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RESEARCH REPORT

Immediate effect of Kinesio taping on shoulder muscle strength and range of motion in healthy individuals: A randomised trial



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KEYWORDS

Kinesio tape;
peak torque;
shoulder rotation
range of motion

Abstract *Background:* Taping is widely used in the field of rehabilitation as both a means of treatment and prevention of sports-related injuries. In recent years, the use of Kinesio tape has become increasingly popular; it can be applied to virtually any muscle or joint in the body. Kinesio tape and its strength-enhancing properties have been the focus of recent research based on the neuromuscular facilitator theory. There has been, however, inconclusive evidence to either support or refute this theory.

Objective: This study investigated the immediate effect of Kinesio taping (KT) on peak torque of shoulder external rotators muscle and shoulder external and internal range of motion (ROM) in healthy individuals.

Methods: This was a single-blinded, placebo-controlled, randomised trial. A total of 39 participants were randomly allocated into three groups. Two main variables were measured—peak torque of shoulder external rotation at two isokinetic speeds (60°/s and 180°/s) was measured with a Biodex isokinetic dynamometer, and shoulder rotation ROM was measured with a standard goniometer. Dependent variables were measured after the application of three different taping conditions—no taping (NT), KT, and placebo taping (PT)—on each participant with 3-day intervals.

Results: The mean peak torque at speeds of 60°/s and 180°/s demonstrated no significant difference among the three taping conditions. No significant difference in external rotation range of motion was detected among the three taping conditions. The PT condition led to a significantly smaller mean internal range of motion value than KT and PT ($p < 0.016$).

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Conclusion: Overall, KT did not cause significant difference in shoulder external rotation peak torque, and shoulder internal and external range of motion in healthy individuals.

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Introduction

For an elite athlete, a small improvement in athletic performance could mean the difference between a gold medal and a silver one. Sports activities that demand jumping, kicking, and throwing require peak muscle strength for outstanding performance. Peak torque is the capability of the neuromuscular system to create the highest muscular force output at any moment during a repetition. The shoulder region is highly involved in all racquet strokes, and it has been shown that shoulder internal, external, and diagonal peak torques contribute substantially to service ball velocity [1]. Thus, it is not surprising that the shoulder region has been a major focus of racquet-related performance and injury prevention/rehabilitation research. Adequate strength and range of motion (ROM) in the rotator cuff muscles, specifically the rotator cuff—the infraspinatus and teres minor—are essential in preventing overhead overuse injuries as they are vital in stabilising and movement throughout the extreme ROM experienced during racquet strokes—specifically the service motion [1,2].

Taping is widely used in the field of rehabilitation as both a means of treatment and prevention of sports-related injuries [1,3–5]. The essential function of most types of tape serves to enhance proprioception and, therefore, to reduce the occurrence of injuries [3–5]. The most commonly used tape applications are done with nonstretch tape. The rationale is to provide protection and support to a joint or a muscle [1,3–9]. In recent years, the use of Kinesio tape (KT) has become increasingly popular [2,10]. KT was designed to mimic the qualities of human skin. It has roughly the same thickness as the epidermis and can be stretched between 30% and 40% of its resting length longitudinally. Kase et al [11] have proposed several benefits, depending on the amount of stretch applied to the tape during application: (1) to provide a positional stimulus through the skin, (2) to align fascial tissues, (3) to create more space by lifting fascia and soft tissues above the area of pain/inflammation, (4) to provide sensory stimulation to assist or limit motion, and (5) to assist in the removal of oedema by directing exudates toward a lymph duct. KT is unique in several respects when compared to most commercial brands of tape. It is latex-free, and the adhesive is 100% acrylic and heat activated. The 100% cotton fibres allow for evaporation and quicker drying. This allows KT to be worn in the shower or pool without having to be reapplied. Lastly, prescribed wear time for one application is longer, usually 3–4 days.

