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The effects of Dynamic® taping on vertical jumps in adolescent volleyball players with low medial longitudinal arch

Dilek Hande ESEN
Hatay Mustafa Kemal University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Antakya,Turkey, dilekhandeercan@gmail.com

Nihan KAFA
Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Turkey, nkaratas@gazi.edu.tr

Nevin ATALAY GUZEL
Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Turkey, natalay@gazi.edu.tr

Cengiz AKARCESME
Gazi University, Faculty of Sport Sciences, Trainer Education Department, Ankara, Turkey, cengizakarcesme@gazi.edu.tr

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Abstract

Introduction: Taping has long been used by health professionals to provide mechanical support for the musculoskeletal system. However, there is insufficient evidence to demonstrate the effect of Dynamic® taping. The aim of this study was to investigate the effect of Dynamic® taping on vertical jump and medial longitudinal arch height in adolescent volleyball players with navicular drop. Material and Methods: 23 female athletes participated in the study (mean age of 15.22 ± 1.54 years). The medial longitudinal arch height was evaluated with the navicular drop test. Vertical jumping was measured with the VERT® device (Mayfonk Athletic, USA). On the first day, athletes were evaluated without a tape, and the next day re-evaluated with the taping on. All athletes jumped on eight different surfaces. Results: The distance of navicular drop in both feet decreased to a statistically significant extent ($P < .05$) following Dynamic® taping. Comparing the vertical jump heights on eight different floor surfaces, it was found that there was no statistically significant difference for all cases ($P > .05$). Conclusions: Dynamic® tape application can be used as an easy-to-apply practical treatment agent to support the MLA in asymptomatic athletes with an increasing navicular drop.

Keywords

tape, navicular drop, hyperpronation, sport performance, athlete

Cover Page Footnote

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Article

The effects of Dynamic® taping on vertical jumps in adolescent volleyball players with low medial longitudinal arch

Dilek Hande ESEN[1], Nihan KAFA[2], Nevin ATALAY GÜZEL[3], Cengiz AKARÇEŞME[4]*

[1] Hatay Mustafa Kemal University, Faculty of Health Sciences Department of Physiotherapy and Rehabilitation, Antakya, Turkey, ORCID 0000-0002-3570-7079
[2] Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Turkey, ORCID 0000-0003-2878-4778
[3] Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Turkey, ORCID 0000-0003-0467-7310
[4] Gazi University, Faculty of Sport Sciences, Trainer Education Department, Ankara, Turkey, ORCID 0000-0001-6231-0950

* Correspondence: Dilek Hande ESEN, PT, PhD(c); Hatay Mustafa Kemal University, Hatay Tayfur Sökmen Campus, 31070 Hatay Center/Hatay/TURKEY; phone: + 90 555 744 20 23; e-mail: dilehandeesen@gmail.com

Abstract: Introduction: Taping has long been used by health professionals to provide mechanical support for the musculoskeletal system. However, there is insufficient evidence to demonstrate the effect of Dynamic® taping. The aim of this study was to investigate the effect of Dynamic® taping on vertical jump and medial longitudinal arch height in adolescent volleyball players with navicular drop. Material and Methods: 23 female athletes participated in the study (mean age of 15.22 ± 1.54 years). The medial longitudinal arch height was evaluated with the navicular drop test. Vertical jumping was measured with the VERT® device (Mayfonk Athletic, USA). On the first day, athletes were evaluated without a tape, and the next day re-evaluated with the taping on. All athletes jumped on eight different surfaces. Results: The distance of navicular drop in both feet decreased to a statistically significant extent ($P < .05$) following Dynamic® taping. Comparing the vertical jump heights on eight different floor surfaces, it was found that there was no statistically significant difference for all cases ($P > .05$). Conclusions: Dynamic® tape application can be used as an easy-to-apply practical treatment agent to support the MLA in asymptomatic athletes with an increasing navicular drop.

