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The effect of kinesiology taping on stability, function, and shuttlecock velocity of badminton players with scapular dyskinesia.

El efecto del vendaje kinesiológico sobre la estabilidad, la función y la velocidad del volante de jugadores de bádminton con discinesia escapular.

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Abstract

Badminton involves repetitive high-velocity overhead strokes that place considerable stress on the shoulder complex, increasing the risk of dysfunction and injury. This risk is further elevated in athletes with scapular dyskinesis, which may impair neuromuscular control and functional performance. The present study aimed to investigate the effect of kinesiology taping (KT) on dynamic balance, functional performance, and shuttlecock velocity in adolescent badminton players with scapular dyskinesis.

This quasi-experimental pre–post study included 25 male badminton players aged 10–16 years with clinically diagnosed scapular dyskinesis. Participants were assessed using the Y Balance Test, Davis test, and shuttlecock velocity measurement before and after KT application. Scapular dyskinesis was identified using a standardized clinical assessment protocol. All participants served as their own control. This study used a paired t-test in SPSS 26 to analyze the data ($p \leq 0.05$). effect sizes (Cohen's) and 95% confidence intervals (95% CI) were calculated to determine the magnitude and precision of changes. Results demonstrated significant improvements in all variables following KT application. Y Balance Test scores, Davis test performance, and shuttlecock velocity all showed statistically significant changes (all $p < 0.001$), accompanied by large to very large effect sizes.

Overall, kinesiology taping appears to improve functional performance and dynamic stability in adolescent badminton players with scapular dyskinesis, suggesting its potential as a non-invasive adjunct intervention to enhance neuromuscular efficiency and upper limb function.

Keywords: badminton; dyskinesia; kinesiology taping; balance; range of motion

Resumen

El bádminton implica golpes repetitivos de alta velocidad por encima de la cabeza que ejercen una considerable presión sobre el complejo del hombro, aumentando el riesgo de disfunción y lesión. Este riesgo se incrementa aún más en atletas con discinesia escapular, lo que puede afectar el control neuromuscular y el rendimiento funcional. El presente estudio tuvo como objetivo investigar el efecto del vendaje neuromuscular (VN) sobre el equilibrio dinámico, el rendimiento funcional y la velocidad del volante en jugadores de bádminton adolescentes con discinesia escapular.

Este estudio cuasiexperimental pre-post incluyó a 25 jugadores de bádminton varones de entre 10 y 16 años con diagnóstico clínico de discinesia escapular. Los participantes fueron evaluados mediante la prueba de equilibrio en Y, la prueba de Davis y la medición de la velocidad del volante antes y después de la aplicación del VN. La discinesia escapular se identificó mediante un protocolo de evaluación clínica estandarizado. Todos los participantes sirvieron como su propio control. Este estudio utilizó una prueba t pareada en SPSS 26 para analizar los datos ($p \leq 0,05$). Se calcularon los tamaños del efecto (coheniano) y los intervalos de confianza del 95 % (IC del 95 %) para determinar la magnitud y la precisión de los cambios.

Los resultados demostraron mejoras significativas en todas las variables tras la aplicación del vendaje neuromuscular. Las puntuaciones de la prueba de equilibrio Y, el rendimiento en la prueba de Davis y la velocidad del volante mostraron cambios estadísticamente

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significativos ($p < 0,001$ en todos los casos), acompañados de tamaños del efecto de grandes a muy grandes.
En general, el vendaje neuromuscular parece mejorar el rendimiento funcional y la estabilidad dinámica en jugadores adolescentes de bádminton con discinesia escapular, lo que sugiere su potencial como intervención complementaria no invasiva para mejorar la eficiencia neuromuscular y la función de las extremidades superiores.
Palabras clave: bádminton; discinesia; vendaje kinesiológico; equilibrio; rango de movimiento

Introduction

Badminton is one of the most popular racket sports worldwide and is characterized by repetitive overhead movements, rapid directional changes, and high-velocity strokes such as the smash. These sport-specific demands place considerable mechanical stress on the musculoskeletal system, making badminton players susceptible to both acute and overuse injuries. Epidemiological studies indicate that shoulder injuries are among the most common upper-extremity injuries in badminton athletes, particularly among adolescent and young adult players (Pardiwala et al., 2020). Given the high frequency of overhead actions performed during training and competition, maintaining optimal shoulder function is essential for both performance and injury prevention.

