Dilek Hande Esen[1,*]
Nihan Kafa[2]
Ulviye Uğur Özyilmaz[2]
Nevin Atalay Güzel[2]

THE EFFECT OF MEDIAL LONGITUDINAL ARCH SUPPORTING DYNAMIC® TAPE APPLICATION ON PLANTAR PRESSURE DISTRIBUTION IN ADOLESCENT VOLLEYBALL PLAYERS

UČINEK APLIKACIJE DINAMIČNEGA TAPINGA, KI PODPIRA MEDIALNI VZDOLŽNI LOK NA PORAZDELITEV PLANTARNEGA PRITISKA PRI MLADOSTNIKIH, KI SE UKVARJAJO Z ODBOJKO

ABSTRACT

Low medial longitudinal arch (MLA), which is accepted as one of the predisposing factors leading to overuse injuries, changes the plantar pressure distribution by disrupting the load distribution. While there are studies investigating the effects of Kinesio® and rigid taping methods on plantar pressure distribution in the literature, there are no studies found investigating the effect of Dynamic® taping (DT) on foot load distribution. The purpose of this study was to examine the effect of arch-supportive DT on plantar pressure distribution in adolescent volleyball players with low MLA. Twenty-five female volleyball players with a navicular drop of 8 mm and above and a mean age of 15.44 ± 1.68 years participated in this study. The distance of navicular drop was evaluated by navicular drop test, and the plantar pressure distribution was evaluated by the pedobarographic analysis method. After the first measurements were taken, Dynamic® tape was applied. The athletes were then reassessed using the same procedure. After taping, the navicular drop was significantly reduced for both feet ($p<0.05$). There was no significant difference between the peak pressure values before and after taping ($p>0.05$). Total forefoot and hindfoot surface contact areas decreased significantly ($p<0.05$). Our study results showed that DT did not affect the peak plantar pressure, but could be effective in decreasing the surface contact area and increasing the MLA height. Dynamic® tape can be used as a practical, easy-to-apply treatment agent that supports the arch in asymptomatic athletes.

Keywords: taping; navicular drop; peak plantar pressure; pedobarograph; athlete

[1]Hatay Mustafa Kemal University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Hatay, Turkey

IZVLEČEK

Nizek medialni vzdolžni lok (MVL), ki velja za enega od predispozicijskih dejavnikov za nastanek poškodb zaradi preobremenitve (prekomerne uporabe) spremeni porazdelitev plantarnega pritiska na stopalo. Medtem ko so v literaturi na voljo študije, ki so preučevale učinke kineziološkega tapinga in kompresijskega povijanja na porazdelitev plantarnega pritiska na stopala, pa ni zaslediti študij, ki bi preučevale isti učinke s pomočjo dinamičnega tapinga (DT). Namen te študije je bil preučiti učinek DT, ki podpira lok na porazdelitev plantarnega pritiska pri mladostnikih, ki se ukvarjajo z odbojko in imajo nizek MLA. V raziskavi je sodelovalo petindvajset odbojkaric (starost = 15.44 ± 1.68 let) s padcem navikularne kosti vsaj za 8 mm. Razdalja padca navikule je bila ocenjena s testom padca navikule, porazdelitev plantarnega pritiska pa z metodo pedobarografske analize obe metodi sta bili opravljeni pred uporabo in po uporabi DT-ja. Po uporabi DT-ja se je padec navikularne kosti pri obeh stopalih statistično značilno zmanjšal ($p<0.05$). Med vrednostmi najvišjega pritiska pred in po uporabi DT-ja ni bilo bistvene razlike ($p>0.05$). Skupna površina stika sprednjega in zadnjega dela stopala se je statistično pomembno zmanjšala ($p <0.05$). Rezultati študije, so pokazali, da DT ni zmanjšal največjega plantarnega pritiska, bil pa je učinkovit pri zmanjšanju površine stika in povečanju višine MVL. DT se lahko uporablja kot zelo praktično ter enostavno sredstvo za zdravljenje, ki podpira MVL pri asimptomatskih športnikih.

