

Research Paper

Short-term Effects of Kinesio Taping Application on Outcomes of Athletes With Shin Splints

Farzaneh Saki^{1*} , Amir Shayesteh¹ , Farzaneh Ramezani¹ *1. Department of Exercise Rehabilitation, Faculty of Sport Sciences, Bu-Ali Sina University, Hamedan, Iran.***Citation** Saki F, Shayesteh A, Ramezani F. Short-term Effects of Kinesio Taping Application on Outcomes of Athletes With Shin Splints. *Physical Treatments*. 2024; 14(1):43-52. <http://dx.doi.org/10.32598/ptj.14.1.493.2> <http://dx.doi.org/10.32598/ptj.14.1.493.2>**Article info:****Received:** 05 Nov 2023**Accepted:** 03 Dec 2023**Available Online:** 01 Jan 2024**Keywords:**Athletic tape, Injury,
Postural balance,
Preventive therapy,
Medial tibial stress
syndrome**ABSTRACT**

Purpose: Shin splints are a common injury in the world of sports, causing pain along the inner edge of the tibia and impacting an athlete's performance and well-being. The study aims to examine how kinesio taping application affects pain, postural control, and plantar pressure parameters in athletes with shin splints.

Methods: A placebo-controlled trial design was used, with 32 athletes with shin splints randomly assigned to either the kinesio taping group (KT=16) or the placebo group (PC=16). The KT group received kinesio tape with 75% tension applied to the affected shin, while the PC group received the same application without tension. Before and after the taping intervention, pain levels, postural control, and plantar pressure parameters were evaluated.

Results: Results indicated that the KT group experienced a significant pain reduction and improved postural control and plantar pressure parameters compared to the PC group.

Conclusion: These results suggest that kinesio tape can relieve pain in the short term and enhance postural control and plantar pressure distribution in athletes with shin splints. Further research is necessary to explore the long-term effects and underlying mechanisms.

*** Corresponding Author:**

Farzaneh Saki, Associate Professor.

Address: Department of Exercise Rehabilitation, Faculty of Sport Sciences, Bu-Ali Sina University, Hamedan, Iran.

Phone: +98 (918) 8503783

E-mail: f_saki@basu.ac.ir

Highlights

- Kinesio tape (KT) is a type of elastic therapeutic tape that is used in the management of shin splints.
- KT improves balance and movement, reduces pain, and prevents injuries.
- KT is not a definitive treatment for shin splints; training and rehab are also needed.

Plain Language Summary

Shin splints (SS) are a common injury among athletes, particularly runners. Kinesio Tape (KT) is a type of elastic therapeutic tape that is used in the management of SS. In the case of SS, KT is applied to the shin area to alleviate pain and promote healing. The study found that KT can provide short-term relief and functional improvement in individuals with SS. It can reduce pain, improve postural control, and distribute plantar pressure more evenly. However, it is important to note that KT is not a definitive solution and should be used in conjunction with comprehensive training and rehabilitation programs for a complete recovery.

Introduction

Shin splints (SS), or medial tibial stress syndrome (MTSS), commonly affects athletes engaged in running and jumping activities [1], causing pain in the muscles, tendons, and bone tissue around the shin bone [2]. The main symptom is experiencing pain along the inner edge of the shin bone, which hinders an athlete's performance and overall well-being [2]. To address this issue, various treatments, including physical therapy modalities [3], leg orthosis [4, 5], and kinesio taping (KT) [6, 7] have been utilized. KT is an elastic tape that provides support to the injured area, promotes better blood circulation, reduces pain, enhances proprioception, facilitates muscle activation, and corrects biomechanical alignment [8-10].

Postural control and plantar pressure parameters play a crucial role in the performance of athletes, especially those suffering from SS. The body's postural control involves the maintenance of the body's position in space for stability and orientation. It is particularly vital for athletes in determining their motor skills, agility, and athletic performance. Feet bear the literal weight of our physical activities, and the distribution of forces and pressures across different foot areas, especially during movement, significantly impacts athletic performance, injury risk, and recovery. Several studies have demonstrated the impact of plantar pressures during running, and walking, and in the incidence of exercise-induced leg pain [1, 7, 11, 12]. Increased medial plantar forces have been linked in previous studies to exercise-induced leg pain, while Sharma et al. [13] hypothesized that the

same may contribute to MTSS, commonly known as SS. The study by Sharma et al. [13] highlighted how plantar pressure variance can serve as a potential predictor for SS because a significant percentage of military recruits developing MTSS had higher rearfoot peak plantar forces and pressures. By monitoring and understanding these factors, conditions, such as SS can be predicted and managed and effective preventative and rehabilitative strategies can be developed for athletes. This underpins the importance of postural control and plantar pressure parameters amongst athletes, specifically those dealing with SS, influencing not just their performance but their overall well-being.

