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The effects of kinesiotape on athletic-based performance outcomes in healthy, active individuals: a literature synthesis

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Context: *The effect of the application of kinesiotape to skin overlying musculature on measurable athletic-based performance outcomes in healthy individuals has not been well established.*

Objective: *To systematically search and assess the quality of the literature on the effect of kinesiotape on athletic-based performance outcomes in healthy, active individuals.*

Methods: *An electronic search strategy was conducted in MANTIS, Cochrane Library and EBSCO databases. Retrieved articles that met the eligibility criteria were rated for methodological quality by using an adaption of the critical appraisal criteria in Clinical Epidemiology by Sackett et al.*

Results: *Ten articles met the inclusion criteria. Seven articles had positive results in at least one athletic-based performance measure compared to controls.*

Conclusion: *Evidence is lacking to support the use of kinesiotape as a successful measure for improving athletic-based performance outcomes in healthy*

Contexte : *l'effet de l'application du Kinesiotape à la peau recouvrant la musculature sur les résultats des performances athlétiques mesurables chez les personnes saines n'a pas été bien établi.*

Objectif : *rechercher et évaluer systématiquement la qualité de la documentation sur l'effet du Kinesiotape sur les résultats des performances athlétiques chez des personnes saines et actives.*

Méthodologie : *une stratégie de recherche électronique a été mise au point pour les bases de données de MANTIS, Cochrane Library et EBSCO. Les documents extraits qui répondaient aux critères d'admissibilité ont été évalués pour leur qualité méthodologique à l'aide d'une adaptation des critères d'évaluation critique dans l'ouvrage Clinical Epidemiology par Sackett et autres.*

Résultats : *dix articles ont satisfait aux critères d'inclusion. Sept articles ont donné des résultats positifs dans au moins une mesure de performance athlétique par rapport aux groupes de contrôle.*

Conclusion : *on manque de données pour appuyer l'utilisation du Kinesiotape comme une mesure efficace pour améliorer les résultats de la performance athlétique*

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individuals. However, there is no evidence to show that kinesiotape has a negative effect on any of the performace measures.

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KEY WORDS: kinesiotape, performance, athlete

chez les personnes saines. Néanmoins, il n'existe aucune preuve pour montrer que le Kinesiotape a un effet négatif sur l'une des mesures de performance.

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MOTS CLÉS : Kinesiotape, performance, athlète

Introduction

Therapeutic taping protocols have demonstrated a well-established presence in the sporting world for years. The three main taping techniques accepted in North America are athletic taping, McConnell taping technique, and Kinesio Taping® technique.[1] It has been theorized that taping may prevent acute injury acquisition by enhancing proprioception via cutaneous afferent stimulation of the skin.[2] Kinesio Taping® technique, employing the newest form of elastic tape developed in the 1970s by Dr. Kenzo Kase, is customarily used for the treatment of sports injuries primarily by orthopedists, chiropractors, acupuncturists, and other medical practitioners.[3,4]

Today, Kase's product is marketed by various companies under brand names such as Spider Tech™, Kinesio® Tape, Kinesio® Tex Tape, Gold Tech™, KT Tape®, PerformTex™ and RockTape®, commonly known as kinesiotape (KT). After garnering international television exposure at the 2008 Beijing Olympic Games, KT has recently gained mainstream recognition for use on a number of conditions by therapists and patients of all backgrounds.[3] Over 150 thousand medical practitioners worldwide utilize KT in their practice.[5]

Kase describes KT as differing from traditional white athletic tape through its wave-like grain, elastic adhesive material, ability to stretch to 20-40% of its original length, and mimicking the thickness of human skin. When applied to the skin, KT is said to lift the fascia and soft tissue to produce additional space below the area of application.[6] Using the methods outlined by Kase et al.[6], the following advantageous effects are proposed to occur: (i) increasing proprioception by providing constant cutaneous afferent stimulation through the skin, (ii) realigning fascial tissue function by normalizing muscle tension, (iii) creating more space for improving circulation of blood and lymph flow by eliminating extra fluid, edema, or bleeding beneath the skin, (iv) correcting muscle function by strengthening muscle weakness, and (v) decreasing pain through neurological suppression. It has also been stated that KT can be used in the treatment and rehabilitation of injuries or as a preventative measure; it is designed to assist the body's natural healing process, provide support and stability to muscles and joints without limiting range of motion, and to extend the benefits of manual therapy by providing extended soft tissue manipulation.[7]