Ključne besede: kineziološki taping, navikularni padec, največji plantarni pritisk, pedobarografija, športniki

[2]Gazi University, Faculty of Health Science, Department of Physiotherapy and Rehabilitation, Ankara, Turkey

Corresponding author:* Dilek Hande Esen,
Hatay Mustafa Kemal University, Hatay Tayfur Sokmen Campus, 31070 Hatay Center/Hatay
Telephone: +90 555 744 20 23
E-mail primary: dilekhande.esen@mku.edu.tr
E-mail secondary: dilekhandeesen@gmail.com

https://doi.org/10.52165/kinsi.28.3.30-42

INTRODUCTION

While body weight is supported by the feet, different amounts of pressure occur in the plantar tissues due to loading. In order to ensure the equal distribution of this pressure on the plantar surface of both feet, the foot biomechanics must function properly. An abnormal flattening that may occur in the medial longitudinal arch (MLA) curvature will adversely affect the biomechanical functioning of the foot, leading to a decrease in optimal foot functions (Kim & Park 2017).

In previous studies, it has been shown that a decrease in MLA height affects the plantar pressure by disrupting the load distribution of the foot (Ünver & Bek 2014). Again, although it could not be fully explained, it was found in the studies that there was a relationship between MLA posture, and injuries in the lower extremity and lumbar spine. It was stated that high MLA structure causes injuries mostly in the lateral part of the foot, while low MLA structure increases the risk of soft tissue injuries such as plantar fasciitis, patellar tendinitis (Jonely et al 2011), and it may also cause overuse injuries such as patellofemoral pain and medial tibial stress syndrome in athletes (Aguilar et al 2016; Boling et al 2009).

Taping is generally used to prevent athlete injuries as well as to provide external support and rehabilitate the athlete after injury. There are various taping methods applied with different tape materials (Kinesio® tape, rigid tape, Dynamic® tape) for this purpose. (McNeill & Pedersen 2016). One of these methods is the anti-pronation taping applications. Anti-pronation taping techniques have been shown to help to preserve the MLA height and shape while the foot is carrying weight and preventing the arch from dropping, and at the same time have a positive effect on the value of navicular drop by temporarily increasing the MLA height. Therefore, it is adopted as a good temporary treatment approach for athletes injured and/or having pain due to low MLA height (Newell et al 2015; Vicenzino et al 2007).

Dynamic® tape is a tape material developed by physiotherapist Ryan Kendrick, containing a high percentage of elastic latex in its texture. It is a tape that has high flexibility, can stretch both transversely and longitudinally (up to 200%), and has high traction torque due to its elastic structure. Acting like the elastic rope used by bungee jumpers, while the tissue in the shortened position stretches, it tends to slow it down strongly and pull it back to the starting position. It is used to imitate the movement without restricting it, and to support muscle and joint movement biomechanically (McNeill & Pedersen 2016).

In the literature, there are studies examining the effect of different taping techniques (Kinesio® and rigid taping) on plantar pressure distribution by restricting low MLA in athletes (Aguilar et al 2016; Cornwall 2019; Kelly 2010; Kim & Park 2017; Nolan & Kennedy 2009; Park & Kim 2019); however, no studies were found investigating the effect of Dynamic® taping. Dynamic taping has recently become a popular taping technique among athletes, which has led to the need for evidence-based scientific research on this taping technique. The aim of the study we planned in the light of this information was to examine the effect of Dynamic® tape application on plantar pressure distribution in adolescent volleyball players with low medial longitudinal arch height.

METHODS

Study Design

The study was designed as a cross-sectional study in a single group. Pre-test and post-test procedures were applied to each athlete participating in the study.

