ORIGINAL ARTICLE

GMJ.2021;10:e1888
www.gmj.ir

Received 2020-03-12
Revised 2020-04-06
Accepted 2020-11-05

Assessment of Kinesio Taping Versus Phonophoresis for the Treatment of Painful Hallux Valgus: A Pilot Study

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Abstract

Background: Hallux valgus (HV) is a deformity that affects the quality of life and function in a negative manner causing disturbed balance and walking and even alters the foot kinematics. Conservative treatments are the choice for mild to moderate HV, but the question about the best method has not been responded yet. In the current study, it is aimed to assess and compare the efficacy of kinesiotaping (KT) versus phonophoresis (PH) for the treatment of painful HV. **Materials and Methods:** This randomized clinical trial has been conducted on a total number of 37 toes (37 toes of a total number of 24 patients) randomly divided into two subgroups of either KT or PH with 1% hydrocortisone among which the total numbers of 31 toes from 20 patients fulfilled the study protocol. The variables including pain (using VAS score), function (using Manchester-Oxford Foot questionnaire)(MOXFD), hallux valgus angle (HVA), and intermetatarsal angle (IMA) were assessed and compared between two groups before and after two months following the interventions. **Results:** The pain score decreased significantly within the time in both groups (P-value<0.001), while the comparison of KT with PH revealed insignificant difference (P-value=0.08). MOXFD assessments showed significantly improved status within two months for both interventions (P-value<0.001) with no remarkable difference between the groups (P-value=0.55). The IMA and HVA altered following both of the techniques. KT was superior to PH for the correction of HVA, but not for IMA (P-value>0.05). **Conclusion:** We found both of the KT and PH techniques could successfully rehabilitate the patients' pain and improve function, however the KT was slightly better than PH due to HVA reduction. **[GMJ.2021;10:e1888]** **DOI:10.31661/gmj.v10i0.1888**

Keywords: Hallux Valgus; Kinesiotape; Phonophoresis; Pain

Introduction

Hallux valgus (HV) is a pathological condition manifested as the lateral deviation of the great toe accompanying with the medial deviation of the first metatarsus [1]. Although numerous predisposing factors including flat foot and hindfoot pronation, female gender, family history, occupation, and in particular inappropriate and constricting shoe wear

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have been demonstrated for hallux valgus [2-4], the primary etiology of this deformity is still a question. HA is a deformity that affects the quality of life and function in a negative manner causing disturbed balance and walking and even alters the foot kinematics [5-7]. Various methods with the general aim of 1) preventing the progression, 2) accommodation of the deformity when it is rigid, and 3) distribution of the pressure at the region of the deformity have been proposed [8]. Conservative treatments, including exercise, taping, orthotic devices, chiropractic mobilization, footwear modification, and physical therapy, are the options widely used for mild to moderate HVs [9-12]. Surgical procedures are other alternatives mostly use for more severe conditions. Over one hundred methods have been introduced for the correction of HV deformities, recurrence and overcorrection have been presented as complications of surgical approaches [13, 14]. Recently, the trends toward the use of taping techniques for the management of HV have gradually increased [15]. Kinesio tape (KT) is a novel adhesive, elastic tape introduced with the thought of enhancing neuromuscular control by stimulation of skin receptors. Besides, the other theory has been raised that the elastic nature of KT improves lymphatic drainage to the deeper tissues. There are studies in the literature representing the efficacy of KT on the restoration of muscle strength and function, mechanical correction, increased lymphatic drainage, improved range of motion, and reduced pain [11, 16, 17]. Phonophoresis (PH) is a technique that has been successfully used for varieties of musculoskeletal disorders such as de Quervain's tenosynovitis, adhesions, bursitis, and knee osteoarthritis [18, 19]. The primary manifestation of this technique is to make better conditions for the local penetration of the drugs, maybe due to the heat effects of ultrasound. The cutaneous use of the agents has the advantages, including preserving the drug from the destructive events in the digestive system, controlling the speed of pharmacologic effects, reducing the risk of drug-related adverse effects, and preventing the complications due to the injections [18, 20]. To the best of our knowledge, there is no study in the literature assessing the efficacy of PH for the treatment of HV. In the current study, we have aimed to assess and compare the efficacy of KT versus PH for the treatment of HV. Besides, the current study is the first one comparing KT with PH.

