

## ORIGINAL ARTICLE

**EFFECTS OF HYDROTHERAPY ON PAIN, GRIP STRENGTH AND FUNCTIONAL OUTCOMES IN OSTEOARTHRITIS OF HAND**

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Rameeza Hassan<sup>v</sup>, Muhammad Salman Bashi<sup>vi</sup>*

**Correspondence**Salwa Atta Mohyudin<sup>ii</sup>**ABSTRACT**

**Background and aim:** This study was conducted to find the effects of hydrotherapy and land-based exercises on pain, grip strength and functional status in hand osteoarthritis patients.

**Methodology:** Eighty participants were randomized into two study groups i.e. hydrotherapy based exercise group or land based exercise group. Both groups were treated for 3 sessions per week for eight weeks and assessed after two months follow up. Numeric Pain Rating Scale (NPRS), Hand held dynamometer and Functional Index for Hand Osteoarthritis (FIHOA) were used to measure pain, grip strength and functional status of hand before and after treatment sessions for eight weeks and again assessed at two months of follow up.

**Results:** Multivariate analysis of variance indicates a statistically significant group-by-time interaction ( $p=.00$ ). Pain intensity was significantly reduced in both groups whereas Grip strength and functional outcomes were significantly improved in patients of group B (hydrotherapy based exercises) as compared to group A (land based exercises) ( $P=.02$  and  $.00$ ).

**Conclusion:** Hydrotherapy based exercises prove to be more efficient in terms of improving functional outcomes of patients of hand osteoarthritis.

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**Keywords:** *Functional outcomes, grip strength, hand, hydrotherapy, land based exercises, osteoarthritis.*

## Introduction

Hand osteoarthritis, is the most frequently occurring joint disease<sup>1</sup>, commonly affecting first carpometacarpal joint, interphalangeal joints, proximal & distal interphalangeal joints (DIP and PIP)<sup>2,3,4</sup>. Impairments of hand osteoarthritis are pain, decreased hand strength and flexibility, and inhibition of activity and limitation of participation in functional tasks<sup>5,6,7</sup>. Deformities, lack of activity, and great loss of function may compromise the role of hand as well as self-identity<sup>8</sup>. Both pharmacological and non-pharmacological interventions are required to achieve ideal management of osteoarthritis of hand<sup>9,10,11</sup> as reported by The European League against Rheumatism (EULAR), as these interventions should be personalized with the patient's needs and anticipations and also considering their pain level, disabilities and restricted life quality<sup>12</sup>. Exercises which are mainly performed under water are known as hydrotherapy<sup>13</sup>. Furthermost the temperature required to heat the water is thirty-two to thirty-six degrees Celsius. Meanwhile the chief objective of physical therapy for patients with osteoarthritis is to reduce aches and enhancing the activity level<sup>14,15,16</sup>, but the only experiments included in this Cochrane review are involving the patients suffering from osteoarthritis of knee joint or hip joint, or suffering from both. It is believed that exercises performed under hot water likely decrease muscle aches, reducing the joint stiffness and induce feelings of relaxation in patients of arthritis<sup>17, 18</sup>. As initial therapy it is more beneficial in patients with arthritis as compare to the same level of training without water<sup>19</sup>. Currently, hydrotherapy is becoming one of the acceptable methods with excessive admiration in rehabilitation<sup>20</sup>. The advantages, which are linked with hydrotherapy, are because of some characteristics of water including water resilience property buoyancy reduces gravity forces and also providing resistance to improve muscle strength<sup>15, 21,22</sup>. A Randomized Clinical trial which was conducted by Luciana E Silva et al. to find out the effects of hydrotherapy based exercises compared with land based exercises on knee osteoarthritis. The results showed in pain reduction and enhancement of function of knee in both groups. But the greater effects have been observed in the group performed hydrotherapy based exercises<sup>23</sup>. Although, few researches are conducted on hydrotherapy involving different regions of body most commonly on knee joint but a little research on hand osteoarthritis had done considering hydrotherapy as a treatment. The objective of this study was to determine the effects of hydrotherapy based exercises compared with land based exercises in osteoarthritis of hand.