Ethical Approval

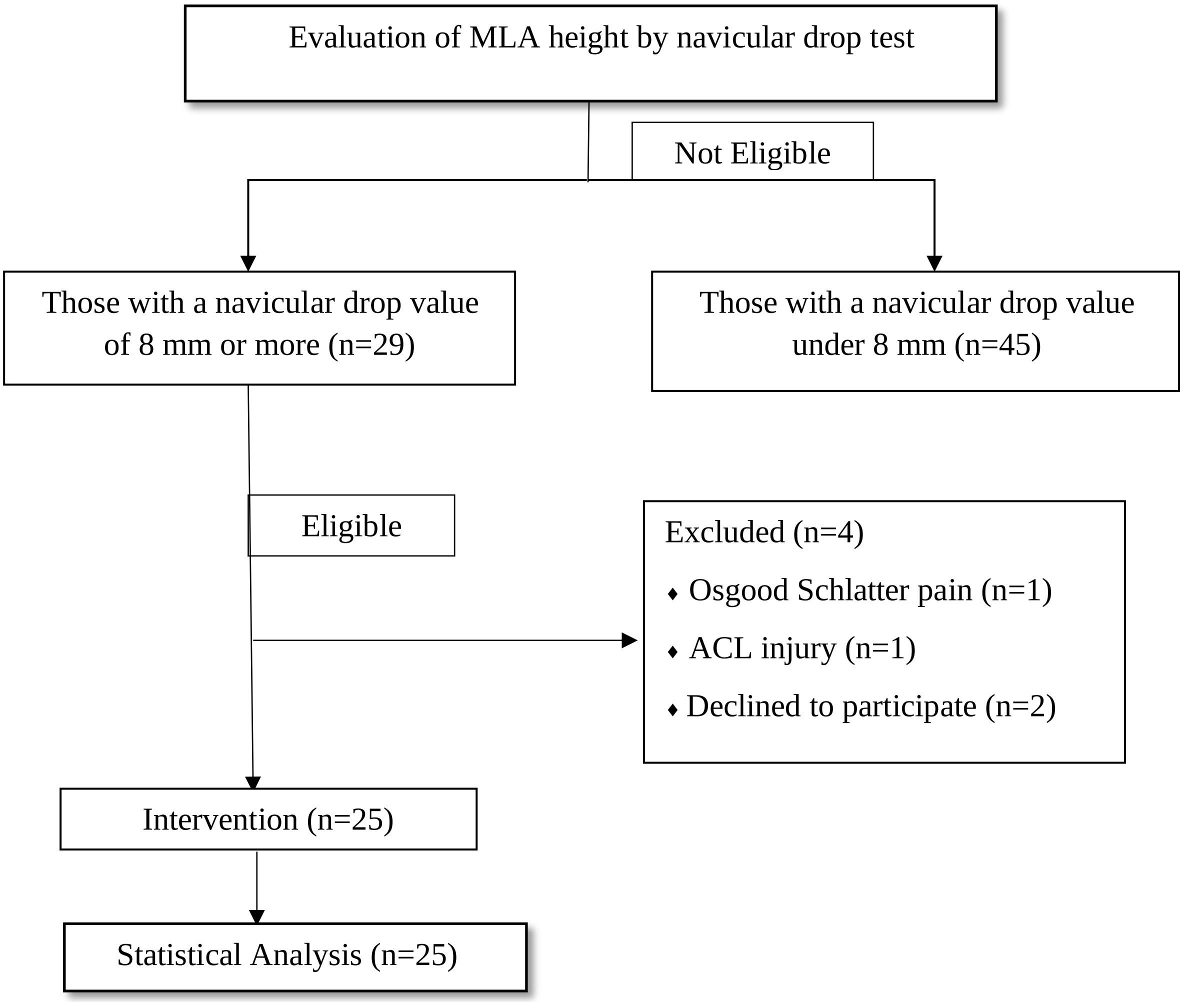
Before conducting the study, ethics committee approval was obtained from the scientific research and publication ethics committee at the relevant institute. After the athletes and their parents were informed about the content of the study, the informed consent form was signed indicating that they voluntarily participated in the study.