KT can be applied to virtually any muscle or joint in the body. KT and its strength-enhancing properties have been the focus of recent research based on the neuromuscular facilitator theory. There has been, however, inconclusive evidence to either support or refute this theory. The application of KT could increase eccentric isokinetic peak torque in healthy normal females upon the application of tape on quadriceps muscle [12].

The rotator cuff muscles play a vital role in normal arthrokinematics and asymptomatic shoulder function. The overhead athlete requires the rotator cuff to maintain an adequate amount of glenohumeral joint congruency for asymptomatic function. The sufficient strength of the external rotators (infraspinatus and teres minor), in particular, is integral during the overhead throwing motion to develop an approximation force on the upper arm at the shoulder equal to body weight to prevent joint distraction. The balance between external and internal rotation strength is important to normal glenohumeral joint function, especially during athletic activities. An adequate external–internal rotator muscle strength ratio has been emphasised in the literature [13].

The addition of KT application to the exercise programme appears to be more effective than the exercise programme alone for the treatment of subacromial impingement syndrome [14]. A number of case studies have provided early evidence supporting KT use in a range of conditions and outcome measures such as pain-free ROM in those with myofascial shoulder pain [5]. The results of all these reports suggest that KT can be clinically beneficial, but the high risk of bias associated with case studies and their inability to demonstrate cause and effect limits the use of these results for informing clinical practice [15].

An investigation was conducted to determine the short-term clinical efficacy of Kinesio taping (KT) when applied to college students with shoulder pain, as compared to sham taping [6]. The results showed that the therapeutic KT group showed an immediate improvement in pain-free shoulder abduction after tape application. No other differences between groups regarding ROM, pain, or disability scores at any time interval were found [6]. Another study aimed to investigate the effect of elastic taping on kinematics, muscle activity, and strength of the scapular region in baseball players with shoulder impingement. The elastic taping resulted in positive changes in scapular motion and muscle performance. The results supported its use as a treatment aid in managing shoulder impingement problems [7]. However, an investigation into the immediate effect of KT on peak torque production and ROM is lacking in the literature. Therefore, the purpose of this study is to determine the immediate effect of KT on peak torque production of shoulder external rotators and shoulder internal and external rotation ROM through quantitative measurements.

Methods

Participants

All participants were enrolled from Jamia Hamdard (Hamdard University) campus, Hamdard Nagar, New Delhi, India. All included participants were allotted specific time to report at the Rehabilitation Centre, Jamia Hamdard.

After the screening of participants on the basis of inclusion and exclusion criteria, they were included in the study, and a pool of participants was created. Selected participants were included in the study and were informed about the benefits, risks, and procedure of the study. Sample size estimation had been done using samples of previous research papers [6,7] and had taken more than the previous research papers to estimate the effect on a larger group. Study duration and availability of the participants had also been considered for sample size.

Upon evaluation, the inclusion criteria were as follows: (1) male, age group 21–29 years; (2) body mass index normal values (18.5–24.9 kg/m²) [16]; (3) normal active ROM of the shoulder on functional testing [17]; and (4) no reported history of skin disease. The exclusion criteria [16,17] were (1) history of dislocation or traumatic injuries on the tested shoulder complex; (2) reported history of shoulder or cervical spine surgery; (3) reported history of cervical spine pathology; (4) reported history of neurological conditions reproduction of symptoms in the cervical screening examination (active and passive ROM, and overpressure); and (5) had pain or pathology in their shoulder as determined by the Shortened Disabilities of the Arm, Shoulder and Hand Questionnaire (QuickDASH) that would interfere with testing [18,19]. Withdrawal criteria were any skin irritation and allergies to tape after application. Overall, 39 participants were enrolled into the study.

The primary author has conducted a workshop on KT application and applied all taping procedures. The Latin-square technique was used to randomly allocate participants to groups. The participants were equally distributed into three groups to eliminate the order effect. A different investigator randomly allocated participants to groups (the allocation was concealed). Informed consent was obtained from all participants prior to enrolment, and all rights of these individuals were protected. The procedures for this

study were approved by the Institutional Review Board and Ethical Committee, Jamia Hamdard. All experiments were conducted in accordance with the Declaration of Helsinki.

