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Original Research

Effect of Custom Foot Orthoses on Vertical Jump in Flat-Footed Basketball Players

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ABSTRACT

Background: *Basketball is one of the most popular and widely enjoyed sports among Indonesians. Vertical jump is one of the elements that determines success in performing several of those techniques. The foot plays a vital role in supporting the body's weight during activities such as walking, standing, running, and jumping. The shape of the arcus pedis influences the biomechanics of the foot. A normal arch will assist in achieving maximum jumps. An abnormal pedal arch affects the outcome of jumps, resulting in suboptimal performance. The device can be provided for abnormal arch conditions, such as a custom foot orthosis. This study aims to determine the effect of custom foot orthoses on vertical jumps in flat-footed basketball players.*

Methods: *One group pretest and posttest design method with population of 25 people and 23 respondents. The evaluation of vertical jump is using vertical jump test that is measured before and after the use of foot orthoses for a month. The data analysis is using a Paired Sample T-test.*

Results: *The results of the statistical test showed a p value of <0.001 (p < 0.05), indicating a significant difference in the use of custom foot orthosis before and after the intervention.*

Conclusion: *There is an improvement in the vertical jump of basketball players with flat foot condition. Custom foot orthoses are recommended for use to improve the vertical jump of basketball players with flatfoot conditions.*

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INTRODUCTION

Sports are systematic bodily activities aimed at developing one's potential both physically, mentally, and socially. The improvement in health quality can also be felt by someone who engages in this new hobby trend (Reswari, 2021). Some health benefits that can be felt include increased physical strength, improved metabolic health, mental health, muscle strength, and increased happiness hormones such as endorphins, serotonin, and dopamine.

Sports are divided into two groups of games, large ball games and small ball games. Soccer, basketball, and volleyball are some examples of large ball games (Smith & Merwin, 2021). Basketball is very popular among various segments of society, as

evidenced by the extensive coverage on TV, YouTube, or social media (Samsudin, 2022). Men, women, the elderly, the young, tall, and short can play this game, including those with physical disabilities.

Basketball is a game that consists of ten players divided into two teams competing to shoot the ball into the hoop to score as many points as possible (Lado et al., 2022). The basic techniques of basketball include shooting (throwing the ball into the basket), passing (throwing), dribbling (bouncing the ball), pivoting (balancing on one foot), and rebounding. In this sport, the vertical jump is one of the key elements that determines success in executing several of these techniques (Lado et al., 2022). Jumping or leaping is a bodily movement effort to lift the body's weight with support on both feet to move from one point to another with support on both feet and return to the ground with support on both feet (Syaifuddin & Martinie Hartatik, 2024; Tang et al., 2023).

When jumping, all support will be fully on the feet. Here, the feet play a vital role in supporting the body's weight during activities such as walking, standing, running, and jumping. According to Aiyegbysi, (2017) in the study by Lado et al., (2022) achieving a high jump is one of the important requirements in basketball, as it can help players score points against the opponent's hoop. Jumping is a movement that will be encountered in basketball, especially when players are shooting. Players with good shooting technique will become a threat to the opposing team, as they can easily score points (Nordahl et al., 2023).

Vertical jump is a movement that involves jumping straight up as high as possible, focusing on the power of the leg muscles (Winata, 2021). The strength of the extremities can be measured using the vertical jump. The height of the vertical jump is a benchmark for assessment in various sports (Grainger et al., 2019). The ability to perform a vertical jump is an important element that needs to be improved in basketball because the vertical jump is predominantly performed when players shoot.

The foot plays a vital role in supporting the body's weight during activities such as walking, standing, running, and jumping. Biomechanics and musculoskeletal aspects of the foot are influenced by the shape of the foot arch or arcus pedis. Arcus pedis plays a key role in the absorption of ground reaction force (GRF). Arcus pedis is a layered structure that functions as a foot spring and will be maximally active when there is an arch (Munawarah et al., 2021).

The function of the arcus pedis is to act as a spring and a launching pad when jumping normal arcus shape will assist in providing a good and maximal jump. An abnormal arcus pedis shape affects the function of the foot in performing activities, including jumping, resulting in a less effective and maximal jump. In general, the arcus pedis can be categorized into three types: normal foot, pes cavus, and flat foot (Tang et al., 2023).

The theory predicts that a person with flat foot condition experiences weakness in the joints of the mid or proximal forefoot, stretching and weakening of the plantar fascia, spring ligament, and posterior tibial tendon. Based on the theory stated by Sari et al., (2021) the flat foot condition in a person will weaken the proximal forefoot joints, plantar fascia, spring ligament, and posterior tibial tendon. The weakening of the spring ligament will affect the spring force on the arch, thereby affecting jump performance.

