Influence of Short-Term Conservative Treatment Using Kinesiotape On Hallux Valgus Angle

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Research Article

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Abstract

Background: Hallux Valgus HV was first proposed as a common pathologic condition affecting the great toe. The mechanism behind it is yet unknown. It has an impact on one's quality of life and ability to perform since it alters the mechanics of the foot and causes pain. conservative treatment is crucial. Kinesiotape (KT) has been demonstrated to be challengeable, cost-effective, and effective tool for restoring muscle function and strength, improving range of motion, reducing discomfort, and increasing lymphatic drainage, as well as having a mechanical correction effect.

Objective: The purpose of this study was to investigate the influence of 8 weeks KT for HV-on-HV angle (HVA) and subsequently on pain.

Design: pretest posttest control group randomized controlled trial.

Subjects: Thirty HV patients their mean age 29.07 ±6.3 years.

Methods: Patients were assigned randomly to study(A) and control(B) groups, study group received KT for HV which is replaced every 5 days for 8 weeks, and home regular exercise program for HV, control group received placebo KT replaced every 5 days and the same exercise program for HV, HVA was measured using x-ray pre and post taping also pain intensity was measured using visual analogue scale (VAS) **Results:** HVA showed a significant reduction in study group ($p = 0.001$) for right and left feet while non-significant reduction occurred in control group ($p = 0.11$ for right foot, $p = 0.09$ for left foot, while pain showed significant improvement in both study and control groups in both feet ($p = 0.001$).

Conclusion: The results of this study revealed that KT in mobile hallux valgus for 8 weeks is effective on improving the metatarsophalangeal joint angle, decreasing pain, and hence may has positive functional impact in patients with hallux valgus**.**

Clinical trial registration: retrospectively registered 5th of DEC. (NCT05165134)

Introduction

Pain and deformities that cause psychological disturbance and may be discomfort to individuals during daily living activities are often seen with Metatarsophalangeal (MTP) joint problems. The most common problem is Hallux Valgus (HV) which has progressive subluxation of the metatarsophalangeal joint of the big toe and increasing its valgus angle combined with proximal phalanx pronation [1].

Till now the main cause of HV is not clear enough. Hence its treatment methods, so many researchers were searching for that as this deformity has negative effects on balance, gait, and even kinematics of the gait alterations, which reflect on human function and quality of life [2].

Adults during ages between eighteen to sixty-five have incidence rate of HV reached to 23%. The incidence decreased in males than females to be 16.3% in males, 29.6% in females, and increased age

lead to increased incidence of HV to be 35.7% in people exceeding 65 years. HV severity increases with using of low mechanical quality styles of the shoes specially shoes with narrow tips, and high heels [1].

Assessment of HV using the Radiographic method depend on measuring a single option of the following angles, Hallux valgus angle (HVA) which is the angle formed by the longitudinal axis of first metatarsal and longitudinal axis of big toe proximal phalanx, its normal value is <15°. Also, the Intermetatarsal angle (IMA) angle formed by the longitudinal axes of metatarsal bones of big and second toes, its normal value is <9° [3].

As mentioned before so many protocols were used for management of HV aiming to Stop the progression of the case, case accommodation with rigid deformities, and pressure distribution on the area of deformity instead of pressure concentration during weight bearing [4]. Many types of tapping, exercise therapy, orthotics, modification of footwear, mobilization, chiropractic, and different modalities of physical therapy are widely being used conservatively to control HV in the shape of mild to moderate cases [5]. While surgical intervention alternatively may be used with severe cases [6].

Poor corrections or deformity recurrences were seen in about 10 to 14% of surgery cases with many postoperative complications which might be noticed. One of the causes that explain the great limitation of surgery success is the development of 150 new methods of surgical intervention for HV reduction [7].

Previously many studies were established to evaluate how much were the conservative non-surgical measures effective in HV control and reduction [8]. A Cochrane review about HV management interventions was published by Ferrari et al, which suggested that foot orthoses, and night splints had the same effect of treatment with nothing, after the assessment of non-surgical measures vs treatment with nothing three trials within the review [6,9].

