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THE EFFECT OF WATER EXERCISE THERAPY GIVEN TO PATIENTS WITH RHEUMATOID ARTHRITIS

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ABSTRACT. It is well known that patients suffering from rheumatoid arthritis have a reduced muscular function. The positive effect of physical training on rheumatic patients has been shown. In this study the effect of exercise therapy performed in a heated swimming pool has been evaluated for eight patients in a non-acute stage of rheumatoid arthritis. The median pre-treatment maximal isometric and isokinetic quadriceps strength was 88 Nm (44–146) and 99 Nm (62–149) respectively, which was 61% and 70% of that found in a control group of healthy persons. After 2 months exercise therapy the median maximal isometric and isokinetic quadriceps strength increased by 38% and 16% compared to the pre-treatment value ($p<0.02$ and $p<0.05$). All patients, except one who developed cardiac arrhythmia during the second test, accomplished a submaximal bicycle test (a.m. Åstrand). An increase in the aerobic capacity was observed in all patients after the training period.

Key words: rheumatoid arthritis, pool exercise, rehabilitation.

Patients with rheumatoid arthritis have a low physical capacity due to both a low muscle strength and low cardiorespiratory fitness (5). An equally reduced strength of the knee extensors and the plantar flexors in patients suffering from rheumatoid arthritis has been found using an isokinetic dynamometer (Cybex II) (3, 4). Because of the progressiveness of the disease and variation in disease activity patients with rheumatoid arthritis may for a shorter or longer time be forced into muscular inactivity resulting in weakness and wasting of muscles.

It has been shown by Halkjær-Kristensen et al. (8) that muscle weakness and muscle wasting develop very soon after ligament injuries of the knee joint. The reversibility is dependent on efficient physical training (10). Ekblom and associates showed the importance for rheumatic patients of maintaining physical activity by physical training (6). The aim of this study was to evaluate the effect of exercise therapy given to patients with rheumatoid arthritis who were trained in a swimming pool with heated water. The exercise therapy given in this study focused on strength training of the muscles of the lower extremities.

PATIENTS AND METHODS

Eight consecutive patients, 6 women and 2 men, diagnosed as having definite or classical rheumatoid arthritis volunteered in the study (13). According to Steinbrocker they all belonged to the functional classes II or III (17). Patients with an acute inflammation in the hip, knee or ankle joints were excluded from the study. The average age of the participants was 54 years (35–66). Mean duration of the disease was 14 years (3–22). Four patients were in a medication with a non steroidal antiinflammatory drug. One patient was in a long term gold therapy, one was treated with chloroquine, one with D-penicillamine and one with a combination of corticosteroid and azathioprine. No one received corticosteroids parenterally during the investigation and in a period of at least 2 months before the start of the study. No patients were using beta-blockers. One of the patients had had a hip replacement operation one month before start of the training period.

The patients performed an exercise program twice a week for two months. Each training session lasted 45 min. Two physiotherapists, familiar with the exercise treatment of rheumatic patients supervised the pool training. The water exercise program was carried out with emphasis on strength training to the muscles of the lower extremities. The intensity of the exercises was adapted individually with respect to threshold of pain and fatigue. The exercise program was performed partly in a "walking" pool and partly in an ordinary swimming pool with a water temperature of 35°–36°C. Only when passing from one pool to the other a little rest in the exercise program was accepted. Eight sex- and age-matched healthy untrained subjects served as controls with respect to the initial strength measurements.

Exercise program in the "walking" pool

1. Common walk forwards and backwards.
2. Walking on one's toes—forwards and backwards.
3. Sideways walk to the left and to the right.
4. Walking with high knee-raising forwards and backwards.
5. Straight-leg swing to and fro and from side to side.
6. Exercises consisting of pressing an air filled inner tube of car tyre or a float down with a leg.

Table I. *Isometric and isokinetic muscle strength before and after exercise therapy for patients with rheumatoid arthritis (n=8)*

Angular velocity	Maximal muscle strength			
	Controls meadian (range)	Before exercise median (range)	After 2 months of exercise median (range)	After 2 months without exercise median (range)
0 °/s[a]	144 (77–180)*	88 (44–146)**	121 (64–167)	104 (78–191)
30 °/s	142 (97–179)**	99 (62–149)*	115 (82–172)	107 (81–153)
60 °/s	138 (73–163)**	89 (50–127)*	97 (41–162)	91 (63–125)
120 °/s	111 (62–122)**	77 (35–113)	78 (26–140)	77 (53–127)
180 °/s	94 (71–108)**	75 (26–106)	69 (17–122)	66 (37–96)
240 °/s	86 (73–101)**	72 (23–107)	67 (19–113)	63 (22–100)
300 °/s	81 (58–107)**	58 (22–108)	62 (14–112)	54 (18–86)

[a] Isometric muscle strength at 60° flexion (Fig. 1).
* $p<0.05$, ** $p<0.01$–0.02.

