Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2017, 6(1): 71-78

Conventional Tape versus Kinesiotape for Hallux Valgus Correction

Nadia Lotfy Radwan[1*], Mervat Abdelrahman Mohamed[2], Abeer Ramadan Ibrahim[3]

[1] Lecturer, Biomechanics Department, Faculty of Physical Therapy, Cairo University, Egypt
[2] Assistant consultant of Physical Therapy, National Heart Institute, Egypt
[3] Lecturer, Basic Sciences Department, Faculty of Physical Therapy, Cairo University, Egypt
**Corresponding e-mail: nadiaradwan18@yahoo.com*

ABSTRACT

Aim: *This study was commenced to compare the effect of Kinesiotape (KT) versus conventional tape (CT) on HVA and IMA as well as the intensity of pain from HV deformity.* ***Methodology:*** *Female patients with age 45 to 60 years and diagnosed with mild to moderate HV were included in the study. The foot pain intensity was assessed by visual analogue scale (VAS) before applying tape and after completion of the study.* ***Results:*** *The outcome measures of pain intensity showed a non-significant difference between both groups before intervention ($p>0.05$). Within both KT and CT groups, the pre-and post-treatment scores were significantly different ($p<0.05$). In the comparison of the post-treatment scores, there was a significant difference ($p<0.05$) between both groups favouring the KT group..*

Keywords: Hallux valgus, kinesiotape, visual analogue scale, exercise

INTRODUCTION

Hallux valgus (HV) is a complex progressive deformity manifested with lateral deviation of the great toe and medial deviation of the first metatarsal bone [1]. The condition is frequently associated with a painful soft tissue and osseous prominence commonly referred to as a "bunion," on the medial side of the hallux base [2].

Inappropriate or constricting footwear appears to be the primary extrinsic cause. Intrinsic factors play a role as well [3]. Previous studies have reported that flat foot has some influence on bunion formation, while others suggested that pronation of the hindfoot as a major cause of this condition [4]. Metatarsus primus varus, which is characterized by an increased angle between the first and second metatarsals, is often associated with an HV deformity [5-7].

Other intrinsic factors of HV include muscle imbalance in abductor and adductor muscles, contracture of the Achilles tendon, generalized joint laxity, hypermobility of the first metatarsi cuneiform joint and neuromuscular diseases. Heredity is also thought to be a factor in the development of HV deformity [8-10].

HV causes symptoms in three stages. First, is the pain in the bunion which hurts to wear a shoe. Second, the valgus deviation of the big toe results in less space for the other toes. Upward displacement of the other toes occurs leading to pressure against the shoe (hammer toe). Third, the valgus deformity overload the metatarsal heads from 2 to 4 and this results in transfer metatarsalgia [11].

Females are significantly more likely to develop HV as compared with the males with sex ratios as high as 9:1, with the predominance of HV, increases steadily with age [2]. The condition has a significant effect on balance and gait patterns and is considered to be a risk factor for falls in older people [1].

Radiographic assessment of HV includes the evaluation of the hallux valgus angle (HVA) which was defined as the angle between the first metatarsal and proximal phalanx. As well as, the first-second inter metatarsal angle (IMA) which was defined as the angle between the first and second metatarsals. An HVA<15° and a first IMA<9° are considered to be normal [12,13].

Conservative treatment is generally proposed for patients with mild to moderate HV. Many patients may find permanent relief with nonsurgical measures [14]. It has 3 objectives: 1) prevent the deformity progression, 2) accommodate the

deformity when it is rigid, and 3) distribute the pressure in the region of the lesion [15]. It includes the use of night splints to balance the pull of the surrounding ligaments, foot exercises to increase the muscle strength and orthotic use to correct the foot biomechanics [16].

Several studies have been carried out in order to assess the effectiveness of different non-operative measures to reduce or control HV [3]. Ferrari, et al. [17] published a Cochrane review on interventions in the treatment of HV. This review included three trials that assessed non-operative measures versus no treatment, finding no evidence for differences in outcome measures. The evidence from these trials suggests that neither foot orthoses nor night splints appear to be more effective than no treatment at all [18].

