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Original

The Effect of Kinesio Tape and Exercise on Maximum Key Pinch Endurance on Assembly Workers

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ABSTRACT

Background: Work-related musculoskeletal pain is generally caused by poor physical conditions and repetitive movement. The aim of this research is to investigate the effect of 8 weeks of kinesio tape and exercise on maximum key pinch endurance and pain reduction regarding the assembly workers. **Method:** This clinical trial study was conducted on 40 female workers employed in the assembly part of an electrical company. The subjects were categorized into three groups: exercise-taping, exercise and control, and performing an 8-week rehabilitation plan twice a week. To assess the upper limb disability and key pinch endurance before and after the intervention, authors used DASH questionnaire and pinch gauge, respectively. Data were evaluated with SPSS 20 and one-way ANOVA, Chi-Square and paired t-test tests. In this study, pinch gauge was used to measure pinch strength. Studies show that pinch gauge has high calibration accuracy and precision. **Results:** The results of this study demonstrated a decrease in upper limb disability in the two groups of exercise and taping-exercise compared to the control group. Chi-square test indicated a statistically significant difference between the history of hand pain in the three groups. Moreover, paired t-test showed that the two hand's key pinch endurance was significantly increased in the two intervention groups compared to the control group.

Conclusion: Using a kinesio tape can be effective in reducing pain and physical damage in hands. Therefore, at least 2 or 3 exercise sessions can be done per week during working hours.

Keywords: Disability Evaluation, Key Pinch, Assembly Workers, Exercise, Kinesiotape

Introduction

Musculoskeletal pain among workers at workplace is rapidly increasing. Many kinds of studies focus on ergonomic risk factors because of the importance of musculoskeletal pain causing activity limitation and quitting the job. Work-related musculoskeletal (WMSDs) refer to those in which muscles, blood vessels and nerves around joints such as the neck, shoulder, elbow, wrists, fingers; lower back and leg are involved. [1, 2]

Tasks, tools, devices and environment influence physical load. Awkward, repeated and prolonged, overstressing movements, high repetition or forces can overload the tissues and exceed their threshold of tolerable stress, resulting in MSDs. [2, 3] In different assembly lines, repetitive activities badly affects workers regarding their physical and psychological

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aspects. This leads to musculoskeletal disorders[2, 4].

For example, in electronic components manufacturing companies, there are a lot of procedures that require the use of upper limbs, especially hands, which can cause WMSD[5]. A study by Yahya N, Zahid M, aimed at evaluating work-related musculoskeletal disorders among the assembly workers of an electronic component manufacturing industry. It suggested that more than half of the participants reported pain in their shoulder, wrists and lower back[6]. These studies highlight the importance of early preventive interventions in reducing WMSDs and in potential saving of health care costs. Some studies have examined benefits of physical activities plans for workers who suffer from musculoskeletal [7, 8, 9].

Several interventions are proposed to reduce work-related MSD rates. They include work adjustments, re-engineering type modifications, training in ergonomic principles, exercise programs and smoking cessation campaigns[10]. There is some evidence for effectiveness of strengthening exercises in reducing work-related MSD[11, 12]. Education plays an important role in reducing musculoskeletal disorders[13].

Lack of time is the main reason for not exercising. Therefore, physical intervention dunning working hours at workplace can motivate workers to exercise. It can provide a suitable environment for being healthy[14]. kinesio taping method is used to achieve various therapeutic effects such as circulation improvement, subcutaneous lymphatic drainage, muscle facilitation or inhibition, fascia correction, and mechanical correction[15].Kinesio tape is a thin porous cloth with acrylic gluey. This adhesive tape can be stretched up to 140% of its normal length, allowing the joint and muscle to move in their full range without the movement of the joint and muscle[16].

Studies have addressed motor recruitment and bioelectrical activities[17, 18]. They found no significant difference in quadriceps isokinetic muscle strength, either immediately following the tape application or after 12 hours of taping [19].There was no vestige of therapeutic effect on pain relief. Besides, increased blood flow existed under taped area[20]. Kinesio tape can also be helpful on increasing ankle joint sense by stimulating mechanical receptors[21].

Muscles which are overworked or elongated can help kinesio tape in muscle treatment. They are pushed from muscular end to the muscle's function. The second ones are weak and have chronic pain[22].