Taping techniques

All participants were allocated into three groups representing the order of three different taping methods: Group 1 (KT, PT, NT), Group 2 (PT, NT, KT), and Group 3 (NT, KT, PT) (Fig. 1).

Standardised KT application was done. The general application guidelines for KT were followed as suggested by Kase et al [11]. To ensure the consistent placement of the tape, it was applied to every participant by the same researcher. The tape was applied with the individual sitting, the elbow bent to 90°, and the forearm across the abdomen to ensure that the shoulder was in internal rotation to elongate the infraspinatus and teres minor. KT was applied from the origin to insertion to facilitate movement. Five-centimetre beige I-shaped kinesiology tape strips (Nitto Denko Corp., Osaka, Japan) were used for every tape application to standardise the taping protocol. Prior to the application, the skin was cleaned with isopropyl alcohol, and the lengths of tape to be used were determined by measuring from 2 cm lateral of the medial border of the scapula just inferior to the scapular spine for the infraspinatus origin to its insertion on the greater tubercle of the humerus for the first piece of tape, and 2 cm superior of the inferior angle of the scapula for the teres minor origin to its insertion on the greater tubercle for the second piece of tape. Rounding the corners of the tape strip prior to application, 2 cm of the length was applied directly over the origin of the infraspinatus with no stretch to act like an anchor, and rubbed gently to activate the glue. Fifty percent tension was applied to the tape as it was stretched out over

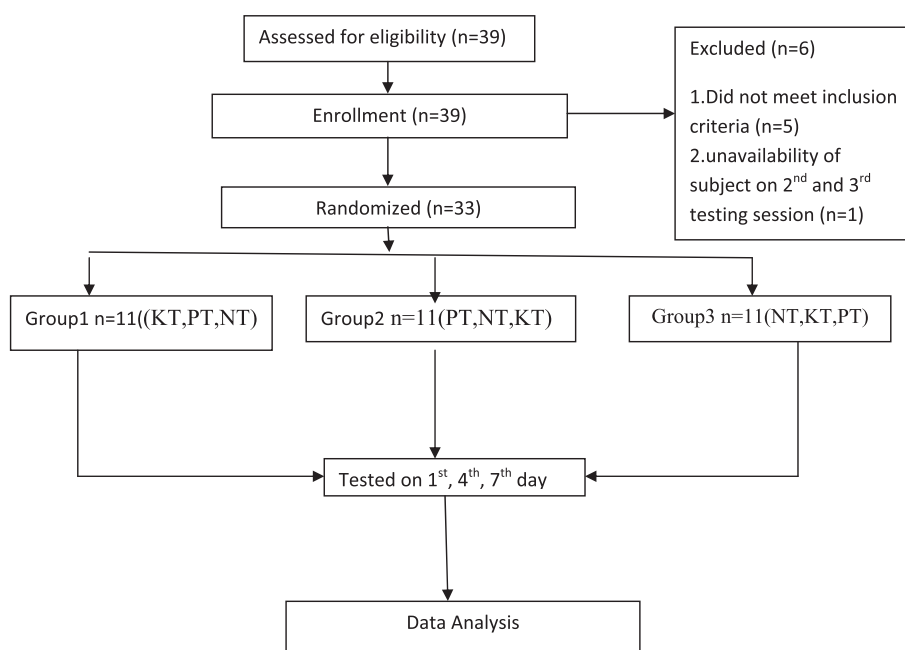


Figure 1. Flow diagram showing the progress of participants at each stage of the study. KT = Kinesio taping; NT = no taping; PT = placebo taping.



Figure 2. Application of tape and direction of tension.

the muscle. To attain this, the tape was stretched out to its maximal tension then subjectively backed off halfway as it was put along the course of the muscle and over the insertion on the greater tubercle (Fig. 2). No stretch was applied to anchor the tape. The tape was rubbed briefly to adhere to the skin. The same tape application technique was then

used to facilitate the teres minor, and it was allowed to overlap onto half the width of the tape over the infraspinatus for the distal half of the tape course, terminating over the greater tubercle of the humerus. The tape was only worn during testing sessions (approximately 30 minutes) and was removed immediately after.