Recently, there has been an increasing trend for the use of taping techniques in the conservative management of HV [19]. Although there are several studies involving taping techniques for knee and ankle problems, the number of studies concerning taping for HV is limited.

A newly adhesive, elastic tape in different colours is called kinesiotape (KT). This is thought to enhance neuromuscular control by stimulating skin receptors, and to improve lymphatic drainage via the elastic pull effect that reaches the deeper tissues [20,21]. Although there are various studies on the effectiveness of KT to restore muscle function and strength, improve range of motion, reduce pain, and increase lymphatic drainage, the effects of mechanical correction are limited [14].

Quantifying the specific effects of KT, conventional tape (CT) would provide helpful data for those patients suffering from painful HV. Moreover, there was no previous study comparing the effect of KT with CT. As such, the aim of this study was to compare the effect of KT versus CT on HVA and IMA as well as the intensity of pain for patients suffering from painful HV deformity.

METHODS

Subjects

Thirty female patients their age ranged from 45 to 60 years old diagnosed as mild to moderate HV (HVA between 20° to 40°) were included in this study. Their BMI was ranged from 20 Kg/m^2 to 25 Kg/m^2. All patients had bilateral flexible HV i.e., the hallux can be restored to the normal position manually without any significant resistance. All of them had pain in the region of the 1st MTP joint. If the patients had evidence of lower extremity malalignment (e.g. genu valgum, genu varum), limitation in the abduction movement of the hallux, a diagnosis of rheumatoid arthritis, a history of previous foot surgery and previous use of foot orthoses were excluded from this study. The patients were randomly assigned into two groups each group of 15 patients using the block randomization method. Group 1 (The KT group) and Group 2 (the CT group). Before participation, all patients were informed about the procedures and gave their written informed consent form.

Assessment

The intensity of foot pain was evaluated by the 10 cm visual analogue scale (VAS) before applying tape and after completion of the study. HVA and IMA were obtained through radiographic assessment before and after the study duration.

Procedures

Following the initial evaluations, both groups were given information about appropriate shoe-wear. The foot exercise program was instructed as a home program for both groups. The patients were asked to exercises 3 times a day with 10 repetitions and for 8 weeks. Each exercise was demonstrated by the physiotherapist. The exercises consisted of a passive abduction of the hallux with the traction of the first MTP joint and active abduction of the hallux.

Taping methods

For Group 1, patients were taped with HV kinesiotaping method developed by Kenzo Kase [22]. Two Y-shaped KT pieces were used; the Y-shaped strip's base was placed on the base of the hallux. After the big toe was aligned to its estimated correct position with a light to moderate tension, the tape was implemented through the first ray. This correction was done once during the implementation of the tape and took less than 10 seconds. The second tape piece was placed over MTP joints with a mechanical correction technique on the big toe (Figure 1). After finishing the

tape application, patients were allowed to walk for 10 min to be adapted with the tape. Each patient was trained by a physiotherapist for the taping. The KT was applied 12 times overall during the eight-week period (every 5 days).

For Group 2, CT was used. Two centimetre wide strip was applied to the distal toe at the base of the toenail, and a 3.8 cm wide strip was applied to the instep and the arch of the foot. Then another strip 2 cm wide was applied parallel to the midline of the medial aspect of the foot, from the distal to the proximal anchor, sustaining the big toe in a midline position. The taping was completed with light circumferential strips covering the sites of the original anchors with 2 cm and 3.8 cm tape [6] (Figure 2). Each subject was trained by a physiotherapist for the taping. The patients were asked to do the taping twice daily.

Outcome measures

Pain: The pain was evaluated by a visual analogue scale (VAS). Patients were instructed to mark their own pain intensity perception on a 10 cm horizontal line, in which 0 states no pain and 10 cm states maximum pain that the patient feels.

