

Joint Protection and Home Hand Exercises Improve Hand Function in Patients With Hand Osteoarthritis: A Randomized Controlled Trial

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Objective. To determine the effect of joint protection and home exercises on hand function of patients with hand osteoarthritis (OA).

Methods. Randomized, controlled, 3-month trial with a blinded assessor. Primary outcome parameter was grip strength; secondary parameters were Health Assessment Questionnaire and visual analog scales (VAS) for pain and global hand function. Forty patients with hand OA were randomly assigned to 2 groups: One group received instruction for joint protection and home hand exercises (JPE group), the control group received an information session about hand OA.

Results. Grip strength improved by 25% in the JPE group (right hand, $P < 0.0001$; left hand, $P = 0.0005$), but not in the control group. Global hand function (by VAS) improved in a larger proportion (65%) of patients in the JPE group ($P < 0.05$).

Conclusions. Joint protection and hand home exercises, easily administered and readily acceptable interventions, were found to increase grip strength and global hand function.

KEY WORDS. Hand osteoarthritis; Joint protection; Hand exercises.

INTRODUCTION

Osteoarthritis (OA) is the most common joint disease and it most frequently involves joints of the hands (1). The disease leads to pain in and around the affected joints and to swelling, stiffness, deformity, and gradual loss of function (2,3). As a consequence, the ability to perform tasks of everyday life may become impaired or lost altogether. OA is characterized by a progressive loss of articular cartilage. Hand OA commonly affects proximal interphalangeal joints (PIP), distal interphalangeal joints (DIP), and the

carpometacarpal joint of the thumb (4). Autopsy studies reveal almost universal evidence of cartilage damage in people over age 65 years. Taking into account that 60–70% of the population above the age of 65 seek medical attention for this condition (5), hand OA has an enormous socioeconomic impact. Because one of the most important social phenomena of the 20th century is the increased longevity of the population, and today almost 80% of the population can expect to live through most of their 7th decade of life, the socioeconomic impact of OA is likely to increase even further in the future (5).

Pain and loss of hand function decrease the patients' ability to perform manual tasks and diminish their quality of life. Drug treatment recommended for hand OA includes analgesics, nonsteroidal antiinflammatory drugs (NSAIDs), and glucosamine sulfate (6). However, none of these treatments have been shown to retard cartilage loss, and thus they have to be regarded as purely symptomatic. Therefore, persons with hand OA are commonly referred to occupational and physical therapists to improve functional performance (7).

Occupational therapy (OT) intervention principles, given their focus on enhancing a person's ability to perform occupational tasks and on maximizing independence (8), constitute a potentially effective approach to treating

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people with hand OA. OT interventions include joint protection, training in activities of daily living, and functional exercises. The goal is to maintain and improve function of the affected hand joints.

Joint protection interventions have been studied in people with rheumatoid arthritis (RA) (9,10). Home hand exercise programs have been used in trials for persons with RA and have been reported to be well tolerated. Hand exercises have been shown to be an effective means of increasing grip strength and decreasing morning stiffness in RA (11–14).

Joint protection is a concept routinely employed in all patients whose joints are affected by arthritis. Originally designed for RA (15), the concept has been expanded to include OA by finding ways to reduce microtrauma to articular cartilage and subchondral bone. For persons with OA, joint protection is designed to strengthen muscular support, improve shock absorption around a joint, and reduce mechanical stress on the joint with different techniques or devices. These techniques are intended to help manage inflammation, avoid pain, reduce fatigue, and increase physical fitness (15), although randomized controlled trials about hand OA have not been published so far.

Because the musculoskeletal system must function as an integrated unit for optimum efficacy, specific exercise programs designed to improve everyday hand function are another essential aspect in the treatment of hand OA. Moderately loading the joint, increasing fitness, and increasing muscle strength are possible ways to stabilize bone and cartilage health (15,16). Moreover, a reduced movement range may generate primary OA, and maintaining the range of motion is essential for optimal function and pain control (17). Exercises for hand OA should be designed to maintain the full range of motion in metacarpophalangeal (MCP), PIP, and DIP joints, and the following principles should be applied: active movement, few repetitions, and a low amount of resistance (16). However, there is no evidence for the efficacy of hand exercises in hand OA.