For placebo taping (PT), a standardised, neutral KT application procedure was followed [17,20]. Participants were positioned sitting with the involved limb at the side that placed the muscles in a relaxed position. PT consisted of two 5-cm beige Nitto Denko Kinesiology Tape, Japan I-strip applied with no tension. They were essentially placed on the skin after paper backing was completely removed, first strip on infraspinatus and second on teres minor muscle. Rubbing of tape was not applied to activate the glue.

Outcome measures

We utilised two primary outcome measures: (1) shoulder rotation ROM, i.e., external rotation and internal rotation, and (2) shoulder external rotators peak torque at two isokinetic speeds, 60°/s and 180°/s. All measures were obtained at three different taping conditions—no taping (NT), KT, and PT—for the same individual.

Shoulder rotation ROM was measured using a universal goniometer (NexGen Ergonomics Inc., Pointe Claire, Quebec, Canada) [20–22]. The participant was placed in a supine position with the shoulder abducted 90° and the elbow flexed 90°. The forearm is midway between pronation/supination

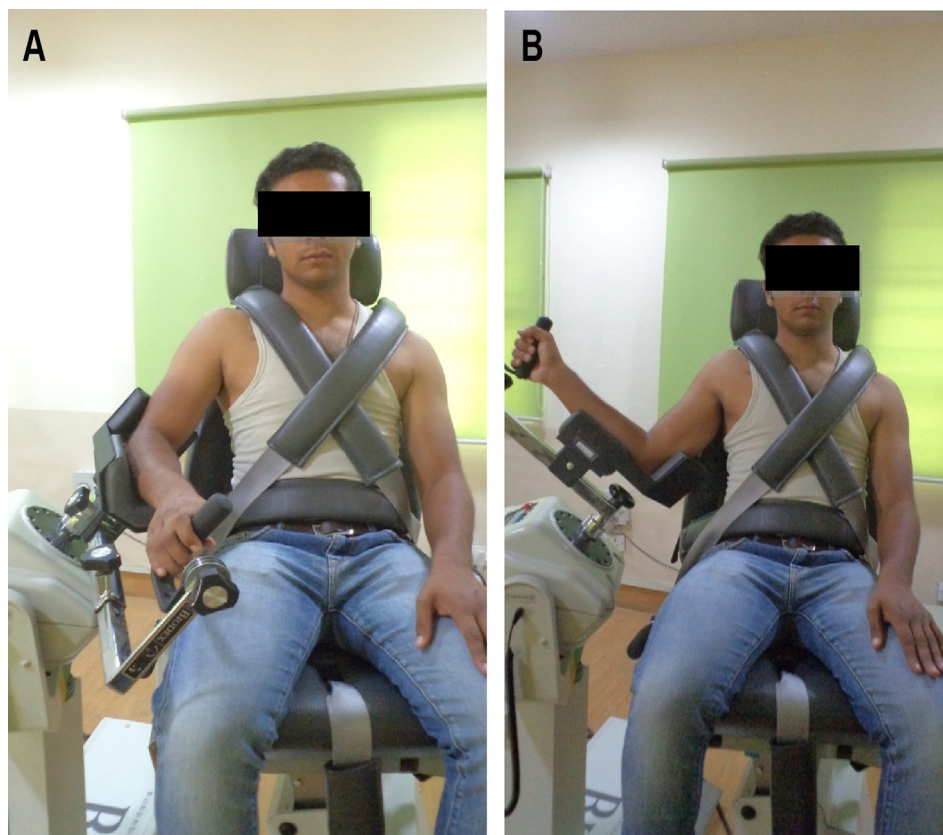


Figure 3. Peak torque measurement (shoulder external rotators). (A) Starting position. (B) End position.

with the entire humerus supported by the table. The primary investigator stabilised the distal humerus through the full ROM, and another therapist stabilised the thorax/scapula at the end ROM. Goniometer axis was placed at the olecranon process of the ulna projecting through the humeral shaft toward the humeral head. The stationary arm was kept perpendicular to the floor, and the moving arm was kept parallel to the longitudinal axis of the ulna pointing toward the styloid process. The participant was instructed to move the shoulder in internal and external rotations.