Introductory observation in electrical equipment factory, indicating the presence of musculoskeletal disorders.Hence, this study can help examine effectiveness of workplace exercise program,symptom reduction and strength increase. To evaluate whether or not kinesio taping can increase maximal grip force and maximal key pinch endurance for healthy non-athletic subjects after 1 hour and 30 minutes, follow the application.

Methods

This clinical trial study was done in Iran on woman workers working in assembly unit in an electrical company. Data were analyzed by SPSS 20, paired T test and Pearson correlation coefficient, and P-value was considered smaller than 0.05.This study protocol was reviewed and confirmed by Ethics committee at Isfahan University **(IR.MUI.REC.1396.1.217)** . All participants consented on attending and were informed about procedure and principles.

Study stage

The purpose of this research was explained to the participants. They shouldn't had had hand surgery in recent years, and suffered from osteoporosis or fracture or disorder in hand or even any malignant diseases that could affect the study variables in the questionnaire and interview.

Exclusion Criteria were unwillingness to cooperate, not doing exercises regularly, allergy to kinesio tape adhesive and neglecting the research test.

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66 out of 100 were accepted to enter this research. 6 of them did not have competency criteria and were excluded. 7 people left the group because of unwillingness, 4 workers were absent in more than 50% sessions, and 9 of them in the taping and exercise group showed their unwillingness. As a result, 11 workers were selected for taping and exercise intervention group, 16, for the exercise intervention group, and 13, for the control group.

Disabilities of the arm, shoulder and hand (DASH) questionnaire

The DASH questionnaire was used for measuring impairment of workers. It contains 30 questions which can measure the function in body. This questionnaire could help due to its unique design regarding limb disabilities and individuals disorders experienced. It can monitor symptoms changes over time. Each question has 5 choices: 1) no difficulty to 5) unable to perform the activity, scoring from one to five. At the end these data are calculated by especial formulas[23]. In 2008, Moussavi et al. translated the questionnaire into Persian and confirmed its validity and reliability[24].

Pinch Gauge device

Another hand function is key pinch. It is related to pinching objects between thumbs and index fingers. Many muscles involve this movement, most notably – the first dorsal interosseous and the adductor policies[25].

The reliability and validity of dynamometer are proved for measuring grip strength and are described as standard for measuring grip power. In this study, pinch gauge (SH 5005 SAEHAN Hydraulic Pinch Gauge, South Korea**)** was used to measure pinch strength. Studies show that pinch gauge has high calibration accuracy and precision[26].

According to American society of hand therapists (ASHT) many endurance test should be taken. Based on ASHT the position of arms attached to the torso not rotating, the elbow flexed, the fore arm is neutral position, the wrist in 0-15 digress of ulnar deviation and the whole body sited. In order to these standards, whole participants should sit on their chairs with their arms held to their body and their wrists are in the position of 0-30 digress of extension and 0-15 degrees of defection to the ulnar. Whole participants should test for two times for each hand around 1 minute to rest between their tasks. This rest is because at avoiding muscle fatigue. The maximum endurance was recorded as the result of each type of pinch endurance based on the method applied by Mathiowetz et al. and the recommendations of ASHT[27, 28].

Intervention program

A standardized intervention program including stretching and strengthening exercises based on wrist – related injuries was instructed and implemented [29, 30, 31]. The test was performed for eight weeks twice before and at the beginning of work. All sessions were observed by physiotherapist. The exercises were done during working hours. At the beginning of every session participants started by four stretching and strengthening exercises. During these activities, resting time was around 30 seconds. In first session, there was wrist bending. Next, palm should be on the table and the other hand on it while participants tried to raise their fingers from the table. After that, the elbow should be straight so the participants held fingers with the other hand and wrist turned once up, once down. Finally, wrists were straight, fingers should be bent and stay with the same position (Figure.1). At the end, participates returned back to their workplace and continued their activities.

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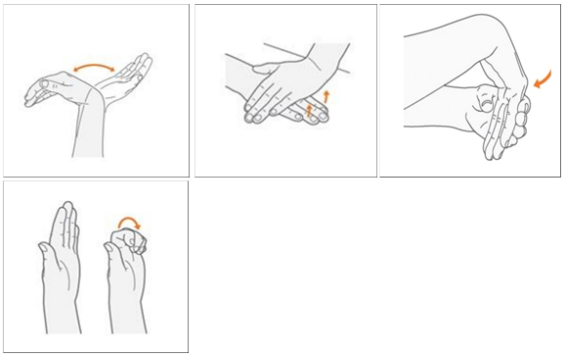

Figure 1. the 4 training exercises used in the present study[29, 30]

Figure 2. How to use of kinesiotype[29, 30]

Result

The mean age and work experiences of the participants were 33.67 (±6.88) and 4.03 (±3.77). One-way analysis of variance showed that there was no significant difference between the three groups in the mean of demographic variables (P > 0.05). Data are shown in Tables 1and 2.