The hypothesis of this research stems from a study [14] that unveiled an acute effect of taping on plantar pressure characteristics in athletes suffering exercise-induced leg pain. Parallely, other studies have advocated the effectiveness of KT in managing pain stemming from conditions, such as knee pain [15-18] and shoulder pain [19, 20]. This placebo-controlled trial aims to bridge the gap in the existing literature by providing insights into the short-term effects of KT on pain, postural control, and plantar pressure parameters of athletes with SS. We further effort to determine the extent to which this taping method may alleviate shin splint-related pain and contribute to the overall performance of the athletes.

Materials and Methods

Research design

This study was designed as a placebo-controlled research, aiming to investigate the effects of kinesio tape

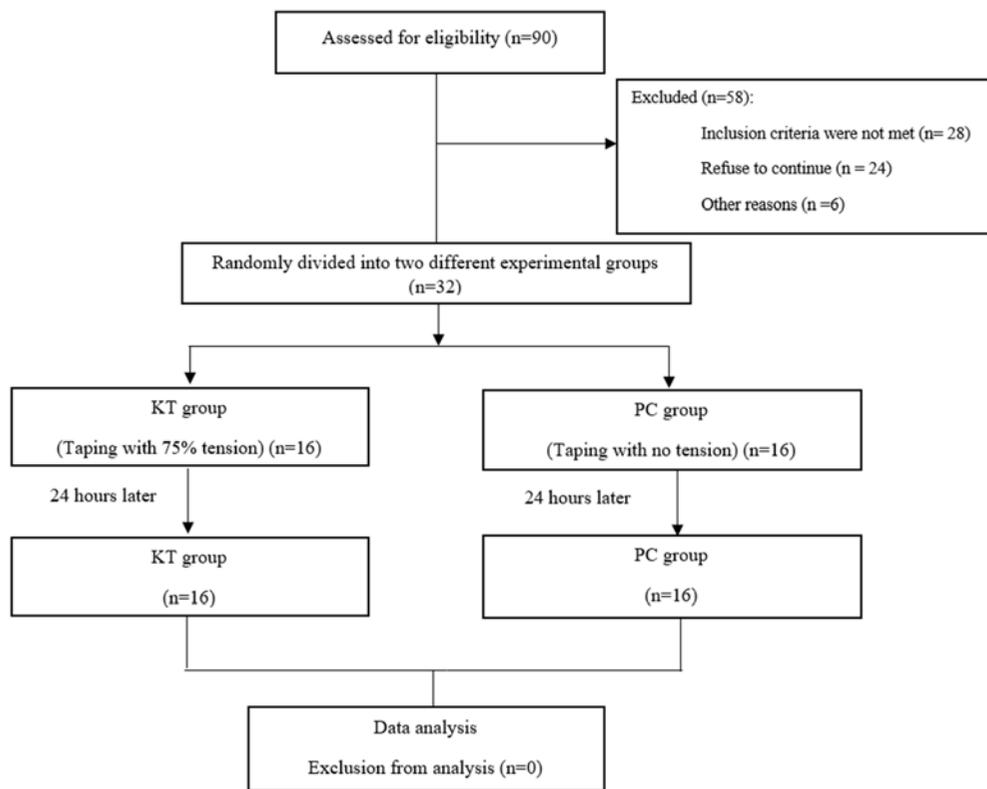


Figure 1. CONSORT flowchart diagram of the study

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on male runners with SS in Hamedan City, Iran. The statistical population of this study consisted of purposefully selected male runner athletes aged between 20 and 32 years. The statistical sample included 32 athletes with SS, with 16 participants assigned to each group; KT and placebo control (PC) groups. To ensure eligibility, athletes had to complete a SS pain questionnaire [21] based on the criteria established by Yates and White.