The shoulder complex possesses the greatest range of motion in the human body, allowing athletes to generate the speed and force required for overhead strokes. However, this mobility depends on coordinated interactions among the glenohumeral joint, the scapula, the rotator cuff, and the scapular stabilizing muscles. Repetitive overhead activity can induce muscular fatigue, alter neuromuscular control, and compromise proprioceptive function, thereby increasing the risk of biomechanical dysfunction and injury (McArdle et al., 1996; Sant'Ana et al., 2017; Weerakkody & Allen, 2017). Consequently, optimal scapular control plays a critical role in maintaining shoulder stability and efficient force transmission during badminton performance (Sant'Ana et al., 2017).

Among the biomechanical impairments affecting overhead athletes, scapular dyskinesia has received considerable attention. Scapular dyskinesia refers to abnormal positioning and movement of the scapula during static posture or arm motion (Kibler et al., 2013). It has been associated with altered scapulohumeral rhythm, reduced shoulder

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function, and several shoulder pathologies, including rotator cuff disorders, impingement syndrome, and glenohumeral instability (Silva et al., 2010; Tate et al., 2008). Muscle imbalance, weakness, fatigue, and impaired neuromuscular control of the scapular stabilizers have been identified as key contributors to dyskinetic movement patterns (Mahmoodi et al., 2014). Because scapular positioning directly influences shoulder biomechanics, interventions that improve scapular control may help reduce functional deficits and enhance athletic performance (Mahmoodi et al., 2014; Tate et al., 2008).

Kinesiology taping (KT) has become a widely used intervention in sports medicine and rehabilitation because of its simplicity, low cost, and non-invasive nature. Proposed mechanisms include enhancing proprioceptive feedback, optimizing muscle activation patterns, supporting scapular alignment, and facilitating movement without restricting joint mobility (Kase, 2003; Kaya et al., 2014). Previous studies have reported that KT may improve pain-free shoulder range of motion, reduce pain, and enhance shoulder function in individuals with musculoskeletal disorders (Kaya et al., 2014; Kaya et al., 2011). Furthermore, several investigations have suggested that KT may influence scapular kinematics and muscle activity in individuals with scapular dyskinesia (Hsu et al., 2009; Van Herzeele et al., 2013; Zanca et al., 2016).

Although KT is widely used in sports medicine, evidence regarding its effectiveness remains inconsistent. Several studies have reported improvements in scapular kinematics, proprioception, and muscle activation following KT application (Hsu et al., 2009; Van Herzeele et al., 2013; Zanca et al., 2016). In contrast, other investigations have reported minimal or no significant effects on shoulder biomechanics, muscle performance, or sport-specific outcomes (Lin et al., 2011; Turgut et al., 2023; Yeşilyaprak et al., 2022). These conflicting findings may be explained by differences in participant characteristics, taping techniques, outcome measures, and study designs. Importantly, many previous studies were conducted in healthy individuals or asymptomatic athletes, whereas athletes with scapular dyskinesia present altered scapular positioning, impaired neuromuscular control, and deficits in proprioception. Therefore, KT may have greater potential to produce measurable improvements in individuals with existing scapular dysfunction than in healthy populations.

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Despite the popularity of badminton and the high prevalence of shoulder-related dysfunctions in overhead athletes, limited evidence exists regarding the effects of KT on functional performance and sport-specific outcomes in badminton players with scapular dyskinesia. In particular, the effects of KT on dynamic upper-extremity stability, closed kinetic chain function, and shuttlecock velocity remain insufficiently understood in this population. Therefore, the aim of the present study was to investigate the effects of KT on Y-Balance Test performance, Davies test, and shuttlecock velocity in badminton players with scapular dyskinesia. It was hypothesized that KT application would significantly increase the composite score of the Y-Balance Test, improve Davies test, and increase shuttlecock velocity compared with pre-intervention values.

Material and method

Participants and Study Design

This study employed a quasi-experimental one-group pretest–posttest design without a control group. The study population consisted of male badminton players aged 10–16 years with scapular dyskinesia. Participants were recruited from local badminton clubs and training centers via convenience sampling; 25 athletes met eligibility criteria and completed the study.