Participants

The sample of the study consisted of asymptomatic volleyball players who played in the same sports club infrastructure and were taken to the same training program. Female athletes aged 12-18 years with a navicular drop of 8 mm or more were included in the study. The exclusion criteria were a history of lower extremity injury and/or pain in the last six months, neurological and/or musculoskeletal disorders that could affect standing and normal walking patterns, and an allergic reaction to the tape material. Before conducting the study, sample size analysis was performed with the G*Power 3.0.1 software to determine the number of participants. According to a similar study in the related literature (Kim & Park 2017), the effect size was calculated as 1.001. To exceed the 95% threshold in determining the power of the study, it was required to reach 17 people with a significance level of 5% and an effect size of 1.001. A total of 74 athletes were evaluated in the preliminary study in which the navicular drop value was determined.

Among these athletes, 29 people were found to have flattened MLA structures. Among 29 people, 2 athletes declared that they had a history of lower extremity injury in the last six months, while another 2 people declared that they wanted to leave the study voluntarily. The study was completed with 25 athletes (Figure 1).

Figure 1. Participant flow chart.



Procedure

The distance of navicular drop of the athletes was determined by the navicular drop test, and the plantar pressure distribution was evaluated with the pedobarographic measurement method. Demographic information and navicular drop test results were recorded in the evaluation form created by the researchers. In the first stage, the demographic information of the athletes that were randomly invited to the evaluation area was taken. Then the navicular drop test was applied. Finally, dynamic pedobarographic measurements were taken. The athletes, who were evaluated without tape on the first day, were taped at similar times the next day. After the taping, the athletes were allowed to adapt to the tape for an average of 20 minutes. The athletes were then reassessed using the same procedure and taped this time.

Navicular drop

The navicular drop test was used to evaluate the MLA height. Athletes sat on a chair with bare feet in a neutral position of the subtalar joint. In this position, the navicular tubercle alignment of both feet was marked on a card with the lower edge touching the ground, using a pencil. Later, the same procedure was repeated while giving full weight and equal weight to both extremities in a standing posture. Marking was done on the same card. The difference between the points marked on the card was measured with a tape measure and recorded as the navicular drop value in mm (Zuil-Escobar et al 2018).

Plantar pressure distribution

The plantar pressure distribution of the foot was evaluated with the pedobarographic measurement method using the baropodometric platform system (Pedowell®). This platform is a system that includes a 240 × 50 cm walking platform with a resistive sensor (pedobarograph), has an advanced technology camera system, and a computer system where the analysis program is recorded and the data is stored and allows the dynamic evaluation of the plantar pressure distribution. The system, which has a sampling frequency (data transfer rate) of 400 Hz, has a capacity of measuring up to 150 N/cm^2 (last access date: 08.02.2021 http://pedowell.com.tr/baropodometric-platforms.html).

Data were collected by dynamic pedobarographic measurement. During the evaluation, the athletes were asked to walk on the walking platform that includes a sensitive middle platform, looking forward, walking barefoot in normal walking speed and step range, by stepping on the middle platform. Before the dynamic evaluation, a few test laps were made on the platform. While measurements were being taken, at least 3 steps were taken freely before the feet hit the platform. During the dynamic evaluation, the measurement of the athlete standing still on the platform or pressing the platform wrongly was repeated. As a result of the dynamic evaluation, the contact area and the maximum pressure value obtained in the middle platform stop (stepping) phase were recorded (Baumfeld et al 2017).

Dynamic® tape application

Taping was done by a certified physiotherapist. The arch support technique was used as the taping method. When starting the application, the athletes were informed about the posture they should keep during taping. For this, the athletes sat in a posture that their feet could be spaced starting from the ankle proximal. Then, the athletes were asked to keep their ankles in plantar flexion, their front feet in adduction, and their thumbs in flexion. Dynamic® tape, 5 cm wide, I-shaped, and in one piece, was applied to the hairless skin sanitized with alcohol. The application was started from the hallux proximal. The tape, which was extended from the mediolateral of the sole to the heel with slight tension, was looped in the posterior of the calcaneus, then was continued obliquely past the lateral midline of the foot and upwards from the plantar surface in a form that would encompass the navicular tubercle. It was terminated at the level of the lateral malleolus towards the distal of the ankle (Figure 2). Maximum tension was applied to the tape while encompassing the navicular tubercle. 0 stretch was applied to the anchor part having the width of the first and the last 3-4 fingers. The athletes were advised to remove the tape immediately in case of any discomfort (itching, burning, pain, or irritation) (McNeill & Pedersen 2016).

