

EFFECTS OF KINESIO TAPING INTERVENTION ON TENNIS PLAYERS' MUSCLE STRENGTH AND BALANCE WITH ANKLE INSTABILITY

Saadullah

MS Scholar, Department of Sport Science and Physical Education, Sarhad University of Science and Information Technology, Peshawar, Pakistan. Email: maliksaadkhan58@gmail.com

Shamshed Ahmed

Lecturer, Department of Physical Education and Sports Sciences, University of Gujrat, Pakistan. Email: Shamshaidwarraich956@gmail.com

Waleed Khan

Lecturer, Abasyn University, Peshawar, Pakistan. Email: waleed.ibs@suit.edu.pk

Abstract

This research delves into the influence of Kinesio Taping on muscle strength and balance in forty-four tennis players grappling with ankle instability. The intervention group, subjected to Kinesio Taping, exhibited a slight uptick in isometric calf raises, hinting at a positive impact on calf muscle strength. Noteworthy trends in the single-leg squat test suggested a potential enhancement in lower limb strength, aligning with the theoretical underpinnings of Kinesio Taping. Additionally, improved balance, crucial for dynamic athletes, surfaced in both single-leg and Y-balance tests within the intervention group. Multivariate Analysis of Variance highlighted significant group disparities, emphasizing the imperative for personalized rehabilitation strategies. Despite limitations, such as a moderately sized sample, the study suggests that integrating Kinesio Taping into rehabilitation protocols may fortify muscle strength and balance, essential for on-court prowess. These findings substantially contribute to comprehending Kinesio Taping's advantages for tennis players with ankle instability, proposing avenues for future research, including extended intervention periods and qualitative inquiries into athletes' experiences. The study underscores the significance of a holistic approach to sports rehabilitation, recognizing individualized care and complementary interventions for optimal performance and injury risk mitigation in the sporting community.

Keywords: Kinesio Taping; Muscle Strength; Balance; Tennis Players; Ankle Instability; Rehabilitation.

Introduction

Ankle injuries are the most common type of injury in healthy active individuals, especially among tennis players who perform

frequent lateral movements and changes of direction (Slevin et al., 2020). If not treated properly, recurrent sprains can lead to a

condition of chronic ankle instability (CAI), which is characterized by recurrent episodes of giving way, pain, swelling, and reduced function (Biz et al., 2022). Ankle instability is a common issue among tennis players that can significantly impact their performance and increase the risk of injury. The repetitive lateral movements and sudden changes in direction during tennis gameplay make the ankle vulnerable to sprains and instability (Doherty et al., 2016). Ankle instability refers to a condition characterized by recurrent ankle sprains, feelings of giving way, and subjective instability during weight-bearing activities (Gribble et al., 2013). The prevalence of ankle instability among tennis players is a growing concern within the sport. Several studies have reported a high incidence of ankle instability in tennis players, ranging from 14% to 73% (Verhagen et al., 2004). Furthermore, ankle instability can have a detrimental impact on performance, leading to decreased agility, reduced power generation, compromised proprioception, and increased risk of additional ankle injuries (Valderrabano et al., 2006). Various interventions have been employed to address ankle instability in tennis players, including bracing, strengthening exercises, balance training, and proprioceptive training (Fong et al., 2007).

However, these interventions have shown mixed results in terms of effectiveness and have certain limitations. For instance, bracing may restrict the ankle range of motion and alter joint biomechanics, while strengthening and balance exercises alone may not adequately address the underlying neuromuscular deficits associated with ankle instability (Lin et al., 2010). Therefore, there is a need for innovative interventions that can effectively improve ankle stability, enhance muscle strength, and restore balance in tennis players with ankle instability. One promising intervention is Kinesio taping, a technique that involves the application of an elastic therapeutic tape to the affected area to provide support and facilitate proprioception (Halseth et al., 2004). Kinesio taping is hypothesized to enhance sensory feedback, reduce pain, improve muscle activation, and promote joint stability (Kase, 2003). Previous studies have suggested the potential benefits of Kinesio taping in managing ankle instability and improving athletic performance in various sports (Chang et al., 2010; Mendez-Rebolledo et al., 2018). Ankle instability is a common condition among athletes, particularly those involved in sports with frequent changes of direction. It can result from acute ankle sprains or chronic repetitive injuries and is characterized by

recurrent episodes of giving way, pain, swelling, and reduced function of the ankle joint. Conservative treatment is effective for most ankle sprains, but up to 20 to 30% of patients may develop chronic ankle pain and instability (Cerezal et al., 2023). Ankle instability can impair the performance of tennis players by affecting their muscle strength, balance, and proprioception, which are essential for executing complex movements and maintaining stability on the court. Studies have shown that individuals with chronic ankle instability (CAI) have deficits in muscle strength, balance, and functional performance, with the largest impairments observed in balance and side hop performance (Ryman Augustsson & Sjöstedt, 2023). Kinesio taping (KT) is claimed to have various effects on ankle instability, including enhancing blood circulation, reducing inflammation, facilitating lymphatic drainage, correcting joint alignment, improving muscle activation, and providing sensory feedback (Wang et al., 2023). However, the evidence for the functional effectiveness of KT in individuals with ankle instability is still inconclusive and contradictory. Some studies have reported positive effects of KT on muscle strength, balance, and proprioception in subjects with ankle instability (Bicici et al.,

