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Effect of kinesiotaping following training inducing ankle stabilisers fatigue on balance and weight bearing ankle dorsiflexion range of motion in male football players

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Abstract

Purpose: This study investigate whether kinesiotaping applied to the ankle joint after exercise causing fatigue of the muscles stabilising this joint has an effect on the ability to maintain static balance, dynamic balance and weight-bearing ankle dorsiflexion range of motion in male football players without ankle pain and instability.

Methods: The study included 50 men aged 18-30 yrs, practising football, assigned to the study group (subjected to kinesiotaping for the ankle joint) or the control group (without kinesiotaping). Exam 1st was performed prior to a 20-minute physical exercise causing fatigue of the muscles stabilising the ankle joint. Kinesiotaping was then applied in the study group. Exam 2nd was performed after exercise. Research tools were the Flamingo Balance Test (FBT), the Y-Balance Test (YBT), and Ankle Lunge Test (ALT). The data were analyzed based on Student's t-test for independent variables, Mann-Whitney U test, Student's t-test for dependent variables, Wilcoxon test.

Results: In the case of FBT, the values of the differences in 1st and 2nd examination results did not yield statistically significant results ($p>0.05$), and for YBT, and ALT, the values for the differences between 1st and 2nd examination in the study group were greater than in the control group ($p<0.05$).

Conclusions: Kinesiotaping applied to the ankle joint after exercise causing fatigue of the muscles stabili-sing this joint has a beneficial effect on the ability to maintain dynamic balance and weight-bearing ankle dorsiflexion range of motion, whereas it does not significantly improve static balance in male football players without ankle pain and instability.

Key words: ankle; physical functional performance, range of motion, football.

1. Introduction

Football is a sport that requires a special psychophysical predisposition and physical fitness [19], [25]. Trainings typical of this sport include exercises to develop technical skills such as dribbling, ball handling, changes in position and direction, and frequent maintenance of single support while performing the pedipulation function with the dominant leg [7], [16], [24].

The ability to maintain balance in static or dynamic situations is one of the factors that improve an athlete's performance [12], and the ankle joint stabilising muscles play an essential role in maintaining balance in both two-legged and single-legged standing [8], [29]. When the muscles become fatigued, the joints become unstable, resulting in increased postural sway and reduced balance capacity. According to Vuillerme et al. [27], the main factor impairing stability in this case is the alteration of proprioception, and the effect of this condition on neuromuscular connections, resulting in peripheral fatigue and disruption of central integration of sensory information. Compensation for the effects of muscle fatigue during a postural task can occur through the recruitment of new motor units, and this process requires a rearrangement of muscle activation and movement control to compensate for deficits.

Chua et al. [5] pointed out the importance of proper ankle joint ranges of motion both in terms of being able to manipulate the ball efficiently and in injury prevention. According to Akbari et al. [1] reduced ankle joint range of motion may be due to poor mobility, past injuries, or excessive strength training, especially without a proper warm-up. Reduced dorsiflexion range of the ankle joint can alter the kinematics of the knee and hip joints, leading to injury and overuse conditions during training or matches.

Kinesiology taping can be employed as a supplementary measure to prevent and manage sports injuries and musculoskeletal and nervous system conditions. It is used in clinical practice to improve kinesthesia, proprioception, control of muscle strength [3], [20], [26], [29], correction of muscle, fascia and joint alignment, and for pain control by activating the nervous system to reduce pain sensations [9]. Although the existing literature acknowledges the findings of studies indicating that kinesiotaping may enhance balance in individuals with ankle disorders [3], [10], [13], [21], there is a noticeable absence of research exploring the immediate impact of kinesiotaping healthy ankle joints on balance and range of motion. This prompted this study to investigate whether kinesiotaping applied to the ankle joint after exercise causing fatigue of the muscles stabilising this joint has an effect on the ability to maintain static balance, dynamic balance and weight-bearing ankle dorsiflexion range of motion in male football players without ankle pain and instability.

2. Material and methods

The study included 50 men aged 18-30 years, practising football in randomly selected third-league clubs in the Podkarpackie Province, Poland.

