http://iahsj.kaums.ac.ir/
International Archives of Health Sciences. 2024; 11(2): 79-84
https://doi.org/10.48307/IAHSJ.2024.411222.1042

Research Article Open Access

Efficacy of local heat therapy in alleviating symptoms of mild to moderate idiopathic carpal tunnel syndrome

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Received: 21 August 2023 **Revised:** 14 January 2024 **Accepted:** 30 January 2024 **e-Published:** 1 April 2024

Abstract

Objectives: This study aims to assess the efficacy of local heat therapy (Kaiy) in alleviating symptoms of mild to moderate idiopathic carpal tunnel syndrome (CTS).

Methods: A single-blind clinical trial was conducted involving patients with mild and moderate idiopathic carpal tunnel syndrome. A total of 120 patients were randomly assigned to either the intervention or control group. Both groups utilized a medical wristband during nighttime. The intervention group received pen moxa as a local heat therapy tool (Kaiy) applied to the wrist region. The Boston questionnaire was employed for assessment.

Results: Heat therapy using Kaiy (pen moxa) significantly improved symptom severity (P≤0.0001), functional status (P≤0.0001), and pain scores (P≤0.0001) in patients with mild to moderate CTS compared to those in the control group without heat therapy.

Conclusion: This study demonstrates the positive impact of heat therapy (Kaiy) as a non-surgical approach for reducing pain, symptom severity, and functional impairment in CTS patients. Integrating complementary and alternative medicine with conventional treatment modalities could enhance symptom management with minimal side effects.

Keywords: Carpal Tunnel Syndrome, Traditional Persian Medicine, Complementary Medicine, Kaiy, Heat Therapy.

Introduction

Carpal Tunnel Syndrome (CTS) is a prevalent peripheral mononeuropathy that affects the median nerve.[1,2] The incidence and prevalence of CTS vary based on diagnostic criteria and study populations, leading to a significant economic burden on healthcare systems and communities.[3] Approximately 3.8% of individuals experiencing hand discomfort, numbness, and itching may have CTS.[4] In Iran, the prevalence of CTS in the general population ranges from 1.8% to 7%.[5] Treatment approaches for CTS typically involve supportive non-surgical interventions followed by surgical options, with medical wristbands commonly used for mild to moderate cases.[6]

In addition to conventional treatments, complementary and alternative medicine modalities such as yoga, acupuncture, reflexology, and massage are utilized to alleviate CTS symptoms. Traditional and complementary medicine, endorsed by the World Health Organization (WHO), offers potential benefits in managing CTS. Local heat therapy, including the use of warm oils and heat applications, is recommended in traditional medicine for nerve-related conditions.[6,7] Kaiy, a form of heat therapy based on plant-derived heat application to specific body areas, aims to remove accumulated moisture and inflammation while restoring bodily function.[7-9]

Kaiy (medieval cautery), an ancient heat therapy method in Traditional Persian Medicine (TPM), falls under

manual therapies with diverse medical applications. Its historical use for various disorders has been overshadowed by modern medical advancements. The localization of Kaiy points aligns with anatomical positions and neural dermatome connections, resembling Chinese medicine's moxibustion techniques that utilize heat to address organ function disorders caused by coldness.[10-12]

Despite the array of treatments available for CTS, many yield short-term results lasting up to six months, with eventual disease recurrence. Steroids, ultrasound therapy, and medical wristbands have shown limited long-term efficacy in managing CTS symptoms.[13-16] Recent clinical studies have highlighted the potential of moxibustion in treating inflammatory conditions through its healing and anti-inflammatory properties, mirroring traditional Persian medicine's approach with Kaiy.[3]

Objectives

This study aims to evaluate the effectiveness of local heat therapy in alleviating symptoms of mild to moderate idiopathic carpal tunnel syndrome.

Methods

The current study was a single-blinded randomized clinical trial (IRCT No: IRCT20201130049540N1) conducted among patients with mild to moderate idiopathic carpal tunnel syndrome who were referred to a private neurology clinic and the government hospital (Ali-Ebne Abitaleb Hospital) in Rafsanjan City, Kerman Province, Iran, between November 2022 and March 2023.

The inclusion criteria were individuals aged between 18 and 65 years old with mild or moderate idiopathic carpal tunnel syndrome diagnosed clinically and confirmed by electrodiagnosis (EDX). Clinical diagnosis of CTS was based on symptoms and signs, with symptoms including night pain, paresthesia, numbness, and tingling of the hands, and signs including positive Phalen's and Tinel's tests. Patients with two symptoms or one symptom and one sign were diagnosed as clinical CTS cases, which were confirmed by EDX based on scores reported in Table 1.