The peak muscle torque of the right shoulder external rotators was measured using the Biodex System 4 Pro dynamometer (Biodex Medical Systems Inc., Shirley, NY, USA) in a modified neutral position at two velocities (60%/s and 180%/s) [23–25]. The dynamometer was calibrated prior to the testing session according to the procedures prescribed by the manufacturer. Each participant was placed in the Biodex chair and stabilised by three straps across the shoulder, chest, and pelvis. The lower limbs were flexed in hip and knee joints (110° and 90°, respectively), the feet were left free, and the hand of the nontesting side was laid on the participant's lap [25].

The tested limb was placed on the lever arm with the elbow joint flexed to 90° and the hand holding the handle (Fig. 3A and B). Machine setup [23] was done with the seat height adjusted as per required and the chair rotated to 15°. The dynamometer was aligned with a 20° rotation and a 50° tilt. The elbow/shoulder attachment was used, and the shaft dot was aligned with R. and secured with a locking knob. Then the participant was moved into position. The individual's axis of rotation was aligned with the dynamometer. If needed, the chair was raised or the tilt of the seat back was adjusted to accommodate the various sizes of participants.

The participants were asked to perform warmup and familiarisation (3 submaximal and 1 maximal rep). They were instructed to do external rotation from the starting position and come back to the initial starting position with their full effort throughout the available set ROM in four repetitions at two velocities, 60%/s and 180%/s (randomisation of testing velocity with counterbalanced test sequence), with a 1-minute rest interval between sets. Standardised and consistent verbal encouragement was provided for all participants using a script during testing. No visual feedback was provided. Recordings of the physical setup used in the first testing session (i.e., chair distance from the dynamometer, Biodex Rt/Lt, seat height, seat fore–aft, seat tilt, and lever arm length) were used to standardise the participant's posture within the device in the latter two testing sessions.

Procedures

Each participant had ROM and peak torque measures completed in three different taping conditions (NT, KT, and

PT). All participants were told to refrain from participating in any sport activity and other unusual activities for at least 24 hours prior to the examination. The measures were preceded by a 10-minute warmup [26,27], consisting of upper limb exercises (arm circles, standing scaption, and Cuban press) with a low intensity (this applied to all participants). Every participant had undergone three trials that consisted of a random sequence of taping modes (NT, KT, and PT) with a 3-day interval between two successive trials to avoid accumulation of taping effects [25]. The participants were allowed to withdraw from the study at any moment because of skin irritation, pain, or discomfort.

Data analysis

Data were analysed using SPSS 17.0 software (IBM Corp., Chicago, IL, USA). One-way repeated-measures analysis of variance was done. Because the analysis of variance showed an overall significant difference, *post-hoc* paired test was done with Bonferroni's correction. A series of paired *t* tests were done for comparison of peak torque and ROM within participants.

Demographic data descriptive statistics were obtained. All dependent variables were compared with the application of paired *t* test on 12 pairs. The tests were applied at 95% confidence interval and because Bonferroni's adjustment had been applied to the level of significance; therefore, the level of significance is divided by the number of comparisons (0.05/3) and adjusted to 0.016. Thus, a *p* value was set at 0.016. The results were regarded as significant if $p < 0.016$.

Results

Baseline characteristics and descriptive statistics of each outcome measure of the participants are shown in Table 1. Thirty-two adult males completed the study.

