To Compare the Effectiveness of Taping and Arch Support on the Flexible Flat Foot on a Random Population

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Abstract

Background: Flat foot is also known as Pes planus caused by injury, prolonged stress on the foot, obesity, and faulty biomechanics. This will cause the posterior tibial tendon dysfunction, collapse of the foot arch and developed flat foot (Pes planus).

Objective: Many of the research studies show the prevalence of flexible flat foot is on raise in recent times due to any number of factors. The majority of researchers focused independently on the effectiveness of Kinesio taping and arch support. So we aim to compare the effectiveness of Kinesio taping and medial arch support.

Method: The study design is an experimental study. The study will be conducted at Aimst University, Kedah, Malaysia. Total of 30 participants of both the gender, age between 18 to 30 years, who have a limitation of ROM and pain while performing dorsiflexion and plantar flexion, will be recruited. Each participant will undergo pre-test and post-test screening for an assessment of Body Mass Index (BMI), ROM, pain, physical examination, and Staheli Arch Index. Later the participants will be divided into two groups by a convenient sampling method. Group A participants will undergo exercises related to strengthening of foot muscles along with non-allergic taping technique while Group B participants will undergo exercises related to the strengthening of foot muscles along with medial arch support.

Data Analysis: Data collected is using IBM SPSS Statistics 23 for analyzing the data. For statistical analysis of the range of motion, VAS scale and Staheli Arch Index, Wilcoxon Signed Ranks Test was used. To compare the outcome of Kinesio Taping and Medial Arch Support, Mann-Whitney U test was used.

Result: After statistical analysis, a significant improvement was found in the range of motion and VAS Scale. The level of improvement ($p<0.05$) was significantly high with Kinesio Taping in flat foot.

Conclusion: The present study concluded that the application of Kinesio tape to flat feet was an effective intervention method for immediately reducing abnormally increased foot pressure and tone and stiffness in the lower extremities muscles and considered to be the most effective intervention for subjects with flat foot.

Keywords: *Flat foot, Kinesio tape, Medial Arch Support, Pes planus.*

Introduction

Background: Flat foot defines as a postural deformity in the combination of the medial longitudinal arch collapse. According to the International Journal of Physiotherapy and Research (2015), the flat foot is also known as Pes Planus caused by injury, prolonged

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stress on the foot, obesity, and faulty biomechanics[1]. This will cause the posterior tibial tendon dysfunction, collapse of the foot arch and developed flat foot (Pes planus). Flat foot can sometimes contribute problems in knees because this condition can alter the optimal alignment of legs. Clinical assessment will determine the characteristics and deformity of the joint[2]. Along with assessment, range of motion (ROM) would place a major roll on the assessment. The ankle is the part of the lower limb, the distal portion of the leg and proximal portions of the foot [3]. The foot contained 26 small bones for weight-bearing, and force distribution. The bony alignment creates three arches to provide efficient weight distribution while avoiding compression of plantar neurovascular structures. There are, lateral and medial longitudinal arch and the transverse arch together create an architectural vault which is one of the strongest load-bearing structures known to mankind[4]. The ankle joint is formed by talus, articular surface of the lower tibia and medial malleolus and lateral malleolus of the fibula. The movements that allow by ankle joint are plantar flexion, dorsiflexion, inversion, and eversion[5]. The foot is anatomically and biomechanically, subdivided into three parts, hindfoot, midfoot and forefoot[6]. The Rearfoot and the hindfoot is the talus and calcaneus bone. The midfoot consists of navicular, cuboid and three cuneiforms and the forefoot consist of fourteen bones of toes and five metatarsals[7]. Flat foot defines as a postural deformity in the combination of the medial longitudinal arch collapse[8]. According to the International Journal of Physiotherapy and Research (2015), the flat foot is also known as Pes planus caused by injury, prolonged stress on the foot, obesity, and faulty biomechanics[9]. This will cause the posterior tibial tendon dysfunction, collapse of the foot arch and developed flat foot (Pes planus). Galen is the most famous physician and he is the first author of the flat foot (Pes planus). Galen didn't use the term (flat foot), but he described it and characterize the patients as liopothes or smooth feet people. There are two types of flat foot[10]. Flexible flat foot is a common type of flat foot. The foot arch will be normal at rest (not during standing or walking), and it will disappear when contact with the ground[11-13]. A rigid type was fixed deformation in the flat position on ankle joint, with or without weight-bearing. Normally the pain will appear in the medial part of the hindfoot and along into posterior tibial tendon. Flat foot can sometimes contribute problems in knees because this condition can alter the optimal alignment of legs. Clinical assessment will determine the characteristics and deformity of the joint. Along with assessment, range of motion (ROM) would place a major roll on the assessment [14].

