RESEARCH ARTICLE

Effect of Kinesio Taping on Pain, Range of Motion, Hand Strength, and Functional Abilities in Patients with Hand Osteoarthritis: A Pilot Randomized Clinical Trial

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Abstract

Background: Osteoarthritis is one of the most prevalent joint diseases in older adults. Since hands play a key role in daily activities, their impairment causes disability and reduction of independency. The present study aimed to investigate the effect of using Kinesio tape on pain, range of motion (ROM), hand strength, and functional abilities in patient with hand osteoarthritis (HOA).

Methods: In this randomized clinical trial study, 38 patients with the diagnosis of HOA were selected and randomly assigned to Kinesio tape plus exercise (KT-EXE) and exercise (EXE) groups. Each group included 19 subjects who participated in an 8-week intervention. Visual analog scale, Disabilities of the Arm, Shoulder, and Hand questionnaire, as well as goniometer and dynamometer measurements, were used to assess pain severity, upper extremity functional disabilities, ROM, and grip strength, respectively, before and after the intervention and at 2 months of follow-up.

Results: There was no significant difference in pre-intervention scores between the two groups. Statistical analysis revealed significant improvement in pain, ROM, hand strength, and upper-extremity functional abilities after the intervention in KT-EXE and EXE groups. In addition, the follow-up analysis showed significant changes, compared to the initial assessments except for the pain in the EXE group. Results of the independent t-test revealed that change was significantly greater in KT-EXE group than that in the EXE group at post-intervention and 2-month follow-up assessments except for the wrist flexion and upper-extremity functional abilities at final evaluation.

Conclusion: Obtained results of this study showed that Kinesio taping and hand exercise may have a positive effect on the improvement of pain, ROM, hand strength, and upper-extremity functional abilities in patients with HOA. In addition, these two methods can be simultaneously used for the rehabilitation of this condition.

Level of evidence: III

Keywords: Exercise, Grip, Kinesio tape, Osteoarthritis, Pain, Range of motion

Introduction

Hand osteoarthritis (HOA) is a common chronic condition that results in soft tissue swelling, inflammation, bony enlargements, and bone erosions in the wrist, distal and proximal interphalangeal joints, as well as first carpometacarpal (CMC) and interphalangeal joints (1-3). Individuals with HOA experience pain, loss of the range of motion (ROM), joint stiffness, reduced muscle strength, including grip and pinch strength, as well as increased fatigue; therefore, the accomplishment of daily tasks, such as grooming,

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eating, cleaning, cooking, driving, dressing, and bathing that requires the use of hands, can be challenging (4-6).

It is shown that HOA causes activity limitations and participation restrictions that may lead to reduced work ability and increased dependency (7-9). Change of physical appearance, loss of activities, and feeling lack of mastery may again result in changes in roles and self-identity (9, 10). Up to now, there has been no treatment for HOA. Optimal management of HOA requires a combination of nonpharmacological and pharmacological treatments (11). Common goals for the treatment of HOA are pain relief, improvement of hand strength and ROM, as well as reduction of stiffness, with an overall goal of enhancing physical hand function (12).

In the rehabilitation of HOA, the interventions, such as exercise, splints, heat therapy, electrotherapy, acupuncture, and joint protection, are recommended for pain relief and improvement of hand function (6, 13, 14). However, the implementation of these interventions is tedious, resource-intensive, and costly, often requiring the transportation of patients to specialized facilities.

Considering the importance of hand function, most of these interventions can be enhanced by performing adjunct techniques, such as Kinesio taping (KT), for the maximization of the recovery. According to the literature, it was shown that Kinesio tape has benefits in the clinical setting for pain reduction, joint approximation, as well as improvement of the joint alignment, ROM, strength, and activity (15-18).

Despite the increasing number of studies regarding the investigation of Kinesio tape as adjunct technique, there are controversies about benefits as a therapeutic modality, especially in individuals with HOA. To the best of our knowledge, there are two studies that investigated the effectiveness of KT in patients with HOA. The first study compared the effects of applying KT with splinting, and the results showed that both interventions improved pain and function significantly. However, there was only a significant improvement in stiffness regarding the application of KT (19).