Despite its recent gain in popularity and the proposed theories of effectiveness, there remains a lack of sufficient evidence supporting these claims and current literature is limited in its ability to draw discernible conclusions. At this time, there is no known systematic literature review commenting on the effects of KT on athletic performance outcomes in healthy individuals. KT has the potential to be a valuable clinical intervention due to the fact that it is highly accessible, simple to apply, and not very restrictive. Therefore, it is important to evaluate the proposed theories to determine their efficacy. The aim of this literature synthesis is to assess the effects of KT on athletic-based performance outcomes in healthy, active individuals.

Methods

Search Strategy

A literature search was conducted using MANTIS, Cochrane Library and the following data bases, through EBSCO publishing: MEDLINE, CINAHL, SportDISCUS, Index to Chiropractic Literature, Alt Health Watch, AMED, Nursing and Allied Health Collection, Psychology and Behavioural Sciences Collection, Rehabilitation & Sports Medicine Source. Only peer reviewed English language articles from January 2000 through to October

2011, purporting to contain information on the subject of the effects of kinesiotape on measurable athletic performance outcomes were selected for review. The selection criteria for incorporated articles consisted of literature reviews, randomized controlled studies, cohort studies and cross-sectional studies to ensure all relevant information was obtained. A series of searches were performed using the following MeSH terms: kinesiotape, kinesiotaping, kinesio tape and kinesio taping and similar terms in CINAHL and SportDISCUS. These terms were combined with text words to capture, for completion: athletic tape, endurance, strength and performance, which were not MeSH terms. Using the AND Boolean operator, a combination of MeSH terms with text words was conducted. Reference list examination was conducted to further identify potential relevant articles that may not have been included in the initial electronic search.

Table 1:
Review of Eligibility Criteria

Inclusion Criteria	Exclusion Criteria
Literature reviews, randomized controlled trials, cohort studies and cross-sectional studies	Case-control studies, case studies, and personal narratives
Published in peer-reviewed journal	Published in a non-peer reviewed journal
Published in the English language	Not published in the English language
Human subjects	Animal subjects
Published between January 2000 and October 2011	Published before January 2000
Intervention group provided with Kinesiotape	Intervention group did not use Kinesiotape
Control group that did not use Kinesiotape	No control group
Healthy subjects	Unhealthy subjects
Performance-based outcomes	Non athletic-based outcomes

Screening of Citations

The three authors independently evaluated the results from the electronic search. The titles and abstracts found in the electronic search were examined to determine which articles met the basic criteria to be included in the review. All of the obtained full text manuscripts were evaluated using the inclusion criteria indicated in Table 1. Interventions included the use of KT compared to a control group without KT. Studies must have contained information on the subject of the effects of KT on measurable athletic performance in healthy individuals only. These criteria were applied to all of the obtained manuscripts. Upon completion of the independent reviews, the authors compared their results and if disagreement between reviewers was identified, it was resolved by consensus.

Data Collection Process

The researchers collectively chose a total of 10 articles that met the inclusion criteria which were further evaluated based on the presence of 10 specific criteria. The criteria utilized to appraise each article were chosen collectively as a group among the researchers. However, to ensure that the appraisal scores were highly accurate depictions of each article's study design and protocol, each researcher independently evaluated the articles without collaboration. The 10 criteria chosen in order to critically appraise each article reflected the study's protocols and methods by evaluating specific details of the study's use of randomization and blinding procedures, interventions, sources of error and specific outcomes.

Firstly, details of the population used in the study were evaluated, including the procedures used in the assignment of subjects, the baseline characteristics of the subjects used in the study and the utilization of prognostic stratification, which reflected the study's ability to limit bias through the use of randomization. Secondly, the study method protocol was critically examined including the use of blinding procedures, the compliance to study methods, the costs and resources required for the study, the explanation of follow up procedures used in the study and the identification of sources of error, contamination or co-intervention in the study. Lastly, the outcomes of the research study were evaluated including the ability of the author to document the statistical and clinical significance of the outcomes derived from the study, as well as their relevance. Pooling of statistics was not completed for the included studies. The critical appraisal scores that were derived for each article were therefore based on the presence of 10 appraisal criteria, are highly accurate depictions of each article's design and protocol, and complete the data collection process utilized in the literature synthesis.