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1. Introduction

Since its early beginnings, volleyball has been a highly dynamic sport discipline attracting fans from all age groups, in particular, from among young people. It involves short and explosive motion patterns that require speed and agility, and various jump positions that may vary depending on the player's position in the game. Jumping is one of the common motor skills in various disciplines of sport and is among the basic criteria for physical performance [1–4]. In a game of volleyball, players often jump repeatedly in vertical and horizontal directions [5]. It is shown that players with higher game performance have higher vertical jump (VJ) values [6]. The higher a player can jump in the vertical direction, the better is their performance in spike shots and block. For a jump serve, a volleyball player needs to meet the ball at the highest point possible for an effective shot. Similarly, if the player wants to prevent an opponent attack through a block jump and attack with a spike shot, they need to jump up to the highest possible point again. In conclusion, to exert superiority over the opponents and contribute to their team's success in

a game, a volleyball player needs well-developed jumping skills [5]. Therefore, it is important for a volleyball player to invest in jumping skills from an early age to make sure they can maintain their career in volleyball with a good jumping performance.

A relationship was shown between medial longitudinal arch (MLA) posture and lower extremity injuries, even though its reason could not be fully explained. The decrease in MLA height causes losses in the optimal foot function, lower extremity injuries, such as plantar fasciitis and patellar tendinitis, and waist problems [7]. Furthermore, previous studies have also shown that a decrease in the arch height increased a risk of lower extremity injuries related to excessive use, including patellofemoral pain syndrome and medial tibial stress syndrome, as well as having a negative effect on the jumping performance [8]. Therefore, low MLA structure in athletes should be considered as a condition requiring intervention.

Taping, a method popular since its beginnings, is among conservative intervention methods long used by health professionals to provide mechanical support for the musculoskeletal system. It is generally used to prevent sports injuries and, failing that, to rehabilitate athletes during their recovery after an injury. There are various taping methods used for this purpose: they can be implemented with flexible tapes (Kinesio® tape, Dynamic® tape) or with inflexible ones (rigid tapes) [9–12]. The decrease in MLA height is often accompanied by excessive foot pronation [13]. Literature contains studies showing that MLA supportive anti-pronation taping techniques provide temporary external support of MLA increasing navicular height, and that it is a good temporary treatment method for athletes with injuries and/or pain due to low MLA. In these studies, taping prevented drop of the arch by helping maintain the MLA height as the foot carried its own weight. Moreover, taping had a positive effect on the extent of navicular drop (ND) as it temporarily increased MLA height [13,14].

Dynamic® tapes contain high-grade elastic latex, enabling them to stretch both longitudinally and transversely. Thanks to this feature they have a high traction torque. With its ability to imitate movement without restricting it, Dynamic® tape finds a use as a biomechanical device to support body structures [10]. The field literature contains studies on how different taping techniques (Kinesio® taping, rigid taping, etc.) used to support MLA affect the VJ performance [15]. However, it is found that as far as athletes with low MLA are concerned, there is a want of studies on the effects of Dynamic® taping (DT) to support MLA on vertical jumping performance. The fact that DT is now a popular technique frequently used by athletes requires more scientific research with a view to producing more objective and evidence-based results on the subject. In light of the aforementioned, the aim of this study was to examine the effects of DT on vertical jump height and MLA height in adolescent volleyball players with a low MLA height.

2. Materials and Methods

This study, in which the effect of DT on vertical jumping with the aim of changing the MLA height was investigated, was designed as a single group study. Participants were invited to two identical test sessions. On the first day, athletes were evaluated without a tape, and they received DT on the next day. Then they were re-evaluated with the taping on. The sessions consisted of tests measuring VJ height and ND distance (dependent variables). All athletes jumped on eight different surfaces, first with shoes and then barefoot (without shoes). Before starting the study, approval from the relevant university Ethics Commission dated 20/11/2018 and numbered 14574941-050.99-153747 was obtained. Furthermore, informed consent forms were submitted to the athletes and their families to the effect that they were participating voluntarily, and the required signatures were obtained. The sample size was determined according to the sample analysis with G*Power 3.1 software. As for the effect size, it was calculated as 1.001 following the study in the field literature by Nakajima and Baldridge [15]. In order to exceed 95% in determining the strength of the study, 13 people were needed at a significance level of 5% and an effect size of 1.001 (df = 11.414, t = 1.790).