In the management of various flat foot conditions, an intervention in the form of custom foot orthosis/medial arch support can be provided. This study demonstrates that medial arch support can play a significant role in alleviating the severity of flatfoot in children aged 8 to 12, suggesting its potential as an effective conservative intervention

during key developmental years. Thus, it will be expected that using a custom foot orthosis will help those with flat feet do vertical jumps more effectively. So, this study aims to determine the effect of custom foot orthoses on vertical jumps in flat-footed basketball players.

MATERIALS AND METHODS

This research uses a type of pre-experimental study with a one-group pre-test and post-test design. A single group of participants was observed before and after the intervention to assess changes in the measured variables. This design allows for the evaluation of the intervention's effects, although it does not include a control group for comparison (Dahlan, 2021). The subjects were given a pre-test first to determine the height of the vertical jump before the subjects received the treatment (custom foot orthosis) and after receiving the treatment (custom foot orthosis). The research was conducted from July to December 2024 in the Surakarta Ministry of Health Polytechnic Basketball Court.

The population consisted of 25 individuals, of whom 23 male respondents were selected based on predetermined inclusion and exclusion criteria using purposive sampling. The purposive sampling technique was employed to ensure that the selected participants specifically matched the study's objectives and were representative of the target population (Dahlan, 2020). Inclusion criteria are male basketball players, being absent from basketball events for more than a year, having flat feet, and having a normal BMI. The exclusion criteria in this study were subjects experiencing leg pain. The dependent variable in this study is the vertical jump, and the independent variable is the custom foot orthosis.

The dependent variable in this study is the vertical jump, and the independent variable in this study is the custom foot orthosis. The arch foot was screened as the first step in the study. After that, the foot is cast to create a foot mold. The researcher then created a custom foot orthosis for the research subject using a mold. The custom foot orthosis is made of polypropylene plastic that is 3 mm thick. For a month, the respondents wore foot orthoses. The evaluation of vertical leaps was then done both before and after the use of foot orthoses with the vertical jump test or the Sargent jump test instrument.

This test has a validity level of 0.86 and a reliability level of 0.92. Data normality test using Shapiro-Wilk because the number of subjects or research samples is <50 with the parametric Paired Sample T-test (Dahlan, 2021). This study uses ethical clearance with the Number. 247/IX/AUEC/2024 from Aisyiyah University of Surakarta, which was obtained on December 6, 2024.

RESULTS

The number of research subjects used is 23 people, with the following characteristics.

Table 1. Characteristics of Respondents on Gender and Degree of flatfoot (n=23**)**

Characteristics	Frequency	Percentage (%)
Gender		
Men	23	100
Women	0	0
Total	23	100

Characteristics	Frequency	Percentage (%)
Degree of flat foot		
1	9	39.1
2	5	21.8
3	9	39.1
Total	23	100

All study participants were male, accounting for 100% of the sample. The most common degrees of flatfoot among participants were grade 1 and grade 3, each observed in 39.1% of the sample. These findings indicate that mild and severe flatfoot conditions were equally prevalent in the study population.

Table 2. Characteristics of Respondents Based on Age, Height, and Weight (n=23)

Variable	Minimal	Maximal	Mean ± Standar Deviation
Age	15	18	16.17 ± 0.83
Weight	45	73	60.21 ± 0.72
Height	159	176	167.86 ± 5.42

The participants' ages ranged from 15 to 18 years, with a mean age of 16.17 ± 0.83 years. Body weight varied between 45 and 73 kilograms, with a mean weight of 60.21 ± 0.72 kilograms. The participants' heights ranged from 159 to 176 cm, with an average height of 167.86 ± 5.42 cm.

Table 3. Categories of vertical jump pre-test and post-test of research subjects

Variable	Pre-test		Post-test	
	n	%	n	%
Vertical Jump				
Very Poor	0	0	0	0
Poor	0	0	0	0
Below Average	3	13.04	0	0
Average	10	43.48	5	21.74
Above Avarage	10	43.48	12	52.17
Very Good	0	0	5	21.74
Excellent	0	0	1	4.35
Total	**23**	**100**	**23**	**100**

Note: n = number of observations; % = percentage

Table 3 shows that there are differences in the vertical jump categories of basketball players before the intervention, which were below average at 13.04%, average at 43.48%, and above average at 43.48%. After the intervention using custom foot orthosis, there were no players in the below average category, and the distribution changed to average at 21.74%, above average at 52.17%, very good at 21.74%, and excellent at 4.35%. Therefore, it can be concluded that there was an increase in the vertical jump categories before and after the intervention.