Table 2:
Critical Appraisal Criteria

1.	Was the assignment of subjects randomized?
2.	Were baseline characteristics of subjects similar between groups to limit bias?
3.	Was prognostic stratification used?
4.	Was an appropriate blinding protocol followed?
5.	Is the study method protocol realistically feasible?
6.	Was compliance to study methods at least 80% or otherwise adequately explained?
7.	Were follow-up procedures adequately explained?
8.	Were sources of error, contamination or co-intervention identified?
9.	Was statistical significance given for all outcomes?
10.	Was relevance of clinical outcomes and their clinical significance given?

Quality of the Studies

Using an adaption of the critical appraisal criteria in Clinical Epidemiology by Sackett et al.[8] found in Table 2, the authors independently evaluated the methodological quality of the 10 studies that met the eligibility conditions. The appraisal criteria used for this review consisted of 10 questions scoring either 2 for acceptable or 1 for lacking, which resulted in a total out of 20. A score of 10-12 was considered of poor methodological quality; 13-15 of moderate quality; 16-18 of high quality; and 19-20 was considered to be of superior methodological quality. Scores from the methodological appraisal can be found in Table 4.

Results

A total of 10 articles were found and included in this literature synthesis.[9-18] The search of EBSCO databases in MEDLINE, CINAHL, SportDISCUS, Index to Chiropractic Literature, Alt Health Watch, AMED, Nursing and Allied Health Collection, Psychology and Behavioural Sciences Collection and Rehabilitation & Sports Medicine Source, using all MeSH terms with limiters resulted in 140 articles in total. Adding all the MeSH terms and search terms combined with limiters produced 22 articles. Upon reviewing the titles and abstracts of these articles, 12 were discarded because they did not meet the inclusion criteria for this review. The principle reason for discarding these articles was due to the inclusion of non-healthy subjects. No additional studies were identified after conducting a reference check of the included articles. The 10 selected articles were then read in full. [9-18] All were found to meet the inclusion criteria and were included in this review. No unpublished preliminary studies were included. For a summary of the results for each of the 10 articles see Table 3.

Methodological Quality

The quality score assigned to each of the 10 studies included in this review is provided in Table 4. In order to systematically evaluate the methodological quality of each study and to aid in developing an objective measurement of the results of the appraisal, an adaptation of the critical appraisal criteria in Clinical Epidemiology by Sackett et al.[8] was applied. The majority of studies (n= 8) included in this review were of high methodological quality.[9,11-13,15-18] None of the studies were considered to be of poor or superior methodological quality. Two studies, namely the study completed by Stupik et al.[14] and Soylu et al.[10], were

of moderate methodological quality and were graded the lowest score consistently among the reviewers. Each study utilized in this review was lacking at least three of the critical appraisal criteria outlined in Table 2. Therefore, the highest score awarded was 17/20, which was achieved by Fu et al.[11], Chang et al.[12] and Yoshida et al.[16]

Three of the 10 appraisal criteria, specifically method protocol, compliance and clinical significance, were utilized in all 10 studies. Firstly, every study demonstrated a study method protocol that was considered to be realistically feasible. The requirements necessary to complete the study procedure were clearly outlined in each paper. Additionally, the data collection methods, which were implemented by the researchers, were outlined sufficiently so that the study could be repeated similarly. Secondly, all of the studies had at least 80% compliance or adequately