Chi-square test indicated a statistically significant difference regarding the history of hand pain in the three groups (p<0.05). However, among other variables no significant difference was found between the three groups (P>0.05).

Analysis of the data recorded in the 3 groups after 8 weeks of intervention and practice demonstrated that DASH score in the type and exercise group (p=0.002) and exercise group (p=0.001) significantly decreased compared to the control group (p=0.097).This indicates improvement in hand function. Moreover, paired t-test showed that the two hands' key pinch endurance was significantly increased in the two intervention groups compared to the control group (p=0.001). The mean of changes in the DASH score was also statistically significant between groups (p<0.001). One-way ANOVA test showed differences between the mean changes in the DASH scale. They were not significant in the left and right hand key pinch endurance before and after the intervention between the 3 groups (p=0.001). The data in this section are presented in Table 3.

Moreover, the mean of changes in the variables between every two groups was statistically analyzed by the least significant difference. The LSD test illustrated that the mean of changes in DASH and hand key pinch endurance in the intervention groups was greater than the mean of the control groups (p=0.001). However, it was not significant between the two intervention groups (p>0.05). As a result, it seems that the use of kinesio tape did not improve hand function significantly. Changes in the group that received adhesive and exercise simultaneously were more than the group that received the exercise only. The data in this section are summarized in Table 4.

Table1. Descriptive statistics regarding quantitative demographic variables of the participants

Characteristic	Intervention group (n =27) Taping and exercise (n=11) Mean ± SD	Intervention group (n =27) Exercise (n=16) Mean ± SD	Control group (n=13) Mean ± SD	P-value¹
Age (years)	35.81±6.60	32.31±6.03	33.53±8.08	0.439
Weight (kg)	66.81±9.78	63.81±10.17	65.07±5.34	0.685
Height (cm)	161.00±7.78	162.56±6.43	163.30±6.47	0.708
Body mass index (kg/m2)	25.74±2.82	24.25±4.22	24.50±2.72	0.520
Work Experience(years)	4.59±2.76	2.84±2.26	5.03±5.51	0.259
Number of children	2.00±0.86	1.72±0.64	1.44±0.72	0.302

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Table 2. Descriptive statistics for qualitative demographic variables of the participants

Qualitative variable	Category	Intervention group (n=27) Taping and exercise (n=11)	Intervention group (n=27) exercise (n=16)	Control group (n=13)	P-value[1]
Marital status	Single	18.2%	25.0%	23.1%	0.913
	Married	81.8%	75%	76.9%	
Sport program	Yes	9.1%	18.8%	30.8%	0.399
	No	90.9%	81.2%	69.2%	
Dominant hand	Right	72.7%	81.2%	92.3%	0.424
	Left	27.3%	18.8%	7.7%	
Past history of pain	Right	27.3%	37.5%	38.5%	0.003
	Left	63.6%	31.2%	0%	
	No	9.1%	31.2%	61.5%	
Consultation with medical or other health professional	Yes	50%	36.4%	40.0%	0.814
	No	50%	63.6%	60.0%	

Table 3. Mean ± SD of DASH score, endurance of the pinch of the right and left hand at baseline and 8 weeks after intervention in intervention and control group

Variable	Groups	Before intervention (Mean ± SD)	After intervention (Mean ± SD)	P[1]	Mean differences (Mean ± SD)	P[2]
DASH score (%)	Taping & sport	38.71±8.20	25.07±5.87	0.002	-13.638±10.79	<0.001
	Sport	20.36±4.70	10.96±2.93	<0.001	-9.405±8.48	
	Control	12.14±4.02	13.63±4.48	0.097	1.494±2.99	
Endurance of the pinch of the right hand(Second)	Taping & sport	9.64±1.66	16.18±3.40	0.012	6.545±7.11	0.086
	Sport	19.75±3.16	28.69±3.71	0.004	8.937±10.50	
	Control	25.15±3.33	24.31±4.32	0.848	-0.846±15.53	
Endurance of the pinch of the left hand(Second)	Taping & sport	8.36±1.33	15.00±2.24	0.001	6.636±4.52	0.102
	Sport	22.75±4.21	29.13±4.02	0.018	6.375±9.56	
	Control	24.38±4.01	22.38±3.42	0.669	-2.000±16.43	

[1] P values show differences between after and before the intervention results in each group and are resulted from paired sample t test.
[2] P values show differences between the three groups and are resulted from one-way ANOVA test.

