). Stiffness was reduced (p < 0.01) in all treatment groups immediately after treatment.

The overall comparison of treatment outcome between groups (Kruskal–Wallis test) showed significant (p < 0.05) differences regarding flexion deficit in the dominant hand and pain with nonresisted motion. The flexion deficit improved significantly (p < 0.05) in both group I (both treatments) and group II (exercise only) compared to group IV (controls). Both the total grip function (20 items) and pinch test (8 items) improved significantly (p < 0.05) in group I (both treatments) compared to all other groups. Finally, pain with nonresisted motion improved significantly (p < 0.05) in group II (exercise only) compared to group III (wax bath only) and IV (controls).

In a comparison of the four groups in an analysis of the overall outcome of exercise and wax bath treatment separately (Mantel’s test), active exercise was found to significantly reduce pain with nonresisted motion (p < 0.01), stiffness (p < 0.05) and flexion deficits in both the dominant and the nondonominant hands (p < 0.01 and p < 0.05, respectively). No significant effect was observed with wax bath treatment, although a tendency to reduced pain with resisted motion was registered.

DISCUSSION
The overall results of this study showed that the exercise program improved hand function. No significant additional effect was obtained with wax bath treatment, but pain relief came immediately after
### TABLE 1
Mean Scores of Outcome Variables in Four Groups of 52 Rheumatoid Arthritis Patients at Baseline and at End of the Four Weeks Treatment/Control Period

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Group</th>
<th>Kruskal-Wallis test of changed scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I (n = 13) Wax bath/exercise</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II (n = 11) Exercise only</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III (n = 15) Wax bath only</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV Control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>End</td>
</tr>
<tr>
<td>Range of motion deficit (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexion, dominant hand</td>
<td>62.3</td>
<td>52.1</td>
</tr>
<tr>
<td>Flexion, non dominant hand</td>
<td>77.0</td>
<td>55.4a</td>
</tr>
<tr>
<td>Extension, dominant hand</td>
<td>42.4</td>
<td>32.9</td>
</tr>
<tr>
<td>Extension, non dominant hand</td>
<td>24.9</td>
<td>15.8a</td>
</tr>
<tr>
<td>Grip function test (0–80 pts)</td>
<td>72.3</td>
<td>74.8a</td>
</tr>
<tr>
<td>Pinch function test (0–32 pts)</td>
<td>27.4</td>
<td>29.3a</td>
</tr>
<tr>
<td>Grip strength (Newton)</td>
<td>93.9</td>
<td>98.8</td>
</tr>
<tr>
<td>Maximum dominant hand</td>
<td>106.8</td>
<td>107.4</td>
</tr>
<tr>
<td>Average dominant hand</td>
<td>72.4</td>
<td>79.2</td>
</tr>
<tr>
<td>Average non dominant hand</td>
<td>88.2</td>
<td>86.9</td>
</tr>
<tr>
<td>Pain</td>
<td>1.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Resisted motion, dominant hand (0–9 pts)</td>
<td>29.3</td>
<td>22.1</td>
</tr>
<tr>
<td>Nonresisted motion, both hands (0–100 mm)</td>
<td>39.3</td>
<td>24.9</td>
</tr>
</tbody>
</table>

*Significance of difference (p < 0.05) between baseline and end of treatment.

The selection of patients excluded those with early disease, because they were allocated to a separate study. However, patients with 6 to 10 years' disease duration usually represent an important part of the clientele of rheumatology units. The majority of these patients reported some degree of hand dysfunction. Because the progression of disability has been reported to level out 10 years after onset [19], training of patients in this period is important in helping them maintain or improve function. Our results show that their hand function can be improved after a training period of 4 weeks. The sample size was estimated by power analysis in the planning of the study, and there was no indication that the results would have been different by including a larger sample.

Hand function is complex and conventionally used ROM and grip strength measurements only give limited information [20]. The hand function training program did not include specific training of muscle strength, which did not significantly improve. Training of mobility was part of the exercise program, and significantly reduced flexion deficits were observed. An attention effect comparing treated groups with controls can not be excluded but was partly controlled by comparing different treatment groups.

The better improvement of grip function in the group receiving both exercise and wax bath treatment compared to the other groups support the beneficial effect for hand function of this training program. The grip function test was the measurement expected to reflect most closely the outcome with the training program of hand function, but all groups scored close to normal for RA patients before treatment. This test in its present form was developed to evaluate surgical interventions and is thus less suitable for outcome studies in patients in ARA functional classes I and II.

The therapeutic use of heating devices for rheumatic joints remains controversial [3–8]. Daily local heating of RA joints for extended time periods did not result in harmful effects [20] and wax bath treat-
ment seems to be superior to other heating methods [21]. On the other hand, others have stated that "only occasional patients feel it worth to bother" [5]. Our results support the view that wax bath treatment alone has limited value [7] except for short-term pain relief. However, the short-term effect seems to facilitate exercise to improve hand function significantly more than in patients not receiving wax bath treatment. This beneficial effect of combined therapy has some support in the study of Hawkes et al. [8, 22], although they had no controls.

Rheumatology care is constantly changing toward more preventive and active training, and toward group therapy and patient instruction to reduce costs and make optimal use of limited resources [23]. Wright et al. [24] found handouts insufficient and repeated instruction not helpful compared to one instruction only. Our patients received altogether 12 sessions of standardized treatments. From a cost-benefit point of view, this may be shortened, but so far no data on the optimal number of treatment session is available.

Evaluation of nonpharmacological treatment of the chronic rheumatic disorders is difficult [25]. However, the expense of such therapies and the efforts required by the patients to obtain results are strong incentives to improve these therapies and the methods for their evaluation. We conclude from this study that hand exercise programs for RA patients 6 to 10 years after disease onset are useful. Surface heat such as wax bath treatment seems to improve the result of training, probably by reducing pain during the exercise, and can be recommended when available.

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