Inclusion criteria: age in the range of 18-30 years, practicing football for at least 10 years, professional training load, consisting of 3-5 hours of training daily 5 days per week, dominating right hand and leg (determined on the basis of Waterloo Handedness and Footedness Questionaire – Revised [17], written informed consent to participate in the study.

Exclusion criteria: ankle joint pain and/or swelling, lower limb musculoskeletal injuries sustained in the last 6 months preceding the study, orthopaedic or neurosurgery in the last 6 months preceding the study, limitations in the range of motion of the lower limb joints, diseases of the nervous system, limitations in the range of motion of the lower limb joints, diseases of the nervous system, including the cerebellum and vestibular system, or other conditions that could affect postural control, psoriasis, wounds, burns, ulcers, a history of contact dermatitis, allergy to kinesiology tape.

Subjects who met the eligibility criteria were randomly assigned to the study group (subjected to kinesiotaping application, n=25) or the control group (not subjected to kinesiotaping application, n=25). The randomisation process was performed using a computer-generated random number table.

The tests were performed 2 times, in the morning, on an indoor football pitch. Examination 1st was performed by the participants prior to a 20-minute physical exercise causing fatigue of the muscles stabilising the ankle joint (trotting, ankle joint circulations, toe climbs, dorsiflexion of the feet with body weight transfer to the heels, squats on both lower limbs, squats on one lower limb, lunges, reverse lunges, jumps, functional exercises such as dribbling, quick changes of direction during running, kickbacks, ball kicks). Kinesiotaping was then applied to the men assigned to the study group by taping the ankle joint with kinesiolo-tape (K-Active Tape, Nitto Denko Corp., Iwadeyama, Osaki, Miyagi, Japan). Examination 2nd was performed after exercise.

The kinesiotaping was performed by a physiotherapist with a minimum of 15 years of experience. The same technique was used for all competitors. Before applying the tape, skin of taping area was shaved, as well as cleaned and degreased with skin disinfection spray Clean Skin CureTape containing 70% alcohol (THYSOL Group, Enschede, Netherlands).

Two sections of 'I' shaped tape were used to perform the application. The foot was placed in a neutral position during taping.

Manner of application:

- tape one - from the lateral side of the ankle joint to the medial side of the ankle joint through the calcaneal tuberosity. The tape was torn in half, holding the ends. The middle part of the tape was then stuck with 75-100% of the original length, over the calcaneal tuberosity, and then directed along the lateral sides of the lower leg, to the lateral and medial side of the ankle joint. The ends of the tape were stuck on the lateral sides of the shin, without tension.
- tape two - the middle part of the tape was taped over the heel (on the Achilles tendon) with a tension of 75-100% of the original length, and the ends were taped without ten-

sion, on the two sides of the foot, covering the anterior part of the ankle joint (so that the lateral and medial ankles were under the tape).

Research tools:

1. The Flamingo Balance Test (FBT) was used to measure static balance. This is part of the Eurofit Testing Battery. Subject stood upright on his fully stretched leg on a wooden beam, flexed the free leg at the knee, and gripped the foot with the hand on the same side. The timekeeper helped the participant get into the right position and started timing when the subject released the timekeeper's hand. The test was scored based on the number of mistakes made within 1 minute. The more mistakes made, the lower the score [6], [22].
2. The Y-Balance Test (YBT) was used to measure functional postural stability and the ability to maintain balance in dynamic conditions. The Y-Balance Test Kit (M-F Athletic Company & Perform Better, West Warwick, USA) instrument was used for measurement purposes. The subjects, while one-leg standing in a central place on the device, had to move the indicator as far as possible with the lower limb opposite to the supporting one, in three directions: anterior, posteromedial and posterolateral. The subjects performed 3 repetitions in each direction, the best result was considered. The test was performed bilaterally, starting with the dominant limb as a fixed foot. After the movement, the test subject attempted to return to the starting position, in full control of the movement. The test was considered invalid, and in need of repetition, when the test subject supported himself with the forefoot limb on the upper surface of the pointer to maintain balance, pushed the pointer to gain more distance, or changed the starting position by taking the hands away from the hips [14]. Interrater test-retest reliability of the maximal reach had intraclass correlation coefficients of 0.80 to 0.85 for the 3 reach directions (anterior, posteromedial, and posterolateral). Interrater test-retest reliability of the average reach of 3 trails had an intraclass correlation coefficients range of 0.85 to 0.93 [23].
3. Ankle Lunge Test (ALT) – was used to measure weight bearing ankle dorsiflexion range of motion (DF-ROM). The test subject was positioned facing the wall, with the hands resting against the wall, and the foot of the stepping out lower limb (tested) adjacent to the ground and perpendicular to the wall so that the knee touched the wall. The stepped back lower limb, straightened at the knee joint, was behind to stabilise the position. During the test, the tested subject gradually moved the foot of the stepping out lower limb backwards until the maximum range of dorsiflexion of the foot was reached. The examiner paid attention to ensure that, while moving the foot, the knee of this limb touched the wall and