Methodology

The study design is an experimental study. The study will be conducted at Aimst University, Kedah, Malaysia. Total of 30 participants of both the gender, age between 18 to 30 years, who have a limitation of ROM and pain while performing dorsiflexion and plantar flexion, will be recruited. Each participant will undergo pre-test and post-test screening for an assessment of Body Mass Index (BMI), ROM, pain, physical examination, and Staheli Arch Index. Later the participants will be divided into two groups by a convenient sampling method. Group A participants will undergo exercises related to strengthening of foot muscles along with non-allergic taping technique while Group B participants will undergo exercises related to the strengthening of foot muscles along with medial arch support.

Result

Total of 30 participants of both the gender, age between 18 to 30 years, who have a limitation of ROM and pain while performing dorsiflexion and plantar flexion, will be recruited. Each participant will undergo pre-test and post-test screening for an assessment of Body Mass Index (BMI), ROM, pain, physical examination, and Staheli Arch Index. Later the participants will be divided into two groups by a convenient sampling method. Group A participants will undergo exercises related to strengthening of foot muscles along with non-allergic taping technique while Group B participants will undergo exercises related to the strengthening of foot muscles along with medial arch support.

Group A: Group A participants will undergo to perform a 30 min exercises related to the strengthening of foot muscles that consisted of a 5 min warm-up exercise, a 20 min main exercise, and a 5 min concluding exercise along with a non-allergic taping technique.

Group B: Group B participants will undergo to perform a 30 min exercises related to the strengthening of foot muscles that consisted of a 5 min warm-up exercise, a 20 min main exercise, and a 5 min concluding Body Mass Index (BMI). The height of each subject was measured using sewing tailor tape and the weight was measured using a digital weight scale. The BMIs of the subject was calculated by divided the body weight by the square of height (kg/m^2). BMI was taken during

assessment because there is a relationship between Body Mass Index and flat foot. Obesity is one factor that causes flat foot. It increases static and dynamic plantar pressure. As a result, the appearance of flattened medial longitudinal arch4. BMI categories – Underweight: below 18.5. Normal: 18.5 – 24.9. Overweight: 25 – 29.9 and Obesity: 30 – 39.95. Range Of Motion (ROM): Ankle joint range of motion was measured by using goniometer as a measurement tool for ankle joint to find out any limitations in the range. For ankle dorsiflexion, the subject is supine with legs off the table. The fulcrum is aligned with the lateral malleolus. The stationary arm is in line with the midline of the lower leg; use the head of the fibula for reference. The moving arm is parallel to the fifth metatarsal. Normal ROM of dorsiflexion is between 0 and 20 degrees. Ankle plantarflexion, the subject is supine with legs off the table. Goniometer alignment is the same as for dorsiflexion. Normal ROM is 45 degrees. For subtalar inversion, the subject is prone to lying with the foot hanging off the table. The fulcrum is placed in the two malleoli. The stationary arm is aligned with the midline of the leg and moving the arm with the midline of the calcaneus. The ROM is between 0 and 30 degrees and subtalar eversion, method are the same as subtalar inversion. The ROM is between 0 and 25 degrees. Pain Scale: Pain evaluated by using the Visual Analog Scale (VAS Scale). A briefly explained to the subjects and showed the scale; that they rated their pain using numbers, faces and words. Toe Raising Test: A toe raising test was conducted under a physical examination of all the subjects. The purpose of this test to check the flexibility of Pes planus. The test was performed with the patient weight-bearing, while the therapist dorsiflexes the hallux. Positive result: (arch formation) from the flat foot being flexible. Negative result: (lack of arch) from the flat foot being rigid. This special test was described by Jack and explained by Hicks due to the "windlass action" of the plantar fascia6. After done with the assessment, the participants equally divided into two groups. Each group 15 participants. Group A was provided exercise and taping technique and Group B was provided exercise and arch support. Exercise along with medial arch support.