Materials and Methods

Study Participants

The current randomized clinical trial (RCT) has been conducted on 20 patients referred to the Physical medicine and Rehabilitation outpatient university clinics affiliated at Isfahan University of Medical Sciences from June 2017 to May 2019. Ethical approval of this study was obtained from ethics committee of Isfahan university of medical science (approval ID: IR.MUI.MED.REC.1397.355). This RCT was registered in Iranian registry of clinical trials (registration reference: IRCT20171030037093N7). Females with the age of 25-60 years who had painful flexible hallux valgus with mild to moderate HV (less than 40 degrees), and intermetatarsal angle of equal or less than 15 degrees, without any limitation in the abduction of great toe, were included. History of diseases including rheumatoid arthritis, gout, and leprosy, diabetes mellitus, lower extremity neuropathies (i.e. tarsal tunnel syndrome and Morton neuroma), history of dislocation or fracture in a metatarsophalangeal joint, chronic use of high dose corticosteroids, use of anticoagulant agents, addiction, diagnosis of hallux rigidus or osteoarthritis in the first metatarsophalangeal joint, and presence of any contraindication for ultrasound administration (acute inflammation, infection, or bleeding) were considered as the unmet criteria. Patients who presented their unwillingness for participation in the study, those who refused to refer for follow-up visits, and those with more than 40 degrees of hallux valgus or more than 15 degrees of IMA were excluded from the study. Eventually, the number of 37 toes (24 patients) met the inclusion criteria and divided into two groups of A and B randomly. The randomization was done using Random Allocation software (GraphPad software, Inc., California, USA); therefore, each involved toe was provided with a particular number allocated it to either group A or group B.

Interventions

Group A underwent the HV kinesiotaping method, first presented by Kenzo Kase. Therefore two Y-shaped KT pieces were utilized. The basis of the Y-shaped strip was placed on the base of the hallux. Then the big toe was aligned to the estimated correct position using a light-moderate tension, and the tape was implemented through the first ray. The correction of the toe alignment was performed once and took about 10 seconds. After that, the second piece of the tape was placed on the metatarsophalangeal (MTP) joints with a mechanical correctional technique on the big toe. After the process, the patients were ordered to walk for 10 minutes. A physiatrist resident taught the taping method to the patients. The KT was performed 12 times (every five days) [16]. Group B (phonophoresis group), were treated with 10 minutes of pulsatile ultrasound (2:1) at 1 MHz, 1.5 W/cm^2, using 1% hydrocortisone ointment. The treatment site was within the tender point, around the metatarsophalangeal joint. This process was performed three times a week for a month [20]. The patients were requested to continue their routine daily activities. In cases with inappropriate shoes, they were recommended to avoid wearing constricted and high-heel shoes. Besides, physical activities were trained, including the stretching of calf muscles, active and passive flexion, and abduction of the toes for twice a day (each exercise should be performed for ten times and held 10 seconds) [21].

Primary Outcomes

The estimated number of the study population was measured using the following formula in which 95% of a confidence interval and 80% of the power factor has been considered. Based on this formula, Z1, Z2, S1, S2, M1, and M2 were measured as 1.96, 0.84, 15.57, 10.94, 38.5, and 19.7, respectively. Therefore, the number of 15 toes were estimated for each of the study groups. Eventually, in the current study, numbers of 20 patients, and the whole number of 31 toes, were included. The hallux valgus angle (HVA) and intermetatarsal angle (IMA) were primarily evaluated by the weight-bearing dorsoplantar X-ray radiographies. The measurements were done using the Ad Hoc Committee of the American Orthopedic Foot and Ankle Society on Angular Measurements [22, 23]. For the measurement, for the first and the second metatarsals, reference points were considered as 1-2 cm proximal to the distal articular surface and 1-2 cm distal to the proximal articular surface in the midshafts. For proximal phalanx, the reference point was considered as 0.5-1 cm proximal and distal to the articular surfaces also in the midline [16] (Figure-1 and 2). Besides, the patients' primary pain was evaluated using the ten-score visual analogue scale(VAS). Furthermore, the Manchester-Oxford Foot questionnaire (MOXFQ) was utilized to assess the malformation and pain status of the toes. This means contains 16 questions evaluating three entities of walking and stance (7 questions), pain (5 questions), and social interactions (4 questions). Each question should be scored from 0 to 4. The worst score equals more severe pain status and worse function [24]. Mousavian *et al*. have provided the validated Persian questionnaire of MOXFQ. They presented Cronbach's alpha of 0.86, 0.88, and 0.89 for pain, walking/standing, and social interactions, respectively [25].