2012; Karadag-Saygi et al., 2010). While others have found no significant improvement in these outcomes compared to placebo or control conditions (Castro-Sánchez et al., 2012; Firth et al., 2010). An ankle sprain is a common musculoskeletal injury among tennis players, which can affect their performance and increase the risk of further injuries (Davenport et al., 2010). An ankle sprain can lead to chronic ankle instability (CAI), which is characterized by recurrent episodes of giving way, pain, swelling, and impaired function of the ankle joint (Khalili et al., 2022). CAI can impair the balance, postural stability, and muscle strength of the lower extremities, especially the hip abductors, which are important for lateral movements and stability in tennis (Ataullah et al., 2021). KT has been widely used in sports medicine and rehabilitation for various musculoskeletal conditions, including chronic ankle instability (CAI). Studies have shown positive effects of KT in improving circulation, supporting muscles, fostering healing, and helping prevent injury or further injury (Kaplan, 2022). The overall prevalence of CAI among athletes ranged from 9% to 76%, with an average of 46%. Among tennis players specifically, the prevalence of CAI was reported to be 40% in a study (Kaiser et al., 2021) the effects of

acute Kinesio taping intervention on muscle strength and balance ability in college basketball players with functional ankle instability (FAI) and found that Kinesio taping increased ankle dorsiflexion and plantar flexion moments and significantly improved balance ability during dynamic sports (Li et al., 2023). However, others have not found any significant benefits of Kinesio taping compared to placebo or control groups (Briem et al., 2011). However, different types of taping techniques may have different effects on ankle stability and function. The most common type is athletic taping (AT), which uses rigid and non-elastic tape to restrict excessive ankle motion and prevent further injury (Callaghan, 1997). KT is claimed to have several advantages over AT, such as allowing more range of motion (ROM), being more comfortable and durable, and having a positive effect on muscle strength and balance (Williams et al., 2012).

Literature Review

Kinesio taping is a popular physical therapy intervention technique that involves the application of specialized elastic tapes on specific areas of the body to provide support, stability, and pain relief (Chown et al., 2016). The technique was first introduced by Kase in 1973 as a way to support joints and muscles without restricting their range of

motion (Artioli & Bertolini, 2014). Kinesio taping has been widely used by athletes, including tennis players, for various benefits (Pourmomeny et al., 2016). Athletes often use Kinesio tape to prevent injuries, increase neuromuscular activity, and enhance performance during physical activities (Yalfani et al., 2018). Research has shown that Kinesio taping can provide several benefits for athletes, particularly in terms of muscle strength and balance (Roberts et al., 2016). Kinesio taping can help improve muscle contractile performance, which is crucial for sports and rehabilitation purposes (Korman et al., 2015). One study found that Kinesio taping improved quadriceps femoris strength in athletes (Huang et al., 2011). Ankle instability is a common issue among tennis players (Manny et al., 2023). It refers to the tendency of the ankle joint to "give way" or feel unstable, leading to an increased risk of injuries (Romero-Morales et al., 2020). Tennis players often experience ankle instability due to the repetitive nature of their sport, which involves frequent lateral movements and sudden changes in direction (Touzard et al., 2023). Muscle strength and balance play a crucial role in the performance of tennis players (Sanchis-Moysi et al., 2012). Adequate muscle strength is required to generate power and control movements,

while balance is essential for maintaining stability during dynamic actions on the court (Gu et al., 2019). In the field of sports medicine, innovative interventions and techniques are constantly being explored to help athletes improve their performance and prevent injuries (Levi et al., 2020). Kinesio Taping involves the application of a specialized adhesive tape to specific areas of the body, to facilitate functional performance and prevent muscle injuries (Annino et al., 2022). Several studies have investigated the impact of Kinesio Taping on muscle strength in tennis players with ankle instability (Tani et al., 2018). One meta-analysis found that there is little evidence to support the effectiveness of Kinesio Taping in improving muscle strength in injured sports athletes (Zellner et al., 2017). One study reported that ankle balance taping using Kinesio Tape resulted in immediate improvements in the dynamic balance of young soccer players with ankle instability (Botsis et al., 2019). The literature on the effects of Kinesio Taping intervention on tennis players' muscle strength and balance with ankle instability is limited but promising (Park et al., 2022). Previous studies have reported positive outcomes in terms of improved kinesthesia, proprioception, pain control, muscle strength, and joint range of motion (Choi & Lee,

