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Original Research

Effect Of Medial Arch Support On Valgus Ankle Angle In Flat Foot Conditions

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ABSTRACT

Background: *Flat foot, or pes planus, is a condition where the medial longitudinal arch is lost, resulting in flat feet. In this case, if there is a problem with the medial longitudinal arch, it will affect the joint above it, called the valgus ankle. Handling flat foot is done by providing medial arch support. The use of medial arch support aims to maintain the foot and ankle in a neutral position by supporting the medial part so that the valgus can be corrected.*

Methods: *This type of research is a quasi-experiment with a one-group pre- and post-test design. The number of subjects was 32 students of the Applied Undergraduate Program, Department of Prosthetic Orthotics.*

Results: *Using the Wilcoxon hypothesis test and the p-value was found to be 0.000 for the right and left pre- and post-test foot. This shows that there is a decrease in the ankle valgus angle before and after the use of medial arch support. The average decrease in valgus ankle angle between pre- and post-test on the right foot was 2.32 degrees, while it was 2.44 degrees on the left foot.*

Conclusion: *The use of medial arch support has an effect on decreasing valgus ankle in flat foot conditions, so it is recommended to use medial arch support in flat foot conditions.*

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INTRODUCTION

Feet are one part of the human body. Feet have a very important role in maintaining balance and shock absorbers (Kim & Kim, 2016). Activities carried out by humans in daily life allow for various movements, both intentionally and unintentionally. Human movement cannot be separated from the role of the joints and muscles in the legs.

The foot and ankle are parts of the foot that function to perform activities such as standing, walking, and running (Ariano & Harjoko, 2013). The integrity of the foot is strengthened by the presence of two longitudinal arches (medial and lateral) and one transverse arch (Utomo et al., 2018). If the medial longitudinal arch is low or even has no arch, it will cause a flat foot (Namsawang et al., 2019).

Flat foot or pes planus, is a condition where the medial longitudinal arch is lost, resulting in flat feet. Flat feet in question occur when all parts of the foot are attached to or close to the ground (Sahabuddin, 2016). Flat foot abnormalities will cause pain in the soles of the feet, ankles, and knees if it occur over the long term (Shih et al., 2012). In addition, it also causes acute trauma that causes deformities in the feet (Wardanie, 2013). If there is a problem in the longitudinal section of the medial arch in a flat foot, it will affect the joint above it, known as the valgus ankle (Ariano & Harjoko, 2013).

Ankle valgus may be due to dysfunction of the posterior tibial tendon that leads to loss of the medial longitudinal arch. The ankle has a normal alignment between 87°-92°. It can be said that the ankle is valgus if it has a Lateral Distal Tibial Angle (LDTA) < 87°. The characteristics of the occurrence of ankle valgus are the os talus surface with an oblique tibia bone, LDTA <87°, the fibular tip rises & the distal epiphysis extends, and the fibular physis is above the ceiling (Stevens et al., 2011). Posturelogist Paul Gane and his colleague, doctor Michael Joubert, said that if the arch of the foot is flat, there will be technical changes such as valgus in the ankle (Nugroho et al., 2017).

A study in Indonesia conducted by Bachtiar in 2012 on 57 students found that subjects with normal arcus were 31 people (54.4%), while those with flat arches or flat feet were as many as 23 people (40.4%). The prevalence of flat foot conditions is 16% of a total sample of 50 people aged 14–20 years (Pranati et al., 2017). The prevalence of flexible flat foot in Gujarat with an age range of 18–21 years is 12.8% in men and 14.4% in women with a total sample of 500 people (250 men and 250 women) (Aenumulapalli et al., 2017).

Handling a flat foot is done by providing action using an orthosis (insole or medial arch support) (Sahabuddin, 2016). The medial arch support is made of a lightweight, spongy material that stretches from the heel to the forefoot. On the medial side, a protrusion is formed that is used to support the arcus pedis of the foot, which is placed directly below the sustentaculum of the talus and the navicular bone of the foot. With this medial arch support, weight support becomes more stable, can control the biomechanics of the foot, and can restore normal alignment of the foot and ankle (Siswiyanti & Syafi'i, 2015).

In a study conducted by Nugroho et al., (2017) explained that the use of medial arch support had an effect on decreasing the degree of ankle valgus in flat foot conditions. The provision of medial arch support is used to minimize stress on the medial longitudinal arch, reduce the degree of abnormal pronation, become more normal weight-bearing, become more stable in the medial longitudinal arch, and also improve the alignment of the body so as to reduce the degree of valgus angle in flat foot conditions.

