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Original Article

Effects of Home-Based Hand Exercises on Pain and Function in Patients with Hand Osteoarthritis

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Abstract

Background: The evidence specific for the benefits and harms of exercises in hand osteoarthritis (OA) is limited and conflicting. We set out to investigate whether hand exercise leads to a clinically important change in hand pain, and its function.

Methods: A total of 40 patients over 40 years of age whose hand OA was confirmed by the American College of Rheumatology (ACR) criteria, were divided into control and intervention groups and filled the visual analogue scale (VAS) and the Functional Index for Hand Osteoarthritis (FIHOA) questionnaires. 4 weeks of physical hand exercise at home was performed by the intervention group and the control group was assigned to waiting list and the indices were recorded again.

Results: The ability to perform daily activities in the patients who received the exercise program showed improvement in their FIHOA questionnaire, and these changes were statistically significant for all movements measured. After four weeks of exercise, the mean FIHOA score in the intervention group was significantly ($P=0.008$) decreased, while the score changes in the control group was not significant ($P=0.344$). Intergroup comparison showed that the FIHOA score changes was statistically significant ($P=0.036$) after intervention between the intervention and control groups. The total VAS score significantly decreased during 4 weeks in the intervention group ($P<0.01$) but increased in the control group.

Conclusion: The hand exercise program resulted in pain reduction and hand function improvement on self-reported measures. Integrating hand exercise in therapy can be beneficial in non-pharmacological treatment of OA of the hand.

Introduction

Hand osteoarthritis (OA) is a common musculoskeletal disease, with a prevalence that increases with aging.[1] Hand OA typically involves one or more finger joints and presents with hand pain, reduced grip strength, stiffness and functional difficulties that cause impaired hand mobility and limitation in performing daily life tasks.[2,3] Patients with OA almost complain from pain as the main reason to seek treatment.[4] In the long time, joints become stiff and lose range of motion due to lack of movement that often leads to impaired hand function. This abnormality affects the quality of life and has negative health and social consequences.[3] Patients may have only interphalangeal joint involvement, only base of thumb involvement or both. The most common joints involved in hand OA are usually the Proximal Interphalangeal Joints, the Distal Interphalangeal Joints, and the first carpometacarpal joint.[5]

The estimated prevalence rate of symptomatic hand OA range from 13% to 26%, and is found to be increased in postmenopausal women.[6] In addition to age and gender, other risk factors including heredity, obesity, joint anatomical abnormalities, trauma, and work have been identified as associated with the disease.[7,8] Given the high incidence of the disease, the growing elderly population, the lack of effective curative therapies, and the side effects

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associated with pharmacologic relief of pain, it is vitally important to establish low-cost, simple, and noninvasive treatment options to attenuate the symptoms and induce the restoration of hand function.[9] In a recommendation by European League Against Rheumatism (EULAR) that was released recently, hand exercises are given attention to manage hand OA symptoms. Despite the unmet need for therapeutic exercise treatment, few studies have been considered into the efficacy of exercise in controlling symptoms and dysfunction in this degenerative disorder.[10] In rehabilitation, maintenance interventions such as splints, joint protection, heat and cold modalities, laser therapy, and hand exercises are recommended.[11] Among these interventions, therapists are often more inclined to use hand exercises, and researches have shown that hand exercises can increase hand strength in these patients.[12]

In a study, a facility-based yoga exercise was shown to have significant effects on pain and tenderness and proved to increase finger motion.[13] Furthermore, a specific hand exercise regimen combined with joint protection education in people with hand OA was demonstrated to enhance isometric grip strength and hand function.[14] The effectiveness of a set of thumb home exercise programs together with thumb base splinting was studied in patients with hand OA. Performing exercise and the splint together decreased pain and improved recovery of hand strength and physical function. On the other hand, in a study by Østerås et al, patients with physically confirmed OA were randomly assigned to a 12-week training intervention. The hand function over 3 months was assessed by the Functional Index for Hand Osteoarthritis (FIHOA) and the patient disability index was measured by the Patient-Specific Functional Scale (PSFS). They observed that the exercise program was well tolerated by patients but only the short-term improvements were reported and also the performance-based tests showed no significant changes.[15] Conservative treatment is expected to recover functionality by inhibition of pain, and providing stability, mobility, and strength. There are numerous conservative measures that include cortisone and/or hyaluronate injections, analgesic drugs, patient education in joint protection, assistive devices, strengthening exercises, and orthosis.[16] Among these interventions, therapists are often more inclined to use hand exercises, and research has shown that hand exercises may improve strength gaining and pain in these patients. However, despite extensive studies and resources on conservative treatments in patients, interventions such as the use of hand exercises and its effects on the symptoms of hand OA still need to be studied and researched. Therefore, the present study aimed to examine the effect of hand exercises on function and physical disabilities in patients with hand OA.