The goal of this study was to evaluate the effect of instruction for joint protection in combination with a hand exercise intervention in persons with hand OA.

METHODS

Patients. Forty patients from 2 Austrian rheumatology outpatient clinics who met the American College of Rheumatology criteria for hand OA (4) were included in the study. Medication with analgesics and/or NSAIDs was permitted during the study and had to remain stable at least 1 month before and throughout the duration of the study. No other nondrug therapy for the upper extremity was permitted for at least 1 month before and throughout the study.

Patients with evidence of RA or any rheumatic disease other than OA were excluded. Furthermore, persons with elevated C-reactive protein levels (>0.5 mg/dl) at the baseline visit or with soft tissue swelling of any of the MCP, PIP, or DIP joints were excluded.

The 40 participants were matched for age and sex and

then randomly assigned to a control group or a joint protection and exercise (JPE) group (20 patients each). Participants were informed in detail about the study procedures and were told that they would be assigned to 1 of the treatment groups. All gave written informed consent.

Interventions. The control group was given oral and written information about hand OA to ensure that these persons also received proper attention. The information about hand OA included information on joint anatomy and pathogenesis of OA. During this session, each control person also received a piece of Dycem (nonslip matting), which they were told to use for opening jars throughout the period of 3 months. Duration of this session was 20 minutes.

The JPE group received oral and written instruction for joint protection and a home hand exercise program, which was to be performed daily throughout a study period of 3 months.

The following principles were explained during the joint protection instruction: the need for balance between movement and resting a joint; dividing stress between as many joints as possible; using larger and stronger joints; using each joint in its most stable plane to reduce pressure on the joint; avoiding staying in one position; and avoiding vibrations for the finger joints (15). In addition, patients were trained to protect their joints, using assistive devices if necessary to perform Activities of Daily Living (ADL). Patients were trained to do the following activities in a protective way: wringing a cloth; using enlarged grips for writing; opening jars, cans, or boxes with Dycem; using a book holder for reading; and using a rocker or angled knife for cutting food. Patients were encouraged to find examples for application of these principles in their own daily activities, which were discussed. Oral and written information was provided. The joint protection instruction and ADL training took 30 minutes for each patient.

The JPE group was also instructed to perform a home exercise program. The exercise program consisted of 7 exercises: making a fist, making a small fist (flexing the PIP and DIP joints only), flexing the MCP joints while keeping the PIP and DIP joints stretched, touching the tip of each finger with the tip of the thumb while keeping each finger flexed, spreading the fingers as far as possible with the hand lying flat on a table, pushing each finger in the direction of the thumb with the hand lying flat on a table, and touching the MCP V joint with the tip of the thumb.

Patients were taught for 15 minutes how to perform the exercises correctly. They were instructed to do every exercise with both hands 10 times daily. To control the patients' adherence, they were asked to write an exercise diary (noting date, time, and duration of exercise).

All instructions, interventions, and information were administered by the same occupational therapist (TAS).

Assessments. Assessments were carried out at baseline and after 3 months. The primary outcome parameter was grip strength. Secondary parameters were the Health Assessment Questionnaire (HAQ) in a validated German version (18) and visual analog scales (VAS) for pain and

Table 1. Group characteristics*

	Age, years	Ratio	
	(mean \pm SD)	women/men	NSAID use
JPE group	60.5 \pm 8.33	17/3	50%
Control group	60.4 \pm 8.43	18/2	40%

* JPE = joint protection and exercise; NSAID = nonsteroidal anti-inflammatory drug.

global hand function. Assessments were performed by a blinded assessor who was unaware of the treatment of the patients (SF).

Grip strength was measured with a Martin vigorimeter (Martin, Tuttlingen, Germany) (19,20) according to the following protocol: Patients were sitting, shoulder in neutral position, elbow 90° flexed, thumb upward and outside of the fist. Resting the arm on a table was not permitted. Patients were encouraged to press as firmly as possible. The middle-sized rubber bulb (Φ 43 mm) was used for all patients.

Patients were asked to assess their general level of pain and their ability to perform everyday tasks (global hand function) on a 100-mm VAS. Improvement was defined as a decrease in pain or increase in global hand function of at least 10% compared with baseline. Patients with less than 10% improvement or worsening were regarded as having no improvement.