Figure 2. Dynamic® tape application.

Statistical Analyses

SPSS version 22.0 (IBM Corporation, New York, USA) software was used for statistical analysis of the data. Whether the data was suitable for normal distribution was examined using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). Descriptive statistics were shown as mean ± standard deviation (x ± ss) as all variables showed normal distribution. To compare the data of the participants' measurement results before and after taping, Paired Samples Students' T-Test was used. The significance level was taken as $p<0.05$.

RESULTS

When the demographic characteristics of the 25 athletes who participated in the study were examined, the following data for the athletes were obtained: age 15.44 ± 1.68 years; sports age 6.20 ± 1.77 years; height 1.75 ± 0.9 m; bodyweight 60.92 ± 8.52 kg; body mass index (BMI) 19.78 ± 1.71 kg/m^2.

The distance of navicular drop after taping was statistically significantly decreased (p<05). The results obtained are given in Table 1.

Table 1. Comparison of the distance of navicular drop.

Foot	**Without tape (mm) (x±ss)**	**Taped (mm) (x±ss)**	**P-value**
Right	9.09±1.56	7.91±1.20	.000*
Left	9.64±1.60	7.88±1.50	.001*

*p<0.05

As a result of the study, it was observed that the total, fore, and hind foot surface contact areas were significantly reduced in both feet after taping (p <05) (Table 2).

Table 2. Comparison of surface contact areas before and after taping according to dynamic pedobarography measurements.

	Side	Without tape (x±ss)	Taped (x±ss)	P-value
Total surface (cm²)	Right	126.20±10.44	123.00±12.12	.006*
	Left	127.40±10.62	123.76±13.89	.013*
Forefoot (%)	Right	26.90±2.27	25.84±2.11	.007*
	Left	27.57±2.06	26.31±2.17	.001*
Hindfoot (%)	Right	23.74±2.24	22.85±2.17	.020*
	Left	23.90±1.73	22.88±1.99	.001*

*$p<0.05$

According to the results of plantar pressure distribution, while a statistically significant decrease was found in the percentage of total pressure on the left forefoot after taping, no statistically significant difference was found before and after taping between the peak pressure values of both feet and the percentages of other pressure values ($p> 0.05$) (Table 3).

Table 3. Comparison of pressure values before and after taping according to dynamic pedobarography measurements.

Pressure Values	Side	Without tape (x±ss)	Taped (x±ss)	P-value
Peak pressure (g/cm²)	Right	9036.54±1154.81	9134.07±1337.83	.361
	Left	9121.78±1284.88	9051.52±1541.71	.532
Total pressure (%)	Right	49.30±1.68	49.92±2.16	.215
	Left	50.70±1.68	50.08±2.16	.215
Pressure on the forefoot (%)	Right	26.29±2.08	26.44±2.41	.711
	Left	27.49±2.08	26.55±2.24	.014*
Pressure on the hindfoot (%)	Right	23.02±2.35	23.47±2.15	.250
	Left	23.21±2.04	23.54±1.84	.285

*$p<0.05$

DISCUSSION

In this study, in which the effect of Dynamic® tape application on the plantar pressure distribution to support the arch in adolescent volleyball players with flattening in the MLA structure was examined, Dynamic® taping reduced the amount of MLA and the total, fore and hind surface contact areas during walking, but did not cause a significant difference in plantar pressure values.