the foot did not pull away from the ground. Chisholm's et al. [4] demonstrated excellent measurement reliability of this test (ICC=0.93-0.99).

Test measures:

- distance of the hallux of the lower lead limb from the wall [cm]. Measurements were taken using anthropometric tape GIMA (Gima S.p.A., Gessate (MI), Italy).
- measurement of the angle of the tibia of the lower leg relative to the ground [°]. Measurements were made using a BASELINE goniometer (Fei Fabrication Ltd., White Plains, New York, USA). The goniometer axis was located on the lateral ankle, the stationary arm parallel to the ground (along the fifth metatarsal bone), and the movable arm along the lower leg [28].

The following tests were used in the analyses: Student's t-test for independent variables or, alternatively, the non-parametric Mann-Whitney U test, Student's t-test for dependent variables or, alternatively, the Wilcoxon signed-rank test. A probability value less than 0.05 was considered to be statistically significant. The Statistica TIBCO application, v.13.3 PL (StatSoft Inc., Tulsa, OK, USA; StatSoft, Krakow, Poland) was used to process the test results.

3. Results

There were no statistically significant intergroup differences in terms of body weight (p=0.621), body height (p=0.157) and BMI: p=0.418 (Table 1).

Table 1. Comparison of anthropometric characteristics in men from the study and control group

Variable	Study group			Control group			Statistics	
	x̄± SD	Max-Min	Me	x̄± SD	Max.-Min.	Me	t_1/Z_1	p
Body mass [kg]	70.92±7.51	90.00-62.00	70.00	70.12±7.48	85.00-60.00	68.00	Z_1=0.49	0.621
Body height [cm]	180.01±7.00	192.03-170.06	180.00	177.03±5.00	188.02-170.01	177.00	t_1=1.43	0.157
BMI	21.98±1.54	24.41-18.92	22.15	22.31±1.34	24.57-19.15	22.23	t_1=-0.81	0.418

x̄ – arithmetic mean value; SD – standard deviation; Max – maximum value; Min – minimum value; Q_{25} – lower quartile; Me – median; Q_{75} – upper quartile; t_1 – value of the Student's t-test for independent variables statistics; Z_1 – value of the Mann Whitney U test statistics; p – probability value
*p<0.05

Data in Table 2 indicate the lack of statistically significant intergroup differences in the FBT results obtained in each examinations for the right and left lower limb. In both groups, the test results for the right lower limb determining the number of errors in 2nd examination were higher than in 1st examination (p=0.016; p=0.024). A comparison of the value of the differences in 1st and 2nd examination results did not yield statistically significant results.