Patients completed the HAQ score form (21). To improve the ability of the HAQ to discern changes in hand function in patients with hand OA, 2 additional items were included and analyzed separately: wringing a cloth and opening a jar of jam (20).

Analysis. Statistical analysis was performed using GraphPad Prism statistical software (version 2.01, GraphPad Software, San Diego, CA) on a personal computer. Values and scores were tested for Gaussian distribution (normality test). Baseline values of grip strength and HAQ scores in both groups, as well as differences of change between baseline and 3 months in JPE and control groups, were tested for statistical significance with unpaired Student's *t*-test. Values of grip strength and HAQ scores of baseline and 3 months in 1 group were tested for statistical significance with paired Student's *t*-test. For improvement in grip strength and VAS scales, the proportion of patients improved were tested for statistical significance with chi-square tests.

RESULTS

Group characteristics. Age and sex distribution, as well as use of NSAIDs, were similar for both the JPE and control group (Table 1).

Grip strength. Baseline values of grip strength for both groups were comparable. Grip strength of both hands was slightly, but not significantly, higher in the control group (mean for the right hand was 0.43 ± 0.21 in the JPE group

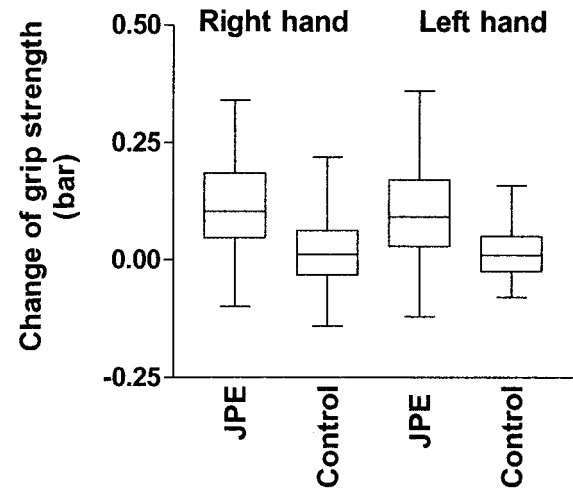


Figure 1. Change of grip strength in the joint protection and exercise (JPE) and control groups. Differences between baseline and 3 months indicate a statistically significant difference between JPE and control groups ($P < 0.0005$ for both hands). The mean of improvement (measured in bar) for the right hand was 0.12 ± 0.03 in the JPE group and 0.004 ± 0.02 in the control group. The mean for the left hand was 0.11 ± 0.03 in the JPE group and 0.008 ± 0.01 in the control group.

and 0.54 ± 0.16 in the control group; mean for the left hand was 0.44 ± 0.19 in the JPE group and 0.53 ± 0.19 in the control group).

After 3 months, grip strength improved statistically significantly in the JPE group to 0.55 ± 0.12 for the right hand and 0.55 ± 0.27 for the left hand ($P < 0.0001$ for the right and $P = 0.0005$ for the left hand, compared with baseline), but not in the control group (0.57 ± 0.21 for the right hand and 0.56 ± 0.21 for the left hand; $P = 0.2335$ for the right hand and $P = 0.1612$ for the left hand compared with baseline). In addition, the improvement in grip strength between baseline and 3 months was significantly higher ($P < 0.0005$) in the JPE group than in the controls (Figure 1). Furthermore, the proportion of patients with an increase in grip strength of at least 10% was significantly higher ($P < 0.05$) in the JPE group (16 of 20 in both hands) than in the controls (5 of 20 in the right and 4 of 20 in the left hand) (Figure 2).

VAS. VAS for self-perceived global hand function showed a significantly higher proportion of patients with improvement ($P < 0.05$) in the JPE group (13 of 20 improved) compared with the control group (4 of 20 improved) (Figure 3). VAS values for general pain were not significantly different between baseline and 3 months in either group (data not shown).

HAQ. HAQ scores, scores of individual HAQ domains relevant to hand function, and the 2 additional items were analyzed separately. No differences between the JPE and the control group were detected in any of these analyses (data not shown).