Table 3:
Results Summary Table

Author(s)	Population	Subjects and Intervention	Outcome Measures	Results
Lee et al., 2011 16/20	Healthy employees of Jinju Seran Hospital free of neurological problems	17 subjects (9 males, 8 females); single group	Measured Orthodromic conduction (bipolar percutaneous stimulator, EP/EMS system; 1ms pulse duration; 20mA to ulnar and median nerves, 30mA to radial nerve) KT applied to volar side of dominant forearm	No statistically significant difference in nerve conduction velocity, latency and amplitude of median, ulnar or radial nerves before and after KT application
Soylu et al., 2011 15/20	Healthy right hand-dominant adults free of masseter, chewing and dental problems	11 subjects (7 males, 4 females); single group	Measured MVCs of sEMG; Ag/AgCl electrodes placed along right and left masseter muscles with 2mm gap (10-500Hz, 5000Hz, 5KΩ, 120 dB) KT applied posterior to TMJ with no tension to mouth and along jaw line to TMJ with 0-15% tension	No statistically significant differences in any measured parameters before and after KT applications
Fu et al., 2008 17/20	Healthy kickboxing athletes from National College of Physical Education and Sports free of active knee pain, lower limb trauma in prior 3 months or history of lower limb surgery	14 subjects (7 males, 7 females); single group, three conditions, order randomly assigned: 1. Without tape 2. immediately after tape application 3. 12h after taping with tape still in situ	Measured MVC concentric and eccentric of quadriceps and hamstring at 60°/s and 180°/s (Cybex NORM isokinetic dynamometer) Y-shaped KT applied to dominant quadriceps with circle around patella	Lowest peak torque in concentric contraction of quadriceps at 180°/s without tape; No significant differences among subjects in other assessments; No significant interaction effect between conditions and assessments
Chang et al., 2010 17/20	Healthy male collegiate athletes from Chung Shan Medical University and National Chang hua University of Education free of elbow, wrist or forearm problems	21 subjects, single group, three conditions, order randomly assigned: 1. Without tape 2. Placebo tape 3. Kinesiotape	Measured MVC of grip (JAMAR Hydraulic Hand Dynamometer) KT Y-strip applied along common wrist flexors with 15-20% tension Placebo tape applied across belly of common wrist flexors 5cm inferior to medial epicondyle with 15-20% tension	No statistically significant differences in grip strength; Statistically significant differences found in absolute and related force sense errors with KT having the smallest errors and absolute force sense errors measurement
Vithoulka et al., 2010 16/20	Healthy, inactive female adults free of knee pain or other musculo-skeletal discomfort	20 subjects, single group, three conditions, order randomly assigned: 1. No taping 2. Placebo tape 3. Kinesiotape	Measured peak muscle torque of dominant knee extensors (Con-Trex MJ Zurich isokinetic dynamometer) at 60 and 240°/s concentric and 60°/s eccentric KT applied to rectus femoris, vastus medialis and vastus lateralis in direction of muscle bellies Placebo tape applied in two strips transverse to quadriceps muscle group at 5cm proximal and distal to middle of femur	Statistically significant increases found with KT application compared to other two taping modes in peak eccentric torque at 60°/s and during both concentric and eccentric mode of quadriceps; No statistically significant differences in peak concentric torque between taping conditions at 60 and 240°/s
Slupik et al., 2007 14/20	Healthy adults free of present or prior knee problems	36 subjects with kinesiotape applied to medial head of dominant quadriceps; 27 (12 females, 15 males) randomly assigned to protocol 1, 9 (5 females, 4 males) randomly assigned to protocol 2	Measured peak torque (Neuro Trac® Simplex transdermal EMG) with active electrodes applied according to SENIAM standards; protocol 1 measured before tape placement, after 10 minutes, 24, 72 and 96 hours; protocol 2 measured before KT placement and after 24 hours, then again 48 hours after removal of tape	Protocol 1 demonstrated statistically significant increases in bio-electric activity and motor unit recruitment after 24 and 72 hours only; Protocol 2 revealed statistically significant increases in peak torque both after 24 hours of KT and after another 48 hours following KT removal; No statistically significant differences at other time intervals

Table 3 continues on next page

explained and provided valid reasoning as to why full compliance was not achieved. Monitoring protocol compliance is essential in order to establish the validity of the study. Lastly, the relevance of clinical outcomes and their clinical significance was provided by all 10 studies. This is necessary in order to continuously improve care in a clinical setting, as well as to guide further research related to the results of the particular study.