Secondary Outcomes

All of the measurements above, including HVA, IMA, pain score based on VAS, and MOXFQ were reassessed before the intervention, and then after two months, as well. Immediately following the procedure, VAS and MOXFQ were also assessed.

Statistical Analysis

The obtained data gathered in the Statistical Package for the Social Sciences (SPSS) version 21 (SPSS Inc., Chicago, IL, USA) for analysis. The descriptive data were presented in mean, standard deviation, percentages, and absolute numbers. For analytics, Kolmogorov-Smirnov, Fisher's Exact Test, Independent Samples T-Test, Mann-Whitney U, and Generalized Linear Models (G.L.M) were used. P-value of less than 0.05 was considered as a significant level.

Results

1. Demographic Information

In the current study, the total number of 45

toes from 29 patients was assessed regarding the eligibility for participation in the study, among which 37 toes of 24 patients met the inclusion criteria and randomly allocated to either the KT group (N=18) or PH group (N=19). Three ones in the KT group were excluded as they did not refer for the intervention, and one person discontinued the intervention because she was not adherent to the routine exercise; therefore, eventually, 14 toes were assessed.

In the PH group, 19 ones were primarily included among which two ones did not refer in the two-month follow-up visit, and finally, 17 ones remained in our study. Consort diagram of the study population is demonstrated in Figure-3. All of the patients were females, 55% of them had bilateral HV (P-value=0.47). Members of the two groups were similar in age (P-value=0.23) and educational level (P-value=0.65). Detailed information is presented in Table-1. The total numbers of 14 toes (from 10 patients) were allocated to the KT intervention, while 17 ones (from 10 patients) underwent PH.

2. Outcomes

2.1.Pain

The comparison of the two groups showed similar pain complaint in all of the assessment intervals, including baseline, immediately after the interventions and within the two-month follow-up (P-value>0.05), while the trend of pain complaint revealed a significant reduction in the pain severity by the time (P-value<0.001) in all of the assessed patients, the comparison of the two groups in general (P-value=0.08) and by the time (P-value=0.99) showed insignificant differences between KT and PH (Table-2).

2.2.The Manchester-Oxford Foot Questionnaire

The MOXFQ assessment showed significant differences between KT and PH in none of the interval assessments, including baseline, immediately following the interventions and within two months. Similar to pain, the MOXFQ improved by the time in general (P-value<0.001); however, this trend was not dependent on the type of the intervention (P-value=0.84), and the comparison of the in-

Figure 1. Before KT (IMA: 11 HVA: 21)

Figure 2. After KT (IMA: 10 HVA: 16)