Radiographic measurements: For all patients, a weight bearing dorsoplantar X-ray was taken of both feet together including the HVA and IMA. An additional lateral or oblique view in this position contributes little extra information because the bones are superimposed [11]. A variety of methods for measuring these angles is reported in the literature. In this study, we used the method recommended by the *Ad Hoc* committee of the American Orthopedic Foot and Ankle Society on Angular Measurements [20,23]. In both the first and second metatarsals, reference points were placed 1 cm to 2 cm proximal to the distal articular surface and 1 cm to 2 cm distal to the proximal articular surface in the middle of the shafts. Proximal phalanx reference points were placed 0.5 cm to 1 cm proximal to distal to the articular surfaces also in the midline.

Statistical analysis

All statistical analyses were carried out using SPSS for Windows, version 20.0. Descriptive statistics were computed for all outcome measures. Parametric data were expressed as mean ± SE. Whereas, non-parametric data were expressed

Figure 1 The KT technique used in the study

Figure 2 The CT technique used in the study

as median (interquartile ranges). Wilcoxon Signed rank test and Mann-Whitney U test was used to determine VAS's scores differences within and between groups respectively. As such, paired and unpaired T-test was used to determine the within and between-group changes regarding HVA and IMA. Data were considered statistically significant if P<0.05.

RESULTS

Baseline demographic characteristics of KT group and CT group were shown in Table 1. There was no significant difference between both groups regarding their age, BMI, and gender. In addition, data from both groups with reference to the severity of HV deformities didn't show any significant changes (p>0.05) which indicate homogeneity of the sample.

VAS scores of subjects of both groups before and after intervention were presented in Table 2. The outcome measures of pain intensity showed a non-significant difference between both groups before intervention (p>0.05). Within both KT and CT groups, the pre-and post-treatment scores were significantly different (p<0.05). In the comparison of the post-treatment scores, there was a significant difference (p<0.05) between both groups favouring the KT group (Figure 3).

HVA and IMA scores

Pre-and post-treatment scores of HVA and IMA for both groups were presented in Table 3. There were no significant

Table 1 Demographic characteristics of patients at the baseline

Parameters		KT group	CT group	p-value
Age (years)		52.60 ± 5.58	50.20 ± 4.52	0.206
BMI (kg/m²)		22.53 ± 1.42	21.60 ± 1.55	0.095
Gender n (%)	Male	6 (40%)	8 (53.3%)	0.492
	Female	9 (60%)	7 (46.7%)	-
HVA n (%)	Mild	11 (73.3%)	12 (80%)	0.671
	Moderate	4 (26.7%)	3 (20%)	-

(kg/m²): Kilogram per meter square, n (%): number of patients (percentage to total group number), p: significance level

Table 2 Visual Analog Scale's scores of both groups before and after intervention

VAS scores	Right side				Left side			
	KT group M (IQR)	CT group M (IQR)	z-value	p-value	KT group M (IQR)	CT group M (IQR)	z-value	p-value
Pre	4 (3-5)	5 (4-6)	-1.271	0.204	5 (4-5)	5 (4-5)	-0.415	0.678
Post	1 (0-2)	2 (1-3)	-1.98	0.046*	1 (0-2)	3 (1-3)	-2.01	0.044*
z-value	-3.46	-3.27	-	-	-3.43	-3.2	-	-
P-value	<0.001*	<0.001*	-	-	<0.001*	0.002*	-	-

KT: Kinesiotaping group, CT: Conventional Taping group, M(IQR): Median (Inter Quartile Ranges), p: significance level, *p<0.05.