Participants

The study’s inclusion criteria included athletes who are runners and experience pain on the inner edge of the lower leg as a result of training that continues for several hours or days after training. It also included tenderness when pressure is applied to the lower inner edge of the leg’s posterior third, diffuse pain extending five centimeters over two-thirds of the lower inner-posterior part of the leg, itching in the front muscles of the leg, pain onset upon palpation of the lower inner-posterior part of the leg, pain lasting for more than a few days, pain relief during warm-up, increased pain with higher training intensity, and an uneven sensation when touching the inside blade of the shin bone [22]. The exclusion criteria included individuals with a history of fractures or surgery in the trunk and lower extremities, as well as

a history of sensitivity to tape from previous skin exposure. It also excludes individuals with balance disorders unrelated to the condition being studied and those who have participated in lower leg and ankle rehabilitation programs within the past six months (Figure 1).

To ensure the subjects’ consent to participate in this research, a written consent form was provided to them. All the potential risks of the test were explained to the subjects. The people present in the research were free to participate or not participate in the test, and after declaring their cooperation, they could withdraw from the research at any time.

Procedures

All the measurements were performed for each participant at baseline and after 24 hours in the Sports Sciences Laboratory of Bu-Ali Sina University. The demographic data were collected in the pre-test session. After the pre-test assessments, the subjects were randomly assigned to the KT and PC groups. The Random Number Generator software was utilized for the randomization process, which was carried out by an individual distinct from the examiner and therapists. Initially, all participants did a pre-test session, and their pain, postural control, and



Figure 2. Kinesio tape application

plantar pressure parameters were assessed. Then after the pre-test session, the KT was applied to their leg. The subjects were asked to keep the tape on and come back after 24 hours. Then, in the post-test, the variables were re-evaluated.

Intervention

The KT group used kinesio tape on their lower leg. They followed the technique described by Griebert et al. [7], which involved shaving hair from the inner part of the tibia and cleaning the area with alcohol. A Y-shaped tape was applied, with the tail of the Y-tape placed in the upper third of the tibia. Each half of the Y-tape was applied to the front and back of the medial malleolus and ended under the arch of the foot (Figure 2). The tape was applied with 75% tension, except for the ends which were applied without any tension. The PC group received a similar application technique but without any tension.

Pain

The visual analog scale (VAS) is a valuable tool to assess subjective qualities or attitudes that are difficult to quantify directly, such as pain levels [23]. It includes a straight horizontal or vertical line with a fixed length, accompanied by a line scale ranging from 0 to 10 (where 0 signifies no pain and 10 denotes the most excruciating pain imaginable). By marking the line at the point they consider reflective of their current condition, respondents establish their visual analog scale (VAS) score. This score is determined by measuring the distance from

the left or bottom end of the line to the respondent's marked point.

Plantar pressure assessment protocol

Plantar pressure data were recorded at a sampling frequency of 300 Hz by using a foot scan system (RSscan International, Belgium, 0.5×0.5×0.02 m, 4363 sensors). For postural control assessment, participants were asked to stand on a foot scan plate with bare feet while the weight was equally distributed between the feet, arms at sides, and eyes facing straight ahead. The duration of the test was 20 s with 3 repetitions and 1 minute of rest between trials [24].

To dynamically assess plantar pressure, the participants walked at a self-selected speed along the gait pathway. The foot scan plate was placed in the middle of a 12-m gait pathway. Then the subjects were asked to start walking in a normal state with bare feet and pass over the foot scan plate. Before the test, the subjects were asked to practice the foot scan for three minutes. Walking speed was not controlled to produce a natural gait pattern. If the foot contact with the foot scan plate was not complete, the subject intentionally and artificially crossed over the foot scan, and the subject used an unusual stepping pattern, his trail was not recorded. All subjects performed three valid trials. An average of three valid trials from the affected foot was recorded. Data were extracted during the stance phases of gait. The stance phase of gait was determined as heel contact with the ground until toe lift. The studied variables were travel distance (TD), the center of pressure displacement in mediolateral

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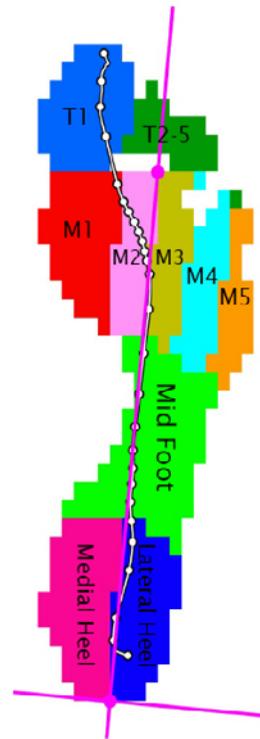


Figure 3. Plantar pressure anatomical regions defined by footscan

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(COP ML) and anterior-posterior (COP AP) directions, and the ellipse area. Plantar pressure parameters were peak pressure in ten areas of the foot. These areas include respectively, big toe (T1), second to fifth toes (T2-5), first metatarsal bone (M1), second metatarsal head (M2), third metatarsal head (M3), fourth metatarsal head (M4), fifth metatarsal head (M5), middle part of the foot (MID), medial part of the heel (MH) and lateral part of the heel (LH) (Figure 3).