Nowadays, usage of different taping techniques as a conservative control and HV management becomes a trend [10]. A single option of the safe, practical, and comfortable taping techniques with good clinical impact is Kinesiotape (KT). Kenzo Kaze firstly develop and use KT in clinical settings to decrease edema, control pain, and improve the motor functionality, he mostly used KT for musculoskeletal problems and in some types of injuries [11].

Although there have been many studies on taping protocols for knee, and ankle problems, those studies concerning taping for HV is limited or short term and the available studies had contradicted results.

The main purpose of this study was for evaluating the long-term effects of KT on hallux valgus deformity. Second, the goal of this research was to determine the taping therapy's long-term effects on pain and functional status in HV joint function.

Materials And Methods

The design for this study was pre-test post-test randomized control trial study. Ethical approval was obtained from the ethics committee of scientific research of Jazan University and each patient signed an

informed consent form authorizing his/her participation. All steps of evaluation and treatment of this study was performed between August 2020 till January 2021.

Participants:

Using G*Power software (Universität Mannheim, Mannheim, Germany), and assuming effect size 0.3 of the main outcome variable obtained from a previous similar study [8] **Radwan et al. 2017**, and prior sample size analysis with 90% power (Type II error rate, 0.10) and alpha-level 0.05 (Type I error rate) predicted that we would totally require 32 participants.

For the case of dropout, the sample size is increased by a 15% rate, and so the appropriate minimum sample size for this study was 45 subjects were assigned to be assessed for eligibility to share in the study, finally 36

Patients were assigned randomly with 1:1 ratio into either to study (A) or control (B) group. Finally, thirty subjects complete the study due to some causes listed with the consort flow chart in (figure.1).

All participants were selected from Physical Therapy department of Jazan University hospital within Jazan city, Jazan, Saudi Arabia. The study included 30 volunteers, 18 females, 12 males; their age ranged from 18 to 40 years old as this is the range of age of productivity, and Their BMI was ranged from 20 Kg/m2 to 25 Kg/m2.

All subjects had mobile HV bilaterally which mean that, hallux can be normally repositioned manually without any significant resistance. Nearly all the volunteers had Metatarsophalangeal (MTP) joint discomfort of big toe. Patients with lower extremity malalignment (e.g., genu valgum, genu varum), limitation in the abduction motion of the big toe, a diagnosis of rheumatoid arthritis, a history of previous foot surgery and previous use of orthotics specially for foot were excluded from this study. Also, patients that had and precautions of exposure to X-ray were excluded.

The patients were assigned randomly into two groups using the block randomization method. **Group A** is the study group and **Group B** is the control group. all subjects were informed about the procedures and gave their written informed consent form. Group A received (KT) for realignment of HVA (Metatarsophalangeal angle MPA) changed every 5 days for 8 weeks [12].

With exercise program for 8 weeks, subjects informed to do 10 repetitions three periods a day. Group B received placebo taping on Metatarsophalangeal joint with exercise the same for study group. [8]

Instrumentation

For evaluation

A Universal Weight and Height Scale: used for measuring the patient's BMI.

Visual analogue scale (VAS): A single dimension pain intensity measure [13], consisting of a straight horizontal line of constant length of 100 mm (10 cm), with 0 indicating no pain and 10 indicating the utmost agony experienced by the patient [14].

X-ray machine: Digital mobile x-ray machine, AGFA DX-D100 model, manufactured in 25-07-2017 by India Mart.

For treatment:

Kinesiotape (KT): (Kinesio) tape, made in Korea 2020 Used for both groups A and B. Cotton is the main constituent of the tape, it has an anti-allergic, evaporating, and quick drying adhesive layer. These properties make it resistant and wearable for extended period, in general, three to five days per once; it is even water resistant. The tape's flexibility reached about 140 percent, which is comparable to human skin [15].

Procedure of assessment:

Pain assessment: Patients in both groups were instructed to mark their own pain intensity perception on a 10 cm horizontal line (VAS), in which 0 states painless and 10 states maximum pain that the patient feels. Pain assessment procedure was done in the department of physical therapy, college of applied medical sciences, Jazan University, Jazan, Kingdom Saudi Arabia.

Radiographic assessment: For both groups, a weight bearing dorsoplantar X-ray was taken of both feet together including the HVA. Pre and post treatment [16].