Subjects and Methods

Study design

This clinical research was carried out by the Rheumatology clinic of Vali-e-Asr hospital, Zanjan during March to October 2018 as a prospective, randomized-controlled and single-blind, pilot study approved by the institutional review board. A total of 40 patients aged over 40 years, who were diagnosed with ACR criteria, and those with a visual analogue scale (VAS) score of ≥ 4 at the baseline, were included in the study. Patients with carpal tunnel syndrome, De Quervein's tenosynovitis, OA secondary to rheumatic diseases, posttraumatic OA after fractures, open wounds or scars in the hand/wrist, peripheral vascular diseases, a history of hand surgery or patients who have been candidates for surgery during the study, a history of peripheral neuropathy, sensory impairment in the hand, cognitive disorders, and interventions including the use of walkers and crutches were not included in the study population.

Randomization and blinding

This study was a randomized controlled, single-blind trial in confirmed hand OA volunteers. We firstly divided all the participants into two groups: test group (n = 20), and a 4-week waiting group (n = 20), using a random number table. Changes in the outcome of the questionnaires before, and 4 weeks after the start of the study were determined in each group by the physician who was blinded to randomization procedure. Also, the patients were instructed not to tell the assessor about the type of treatment they received. Adverse events such as skin irritation, itching, and overheat were tracked and monitored throughout the treatment session by another physician. None of the subjects from either group received anti-inflammatory or analgesic medications (NSAIDs or paracetamol). Those participants who needed these medications due to old age were excluded from the study.

Evaluated parameters

The FIHOA is a measure to assess hand function in patients with hand OA. It is a 10-item questionnaire with a score range of 0-30 (0 = best and 30 = worst) developed by Dreiser et al in 1995.[17] In FIHOA questionnaire, ten questions have been designed, which have 4 answers for each question, including possible without difficulty (score 0), possible with slight difficulty (score 1), possible with important difficulty (score 2), and impossible (score 3). It is targeted towards the functional capacity of hands in OA affected patients and was found to be reliable, valid and reproducible for hand OA patients.[18]

VAS was employed for assessing pain intensity. VAS is a measurement instrument often used in epidemiologic and clinical research to measure the intensity or frequency of a characteristic believed to range across of values and cannot be directly measured.[19] A 100-mm horizontal scale was constructed for this measure and the score is calculated by measuring the distance (mm) on the 100-mm yielding a range of scores from 0–100. Subjects were asked to rate their perceived pain intensity on a scale that represents the severity of pain as: no pain (0–4 mm), mild pain (5-44 mm), moderate pain (45–74 mm), and severe

pain (75–100 mm). The distance from 0 to the point that was marked by the patient indicated the level of pain that the patient felt.[19]

Interventions

Patients in trial group underwent exercise therapy over 28 consecutive days, as two sessions per day (in the morning and evening) and each exercise was repeated for ten times.

The exercises given to the subjects were as in Table 1.

Statistical analysis

An IBM SPSS 23.0 Statistics software was used to analyze the obtained data. In descriptive statistics, mean and standard deviation were used for quantitative data and percentage and frequency were used for qualitative data. In assessment of the data, chi-square (χ^2) test was used to compare the categorical data. Shapiro-Wilk test was used to assess the data distribution. Student's t test was used to analyze normally distributed data and Wilcoxon signed-rank test was used for intragroup comparisons. Mann-Whitney U test was used for intergroup comparisons to analyze non-normally distributed data. p values less than 0.05 were evaluated as significant.

Results

Forty patients with hand OA were included in the present study. Two participants in each group lost to follow-up; thus, a total of 18 patients in each group were studied. Demographic characteristics of patients were not significantly different between the two groups at the baseline in mean age, gender distribution, and disease duration (Table 2). The mean ages were 54.5 and 56.5 in test and control groups, respectively ($P=0.06$). The age distribution was normal in both groups. Totally, 29 participants were female and 7 were male. In intervention group there were 14 (78%) females and 4 (22%) males and there were 15 (83%) females and 3 (17%) males in the control group.