## Methodology

This was a double blinded Randomized Clinical Trial conducted in Aziz Bhatti Shaheed Hospital, Gujrat, Pakistan in a duration of six months. 86 patients were assessed for inclusion criteria. 80 patients were recruited. The inclusion criteria was based according to American College of Rheumatology (ACR) which was pain of hand, stiffness or aching including 3 or 4 of the features mentioned here: tissue enlargement of two or more of ten selected joints, tissue hypertrophy of 2 or more Distal Interphalangeal joints, fewer than 3 swollen Metacarpo-phalangeal joints and deformity of at least 1 out of 10 selected joints. Participants were excluded if they exhibited other diseases including rheumatoid arthritis, co morbidities i.e., hypertension, diabetes etc., traumatic injuries of hand, surgery of hand past 6 weeks, steroid injections past 2 weeks, cognitive or mental dysfunction or if they had any skin disease. The participants were allocated randomly into either a water-based or land based exercise group by using lottery method. The participants were assigned the group according to even or odd number drawn by the patient from the box. The participants with even number were allocated to land-based exercise group and the participants with odd number were allocated to water-based exercise group. Participants were blind to the groups they were allocated and assessor was also blind to the assigned intervention. Sample size of 68 was calculated by using G-power Analysis Software, Version (3.1.9.2) with 0.80 power of study, with 0.5 margin of error and 95% confidence interval. To manage anticipated dropouts total recruited participants were 80 before the completion of the study and in each group, forty patients were allocated.

## Outcome Measures

### Primary Outcome Measures

Numeric pain rating scale (NPRS) and hand-held dynamometers were used as primary outcome measures for pain and grip strength of hand respectively. Numeric Pain Rating Scale (NPRS) was

used for pain measurement, which is a single dimensional 11point scale (0-10) which measures pain intensity, with test–retest reliability of  $r = 0.96$  and validity correlations of 0.86 to 0.95. Grip strength of affected hand was measured with the help of hand-held dynamometer, patient was in sitting position and forearm was in extended position while taking the measurements.

### Secondary Outcome Measure

Functional Index for Hand Osteoarthritis (FIHOA) was used as secondary outcome tool for functional status of hand<sup>24</sup>. It was used to evaluate the functional impairments of hand with osteoarthritis, scoring from 0 (no functional impairment) to 30 points (maximal impairment). Mean Standardized Response (MSR) value for FIHOA was 0.58.

The measurements were taken before the application of treatment which was baseline measurements by the assessor who was blind to the group of the patient being allotted. After eight weeks, same assessor took second measurements known as post treatment measurements and follow up measurements were taken after two months. Patients were also blinded to the treatment being given to them.

### Intervention

**Land Based Exercises:** Participants of land based exercise group (Group A) performed exercises, which included in the protocol, were Tabletop, Small fist, Large fist, Okay sign, Finger spread, Thumb reach, Key pinch, Gripping and Fingertip pinch without water as patient was in seated position. Patients were asked to perform the aforementioned exercises under the supervision of therapist and last three above mentioned exercises were performed with the help of ball. The patients were instructed to take 3 sessions per week, with 10 repetitions of each exercise for 1-2 weeks, 12 repetitions in 3-4 weeks and 15 repetitions in 5-8 weeks.

**Hydrotherapy Based Exercises:** Participants included in Hydrotherapy based exercises (Group B) performed all exercises under the supervision of physiotherapist while patient was in seated position. Total nine exercises were performed including Tabletop, Small fist, Large fist, Okay sign, Finger spread, Thumb reach, Key pinch, Gripping and Fingertip pinch. Patient was asked to place his hand in a container filled with water at room temperature and performed all the exercises under water. Similarly last three respective exercises were performed while holding the ball in hand. The patients were instructed to take 3 sessions per week, with 10 repetitions of each exercise for 1-2 weeks, 12 repetitions in 3-4 weeks and 15 repetitions in 5-8 weeks. Baseline treatment was given to both groups.

### Ethical concerns

This trial was registered in WHO Registry of IRCT having reference number IRCT20200511047403N1. The trial was also approved from the Institutional Ethical Review Board.

### Statistical Analysis

The statistical Package for Social Sciences – version 25 was used for statistical analysis. Statistical significance was set at  $P=0.05$  and it was performed on the basis of intention to treat analysis. For Descriptive Statistics Frequency tables and bar charts were used. Parametric test was used to compare two population at different various intervals. Independent sample t-test was applied to measure difference between two groups. Mixed Modal ANOVA was applied to measure the differences collectively between the groups. Repeated measure ANOVA was applied to measure difference within each group.

### Results

40 patients of group A: Land based exercises group ( $n=40$ ) (age,  $49.65\pm 6.09$  years; BMI,  $27.82\pm 3.31$ ; males: 15, females: 25) group B: Hydrotherapy group ( $n=40$ ) (age,  $50.12\pm 4.90$  years; BMI,  $27.86\pm 3.16$ ; males: 16, females: 24). No significant differences were found among both groups for demographics i.e. age, gender, BMI, duration of symptoms and measured variables (NPRS, Grip strength, FIHOA) at pre-treatment level (Table 1).