MATERIALS AND METHOD

The research method used in this study is a quantitative method. The type of research used in this study is a quasi-experimental research design with one group pre- and post-test, which is a measurement study that uses only one group as research subjects without a comparison group. This study aims to study the effect of using medial arch support on changes in the valgus ankle angle in flat foot conditions. The population used is students, who experience flat foot by 51 students. The sample used was made up of 31 students.

The sampling technique is purposive sampling. This sampling technique is based on the criteria set by the researcher. The criteria set include inclusion criteria and

exclusion criteria. Inclusion criteria: 1) Applied Undergraduate Student, Department of Orthotic Prosthetics, Poltekkes Kemenkes Surakarta 2) Lives in Solo 3) Has flat foot grades 2 and 3 4) Willing to take part in the research. Exclusion criteria: 1) Subject has a deformity other than flat foot 2) The subject is in pain when taking the data.

In this study, there are two variables, the independent variable is medial arch support. A medial arch support is a type of foot orthosis that is attached to the medial longitudinal arch. This study uses a semi-rigid medial arch support with an arc height of 15 mm made of EVA. The dependent variable is the valgus ankle. The valgus ankle is a condition with the Lateral Distal Tibial Angle (LDTA) < 87°.

At the implementation stage, each subject who met the criteria was measured for the valgus ankle angle before and after using the medial arch support. The instrument used to measure the ankle valgus angle is a goniometer. Previously, the subject was marked on the back of the foot (hindfoot) with the subject lying down or with their feet not touching the ground.

The parts marked are the dorsal ankle, namely: (1) the base of the calcaneus; (2) the Achilles tendon attachment; (3) the center of the Achilles tendon at the level of the medial malleolus; and (4) the center of the calf rises 15 cm. Then the subject stands straight facing forward and draws a line of projection between lines (1), (2) and (3), (4). From the drawing of the line, it will produce a line intersection, which will be used as an axis to measure the initial angle before and after the medial arch support intervention is used.

The normality test used is Shapiro-Wilk because the number of observations is less than 50. There are data that are not normally distributed, so the data is considered abnormal, and the hypothesis test used is Wilcoxon. Poltekkes Kemenkes Surakarta has received clearance with the number LB.02.02/1.1/2925/2021.

RESULTS

The research method used in this study is a quantitative method. The type of research used in this study is a quasi-experimental research design with one group pre- and post-test, which is a measurement study that uses only one group as research subjects without a comparison group. This study aims to study the effect of using medial arch support on changes in the valgus ankle angle in flat foot conditions. The population used is students, who experience flat foot by 51 students. The sample used was made up of 31 students.

Table 1. Characteristics of Subjects

Description	Frequency	Percentage
Gender		
Male	9	28
Female	23	72
Age		
18 years old	1	3
19 years old	3	9
21 years old	15	47
22 years old	13	41
Grade		
Grade 2	27	84
Grade 3	5	16

Based on the characteristics of the subject by gender, the female has more than the male. There were 23 females (72%) while only 9 males (28%). This is in line with research conducted by Rustanti & Wahyu, (2014), which showed that the highest prevalence was in females. Based on the age of the subjects with a vulnerable age of 18-22 years, with the most age being at the age of 21 years with a frequency of 15 students (47%). The average student is in flat foot grade 2 condition, the frequency of experiencing grade 2 is 27 students (84%).

Table 2. Result of valgus ankle angle measurement

Data	Min	Max	Mean
Right foot pre test	79	84	82.37
Right foot post test	82	86	84.69
Left foot pre test	80	85	82.78
Left foot post test	83	88	85.22

Based on table 2, the results of the valgus ankle angle measurement obtained without using medial arch support are smaller than those using medial arch support. These data were obtained from the results of valgus ankle angle measurements, which were carried out alternately on each research subject using a goniometer.

Table 3. Data normality test

Data	Sig.	Result
Right foot pre test	0.001	Abnormal
Right foot post test	0.003	Abnormal
Left foot pre test	0.004	Abnormal
Left foot post test	0.042	Normal

Based on table 3, the normality test used is Shapiro Wilk because the number of data points is less than 50. Of the four data points, it shows that the normality distribution of the data is normally distributed with a p-value> 0.05, namely on the left foot post-test, while those that are not normally distributed with a p-value < 0.05, namely on the right foot pre-test, right foot post-test, left foot pre-test because the data is not normally distributed, the data is considered abnormal and the hypothesis test used is Wilcoxon.