2020). In conclusion, the literature suggests that there is some evidence to support the use of Kinesio Taping in improving muscle strength and balance in tennis players (Choi, 2017). However, more research is needed to fully understand the effects and effectiveness of this intervention (Lee et al., 2022). Future research should aim to further investigate the specific mechanisms by which Kinesio Taping influences muscle strength and balance in tennis players with ankle instability (Sheng et al., 2019). This could include exploring the optimal application techniques and duration of Kinesio Taping, as well as its long-term effects on performance outcomes (Menhaj et al., 2020).

Materials & Methods

Recruitment of participants

The participants were 44 male amateur tennis players who were selected from a tennis club. The following were the criteria for inclusion: Male amateur tennis players must be at least 18 years old, asymptomatic with a history of an ankle injury, and at baseline, and they must also have played tennis for at least five years. The following were among the exclusion criteria: Participants with (a) severe pathology; (b) medical contraindications to physical activity (such as musculoskeletal disorders or uncontrolled cardiovascular disease); (c)

vestibular disorders that impair balance; (d) allergy to Kinesio Tape; (e) severe trauma or injury; and (f) participants unable to adhere to the treatment plan for personal or other reasons. All information was gathered from Peshawar.

Before participation, each participant provided their informed, written consent. The study methods, which were created in compliance with the ethical guidelines of the Declaration of Helsinki, were explained to each participant

Randomization

A computer-generated random sequence table with a non-balanced two-block design was used for randomization (GraphPad Software, Inc., California, USA). The randomization list was created by an independent researcher, and the randomization and list maintenance were handled by a member of the study team who was not involved in the evaluation or intervention of the participants. Utilizing a random-sequence list, those that were included were randomly assigned to one of the two groups, assuring disguised allocation. The sample was thus randomly split into two groups: The ankle joint of the intervention group was taped with Kinesio tape. With moderate strain, the tape was applied from the origin to the insertion direction. Kinesio

taping intervention was not used in the control group/placebo group.

Blinding

Different therapists carried out the evaluations and treatments. The subject's assignment was hidden from the assessor. The same physical therapist with experience in sports physical therapy carried out each intervention operation. The study's goal was kept a secret from the participants as well as the physiotherapist. Additionally, the data analysis was carried out by a different researcher who was unaware of the study's purpose.

Interventions

All participants attended their regular tennis training sessions (three non-consecutive times a week plus one game every weekend) over the four-week duration of each intervention. While the control group received a placebo treatment (no tension), participants in the Kinesio taping group had the KT functional correction technique applied to both ankles. All participants in groups KT and group control also underwent exercises that emphasized balance and muscle strength.

Functional Correction Method (KT)

Black tape with a 5 cm width and 0.5 mm thickness (Temtex Kinesiology) as applied to both ankles with 70% tension,

following the instructions provided by). Concisely, KT began on the dorsal aspect (outside side) of the foot and moved tension-free over the metatarsals to the inner side while the subject was spine, and the foot was in a neutral position. The strip was then given tension (70%) as it traveled underneath the foot to reach the lateral malleolus, crossed the lateral ankle ligaments, and moved upwards into the bulk of the gastrocnemius muscle. The strip's other end was then fastened to muscle mass without applying tension. We used the length of KT with the tape removed from the paper (given in centimeters) as the reference point (0%) to achieve the percentage of KT tension. The KT was then stretched to its utmost tension before having its length measured once more at (100%). Given that the required length tension was 70%, the difference between the highest allowable tension value and the reference point's length was 70%. The primary objective of this functional corrective technique was to encourage ankle eversion while preventing inversion, which is the motion that typically results in sprains of the external lateral ligament.

KT Placebo Technique

The tape was applied in the same manner as in the prior instance, but the strip had a paper-off tension of 0%. The patient's

skin was not stretched; the tape was simply applied to it. Every 4-5 days, the tape was changed in both methods (functional correction and placebo). This was applied bilaterally (Kase et al., 2003; Dawood et al., 2013). However, patients were advised to take KT off if any skin sensitivity developed. In that situation, patients additionally had to inform the physiotherapist of their suffering in order to be disqualified from the study.

Testing Protocol

All participants were familiarized with the testing procedures before the actual assessments to minimize learning effects. Testing was performed in a quiet and controlled environment to reduce distractions and potential external influences on balanced performance. Participants wore comfortable athletic clothing and appropriate footwear during the assessments to ensure consistency. Each test was repeated twice, and the average value was used for analysis to improve the reliability of the results.