According to another case report study, it was revealed that mobilization with the movement technique in combination with KT led to the improvement of pain, ROM, grip force, and daily activities in patients with HOA (20). Considering the studies related to KT in HOA, the available evidence supporting the use of KT is not sufficient. Therefore, the purpose of this study was to assess the additional effects of KT during exercise therapy on pain, ROM, hand strength, and functional abilities in patients with HOA.

Materials and Methods

Participants

A total of 38 subjects (19 males and 19 females) participated in this study using a simple sampling method from June 2016 to September 2106. All of the participants were recruited through outpatient therapeutic centers in Tehran, Iran, that provide rehabilitation treatments and assessed by an orthopedist for enrolling in this study. Inclusion criteria were 1) being older than or equal to 60 years, 2) having been previously diagnosed with HOA, 3) being stable (i.e., no change in the symptoms of the disease) at least 4 weeks before and during the period of the study based on diagnosis of specialist, 4) considering the absence of obvious cognitive deficits, 5) currently not receiving another specific rehabilitation intervention, 6) not suffering from neurological pathologies or severe visual or sensory deficits [Figure 1; 2].

Research Design and Procedure

The present study was a randomized controlled trial (IRCT code: IRCT201701038371N1) with a subset of individuals with HOA approved by Baqiyatallah University of Medical Science, Tehran, Iran (ethics code: IR.BMSU.REC.1396.43). The participants were informed about the objectives, benefits, and possible inconveniences associated with the research protocol and ensured that their participation in the research is voluntary, and they could withdraw from the study whenever they wish.

After obtaining written consent forms from the participants, assessments and interventions were performed by the occupational therapists. All the assessments (i.e., pre-intervention, post-intervention, and follow-up) were individually administered by an

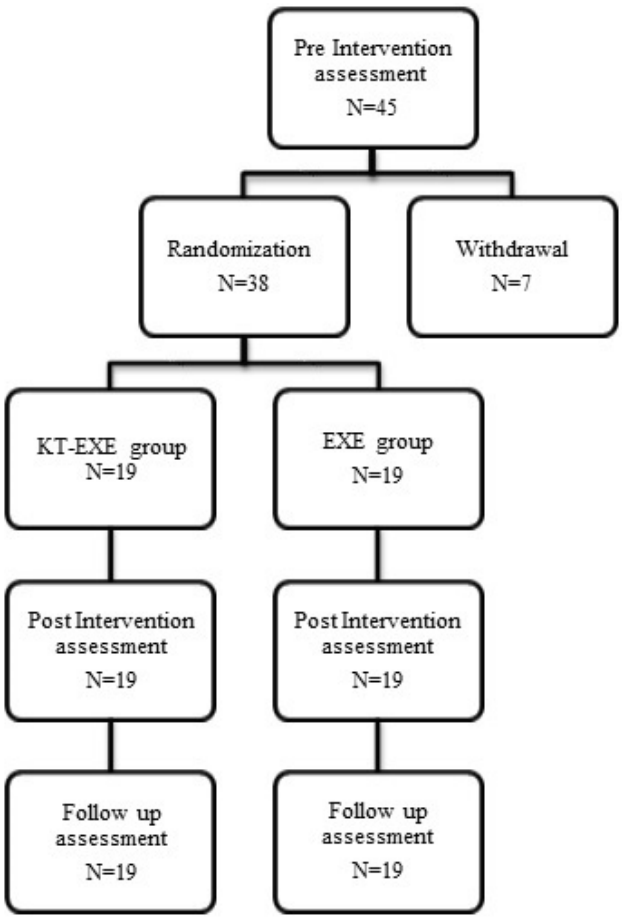

Figure 1. The CONSORT Flow Diagram of the sampling stages.

occupational therapist that was blinded to the subject groups. The assessments were administered in a single session that lasted about 1 h.