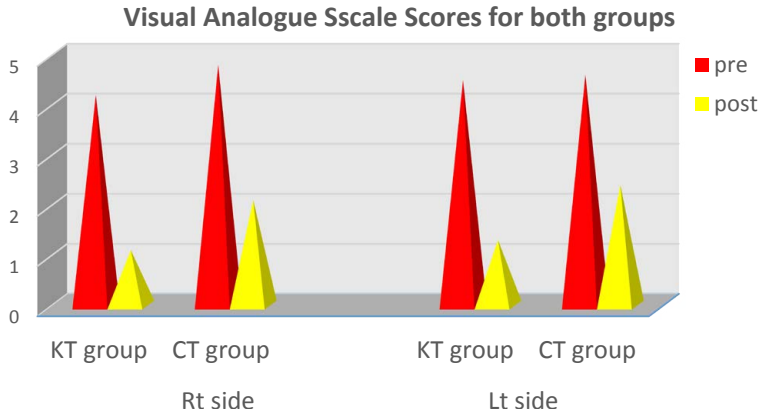

Figure 3 Pre-and post-treatment mean difference of VAS 's scores for both groups

Table 3 HVA and IMA for both groups before and after the intervention

Variables		Right side			Left side		
		KT group $\bar{X}$ ± SD	CT group $\bar{X}$ ± SD	p-value	KT group $\bar{X}$ ± SD	CT group $\bar{X}$ ± SD	p-value
HVA	Pre	28.33 ± 2.35	28.73 ± 3.31	0.705	29 ± 3.16	30.33 ± 1.92	0.173
	Post	16.40 ± 1.96	19.07 ± 3.92	0.026*	18.73 ± 2.58	21.60 ± 3.31	0.014*
	P-value	<0.001*	<0.001*	-	<0.001*	<0.001*	-
IMA	Pre	13.67 ± 2.53	14.10 ± 2.43	0.662	14.33 ± 2.7	15.13 ± 2.5	0.401
	Post	8.40 ± 1.18	9.47 ± 1.72	0.033	8.33 ± 1.30	9.53 ± 1.46	0.024
	P-value	<0.001*	<0.001*	-	<0.001*	<0.001*	-

differences of either the right or left HVA or IMA between both groups. Within both groups, the right and left HVA and IMA significantly changed ($p<0.05$). Additionally, statistically significant differences in the post-treatment scores of HVA and IMA between both groups were recorded in favour of the KT group ($p<0.05$).

DISCUSSION

HV is the commonest forefoot deformity with high prevalence. It causes symptoms on the medial edge of the foot, the sole, and the small toes. A diagnosis of HV is made in patients with an HVA greater than 15°; a slight lateral deviation of the great toe is normal [24]. The severity of the deformity includes: mild (HVA up to 19°, IMA up to 13°); moderate (HVA 20° to 40°, IMA 14° to 20°); severe (HVA>40°, IMA>20°) [5]. Patients recruited for our study had at least a mild deformity of 20°; the most serious deformity was 40°.

Muscle imbalance in abductor and adductor muscles is cited as a major factor in the production of HV [25]. Thus, in order to increase muscle strength and attain joint mobility, both groups were instructed to perform passive and active abduction exercises.

Moreover, the use of an ill-fitting shoe is agreed to be the main factor in most forefoot deformities, especially in women [26,27]. Because of fashion trends, some women wear shoes that are narrower than their feet and have narrow toe boxes. In addition, high heels shift the forefoot forward into the toe box, causing crowding of the toes [10,28]. To put this in consideration, all patients were instructed about the suitable shoe wear (wide round toe box with normal heel height from 1 inch to 1.5 inch).

Considering the effect of taping on pain intensity

After eight-week treatment program, the results revealed that: within both KT and CT groups, the pre-and post-treatment scores were significantly different. In comparing the post-treatment scores of both groups, there was a significant difference between both groups favouring the KT group. Pain reduction might be attributed to the correction of toes alignment which may help the foot to propel better in the gait cycles.