Measurement of HVA: within literature, a variety of methods for measuring these angles have been documented. This study employed the approach specified by the American Orthopedic Foot and Ankle Society's ***Ad Hoc*** Committee on Angular Measurements [17,18].

The bared feet were in a standing erect position (figure 2), the tube was 100 cm away from feet, and the voltage and ampere of current were 55 KVP and 1.7 mAS, respectively. After that, the CorelDraw software was used to examine the image (Version 12.0, Corel Corporation, Ottawa, Canada). An angle between the lines of the first metatarsal's central longitudinal axis and the axis of the hallux connecting to the first MTP joint was established (figure 3).

Radiographic assessment procedure was done in the department of Radiology, College of applied medical sciences, Jazan University, Jazan, Kingdom Saudi Arabia, the radiologic evaluation was completed by radiologists who were kept in the dark about the study's purpose to avoid bias.

Procedure of treatment:

Kinesiotape (KT):

KT procedure was done in the department of physical therapy, college of applied medical sciences, Jazan University, Jazan, Kingdom Saudi Arabia.

Group A (Study group):

The KT method for HV, invented by Kenzo Kase, was applied to tape the subjects [19]. Two Y-shaped strips of elastic tape were employed, with the base end of the Y-shaped strip put on the hallux's base. After the big toe was adjusted to its estimated normal position, the tape was put through the first ray (it was manually abducted by the practitioner) with a light to moderate stretch (figure 4).

This adjustment was made only once during the tape's installation and took less than 10 seconds. There wasn't any traction used, performing a mechanical correction technique on hallux, the second tape piece was placed over metatarsophalangeal joints [7]. KT was applied on both right and left side and was being replaced every 5 days for the period of 8 weeks which is the period of study [8].

Group B (control group):

KT for placebo taping. The tape had been cut in I shape and applied to the foot's medial surface just above the 1st MTP joint without any stretch force [1].

All the patients were made aware of the significance of using appropriate shoes for their deformities, and they were given an exercise program for deformity of HV to perform during the period of study for 8 weeks.

Strengthening and mobilization activities were included in the workout. The patient was effectively abducting the hallux during the strengthening exercise, which was done in a sitting position (moving hallux medially while fixing the second toe).

Patients were taught to count to five with ten repetitions for this activity. In a sitting position, the patient applied traction to his/her own hallux in a longitudinal direction, then aligned the hallux for 30 seconds without releasing the traction. This practice was completed five times. The physiotherapist demonstrated each exercise, and Patients were instructed to do them twice a day at the very least 8 weeks [20].

Statistical analysis

Unpaired t-test was conducted for comparison of subject characteristics between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to ensure the homogeneity between groups. Mixed design MANOVA was performed to compare within and between groups effects on HVA and pain. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

Results

Thirty participants finished the study. table (1) illustrate the comparison of subject characteristics within the study (A) and control (B) groups. HVA and VAS results are shown in table (2) were measured pre and post treatment for both study (A) and control (B) group, HVA and pain perception (VAS) showed great improvement in study group with nonsignificant changes of HVA with significant improvement of pain perception (VAS) in control group. HVA improved in control group, but both groups had significant improvement in pain perception (VAS). $P \leq 0.001$.

Subject characteristics:

Table (1) showed the subject characteristics of the study and control groups. There was no significant difference between groups in age, weight, height, and BMI ($p > 0.05$).

Effect of treatment on HVA and pain:

There was a significant interaction of treatment and time ($F_{(4.25)} = 21.63$, $p = 0.001$, $= 0.77$). There was a significant main effect of time ($F_{(4.25)} = 80.79$, $p = 0.001$, $= 0.92$). There was no significant main effect of treatment ($F_{(4.25)} = 1.21$, $p = 0.32$, $= 0.16$).

Within group comparison

There was a significant decrease in right and left HVA of the study group post treatment compared with that pretreatment ($p > 0.001$), while there was no significant difference in right and left HVA of the control group between pre and post treatment ($p > 0.05$). The percent of change of right and left HVA of study group was 17.61 and 12.32% respectively and that of control group was 2.06 and 2.48% respectively (Fig. 5).

There was a significant decrease in VAS of right and left sides of the study and control groups post treatment compared with that pretreatment ($p < 0.001$). The percent of change of VAS of right and left sides of study group was 60.71 and 52.97% respectively and that of control group was 55.84 and 41.8% respectively (Fig. 6) (Table 2).