After the first evaluation, the patients were randomly assigned to Kinesio tape plus exercise (KT-EXE) and exercise (EXE) groups using a random number table. Three times assessments were considered for data collection, including 1) initial assessment 1 day before the intervention, 2) post-intervention assessment 1 day after the intervention, and 3) follow-up assessment 2 months after the intervention.

Randomization

The eligible participants were matched by gender and then randomly assigned to either the KT-EXE group or EXE group. This procedure was conducted to ensure an approximately equal number of men and women in each of the groups. The randomization procedure was performed using a random number table. The person who conducted the randomization was not involved in enrollment or any of the screening and outcome assessments.

Blinding

This was a single-blind pilot randomized controlled trial. The research personnel who performed the outcome assessments were blinded to the group assignment; however, the participants were not blinded to the group assignment. To minimize systematic bias due to the nonbinding of the patients, the subjects were instructed not to tell the assessors about the group assignment or treatment they received.

Intervention

Hand exercises performed in the EXE group include using a hot pack or paraffin wax for 15 min, stretching exercises, grip strength training exercise, and recommendation for use of the hands in real-life tasks. The aforementioned tasks consist of opening drawers, washing and putting away dishes, carrying bags, cleaning windows, counting change, and writing or typing.

All the above-mentioned interventions were performed in the KT-EXE group plus the application of Kinesio tape. The subjects were taped in accordance with Kenzo Kase's Kinesio taping Manual (21). Taping was applied for the subjects in a sitting position; while the shoulder was abducted, the forearm was in the neutral position, the elbow was flexed to 90°, and the wrist was also in the neutral position. An I-strip was placed over the extensor muscles of the forearm from proximal to distal to cover all of the CMC joints except the trapeziometacarpal (TMC) joint.

The second I-strip was placed over the TMC joint up to the first thumb phalanx as a corrective strip over the snuff box and parallel to tendons [Figure 2]. For each patient, the grip strength of the hand was assessed three times; then, their average score was considered to be the grip strength. The tape was removed and changed after 3 days or when it was necessary. There was 1-day rest after each KT session to allow the skin of the participants to rest.

Outcome measurements

There were six tools for data collection as follows:

Demographic questionnaire: It contained general and medical information, such as gender, age, and duration of illness.

Visual analog scale (VAS): The VAS consisted of a 100-millimeter line with the ends of the line designated with descriptions, such as "no pain at all" and "worst pain possible". The patient marked the point that represented the intensity of the pain he/she felt on the line (22). The VAS has demonstrated acceptable test-retest and inter-

Figure 2. Kinesio taping method used in this study.

rater reliability (23).

Goniometer: A goniometer made of stainless steel was used to assess the active ROMs of the wrist (24, 25). The ruler measurement was used for the thumb opposition. Pad of the thumb was rotated to meet the pad of each finger. The little finger was rotated to better meet the pad of the thumb. In summary, the measurement of opposition recorded the distance from the tip of the thumb pad to tip of another fingers.

Dynamometer: Grip strength measurements were obtained with a grip dynamometer while the patient was also in the sitting position (26). Reliability of the measurements was expressed by intraclass correlation coefficients (ICC) that was reported between 0.82 and 0.97 for grip strength measurements (27). Pinch and grip strength measurements were expressed in kilogram. The instrument was calibrated before and after the treatment of each subject.

Pinch gauge: Pinch strength was evaluated using the finger dynamometer (i.e., pinch gauge) that was correctly and periodically calibrated during the study. For calibration, the pinch gauge must be "zeroed" before each pinch test. The pad to pad pinch strength and the pad to side pinch strength, which were exerted by the thumb and index finger, were measured in this study. The participants were trained to pinch the dynamometers as hard as possible. They were seated with their shoulders adducted and rotated in a neural manner; the elbow was also flexed at 90°. Three repetitions for approximately 3 or 4 sec were completed and registered. The final score was calculated by measuring the average of three values. The instrument showed very high inter-rater and test-retest reliability (28).