Table 2. Comparison of Flamingo Balance Test results in men from the study and control group

Examination	Study group			Control group			Mann Whitney U test	
	x̄±SD	Max-Min	Me	x̄±SD	Max-Min	Me	Z_1	p
Right lower limb [number of mistakes]								
1st	0.48±0.59	2.00-0.00	0.00	0.56±0.58	2.00-0.00	1.00	-0.46	0.648
2nd	0.84±0.55	2.00-0.00	1.00	0.88±0.44	2.00-0.00	1.00	-0.25	0.801
Difference (1st-2nd)	0.36±0.57	1.00-(-1.00)	0.00	0.32±0.56	1.00-(-1.00)	0.00	0.22	0.823
Wilcoxon test	Z_2=2.40; p=0.016*			Z_2=2.24; p=0.024*				
Left lower limb [number of mistakes]								
1st	0.48±0.59	2.00-0.00	0.00	0.56±0.58	2.00-0.00	1.00	-0.46	0.648
2nd	0.68±0.56	2.00-0.00	1.00	0.80±0.50	2.00-0.00	1.00	-0.69	0.491
Difference (1st-2nd)	0.20±0.50	1.00-(-1.00)	0.00	0.24±0.52	1.00-(-1.00)	0.00	-0.22	0.823
Wilcoxon test	Z_2=1.69; p=0.090			Z_2=1.89; p=0.058				

$\bar{x}$ – arithmetic mean value; SD – standard deviation; Max – maximum value; Min – minimum value; Q_{25} – lower quartile; Me – median; Q_{75} – upper quartile; Z_1 – value of the Mann Whitney U test statistics; Z_2 – value of the Wilcoxon signed-rank test statistics; p – probability value
*p<0.05

Data in Table 3 indicate the lack of statistically significant intergroup differences in YBT results for anterior, posteromedial and posterolateral directions, obtained in 1st examination for the right and left lower limb. In 2nd examination, statistically significant intergroup differences concerned the following directions: posteromedial (right lower limb: p=0.024; left lower limb: p=0.030) and posterolateral (right lower limb: p=0.010; left lower limb: p=0.034). Men from the study group achieved better results in 2nd examination than men from the control group.

In the study group, statistically significant differences were found between 1st and 2nd examination for each direction (anterior, right lower limb: p<0.001; anterior, left lower limb: p<0.001; posteromedial, right lower limb: p<0.001; posteromedial, left lower limb: p<0.001; posterolateral, right lower limb: p<0.001; posterolateral, left lower limb: p<0.001). In the control group, statistically significant differences between 1st and 2nd examination concerned the following directions: posteromedial, right lower limb: p=0.001; posteromedial, left lower limb: p=0.004; posterolateral, right lower limb: p<0.001; posterolateral, left lower limb: p=0.027. The test values in 2nd examination were higher than in 1st examination.

In each direction, the values for the differences between 1st and 2nd examination in the men in the study group were greater than in the men from the control group (anterior, right lower limb: p<0.001; anterior, left lower limb: p<0.001; posteromedial, right lower limb: p<0.001; posteromedial, left lower limb: p<0.001; posterolateral, right lower limb: p<0.001; posterolateral, left lower limb: p<0.001).

Table 3. Comparison of Y-Balance Test results in men from the study and control group