Peak torque

The mean values of peak torque at speeds of 60%/s and 180%/s were compared between different taping conditions (Table 2). The mean peak torque at 60%/s speed in NT, KT, and PT was 18.2 ± 6.1 , 20.2 ± 8.2 , and 19.4 ± 6.5 , respectively. The mean peak torque at 180%/s speed in NT, KT, and PT was 17.2 ± 5.7 , 20.1 ± 9.1 , and 17.6 ± 5.6 , respectively.

The ascending order of mean peak torque at 60%/s and 180%/s was as follows: NT < PT < KT. When we compared the *t* value of all taping conditions, the result showed that the *t* value was <1.96 and was not statistically significant for both speeds (Table 3). When we compared the *p* value of all

Table 1 Descriptive statistics of participants (demographic data).

	Age, y	Weight, kg	Height, cm	BMI, kg/m ²
Mean ± SD	24.4 ± 1.8	65.9 ± 5.7	169.3 ± 6.3	23.0 ± 1.8

BMI = body mass index; SD = standard deviation.

Table 2 Descriptive statistics of participants (peak torque at 60°/s and 180°/s speed).

	NTT60	KTT60	PTT60	NTT180	KTT180	PTT180
Mean \pm SD	18.2 \pm 6.1	20.2 \pm 8.2	19.4 \pm 6.5	17.2 \pm 5.7	20.1 \pm 9.1	17.6 \pm 5.6

KTT60 = Kinesio taping torque at 60°/s; KTT180 = Kinesio taping torque at 180°/s; NTT60 = no taping torque at 60°/s; NTT180 = no taping torque at 180°/s; PTT60 = placebo taping torque at 60°/s; PTT180 = placebo taping torque at 180°/s; SD = standard deviation.

Table 3 Comparison of different taping conditions for variable—peak torque.

	NTT60–KTT60	NTT60–PTT60	KTT60–PTT60	NTT180–KTT180	NTT180–PTT180	KTT180–PTT180
<i>t</i> statistic	–1.936	–1.273	1.341	–1.769	–0.602	1.759
<i>p</i>	0.062	0.213	0.190	0.087	0.551	0.089

KTT60 = Kinesio taping torque at 60°/s; KTT180 = Kinesio taping torque at 180°/s; NTT60 = no taping torque at 60°/s; NTT180 = no taping torque at 180°/s; PTT60 = placebo taping torque at 60°/s; PTT180 = placebo taping torque at 180°/s.

taping conditions, the result that showed $p > 0.016$ and was not statistically significant for both speeds.

ROM

The mean ROM of shoulder external and internal rotation of the participants in different taping conditions was compared (Table 4). The mean shoulder external rotation range in NT, KT, and PT was 86.3 \pm 7.8, 85.9 \pm 7.5, and 85.3 \pm 7.8, respectively. The mean shoulder internal rotation range in NT, KT, and PT was 79.7 \pm 7.2, 78.9 \pm 7.5, and 78.0 \pm 7.2, respectively (Table 5).

The ascending order of mean shoulder external and internal rotation range was PT < KT < NT. When we examined the *t* and *p* values of all taping conditions, the results showed $t < 1.96$ and $p > 0.016$ and was thus not statistically significant for external rotation (Table 5).

When we examined the *t* and *p* values of all taping conditions, the result showed $t > 1.96$ and $p < 0.016$ and was thus statistically significant for pairs KT–PT and NT–PT for internal rotation. However, the results for the NT–KT pair was not significant ($t < 1.96$) for internal rotation.

Discussion

The purpose of the study was to investigate the immediate effect of KT on the peak torque of shoulder external rotators muscle and shoulder external and internal ROM in healthy individuals.

Peak torque

The results showed that while there was a tendency for the peak torque to increase after KT application compared with PT and NT, the differences did not quite reach statistical significance ($p < 0.10$).

The ascending order of mean peak torque at speeds of 60°/s and 180°/s was as follows: NT < PT < KT. The main finding was that KT improves the immediate peak torque of the shoulder external rotators directly after application. Despite not reaching statistical significance, the values still clearly showed a trend of minor improvements in peak torque when KT was applied (20.2 \pm 8.2 and 20.1 \pm 9.1 at 60°/s and 180°/s, respectively) compared to NT and PT conditions. As we know in the real world of sports, even

Table 4 Descriptive statistics of participants (external and internal rotation range of motion).