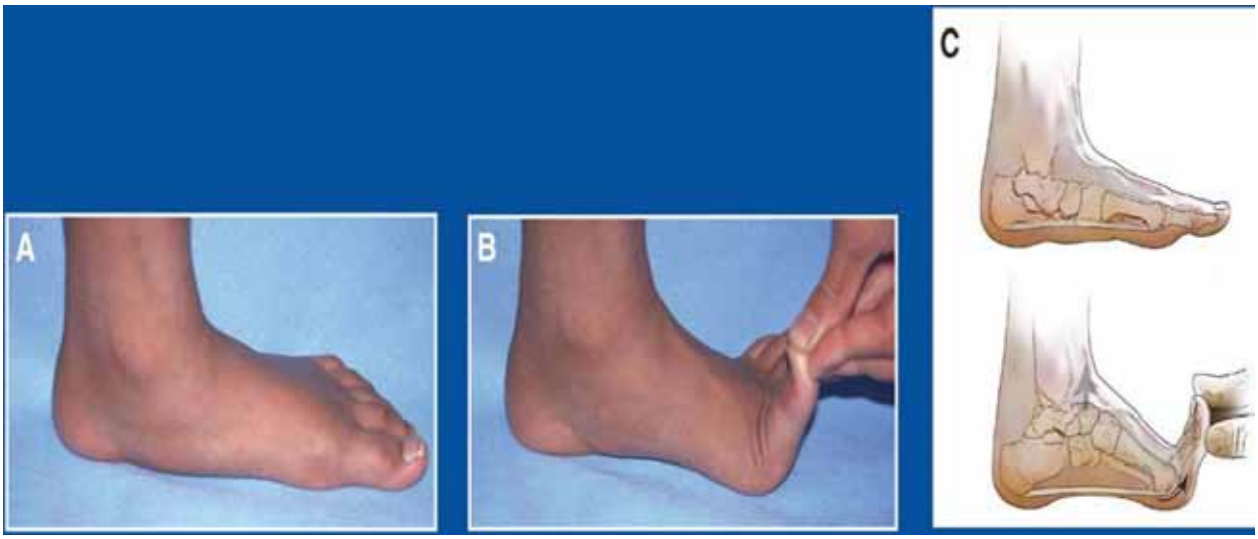


Figure 1: Toe raising test

The collected data were recorded and tabulated. The data was analyzed using statistical package for social science (IBM SPSS Statistics 23) to present the finding of the study - compare the effectiveness of Kinesio taping and medial arch support on random population. Range of motion, VAS scale, and Staheli Arch Index, Wilcoxon Signed Ranks Test was used for statistical analysis. The Wilcoxon Signed Ranks Test used to determine whether there were changes in between pre-test and post-test. To compare the outcome of Kinesio Taping and Medial Arch Support, Mann-Whitney U test was used. After statistical analysis, a significant improvement was found in the range of motion and VAS Scale. Results were considered significant at $p<0.05$.