Examination	Study group			Control group			Statistics	
	$\bar{x}$±SD	Max-Min	Me	$\bar{x}$±SD	Max-Min	Me	t_1/ Z_1	p
Anterior direction - examination of the right lower limb [cm]								
1st	67.36±5.42	81.00-60.00	68.00	70.52±8.31	90.00-55.00	70.00	$t_1=-1.59$	0.118
2nd	69.84±5.86	84.00-61.00	70.00	70.92±8.24	90.00-57.00	70.00	$t_1=-0.53$	0.596
Statistics	$t_2=-6.47$; p<0.001*			$t_2=-2.08$ p=0.051				
Difference (1st-2nd)	2.48±1.92	7.00-0.00	2.00	0.40±0.96	3.00-(-1.00)	0.00	$t_1=4.85$	<0.001*
Anterior direction - examination of the left lower limb [cm]								
1st	67.56±4.49	76.00-60.00	68.00	70.36±7.99	88.00-55.00	70.00	$t_1=-1.39$	0.165
2nd	69.68±4.99	79.00-60.00	69.00	70.80±8.18	90.00-56.00	70.00	$t_1=-0.50$	0.614
Statistics	$t_2=-5.28$; p<0.001*			$t_2=-2.03$; p=0.053				
Difference (1st-2nd)	2.12±2.01	8.00-0.00	2.00	0.44±1.08	4.00-(-1.00)	0.00	$t_1=3.53$	<0.001*
Posteromedial direction - examination of the right lower limb [cm]								
1st	96.56±7.63	110.00-80.00	97.00	98.84±4.90	108.00-87.00	100.00	$t_1=-1.26$	0.215
2nd	105.70±7.20	120.00-91.00	105.00	101.50±5.59	110.00-89.00	102.00	$t_1=2.33$	0.024*
Statistics	$t_2=-10.57$; p<0.001*			$t_2=-3.87$; p=0.001*				
Difference (1st-2nd)	9.20±4.35	20.00-0.00	9.00	2.68±3.46	9.00-(-5.00)	2.00	$t_1=5.87$	<0.001*
Posteromedial direction - examination of the left lower limb [cm]								
1st	98.24±6.03	113.00-86.00	100.00	99.40±4.68	108.00-88.00	100.00	$t_1=-0.76$	0.451
2nd	105.90±7.14	120.00-92.00	109.00	101.90±5.22	110.00-88.00	102.00	$t_1=2.24$	0.030*
Statistics	$t_2=-10.62$; p<0.001*			$t_2=-3.17$; p=0.004*				
Difference (1st-2nd)	7.68±3.61	18.00-0.00	8.00	2.56±4.03	10.00-(-4.00)	2.00	$t_1=4.73$	<0.001*
Posterolateral direction - examination of the right lower limb [cm]								
1st	99.28±8.80	115.00-76.00	100.00	98.04±4.95	104.00-90.00	100.00	$Z_1=0.41$	0.684
2nd	106.60±8.32	124.00-84.00	105.00	101.00±5.57	110.00-90.00	102.00	$Z_1=2.58$	0.010*
Statistics	$Z_2=4.37$; p<0.001*			$Z_2=3.33$; p<0.001*				
Difference (1st-2nd)	7.36±2.94	15.00-2.00	7.00	2.96±3.27	10.00-(-4.00)	3.00	$Z_1=4.13$	<0.001*
Posterolateral direction - examination of the left lower limb [cm]								
1st	98.40±8.32	115.00-74.00	99.00	100.40±4.31	109.00-90.00	101.00	$Z_1=-0.87$	0.383
2nd	106.40±9.01	125.00-80.00	108.00	102.20±5.26	110.00-89.00	102.00	$Z_1=211$	0.034*
Statistics	$Z_2=4.37$; p<0.001*			$Z_2=2.20$; p=0.027*				
Difference (1st-2nd)	8.08±3.48	16.00-3.00	8.00	1.80±3.58	10.00-(-5.00)	1.00	$Z_1=4.88$	<0.001*

$\bar{x}$ – arithmetic mean value; SD – standard deviation; Max – maximum value; Min – minimum value; Q_{25} – lower quartile; Me – median; Q_{75} – upper quartile; t_1 – value of the Student's t-test for independent variables statistics; Z_1 – value of the Mann Whitney U test statistics; t_2 – value of the Student's t

test for dependent variables statistics; Z_2 – value of the Wilcoxon signed-rank test statistics; p – probability value
*p<0.05

Data in Table 4 indicate the lack of statistically significant intergroup differences in ALT results for linear and angular measurements, obtained in 1st, and 2nd examinations for the right and left lower limb.

In the study group, both linear and angular measurements showed statistically significant differences between 1st and 2nd examination (linear DF-ROM of the right ankle: p<0.001; linear DF-ROM of the left ankle: p=0.005; angular DF-ROM of the right ankle: p<0.001; linear DF-ROM of the left ankle: p<0.001). In the control group, statistically significant differences between 1st and 2nd examinations concerned only linear DF-ROM of the left ankle: p=0.002. In 2nd examination the results of linear measurements were higher, and in the case of angular measurements - lower than in 1st examination.