	NTREXT	KTREXT	PTREXT	NTRINT	KTRINT	PTRINT
Mean \pm SD	86.2 \pm 7.8	85.9 \pm 7.5	85.3 \pm 7.8	79.7 \pm 7.2	78.9 \pm 7.5	78.0 \pm 7.2

KTREXT = Kinesio taping external rotation; KTRINT = Kinesio taping internal rotation; NTREXT = no taping external rotation; NTRINT = no taping internal rotation; PTREXT = placebo taping external rotation; PTRINT = placebo taping internal rotation; SD = standard deviation.

Table 5 Comparison of different taping conditions for variable—range of motion.

	NTREXT–KTREXT	NTREXT–PTREXT	KTREXT–PTREXT	NTRINT–KTRINT	NTRINT–PTRINT	KTRINT–PTRINT
<i>t</i> statistic	0.416	1.922	1.208	1.294	2.928*	2.865*
<i>p</i>	0.680	0.064	0.236	0.205	0.006*	0.007*

* Statistically significant.

KTREXT = Kinesio taping external rotation; KTRINT = Kinesio taping internal rotation; NTREXT = no taping external rotation; NTRINT = no taping internal rotation; PTREXT = placebo taping external rotation; PTRINT = placebo taping internal rotation.

differences of this magnitude can influence medal placing at a high-performance level. Therefore, a small improvement in peak torque after applying KT would be important for athletes especially in racquet sports to enhance their performance during backhand strokes and cocking. This fact would suggest that the application of KT may provide a meaningful improvement in performance in certain sports.

The effects of KT in our study were similar to those reported by a number of other researchers. Such findings echoed the study conducted by Hsu et al [7], who noted positive effects on both muscle activity and motion performance of scapular after KT. Similar findings were demonstrated by Wong et al [28], in that KT was able to improve the mean peak torque of quadriceps with small mean differences (although not statistically significant) in healthy individuals. This phenomenon could be explained by a physiological mechanism.

The main effect of KT is attributed to applying the tape with tension, as was done for the KT application method in this study. This provides a pulling force, which causes a change in stretch load, pressure, and shear force, triggering the mechanoreceptors in the subdermal soft tissue and fascia. The central nervous system integrates the sensory input and modulates gamma-motor firing, which in turn leads to increased muscle tone. Slupik et al [29] speculated that a reflex effect on the nervous system may have been responsible for the increase in peak torque. They proposed that a greater number of motor units are stimulated during a maximal contraction or that higher tone is generated by a single motor unit, or a combination of both of these factors. Another explanation could be that an increase in the stability of the body or extremities, support or protection of the joint, the correction of the alignment of the body or limbs, the modification of the biomechanics of movements and the promotion of sensorimotor functions such as proprioception influence, and insignificant sensory input inhibition might be factors that have contributed to the effects of elastic taping [25].

However, we also noted that there was mean difference in peak torque production after the application of PT. The opinion given by Slupik et al [29]—that strapping has a facilitating effect on cutaneous mechanoreceptors with subsequent reflex motor stimulation—might be a possible mechanism that could explain why there was a mean difference in peak torque after PT application [29].

Fu et al [10] explained that KT probably was not able to enhance muscle strength in healthy individuals. In order to enhance muscle strength, a period of specific overload training would be required to promote neural activation and muscle fibre regeneration. The tactile input generated by KT might not be strong enough to alter the instantaneous muscle force output. This might be a possible reason why the immediate peak torque differences were so small.

Another factor to consider is that the duration of muscle taping may not be enough to produce greater muscle strength. Slupik et al [29] pointed out that the participation of a muscle's motor units increased maximally after 24 hours of KT, which defined the minor immediate peak torque changes observed in our study.