Table 1: Demographic Characteristics of Study Samples

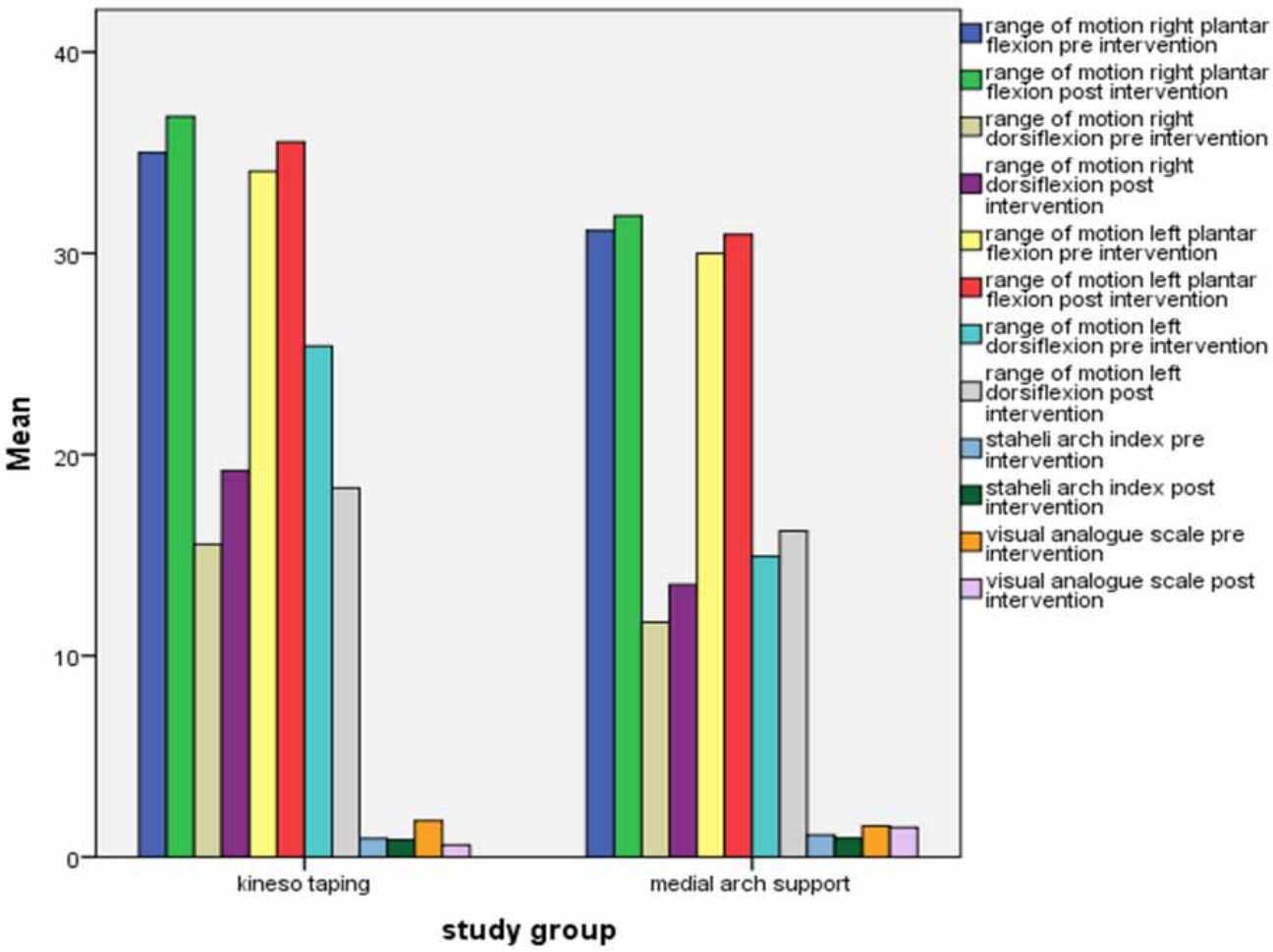
Gender	Mean (SD)	Frequency	Percentage (%)
Male		12	40.0
Female		18	60.0
Race			
Malay		3	10.0
Chinese		10	33.3
Indian		17	56.7
Study group			
Kinesio taping		15	50.0
Medial arch support		15	50.0
Age	21.6 (2.5)		
Weight	64.1 (18.3)		
Height	162.7 (9.4)		
BMI	24.0 (5.5)		

