

Original Research

The Effect Of Using Medial Arch Support On Dynamic Balance

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ABSTRACT

Background: *Pes planus* is a clinical orthopedic condition in which the medial longitudinal arch is not visible from birth and the area is covered with fatty tissue, by using medial arch support it is hope that it can encourage the formation of the medial longitudinal arch and position the sole of the foot in the correct potition The arch normally forms from the first 5 years with an age range of 2-6 years. The critical period for arch formation is 6 years of age (Campbell, 2012). In the early school years, 28% - 35% of children have *pes planus* deformities, 80% of whom are categorized as "moderate". This study aims to illustrate that the incidence of *pes planus* at the age of shildren requires early sedation because 80% of the *pes planus* in children is categorized as moderate .

Methods: This research is a true experimental type with a ype of pre and post test design which aims to determine the effect of using medial arch support on the dynamic balance of *pes planus* students of MI Nurul Karim Colomadu. The subjects used were grade 1 - 5 students with the condition of *pes planus* who had determined the inclusion and exclusion criteria. The number of subjects was 29 people with male and female gender from a total population of 92 student

Results: Using the Wolcoxon Correlation Test, it is known that the value of $p = 0.000$ ($P < 0.05$) shows that there is an effect of the use of medial arc support on dynamic balance in flat foot patients.

Conclusion: The use of medial arch support has an effect on increasing dynamic balance in children with flat foot , so it is recommended to use medial arch support in children with flat foot.

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INTRODUCTION

The balance ability of children at developmental age is very important to review, both in terms of balance siting, standing, and when walking. Balance is one of the most important parts or things in activities where everyone need balance in maintaining their body position moving or doing activities. Balance is the ability to maintain the body in the body's center of mass (center of mass) against the base of support to fight gravity

(center of gravity) influenced by sensory processes or the nervous, motor or musculoskeletal system, and external effects (Boccolini.,2013).

One of the factors that can cause balance disorders in children is musculoskeletal disorders in the form of foot deformities. The shape of the human foot is divided into three types, namely normal foot, pes planus and cavus foot according to the structure of the arcus pedis or the arch of the sole of the foot. This arch also serves to the increase speed and agility during walking and provides stabilization and flexibility. Early childhood is children who are aged 0-8 years according to the National association for the education of young children.

Early childhood is an important period or often called the golden age because this period only comes once and cannot be repeated. This period is a period of great potential to train and develop various aspects of children's development. Early childhood has enormous potential to optimize all aspects of development, including the development of motor skills. According a person's motor abilities consist of several mutually supportive elements, such as strength, coordination, speed, balance, agility (Primasoni & Yudanto, 2011).

During the child's growth and development, most of the soles of the child's feet experience thickening of the soft tissue on the inner side (medial), this situation will decrease along with the growth period. One of the disorders / disorders that can cause walking difficulties is pes planus. This condition is caused by a weakness in the structures that support the longitudinal arch of the pedis, namely (1) the short muscles of the foot, (2) the plantar ligament, (3) the anterior and posterior tibial tendons.

Pes planus is a clinical orthopedic condition in which the medial longitudinal arch is not visible from birth and the area is covered with fatty tissue. Normally the arch is formed from the first 5 years with an age range of 2-6 years. The critical period for the formation of the arch is the age of 6 years (Campbell et al.,2017). During early school age, 28%-35% of children experience pes planus deformity, 80% of them are categorized as "Moderate".

After birth, 80% of flat arches or first-degree pes planus gradually change to normal curve. Arcus pes planus third degree, the frequency remains in each age strata 0-18 years. Arcus pes planus second degree, the frequency decreased partially. This applies to both men and women. Thus, it can be concludes that about 20% of the population, the arcus pedis has not yet reaches its normal shape and 0,6-1,2% has overgrowth or cavus foot (Hadipoetro Idris.,2010).

From research conducted by (Dabholkar et al.,2012) that there are significant differences in static and dynamic balance and agility in children with pes planus and normal feet. In a study conducted by (Ali et al .,2011) there were differences in the dynamic balances between the pes planus group and the normal foot group. It can occur at any age and can occur in the one or both legs. A survey of 297 school children in Allahabad, India revealed that 40,32% of children under 5 years, 22,15% of children between 5 to 10 years, and 15,48% of children over 10 years had bilateral pes planus (Sharma.,2005).

According to as many as 75,3% of children with pes planus are unable to stand on one leg for a long time due to instability of the subtalar joint which hinders balance while standing on one leg. Dynamic balance is very important for children because it is related to the agility of children in carrying out their daily activities. From previous research that has been conducted on students of MI Nurul Karim Colomadu, it shows

that there is a significant relationship between pes planus and dynamic balance with moderate correlation strength.

By looking at the above phenomenon, it makes researchers interested in conducting further research from previous research by providing interventions in the form of medial arch support and then examining the effect of using medial arch support on dynamic balance in pes planus students of MI Nurul Karim Colomadu. The current study is a follow up study from previous study by the same researcher, the difference is that for the current study the respondents were given intervention with medial arch support, previous study have not given intervention with medial arch support.