The peak torque after the application of KT followed the torque–velocity relationship of the muscle and showed that the increase in speed of movement resulted in decreased peak torque production.

ROM

The results showed that shoulder internal rotation ROM after PT showed a statistically significant ($t > 1.96$, $p < 0.016$) difference when compared to KT and NT. However, external rotation ROM was not statistically significant among the three different taping conditions. The ascending order of mean shoulder external and internal ROM was $PT < KT < NT$.

The main finding was that KT did not significantly affect shoulder external and internal rotation immediately after application, although there was a mean difference in ROM after KT application. One possible contributing factor could be the stabilisation of the scapula that may decrease the ROM arc available. KT is theorised to increase the ROM by increasing the interstitial space; yet, in the shoulder, a scapula stabilisation effect of KT may have contributed to a short-lived ROM arc decrease observed directly after the application of KT. Stabilisation of the scapula may decrease the ROM arc available; however, this was normalised among all participants [2,25,30]. Another factor that could be considered is that KT application may contribute to increased strength/activation of muscles [25]. KT could have positioned the scapula posteriorly in relation to the normal position, and as a result, proper positioning of the scapula increased the activation of the shoulder stabiliser muscles, thereby decreasing shoulder internal rotation ROM [1,3,6]. Thus, when applied in the current study, KT over the infraspinatus and teres minor may have caused increased muscle activation impeding the ROM arc.

Overall, KT only produced slight changes in ROM arc, but it was not statistically or practically significant in order to substantiate an effect caused by KT application. In previous studies, increased ROM with KT was presented in the lower trunk and neck [31], which may indicate that the effects of KT on ROM may be joint specific. Another study [31] examined the changes in ROM of the trunk flexors, extensors, and lateral flexors when KT is applied to the lumbar region in 30 healthy individuals. Yoshida and Kahanov [31] found that trunk flexion improved by an average of 17.8 cm. No other ROM indicators were significant. The complex ROM system of the shoulder may impact the effects of KT and therefore should be assessed not only on an individual basis but by joint. Given that the shoulder has more mobility, KT may not be able to replicate the movement as effectively as in previous studies.

Internal rotation ROM was significantly decreased when measured after PT application as compared to KT and NT conditions. One possible contributing factor could be that the placebo tape acted as a rigid tape (applied with no tension); hence, the decrease in ROM is greater compared to that of KT (i.e., elastic tape and NT). As a rigid tape, more stabilisation of the scapula that may decrease the ROM is available.

Limitations of the study

The results of this study cannot be generally applied to the population at large owing to the limitations of age and health criteria of our participants. The outcome of the study may have been affected by the outdoor testing environment; the testing took place in well-equipped, shielded rooms that protect the participants from cold weather. The maximum temperature reported according to the weather forecast for the 1st week of testing was an average of 17°C and an average of 26°C in the last week of testing. This temperature variation may account for the differences in peak torque values between participants after KT application.

The application technique of KT and skin irritation caused by KT may be a limitation of the current investigation. Patients respond differently to the application of KT. The small sample size is another factor that can also affect the outcome.

Future research

The effect of KT also needs to be tested after injury, as the use of KT, in addition to other modalities, may be effective in rehabilitating overuse injuries in sports. Future studies that monitor the long-term effects in a multistaged manner are also recommended. A continued investigation of sex differences associated with KT tape applications is required to contribute to an understanding of differing peak torque and ROM arc changes. Differing taping techniques may also need assessment to determine if significant peak torque and ROM arc differences on the shoulder are produced.

Conclusion

As shown from the results of this study, there are no differences in muscle strength as well as external/internal rotation ROM induced by KT, when compared with PT and NT.

Conflicts of interest

The authors declare that they have no financial affiliations (including research funding) or involvement with any commercial organization that has a direct financial interest in any matter described in this manuscript. The authors have no other financial or nonfinancial conflicts of interest related to any matter in this study.

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Disclaimer

The opinions or assertions herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of Rehabilitation, Jamia Hamdard, New Delhi, India.

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