Statistical analysis

The study's statistical analysis was done using G*Power software, version 3.1.9.2 to determine the sample size. A minimum of 24 participants was determined to be necessary (medium effect size of 0.35 [14], an α level of 0.05, and a power of 0.8), and due to the dropout with 32 individuals included in the sample size. SPSS software, version 26 was used for the statistical analysis, assessing the normality of the data and the homogeneity of the variances. An independent t-test was conducted to compare demographic information between the groups and a mixed repeated measure analysis of variance (ANOVA) was employed to assess any interaction between the groups (KT and PC) and time (pre and post-intervention). Pairwise comparisons were performed using Bonferroni corrections. The effect size was calculated using

partial eta squared, with values of 0.10, 0.25, and 0.40 considered as small, medium, and large, respectively. Statistical significance was determined at $P < 0.05$.

Results

Parametric tests were employed for analysis due to the normal data distribution ($P > 0.05$). Table 1 presents the demographic characteristics of each group and the outcomes of the independent t-test. No significant distinctions were observed among the groups regarding mean age, height, body mass, and experience ($P > 0.05$; independent t-test).

Results from a mixed repeated measure ANOVA showed a significant interaction effect of group \times time on pain ($P = 0.001$, $\eta^2 = 0.432$), ellipse area ($P = 0.041$, $\eta^2 = 0.132$), and COP in the ML direction ($P = 0.002$, $\eta^2 = 0.280$). However, no statistically significant interaction effects of group \times time were observed on travel distance and COP in the AP direction (Table 2). Pairwise comparisons indicated that pain, ellipse area, and COP in the ML direction were significantly lower in the post-test compared to the pre-test after KT intervention ($P < 0.05$). No significant differences were observed in COP in the AP direction and travel distance (TD) from pre-test to post-test in the KT group.

Table 1. Demographic characteristics of the participants

Variables	Mean±SD		P
	PC Group	KT Group	
Age (y)	26.25±3.94	24.63±2.72	0.18
Height (cm)	176.12±5.53	180.00±6.16	0.07
Body mass (kg)	76.62±11.06	79.45±11.66	0.49
Experience (y)	3.68±0.94	3.43±0.89	0.44

KT: Kinesio taping group; PC: Placebo control group.
Experience: The length of athletic experience in years.

Results from a mixed repeated measure ANOVA revealed significant interaction effects of group×time on M1 (P=0.015, $\eta^2=0.181$), M2 (P=0.004, $\eta^2=0.240$), M3 (P=0.002, $\eta^2=0.276$), MID (P=0.022, $\eta^2=0.162$), and MH (P=0.030, $\eta^2=0.148$). However, no significant interaction effects of group×time were found for other plantar pressure parameters (T1, T2-5, M4, M5, and LH) (Table 3).

Discussion

This study was conducted to investigate the short-term effects of using KT on pain, postural control, and plantar pressure in athletes with SS. The results suggest that KT provides immediate pain relief and demonstrates improvements in postural control and redistribution of plantar pressure. However, it is essential to note that it does not completely remove the underlying cause of SS.

The reduction in perceived pain among athletes is consistent with previous research that has identified the analgesic effects of KT [6, 25]. These pain-relieving effects may be attributed to neural suppression that can alter the sensory inputs responsible for pain perception

[20, 26]. Additionally, KT appears to facilitate an immediate physiological response that helps normalize muscle function and improve lymphatic circulation, making it an effective conservative management option for athletes with SS [20]. Furthermore, the KT method used in this study may control stress and strain on the muscles, tendons, and bones of the lower leg, specifically targeting the tibialis posterior and soleus muscles that attach to the medial tibial border, thereby reducing pain associated with SS. Several studies have demonstrated that interventions, such as supportive shoes, orthotics, insoles, and KT, can help reduce pain and prevent SS in athletes [6, 27-29]. These interventions aim to provide stability and cushioning for the foot, prevent excessive pronation, and correct biomechanical alignment. By doing so, they may decrease stress on the lower leg, improve shock absorption, and optimize pressure distribution throughout the foot. The anti-pronation KT group showed a larger decrease in pain intensity than the space correction KT group in a study comparing it to taping for space correction [6, 14]. Nevertheless, several other studies have discovered no significant distinction in pain relief or prevention of shin splints between anti-pronation inter-