MATERIALS AND METHOD

This study is a quasi-experimental study with a type one group pre and post test design, the treatment in the group is to measure dynamic balance when without using medial arch support and measuring dynamic balance when using medial arch support. This research was conducted at MI Nurul Karim and was carried out in 2019. The population used was all students of MI Nurul Karim with a total of 92 students. Respondents in this study were students of MI Nurul Karim who experienced flat foot as many as 29 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) MI Nurul Karim Colomadu students are male and female aged 6-10 years, 2) Students who have pes planus based on the wet footprint test, 3) Research subjects are in good health, 4) Cooperative and willing to participate in research. Exclusion criteria: 1) Obesity, 2) Children with special needs.

In this study there are two variables, the dependent variable is dynamic balance. The dynamic balance referred to in this study is the ability of children aged 5-7 years to pass the balance beam in a certain time which is measured using the balance beam walking test. The independent variable in this research is the use of medial arch support, the intervention of giving medial arch support is given to students who are known to have flat foot.

The dynamic balance data obtained are primary data obtained from observations using a Balance beam or a horizontally longitudinal balance beam. The balance beam is used to measure the balance of the research subject. Balance beams can be made simply from a beam placed in two places higher than the ground with a size of 15 x 120 x 20 cm, so that it can be moved around.

The dynamic balance referred to in this study is the ability of children aged 5-7 years to pass the balance beam in a certain time which is measured using the balance beam walking test. The objective criteria for dynamic balance are: Very good : score 5, good : score 4, enough : score 3, less : score 2, very poor : score 1, bad : score 0. With the explanation of each score is as follows : 5 = able to pass the balance beam with perfect balance in 6 seconds, 4 = able to pass the balance beam slightly wobbly in 6 seconds, 3 = able to pass the balance beam with more than one stop and takes more than/equal to 6 seconds, 2 = able to cross the balance beam by stopping more than once and nearly falling, possibly pausing one or more times, and/or taking more than 6 seconds, 1 = Fall off the block before completing the walk, 0 = Fall off the block immediately.

Initial data collection was carried out including in the pre test by measuring dynamic balance using a balance beam walking test to students with flat foot conditions

without using medial arch support, then post test data was also carried out in the form of dynamic balance data collection using a balance beam walking test on students which is the same as the flat foot condition with intervention in the form of medial arch support. Normality test using Shapiro-Wilk. The difference between pre and post test is to describe the difference in dynamic balance before and after using medial arch support in children's flat foot conditions. the results of normality test data are not normally distributed. statistical analysis using wilcoxon, ethical clearance has been given poltekkes surakarta with number LB.02.02/1.1/8791/2019.

RESULTS

This research is a quasi experimental type with a type of pre and post test design which aims to determine the effect of using medial arch support on the dynamic balance of pes planus students of MI Nurul Karim Colomadu. The subjects used were grade 1-5 with the condition of pes planus at MI Nurul Karim Colomadu, who had determined the inclusion and exclusion criteria. The number of subjects was 29 people with male and female gender from a total population of 92 students.

Table 1. Distribution of Research Subjects by Gender

Gender	Frequency	Percentage (%)
Male	10	34,5
Female	19	65,5
Total	29	100

Based on table 1, the number of male subjects is less than female subjects, where the number of male subjects is 10 people (34.5%) and women are 19 people (65.5%). with a vulnerable age of 6-11 years which is the age of growth in children

Table 2. Results of dynamic balance measurements

Balance result	N	Min	Maks	Mean	Std. deviation
Without <i>medial arch support</i>	29	2	4	3.10	0.976
With <i>medial arch support</i>	29	2	5	3.79	0.902

Based on table 2, the results of dynamic balance measurements obtained without using medial arch support are smaller than those using medial arch support. These data were obtained from the results of dynamic balance measurements which were carried out alternately on each research subject using the balance beam test.

Table 3. Data normality test

Treatment	Sig. Shapiro-Wilk	Description
Without <i>medial arch support</i>	0,000	abnormal
With <i>medial arch support</i>	0,002	abnormal

*= Normality test Shapiro - wilk

Based on table 3 above, the normality test of the dynamic balance test results using Shapiro-Wilk in the first treatment without using medial arch support showed $P = 0.000$ where the P value <0.05 so that the data was not normally distributed. While the normality test of the dynamic balance test results in the second treatment using the medial arch support, the results were $P = 0.002$ where the P value <0.05 so that the data was not normally distributed.

So it can be concluded that the two data are not normally distributed. Based on the results of the normality test of the data, to determine the effect of using medial arch support on dynamic balance, a parametric test is carried out, namely the Wilcoxon test because it is paired data with a ratio measurement scale and the data is not normally distributed.

Table 4. Hipotesis test with Wilcoxon

Description	N	Mean
Total	29	
Score Z	-3.503	-0.25533
Asymp. Sig. (2-tailed)	0,000	

*= *Hipotesis test wilcoxon*

Based on table 4 above, the results of statistical analysis with the Wilcoxon test that have been carried out have a value of $P = 0.000$ ($P <0.05$), so this can answer the effect of using medial arch support on dynamic balance in flat foot patients. H_0 is rejected and H_a is accepted.