Disabilities of the Arm, Shoulder, and Hand (DASH): The DASH questionnaire is a single reliable and valid instrument that can be used in a wide variety of upper-extremity disorders. It is a 30-item questionnaire that measures the patient functional status during the preceding week (29, 30).

Statistical analysis

The Kolmogorov–Smirnov test was used to assess the distribution of variable scores. The interval measurements were normally distributed; therefore, parametric statistical methods were used to analyze the variables. The independent t-test was used for group comparisons before the intervention, after the intervention, and at 2-month follow-up. Repeated measure analysis of variance was used to study the relationship between the variables, and significant differences were evaluated using the Bonferroni post hoc test. All the tests were performed at a confidence interval of 95% ($P<0.05$).

Results

Table 1 tabulates a summary of the demographic and clinical characteristics of the study population. As it is shown, the EXE and KT-EXE groups were quite similar in terms of age, gender, education, and duration of illness. They were also similarly scored on all baseline measurements. Results of the independent samples t-test comparing these differences were all significant. There were significant differences among the results of pre-intervention, post-intervention, and follow-up assessments in both groups except for the pain severity in the EXE group. As it is shown in Table 2, In the EXE group, pain reduced from the pre- to post-intervention assessments; however, this pattern of improvement was not shown over time at follow-up assessments. Based on the obtained results, the participants showed higher level of improvement in the post-intervention assessments, compared to that in the follow-up

Table 1. Demographic characteristics and baseline assessment scores of two groups (Mean±standard deviation)

Variables	EXE group (12 males, 7 females)	KT-EXE group (12 males, 7 females)	*P-value*
Age	68.52±3.90	69.47±3.99	0.464
Education (year)	9.42±2.30	9.78±2.58	0.646
HOA duration (year)	7.01±1.69	7.31±1.82	0.715
Pain	6.47±1.07	6.42±1.21	0.888
Pinch strength (kilogram)	4.94±0.97	5.26±1.29	0.401
Grip strength (kilogram)	18.94±2.29	18.21±2.69	0.371
ROM_Opposition (millimeter)	24.36±5.54	23.21±5.02	0.505
ROM_Wrist flex (degree)	51.47±3.22	50.63±4.04	0.483
ROM_Wrist extention (degree)	50.15±4.83	48.84±3.96	0.365
Functional disability	63.37±14.59	62.82±14.49	0.909

KT-EXE: Kinesio tape plus exercise
EXE: Exercise
HOA: Hand osteoarthritis
ROM: Range of motion

Table 2. Mean scores, standard deviations, and ANOVA results for pre-intervention, post-intervention, and follow-up assessments

Variables	Pre-intervention (Mean±standard deviation)	Post-intervention (Mean±standard deviation)	Follow-up at 8 weeks (Mean±standard deviation)	ANOVA	
				F	*P-value*
Pain					
KT-EXE group	6.42±1.21	4.36±0.83	5.42±1.07	23.025	0.000
EXE group	6.47±1.07	5.57±1.21	6.21±1.08	3.810	0.067
Pinch strength					
KT-EXE group	5.26±1.29	7.26±1.39	6.36±1.24	44.69	0.000
EXE group	4.94±0.97	5.81±0.83	5.47±0.80	7.67	0.005
Grip strength					
KT-EXE group	18.21±2.69	25.52±5.36	23.47±4.74	23.99	0.000
EXE group	18.94±2.29	22.10±2.99	20.68±2.98	11.23	0.001
OP					
KT-EXE group	23.21±5.02	16.10±3.84	18.10±3.82	35.427	0.000
EXE group	24.36±5.54	20.42±3.23	21.89±3.46	9.190	0.003
Wrist flex					
KT-EXE group	50.63±4.04	62.73±5.17	56.89±5.66	74.459	0.000
EXE group	51.47±3.22	58.26±4.35	54.10±3.05	16.582	0.000
Wrist extension					
KT-EXE group	48.84±3.96	62.26±4.42	57.21±3.39	90.658	0.000
EXE group	50.15±4.83	57.21±4.23	53.89±4.86	16.799	0.000
DASH					
KT-EXE group	62.82±14.49	50.09±9.48	52.76±8.60	32.22	0.000
EXE group	63.37±14.59	59.67±13.60	60.34±13.85	7.96	0.002