2.1. Participants

In the study, 23 volunteer and asymptomatic adolescent female volleyball players participated with the age (mean ± ss) = 15.22 ± 1.54 years and BMI (mean ± ss) = 19.66 ± 1.74 kg/m²; all participants were engaged in the same sports club and admitted in the same training program. The study included athletes between ages 12 to 19, with a ND of 8 mm and more, and no history of injury to the lower extremity in the past 6 months or no history of surgical operation on the lower extremity at all. Athletes who described lower back pain or exercise-induced pain, had acute orthopedic or systemic discomfort during the measurements, or were allergic to the tape material were excluded from the study.

2.2. Procedures

All evaluations were performed in the same facility, during the morning hours. Demographic information of the athletes was recorded on the evaluation form prepared by the researchers. After this, athletes were randomly invited to take the ND and vertical jumping tests. Taping was not used on the first day of evaluation. Athletes who were invited for re-evaluation at the same time the next day first received DT before the evaluations started. The average delay before the start for adaptation to the tape was 20 minutes. Then the same evaluation procedure was repeated with all athletes.

Navicular Drop Test. The navicular drop test was used to evaluate the height of the MLA. For the test, athletes were seated in a chair with feet bare and subtalar joints in a neutral position. Using a card lain on the floor and a pen, both feet were demarcated at the level of the navicular tubercle. The same procedure was then repeated in the standing position, first with full body weight on one foot, then with both feet bearing equal weight. All demarcation for one athlete was done on the same card. The distances between the points marked on the card were measured with a tape and recorded in mm as the extent of ND [16].

Vertical Jump Test. VJ heights of volleyball players were evaluated with VERT® (Mayfonk Athletic, Florida, USA), a device of proven reliability and validity [17–19]. All athletes jumped first with, then without shoes on a total of 8 different floors: taraflex, concrete, parquet, grass, soil, artificial grass, sand, and tartan (Figure 1). Before starting the test, athletes had warmed up with stretching exercises. On each surface, 3 maximum jumps were performed. After obtaining the measurement with shoes on the same floor, a 3-minute break was taken. Then, measurements were repeated barefoot on the same floor. Each time there was a 5-minute break before moving on to the next floor surface. The average of 3 maximum jumps was recorded [17].

Fig. 1. Evaluating vertical jump height on different floor surfaces.

Dynamic® Taping. Taping was applied by a certified physiotherapist with original Dynamic® tape, 5 cm wide. The arch support technique was used as a taping method. For the taping procedure, the athletes were required to sit steadily in a reclining position with feet and ankles free in space and ankles at plantar flexion and inversion, forefoot at adduction, and hallux at flexion. The tape was applied as one piece in an 'I' shape on hairless skin already cleaned with alcohol. Taping began from the plantar surface of the hallux proximal phalanx with zero tension in the first anchor section with a width of 3 or 4 toes. Then the tape was stretched towards the mediolateral calcaneus of the sole and wrapped around the posterior of the calcaneus, from which it extended obliquely onward to include the navicular tubercle from the lateral to the mid-plantar section of the foot. Finally, zero tension was applied on the anchor section of 3- or 4-toe width in the dorsum of the foot, towards the distal part of the ankle (Figure 2). Maximum tension was applied on the tape as it crossed the navicular tubercle [10].

Fig. 2. Dynamic® tape application.

2.3. Statistical Analysis

For the statistical analysis of the data, the software SPSS version 22.0 for IBM (SPSS Inc., Chicago, Il, USA) was used. The suitability of variables for normal distribution was examined by visual (histogram and probability graphs) and analytical (Kolmogorov-Smirnov/Shapiro-Wilk tests) methods. Descriptive statistics of the data with normal distribution were presented as mean ± standard deviation (SD), with P-value accepted as 0.05, and cases where $P < .05$ were considered statistically significant. Dependent groups Student's t-test was used to analyze the data from the measurement results obtained before and after taping and also to compare mean values.