Table 4. Hypothesis test with Wilcoxon

Data	Z	P Value
Right foot pre and post test	-5.097	0.000
Left foot pre and post test	-5.019	0.000

Based on table 4, the results of the right foot pre and post-test have a p-value of 0.000 while the results of the left foot pre- and post-test have a p-value of 0.000. From these data, it can be concluded that there is an effect of using medial arch support on the valgus ankle angle in flat foot conditions. The magnitude of the effect can be seen from the z value, which is -5.097 on the right foot pre- and post-test and -5.019 on the left foot pre- and post-test.

DISCUSSION

The type of research used in this study is a quasi-experimental research design with one group pre-test and post-test. The study was conducted using one group with two measurements. This study aims to determine the effect of the use of medial arch support on the valgus ankle angle in flat foot conditions.

This research was conducted on undergraduate students in the Department of Prosthetic Orthotics, Poltekkes, Ministry of Health, Surakarta, with 51 students experiencing flat foot. From this population, the number of samples can be determined to be as many as 32 students. The sampling technique used is purposive sampling. The sample in this study were students who were present during the study and met the inclusion and exclusion criteria set by the researcher. This research was conducted using the rearfoot angle test (RFA) as measured by a goniometer.

A descriptive bivariate statistical test using a non-parametric Wilcoxon test obtained a significance value or Sig. (2-tailed) of 0.000 on the right and left foot, because of the value of Sig. (2-tailed) < 0.05, it means that there is a significant effect on the use of medial arch support on changes in ankle valgus angle in flat foot conditions. This is in line with Y.A. (2017) which states that giving medial arch support is very effective in reducing the eversion of the ankle, stabilizing the longitudinal arch of the pedis, placing weight more evenly, improving body balance, and improving walking function. The medial arch support functions as a support with the hope that the base of support can be distributed over the entire surface of the foot so that the base of support is wider and the balance is more stable.

The decrease in the ankle valgus angle can be seen from the average angle value of the right foot pre- and post-test, which went from 82.37 to 84.69, or a difference of 2.32 degrees, while the left foot pre- and post-test went from 82.78 to 85.22, or a difference of 2.44 degrees. This is in line with research conducted by Nugroho et al., (2017) that there is an effect of using medial arch support on decreasing the degree of ankle valgus. In this study, the normal angle used as a reference is 87°, as stated by (Stevens et al., 2011).

In the statistical test, the z value, or the difference in influence before and after using the tool, is -5.097 for the right pre-and post-test, and -5.019 for the left pre- and post-test. The negative value in these results indicates that the research flow is negative, which means that the more medial arch support is used, the lower the ankle valgus angle will be. Hsien and Ru-Lan, (2018) argue that the working mechanism of the medial arch support is to keep the foot in a neutral position, namely by keeping the subtalar joint in a neutral position to correct forefoot abduction and hindfoot pronation. Contours from the medial side that are made higher or in line with the contours of the arc also help keep the talar head in a neutral position. This process will occur while standing in a weight-bearing position to ensure the foot is in a neutral subtalar position when in contact with the medial arch support.

The medial arch support extends the support area when standing in a static position because the medial side surface has a protrusion that can be used to support the medial longitudinal arch and also provide stability to the foot. It is hoped that by giving this medial arch support, the longitudinal arch of the pedis becomes more stable, weight support becomes more even, and body balance improves so that it can correct deformities such as valgus in the ankle.

CONCLUSION

Research on the effect of the use of medial arch support on the valgus ankle angle in flat foot conditions at Campus 2 Poltekkes Kemenkes Surakarta has been carried out as well as possible in March 2022 with a sample of 32 students who have met the inclusion and exclusion criteria set by the researcher. The conclusion drawn is that there is an effect of the use of medial arch support on the angle of the valgus ankle in flat foot conditions. Decision-making is based on the output of the Wilcoxon test, which obtained a significance value of 0.000 on the right and left foot in the pre-and post-tests. The condition for the hypothesis to be accepted is the p-value < 0.05. Based on the data above, the significance value of the two data points is 0.000, which is less than 0.05, so it can be concluded that "the hypothesis is accepted". This means that there is an effect of medial arch support on the valgus ankle angle in flat foot conditions.

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