KT-EXE: Kinesio tape plus exercise
EXE: Exercise
ANOVA: Analysis of variance
DASH: Disabilities of the Arm, Shoulder, and Hand

assessments.

In KT-EXE group, post hoc comparisons using Bonferroni test showed that the pain severity reduced significantly at the post-intervention and follow-up assessments, compared to that in the pre-intervention assessments. In addition, there was no significant difference in pain severity between the post-intervention and follow-up assessments that showed stable improvement over time. There were significant differences between other outcome measurements at the post-intervention and follow-up assessments, compared to those at the pre-intervention assessments. Furthermore, the follow-up assessment demonstrated a significant change, compared to the post-intervention assessment in these outcome measurements that revealed a reduction in improvement after 2 months [Table 3].

In the EXE group, post hoc comparisons using Bonferroni test showed that pain, grip strength, and wrist extension ROM changed significantly only at the post-intervention assessments, compared to those in the pre-intervention assessments. Although these outcome measurements improved after the intervention in the EXE group, these improvements were not statistically significant at the follow-up assessments [Table 4].

There were significant differences between other outcome measurements (i.e., pinch strength, wrist flexion, thumb opposition ROM, and upper-extremity disability) at the post-intervention and follow-up assessments, compared to those at the pre-intervention assessments. Furthermore, the follow-up assessments showed a significant change, compared to the post-intervention assessments in wrist flexion ROM outcome

Table 3. Differences between pre-intervention, post-intervention, and follow-up assessments using Bonferroni post hoc test in KT-EXE group

Variable	Assessment	Mean differences	Standard error	*P-value*
Pain	Pre-intervention/Post-intervention	2.053	.329	.000
	Pre-intervention/Follow-up	1.000	.359	.036
	Post-intervention/Follow-up	3	-1.053	.195
Pinch	Pre-intervention/Post-intervention	-2.000	.259	.000
	Pre-intervention/Follow-up	-1.105	.228	.000
	Post-intervention/Follow-up	.895	.124	.000
Grip	Pre-intervention/Post-intervention	-7.316	1.377	.000
	Pre-intervention/Follow-up	-5.263	1.237	.001
	Post-intervention/Follow-up	2.053	.474	.001
Opposition	Pre-intervention/Post-intervention	7.105	1.006	.000
	Pre-intervention/Follow-up	5.105	1.048	.000
	Post-intervention/Follow-up	-2.000	.405	.000
Wrist extension (degree)	Pre-intervention/Post-intervention	-13.421	1.303	.000
	Pre-intervention/Follow-up	-8.368	.968	.000
	Post-intervention/Follow-up	5.053	.637	.000
Wrist flex (degree)	Pre-intervention/Post-intervention	-12.105	1.147	.000
	Pre-intervention/Follow-up	-6.263	1.110	.000
	Post-intervention/Follow-up	5.842	.636	.000
DASH	Pre-intervention/Post-intervention	12.735	2.002	.000
	Pre-intervention/Follow-up	10.058	1.966	.000
	Post-intervention/Follow-up	-2.677	.721	.005

KT-EXE: Kinesio tape plus exercise
DASH: Disabilities of the Arm, Shoulder, and Hand

Table 4. Differences between pre-intervention, post-intervention, and follow-up assessments using Bonferroni post hoc test in EXE group