Between groups comparison:

There was no significant difference between groups pre-treatment ($p > 0.05$). There was a significant decrease in right and left HVA of study group compared with that of control group post treatment ($p < 0.01$). However, there was no significant difference in VAS of right and left sides between groups post treatment ($p > 0.05$) (Table 2).

Discussion

In this study (KT) was used which is well known as therapeutic elastic tape that have an effect of mechanical correction of malalignment and malorientation of pelvis [21], shoulder [22], it may also share in injury prevention [23], great role in pain alleviation [24,25,26,27], and improvement of lymphatic system function [28].

The current study had some differences with previous studies in the method and duration of tape application**.** The results of the current study revealed that HVA and pain perception VAS showed great improvement in study group with nonsignificant changes of HVA with significant improvement of pain perception (VAS) in control group.

The most common toes, and feet deformities is HV specially between females. Medial edge, sole of the feet, and other toes than big toe are the most common feet sites that suffer from symptoms related to HV in which there is involvement of adductor and abductor muscles of big toe mainly. The underlying HV etiology is still not have detailed definition, but there is a common explanation between researchers talking about foot deformities due to ill-fitting shoes. Females are the most who run after fashion trends which in common lead to wear high heel shoes with narrow toe boxes that leads to crowd toes due to forefoot shift towards toe box [8].

The significant improvement of HVA in study group after using KT also was reported in previous studies with other authors as well. The better information integration occurs consistent use of KT on skin due to increased sensory signals to the central nervous system (CNS) which occurred in response to cutaneous mechanoreceptors stimulation [29,30].

On the other hand, continuous cutaneous stimulation may reduce the threshold of motor neurons which increase recruitment of more motor units, that will enhance muscle contraction and therefore muscle strength. These findings agree with **Kim et al, 2016** who stated that, improvement of contraction of inactive muscles may be achieved with enhancement of sensory feedback occurred within the skin area under KT in response to the combined previous mentioned mechanisms [31].

Also, there may be a possibility of creating axial mobilization similar action by correcting the alignment position of the joint. This come in agree with the opinion of Karabicak et al, 2015 they stated that KT in HV leads to mechanical correction that greatly help in fascia, muscle, and joint realignment and positioning, therefore lead to stimulus adaptation of the body to normalize the positioning [7].

Brantingham et al, 2005 also cited that light mobilization exercises may have a great impact on pain sensation, which is obtained in this study due to the correction method that being like these light mobilization exercises [32].

Also, muscle strengthening which is performed in both groups as routine exercise for the whole period of the study and combined with KT in study group may lead to improvement of HVA due to abductor hallucis strength improvement, this finding come in agree with **Glasoe, 2016** who reported that in patients with HV, in spite the effect of strengthening of big toe muscles is totally unexamined but, a program of

exercise in combination with taping may decrease pain and, gradually lead to patient's walking ability improvement [20].

The improvement of pain sensation with KT in study group and placebo KT in control group may occurred due to the slight stretch occurred to the skin under the KT, that will open the superficial lymphatic channels due to the skin recoil occurred after stretch. That agreed with **Radwan et al, 2017** who reported that the area under KT is very rich in circulation after opening of the superficial lymphatic channels.

Hence, the lactic acid that induce pain with the waste products efficiently removed with the fluid through the superficial lymphatic channels and leave the superficial pain receptors under KT free of pressure [8]. That may reflect on the results of pain relief in study and control groups of this study.

Usage of orthotics with HV may lead to lose of active Range of Motion (ROM) and/or circulation inhibition, the KT technique with this study and generally maintains a position of functional correction without suffering of the previous complications, beside the effect of manipulative correction due to continuity of application. So, KT may produce the same axial mobilization exercise which shared previously in normalization of joint alignment but this time it will share also share in pain inhibition in study group [32].

Finally, pain reduction according to Easly and Trnka may occurred due to correction of the toe, and foot mechanics produced by KT [33]. The results of this study report that functional improvement obviously noticed but more studies will be needed to measure this functional improvement with KT objectively.

Conclusion

This study concluded that KT in mobile hallux valgus for 8 weeks is effective on improving the metatarsophalangeal joint angle, decreasing pain, and hence may has positive functional impact in patients with hallux valgus.