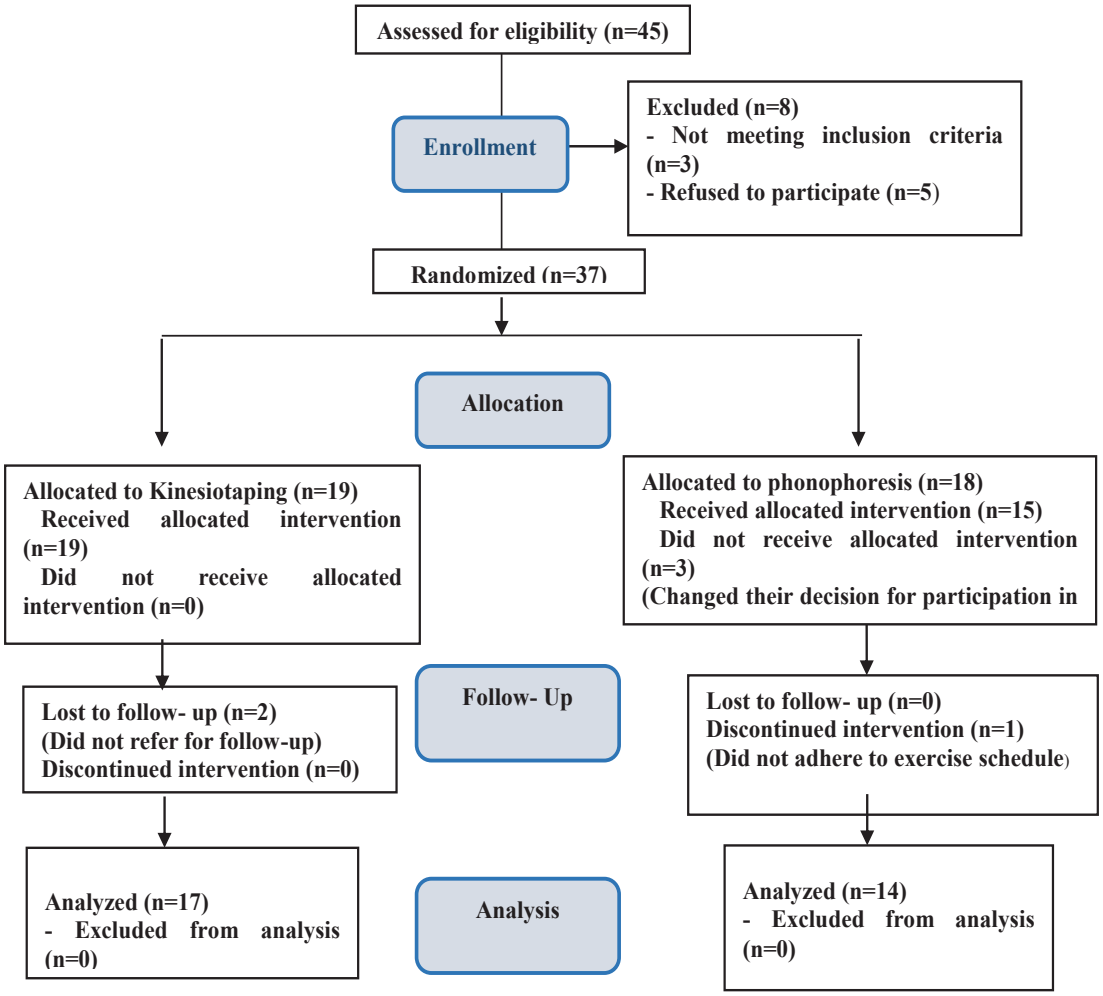

Figure 3. Consort flowchart of the studied toes population

terventions regardless of the time showed insignificant differences (P-value=0.55).

2.3.Angular Measurements

The comparison of the HVA between KT- and PH-treated patients revealed insignificant difference as well as within the two months follow-up (P-value>0.05), while the KT-treated cases presented statistically more HVA alterations (P-value=0.003). The IMA measurements revealed remarkable differences between the two approaches, neither at baseline (P-value=0.08) nor at follow-up study (P-value=0.06).

The general comparison of the two approaches showed an insignificant difference. Besides, the HVA and IMA were similar between KT and PH within the time, as well (P-value>0.05). Detailed information is presented in Table-2.

Discussion

HV is one the most common foot deformities; in particular among females. Abductor and adductor muscles are the main involved muscles causing the HV-related symptoms at the foot sites, including medial edge, sole, and small toes. Although the etiology of HV is not well-defined yet, scientists are unified about the role of ill-fitting shoes for foot deformities. Fashion trends make some females wear shoes with narrow toe boxes. Besides, high-heels shift the forefoot into the toe box, posing crowding of the toes [16, 26]. Consistent with the other studies, the female gender was predominant in our study as well.

Participants of the two groups were similar in terms of demographics; therefore, the probable confounding roles of these variables on

Table 1. The Demographic Information of the Studied Population

Parameters		Kinesio tape	Phonophoresis	P-value
Gender N (%)	Female	10 (100%)	10 (100%)	1*
	Male	0	0	
Intervention side N (%)	Left	2 (20%)	1 (10%)	0.47*
	Right	4 (40%)	2 (20%)	
	Bilateral	4 (40%)	7 (70%)	
Educational level N (%)	Under diploma	1 (10%)	2 (20%)	0.65*
	Diploma	5 (50%)	2 (20%)	
	More than a diploma	4 (40%)	6 (60%)	
Age (mean±standard deviation)	---	35.7±9.46	41±9.60	0.23**

* Chi-square test
**Mann-Whitney test

the outcomes of the interventions were eliminated. We found that both of the KT and PH interventions could successfully improve the patients' pain and function. In general, none of the techniques was superior to the other in terms of pain, function, and intermetatarsal angle, but KT could alter the HVA to a better status than the PH approach. Despite the changes in the IMA and HVA, the corrected angles did not turn to the normal ranges, which may have required a longer duration of interventions to achieve the aimed angles. Also the persistency of angles` changes must be assessed later.