In each case study, the values for the differences between 1st and 2nd examination in men in the study group were greater than in men in the control group (linear DF-ROM of the right ankle: p=0.003; linear DF-ROM of the left ankle: p=0.013; angular DF-ROM of the right ankle: p=0.030; linear DF-ROM of the left ankle: p=0.023).

Table 4. Comparison of Ankle Lunge Test results in men from the study and control group

Examination	Study group			Control group			Statistics	
	x̄±SD	Max-Min	Me	x̄±SD	Max-Min	Me	t_1/ Z_1	p
DF-ROM of the right ankle [cm]								
1st	10.62±1.54	14.00-8.00	10.50	10.20±1.34	13.00-8.00	10.00	t_1=1.03	0.308
2nd	11.16±1.70	15.00-8.00	11.00	10.36±1.37	13.50-8.00	10.50	t_1=1.83	0.073
Statistics	t_2=-5.20; p<0.001*			t_2=-2.55; p=0.057				
Difference (1st-2nd)	0.54±0.52	1.00-(-1.00)	0.50	0.16±0.31	1.00-(-0.5)	0.00	t_1=3.13	0.003*
DF-ROM of the left ankle [cm]								
1st	10.60±1.65	14.00-7.00	10.50	10.46±1.45	13.00-7.00	10.50	Z_1=0.20	0.839
2nd	11.10±1.80	15.00-7.00	11.00	12.34±9.01	55.00-7.00	11.00	Z_1=0.89	0.372
Statistics	Z_2=2.77; p=0.005*			Z_2=1.78; p=0.074				
Difference (1st-2nd)	0.50±0.66	2.00-(-1.00)	0.50	1.88±8.88	44.50-(-1.50)	0.00	Z_1=2.47	0.013*
DF-ROM of the right ankle [°]								
1st	60.40±4.31	70.00-55.00	60.00	59.20±3.44	65.00-50.00	60.00	Z_1=0.66	0.509
2nd	56.80±4.30	70.00-55.00	55.00	57.76±4.02	69.00-50.00	60.00	Z_1=-1.14	0.256
Statistics	Z_2=3.62; p<0.001*			Z_2=1.95; p=0.052				
Difference (1st-2nd)	-3.60±2.71	0.00-(-10.00)	-5.00	-1.44±3.18	9.00-(-5.00)	0.00	Z_1=-2.17	0.030*
DF-ROM of the left ankle [°]								
1st	61.12±4.34	70.00-55.00	60.00	58.32±3.98	65.00-50.00	60.00	Z_1=2.04	0.052
2nd	57.12±4.55	70.00-50.00	55.00	56.20±3.38	65.00-50.00	55.00	Z_1=0.50	0.614

Statistics	Z_2=3.82; p<0.001*			Z_2=3.06; p=0.002*				
Difference (1st-2nd)	-4.00±2.65	0.00-(-10.00)	-5.00	-2.12±2.37	0.00-(-5.00)	0.00	Z_1=-2.28	0.023*

$\overline{x}$ – arithmetic mean value; SD – standard deviation; Max – maximum value; Min – minimum value; Q_{25} – lower quartile; Me – median; Q_{75} – upper quartile; t_1 – value of the Student's t-test for independent variables statistics; Z_1 – value of the Mann Whitney U test statistics; t_2 – value of the Student's t test for dependent variables statistics; Z_2 – value of the Wilcoxon signed-rank test statistics; p – probability value
*p<0.05