In literature studies, it was found that there is a relevance between MLA posture and lower extremity injuries. In a study investigating the biomechanical factors that predispose to injuries for runners, it was reported that increased foot pronation and low MLA structure were observed in approximately 20% of the population and it was stated that excessive foot pronation was one of the biomechanical factors that lead to athlete injuries (Subotnick 1985; Tong & Kong 2013). One of the commonly used conservative treatment options to control excessive foot pronation in athletes is arch-supporting taping techniques. Most of the studies examining the effect of taping on MLA height investigated the acute effect and found that the applied tape limits the navicular drop value immediately after taping (Cornwall et al 2013; Franettovich et al 2008; Franettovich et al 2012; Kim & Park 2017; Vicenzino et al 2005; Vicenzino et al 2000; Prusak et al 2014). Cheung et al (2011) reported in a meta-analysis study that different taping techniques (low-dye, high-dye, and stirrups taping technique) had positive effects on increasing MLA height. Vicenzino et al (2005) found that the Low-dye taping technique acutely increased the medial longitudinal arch height during standing, walking, and running. Siu et al (2020), in a study examining the anti-pronation effect of Kinesio® taping on runners, showed that taping increased longitudinal arch height. In another study conducted on asymptomatic professional athletes, the acute effect of taping on the value of navicular height was investigated under four different conditions: rigid taping, kinesio taping, placebo taping, and no tape. As a result of the study, it was reported that rigid taping was effective in increasing the height of the navicular compared to other methods. It was interpreted that this result was because of the fact that the rigid tape has less flexibility than the flexible kinesio tape (Kim & Park 2017). As a result of our study, the distance of navicular drop after Dynamic® taping was statistically significantly reduced for both the right and left foot. This result may be due to the Dynamic® tape given to the MLA which tends to fall under the influence of body weight. In this respect, our study was compatible with the previous study results.

In a study conducted by Fernández-Seguín et al. (2014) the total surface contact area measurements of the normal foot structure and the foot structure with pes cavus (high arch) were compared, and it was found that the total surface contact area measurements were less in the foot having pes cavus. However, the relative plantar pressure distribution was in similar equality in both groups. The data obtained from our study support this result. As a result of our study, the anterior, posterior and total surface contact area of both feet decreased. This decrease in the contact area may have been caused by a decrease in the amount of drop in the MLA of taping. With a higher MLA, less part of the foot that touches the ground is an expected result.

Newell et al (2015) used two different taping techniques (low-dye and navicular sling technique) to increase navicular height in a study they conducted on 25 individuals with a navicular drop of more than 8 mm. They examined the effect of these techniques on plantar pressure distribution and found that taping techniques shift the pressure in the midfoot to the lateral. Lange et al (2004) reported that the low-dye taping technique increased the amount of plantar pressure in the lateral foot area while decreasing the amount of plantar pressure in the fore and hind foot. O'Sullivan et al (2008) reported that taping in the direction of anti-pronation reduced the maximum plantar pressure distribution in the medial of the forefoot and the hindfoot. It has been interpreted that the plantar pressure decreases in the medial part of the foot and increases towards the lateral, which may be an indicator of the MLA supportive effect of taping.

In our study, while the amount of pressure carried by the left forefoot increased with taping, there was no statistically significant difference in the values of peak plantar pressure, left hindfoot, right-left forefoot, and the pressure laying on the total contact area. This result showed us that, unlike other studies, Dynamic® taping is ineffective in changing foot load during activity. In our study, the peak plantar pressure distribution was not evaluated separately as the fore, mid and hind medial-lateral of the foot, unlike similar studies. Therefore, our findings may be insufficient to explain the effect of taping on plantar pressure distribution.

Although it has been concluded in previous studies that rigid tape is used most frequently in individuals with low MLA, that it can reduce the navicular drop value at most, and that it limits active movement to a certain extent due to its inability to stretch. However, the scarcity of scientific studies using flexible taping has led to the inability to determine the controlling effect of flexible taping on foot pronation. Although the restrictive effect of rigid taping on pronation has been proven, the use of flexible taping has become more popular in recent years. (Aguilar et al 2016). In this context, it can be thought that the Dynamic® tape, which does not restrict voluntary movement and can stretch in all four directions while providing biomechanical support to the tissue to which it is applied, can provide an advantage in clinical use. Dynamic® taping has recently become a popular taping technique widely used among athletes. However, in the literature review conducted by the authors of the study, there are very few studies on Dynamic® taping. We believe that our study has a unique value in this respect and will make important contributions to the literature.

