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COMPARISON FOR THE USED OF RIGID MEDIAL ARCH SUPPORT AND FLEXIBLE MEDIAL ARCH SUPPORT ON FLAT FEET PATIENTS' WALKING SPEED

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Abstract

Background: Flat foot patients requires more muscle activity when walking due to lack of medial longitudinal arch arches and results in increased pressure on the second area of metatarsal during the stance phase, causing the gait cycle in flat foot patients to be longer than for children who have normal foot. The speed of walking of flat foot patients can be faster using flexible medial arch support compared to when using rigid medial arch support. Purpose: to determine difference in walking speed using rigid medial arch support and flexible medial arch support in patients with flat foot. Methods: 30 subjects according to inclusion and exclusion criteria. Subject divided into two groups and given treatment using rigid medial arch support and flexible medial arch support the calculating walking speed using 10 Meter Walk Test. Quasi Experiment with Post Test Only Design. Material used (1) rigid medial arch support, (2) flexible medial arch support, (3) midline, (4) stopwatch, (5) HVS paper, (6) liquidcolor, (7) cone, (8) stationary, (9) measuring form. Results: The average walking speed using rigid medial arch support at the fast walking speed is 1.6800 m/s and the comfortable walking speed is 1.2627 m/s. The average walking speed using flexible medial arch support at the fast walking speed is 1.8140 m/s and the comfortable walking speed is 1.6467 m/s. The results of Shapiro Wilk data (N=15: 15) showed normally distributed data. Therefore, usingthe parametric test (Independent Sample T-test) obtained $p < 0.05$. Conclusion: Based on statistical tests, it was found that there was a significant difference in walking speed using rigid medial arch support andflexible medial arch support in patients with flat foot. Based on field data, it was found that comfortable walking speed of rigid medial arch support was faster than the flexible medial arch support by 30.4%.

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Introduction

Flat foot (pes planus) is a medical condition where the medial longitudinal arch is flatter than usual (Aenumulapalli, 2017). Flat foot can be caused by congenital and several factors including obesity, shoe use, abnormalities in the limb, muscle weakness and ligaments as well as tears in the tendon (Pourghasem, 2016). Flat foot can be categorized as flexible flat foot and rigid flat foot (Halabchi, 2013). In research conducted by Kim & Lee (2013) found that muscle activity in flat foot and normal foot showed significant differences during the running phase. In his research concluding the extremities of lowers in flat foot Patients requires more muscle activity when walking due to lack of medial longitudinal arch arches and results in increased pressure on the second area of metatarsal metatarsal during the stance phase, causing the gait cycle in flat foot Patients to be longer than for children who have normal foot. Research conducted by Anggriani et al, (2020) concluded that there were significant differences in walking speed using rigid medial arch support with walking speed using flexible medial arch support. However, we need to investigate if the speed of walking is faster using flexible medial arch support compared to when using rigid medial arch support.

Handling of flat foot Patients can be done in two ways namely surgical intervention and non-surgical interventions. In handling non-surgical interventions divided into giving advice and education to parents and patients, modification of footwear, exercise and using foot orthosis for flat foot Patients. The intended foot orthosis is medial arch support (Halabchi et al, 2013).

Methods

The type of research used is quantitative method and used crosectional study with comparison methods to know the difference in walking speed the use of rigid medial arch support and flexible medial arch support in flat foot Patients. This research is comparative. In this study compared two samples, namely samples using rigid medial arch support and samples using flexible medial arch support.

The population in this study was 50 students both men and women of the Health Polytechnic of the Ministry of Health of Surakarta who experienced a flat foot. Samples in this study of 30 that met the specified inclusion and exclusion criteria.

On the study subject, walking speed was measured by measuring the distance traveled by patients (10 meters) within a certain time, measured in meters / seconds. Measuring instruments used are stopwatches, meters, measuring blanks and stationery. For the first 2 meters it is considered as acceleration and the last 2 meters are deceleration (Karpman et al, 2014). The medial arch support used in this study was rigid medial arch support with custom design made from 3mm polyethylene. And flexible medial arch support from Ethylene-Vinyl Acetate material with custom design or ready size design.

The data analysis method in this study is subjecting the Shapiro wilk normality test, because the number of samples <50 and the hypothesis test uses the Independent T-test.

Results

Subjects in this study were normal 43.3% (13 people), overweight 6.7% (2 people), at risk 16.7% (5 people), obesity-1 13% (4 people) and obesity-2 10% (3 people).

Table 1. Average walking speed

Kecepatan berjalan	N	Min	Max	Sum	Mean	Std. Deviation
Rigid medial arch support						
Comfortable walking speed	15	.96	1.49	18.94	1.2627	.14454
Fast walking speed	15	1.29	1.95	25.20	1.6800	.21481
Flexible medial arch support						
Comfortable walking speed	15	1.46	1.82	24.70	1.6467	.12063
Fast walking speed	15	1.74	1.89	27.21	1.8140	.05289

From the measurement results of the average walking speed at the comfortable walking speed stage of the flexible medial

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arch support group (1.6467) and rigid medial arch support (1.2627) obtained a difference of 0.384 m/s. Whereas the measurement of walking speed fast walking speed flexible medial arch support (1.8140) and rigid medial arch support (1.6800) obtained a difference of 0.134 m/s.

