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Comparison of Joint Mobilization with Manual Stretching Exercises in the Treatment of Hallux Valgus

The purpose of this study was to evaluate the effect of joint mobilization and manual stretching exercises in patients with hallux valgus. Twenty-three participants were divided into two groups; joint mobilization (n=11) and manual stretching exercises (n=12). The subjects participated in the experiment for 15minutes, three times a week, four weeks. The joint mobilization (Grade III, Maitland) was performed to experimental group for a minute and then rested for 10 seconds for each set. The manual stretching was performed to control group with three exercise session (preparatory and finishing exercises, agonist contraction exercises, agonist contraction and hold-relax exercises). In the results of the study, intragroup comparison of the deformity angles (DA) was shown to decrease from 15.18° to 13.09° in the joint mobilization group ($p<.05$) and from 19.00° to 16.83° in the stretching exercises group ($p<.05$). However, left static foot pressure (LSFP), right static foot pressure (RSFP), left dynamic foot pressure (LDFP) and right dynamic foot pressure (RDFP) did not significantly increase or decrease after the experiment. Intergroup differences also were not statistically significant in all variables ($p>.05$). The current study suggests that JM and MSE are effective in decreasing the DA in patients with hallux valgus.

Key words: *Joint mobilization, Manual stretching exercises, Foot pressure, Hallux valgus*

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INTRODUCTION

Hallux valgus is a typicalcommon condition influence the forefoot, and the first metatarsophalangeal joint is gradually subluxed since the medial deviation of the first metatarsal and lateral deviation of the hallux [1]. An angle of $< 15°$ in the first metatarsophalangeal joint is considered to be normal. That between 15° and $< 20°$ is classified as mild hallux valgus, an angle between 20° and $< 40°$ is thought to be moderate, and one of $\geq 40°$ is regarded as severe [2].

Hallux valgus is a complex disease and is characterized by the first metatarsal bone tilting inward and away from the second metatarsal bone. The medial hypertrophy of the head of the first metatarsal bone, in conjunction with deformation of the other toes, can cause severe pain in the hallux [3]. It is essential to try to prevent hallux valgus and to treat it timeously if it identified. This is because the movement of the metatarsal bone may result in of the lateral arch, as well as pressure on the toe nerve. In, turn, this induces Morton's neuroma or causes the formation of hardened skin under the head of the metatarsal bone [4].

Surgery and orthosis are indicated as the primary treatment options for hallux valgus. Other approaches include the provision of shoe insole adjustments and participation in exercise. is recommended as a suitable treatment because it has been found to be efficacious in correcting foot deformity and minimizing pain due to hallux valgus [5]. However, it has been reported that the recovery period is lengthy, excessive costs are involved, the treatment is not applicable to joint diseases such as arthritis, and the recurrence rate is reportedly high [6].

Joint mobilization is a manual treatment method in which a combination of manual friction and is performed to restore the free and normal range of motion [7]. It has been proposed that this technique can be used effectively to treat pathological disorders, such as pain, muscle defects or muscle cramps, as well as joints with low mobility characterized by progressive limitation during exercise [8]. Elsewhere, stretching and muscular strengthing exercises have been found to be effective in correcting the valgus angle in patients with hallux valgus [9, 10]. Stretching the hallux using a TheraBand® was also demonstrated to be effective in reducing the hallux valgus angle in the study [11]. This was also achieved with taping and manual therapy in the other study [12]. The distribution of pressure on the sole was thought to be the most critical factor to consider when attempting to alleviate the mechanical stimulation of the foot [13]. A correlation has been identified between an increase in the contact area of the metatarsal bones and the progression of hallux valgus, leading to the application of excessive pressure and impact at the site [14]. Foot pressure at the distal part of the first metatarsal bone and big toe was observed to be high before correcting the shape of the hallux valgus, while an increase therein in the second and third metatarsal bones was noted after the adjustment [15]. Reported that eight-week foot strengthening exercises were helpful in achieving a reduction in pressure and an increase in the range of motion in the feet, an improvement in the flat foot, and the correction of hallux valgus in hallux valgus cases with flexible flatfoot [16].

As reported in previous studies, various interventions have been proposed for the treatment of hallux valgus, however insufficient studies have been carried out to determine and compare the effect of joint mobilization and manual stretching exercises on angular variation and foot pressure in adults with hallux valgus. Therefore, the purpose of the current study was to determine the effects of both interventions and compare the impact in order to establish effective therapeutic interventions for hallux valgus patients.