Initial screening was performed using a health history and injury screening questionnaire to identify prior musculoskeletal injuries, current symptoms, medical conditions, and eligibility for participation. Subsequently, participants underwent clinical assessment by a sports medicine physician to confirm the presence of scapular dyskinesia. The inclusion criteria were: (1) male badminton players aged 10–16 years, (2) a confirmed diagnosis of scapular dyskinesia, (3) a minimum of three years of badminton experience, and (4) regular participation in badminton training. Exclusion criteria included: (1) musculoskeletal injury within the previous six months that could affect performance, (2) current shoulder pain requiring treatment, (3) allergy or hypersensitivity to adhesive materials, (4) neurological, cardiovascular, or other medical disorders affecting upper-extremity function, and (5) participation in a concurrent rehabilitation program. Because all participants were minors, written informed consent was obtained from their parents or legal guardians prior to participation. In addition, verbal assent was

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obtained from the athletes. Baseline anthropometric measurements, including height and body mass, were recorded. Participants were instructed to avoid caffeine-containing beverages, energy drinks, and other ergogenic aids before testing sessions (Girard & Millet, 2009).

The study protocol was approved by the Research Ethics Committee of the University of Tehran (IR.UT.SPORT.REC.1404.043) and was conducted in accordance with the Declaration of Helsinki.

To minimize potential learning effects, participants completed a familiarization session before formal data collection. During this session, standardized instructions and practice trials were provided for all outcome measures. Testing commenced only after participants demonstrated adequate understanding of the procedures.

Assessment of Scapular Dyskinesia

Scapular dyskinesia was assessed using the Lateral Scapular Slide Test (LSST) originally described by Kibler (WB, 1991). Measurements were obtained bilaterally in three test positions: (1) arms resting at the sides (0° abduction), (2) hands placed on the hips with approximately 45° shoulder abduction, and (3) shoulders positioned at 90° abduction with maximal internal rotation. In each position, the distance between the inferior angle or medial border of the scapula and the corresponding thoracic spinous processes was measured using a tape measure. A side-to-side difference greater than 1.0–1.5 cm was considered indicative of abnormal scapular positioning and consistent with scapular dyskinesia, according to previously published criteria (WB, 1991). Clinical findings were reviewed by the examining physician before final participant inclusion.

Kinesio Taping Procedure

Kinesio Tape® (Kinesio Holding Corporation, Albuquerque, NM, USA) was applied by a certified physiotherapist with more than 8 years of clinical experience and formal training in Kinesio Taping®. Prior to application, the skin was cleaned and dried.

Following the Kinesio Taping method described by Kase et al., I- and Y-shaped strips were applied over the target muscles while the shoulder was positioned in a stretched posture (Kase et al., 2003). The anchor and terminal ends of the tape were applied without tension, whereas approximately 50–75% tension was applied to the

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therapeutic portion of the tape. After application, the tape was gently rubbed to activate the adhesive and ensure proper fixation.

Kinesio taping was applied in a scapular correction configuration primarily intended to facilitate lower trapezius activity while inhibiting excessive upper trapezius dominance, thereby improving scapular positioning during dynamic upper-extremity movements (applied to the dominant shoulder). Post-intervention testing was conducted 30 minutes after tape application to allow participants to accommodate to the tape before reassessment (Figure 2).

Figure 2. KT method for the participants with dyskinesia**.** (KT) kinesiology taping

Y-balance test

To perform the upper limb Y-balance test, the participants were asked to stand on the palms of their hands (thumb attached to the index finger and elbows in an extended position) and toes of their feet (without shoes) in the starting position, as in the Swedish push-up movement, and to keep the spine and lower limbs in one line. The thumb position was marked by a line and the feet were shoulder-width apart. In this position, the participants were asked to reach with their free hand in the internal, inferior-external and superior-external directions, respectively, as far as possible, while maintaining the position of the supporting hand, trunk, and legs. In order to allow comparison with other

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participants, the reach values were normalized to the length of the upper limb (distance from the spinous process of the seventh cervical vertebra to the tip of the longest finger in a 90-degree abduction of the shoulder and extension of the elbow, wrist, and fingers). The reaching action was performed in all three directions in succession, without rest and without the free hand touching the ground. Participants were allowed to place their free hand on the ground and rest after completing each round of reaching in three directions, and the process was repeated three times. If during each round the person's fixed hand lifted off the flat surface, the free hand hit the ground or indicator or leaned on it, or the participant could not control his free hand to return to the starting position and his balance was lost, or either foot left the ground, that round was repeated. The highest reaching rate in each direction was recorded and included in the formula for calculating the overall composite score (Gorman et al., 2012).