DISCUSSION

The research subject criteria data is primary data obtained from the results of direct measurements on the research subject. The research subjects were students of MI Nurul Karim Colomadu, with an age range of 8 to 12 years. This is in line with the theory presented by (Putri et al., 2019) where the age of 7 to 9 years is included in late childhood which has enormous potential to optimize all aspects of development, including the development of motor skills.

At the age of 7 to 12 years, children's motor skills reach the stage of specialized skills, where children master their motor skills and achieve optimal motor development. In addition, this theory is also in line with the theory presented by (Fajar & Permana, 2013) which states that motor skills are very influential on children's development. If there is a delay in motor skills, there will be delays in the development and growth of children which will have an impact on functional abilities, especially mobility abilities such as decreased balance, increased risk of falling, and decreased walking speed (Putri et al., 2019).

During the child's growth and development, most of the soles of the child's feet experience thickening of the soft tissue on the inner side (medial), this situation will decrease along with the growth period. One of the disorders/disorders that can cause walking barriers is flat foot (Siswiyanti et al., 2013).

A study using gait measurements by (Huxham et al., 2001), found that children with flat feet performed worse on physical tasks or were unskilled and walked more slowly than normal children. This is also in accordance with the theory presented by (Hadipoetro Idris, 2010) where the flat shape of the foot without an arch is less able to

function as a rigid lever system to lift the body when the foot will leave the footing in the walking process (push off phase). Whereas the normal foot has a sufficient arch so that it can be a good lever when walking.

In addition, in the condition of the foot with a flat arch (flat foot) hyperpronation occurs in the medial longitudinal area, this situation causes the foot to require a large force to push the body weight forward during the take off phase so that the hyperpronated foot condition takes time to perform resupination movements and produces spring. (spring force). When compared with a normal foot shape, the time needed by someone with a flat foot arch will be longer because they have to enter a longer take-off phase and the resulting spring force is smaller so that the force when walking is smaller. Then the road speed (speed) will also be lower (Putri et al., 2019).

In this study, subjects with flat foot were measured for dynamic balance without using medial arch support, then intervention was given and dynamic balance was measured using medial arch support. This intervention was given because according to what was conveyed by (Abdelgaid, 2013) the use of medial arch support can improve the physiology of the foot so that leverage when standing and walking will increase and cause a more even distribution of body weight. In addition, according to the assumption conveyed by (Siswiyanti et al., 2013). That the provision of medial arch support causes the longitudinal arch of the pedis to become more stable so that the walking function of patients with flat foot becomes better.

The dynamic balance data obtained are primary data obtained from observations using the Balance beam or horizontal balance beam. The balance beam is used to measure the balance of the research subject. According to balance beams can be made simply from a beam placed in two places higher than the ground with a size of 15 x 120 x 20 cm, so that it can be moved around.

Based on the results of the Wilcoxon test that has been carried out with $N = 29$, the value of $P = 0.000$ ($P < 0.05$) is statistically stated that there is a significant effect on the use of medial arch support on dynamic balance. The dynamic balance of flat foot sufferers is better when using medial arch support than without using medial arch support. If an assessment is made of the gait analysis of the research subject while walking, the use of the medial arch support is more flexible and able to adjust the movement of the foot so that the walking phase from heel strike to heel strike again can be passed well and the toe off phase can be passed without any obstacles, especially in the metatarsophalangeal section joints.

This is in accordance with what was conveyed by (Siswiyanti et al., 2013) that the selection of the use of medial arch support with flexible materials can be used to support the arch remains intact. Medial arch support from a soft material functions as a shock absorber. The heel pad will dampen or reduce the pressure on the heel. Plantar foot pressure will be distributed on the arch support, metatarsal shaft, heel, to the forefoot. Biomechanically, the medial wedge will hold the weight of the foot, especially the mid-foot (middle of the foot) so as to prevent foot pronation which disrupts balance.

If flat foot is found in children aged 8 to 12 years, intervention in the form of medial arch support can be chosen so that the dynamic balance of flat foot sufferers is faster and comfort when walking can be achieved. This is in accordance with the statement conveyed by the subject of his subordinate research, all subjects feel comfortable when walking using medial arch support. In addition, it is also in accordance with the theory that soft materials can provide comfort by providing limited joint control when used.

CONCLUSION

This research was conducted at MI Nurul Karim Colomadu. In this study, 29 research subjects were male and female with a degree of flatfoot 2-3. In this study, research subjects were selected using a purposive sampling technique and then a comparison of dynamic balance was performed without using medial arch support and dynamic balance using medial arch support. Normality test was carried out using Shapiro-Wilk. From the results of the normality test, the data obtained are not normally distributed, so the test used is the Wilcoxon test, with the results that medial arch support can improve dynamic balance in cases of flat foot children.

In this study, the researcher proposed the following suggestions: In the case of flat foot conditions in children, it is recommended to use medial arch support, this will help improve dynamic balance and encourage the growth of the medial longitudinal arch in children.

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