Conversely, one of the 10 appraisal criteria was not incorporated into any of the studies. Follow-up procedures were either not adequately explained or not utilized entirely in all 10 studies. Half of the studies (n=5) did not use adequate randomization protocols[9,10,14,15,17] and therefore, the study results did not adequately represent the entire population and ultimately could not be applied to the general population. Randomization procedures are neces-

Table 3:
Results Summary Table (continued)

Author(s)	Population	Subjects and Intervention	Outcome Measures	Results
Aktas et al., 2011 16/20	Healthy, active university students free of lower limb pathology in past 12 months and no history of ankle sprain	20 subjects (11 females, 9 males), single group, four conditions, order randomly assigned: 1. control 2. bracing 3. Kinesiotape 4. KT plus brace	Measured peak torque/weight, angular velocity (Isomed 2000 isokinetic dynamometer) at 60 and 180°/s, vertical jump and one leg hop distance KT applied using quadriceps muscle and patellar mechanical correction techniques Brace used was DonJoy tru pull advance system, worn unilaterally in testing	Statistically significant increases found in one leg hop test: between control and KT in dominant leg for males and non-dominant for females; between males and females for KT and KT plus brace; Statistically significant increases found in normalized peak torque: between control and KT, and brace and KT in males and females at 180°/s; between males and females in control and KT results at 180°/s; KT more effective than brace and KT plus brace; No statistically significant differences in vertical jump or peak torque at 60°/s
Yoshida et al., 2007 17/20	Healthy adults free of lower trunk injury or pain in 6 months prior	30 subjects (15 females, 15 males), single group, two conditions conducted in sequence: 1. No tape 2. Kinesiotape	Measured trunk ranges of motion (flexion, extension and lateral flexion) with tape measure KT Y-strip applied along lower trunk from center of sacrum without stretching to mid thoracic spine	Statistically significant increase found in trunk flexion between control and KT application; No statistically significant differences in trunk extension or lateral flexion
Huang et al., 2011 16/20	Healthy, inactive adults free of history of spinal or lower limb pathology, fracture and impairment	31 subjects (19 males, 12 females), single group, three conditions, second two conducted randomly after baseline: 1. No tape 2. Kinesiotape 3. Micropore non-elastic tape	Measured jump height (Motion Analysis Corp. video-based motion analysis system), vertical ground reaction force (Kistler force platform) and EMG activity of medial gastrocnemius, tibialis anterior and soleus muscles (Motion Control MA-300 EMG system with Ag-AgCl electrodes) KT Y-strip applied to calf muscles using KT protocol Micropore tape applied to mimic KT	Statistically significant increases found in VGRF and EMG activity of medial gastrocnemius with KT applied; Statistically significant decrease in jump height with Micropore tape applied; No statistically significant differences in other protocols
Lee et al., 2010 16/20	Healthy adults free of upper limb range of motion limitations or orthopedic problems	40 subjects (20 males, 20 females), single group, three conditions, order randomly assigned: 1. No tape, head-neck neutral 2. No tape with head-neck rotation toward non-dominant hand 3. Kinesiotape, head-neck neutral	Measured dominant hand grip strength (Jamer Hydraulic Hand Dynamometer) with forearm in supination KT applied along full length of forearm flexor group with 15-25% stretch	Statistically significant increases found in grip strength for males and females with KT over no tape and head-neck rotation position; No statistically significant difference between no tape and head-neck rotation position

Table 4:
Methodological Quality Appraisal Results

No.	Item Description	Lee et al.[9]	Soylu et al.[10]	Fu et al.[11]	Chang et al.[12]	Vithoulka et al.[13]	Slupik et al.[14]	Aktas et al.[15]	Yoshida et al.[16]	Huang et al.[17]	Lee et al.[18]
1	Randomized	1	1	2	2	2	1	1	2	1	2
2	Baseline Characteristics	2	2	2	2	2	1	2	2	2	2
3	Prognostic Stratification	1	1	1	1	1	1	1	1	1	2
4	Blinding	1	1	1	1	1	1	1	1	2	1
5	Method Protocol	2	2	2	2	2	2	2	2	2	2
6	Compliance	2	2	2	2	2	2	2	2	2	2
7	Follow-up	1	1	1	1	1	1	1	1	1	1
8	Sources of Error	2	2	2	2	1	1	2	2	1	1
9	Statistical Significance	2	1	2	2	2	2	2	2	2	1
10	Clinical Significance	2	2	2	2	2	2	2	2	2	2
	Total Score	16/20	15/20	17/20	17/20	16/20	14/20	16/20	17/20	16/20	16/20

sary in order to eliminate a selection bias. Each study ensured that baseline characteristics of subjects were similar between groups to limit bias, except for the research completed by Stupik et al.[14] The two groups used in this study differed in the average age of group members, the total number of group members and the percentage of females versus males within each group. The majority of studies (n=9) failed to adequately report or incorporate blinding procedures into their study protocol,[9-16,18] except for the research completed by Huang, et al.[17] In this study, the test sequence was randomly processed for each subject in order to avoid potential bias. The majority of studies (n=6) successfully identified the potential sources of error in the discussion portion of their paper.[9-12,15,16] Lastly, most of the studies (n=8) reviewed provided statistical significance for all outcomes.[9,11-17] Only two studies, namely those completely by Soylu et al.[10] and Lee et al.[18], failed to accurately reveal this appraisal criteria.