Study Limitations

First, the acute effects of Dynamic® taping were examined in the study. Participants were evaluated within approximately 20-30 minutes after taping. This period was perhaps sufficient to reveal the possible effects, but studies to determine the long-term effects of taping are needed to obtain more precise information. Secondly, in our study, asymptomatic female athletes with no history of injury were evaluated. There is a need for future studies examining the effects of taping on symptomatic disorders. Finally, there was no study found in the literature that scientifically demonstrates whether Dynamic® taping affects MLA height and plantar pressure distribution. Further studies are needed to clarify the clinical significance of our study findings.

CONCLUSION

In conclusion, although its effect on direct plantar pressure distribution could not be demonstrated, Dynamic® taping can be used as a practical intervention method to support MLA in asymptomatic athletes who are at risk of an excessive drop in MLA, especially to prevent lower extremity injuries.

Clinical Relevance

1) Although dynamic taping has become a very common taping method in the field of athlete health and orthopedic rehabilitation in recent years, there are very few studies that reveal its effects with scientific evidence. This study is the first to examine the effects of Dynamic® taping on arch structure and plantar load distribution in athletes.

2) It has been observed that the foot structure tends towards hyperpronation in the majority of athletes.

3) It was shown that the Dynamic® tape supported the medial longitudinal arch structure biomechanically in athletes.

Acknowledgment

The authors would like to thank all the participants and the families of the participants who supported them, and everyone who helped the organization in the data collection process throughout the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

Aguilar, MB., Abián-Vicén, J., Halstead, J., Gijon-Nogueron, G. (2016). Effectiveness of neuromuscular taping on pronated foot posture and walking plantar pressures in amateur runners. Journal of Science and Medicine in Sport 19(4): 348-53.

Baumfeld, D., Baumfeld, T., Rocha, RL., Macedo, B., Raduan, F., Zambelli, R., Silva, TAA., Nery, C. (2017). Reliability of baropodometry on the evaluation of plantar load distribution: a transversal study. BioMed Research International 5: 1-4.

Boling, MC., Padua, DA., Marshall, SW., Guskiewicz, K., Pyne, S., Beutler, A. (2009). A prospective investigation of biomechanical risk factors for patellofemoral pain syndrome: the joint undertaking to monitor and prevent ACL injury (JUMP-ACL) cohort. American Journal of Sports Medicine 37(11): 2108–2116.

Cheung, RTH., Chung, RCK., Ng, GYF. (2011). Efficacies of different external controls for excessive foot pronation: a meta-analysis. British Journal of Sports Medicine 45: 743-751.

Cornwall, MW., Jain, TK., Holmgren, S., Dorri, A., Young, C. (2019). The effect of Kınesıo Tape® on statıc foot posture, plantar pressure, and rearfoot motıon in ındıvıduals with pronated feet. International Journal of Sports Physical Therapy 14(3): 368–375.

Fernández-Seguín, LM., Diaz Mancha, JA., Sánchez Rodríguez, R., Escamilla Martínez, E., Gómez Martín, B., Ramos Ortega, J. (2014). Comparison of plantar pressures and contact area between normal and cavus foot. Gait Posture 39(2): 789-92.

Jonely, H., Brismée, JM., Sizer, PS., James, CR. (2011). Relationships between clinical measures of static foot posture and plantar pressure during static standing and walking. Clinical Biomechanics 26(8): 873-879.

Franettovich, M., Chapman, A., Blanch, P., Vicenzino, B. (2008). A physiological and psychological basis for anti-pronation taping from a critical review of the literature. Sports Medicine 38(8): 617-631.