3. Results

A statistically significant difference was found in the ND distances before and after taping ($P < .05$), with the extent of ND significantly reduced after taping in both the right and the left foot (Table 1).

Table 1. Comparison of navicular drop distance (mean ± SD).

Foot	Before taping (mm)	After taping (mm)	*P*-value
Right	9.09±1.56	7.91±1.20	.000*
Left	9.61±1.67	7.87±1.55	.001*

**P < .05, SD: Standard Deviation*

The vertical jump test was performed on eight different floor surfaces, with and without shoes on, and before and after taping. Table 2 shows the test results. There was no statistically significant difference in the VJ height based on any of the above parameters ($P > .05$).

Table 2. Comparison of vertical jump heights with and without shoes (mean ± SD).

Surface		Before taping (cm)	After taping (cm)	*P*-value
Taraflex	without shoes	43.94±6.78	44.18±6.35	.821
	with shoes	44.24±6.74	43.25±5.17	.387
Concrete	without shoes	44.07±6.02	43.45±5.27	.535
	with shoes	43.90±6.00	44.42±5.78	.611
Parquet	without shoes	43.27±5.25	43.71±5.64	.633
	with shoes	42.76±5.77	43.83±5.81	.391
Grass	without shoes	44.80±5.36	43.69±5.72	.353
	with shoes	45.68±6.68	43.57±4.86	.136
Soil	without shoes	43.85±5.86	43.17±5.89	.557
	with shoes	45.17±6.64	42.72±5.13	.059
Artificial grass	without shoes	44.42±7.10	45.31±7.29	.397
	with shoes	44.78±6.85	44.83±5.97	.961
Sand	without shoes	42.72±6.47	43.26±7.00	.648
	with shoes	43.93±7.17	43.42±7.55	.712
Tartan	without shoes	42.65±6.41	44.02±6.38	.433
	with shoes	44.07±5.80	42.37±6.78	.107

**P < .05, SD: Standard Deviation*

4. Discussion

This was the first study to investigate the effects of DT on VJ and MLA height in adolescent volleyball players with low MLA height. As a result of this study, it was observed that DT significantly reduced the ND distance, but did not have any significant effect on a functional parameter such as the VJ height.

A low MLA structure is implicated as a factor in lower extremity injuries in athletes due to overuse, together with excessive foot pronation [20]. Taping is one of the conservative treatment options used to control increased pronation. Many studies investigating the acute effect of anti-pronation taping methods on MLA showed its positive effect on the distance of ND [21, 22, 14]. One study with elite athletes found that rigid taping was more effective than Kinesio® taping in increasing the navicular height. This finding was associated with the fact that rigid tapes had no stretching margin [23]. In this study, the ND distance after DT was observed to decrease by the statistically significant extent of 1.7 mm in both feet. This finding was consistent with previous studies supporting the literature and might be due to the strong support the Dynamic® tape provides to the MLA, which tends to flatten under the weight of the foot to retract towards a high arch position. The main aspect of this study that differs from previous ones was the use of Dynamic® tapes as the taping material. They are more rigid than Kinesio® tapes, albeit still flexible. Despite previous study results suggesting that rigid tapes were to be used most frequently in individuals with a low MLA and that the ND distance could be reduced best with a rigid tape, these tapes limit movement to a certain extent because of their inflexibility.

Kinesio® tapes, on the other hand, were found to have some restrictive effect on the soft tissue without limiting active movement, but the number of studies with Kinesio® tapes is insufficient to have evidential value [10]. Consequently, the Dynamic® tape is considered to be advantageous over the other types with its ability to easily stretch in four directions without restricting voluntary movement, while providing biomechanical support to the tissues involved.