Diaries. Sixteen patients (80%) provided diaries. The average exercise time was 11 minutes per day (range, 2–30 minutes). Neither improvement in grip strength nor im-

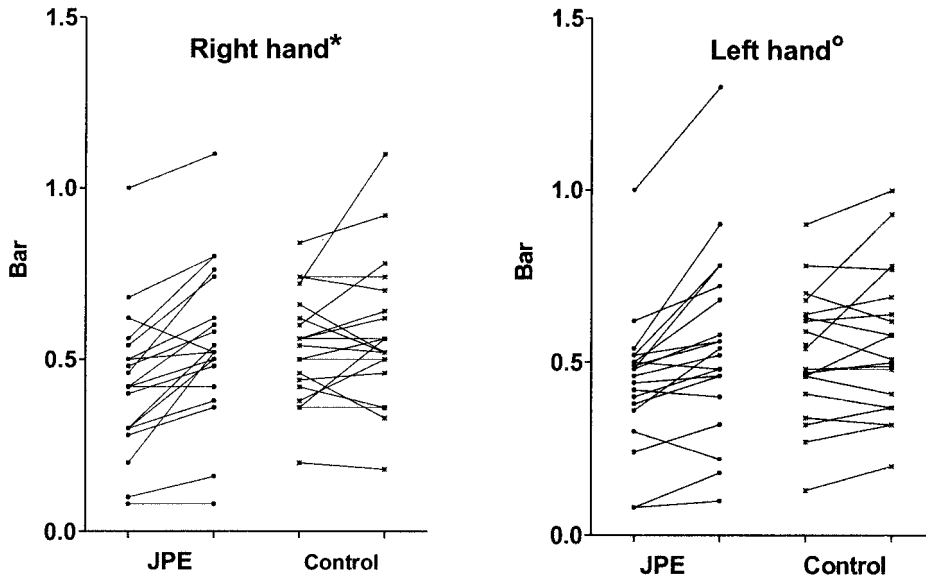


Figure 2. Grip strength development over 3 months. Each patient is represented by 1 line. The proportion of patients with grip strength improved by at least 10% was significantly higher in the joint protection and exercise (JPE) group than in the controls in both hands ($P < 0.05$, chi-square test).

* $p=0.0226$ ° $p=0.0253$

provement in global hand function (by VAS) correlated with exercise time (data not shown). Exercises were well tolerated; few periods of mild discomfort, such as an increase in pain, were reported.

DISCUSSION

In this study, we investigated immediate and short-term effects of a home exercise program and a joint protection intervention for patients with hand OA. We found a statistically significant increase in grip strength in both hands in the JPE group. In contrast, no such changes were seen in the controls. Moreover, global hand function (by VAS) showed improvement in a significantly higher number of persons in the intervention group as compared with the control group. Global pain assessment (by VAS) and global

HAQ scores did not change significantly. This includes HAQ scores in items relevant to hand function and 2 additional items related to hand function and grip strength.

We selected grip strength, a variable representing impairment level, as the primary outcome measure for this study because it has been found to better represent the actual disability (disability with personal assistance or use of assistive devices or personal assistance) than the HAQ (22). In the literature, grip strength has been frequently regarded to reflect a certain aspect of hand function in persons with RA (23). In RA, grip strength is commonly limited by pain and cannot easily be interpreted simply as function of muscle force production (22). In OA, the increase in grip strength is more likely to represent better hand function, which is consistent with the improvement of the VAS score for everyday hand function.

Our results show a moderate, but significant, effect of our JPE intervention program on grip strength. The control group, which received an intervention that gave only verbal information without pointing out the possible value of a joint protection and an exercise program, essentially did not improve at all during the observation period of 3 months. Because the exercise program contained no elements aimed specifically at increasing grip strength, the results are all the more remarkable. The moderate effect in our trial can be related to the use of range-of-motion exercises (11) and probably also to the adoption of joint protection behavior by the participants. Resistive exercises might have led to a greater increase in strength, but we felt that they could also have caused further damage to the cartilage of the hand joints. Particularly in standard programs such as the ones used in this study, adding resistive training, which imposes the same resistance to every participant, might produce negative effects on hand joints in persons with low muscle strength. A moderate effect in