Table 2: Results of ROMPFR, ROMPFL, ROMDFR, ROMDFL, SAI and VAS Measures in Kinesio Taping and Medial Arch Support

	Median	Range	Percentile		Z	pa
			25th	75th		
Kineso taping						
ROMPFR-pre intervention	35.0000	30.0000	25.0000	45.0000		
ROMPFR-post intervention	40.0000	25.0000	50.0000	40.0000		
ROMPFL-pre intervention	35.0000	25.0000	30.0000	40.0000		
ROMPFL-post intervention	35.0000	26.0000	30.0000	40.0000	-2.226	0.026
ROMDFR-pre intervention	15.0000	15.0000	12.0000	20.0000	-2.536	0.011
ROMDFR-post intervention	18.0000	13.0000	17.0000	22.0000	-3.316	0.001
ROMDFL-pre intervention	15.0000	145.0000	15.0000	20.0000	-1.791	0.073
ROMDFL-post intervention	16.0000	22.0000	15.0000	22.0000	-1.633	0.102
SAI-pre intervention	0.9000	0.5000	0.8000	0.9211	-3.491	0.000
SAI-post intervention	0.8000	0.5000	0.8000	0.9000		
VAS-pre intervention	2.0000	3.0000	1.0000	2.0000		
VAS-post intervention	0.0000	4.0000	0.0000	1.0000		
Medial arch support						
ROMPFR-pre intervention	30.0000	15.0000	25.0000	35.0000		
ROMPFR-post intervention	30.0000	25.0000	26.0000	36.0000		
ROMPFL-pre intervention	30.0000	35.0000	20.0000	40.0000		
ROMPFL-post intervention	30.0000	35.000	21.0000	40.0000	-2.041	0.041
ROMDFR-pre intervention	10.0000	10.0000	10.0000	15.0000	-1.841	0.066
ROMDFR-post intervention	12.0000	15.0000	10.0000	17.0000	-2.724	0.006
ROMDFL-pre intervention	15.0000	20.0000	12.0000	20.0000	-2.388	0.017
ROMDFL-post intervention	15.0000	20.0000	15.0000	20.0000	-1.633	0.102
SAI-pre intervention	0.9000	2.3000	0.8000	1.2000	-0.333	0.739
SAI-post intervention	0.8000	0.5000	0.8000	1.2000		
VAS-pre intervention	1.0000	2.0000	1.0000	2.0000		
VAS-post intervention	1.0000	3.0000	1.0000	2.0000		

Table 3: Comparison Of Outcome Results Between Kinesio Taping And Medial Arch Support