Declarations

Ethics approval and consent to participate:

The research protocols were approved (REC41/5/138) by the Ethics Committee of the University of Jazan, Jazan, Kingdom of Saudi Arabia. A written informed consent was obtained from all participants.

Consent for publication

Not applicable.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the

corresponding author on reasonable request.

Competing interests

Not applicable.

Funding

None.

Authors' contributions

Mohamed m. m. Ahmed designed the experiment after literature review, performing most of the practical part of treatment and evaluation pre and post experiment, and prepared the draft manuscript. **Magdy Gharib** applied the radiographic procedure, collected data, and shared in preparation of draft manuscript. **Mahmoud Moustafa** finished the process of measuring the HV angle and data analysis. **Mohammed Qasheesh** sample selection, data analysis and results review and shared in preparation of draft manuscript. All authors read and approved the final manuscript.

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Tables

Table 1. Comparison of subject characteristics between study and control groups:

	Mean ±SD		p-value
	Study group	Control group	
Age (years)	29.86 ± 7.08	28.26 ± 5.41	0.49
Weight (kg)	61.4 ± 6.44	61.86 ± 6.35	0.84
Height (cm)	164.4 ± 5.74	163.13 ± 6.44	0.57
BMI (kg/m²)	22.65 ± 1.22	23.18 ± 0.89	0.19

SD, Standard deviation; p-value, level of significance

Table 2. Mean HVA and pain pre and post treatment of study and control groups:

	Study group	Control group		
	Mean ±SD	Mean ±SD	MD (95% CI)	P value
Right HVA				
Pretreatment	29.53 ± 4.1	29.13 ± 3.73	0.4 (-2.53: 3.33)	0.78
Post treatment	24.33 ± 2.89	28.53 ± 4.01	-4.2 (-6.81: -1.58)	0.003
MD (95% CI)	5.2 (4.45: 5.94)	0.6 (-0.14: 1.34)		
% Of change	17.61	2.06		
	p = 0.001	***p = 0.11***		
Left HVA				
Pretreatment	26.53 ± 2.89	27 ± 2.75	-0.47 (–2.58: 1.64)	0.65
Post treatment	23.26 ± 2.63	26.33 ± 2.32	-3.07 (-4.92: -1.21)	0.002
MD (95% CI)	3.27 (2.46: 4.06)	0.67 (-0.13: 1.46)		
% Of change	12.32	2.48		
	p = 0.001	***p = 0.09***		
VAS of right side				
Pretreatment	5.6 ± 1.68	5.73 ± 1.94	-0.13 (-1.49: 1.22)	0.84
Post treatment	2.2 ± 1.93	2.53 ± 1.59	-0.33 (-1.66: 0.99)	0.61
MD (95% CI)	3.4 (2.64: 4.16)	3.2 (2.43: 3.96)		
% Of change	60.71	55.84		
	p = 0.001	***p = 0.001***		
VAS of left side				
Pretreatment	3.53 ± 1.88	3.66 ± 1.91	-0.13 (-1.55: 1.28)	0.84
Post treatment	1.66 ± 1.23	2.13 ± 1.45	-0.47 (-1.47: 0.54)	0.35
MD (95% CI)	1.87 (1.25: 2.47)	1.53 (0.92: 0.14)		
% of change	52.97	41.8		
	p = 0.001	***p = 0.001***		

SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p-value, Level of significance