Participants

The sample sizes in the 10 studies ranged from 11 to 40. All of the studies had an average age range of 20.86 to 34.35 years old.[9-18] Eight of the studies mentioned average height and weight with respective ranges of 167.06 to 181.24 cm and 56.94 to 72.86 kg.[9-13,15,17,18] One study measured BMI in subjects and excluded individuals with BMI > 25 from participation.[15] Two studies utilized subjects of only one sex.[12,13] Two of the studies used collegiate athletes[11,12] and two other studies specified that subjects were previously inactive[13,17]. All of the studies used healthy volunteers with no current pain or injury.[9-18]

Primary Outcome

In all the articles examined, the primary health outcome measured was always athletic based performance. In many of the experimental studies, the primary aim of the study was to improve maximum voluntary contraction.[10-12] All 10 of the studies looked at different methods of measuring athletic based performance including MVC[10-12], grip strength[18], peak muscle torque[13-15], muscle bioelectrical activity[14], range of motion[15], vertical ground reaction force[17], and Orthodromic conduction[9]. This lack of homogeneity amongst outcome measures in the studies prevented the ability to pool statistical data. The most common control intervention used within the studies was repeated measures within a single group, with and without KT (n=3).[9,10,16] Three studies involved a single group with three conditions, order randomly assigned.[11-13] One study had a single group with four conditions, order randomly assigned.[14] One study was a single group with three conditions, the second two conducted randomly after the controlled baseline.[17] Another study divided participants

into two protocol groups, both tested without KT initially. The first group was then tested at 10 minutes, 24 hours, 72 hours, and 96 hours after KT application. The second group was tested at 24 hours after KT application and 48 hours after removal of tape.[14] The final study was a single group with three conditions randomly assigned, two being without tape and one with KT.[18]

The timing of the testing varied between all 10 studies in this review. The timing of testing ranged from immediately after the application of KT to 96 hours after the application. The results show that KT has beneficial effects on athletic performance up to 72 hours after application.[14] The number of variables tested in each individual ranged from one to four different conditions. The location of KT application varied between studies and included the forearm muscles[9,12,18], masseter muscles[10], quadriceps and hamstring muscles[11-15], lumbar erector muscles[16], and gastrocnemius, soleus, and tibialis anterior muscles[17]. Four of the intervention studies showed no statistically significant differences in any measured parameters before and after KT applications.[9-12] Five studies found immediate statistically significant increases in grip strength, vertical ground reaction force, EMG activity, range of motion, and peak torque with KT over no tape when measurements were taken between 0 and 45 minutes following tape application.[13,15-18] Lee et al.[18] showed an increase in dominant hand grip strength for males and females with KT applied to the flexor muscles over no tape. Huang et al.[17] showed increases found in vertical ground reaction force and EMG activity of medial gastrocnemius with KT applied and a statistically significant decrease in jump height with the non-elastic tape applied, after 30 minutes of tape application. Yoshida et al.[16] found an increase in trunk flexion between control and KT application, when measured immediately following tape application. Aktas et al.[15] found increases in the single-leg hop test and in normalized peak torque between control and KT, with KT being more effective than the brace and KT plus brace groups, when testing was completed 45 minutes after tape application. Vithoulka et al.[13] showed increases with KT application to the rectus femoris, vastus lateralis and vastus medialis over placebo and no tape methods in peak eccentric torque at 60°/s and during both the concentric and eccentric mode of quadriceps contraction. None of the previous studies included follow up to assess the sustained effects of KT application. One study, by Slupik et al.[14] evaluated the longer term results of KT application and found increases in bio-electric activity and motor unit recruitment of the vastuss medialis after 24 and 72 hours of KT application, and at 48 hours following KT removal, with no improvement found 96 hours after removal.