METHODS

Subjects

This study was conducted over four weeks; from July 16 to August 11, 2018. Twenty-three participants aged 20-29 years were recruited and allocated to either a joint mobilization or a manual stretching exercises group.Requirements for inclusion were 1) A hallux valgus angle of 〉 15°; 2) The absence of prior neurosurgical disease and severe musculoskeletal disorders, and participants who had exercise therapy or surgery due to hallux valgus were excluded from the study.

Experimental procedures

Joint mobilization

Joint mobilization is used to improve the mobility of one joint and soft tissues [11, 12]. The subjects were asked to lie down on their side. Support was placed beneath their feet to secure the first metatarsal bones. They were told to hold an area near the metatarsophalangeal joint with one hand and to hold them with the other to further stabilize the metatarsal bone. It was ensured that the direction of the movement conducted was performed parallel to the treatment plane. Maitland`s grade III is slow ,and the large amplitude movement slightly passes the limit of the range of motion, it is applied to the force of the moving force and the distraction technique, inferior gliding technique, anterior gliding technique [13]. Ten sets of joint mobilization (Grade III, Maitland) per session were carried out three times a week for four weeks. The subjects performed joint mobilization for a minute and then rested for 10 seconds for each set [12].

Manual stretching exercises

Static and dynamic stretching methods were applied [14] and subjects performed the exercises on a one-to-one basis. The sequence was preparation exercises, followed by body exercises, and then finishing exercises. The subjects performed stretching exercises for a minute and then rested for 10 seconds for each set. The subjects performed three exercise sessions per week for four weeks.

Preparatory and finishing exercises

The subjects were educated how to exercise the abductor and adductor hallucis muscles, rather than focusing on ankle strengthening [14].

Agonist contraction exercises

The subjects were asked to sit with their hands gripping their big toes and to apply constant resistance in the direction of the small toes. They were then asked to resist this action in order to induce contraction of the abductor hallucis muscle. Resistance was maintained for 30 seconds, followed by a 15 second

break for each set. Ten sets (total duration of seven minutes and 30 seconds) were carried out [11].

Agonist contraction and hold-relax exercises

The subjects were asked to sit and apply constant resistance to both halluces (using their hands. They were then asked to resist this action in order to induce contraction of the adductor hallucis muscle and maintain isometric contraction. Ather that, they were told to perform abduction to stretch the adductor hallucis muscle actively. The isometric contraction was maintained for 25 seconds and active stretching for 10 seconds. A 15 second rest was taken in each set. Ten sets (total duration of seven minutes and 30 seconds) were carried out [11]. Support was placed between the feet of the subjects to facilitate a sufficient range of motion for the abduction of the hallux while performing both the agonist contraction, and agonist contraction and hold-relax exercises.

Measuring the angle of foot deformity

Footprint analysis was used to determine the angle of foot deformity. According to this approach, paint is applied to the soles of the subjects' feet, and they are asked to make imprints of their feet on a sheet of paper with a distance of about 10 cm between them. Their body weight must be evenly distributed. Measurements are then taken of the angle on the paper formed by the inner line of the foot and the line that insects with the most protruding part of the hallux. Participants for whom an angle of $> 15^{\circ}$ and $< 40^{\circ}$ was recorded were included in the current study [17].

Measuring foot pressure

Static test

Foot pressure was measured using the Gaitview (Allfoots medical, Korea). The static foot pressure of subjects was measured during the subjects stood on a pad while holding a static posture and looking at the front for 20 seconds.

Dynamic test

The dynamic foot pressure of subjects was measured during subjects walked back and forth on the mat, placing each foot in turn on the at the center of the mat to measure their foot pressure while walking.

Statistical analysis

SPSS Statistics®20.0 forWindows® was used to perform the data analysis. Kolmogorov-Smirnov test was used to verify normal distribution and the independent t-test was employed to verify homogeneity. The independent t-test was also utilized to compare and analyze changes in balance (determined by the bending angle of the hallux) and foot pressure between the groups after the intervention. The paired t-test was used to compare and analyze changes in balance (determined by the bending angle of the hallux) and foot pressure within each group before and following the intervention. Statistical significance was set at $p = .05$.

RESULTS

Changes in the hallux valgus angle

On average, a significant decrease of 2.09° (from 15.18° to 13.09°) and ° (from 19.00° to 16.83°) in the bending angle of the hallux was reported in the joint mobilization and manual stretching exercise groups, respectively, pre- and post-intervention in the current study ($p < .05$). However, this difference was not statistically significant.

Changes in foot pressure

When static foot pressure was measured using manual stretching exercises and joint mobilization, a similar decrease and the increase were reported in the left and right foot, respectively, in the manual stretching exercises group. By comparison, a similar increase of 0.84% was seen in the left and right foot, respectively, in the joint mobilization group. When dynamic foot pressure was evaluated, a decrease and increase of 0.28% and 0.27% were reported in the left and right foot, respectively, in the manual stretch exercises group. By contrast, a similar increase and decrease of 1.29% in the left and right foot, respectively, was seen in the joint mobilization group. A significant difference (%) in the left and right foot was not observed following an intra- and inter-group comparison of changes.