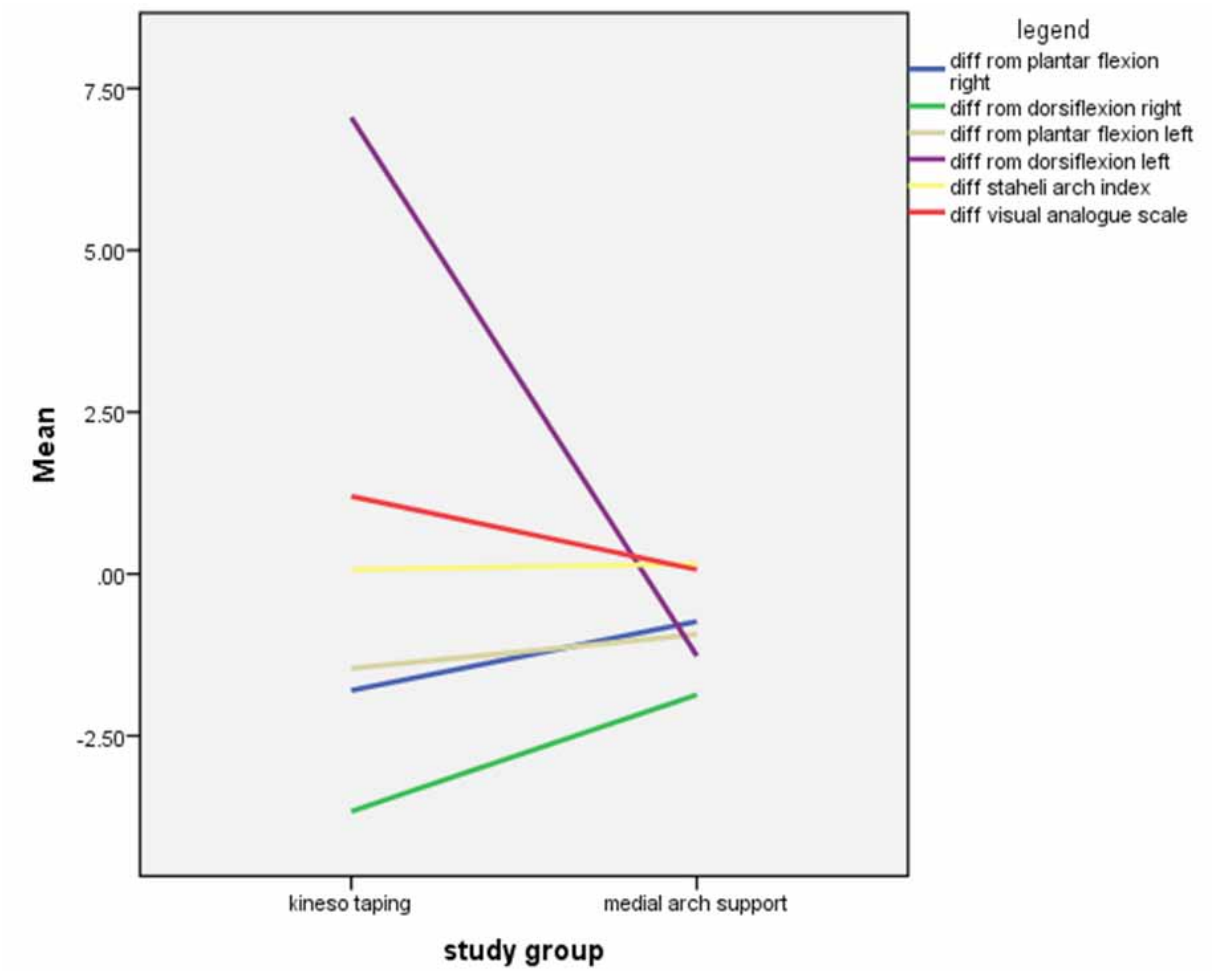
Study group	Outcome	Median	Range	Percentile		U[a]	P
				25th	75th		
Kineso taping Medial arch support	ROMPFR	0.0000	7.0000	-2.0000	0.0000	94.500	0.386
	ROMPFL	0.0000	9.0000	-2.0000	0.0000	81.500	0.146
	ROMDFR	-2.0000	7.0000	-5.0000	-0.7500	58.000	0.020
	ROMDFL	-1.0000	144.8000	-3.0000	0.0000	101.500	0.633
	SAI	0.0000	2.5000	0.0000	0.1000	85.000	0.220
	VAS	1.0000	1.0000	0.0000	1.0000	30.500	0.000



Graph 1: The distribution measures of pre and post-intervention for ROMPFR, ROMPFL, ROMDFR, ROMDFL, SAI and VAS between Kinesio Taping and Medial Arch Support