The exclusion criteria for this study were pregnancy, diabetes, hypothyroidism, recurrent carpal tunnel syndrome, recent use of corticosteroids and painkillers for other conditions, prior surgery for carpal tunnel syndrome, severe trauma or wrist fracture history, direct injection into the carpal tunnel, evidence of cervical radiculopathy in electrodiagnosis, vascular collagen diseases such as systemic lupus erythematosus, rheumatoid arthritis, scleroderma, amyloidosis, and a history of drug abuse.

Table 1. The severity scores of electrodiagnostic in diagnosis of mild and moderate CTS

Severity	CL [1]	MDL [2]	SNCV [3]	SDL [4]
Mild	>2.4m Sec	>4.2m Sec	<40m Sec	>3.7m Sec
Moderate	>2.8m Sec	>5.5m Sec	<32m Sec	>4.5m Sec

[1] compound latency; [2] motor distal latency; [3] sensory nerve conduction velocity; [4] sensory distal latency

Intervention Group

Patients in the intervention group wore a medical wristband during nighttime sleep similar to the control group. The intervention involved using a pen moxa for heat therapy containing various ingredients (different plants and charcoal). For standardization and safety, a ready-made charcoal type with controlled heat emission was utilized to avoid smoke-related issues from burning the plant material. Insulating bases were employed to prevent heat damage by maintaining a specific distance from the skin. The heat therapy using moxa was administered in 10 sessions, three times a week, with each session lasting approximately 10 to 12 minutes. Prior to the intervention, patients received detailed explanations from the doctor. Patients were instructed to maintain their regular daily routines without lifestyle changes. A designated schedule was established for patient visits to the doctor's office for the intervention. The heating points in this method were the palmar area of the wrist and palm, heated from a distance of half a centimeter using charcoal for ten minutes without direct contact.

Control Group

Patients in the control group only received treatment with a medical wristband.

Data were collected using the Boston Questionnaire to assess the severity of symptoms and functional status, as well as the Visual Analogue Scale (VAS) to evaluate pain levels.

Boston questionnaire: The Boston Questionnaire is a self-administered tool consisting of a symptom severity scale and a functional status scale, each comprising 11 and 8 questions, respectively. Each question is rated on a scale of 1 to 5, with 1 indicating no symptoms and 5 indicating severe symptoms. The symptom severity scale evaluates the severity, frequency, duration, and type of symptoms,

while the functional status scale assesses the impact of carpal tunnel syndrome on daily activities.[17] This questionnaire has been translated and validated in Iran.[18]

VAS: The VAS is used to measure pain intensity on a 10 cm ruler, with 0 representing no pain and 10 signifying unbearable pain.

Outcomes: The severity of symptoms, functional status, and pain intensity, measured as continuous variables, were the primary outcomes of this study.