Exercise program in the ordinary swimming pool

These exercises are carried out wearing the obligatory equipment e.g. an "aircollar", a cork belt (life belt) and "wings" on the legs.

1. Exercises in the supine position:
   "Bicycle" movements with legs.
   Abduction and adduction of the legs. "Scissors" movements with legs.
   Backstroke movements with legs.
   High knee bends, alternating with right and left leg.
2. Side (right and left) lying:
   "Scissors" movements.
3. Exercises in the prone position:
   Abduction and adduction of legs.
   "Scissors" movements of legs.
   Breast-swimming movements with legs.

Besides those exercises every patient was given resistance training individually for both leg- and hip muscles.

All the participants in the study were asked to give their opinion on the effect of the physical training.

Muscle strength measurements

The isometric and isokinetic muscle strength of the right knee extensors were tested on a dynamometer (Cybex II, Lumex Ny) before and after the exercise period by a method described in an earlier study (2, 3). The isometric muscle strength was measured as maximal torque at knee angles of 90, 60 and 30 degrees. The maximal isokinetic muscle strength was determined during knee extension with a preset constant angular velocity (30, 60, 120, 180, 240, 300 degrees per second (°/s), respectively). The patients were placed with a hip angle of 90–100 degrees and the lower leg attached to the lever of the dynamometer. Knee extension was performed from 100 degrees of knee flexion to full extension. The strength measurements were adjusted for the weight of the leg below the knee. Three measurements were performed at each angular velocity and the highest value was recorded. Torque and knee angles were recorded on an *x–y* oscilloscope (Tectronix). The coefficient of variation (CV) for duplicated examinations has earlier been shown in both patients and controls to be 6.0% (3).

Bicycle test for determination of aerobic capacity

Aerobic capacity was estimated by means of a submaximal test a.m. Åstrand (19)—both before and after the training period.

STATISTICAL METHODS

Non parametric tests have been used (median and range). The Mann-Whitney non parametric test for two independent samples was used to test the significance of the difference between the controls and patients (16). The Wilcoxon's non parametric test for the dependent measurements was used to test the significance of differences between pre-training and post-training muscle strength values (16).

RESULTS

The quadriceps strength

Isometric strength measurements. The median maximal isometric muscle strength of the knee extensors—measured at a 60 degrees flexed knee joint—was 88 Nm (44–146) before and 121 Nm (64–167) after the training period, a significant increase of 38% ($p<0.02$) (Table I, Figs. 1, 2). The pre-exercise value was 39% lower ($p<0.05$) than that of healthy age- and sex-matched subjects (Fig. 1). Two months after the end of the training period the muscle strength was still somewhat greater than before, but not significantly so (Table I).

Isokinetic strength measurements. At low angular velocities (30°/s and 60°/s) the training resulted in a significant increase (16% at 30°/s) of the maximal

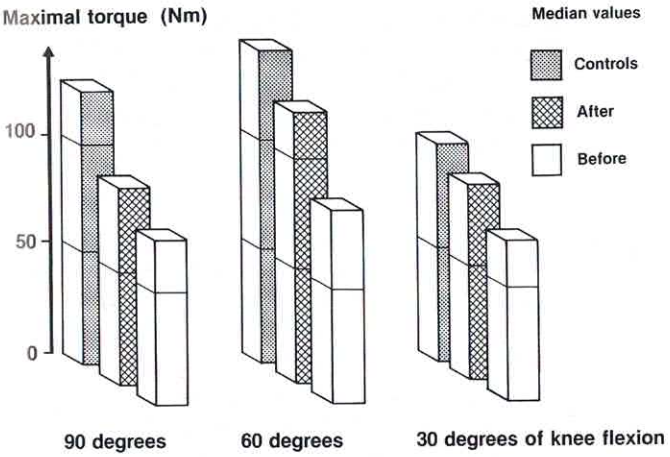

Fig. 1. The isometric muscle strength in patients with rheumatoid arthritis before and after two months of water exercise. The upper values belong to a control group. Median values are given in Nm.

isokinetic muscle strength (Table I, Fig. 2); whereas no significant differences were seen when measuring at high angular velocities (180°/s, 240°/s, 300°/s) (Table I, Fig. 3). The pre-exercise maximal isokinetic muscle strength was significantly lower (about 30%) than that of healthy controls ($p<0.02$–0.01) (Table I, Fig. 3). The shape of the force velocity curves seen in the patients did not differ essentially from that of normals (Fig. 3). Two months after the end of the training period the median maximal isokinetic muscle strength had decreased, but was still (30%) greater (not significant) than before start of exercises (Table I).