Volleyball is a sport that can be performed on different surfaces including sand, grass, wood/parquet, etc. In a study with 15 beach volleyball players, Bishop [24] compared the heights of 4 different types of VJ on a wooden floor and sand and reported higher vertical jumps on the wooden floor in all types of jumps. In another study, Giatsis et al. [25] compared the VJ height of volleyball players on sand and wood surfaces and found lower vertical jumps on the sand as compared to the wooden floor, resulting in an increase of the friction coefficient between the foot and the ground, due to the fact that sand was a mobile surface. In similar studies with elite adolescent volleyball players, it was reported that a mobile floor surface structure, such as sand, negatively affected jumping performance, and this finding was associated with a greater decrease in fatigue-related lower limb muscle activation on a mobile ground [26]. In the present study, after the taping procedure, no significant difference was found between VJ height values of the volleyball players either with or without shoes on or depending on the floor type, namely, the eight different floor surfaces used: taraflex, concrete, parquet, grass, soil, artificial grass, sand, and tartan. Although the measurement results were not statistically significant, the biggest increase in the VJ height after taping was obtained on a parquet floor with shoes on and on a tartan surface without shoes. Furthermore, VJ height on sand turned out to be relatively low compared to other floor surfaces. The results of this study were consistent with previous study results. Based on these results, it is possible to argue that a fragmented and mobile surface structure, such as sand, may have an adverse effect on the jumping performance by causing resistance against athlete's foot movements. The relatively higher vertical jumps recorded on parquet and tartan floors as compared to grass can be associated with a weaker shoe grip (amount of friction) on the parquet and tartan than on grass. A reduced amount of friction might be responsible for smaller resistance in the beginning of an active movement, enabling the athlete to jump higher.

Taping is a method frequently used among athletes to prevent injuries and improve performance components such as jumping function. As a sub-parameter of jumping performance, VJ is considered as a widely used assessment criterion in many sports about an athlete's lower limb strength and neuromuscular fatigue [1, 4, 18]. Nakajima and Baldridge [15] investigated the short-term effect of Kinesio® taping on VJ height in healthy individuals and found that taping did not have a positive or negative effect on VJ height. Nunes et al. [27] reported in their study on 20 healthy athletes from different disciplines that Kinesio® taping did not instantly create significant changes in VJ height. In their study with 18 healthy female track-and-field athletes, Schiffer et al. [28] also stated that Kinesio® taping did not affect jumping performance, while Cheung et al. [29] showed on 64 experienced volleyball players that Kinesio® taping did not acutely increase VJ height. As a result of this study, it was found that DT had no statistically significant effect on VJ height. In conclusion, findings of the study are complementary with the previous studies explored in the literature review. A possible interpretation is that a change in a single component, for example in MLA height, is insufficient to improve VJ performance, which varies in relation to many components. Furthermore, recent studies investigating the relationship between MLA height and sports performance have expressed a view that the static foot posture measurements used in the assessment were insufficient to provide a complete picture on the dynamic functions of the foot [30]. As MLA height was statistically evaluated in this study, the results of the applied NDT might be insufficient to show how a taping intervention to support the arch might affect vertical jumping height as a dynamic activity.

The limitations of this study can be listed as follows: first, 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. Secondly, participants were evaluated within approximately 20–25 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. Finally, there was no study found in the literature that scientifically demonstrates whether Dynamic® taping has an effect on vertical jumping performance. Further studies are needed to clarify the clinical significance of our study findings.

5. Conclusions

This was the first study to investigate the effects of DT on VJ and MLA height in adolescent volleyball players with low MLA height. As a result of the study, it was found that DT did not have a statistically significant effect on the vertical jump height, but it decreased ND distance at statistically significant levels. It is our conviction that the study is unique and original in this respect and may lead the way for future studies with valuable scientific contributions. DT is a practical and effective method of intervention in asymptomatic athletes under the risk of increased ND. As a result, DT can now be used in athletes to support the medial longitudinal arch.

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