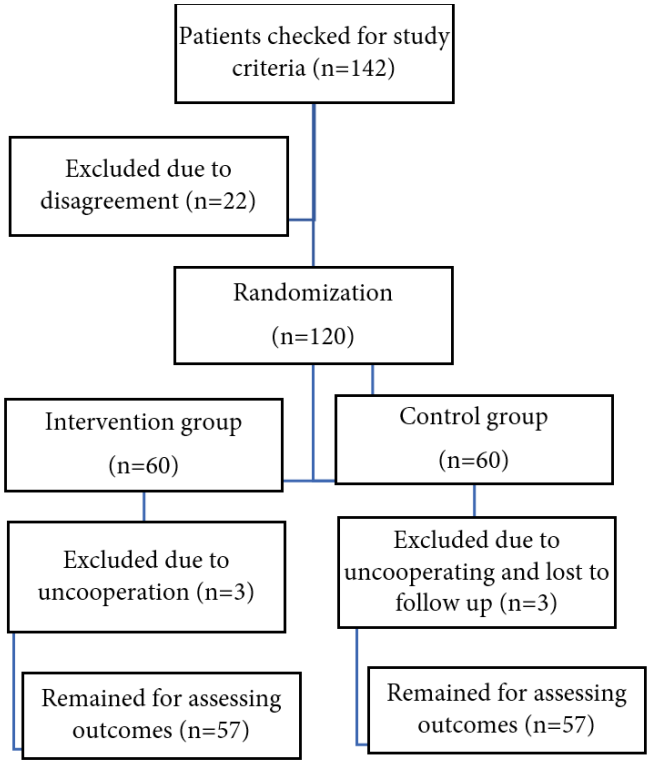

Figure 1. The flow chart of study and patients' allocation

Sample size: To determine the sample size, considering the range of score changes in the Boston questionnaire, α=0.05, 1−β=0.2, and d=4 (expected difference between average scores before and after intervention), a sample size of 48 individuals per group was calculated. Factoring in a 20% dropout rate, the final sample size was set at 57 participants per group. Patients were randomly assigned using a permuted block randomization scheme with a block size of 4.

Descriptive statistics such as mean ± standard deviation (SD) and frequencies with percentages were used to present the data. Demographic characteristics like age groups and gender were compared between the intervention and control groups using Chi-Square tests. Within-group comparisons of symptom severity, hand function, and VAS scores before and after intervention were conducted using paired T-tests. Between-group comparisons were performed using independent T-tests and Analysis of Covariance (ANCOVA). Data analysis was carried out using SPSS (version 16.0, SPSS Inc, Chicago, IL, USA). A "P-value" less than 0.05 was considered significant.

The study was conducted in accordance with the Declaration of Helsinki. The study protocol was reviewed and approved by the Ethics Committee of Kerman University of Medical Sciences (Ethics No: IR.KMU.REC.1399.473). Written informed consent was obtained from all participants prior to their involvement in the study, and all treatments and assessments were provided free of charge to the patients.

Results

A total of 114 patients were enrolled. Patients aged 31-40 years constituted approximately one-third of the participants in each group (45.6% in the intervention group and 38.6% in the control group). The majority of patients in both groups were females (93.0% in the intervention group, 89.5% in the control group). There were no statistically significant differences between the groups in terms of age and gender distribution (P values: 0.70 and 0.50, respectively) [Table 2].

Table 2. Baseline information of participants

	Intervention (n=57)	Control (n=57)	P value of Chi-Square tests
Age groups, n (%)			
18-30	14 (24.6)	12 (21.1)	0.70
31-40	26 (45.6)	22 (38.6)	
41-50	12 (21.1)	17 (29.8)	
≥51	5 (8.8)	6 (10.5)	
Sex, n (%)			
Male	4 (7.0)	6 (10.5)	0.50
Female	53 (93.0)	51 (89.5)	

The findings revealed that the severity scores of symptoms before the intervention did not differ significantly between the groups (P=0.51). However, following the intervention, the severity scores significantly decreased in the intervention group (ANCOVA P≤0.0001). Both groups exhibited a reduction in symptom severity by the end of the study (paired T-tests P≤0.0001) [Table 3].

Initially, there were no significant differences in functional scores between the groups before the intervention, as shown in Table 3. Subsequent to the intervention and at the study's outcome, patients in the intervention group reported lower functional scores

compared to those in the control group (ANCOVA P≤0.0001). Notably, functional scores decreased significantly for all patients in both groups (paired T-tests P≤0.0001) [Table 3].

Although there was a difference in pain scores between the groups before the intervention, with patients in the intervention group reporting higher pain scores than those in the control group (P=0.01), ANCOVA analysis revealed a significant decrease in pain scores for patients in the intervention group by the end of the study (P≤0.0001). Both groups experienced a statistically significant reduction in pain scores (paired T-tests P≤0.0001) by the study's conclusion [Table 3].

Table 3. The scores of severity (symptoms), functional and pain before and after intervention in both groups

Variables	Time interval	Groups		P value of T-test	P value of ANCOVA
		Intervention (n=57)	**Control** (n=57)		
Severity of symptoms score, (mean±SD)	Before intervention	34.14 ± 8.4	35.10 ± 7.3	0.51	≤0.0001
	After intervention	19.50 ± 6.8	28.46 ± 9.1	0.0001	
P-value of paired T test		≤0.0001	≤0.0001	-	-
Functional score, (mean±SD)	Before intervention	23.44 ± 7.2	21.82 ± 7.3	0.25	≤0.0001
	After intervention	15.32 ± 5.5	18.70 ± 4.4	0.009	
P-value of paired T test		≤0.0001	≤0.0001	-	-
Pain score, (mean±SD)	Before intervention	7.23 ± 2.2	5.56 ± 2.0	0.01	≤0.0001
	After intervention	3.31 ± 1.6	4.69 ± 2.4	0.02	
P-value of paired T test		≤0.0001	≤0.0001	-	-