Based on the normality test using the Shapiro Wilk test, in the Rigid medial arch support group and Flexible medial arch support both measurement of comfortable walking speed and fast walking speed obtained the results of p > 0.05 it shows that the running speed data is normally distributed. Because the data is normally distributed, to find out the difference in running speed in the two groups is covered by a parametric statistical test, the Independent sample T-test.

Table 2. *Independent T-test comfortable walking speed*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	df	Sig. (2-tailed)
Rata-rata kecepatan berjalan *comfortable walking speed*	Equal variances assumed	.206	.653	-7.900	28	.000
	Equal variances not assumed			-7.900	27.132	.000

Source: primary data (2022)

Based on the results of the Independent Sample T-test that has been carried out with N= 15 : 15 on (the number of participants are not matched with previous information), measurement of comfortable walking speed use rigid medial arch support and flexible medial arch support obtained equal variance assumed values are 0,000 and the value of equal variance not assumed is 0,000 seen from significance of 0.653 then the data has the same variant because of the variance testing requirements if the significance value > 0.05 then the data has the same variance, if the significance value is < 0.05 then the data has different variance. Based on the table, the data is considered to have the same variance because the significance value is > 0.05 so that the p value used corresponds to the table on the assumed equal variance. Where p = 0,000 (p < 0.05) so statistically states that there are significant differences in the speed of running using rigid medial arch support with the speed of running using flexible medial arch support.

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	Df	Sig. (2-tailed)
Rata-rata kecepatan berjalan *fast walking speed*	Equal variances assumed	27.798	.000	-2.346	28	.026
	Equal variances not assumed			-2.346	15.691	032

Source: primary data (2022)

Independent Sample T-test test results with N = 15 : 15 on fast walking speed measurements the use of rigid medial arch support and flexible medial arch support is obtained the value of equal variance assumed is 0.026 and the value of equal variance not assumed is 0.032. Judging from the significance of 0,000, the data has different variance because < 0.05. So that the p value used is p = 0.032 (p < 0.05) statistically states that there are significant differences in the speed of running using rigid medial arch support with the speed of running of flexible medial use arch support.

Discussion

In the case of flat-foot the use of medial arch support becomes the first handling option (Wahmkow et al, 2017). When walking, arch support is important to reduce plantar pressure and maintain dynamic stability (Huang et al, 2017). The use of medial arch support influences the distribution of pressure when standing and walking. The wider the area supported by eating the wider and equitable distribution of pressure, so that the pressure obtained gets smaller and makes the wearer more stable and balanced (Lee et al, 2012).

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In this study the subject of flexible flat foot was divided into two groups and each group was given an intervention with the use of rigid medial arch support and flexible medial arch support, then observations were made about the speed of walking of each research group. The granting of this tool is in accordance with research conducted by Su et al (2017) that corrective effectiveness is significantly affected by the form of insole and material hardness used in the insole. The results of his research were found that the height of the arch increased twice using hardness material with shore 40^{0} and with an insole height of 33 mm.

Research conducted by Dewi et al, (2020) explains that the lowest speed when walking occurs in flat foot groups, this happens because flat foot tends to over pronation in the medial area of the longitudinal arch. Excessive pronation during the push off phase causes the foot to become unstable, because in this phase the foot tends to maintain the rigid position and the foot cannot transmit force when push off. This causes the foot to need large force to push the body load forward during the push off phase. So that it affects the speed of walking because it has to go through a longer push off phase and the resulting force is smaller so that the urge for the body going forward when walking is also small.

In this study, the fast walking speed stage between the use of rigid medial arch support and flexible medial arch support there was no difference in walking speed between the two, this was subjected to a large difference in the difference (0.134 m/s) still under MDC90 10MWT. Whereas at the comfortable walking speed stage between the use of rigid medial arch support and flexible medial arch support there is a difference in walking speed between the two, this is subject to a large difference in difference (0,384 m/s) above MDC90 10MWT with a faster percentage of rigid arch support of 30.4% compared to the use of flexible medial arch support.

Based on biomechanics theory, the feet work together to support the body during foot strike and push off. The posterior tibial muscle is the main dent of the medial longitudinal arch, functioning to control foot pronation with eccentric contractions and foot supination with concentric contractions. Excessive pronation of flat foot occurs because the ability of shock absorption decreases. Flat foot conditions spread plantar fascia overtretched, talonavicular joint hypermobility, increased pressure in the dorsal midfoot area, and decreased posterior tibial tendon movement. This results in decreased leg ability as a component of the body's levers, causing flat foot Patients to experience a change in balance (Setyaningrahayu et al, 2020).

According to research conducted by Akbari et al, (2012) shows that orthosis with rigid materials provides a better feedback to improve stability. In addition, a soft orthosis surface causes high amplitude movement on the surface of the plantar foot against the foot, this can cause a decrease in awareness of the position of the foot and increase postural sway on the foot. His research explains that after a two-week period wearing rigid arch support, the subject shows an increase in dynamic balance when standing. Arch support can stabilize the talocrural joint, as well as leveling the distribution of pressure on the plantar section of the foot so as to reduce the postural sway. Another discharge of arch support on rigid medial arch support increases support on the medial side of the foot and justifies foot alignment to reduce abnormal pronation.

Conclusion and Recommendation

There are significant differences in the speed of running using rigid medial arch support and flexible medial arch support--on fast walking speed. Previous studies supported that orthoses with rigid materials provides a better feedback to improve stability.

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