As the results show in Table 3, the ability of the patients who received the exercise program improved in all movements in the questionnaire, and these changes were also statistically significant for all movements in the trial group ($P<0.05$). While the control group showed no significant change during the four weeks compared to the baseline.

Table 4 shows that the mean total score of FIHOA in the intervention group was respectively 19.2 ± 7.02 and 16.5 ± 9.2 before and after four weeks of hand exercise and in the control group was 23.4 ± 3.7 and 26.7 ± 2.3 before and after the intervention, respectively. FIHOA before the intervention was not significantly different between the two groups ($P=0.477$) but the mean FIHOA score four weeks later in the intervention group was decreased and difference in the mean scores following intervention was statistically significant ($P=0.036$) between the two groups.

The mean VAS score on the first day in the intervention group was 72.2 ± 17.1 and after the intervention was 41.3 ± 12.03. In the control group the rate was 77.7 ± 17.32 and 79.5 ± 17.32 at baseline and four weeks later, respectively. The mean VAS score decreased during 4 weeks in the intervention group ($P=0.01$) but increased in the control group ($P=0.123$). When compared between the intervention and control groups, the VAS score changes were significant ($P=0.012$) after intervention between the two groups. Whereas comparison of VAS scores between the two groups at baseline showed no statistically significant difference ($P=0.968$). Totally, the ability to perform daily tasks in the intervention group significantly improved over 4 weeks compared to the control, and the pain was significantly reduced (Table 5).

Table 1. The set of exercises given to the patients with hand osteoarthritis

Exercises		Definition
1		The hands are held in a fist position and then fingers are spread apart as wide as possible
2		Subjects bend and straighten each individual finger at the middle joint and then returns to neutral position
3		Hand is placed on flat table top and each finger is bent at the first joint returning to neutral after each
4		Subjects bend the fingers with 180 degree and spread the fingers apart
5		A thumbs up sign
6		Hand Exerciser ball between side of thumb and side of the index finger
7		The hand and wrist are held in a neutral position; subject bending fingers upward
8		Positive prayer sign; Subjects press the palms of the hands together as if in prayer

Discussion

As the elderly population increases, the prevalence of OA grows and continues to pose challenges for health care systems.[20] It can affect both female and male but is more

Table 2. Demographic data from patients with hand osteoarthritis

Variable	Intervention	Control	*P* value
No. of subjects	18	18	NS*
Age (y)	54.5	56.5	NS
Gender			
Male	4 (22%)	3 (17%)	-
Female	14 (78%)	15 (83%)	-

*NS, not significant.

Table 3. Scoring of FIHOA questionnaire questions by studied group

Question	Referral time	Control (n=18)	Mean Score	*P* value	Intervention (n=18)	Mean Score	*P* value
		Total Scores			Total scores		
Ability to rotate the key	Before	36	2.2	0.016	41	2.2	0.353
	After	49	2.7		36	1.83	
Working with a knife	Before	34	1.88	0.017	31	1.7	0.461
	After	47	2.6		27	1.3	
Working with scissors	Before	42	2.3	0.038	40	2.2	0.339
	After	49	2.7		35	1.6	
Lift the bottle	Before	42	2.3	0.041	37	2	0.326
	After	48	2.6		32	1.7	
Ability to punch	Before	39	2.1	0.02	30	1.6	0.468
	After	49	2.7		26	1.3	
Ability to tie	Before	42	2.3	0.031	32	1.7	0.416
	After	50	2.7		28	1.1	
Ability to rotate the wrist	Before	37	2	0.0391	22	1.2	0.316
	After	44	2.4		17	1	
Close the button	Before	30	2.38	0.032	51	2.8	0.85
	After	38	2		48	2.8	
Continuous writing	Before	36	2.2	0.036	36	2	0.859
	After	44	2.4		34	1.3	
Ability to handclasp	Before	42	2.3	0.011	33	1.8	0.334
	After	54	2.99		28	1.5	

FIHOA, Functional Index for Hand Osteoarthritis.

Table 4. FIHOA total score changes between intervention and control groups

	Intervention (n=18)	Control (n=18)	*P* value
Total FIHOA score before intervention	19.2±7.02	23.4±3.7	0.477
Total FIHOA score after intervention	16.5±9.2	26.7±2.3	0.036
P value of FIHOA score changes	0.008	0.344	

FIHOA, Functional Index for Hand Osteoarthritis.