Pain reduction in the KT group may be attributed to the way in which the tape was applied to the skin. The KT was applied to the skin in a slightly stretched position and adheres to it. When the tape recoils from the stretched position, it lifts the skin creating visible convolutions on the skin surface. When the skin is lifted, the superficial lymphatic channels are opened which allow for more efficient circulation. Consequently, the congested fluid is removed taking with pain-inducing lactic acid and waste products. So, blood rich in oxygen enter the area more easily. These mechanisms take pressure off pain receptors embedded under the skin. Pain is reduced as a result [29].

In consistency with our results, Öztürk, et al. [30] found an improvement in pain intensity with KT application. They suggested that this pain relieve mechanism may be attributed to the reduction of the subcutaneous nociceptor pressure in the skin or to the afferent stimuli to the soft tissue structures.

Pain reduction in the CT group may explain that taping enhances the correct alignment of the hallux and prolongs this position during ambulation.

Considering the effect of taping on HVA and IMA scores

Also, statistically significant differences in the post-treatment scores of HVA and IMA between both groups were recorded in favour of the KT group. The results of this study showed no significant differences of either the right or left HVA or IMA between both groups. Within both groups, the right and left HVA and IMA significantly changed.

In a study carried out by Du Plessis, et al. [31], 20% change in HVA was considered to be clinically meaningful. The results of this study showed a meaningful clinical change regardless the severity of patient's deformity. The improvement in both groups suggests that both tape types exerts a corrective force on the hallux.

The reduction of HVA and IMA in the KT group

The results of the KT may be attributed to the reflex mechanism of the nervous system on muscles. Recent researchers have stated that constant application of tape over the skin stimulates the cutaneous mechanoreceptors, so this allows for more sensory signals to the central nervous system for integration of the information [32]. Also, motor neuron threshold reduction caused by cutaneous stimulation may affect the motor unit recruitment, which can facilitate muscle contraction, and hence improve muscle strength. Also, it was suggested that KT enhances sensory feedback of the taped area by skin stretching which improves contraction of inactive muscles [32].

Another mechanism that in our study, a correction was done to the first MTP to align it to its adjusted position manually, this correction was done without applying any traction to the hallux joint. This method is known as a mechanical correction, and it is used to assist in the positioning of muscle, fascia, or joint to stimulate a sensation, that results in body's adaptation to the stimulus [33,34].

This correction method is similar to the light mobilization exercise, which was cited in a study carried out by Brantingham, et al. [34] and the exercise reported in this study included repetition of 5 to 10 times. A statistically meaningful reduction of pain and foot function index was noted in the treatment group as a result of this protocol. In our study, we used the KT method for 8 weeks renewing it every 5 days and had similar results.

Moreover, the KT technique maintains a functional correction without limiting the active range of motion or inhibiting the circulation. When the tape is on the tissue, it acts as if the manipulative correction effect was still effective [14].

According to Williams, et al. [35], KT application results in a small immediate increase in muscle strength by inducing a concentric pull on the fascia, which may increase muscle contraction. Another hypothesis suggests that, muscle strength improvement may be due to the facilitation of muscle activity and proper muscle alignment [30,36].

The reduction of HVA and IMA in the CT group

This may be explained by, CT maintains the joint in an appropriate anatomic position to prevent or reduce positioning default. It also helps to decrease the stress on the joint and prevent subluxation by reducing the gravitational pull on the joint [37].

Alexander, et al. [38] suggested that the shortened position of the muscle which maintained by the tension of the tape results in a reduction in tonic muscle spindle activity. The reduction in the spindle afferent input may lead to its inhibition. This is the same as in the CT application. These results come in agreement with our study which demonstrated that CT provides less effect than KT. Moreover, the significant difference between KT and CT groups may be due to different techniques of taping application with different tensions which give different tactile stimuli [32].

CONCLUSIONS

HV deformity can be corrected by KT or CT application when combined with the exercise training program. So, this approach may be considered as an effective and safe conservative approach for patients with mild to moderate HV.

ACKNOWLEDGEMENTS

The authors would like to express their appreciation to all patients who participated in this study for their cooperation.