Davis Test

To perform the Davis test, two pieces of tape, with their inner edges 90 cm apart, were taped to the floor. The participants were asked to push up in the space between the two bands. Then, at full speed, they touched the outer edges of the tapes with their hands in a crisscross pattern for 15 seconds. The number of hand contacts was the individual's test score, which was recorded on the associated form. This was repeated three times, and the highest test score was the average of the three tests (Heick et al., 2021).

Shuttlecock Velocity Assessment

Participants completed a standardized warm-up protocol (15 min), followed by a familiarization session (15 min). After receiving a high serve, each participant performed a maximal badminton smash toward a predefined target area. Three successful trials were recorded for each participant (Ramasamy et al., 2024).

Shuttlecock velocity was assessed using two-dimensional video-based motion analysis (Kinovea software, version 0.9.5). An iPhone 13 camera was positioned perpendicular to the plane of motion at a distance of 1.0 m from the hitting zone and mounted on a fixed tripod to minimize camera movement (De Oliveira Mota Ribeiro & Bezerra de Almeida, 2020). Video recordings were obtained at 120 frames·s^{-1} using the slow-motion recording mode with a resolution of 1920 × 1080 pixels.

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Prior to data collection, the recording area was calibrated using a reference distance of 2.0 m marked within the camera field of view. Camera alignment and lens orientation were carefully checked to minimize parallax and perspective errors. The shuttlecock position was digitized frame-by-frame immediately following racket–shuttle contact. Instantaneous shuttlecock velocity was calculated from the displacement of the shuttlecock across consecutive frames using the calibrated scale factor.

To improve measurement reliability, each participant performed three valid smash trials separated by 60 s of passive recovery. The highest shuttlecock velocity obtained across the three trials was retained for statistical analysis.

Statistical analysis

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were calculated and reported as mean ± standard deviation (SD). Prior to inferential analyses, the normality of the distribution of all outcome variables (Y-Balance Test score, Davies test score, and shuttlecock velocity) was assessed using the Shapiro–Wilk test, which is recommended for small sample sizes. The paired t-test was used to investigate the Y-balance test, Davis test, and shuttlecock velocity. Cohen's effect size (ES) and its 95% confidence interval (95% CI) were calculated to determine the magnitude of the pre- to post-test changes. Effect sizes were interpreted as trivial (<0.20), small (0.20–0.49), moderate (0.50–0.79), large (0.80–1.29), and very large (≥1.30) (Lakens, 2013). Statistical significance was set at $p \leq 0.05$ for all analyses.

Result

The Shapiro–Wilk test indicated that all study variables were normally distributed ($p > 0.05$). Therefore, parametric analyses using paired-samples t-tests were performed.

Table 1. Participants' mean and standard deviation.

	Mean ± SD
Age (years)	14.48 ± 3.92
Height (cm)	169.42 ± 14.51
Weight (kg)	64.76 ± 9.81

The mean and standard deviation of the participants' characteristics are presented in Table 1 and figure 2.