Table 1. Changes of foot deformity, static/dynamic foot pressure

	Group	Pre	Post	t	P	Pre-Post	t	p
DA	JM	15.18±1.16	13.09±1.30	6.104	.000*	-2.09±1.13	.497	.625
	MSE	19.00±2.69	16.83±2.88	4.056	.002*	-2.42±1.88		
LSFP	JM	49.78±3.20	50.62±2.96	-.787	.450	-.84±3.54	-1.209	.240
	MSE	50.03±2.78	49.39±3.13	.989	.344	.64±2.24		
RSFP	JM	50.21±3.20	49.37±2.96	.787	.450	.84±3.54	1.209	.240
	MSE	49.96±2.78	50.60±3.13	-.989	.344	-.64±2.24		
LDFP	JM	48.73±1.38	50.02±2.25	-1.947	.080	1.29±2.20	-1.661	.112
	MSE	50.03±2.61	49.75±2.24	.416	.686	-.280±2.32		
RDFP	JM	51.26±1.38	49.97±2.25	1.947	.080	-1.295±2.20	1.661	.112
	MSE	49.97±2.61	50.24±2.24	-.416	.686	.279±2.32		

* $p < .05$
Mean ± SD
JM; joint mobilization, MSE; manual stretching exercise, DA; deformity angle, LSFP; left static foot pressure, RSFP; right static foot pressure, LDFP; left dynamic foot pressure, RDFP; right dynamic foot pressure

DISCUSSION

Hallux valgus accounts for the highest number of foot deformities [11], developing as a result of continuous pressure being applied to the hallux over a lengthy period, and usually associated with wearing pointy shoes [18]. A muscle imbalance between the adductor (agonist) and abductor hallucis (antagonist) muscles can also cause hallux valgus [19]. Therefore muscle shortening results from the continuous pulling of the adductor hallucis muscle and weakening of the antagonist abductor hallucis muscle. Repeated use of the shortened muscles further worsens muscle imbalance because maximum tension posture is sustained by gravity [20].

Similarly, the other study reported a significant decrease in the hallux valgus angle of ° (from 20.51° to 15.47°) in their study in which joint mobilization with taping was administered three times a week for six weeks to 11 patients to reduce the hallux valgus angle and pain [12]. Joint mobilization (Grade III, Maitland) consider aiding recovery by mobilizing and alleviating damaged joint-related symptoms, as well as facilitating the supply of nutrients, both of which are known to be effective in reducing the hallux valgus angle. Elsewhere, a greater increase in the range of motion was achieved using agonist contraction and agonist contraction and hold-relax exercises compared to static stretching through enhanced suppression of the motor pool in the spinal cord anterior horn [21]. Likewise, a reduction in the hallux valgus angle of 8.10° and 6.30°, respectively, was reported following the administration of agonist contraction exercises and agonist contraction and hold-relax exercises, respectively, to 20 patients five times a week for six weeks in the study [11]. A significant difference in results was achieved using both types of exercise in the current study. This can be elucidated by the fact that the manual stretching exercises performed in the present study were effective in increasing the muscle activity of the abductor hallucis muscle and reducing the hallux valgus angle. However, both interventions led to a reduction in the hallux valgus angle range, while the decrease in values was similar between the two groups. Thus, an inter-group difference was not observed.

In a similar study found that elastic band and short foot exercises did not lead to a significant change in foot pressure in patients with hallux valgus [22]. The other study used balance exercises (a 90-minute session three times a week for eight weeks) and measured the changes using an F-Scan™system, however, the results were without statistical significance and the exercises did not affect the during walking [23]. The reason for a lack of significant change in the present study could be attributed to being the lack of control over the everyday activity-related habits of the subjects, i.e., their gait. In the future, it is expected that ensuring that the subjects adopt the correct posture while conducting the exercises while performing them for a longer period will lead to significant differences in muscular strength between

the groups. The study results cannot be generalized because the subjects were adults in their 20s. The accuracy of future research could be improved by selecting the study participants more objectively and increasing the age range and number of subjects. Based on the current study findings, various interventions that are capable of overcoming these limitations and modifying the hallux valgus angle and foot pressure should be developed.

CONCLUSION

In this study, the deformity angle was significantly decreased after intervention in both joint mobilization and manual stretching exercise, however, all of the static and dynamic pressure did not increase or decrease significantly. There was no significant difference in the changes of DA, LSFP, RSFP, LDFP, and RDFP in the two groups.

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