Table 5. Comparison of VAS score changes between intervention and control groups

	Intervention (n=18)	Control (n=18)	*P* value
VAS score before intervention	72.2±17.1	77.7±17.32	0.968
VAS score after intervention	41.3±12.03	79.5±17.32	0.012
P value of VAS score changes	0.01	0.123	

VAS, Visual Analogue Scale.

common in women.[21] This implies that there is an age and gender bias associated with OA.[22] In general, the disease burden of hand OA in public is not only associated with symptomatic hand OA but also with asymptomatic hand OA that is diagnosed with radiographic findings only.[23] Clinical signs show that hand OA typically involves one or more joints of the thumb and fingers and is characterized with pain, reduced grip strength, stiffness and functional difficulties leading to impaired hand function and difficulty in performing daily activities.[24] Hand OA has a variable disease course and in recent years attention has been given to develop non-pharmacological treatments for it.[12] There is an ongoing search to find non-pharmacological therapies which improve pain or the underlying OA processes. Therefore, the effect of daily exercise therapy on pain, range of motion and hand strength was evaluated. The results of this investigation showed that range of motion and strength gain increased in the intervention group following a consecutive 28-day practice. Also, there was a statistically significant decrease in pain intensity in this group.

To date, only few studies have examined the efficacy of physical activity in patients with 'hand' OA, however, many studies point to the beneficial effects of regular exercise in OA.[25,26] Our results on the improving the range of motion and strength after a course of therapeutic exercise are consistent with previous findings. The results of the study conducted by Stamm et al. indicated a modest improvement in hand strength of the participants during moderate routine activity, without performing specific strengthening exercises. They also demonstrated significantly more improvement on a VAS evaluation of "hand function" compared to controls.[14] In another study conducted by Hennig et al participants received eight exercise programs over 3 months. Activity performance after 3 months was measured by the PSFS and hand function was evaluated according to OMERACT-OARST criteria. The exercise program administered in that study was well tolerated among women with Hand OA and the subjects reported significant improvement in hand performance, strength, and pain.[27] Also, in a

systematic review, the positive effect of hand exercise therapy on range of motion and strength has been discussed.[28] According to the findings obtained from this study and the mentioned examinations, it seems that a period of hand exercises (one month or longer) using similar active range of motion exercises including similar strengthening exercises in repetitions, under the guidance of the therapist, can result in improved static and dynamic strength and range of motion in patients with hand OA.

When critically evaluating the literature, there is controversy regarding the effect of exercise on people with hand OA. In study conducted by Rogers et al., no significant changes were reported between the exercise and placebo scores on self-reported hand function. That study demonstrated that the exercise treatment confers only a minimum improvement in overall hand and finger grip in AUSCAN hand function scale.[29] However, we found that the subjects were significantly improved on a FIHOA and VAS of "global hand function" in comparison to control. These conflicts may be related to the approaches for measuring hand physical functioning. Additionally, in Sterås et al study, the ineffectiveness of hand exercises on pain in hand OA has been pointed out as in the present study. Contrary, Barthel et al. showed that hand exercises could significantly reduce pain.[30] Due to limited studies and inconsistency in available information, it seems that more research is needed.

The European League Against Rheumatism (EULAR) and the American College of Rheumatology (ACR) propose employing a combination of surgical interventions and conservative management (including both pharmacological and non-pharmacological treatment) as an optimal treatment strategy for hand OA.[10] Although there is not enough evidence available to ensure the benefits of exercise and physical activity, heat therapy, splint treatment, electrotherapy, and acupuncture, these approaches have been suggested for pain alleviation and improving function in hand OA.[31] Findings of this investigation showed that a 4-week program of daily exercises may be effective for hand function improvement and reducing the pain. However, longer period studies must be conducted to validate the exercise treatment outcomes and future studies should address the clinical impact of exercises for the management of the symptoms in persons with hand OA based on performance-based measures rather than self-reported tests.

Conclusion

Daily Activities could be substantially restricted due to common effects of hand OA such as pain and disability. The result of the present study showed that hand exercises can be beneficial in the non-pharmacological management of the hand OA.

Authors' Contribution

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Writing–original draft: Mahnaz Ghaebi.
Writing–review & editing: Mahnaz Ghaebi.

Competing Interests

The authors have no conflicts of interest to declare.

Consent to Participate

Informed consent was signed prior to participation in the study.

Data Availability Statement

Data is available with the requests from Author 1.

Ethical Approval

All procedures were approved by the ethics committee and have been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. A signed informed consent form was obtained from each enrolled subject.

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