Variable	Assessment	Mean Differences	Standard error	*P-value*
Pain	Pre-intervention/Post-intervention	.895	.332	.045
	Pre-intervention/Follow-up	.263	.285	1.000
	Post-intervention/Follow-up	-.632	.376	.332
Pinch	Pre-intervention/Post-intervention	-.868	.273	.015
	Pre-intervention/Follow-up	-.526	.145	.006
	Post-intervention/Follow-up	.342	.233	.477
Grip	Pre-intervention/Post-intervention	-3.158	.792	.003
	Pre-intervention/Follow-up	-1.737	.733	.088
	Post-intervention/Follow-up	1.421	.414	.009
Opposition	Pre-intervention/Post-intervention	3.947	1.198	.012
	Pre-intervention/Follow-up	2.474	.876	.034
	Post-intervention/Follow-up	-1.474	.628	.092

Table 4 Continued.

Wrist extension (degree)	Pre-intervention/Post-intervention	-7.053	1.156	.000
	Pre-intervention/Follow-up	-3.737	1.500	.068
	Post-intervention/Follow-up	3.316	.927	.006
Wrist flex (degree)	Pre-intervention/Post-intervention	-6.789	1.256	.000
	Pre-intervention/Follow-up	-2.632	.883	.024
	Post-intervention/Follow-up	4.158	1.373	.022
DASH	Pre-intervention/Post-intervention	3.698	1.039	.007
	Pre-intervention/Follow-up	3.032	1.070	.033
	Post-intervention/Follow-up	-.667	.838	1.000

EXE: Exercise
DASH: Disabilities of the Arm, Shoulder, and Hand

Table 5. Comparison between groups

Variable	Post-intervention assessment				2-month follow-up assessment			
	KT-EXE	EXE	Mean differences	*P-value*	KT-EXE	EXE	Mean differences	*P-value*
Pain	4.36±0.83	5.57±1.21	1.21	0.001	5.42±1.07	6.21±1.08	0.79	0.030
Pinch PP	7.26±1.39	5.81±0.83	1.45	0.001	6.36±1.24	5.47±0.80	0.89	0.013
Grip	25.52±5.36	22.10±2.99	3.42	0.022	23.47±4.74	20.68±2.98	2.79	0.037
OP	16.10±3.84	20.42±3.23	4.32	0.001	18.10±3.82	21.89±3.46	3.79	0.003
Wrist extension	62.26±4.42	57.21±4.23	5.05	0.001	57.21±3.39	53.89±4.86	3.31	0.021
Wrist flex	62.73±5.17	58.26±4.35	4.47	0.007	56.89±5.66	54.10±3.05	2.78	0.067
DASH	50.09±9.48	59.67±13.60	9.58	0.016	52.76±8.60	60.34±13.85	7.57	0.052

KT-EXE: Kinesio tape plus exercise
EXE: Exercise
DASH: Disabilities of the Arm, Shoulder, and Hand

measurements that revealed a reduction in improvement after the intervention [Table 4].

As it is shown in Table 5, at the post-intervention assessments, the KT-EXE group reported a significantly lower level of hand pain and higher improvement level of hand functions in daily activities, compared to the EXE group. Thumb and wrist ROM, as well as grip and pinch strength, were also significantly better in the KT-EXE group, compared to those in the EXE group at the post-intervention assessments. At the 2-month follow-up assessments, there were statistically significant differences between the two groups in pain, pinch and grip strength, as well as thumb and wrist extension ROM. However, no statistically significant difference was observed between the two groups in DASH score and wrist flexion ROM [Table 5].

Discussion

Purpose of this study was to determine the effect of KT on pain, ROM, hand strength, and functional abilities in patients with HOA. Obtained results of the present study indicated that the combination of KT and hand exercise may be more effective in improvement of hand symptoms and functions. In addition, the findings of this study showed a significant decrease in pain severity after the intervention in the KT-EXE and EXE groups. Although there was a change in pain in both groups 2 months after the intervention at the follow-up assessments, only significant improvement was observed in the KT-EXE group.