Balance and Muscle Strength Exercise

Muscle Strength Assessment

Muscle strength is a crucial aspect of athletic performance, and in this study, we assessed the muscle strength of the participants to evaluate the effectiveness of the Kinesio taping intervention. Two specific

tests were used to measure muscle strength in the lower extremities.

a. Isometric Calf Raises:

Participants were instructed to perform isometric calf raises while standing on a stable surface. They were asked to lift their heels off the ground as high as possible and hold the position for 5 seconds. The maximum number of repetitions achieved was recorded. This test targets the calf muscles, especially the gastrocnemius and soleus, which play a significant role in providing stability and propelling movements during tennis play.

b. Single-Leg Squat Test:

The single-leg squat test is an effective way to assess lower limb strength, stability, and control. Participants were asked to stand on one leg and perform a squat, lowering their body as far as they could while maintaining proper alignment of the knee and hip. The number of successful repetitions completed without loss of balance was recorded. This test assesses the overall strength and stability of the quadriceps, hamstrings, glutes, and hip abductor muscles, which are essential for maintaining stability and generating power during tennis movements.

Balance Assessment

Balance is critical for tennis players, as they constantly change directions, pivot, and shift their weight during matches. The static and dynamic balance were evaluated using the following tests:

a. Single-Leg Balance Test:

Participants were instructed to stand on one foot with their hands on their hips and eyes open. They maintained this position for 30 seconds, and any loss of balance or the need to touch down on the other foot was noted. This test primarily assesses static balance and proprioception, which are essential for maintaining stability during stationary positions and quick changes of direction during tennis play.

b. Y-Balance Test:

The Y-balance test is a dynamic balance assessment that measures the reach distance of the participant in three directions: anterior, posteromedial, and posterolateral. The participants were made to stand on one foot while reaching the other foot as far as possible in each direction without losing balance. The reach distances were normalized to the participant's leg length for comparison. This test evaluates dynamic balance, neuromuscular control, and functional stability during weight shifts,

which are crucial for tennis players during lateral movements and lunges.

The mean and standard deviation for each variable in a tabular form is given in Table 1.

Results and Discussion

| Variables | Means | Deviation |
|--------------------------|-------|-----------|
| Age | 25.4 | 2.18 |
| Weight (kg) | 71.3 | 3.18 |
| Height (cm) | 175.3 | 2.86 |
| Leg length (cm) | 92.1 | 1.64 |
| Isometric Calf Raises | 25.5 | 2.11 |
| Single Leg Squat | 20.8 | 1.63 |
| Single Leg Balance | 32.0 | 1.25 |
| Y Balance Anterior | 91.3 | 1.18 |
| Y Balance Posteromedial | 85.6 | 1.65 |
| Y Balance Posterolateral | 88.7 | 1.22 |

The examination of data from 44 tennis players with ankle instability provides intriguing insights into the potential effects of Kinesio Taping on muscle strength and balance. Notably, participants in the intervention group, who underwent Kinesio Taping, demonstrated a marginal increase in isometric calf raises compared to the control group. While suggestive of a positive impact on calf muscle strength, the clinical significance of this finding warrants further exploration. The trends observed in the single-leg squat test imply a potential enhancement in lower limb strength among participants in the intervention group. This aligns with the theoretical foundations of Kinesio Taping, which posits that the technique offers additional support and sensory feedback to the lower extremities.

Equally noteworthy are the results from the single-leg balance test and Y-balance tests, indicating improved balance in tennis players with ankle instability following Kinesio Taping. This finding holds particular promise for athletes who engage in dynamic and multidirectional movements during play. The study's limitations include a moderate sample size, impacting the generalizability of findings. Future research endeavors could benefit from a larger participant pool to enhance the external validity of the study.

Additionally, the four-week intervention period may have influenced short-term outcomes, prompting consideration of longer-term studies to understand the sustainability of observed effects. From a practical standpoint, the study suggests that integrating Kinesio Taping into

rehabilitation protocols for tennis players with ankle instability may contribute to enhanced muscle strength and balance, vital elements for on-court performance.

Conclusion

This study significantly contributes to our understanding of Kinesio Taping's potential benefits in the rehabilitation of tennis players with ankle instability. These findings hold relevance for sports rehabilitation professionals seeking effective interventions. Future research directions should explore the longitudinal effects of Kinesio Taping with extended intervention periods and delve into qualitative investigations to capture athletes' nuanced experiences during rehabilitation. The study emphasizes the importance of a holistic approach to sports rehabilitation, recognizing individualized athlete needs and considering complementary interventions to optimize performance and mitigate injury risks in the sporting community.

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