Table 1 shows the demographic characteristics of 30 subjects included gender, race, study group, age, weight, height, and body mass index category. According to Table 2, for the subjects treated with Kinesio tape, the ankle range of motion, showed significant differences in pre-test and post-test of plantar flexion on the right side with 'Z' value -2.226 at $p<0.05$. There was a significant difference between pre-test and post-test of Medial Arch Support in plantar flexion on the right side with 'Z' value -2.041 at $p<0.05$. There was a significant difference in pre-test and post-test of Kinesio tape in plantar flexion on the left side with 'Z' value -2.536 at $p<0.05$. Comparison of pre-test and post-test of Medial Arch Support in plantar flexion on the left side with 'Z' value -1.841 at $p>0.05$, thus stating that there is no significant difference. There was a significant difference

in dorsiflexion of the right sides between the Kinesio tape group and the Medial Arch Support group ($p<0.05$). Pre-test and post-test of Kinesio tape in dorsiflexion on the left side with 'Z' value -1.791 at $p>0.05$, thus stating that there is no significant difference. For the subjects treated with Medial Arch Support, the pre-test and post-test of dorsiflexion on the left side show a significant difference with 'Z' value -2.724 at $p<0.05$. There is no significant difference in Staheli Arch Index on pre-test and post-test between the Kinesio tape group and the Medial Arch Support group ($p>0.05$). There was a significant difference in pre-test and post-test of Kinesio tape in the Visual Analogue Scale with 'Z' value -3.491 at $p<0.05$. Comparison of pre-test and post-test of Medial Arch Support in Visual Analogue Scale with 'Z' value -0.333 at $p>0.05$, thus stating that there is no significant difference. Table 3 shows the comparison of outcome values for Range of motion, Staheli arch index and Visual analogue scale test within the group and between the groups by Mann-Whitney U test. For the range of motion of right plantar flexion on both sides, the 'U' value is 94.500 on right and 81.500 on the left side at $p>0.05$, thus stating that there is no significant difference between the groups. Hence there is a significant difference of dorsiflexion in both groups at the right side with 'U' value is 58.000 at $p<0.05$. Nevertheless, the 'U' value of left side dorsiflexion is 101.500 at $p>0.05$, thus stating that there is no significant difference between the groups. For Staheli Arch Index, the 'U' is 85.000 at $p>0.05$. So, stating that there is no significant difference between the groups. There is a significant difference in the Visual Analogue Scale in both groups with the 'U' value is 30.500 at $p<0.05$. Graph 1 and 2shows the distribution on measures of pre-test and post-test for Range of motion, Staheli arch index and Visual analogue scale test within the group and between Kinesio Taping and Medial Arch Support. The result significantly shows that an improvement in Kinesio Tape than Medial Arch Support.



Graph 2: Improvement in Rompfr, Rompfl, Romdfr, Romdfl, Sai and Vas Measures Between Kinesio Taping and Medial Arch Support

Discussion

This study was done to compare to the effectiveness of Kinesio taping and medial arch support on the flexible flat foot on a random population in AIMST University. The outcome measure used in this study was Range of Motion, Staheli Arch Index, and VAS Scale. Subjects are selected after confirming with the parameter of the arch which measured by Staheli Index Arch.

Plantar Arch Index = A/B

A = Measurement of the support width of the central region to the foot.