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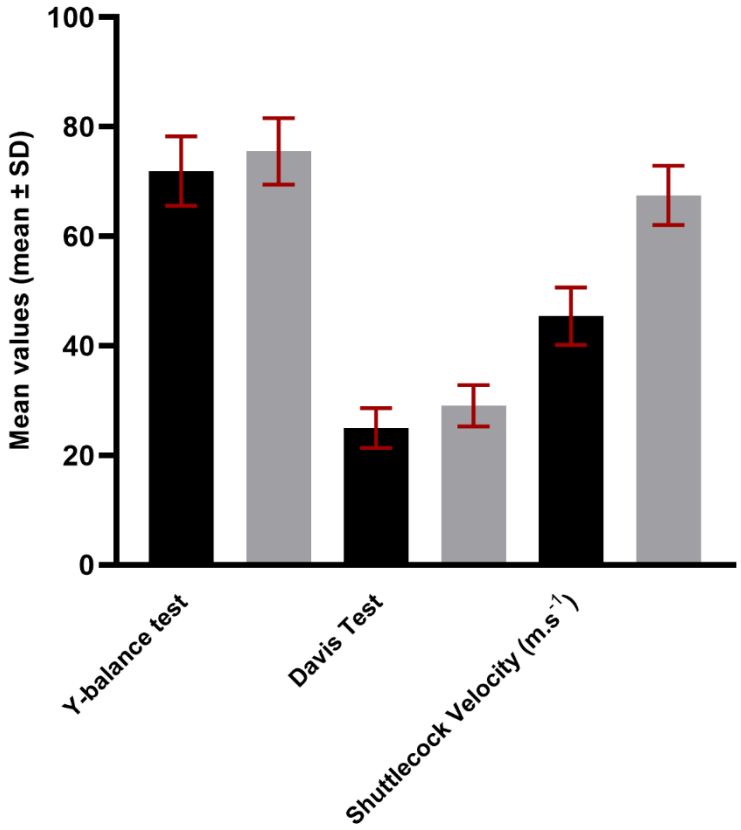

Figure 2. Comparison of pre- and post-intervention mean values for the Y test, Davis test and Shuttlecock Velocity. ■ pre ■ post

To examine the changes within the group, a paired t-test was used, and the results showed that the Y-balance test had significant changes between the pre-test and post-test (ES = 2.63, $p < 0.001$). In addition, the changes in the Davis test in athletes after using the KT had a significant difference (ES = 1.52, $p < 0.001$) (Table 2). The t-test results in Table 2 show that KT use significantly increased shuttlecock velocity in athletes with dyskinesia (ES = 3.39, $p < 0.001$) (Table 2).

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Table 2. Comparing pre and post-test Y, Davis balance and shuttlecock velocity in badminton players with scapular dyskinesia.

	Pre test	Post test	Mean Difference (95% CI)	Cohen's (95% CI)	p
Y-balance test	71.95 ± 6.34	75.54 ± 6.07	3.59 (3.03–4.15)	2.63 (1.85–3.41)	<0.001*
Davis Test	25.00 ± 3.64	29.08 ± 3.78	4.08 (2.98–5.18)	1.52 (0.90–2.14)	<0.001*
Shuttlecock Velocity (m.s^{-1})	45.44 ± 5.22	67.50 ± 5.39	22.06 (19.38–24.75)	3.39 (2.46–4.32)	<0.001*

* denotes significant differences between pre and post-test ($p \leq 0.05$).

Discussion

The purpose of this study was to investigate the effects of Kinesio Taping (KT) on dynamic stability, upper-extremity function, and shuttlecock velocity in badminton players with scapular dyskinesia. The main findings demonstrated that KT application resulted in significant improvements in Y-Balance Test performance, Davies test scores, and smash shuttlecock velocity; however, given the pre–post design without a control group, these changes cannot be attributed solely to KT. These findings suggest a potential association between KT application and immediate functional improvements in athletes presenting with altered scapular mechanics and may positively influence sport-specific performance.

The present findings are consistent with previous studies reporting beneficial effects of KT on shoulder function and scapular control. Mehta et al. (2022) reported that KT may contribute to maintaining shoulder proprioception, muscle strength, and reaction time in badminton players (Mehta et al., 2022). Similarly, Huang et al. (2019) demonstrated that taping could modify scapular kinematics and muscle activation patterns according to the type of scapular dyskinesia (Huang et al., 2019). Ozer et al. (2018) observed improvements in scapular dyskinesia and pectoralis minor flexibility following scapular KT application in overhead athletes (Ozer et al., 2018). Furthermore, Hsu et al. (2009), Huang et al. (2012), and Van Herzeele et al. (2013) reported that KT may facilitate scapular repositioning and optimize activation of scapular stabilizing muscles during dynamic movements. Collectively, these findings support the notion that KT may

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enhance scapular control and upper-extremity function, particularly in athletes who perform repetitive overhead activities (Hsu et al., 2009; Huang et al., 2012; Van Herzeele et al., 2013).