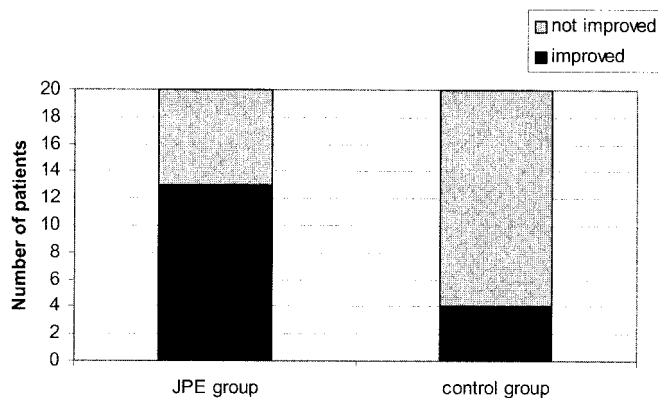


Figure 3. Proportion of improvement in self-reported global hand function. On the visual analog scale, 13 patients of the joint protection and exercise (JPE) group reported improvement in global hand function, whereas 7 patients did not improve. In the control group, 4 patients reported improvement and 16 did not improve ($P < 0.05$, chi-square test).

grip strength, which is also related to self-perceived improvement in function, may have more clinical relevance for treatment of hand OA than a great increase in strength, which might have more deleterious effects on cartilage. Very high grip strength has been found to be related to an increased risk of developing hand OA, whereas appropriate hand strengthening may help prevent or even treat hand OA (24).

Self-reported general pain level by VAS did not decrease significantly in either group. Because the question referring to pain levels did not specifically ask for pain in the hands, it cannot be excluded that some of the answers could be related to pain in other joints, such as from knee or hip OA.

The HAQ was selected as the assessment tool because no other standardized questionnaire specific for hand OA is currently available. The HAQ has been developed to assess quality of life and daily function in persons with various forms of inflammatory arthritis. To make the HAQ more specific for hand OA, two additional items were included (20) and analyzed separately. Despite this modification, the HAQ might not be an adequate questionnaire for persons with hand OA, even if variables concerning only hand function were analyzed. Further research is needed to develop a specific questionnaire for persons with hand OA.

Some methodologic problems might have affected the results. It was not possible to fully blind the participants. The participants were told that they would get an intervention for hand OA, but were not told into which group they were randomized. Assessments, however, were performed by a blinded assessor who was unaware of the group to which the participant had been randomized. Furthermore, only persons willing to participate were included. To estimate the adherence of the participants, exercise diaries were used. However, a correlation between the self-reported length of exercise training with the outcome parameters could not be found.

The JPE intervention consisted of 2 different parts: joint protection and hand home exercises. According to our clinical experience, a combination of both was most likely to improve the situation of patients with hand OA. Therefore, we decided that the intervention in this study should comprise both joint protection and hand exercises. Additional research is needed to analyze the effects of joint protection or hand exercises alone.

The intervention in this study was a standard program for joint protection and hand exercise. The standard program was used to ensure that every participant received the same intervention. Most participants reported a subjective beneficial effect when performing this program at home. Some persons did not feel comfortable with the standard therapy program and might have appreciated more therapy sessions and/or more specific procedures to improve their individual everyday activities. More individualized treatments might be necessary for these persons. Especially in OT, exercises could be embedded in purposeful activity or replaced by meaningful activities (25,26). However, the advantage of a standard program is that it can easily be memorized and takes little time to be performed, which was appreciated by most of our participants. Furthermore, the joint protection sessions pro-

vided some individual advice according to specific problems based on standard principles (15) and focused on the daily activities of the participants.

Taken together, in this short-term study, joint protection and hand home exercises were found to be an effective means to increase hand function, as measured by grip strength and self-reported global function in persons with hand OA. The JPE intervention has no side effects, is readily accepted by patients, and can be performed in any environment where the patient feels comfortable. These favorable short-term results need to be extended to a larger number of patients over a longer period of time.

Hand OA is a chronic disease for which no cure is currently available, the symptomatic pharmacologic treatment has significant side effects (27), and none of the recommended physical therapies have been demonstrated to improve function. To this end, our study constitutes a systematic approach to show how patients with hand OA might benefit from an intervention that is free of side effects, easily administered, and readily acceptable.

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