B = Measurement of the support width of the heel region to the foot

All 45 participants selected and agreed to take part in this study. However, there were 15 dropouts and a total of 30 participants completed the course of the research study. 12 male and 18 female subjects participated in this research. The reason of subjects for dropouts was declined to participate, due to semester breaks, and a packed schedule. Consents were gained from all participants before the assessment. Each participant undergo pre-test and post-test screening for an assessment of Body Mass Index (BMI), ROM, pain, physical examination, and Staheli Arch Index. The participants divided into two groups by a convenient sampling method. Group A participants will undergo exercises related to strengthening of foot muscles along with non-allergic taping technique while Group B participants will undergo exercises related to the strengthening of foot muscles along with medial arch support. Data of a total of 30 subjects were taken for analysis. The findings of this study were support the hypothesis. This result reflects in agreement with, after applying Kinesio tape, foot pressure, pain and foot arch on the bilateral leg significantly reduced and improved in a range of motion. According to the subject's feedback at the end of the research session, those who applied Kinesio Tape claimed that they feels comfort and better after applied Kinesio Tape, pain was reduced and improvement seen in the ankle movement. Therefore, Kinesio tape was a more effective method than Medial Arch Support to improve muscle tone, range of motion and the foot pronation decreased. Some of these studies are similar to the current study was observed, especially the increase in peroneus longus activity. This study was conducted to compare the effectiveness of taping and arch support on the flexible flat foot on a random population.Weng-Sam Siu et al, stated that using Kinesio tapes that reinforce the transverse arch for static stability and facilitate tibialis posterior for dynamic stability immediately after its application and increase the muscle activity of tibialis anterior during treadmill running in individuals with functional flatfoot, which was similar results of the present study.Joong-San Wang et al stated that the application of Kinesio tape to flexible flat feet was an effective intervention method for immediately reducing abnormally increased foot pressure and tone and stiffness in the lower extremities muscles. Agnieszka Straczynskaa et al stated that the application of Kinesio taping was a statistically significant decrease in pain and improvement in the deviation angle of the calcaneus was identified. Sivachandrian et al stated that the exercise programs significantly improved the angle of the arch foot, navicular height, and medial longitudinal arch. In additional, Smith et al. (Smith, Coates, Leung, & Creaby (2015) compared rigid and elastic anti-pronation taping effect on exercise related leg pain in females. The elastic tape was ranked as the most comfortable condition by a higher percentage of the participants. This implies that the elastic tape, like Kinesio tape, which was intended to provide therapeutic effects, may also provide greater comfort during exercise. Robert Yolo et at stated that taping acts as controlling pronation of the foot by pulling the calcaneus anteriorly and medially, thus limiting hindfoot eversion and restricting the associated talar adduction and plantarflexion. When the subtalar motion is limited, the arch is elevated subsequently reducing the stretch on the plantar aponeurosis. Similarly, the medial arch height is raised as the tape pulls the lateral aspect of the foot medially. According to Park et al. (2015); Tsai, Chang, & Lee (2010) have reported a reduction of pain in patients with plantar fasciitis and hallux valgus after taping. Our flatfoot participants did not have such pain level. Pain scores were not more than 4 (out of 10) due to the acute stage of their condition. These grading was taken before the treatment. Range of motion is defined as the movable range of a joint's potential movement. As for the ankle range of motion, the subject is asked to perform ankle plantar flexion and dorsi flexion. The measurements were taken with the help of goniometer. Quackenbush et al (2008) reported that ankle taping in female athlete's involked significant differences in pre- and post- exercise active range of motion for plantarflexion and Dorsiflexors. In the present study, the taping group showed significant differences in dorsiflexion and plantarflexion at $p<0.05$. This is consistent with prior studies suggesting that,

with taping, the ankle range of motion is greater after exercise than before. Because of the loosened taping during exercise, ankle range of motion increases after exercise. After the treatment session, it was shown that there was a statistically significant reduction in pain and improved in a range of motion in the post-test in Group an after applied Kinesio Tape.

Conclusion

This study was done to compare to the effectiveness of Kinesio taping and medial arch support on the flexible flat foot on a random population aged 18 to 29 years. This conclusion was drawn from the statistics shown in the SPSS after the data analysis was done. There was a statistically significant reduction in pain and improved in a range of motion in the post-test in Group an after applied Kinesio Tape. Thus, the results of the present study concluded that the application of Kinesio tape to flexible flat feet was an effective intervention method for immediately reducing abnormally increased foot pressure and tone and stiffness in the lower extremities muscles and it improved medial longitudinal arch. The study also concluded that taping is effective for 24 hours in the management of flexible flat feet. Having said that, it was statistically found in this study. These findings may have important implications for clinical practice as they will help guide treatment choices for flat foot.

Ethical Clearance: No ethical approval is needed.

Source of Funding: Self

Conflict of Interest: Nil

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