To the best of our knowledge, this is the first study performing PH for the treatment of HV. Besides, it is the first study comparing KT with PH for the correction of HV-related complications. The previous studies have abundantly presented the efficacy of KT for the pain relief of HV. Öztürk *et al*. [27], and Karabicak *et al*. [11] have separately presented the remarkable ability of KT for the pain relief among the patients resenting from HV. Besides, Radwan *et al*. conducted their study intending to compare the KT versus conventional tape for the correction of HV, and declared significantly reduced pain within eight weeks of KT intervention while their study was conducted for 12 weeks [16].

The studies have hypothesized that the slightly stretched skin beneath the KT, and then the recoil of the skin poses the superficial lymphatic channels to be opened, and thus the circulation is more efficient at the site of KT. Therefore, fluid removal occurs with better efficacy taking with pain-inducing lactic acid and waste products. The mentioned mechanism can probably take the pressure off the pain receptors located under the skin at the site of KT [16]. The other assessment of our study was about the function and deformed angle change following the KT that all improved within duration of intervention. Karabicak *et al*. used a different means for the assessment of function but presented similar outcomes as ours while they have performed their study only four times and for ten days [11].

The alteration of IMA and HVA to better statuses have presented by other authors as well [28, 29]. It seems that the consistent application of KT on the skin leads to the stimulation of cutaneous mechanoreceptors. Therefore more sensory signals will be sent to the central nervous system that helps the better integration of the information. On the other hand, motor neuron thresholds may be reduced due to the constant cutaneous stimulation that can

Table 2. Comparison of Pain Score, Manchester-Oxford Foot Questionnaire, Hallux Valgus Angle, and Intermetatarsal Angle between Kinsiotape Versus Phonophoresis

	Kinsiotape (mean±standard deviation)	Phonophoresis (mean±standard deviation)	P1	P2 (Intervention)	P3 (Time)	P4 (Intervention* Time)
Pain (visual analogue scale)						
Before the intervention	6.35±0.94	5.75±0.95	0.12			
Immediately after intervention	1.90±1.91	1.30±1.15	0.73	0.08	<0.001	0.99
Within two months after the intervention	1.60±1.64	1.10±1.10	0.63			
Manchester-Oxford Foot questionnaire						
Before the intervention	37.60±12.56	35.20±6.37	0.97			
Immediately after intervention	19±4.29	18.70±5.18	0.85	0.55	<0.001	0.84
Within two months after the intervention	19±4.37	18.70±5.18	0.85			
Hallux valgus angle						
Before the intervention	27±6.49	21.40±10.03	0.38			
Within two months after the intervention	26.65±6.78	21.25±9.98	0.47	0.003	0.89	0.95
Intermetatarsal angle						
Before the intervention	12.10±1.88	11.85±5.34	0.08			
Within two months after the intervention	11.90±1.77	11.75±5.32	0.06	0.81	0.86	0.95

P1: Mann-Whitney test
P2: GLM

lead to motor unit recruitment, which in turn improves the muscle strength for contraction. The combination of mentioned mechanisms can improve the inactive muscle contraction due to the enhanced sensory feedback by the area of skin taped by KT [30].

Although the use of phonophoresis for the treatment of HV is at the earliest steps, we found significant improvement in all of the entities, including pain and function following 12 sessions of phonophoresis. Studies about the efficacy of phonophoresis have presented uncertain outcomes. Baktir *et al*. assessed PH use for lateral epicondylitis and declared insignificant alterations in pain and function [31]. Kleiman *et al*. conducted another study assessing the mere use of ultrasound versus PH, and represented the uselessness of PH, as their outcomes were not remarkably different while using ultrasound alone or as PH [32].

Kleinkort *et al*. compared the quality of 1% versus 10% of hydrocortisone while performing PH for varieties of inflammatory conditions, including bursitis, tendinitis, and epicondylitis. Regardless of the dilution of used hydrocortisone, PH could successfully help the patients rehabilitate [24]. In another study, the PH was compared with KT for the treatment of knee osteoarthritis. Although both of the techniques could considerably improve the patients' function, and decrease their pain, KT was superior to PH [19].
Further studies are required to make an accurate conclusion about the value of PH for inflammatory musculoskeletal disorders.

Conclusion

In conclusion, we found both KT and PH techniques as successful means for pain reduction and function improvement; however, due to the superiority of KT in the HVA correction; further studies with a longer duration of follow-up to evaluate the treatment-effect persistence and the required time to achieve corrected HVA are recommended.

Conflict of Interest

The authors of this study declared no conflict of interest.

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