	GROUP A	GROUP B	P-VALUE
Age of patients (y)	49.65 ± 6.09	50.12 ± 4.90	0.898
Gender of patients±	Males – 15	Males – 16	0.59
	Females - 25	Females – 24	
BMI (kg/m <sup>2</sup> )	27.82 ± 3.31	27.86 ± 3.16	0.994
Duration of symptoms	More than 1 year – 15	More than 1 year – 8	0.76
	More than 2 years – 14	More than 2 years – 18	
	More than 3 years – 11	More than 3 years – 14	
Numerical Pain Rating Scale	6.18 ± 0.38	6.08 ± 0.26	0.18
Grip Strength	23.95 ± 0.87	24.05 ± 0.8	0.63
FIHOA	24.00 ± 0.84	24.25 ± 0.80	0.18

Table 1. Demographic and baseline characteristics of the 2 studied groups

Multivariate tests for outcome measures indicate a statistically significant group-by-time interaction ( $F=4.46$ ,  $p=.00$ ). The univariate group-by-interaction was statistically significant group-by-time interaction. ( $F=2.23$ ,  $P=.11$ ). The results of post hoc test revealed that at Post treatment level and at follow up level the mean values of the NPRS reduced significantly in patients of both groups ( $P=.001$ ). Mean values of grip strength were significantly reduced at follow up level in Group B who received hydrotherapy ( $P=.001$ ) compared to group A (.022) whereas FIHOA was significantly increased in group B (0.00) compared to Group A ( $P=0.02$ ) (Table 2). A paired t test revealed that there was a significant increase in mean values of MDF in all groups ( $p<.01$ ).

Variable & group	Pre-test	Post-test	Follow-up	Within Group Change			Group ×T Interaction	
				t	P	MD(95%CI)	F	P
Pain								
Group A	6.18 ± 0.38	3.61± 0.50	1.61 ± 0.49	13.999	.00 <sup>a</sup>	3(2.56-3.44)	6.33	0.002 <sup>a</sup>
Group B	6.08 ± 0.27	3.34± 0.48	1.42 ±0.50	14.95	.00 <sup>a</sup>	2.65(2.28-3.01)		
Grip Strength								
Group A	23.95± 0.88	27.39± 1.02	31.58 ± 1.16	10.25	.00 <sup>a</sup>	7.97(6.38-9.56)	2.23	0.02 <sup>a</sup>
Group B	24.05± 0.85	27.45 ± 1.11	36.42 ± 1.27	5.74	.00 <sup>a</sup>	5.57(3.59-7.55)		
FIHOA								
Group A	24.00 ±0.85	21.50 ± 0.98	17.33 ±1.17	8.04	.00 <sup>a</sup>	14.55(18.24-10.85)	5.28	0.006 <sup>a</sup>
Group B	24.25 ± 0.81	13.03 ± 1.37	6.91± 1.34	12.42	.00 <sup>a</sup>	18.7(21.79-15.63)		

Table 2. Post intervention, within-group and group by time interaction for pain, grip strength and FIHOA

## Discussion

The study was conducted to find out the effects of hydrotherapy-based exercises and land-based exercises on pain, grip strength and FIHOA in patients of osteoarthritis of hand. The results of this study showed significantly reduction in pain intensity in both groups, grip strength was improved in hydrotherapy-based group at two months follow up while more significant improvement had been seen in FIHOA at post treatment and after two months follow up assessment in hydrotherapy-based exercise group.

A latest study conducted in Iran on hand osteoarthritis to find out the effects of kinesio taping with exercise on pain, ROM, strength of hand and functional capabilities of hand in comparison with only exercise. The result of this study revealed that the group with kinesio taping and exercise showed significant improvement as reduction in pain intensity, increased ROM and hand strength,

and enhancement of functional status of hand compared with only exercise group in patients suffering with hand osteoarthritis<sup>25</sup>. The results of under discussion study showed significantly reduction in pain intensity, increased grip strength in both hydrotherapy and land-based exercise group while more significant improvement had been seen in FIHOA at post treatment and after two months follow up assessment in hydrotherapy-based exercise group.

In other study, conducted on the different kinds of osteoarthritis patients predominantly with affected knee, hip, hand and foot involvement. The applied intervention was balneotherapy including the combination of peloid (mud) therapy and hydrotherapy (aquatic exercises or mineral water dipping). It was an out-patient and single centered study and results showed the significant decrease in pain and improvement in other outcome measures in all types of osteoarthritis except hip osteoarthritis<sup>26</sup>. In contrast, the present study the targeted population was adult to older patients between the ages of forty to sixty years were involved. Further studies with extended follow up are recommended to evaluate the long-term effects of hydrotherapy.

### Conclusion

Hydrotherapy based exercises prove to be more efficient in terms of improving functional outcomes of patients of hand osteoarthritis.

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