Discussion

Kaiy is an ancient therapeutic method used in traditional Persian medicine. In this study, we combined this therapeutic method with modern medicine (a medical wristband) to reduce the severity, functional limitations, and pain among patients with mild to moderate Carpal Tunnel Syndrome (CTS). The results of this study showed that Kaiy (heat therapy) in combination with the medical wristband improved the severity of symptoms, functional status, and pain scores for patients. Additionally, no side effects were reported by patients in the intervention group. While there are no direct studies focusing on Kaiy as a therapeutic method for CTS patients, heat therapy, with similar effects to Kaiy, has been evaluated in several studies, clarifying its advantages and disadvantages. For instance, some studies have reported that heat therapy is not recommended for CTS,[19,20] while others have confirmed its positive effects in reducing symptoms and pain associated with CTS.[21-24]

Piravej et al., demonstrated the therapeutic efficacy of low-intensity ultrasound heat therapy for mild to moderate CTS.[23] Ding et al., investigated the effects of acupuncture and moxibustion (heat therapy) on CTS patients, showing that the combination of acupuncture with moxibustion effectively reduced pain, numbness, and motor activity in CTS patients.[21] These studies align with our findings and support the positive effects of heat therapy on symptom severity and functional status.

Our study found a significant decrease in pain intensity for patients receiving heat therapy (Kaiy). This result is consistent with Michlovitz et al.'s study, which reported the positive effects of low-level heat wrap therapy for treating wrist pain.[22] Other studies have shown that heat therapy can improve back pain, with continuous low-level heat therapy providing pain relief, enhancing muscular strength, and increasing flexibility.[25] Research on moxibustion has demonstrated its effectiveness in treating inflammatory diseases such as Rheumatoid Arthritis through healing and anti-inflammatory processes.[3,26]

Such methods can be beneficial in alleviating the symptoms of carpal tunnel syndrome due to their localized heat therapy effect. In countries such as China, a similar technique known as moxibustion is utilized. This traditional method involves using plant materials to generate heat in specific areas of the body for therapeutic or preventive purposes. Primarily employed in treating conditions arising from cold and deficiency syndromes, moxibustion aims to address the sluggish movement or stagnation of vital energy caused by cold, as opposed to the rapid movement induced by heat. By promoting fluid movement and vital energy, moxibustion helps alleviate the stagnation of vital energy and blood, ultimately

improving circulation. Essentially, moxibustion functions by warming the meridians and enhancing blood flow, making it particularly effective in treating conditions resulting from cold imbalances or deeply rooted pathogens within the muscles.[12]

Modern research on moxibustion focuses on its thermal, radiation, and medicinal effects, as well as its combustion products.[11,27]

In the current study, the selection of appropriate and modified tools for local heat therapy did not result in any notable complications such as itching, redness, or swelling. However, the study was limited by the small sample size and the lack of blinding in the two groups due to the absence of an adequate equivalent for moxibustion. Another limitation was the short duration of the study, which only allowed for the investigation of short-term effects of the intervention. We recommend conducting a study with a larger sample size and a longer follow-up period.

Conclusions

Pain management in a patient with limb amputations secondary to severe electrical injuries can be expected to be challenging.

Acknowledgment

The authors take this opportunity to thank the officials at the Kerman University of Medical Sciences and the participants who contributed to conducting this study.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

Carpal tunnel syndrome: CTS;
Traditional Persian Medicine: TPM;
Visual Analogue Scale: VAS;
World Health Organization: WHO.

Authors' contributions

All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

Funding

None.

Role of the funding source

None.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. The study protocol was reviewed and approved by the Ethics Committee of Kerman University of Medical Sciences (Ethics No: IR.KMU.REC.1399.473) and registered on https://irct.behdasht.gov.ir/ (IRCT20201130049540N1). Written informed consent was obtained from all participants prior to their involvement in the study, and all treatments and assessments were provided free of charge to the patients.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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How to Cite this Article:
Farzadkia M, Tajadini H, Moghadam Ahmadi A, Dehesh T, Setayesh M. Efficacy of local heat therapy in reducing symptoms of mild or moderate idiopathic carpal tunnel syndrome. Int Arch Health Sci. 2024;11(2):79-84. doi: 10.48307/IAHSJ.2024.411222.1042