Figures

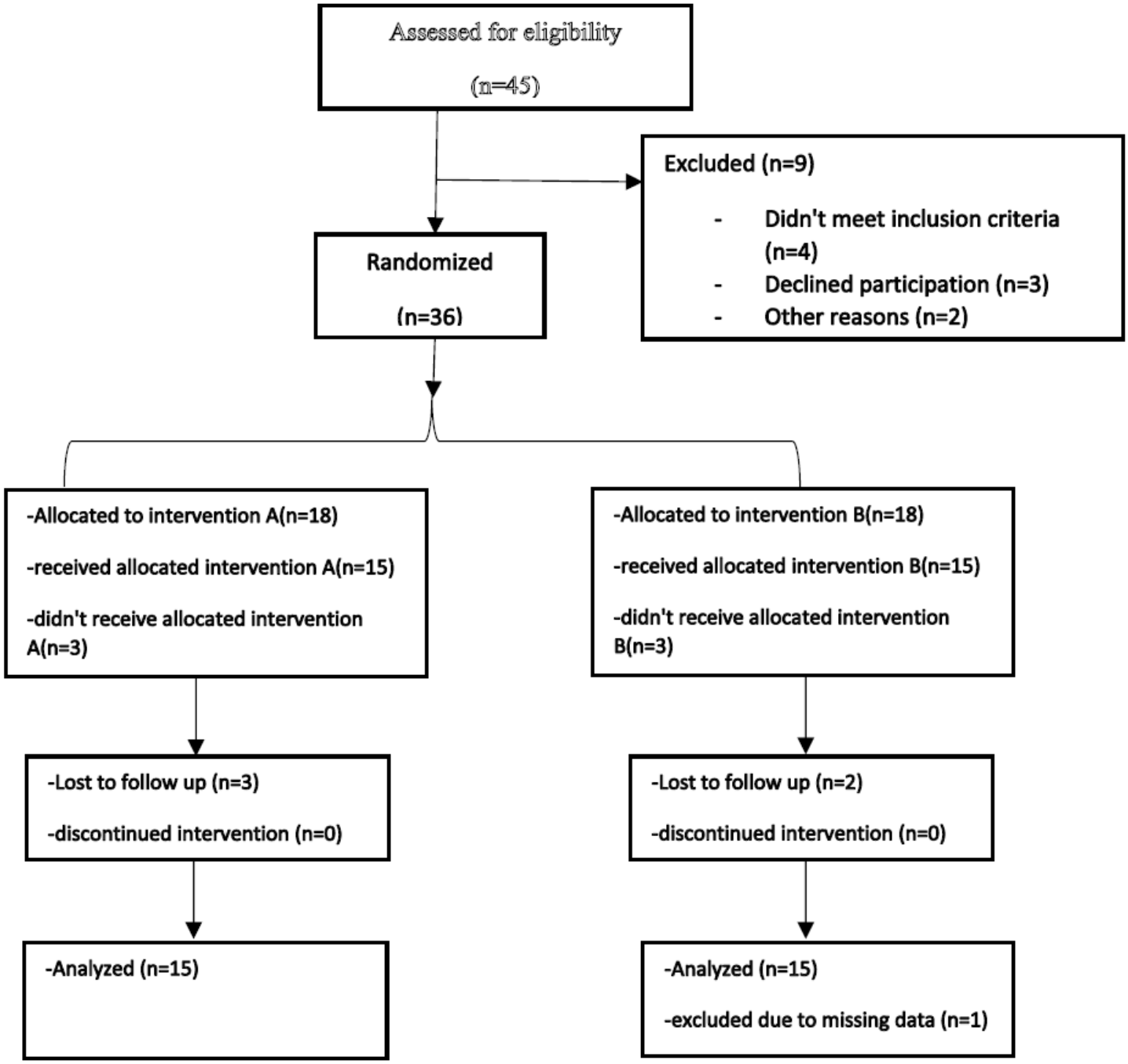

Figure 1

Consort flow chart of the participants with randomization

the appropriate minimum sample size for this study was 45 subjects were assigned to be assessed for eligibility to share in the study, 9 were excluded because they didn't meet criteria (4), declined participation (3), (2) for other reasons. Finally, 36 Patients were assigned randomly with 1:1 ratio into either to study (A) or control (B) group. 15 participants only complete the study in each group due to lost to follow up and exclusion due to loss of data.

Figure 2

Standing erect with bared feet during radiographic evaluation

Using the Digital mobile x-ray machine, AGFA DX-D100 model, manufactured in 25-07-2017 by India Mart. The patient stands with both feet on the cassette. The cassette is positioned to include all the metatarsals and phalanges. The weight of the patient's body is distributed equally. The vertical ray 15 degree for feet is centered midway between the feet at the level of the first metatarsophalangeal joint.

Figure 3

Measurement of HVA on X-ray film

The angle between the lines of the first metatarsal's central longitudinal axis and the axis of the hallux connecting to the first MTP joint measured using the CorelDraw software.