Table 4. Results of the Paired Sample T-test for custom foot orthosis

Variable	Pre-Intervention		Post-Intervention		*95% CI*		*p Value**
	Mean	Std Deviation	Mean	Std Deviation	Lower	Upper	
The vertical jump	48.47	6.33	57.08	7.44	-11.65	-5.57	<0.001

Note: * The Paired Sample T-test

Based on the results of the statistical analysis using the Paired Sample T-test conducted on the use of custom foot orthosis, a p value of <0.001 (p value < 0.05) was obtained. This indicates a significant difference in the use of custom foot orthosis before and after the intervention in improving the vertical jump of basketball players with flat foot condition.

DISCUSSION

Custom foot orthosis before and after the intervention in improving the vertical jump of basketball players with flat foot condition. The function of the arcus pedis is to provide spring force and a launching pad for jumping (Tarsono & Nurdin, 2024). The normal shape of the arcus will assist in providing a good and maximum jump. An abnormal shape of the pedis arcus affects the function of the pedis in performing activities, including jumping, resulting in less optimal jump outcomes. In line with the research conducted by Ismi and Pasaribu (2023) on 63 preschool children in Daya Murni Village, where a significant number of children were found to be female (53.9%) with the majority aged 4-5 years (53.9%), and children with poor motor agility at 50.5% with a frequency of children experiencing pes planus at 56.6%.

It was found that there is a relationship between normal arcus pedis and motor agility and a weak correlation strength in a positive direction, meaning that the more normal the arcus pedis shape, the better the motor agility (Ismi & Pasaribu, 2023). In this study, it was found that during the pre-test, there were 3 subjects in the below-average vertical jump category, 10 subjects in the average category, and 10 subjects in the above-average category. Meanwhile, during the post-test, it was found that there were 5 subjects in the average category, 12 subjects in the below-average category, 5 subjects in the very good category, and 1 subject in the excellent category. A similar study was conducted by Winata (2021) on 10 players from the Magic Kid club in Lubuklinggau. Among the 10 players, the highest score was in the above-average category and the lowest in the below-average category.

In this study, subjects with flat feet were then given an intervention using custom foot orthoses for 1 month, followed by measuring the vertical jump of each group of research subjects after the intervention. This intervention was given because, according to what was stated by Hajizadeh et al. (2020), foot orthoses (FOs) are one of the popular treatments used to alleviate several disorders of the lower extremities.

From the research results, it was found that the height of the vertical jump of the research subjects before and after the intervention had a difference of 8.61 cm, where subjects using custom foot orthoses had a higher vertical jump compared to before the intervention with the use of custom foot orthoses. Based on the results of the statistical analysis using the Paired Sample T-Test conducted on the use of custom foot orthosis, there is a significant effect of the use of custom foot orthosis on the improvement of vertical jump in basketball players.

Custom foot orthosis has a shock absorber function to provide a spring-like force while walking and to stabilize the foot during a vertical jump. At the initial push-off when jumping, the foot mechanism in the plantar fascia area forms a cable or connector between the calcaneus and phalanges that can absorb 60% of the total body weight distribution. At the push-off, the plantar fascia stretches and induces an arch elevation. Custom foot orthosis induces a better perception of cushioning in the front and back of the foot and improves vertical jump, but the plantarflexion moment is smaller than that of a regular custom foot orthosis (Wang et al., 2020).

Medial arch support functions as a shock absorber for body weight distribution in the foot (Syafii & Anggriani, 2020). This type of orthosis supports the foot arch, helping the foot to be more balanced and keeping the center of gravity (COG) in place, acting as a shock absorber, normalizing weight distribution across the entire foot, which is useful for improving the arch structure and providing stability to the foot. This shows that custom foot orthoses can be more effective in reducing GRF load on individuals with flat foot conditions, compared to individuals with normal feet, when the subject touches the ground (Tang et al., 2023).

The subject stated that when using a custom foot orthosis, they felt compensation in the arch area of the medial arch and found it easier to jump. This is because custom foot orthosis is effective in helping to transfer weight, stabilizing flexible deformities, and controlling abnormal movements. Research limitations: (1) several players were unable to participate in the study; (2) additional supporting elements, such as leg length and respondent fitness during the vertical jump test, were not examined.

Future research should focus on the long-term effects of custom foot orthoses, including a broader and more diverse participant pool, and examine additional variables like leg length and fitness levels. Biomechanical assessments and comparative studies with other interventions could also provide deeper insights into the efficacy of custom foot orthoses in enhancing performance and preventing injuries.

CONCLUSION

From the research results, it was found that the height of the vertical jump of the research subjects before and after the intervention had a difference of 8.61 cm, where subjects using custom foot orthosis had a higher vertical jump compared to before the intervention with the use of custom foot orthosis. Custom foot orthoses have been shown to improve the vertical jump performance of basketball players with flat feet by providing better weight distribution and stabilizing the foot structure. This intervention may help enhance athletic performance and reduce discomfort associated with flat foot conditions.

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