REFERENCES

[1] Tehraninasr, Ali., et al. "Effects of insole with toe-separator and night splint on patients with painful hallux valgus: a comparative study." *Prosthetics and orthotics international* 32.1 (2008): 79-83.
[2] Menz, Hylton B., et al. "Impact of hallux valgus severity on general and foot-specific health-related quality of life." *Arthritis care and research* 63.3 (2011): 396-404.
[3] Sobel E, Levitz S. Hallux valgus assessment and conservative management, and the role of faulty footwear. *Podiatry Management* (2001): 75-96.
[4] Nix, Sheree, Michelle Smith, and Bill Vicenzino. "Prevalence of hallux valgus in the general population: A systematic review and meta-analysis." *Journal of foot and ankle research* 3.1 (2010): 21.

[5] Robinson, A. H. N., and Limbers J. P. "Modern concepts in the treatment of hallux valgus." *Bone and Joint Journal* 87.8 (2005): 1038-1045.
[6] Bayar, Banu, et al. "The effects of taping and foot exercises on patients with hallux valgus: a preliminary study." *Turkish Journal of Medical Sciences* 41.3 (2011): 403-409.
[7] Schuh, Reinhard, et al. "Rehabilitation after hallux valgus surgery: Importance of physical therapy to restore weight bearing of the first ray during the stance phase." *Physical therapy* 89.9 (2009): 934.
[8] Coetzee, J. Chris, et al. "The Lapidus procedure as salvage after failed surgical treatment of hallux valgus." *J Bone Joint Surg Am* suppl 1 (2004): 30-36.
[9] Coughlin, Michael J., and Caroll P. Jones. "Hallux valgus: Demographics, etiology, and radiographic assessment." *Foot and ankle international* 28.7 (2007): 759-777.
[10] Perera, A. M., Lyndon Mason, and Stephens, M. M. "The pathogenesis of hallux valgus." *J Bone Joint Surg Am* 93.17 (2011): 1650-1661.
[11] Wülker, Nikolaus, and Falk Mittag. "The treatment of hallux valgus." *Dtsch Arztebl Int* 109.49 (2012): 857-68.
[12] Wen, Jianmin, et al. "Adaptive changes of foot pressure in hallux valgus patients." *Gait and posture* 36.3 (2012): 344-349.
[13] Iliou, Kalliopi, et al. "Correlation between manchester grading scale and american orthopaedic foot and ankle society score in patients with hallux valgus." *Medical Principles and Practice* 25.1 (2015): 21-24.
[14] Karabicak, Gul Oznur, Nilgun Bek, and Ugur Tiftikci. "Short-term effects of kinesiotaping on pain and joint alignment in conservative treatment of hallux valgus." *Journal of manipulative and physiological therapeutics* 38.8 (2015): 564-571.
[15] Tang, Simon F., et al. "The effects of a new foot-toe orthosis in treating painful hallux valgus." *Archives of physical medicine and rehabilitation* 83.12 (2002): 1792-1795.
[16] Torkki, Markus, et al. "Surgery vs orthosis vs watchful waiting for hallux valgus: A randomized controlled trial." *Jama* 285.19 (2001): 2474-2480.
[17] Ferrari, Jill, Julian Higgins, and Trevor D. Prior. "Interventions for treating hallux valgus (abductovalgus) and bunions." *The Cochrane Library* (2004).
[18] Reina, María, Guillermo Lafuente, and Pedro V. Munuera. "Effect of custom-made foot orthoses in female hallux valgus after one-year follow up." *Prosthetics and orthotics international* 37.2 (2013): 113-119.
[19] Jeon, Mi Yang, et al. "Effects of taping therapy on the deformed angle of the foot and pain in hallux valgus patients." *Taehan Kanho Hakhoe Chi* 34.5 (2004): 685-692.
[20] Coughlin, Michael J., Charles L. Saltzman, and James A. Nunley. "Angular measurements in the evaluation of hallux valgus deformities: a report of the ad hoc committee of the American Orthopaedic Foot and Ankle Society on angular measurements." *Foot and ankle international* 23.1 (2002): 68-74.
[21] Grampurohit, Namrata, Sujata Pradhan, and Deborah Kartin. "Efficacy of adhesive taping as an adjunt to physical rehabilitation to influence outcomes post-stroke: A systematic review." *Topics in stroke rehabilitation* 22.1 (2015): 72-82.
[22] Kase, Kenzo. "Clinical therapeutic applications of the Kinesiotaping methods." (2016).
[23] Srivastava, Subodh, Nachiappan Chockalingam, and Tarek El Fakhri. "Radiographic angles in hallux valgus: comparison between manual and computer-assisted measurements." *The Journal of Foot and Ankle Surgery* 49.6 (2010): 523-528.
[24] Garrow, Adam P., et al. "The grading of hallux valgus: The Manchester Scale." *Journal of the American Podiatric Medical Association* 91.2 (2001): 74-78.
[25] Incel, Nurgül Arinci, et al. "Muscle imbalance in hallux valgus: an electromyographic study." *American Journal of physical medicine and rehabilitation* 82.5 (2003): 345-349.
[26] Easley, Mark E., and Hans-Joerg Trnka. "Current concepts review: Hallux valgus part 1: pathomechanics, clinical assessment, and nonoperative management." *Foot and ankle international* 28.5 (2007): 654-659.
[27] Hart, Erin S., and Brian E. Grottkau. "Current concepts in the treatment of hallux valgus." *Orthopaedic Nursing* 27.5 (2008): 274-280.
[28] McClure, Shannon K., Julie E. Adams, and Diane L. Dahm. "Common musculoskeletal disorders in women." *Mayo Clinic Proceedings*. Vol. 80. No. 6. Elsevier, 2005.
[29] Wolkenberg A. The Kinesio Taping Method and the Treatment of CRPS. *RSDSA Review* 25.4 (2012): 8-9.
[30] Öztürk, Gülcan, et al. "Efficacy of kinesiotape application on pain and muscle strength in patients with myofascial pain syndrome: A placebo-controlled trial." *Journal of physical therapy science* 28.4 (2016): 1074-1079.
[31] du Plessis, Morne, et al. "Manual and manipulative therapy compared to night splint for symptomatic hallux abducto valgus: An exploratory randomised clinical trial." *The Foot* 21.2 (2011): 71-78.
[32] Kim, Ji Young, and Seong Yeol Kim. "Effects of kinesio tape compared with non-elastic tape on hand grip