Figure 4

KT for hallux valgus

Two Y-shaped strips of elastic tape were employed, with the base end of the Y-shaped strip put on the hallux's base. the tape was put through the first ray with a light to moderate stretch. The second tape piece was placed over metatarsophalangeal joints.

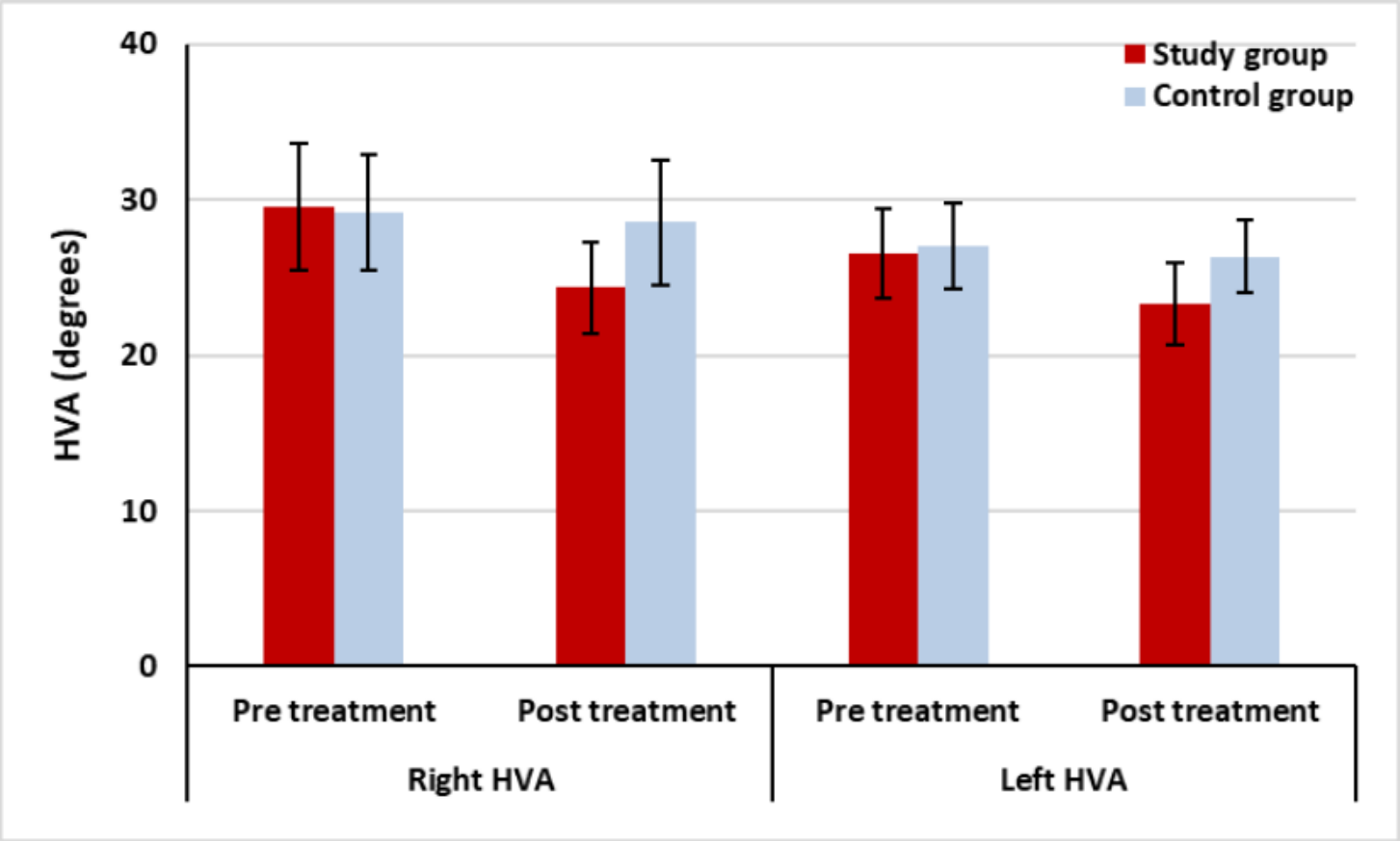

Figure 5

Mean HVA pre and post treatment of study and control groups

The figure showed a significant decrease in right and left HVA of the study group post treatment compared with that pretreatment ($p > 0.001$), while there was no significant difference in right and left HVA of the control group between pre and post treatment ($p > 0.05$).