Table 2. Between and within-group differences in pain and postural control parameters

Variables	KT Group			PC Group			Group×Time		
	Mean±SD		p ^a	Mean±SD		p ^a	F _(1, 23)	p ^b	η^2
	Pre-test	Post-test		Pre-test	Post-test				
Pain	5.56±0.89	3.56±0.62	0.001	5.62±0.95	5.25±0.85	0.129	22.83	0.001	0.432
Elips area (mm ²)	16.99±9.1	7.54±4.43	0.003	17.12±13.33	16.49±6.62	0.831	4.56	0.041	0.132
COP ML (mm)	10.39±4.83	6.73±2.25	0.001	10.06±3.97	10.93±4.79	0.358	11.69	0.002	0.280
COP AP (mm)	8.57±5.52	6.12±2.81	0.053	8.25±4.69	8.50±4.73	0.839	2.46	0.127	0.076
Travel distance (mm)	51.87±23.46	46.18±19.17	0.312	50.37±21.33	52.25±17.36	0.737	0.935	0.341	0.030

Abbreviations: KT: Kinesio taping group; PC: Placebo control group; COP ML: The center of pressure displacement in medio-lateral; COP AP: The center of pressure displacement in anterior-posterior.

^aPairwise comparison (within-group comparison), ^bA mixed factorial analysis of variance (within-between interactions).

Table 3. Between and within-group differences in peak plantar pressure parameters

Variables	KT Group			PC Group			Group×Time		
	Mean±SD		p ^a	Mean±SD		p ^a	F _(1, 23)	p ^b	η ²
	Pre-test	Post-test		Pre-test	Post-test				
T1 (N/cm ²)	10.19±2.76	10.16±2.25	0.915	10.46±1.66	10.61±1.41	0.716	0.113	0.739	0.004
T2-5 (N/cm ²)	5.38±1.66	5.59±1.71	0.526	5.17±1.66	5.44±1.28	0.358	0.043	0.838	0.001
M1 (N/cm ²)	9.52±3.1	5.92±2.74	0.001	10.54±3.25	9.96±2.78	0.483	6.64	0.015	0.181
M2 (N/cm ²)	15.43±4.41	10.75±3.52	0.001	16.50±3.28	16.11±3.80	0.695	9.74	0.004	0.240
M3 (N/cm ²)	15.00±4.06	10.18±3.25	0.001	14.37±3.38	14.64±3.59	0.805	11.44	0.002	0.276
M4 (N/cm ²)	12.01±2.82	12.47±2.62	0.496	11.21±2.85	11.27±2.51	0.926	0.178	0.676	0.006
M5 (N/cm ²)	5.85±1.4	5.55±1.45	0.488	6.76±2.36	6.70±1.66	0.893	0.160	0.692	0.005
MID (N/cm ²)	5.74±0.90	5.04±1.09	0.003	5.07±1.29	5.10±1.42	0.871	5.793	0.022	0.162
MH (N/cm ²)	12.91±2.58	10.55±2.74	0.001	13.95±2.05	13.70±1.68	0.713	5.21	0.030	0.148
LH (N/cm ²)	12.69±2.69	13.11±3.09	0.470	13.30±2.07	12.98±1.41	0.551	0.826	0.584	0.027

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Abbreviations: KT: Kinesio taping group; PC: Placebo control group; T1: Big toe; T2-5: 2nd to 5th toes; M1: 1st metatarsal bone; M2: 2nd metatarsal head; M3: 3rd metatarsal head; M4: 4th metatarsal head; M5: 5th metatarsal head; MID: Middle part of the foot; MH: Medial part of the heel; LH: Lateral part of the heel.

^aPairwise comparison (within-group comparison), ^bA mixed factorial analysis of variance (within-between interactions).

ventions and placebo or control interventions [14, 27]. These studies propose that foot pronation may not be a significant risk factor for shin splints and that other factors such as training load, volume, intensity, surface area, technique, muscle strength, flexibility, and fatigue could have a more crucial role in its development.