strength." *Journal of Physical Therapy Science* 28.5 (2016): 1565-1568.
[33] Button, Gavin, and Stephen Pinney. "A meta-analysis of outcome rating scales in foot and ankle surgery: Is there a valid, reliable, and responsive system?" *Foot and Ankle International* 25.8 (2004): 521-525.
[34] Brantingham, James W., et al. "A pilot study of the efficacy of a conservative chiropractic protocol using graded mobilization, manipulation and ice in the treatment of symptomatic hallux abductovalgus bunion." *Clinical Chiropractic* 8.3 (2005): 117-133.
[35] Williams, Sean, et al. "Kinesio taping in treatment and prevention of sports injuries." *Sports medicine* 42.2 (2012): 153-164.
[36] Kim, Woo-Il, et al. "The effect of muscle facilitation using kinesio taping on walking and balance of stroke patients." *Journal of physical therapy science* 26.11 (2014): 1831-1834.
[37] Kim, Ji Young, et al. "The effects of non-elastic taping on muscle tone in stroke patients: a pilot study." *Journal of physical therapy science* 27.12 (2015): 3901-3905.
[38] Alexander, Caroline M., Marie McMullan, and Philip J. Harrison. "What is the effect of taping along or across a muscle on motoneurone excitability? A study using triceps surae." *Manual therapy* 13.1 (2008): 57-62.