Several studies have reported limited or no effects of KT on muscle performance and athletic outcomes. Zhang et al. (2016) found no improvement in wrist flexor and extensor strength following KT application (Zhang et al., 2016), while de Jesus et al. (2016) reported no significant effects on quadriceps strength in healthy individuals (de Jesus et al., 2016). Bruce et al. (2017) observed no enhancement in shoulder reaction time (Bruce et al., 2017), and Intelangelo et al. (2016) reported no significant changes in shoulder muscle electromyographic activity or isometric strength after taping (Intelangelo et al., 2016). Moreover, a systematic review by Turgut et al. (2023) concluded that taping may improve proprioception and scapular kinematics but is unlikely to substantially increase muscle activity, strength, or athletic performance (Turgut et al., 2023). Differences between these studies and the present findings may be attributed to variations in participant characteristics, the presence or absence of scapular dyskinesia, taping techniques, tape tension, targeted muscles, outcome measures, and assessment timing. Importantly, many studies reporting null findings were conducted in healthy or asymptomatic individuals, whereas the current study focused specifically on athletes with scapular dyskinesia, who may derive greater benefit from corrective taping interventions due to their underlying biomechanical deficits.

Several physiological and biomechanical mechanisms may explain the improvements observed in the present study. KT is proposed to enhance proprioceptive input through continuous stimulation of cutaneous mechanoreceptors, thereby improving sensorimotor control and neuromuscular coordination (Hsu et al., 2009). Improved afferent feedback may facilitate more efficient recruitment of scapular stabilizing muscles and contribute to better scapular positioning during upper-extremity movements. In addition, KT has been suggested to promote a mild lifting effect on the skin, potentially increasing local circulation and reducing pressure on subcutaneous nociceptors (Hwang-Bo & Lee, 2011). Improved scapular alignment may optimize the length–tension relationship of the scapular stabilizers and rotator cuff muscles, resulting in more effective force transmission throughout the kinetic chain during the smash stroke. Consequently,

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improvements in dynamic stability and upper-extremity function may contribute to the increased shuttlecock velocity observed in the present study (Hsu et al., 2009; Hwang-Bo & Lee, 2011).

From a practical perspective, the findings of this study may be relevant for athletes, coaches, and sports rehabilitation professionals. For badminton players with scapular dyskinesia, KT may serve as a simple, non-invasive, and relatively inexpensive adjunct strategy to improve functional performance during training and competition. Physiotherapists may incorporate KT as a short-term adjunct to corrective exercise programs, particularly during early phases of rehabilitation or return-to-play when scapular control deficits are present. KT may be applied prior to training or competition to temporarily enhance proprioceptive feedback, while corrective exercises remain the primary intervention for long-term neuromuscular adaptation. Coaches may also consider KT as a temporary supportive measure during periods of intensive training or return-to-sport progression. Nevertheless, KT should not be viewed as a replacement for comprehensive rehabilitation programs, as long-term correction of scapular dyskinesia likely requires targeted strengthening, neuromuscular retraining, and movement re-education.

Several limitations should be considered when interpreting these findings. The absence of a control or placebo-taping group limits the ability to distinguish the specific effects of KT from potential placebo or learning effects. Additionally, potential influences such as learning effects, placebo responses, fatigue, and the Hawthorne effect may have contributed to the observed improvements, given the repeated testing design. The fixed order of testing may have introduced order or familiarity effects, and the lack of assessor blinding could have influenced outcome measurements. The relatively small sample size may reduce the generalizability of the results. Third, only the immediate effects of KT were evaluated; therefore, the persistence of these benefits over time remains unknown. Additionally, psychological factors such as motivation, concentration, and competitive stress were not controlled and may have influenced test performance. Future research should employ randomized controlled designs with larger sample sizes, placebo and sham-taping conditions, and longer follow-up periods. Further investigations should also examine the effects of different taping techniques, tensions, and application durations, as

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well as the interaction between KT and structured rehabilitation programs in athletes with scapular dyskinesia.

Conclusion

In conclusion, Kinesio Taping appears to be associated with immediate improvements in dynamic stability, upper-extremity function, and shuttlecock velocity in male badminton players aged 10–16 years with scapular dyskinesia. However, these findings are limited to short-term effects, and the impact on long-term adaptation and actual competitive performance remains unknown. Kinesio Taping should be considered as an adjunct intervention and is recommended to be used in combination with individualized scapular retraining and corrective exercise programs, which remain essential for addressing the underlying neuromuscular deficits.

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