This study demonstrated an impressive improvement in both ellipse area and COP displacement, indicating enhanced balance, stability, and control over movements following the application of the KT. The reduction in ellipse area suggests that participants gained better command over their foot pressure, which is crucial for runners and athletes in terms of stability, balance, injury prevention, and energy efficiency. Decreasing in COP displacement was observed in both the ML and AP directions in the KT group. The reduction was particularly significant in the ML direction, while it approached significance in the AP direction. This result suggests that the COP ML displacement is more sensitive to external disturbances or internal disruptions compared to COP AP. This sensitivity can be attributed to the body's lower inertia and muscle strength in the frontal plane compared to the sagittal plane [30, 31]. The decrease in COP ML displacement indicates a reduction in lateral movements and an increase in forward movements in runners, highlighting their improved balance and body control due to

the KT [32]. This improvement may be attributed to the tactile stimulation provided by the tape, which enhances proprioceptive feedback and aids in increasing postural control [33]. Furthermore, the results suggest that KT may have a beneficial role in managing SS. The tape's elevation of superficial tissues promotes healing by facilitating the removal of waste products from the area and stimulating nerve endings that help relax the muscles. Additionally, KT may effectively modulate foot motion and reduce overpronation [14].

A reduction in peak pressure was observed in the M1, M2, M3, MID, and MH, suggesting a more balanced distribution of plantar pressure. The use of KT may have contributed to gait changes by correcting biomechanical factors associated with musculoskeletal pathology, resulting in optimal pressure redistribution and pain relief [14, 33]. This enables athletes to return to a more natural foot pattern. Previous studies have identified foot pronation as a risk factor for developing SS [1, 12]. KT reduces the peak stress on the midfoot of people with SS during walking [7]. The mechanisms by which KT affects SS seem to involve the modification of leg biomechanics, activation pattern of leg muscles, facilitation of proprioception, and pain relief [20, 26, 33]. Previous studies have shown that KT has a greater effect on pain and physical performance compared to space correction

taping [28]. Therefore, it can be considered an effective preventive and therapeutic solution for individuals with SS. Clinicians often use the low-dye tape technique to address pain and musculoskeletal injuries in the lower limbs [34]. According to a review study, this technique can bring about positive biomechanical impacts, such as raising the internal longitudinal arch, reducing heel protrusion and internal rotation of the tibia, and altering pressure distribution while standing or walking. Additionally, the tape may provide neuromuscular benefits, such as decreased activation of the tibialis anterior and tibialis posterior muscles when walking [34]. These biomechanical and neuromuscular changes observed immediately after using low-dye tape and KT suggest that their use can reduce the stress applied to the tibia and, consequently, prevent and treat MTSS. Another study has shown that low-dye tape reduces the contact area of the inner part of the foot, increases the arch of the foot, and decreases the activity of the tibialis anterior and tibialis posterior muscles [35]. This supports the use of tape as a suitable method for treating and preventing MTSS in athletes and military personnel.

Conclusion

In summary, the results of this study provide compelling evidence of the beneficial impact of KT on various aspects of foot function. The positive effects demonstrated in pain reduction, postural control enhancement, and plantar pressure distribution highlight the potential of this intervention for promoting overall balance and preventing injuries. Moreover, the potential benefits of managing shin splints underscore the practical applications of KT in athletic settings. However, further investigations are warranted to gain a comprehensive understanding of the mechanisms underlying these improvements and to explore the full range of practical applications in diverse populations and conditions. By expanding upon these initial findings, future research can provide valuable insights and guide sports therapists and athletes in maximizing the benefits of KT.

However, it is essential to note that while KT may provide short-term relief and functional improvement, it is not a definitive solution for SS. This relief is temporary and should be supplemented with comprehensive training and rehabilitation programs for complete recovery. Although our research provided valuable insights, certain limitations should be considered. Future longitudinal studies should enroll larger cohorts and evaluate the long-term effects of KT to validate our results. Additionally, while walking was chosen as the activity for observing the effect of KT on plantar loading, further studies

should investigate whether these differences exist during specific exercise maneuvers that may be more representative of the population as a whole.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the study Ethics Committee of [BU-Ali Sina University](#) (Code: IR.BASU.REC.1398.046) and was registered in the [Iranian Registry of Clinical Trials IRCT](#) (Code: IRCT20210629051737N1). Informed consent was obtained from all subjects involved in the study.

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Authors' contributions

Conceptualization, methodology, project administration, resources and formal analysis: Farzaneh Saki and Amir Shayesteh; Investigation: Amir Shayesteh; Data curation: All authors; Writing: Farzaneh Saki and Farzaneh Ramezani; Supervision: Farzaneh Saki.

Conflict of interest

The authors declared no conflict of interest.

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