In addition, the results of this study revealed that the subjects in the KT-EXE group had a lower level of pain, compared to those in the EXE group at the post-intervention and follow-up assessments. This finding complements the results of the previous studies indicative of the effectiveness of therapeutics exercise and Kinesio tape in patients with HOA. In a study carried out by Rogers and Wilder, it was shown that strength

training and grip exercise reduce pain severity in older people with HOA (31).

According to the results of a systematic review performed by Osteras et al., it was revealed that performing hand exercise is beneficial in the reduction of hand pain during the post-intervention period; however, the effect is not sustained at later follow-up (32). In addition to the effect of exercise on pain, it could be postulated that the stimulation of different receptors in the skin by KT led to different responses in the nervous system with an effect on pain reduction (33-35). This finding is consistent with those of the previous studies suggesting that joints KT could be an effective intervention to improve pain (36-41).

In the field of HOA rehabilitation, few studies have assessed the effect of KT on pain relief. A study investigated the effect of KT on rhizarthrosis symptoms, and the results showed the improvement of pain severity in the trapezoid first metacarpal joint (19). In another study, joint mobilization was used in combination with KT, and the results showed significant pain relief after the intervention (20). Other studies utilized KT in rheumatoid hand and recommended KT as an effective intervention to improve the pain (42, 43).

Other findings revealed that grip and pinch strength improved after the intervention in KT-EXE and EXE groups. These results are in line with those of the previous studies that suggested hand strength and ROM exercises in the improvement of grip and pinch strength (14, 31, 44). In addition, the collected data in the present study showed that the changes in grip and pinch strength at the post-intervention and follow-up assessments were significantly greater in the KT-EXE group, compared to those in the EXE group. It seems that Kinesio tape had a positive effect on the improvement of grip and pinch strength. In a previous study, Mohammadi et al. concluded that the forearm muscles KT could significantly improve grip strength in healthy participants (45).

In the domain of hand rehabilitation, an earlier study using mobilization in combination with KT reported the increased pinch strength in patients with trapeziometacarpal osteoarthritis (20). Other studies using KT for hand arthritis reported the improvement of grip and pinch strength and better hand functions that could be related to hand strength (42, 46). It seems that the application of KT could lead to the stimulation of pain receptors and proprioceptors, as well as better alignment of joints, thereby improving hand functions and strength.

Results of our study also revealed the positive effect of KT and exercise on wrist ROM and thumb opposition. Wrist extension and thumb opposition improved significantly at the post-intervention and follow-up assessments in the KT-EXE group, compared to those in the EXE group. These findings are consistent with the results of the previous studies that suggested strength training exercises as a beneficial intervention to improve ROM in Individuals with HOA (14, 44, 47).

In a previous study, it was shown that mobilization technique with KT improved the ROM of the trapeziometacarpal joint (20). Another study also reported improvement in stiffness after using Kinesio tape in patients with first metacarpal joint osteoarthritis (19). Similar to the aforementioned findings, some studies have suggested KT as an adjunctive intervention to improve the ROM in rheumatoid hand (42, 43). Results of the present study showed the significant positive effect of intervention programs on upper-extremity disability in both groups.

In addition, the collected data of the present study demonstrated that the changes in upper-extremity function at the post-intervention and follow-up assessments were significantly greater in the KT-EXE group, compared to those in the EXE group. Few studies reported the effects of exercise or KT in upper-extremity or hand functions. Results of a study that investigated the effects of active ROM in hand exercises revealed that this intervention improved global hand function of patient with HOA (48).

Another study reported benefits of exercise on self-reported hand function (32). In another study, the improvement of hand functions by KT was reported in patients with trapezoid first metacarpal joint osteoarthritis (19). Furthermore, some studies that used KT for hand arthritis reported improvement in hand strength and better hand functions that could be related to hand strength (42, 46).

Obtained results of this study revealed that KT could be an effective intervention for the improvement of pain, ROM, as well as pinch and grip strength, in elderly individuals with HOA. However, these findings require further confirmation by performing further designed randomized control trials before any conclusion could be drawn regarding the effectiveness of this modality.

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