Table 4. Comparison of the mean variations of variables between two groups by LSD test

Variable	between the groups	P[1]
DASH score (%)	Control and (taping and sport)	0.000
	Control and sport	0.001
	Sport and (taping and sport)	0.183

[1] P values show differences between the two groups and are resulted from least significant difference test.

Discussion

This study was conducted to understand the collateral effect of using kinesio tape during 8 weeks for pain relief and function on female hands who are exposed to physiological and repetitive activities. The result showed decrease regarding DASH questionnaire scores and key pinch endurance increased in two groups of exercise and taping compared to the control group ($p<0.05$)

According to this study, for hand function improvement, doing sports exercises two or three times in a week is sufficient. In the same line, Bany and Deyle confirmed the result of the present study. They concluded that performing exercises for two or three times in a week have better results than daily exercises. It may also be inapplicable due to people's time limitations[32]. A systematic review suggested benefit of therapeutic exercises was more than other treatments such as laser therapy, ultrasound and acupuncture[33]. Azadi et al.'s evaluation of the effect of 12 weeks of neck, core, and combined stabilization exercises on pain and disability of the elderly patients with chronic non-specific neck pain showed that 12 sessions of neck, core, and combined stabilization training in the neck region could improve the tolerance and pain of the elderly with non- specific chronic neck pain[34].

An appropriate rehabilitation plan is useful for getting the best result of DASH with sub acromial

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impingement syndrome and intermediation program such as strengthening and physical impairment in males[35]. Chiara Rasotto et al. investigated the effectiveness of an appropriate physical activity program in the workplace on reducing symptoms in the upper extremities and neck.

The result specified great pain reduction in neck, shoulders, elbows and wrists and amazing improvement scores in DASH questionnaire. An appropriate exercise program can be helpful for pain reduction and limb WRMDS disabilities[36].

On the other hand, the results of this research showed that the mean differences in DASH and hand grip strength were significant between the intervention groups and the control group (p=0.001). But it was not significant between the two intervention groups (p>0.05). Kinesio tape doesn't play a significant role in hands function improving. The changes in the group that received the adhesive and exercise simultaneously were more than those in the exercise group. By participants increase in the group or increase of intermediation sessions, the differences between the two intervention groups and the effect of simultaneous use at the tape and sport adhesive tape will be greater than the effect at exercise alone. The effects of kinesio taping are limited so far[17, 18]. Fu et al. in their pilot study found no significant difference in quadriceps isokinetic muscle strength ,either immediately following the tape application or after 12 hours of taping[19].

Hsiao-Yun change et al. examined the effects on healthy force sense and grip strength after kinesio taping application. Kinesio taping does not have any results in maximal grip strength changes[37].

Donec et al. determined the effect of kinesio tape on the maximal key pinch strength force of 54 healthy, non-athlete players regarding both hands. The kinesio tape group showed significant increase in key pinch strength. Therefore, key pinch strength changed in both groups[15]. Other studies showed no changes after 10 minutes. The muscles activity increased after 24 hours of kinesio taping using and its effects existed for 48 hours[38].

Dr Rania et al. mentioned kinesio effect on 60-40 years participants pain removal with carpal tunnel syndrome. They were divided into two groups. The treatment group included a standard physiotherapy program plus kinesio tape for 4 weeks every other day. The treatment group b included only standard physiotherapy. The result showed pain reduction[30]. Thelen et al. (2008) carried out a study on 42 students with traumatic arrest or inflammation of the shoulder crown tendons. The result showed pain relief and motion range in the kinesio tape treatment group[39].

Conclusion

Studies demonstrated beneficial effects of stretching in preventing work-related musculoskeletal disorders. Generally, results suggested that an intervention program including at least 2 or 3 exercise sessions per week during working hours is effective to reduce pain and physical damage in of hands assembly workers. Authors recommend that another study be done to examine the similar effect of kinesio tape on pain and performance in assembly workers. One of the limitations of this research was the small number of participants, due to the small number of women working in the industry. Some women, on the other hand, were reluctant to cooperate, despite sufficient explanations.

Conflict of Interest

The authors declared no conflict of interest.

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Authors Contribution

All authors contributed equally to the study.

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