The aerobic capacity test a.m. Åstrand. In seven patients the bicycle test was carried out before and after the training period. One patient developed cardiac arrhythmia during the second test, and had to stop. The median pre-exercise oxygen uptake was estimated to 1.7 l/min and increased significantly ($p<0.02$) to a median post-exercise value of 1.9 l/min. All showed an increase (Fig. 4).

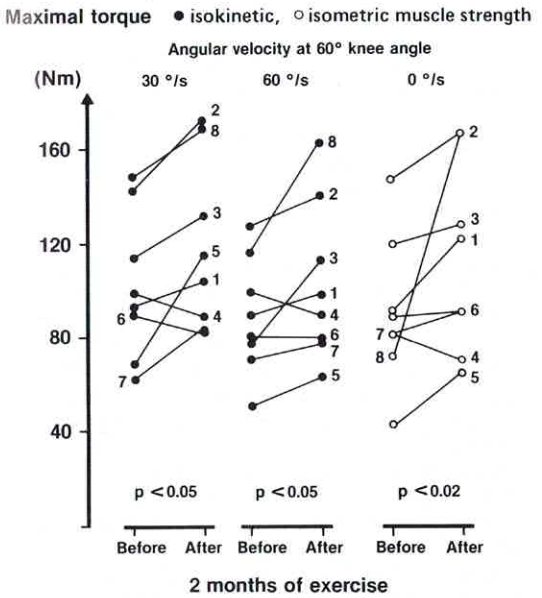

Fig. 2. The isometric and isokinetic muscle strength in patients with rheumatoid arthritis before and after two months of water exercise.

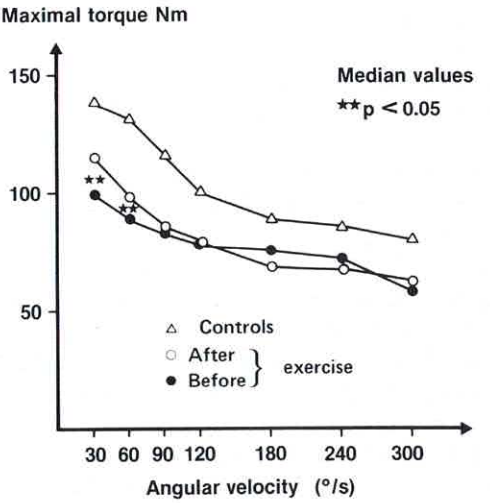

Fig. 3. The force velocity curves in patients with rheumatoid arthritis before and after two months of water exercise. The upper curve belongs to a control group.

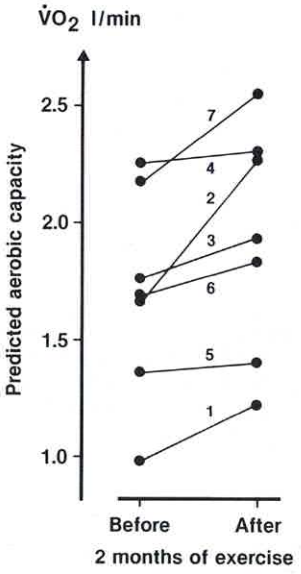

Fig. 4. The bicycle test a.m. Åstrand. The oxygen uptake (the predicted aerobic capacity) in patients with rheumatoid arthritis before and after two months of water exercise.

DISCUSSION

In patients suffering from rheumatoid arthritis isometric and isokinetic muscle strength of the quadriceps was found to increase markedly after a moderate amount of training in the pool. Not only the muscle strength but also the aerobic capacity increased during the training. As shown in Table I the effect of training appeared to have decreased two months after the cessation.

However, even if the effect of 2 months of water exercises was evident, the muscle strength in patients with rheumatoid arthritis did not reach normal values.

The improvement of isokinetic strength seen only at low angular velocities reflects presumably the method of training.

The relationship between leg muscle strength and physical performance capacity has formerly been reported (3, 4). The low muscle strength found in patients with rheumatoid arthritis may cause disability and handicap. The question is whether this physical state could be prevented by training—perhaps given in a greater amount than in the present investigation.

Warnings against physical therapy applied to patients with rheumatoid arthritis are sometimes presented in the literature (11, 18). In our study, however, no side effects of the water exercise therapy were observed, particulaly no flare up in the joints. To our knowledge no investigations have shown joint damage caused by "over"-exercising. Harkcorm et al. (1985), on the contrary have observed an improvement both concerning oxygen uptake capacity and "joint counts".

Lastly, several patients reported a higher degree of self-help in daily activities and more freedom to move after the training period. This is in agreement with the findings of Ekblom et al. and Nordemar et al. (5, 12).

In this study the benefit of specific water exercises for patients with rheumatoid arthritis is presented. It is of importance that the reproducibility of these findings will be tested by future controlled investigations.

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