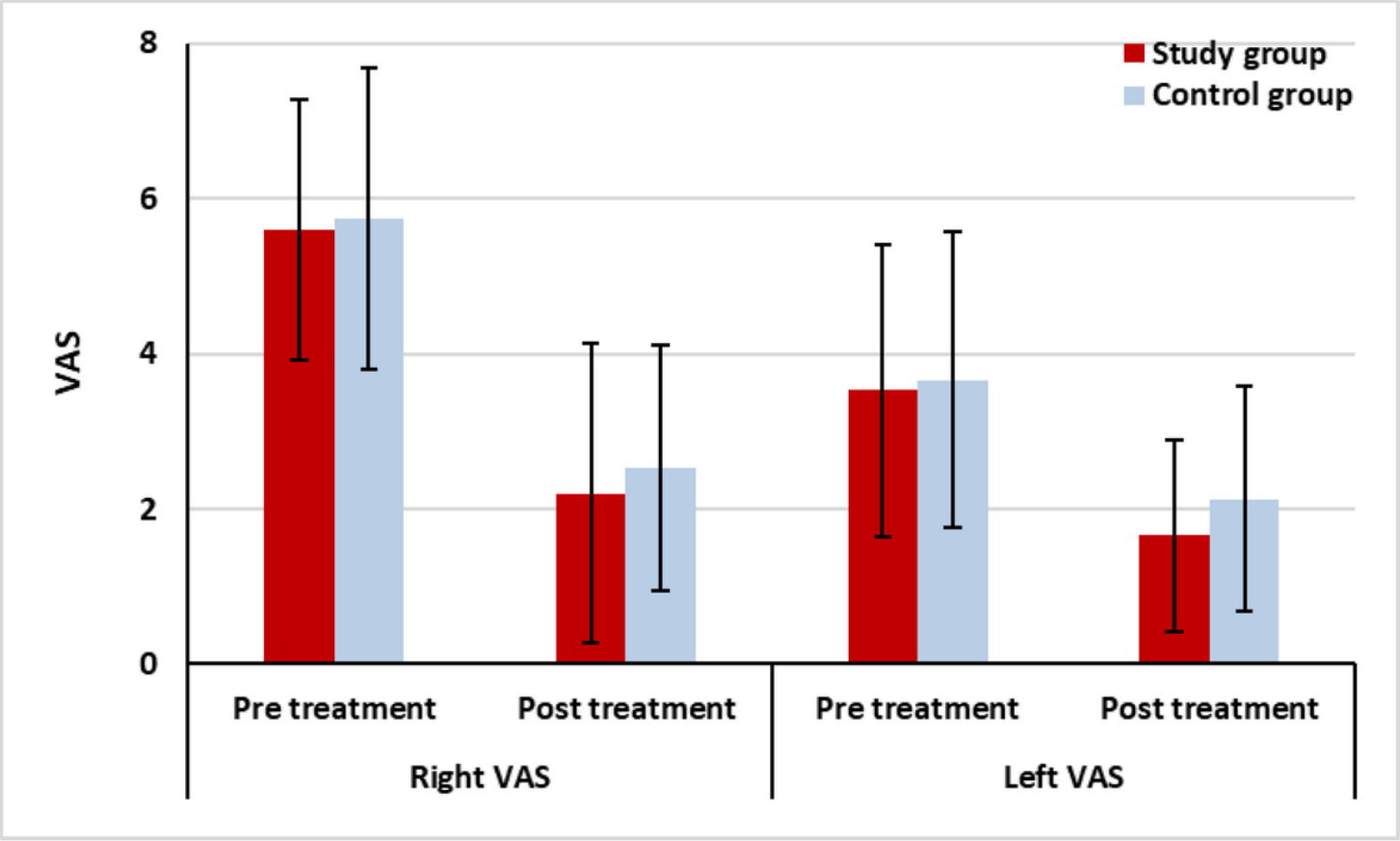

Figure 6

Mean VAS pre and post treatment of study and control groups

The figure showed a significant decrease in VAS of right and left sides of the study and control groups post treatment compared with that pretreatment ($p > 0.001$).