4. Discussion

In our study, there were no intergroup differences in the FBT results obtained in either 1st and 2nd examination for each lower limb. In both groups, the number of errors in test II was higher for the right lower limb, which may be explained by fatigue from the 20-minute exercise. Also, Salo and Chaconas [20] found that training-induced fatigue has an effect on the reduction of balance and coordination abilities, and Liu et al. [13] pointed out the effect of fatigue on the deterioration of not only static balance but also dynamic balance in subjects with ankle instability. The poorer results for the right limb suggest the influence of lower limb asymmetry in stabilisation and support function. This is because the right lower limb, being dominant, is used for pedipulation (e.g. ball handling and passing). In contrast, the role of the non-dominant (supporting) lower limb, in this case the left limb, comes down to postural stabilisation and thus creating optimal conditions for the dominant limb to perform movement tasks. Similar observations were reached by Bigoni et al. [2], indicating a greater contribution of the non-dominant lower limb in stabilising and maintaining body weight. The lack of intergroup divergence in terms of differences between 1st and 2nd examination results indicates that kinesiology tape application does not fundamentally affect the ability to maintain static balance. Similar conclusions were reached by Inglés et al. [9], who found no effect of ankle kinesiotaping on static balance, dynamic balance and flexibility in amateur football players. In contrast, Boonkerd et al. [3] confirmed a positive effect of kinesiotaping application on static balance capacity and proprioception in individuals with chronic ankle instability.

In their study, men who were applied with kinesiotape performed better in a test after a 20-minute exercise than men who did not undergo kinesiotaping. In the study group, statistically significant differences were found between 1st and 2nd examination for each of the directions, while in the control group, differences were found in the directions: posteromedial and posterolateral. In each of the cases studied, the values for the differences in 1st and 2nd examination results in men who were applied kinesiology tape were greater than in men in the control group. Therefore, kinesiotaping with kinesiology tape, which has elastic properties, can be expected to improve a man's dynamic postural control. Lee and Lee [10], and also Lee and Lee [11] in a study of young male soccer players with functional ankle instability, showed that after application of kinesiology tape to the ankle joint, stretched by 30-40% of the original length, the tape immediately stretches further under the influence of joint movement, and stability can be improved due to the flexibility of the tape, which quickly returns the joint alignment to a neutral position.

Own research showed the lack of statistically significant intergroup differences in results for linear and angular measurements, obtained in 1st, and 2nd examinations for the right and left lower limb. In the men who were treated with kinesiology tape, there were differences in both linear and angular measurements between 1st and 2nd examinations, while in the control group there were differences only in the linear measurement of the DF-ROM of the left ankle. In 2nd examination, the results for linear measurements were higher, and for angular measurements lower, than in 1st examination. In addition, in each of the measurements, the difference values between 1st and 2nd examination in men who received kinesiotape were higher than in men who did not receive kinesiotaping. These data suggest that kinesiotaping has a beneficial effect on weight-bearing ankle dorsiflexion range of motion. However, the opinions of other authors on this issue are divided. Merino-Marban et al. [15], in a study of duathletes with calf pain, found that kinesiotaping may have an effect on improving ankle dorsiflexion range of motion. Sarvestan and Svoboda [21] observed a beneficial effect of ankle kinesiotaping on increasing foot range of motion in athletes with chronic ankle sprain. In contrast, Tomruk et al. [26] found no effect of kinesiotaping application on dorsiflexion range of motion.

Our study showed that kinesiotaping application is useful in providing immediate improvements in dynamic balance and weight-bearing ankle dorsiflexion range of motion in healthy individuals. Therefore, in conclusion, it can be considered that the application of kinesiotaping of the ankle joint can increase stability during activities requiring balance, without limiting or even improving the range of motion, and can be used in sports. Kinesiotaping can be applied to both healthy athletes and those who have experienced previous injuries, with the aim of preventing further dysfunction and aiding performance during training. In addition, the application of kinesiotaping by increasing the sense of stability may indirectly translate into better sports performance. The results of our study may be useful for sports rehabilitation, in terms of decision-making regarding the application of kinesiotaping to football players in situations where improved balance and range of motion of the ankle joint is desired.

In our study, we tested the immediate effect of kinesiology tape on the ankle joint, which can be considered a limitation. Therefore, future research should focus on testing the long-term effect of kinesiotaping on components of athletes' physical functional performance.

5. Conclusions

Kinesiotaping applied to the ankle joint after exercise causing fatigue of the muscles stabilising this joint has a beneficial effect on the ability to maintain dynamic balance and weight-bearing ankle dorsiflexion range of motion, whereas it does not significantly improve static balance in male football players without ankle pain and instability.

Competing Interests

The authors declares that they have no competing interests.

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