Franettovich, MM., Murley, GS., David, BS., Bird, AR. (2012). Comparison of augmented low-Dye taping and ankle bracing on lower limb muscle activity during walking in adults with flat-arched foot posture. Journal of Science and Medicine in Sport 15(1): 8-13.

http://pedowell.com.tr/baropodometric-platforms.html

Kelly, LA., Racinais, S., Tanner, CM., Grantham, J., Chalabi, H. (2010). Augmented low dye taping changes muscle activation patterns and plantar pressure during treadmill running. Journal of Orthopaedic & Sports Physical Therapy 40(10): 648-55.

Kim, T., Park, JC. (2017). Short-term effects of sports taping on navicular height, navicular drop and peak plantar pressure in healthy elite athletes: A within-subject comparison. Journal of Athletic Training 50(8): 825–832.

Lange, B., Chipchase, L., Evans, A. (2004). The effect of low-dye taping on plantar pressures, during gait, in subjects with navicular drop exceeding 10 mm. Journal of Orthopaedic & Sports Physical Therapy 34(4): 201–209.

McNeill, W., Pedersen, C. (2016). Dynamic tape. Is it all about controlling load?. Journal of Bodywork and Movement Therapies 20(1): 179-188.

Newell, T., Simon, J., Docherty, CL. (2015). Arch-taping techniques for altering navicular height and plantar pressures during activity. Journal of Athletic Training 50(8): 825-832.

Nolan, D., Kennedy, N. (2009). Effects of low-dye taping on plantar pressure pre and post exercise: an exploratory study. BMC Musculoskeletal Disorders 10:40.

O'Sullivan, K., Kennedy, N., O'Neill, E., Ni Mhainin, U. (2008). The effect of low-dye taping on rearfoot motion and plantar pressure during the stance phase of gait. BMC Musculoskeletal Disorders (18)9: 111–119.

Park, J., Kim, T. (2019). Acute effect of taping on plantar pressure characteristics in athletes with exercise-induced leg pain: a description and comparison of groups. The Physician and Sportsmedicine 47(2): 212-219.

Prusak, KM., Prusak, KA., Hunter, I., Seeley, MK. (2014). Comparison of Two Taping Techniques on Navicular Drop and Center-of-Pressure Measurements During Stance. Athletic Training & Sports Health Care 6(6): 252–260.

Siu, WS., Shih, YF., Lin, HC. (2020). Effects of Kinesio tape on supporting medial foot arch in runners with functional flatfoot: a preliminary study. Research in Sports Medicine 28(2): 168-180.

Subotnick, SI. (1985). The biomechanics of runnig: implications for the prevention of foot injuries. Sports Medicine 2(2): 144-53.

Tong, JW., Kong, PW. (2013). Association between foot type and lower extremity injuries: systematic literature review with meta-analysis. Journal of Orthopaedic & Sports Physical Therapy 43(10): 700-714.

Ünver, B., Bek, N. (2014). The effect of using insoles on plantar contact areas and pressure distribution. Turkish Journal of Physiotherapy and Rehabilitation 25(2): 86-92.

Vicenzino, B., Griffiths, SR., Griffiths, LA., Hadley, A. (2000). Effect of antipronation tape and temporary orthotic on vertical navicular height before and after exercise. Journal of Orthopaedic & Sports Physical Therapy 30(6): 333-339.

Vicenzino, B., Franettovich, M., McPoil, T., Russell, T., Skardoon, G. (2005). Initial effects of anti-pronation tape on the medial longitudinal arch during walking and running. British Journal of Sports Medicine 39(12): 939-943.

Vicenzino, B., McPoil, T., Buckland, S. (2007). Plantar foot pressures after the augmented lowdye taping technique. Journal of Athletic Training 42(3): 374–380.

Zuil-Escobar, JC., Martínez-Cepa, CB., Martín-Urrialde, JA., Gómez-Conesa, A. (2018). Medial longitudinal arch: accuracy, reliability, and correlation between navicular drop test and footprint parameters. Journal of Manipulative & Physiological Therapeutics 41(8): 672-679.