Discussion

The evidence is not adequately strong to determine the effectiveness of KT on improving athletic-based performance outcome measures in healthy individuals. Merely six studies showed positive results of KT as an effective method for improving some measures of athletic-based performance.[13-18] This review demonstrates that there is scant evidence that KT application immediately improves grip strength, vertical ground reaction force, gastrocnemius EMG activity, trunk flexion, single-leg hop test and peak torque within 0 to 45 minutes of application.[13,15-18] As well, it was shown that bio-electric activity and motor unit recruitment in the vastus medialis was increased after 24 and 72 hours of KT application and after 48 hours following removal of the KT only.[14] There are numerous studies assessing the effectiveness of using KT as a treatment for a variety of injuries and disorders; however, only 10 studies[9-18] evaluating its effect on performance in healthy individuals were identified. Evidence to suggest that KT should be used as a method for improving athletic-based performance is lacking. Consequently, chiropractors and other healthcare practitioners should proceed with caution when considering the use of KT as a method for improving athletic-based performance measures.

Limited conclusions can be made on recommendations for appropriate instructions, location and duration of KT application due to variation in age, sex, tape application protocols and duration of application of tape. In addition, the wide variety of athletic-based performance measures assessed in each study and the dearth of sufficient intervention sizes makes it difficult to draw definite conclusions as to whether or not KT affects athletic-based performance measures in healthy persons.

This review has potential limitations including the limitations of the original literature, such as the inherent bias that may have been present in these studies. The language bias in this review is another possible limitation as we included articles published in the English language alone. It may stand to reason an additional flaw of this review was the inclusion criteria. The search timeline expanded

back only as far as the year 2000, which could have excluded studies that may have had an impact on the results of this review. The inclusion of cohort and cross-sectional studies and not limiting the studies to RCTs could have limited the quality of the results found in this review. However, a thorough search strategy was conducted using multiple electronic databases with hand reference searching of the obtained articles, thus actions were taken to assess the current state of the literature. The lack of pooled statistics may have also limited the quality and strength of our results. Furthermore, this review focused entirely on athletic-based performance outcomes, limiting the clinical application of these results to the general population.

The principle limitation amid the included studies was the lack of homogeneity of the methodological designs and outcome measures resulting in inconclusive findings regarding appropriate instructions, location and duration of KT application to affect athletic performance. Additional limitations present in the articles of this review include small study sizes, inadequately described follow-up procedures, lack of blinding protocols, failure to describe the experience level of those applying the KT, failure to address the possible placebo effect of KT and lack of control groups. There were only ten studies identified in total which involved entirely healthy subjects, which also limited the conclusiveness of results found in this review.

There are currently no literature reviews assessing the effects of KT on athletic-based performance measures in healthy individuals. Future research in this area should focus on higher quality RCTs involving larger study sizes, appropriate blinding procedures and extended follow-up protocol. More consistent use of outcome measures should also be included in future research to enable comparison and pooling of data. Additionally, research focused on confirming the mechanism of the function of KT, assessing the potential placebo effect of KT, assessing the importance of application experience on various outcome measures, determining the rates at which chiropractors apply or recommend kinesiotaping techniques as a means of improving athletic performance and the effects produced with KT use in combination with other treatment protocols should be conducted.

Conventionally, KT has been used in the treatment of athletic injury or to limit pain in athletes and is used as a substitute for the traditional white athletic tape. The evidence is lacking to support the use of KT in improving athletic-based performance outcomes in healthy subjects; however, there was no evidence KT had a negative effect on the measured outcomes. A more extensive review of the effect of KT on various athletic injuries would be beneficial, as its ease of use, its relatively low risk of minimal side effects and the non-detrimental impact it appears to have on athletic performance give KT the potential to be a viable treatment option. Chiropractors and other healthcare providers need to educate themselves, coaches and athletes on the possible benefits KT can have on athletic performance with caution since more research is required to establish concrete outcomes.

Conclusions

KT has quickly garnered popularity in the athletic population as it has gained more mainstream use since the 2008 Beijing Olympic Games. It has been suggested by its creator, Dr. Kenzo Kase, that KT has the following effects: (i) increasing proprioception by providing constant cutaneous afferent stimulation through the skin, (ii) realigning fascial tissue function by normalizing muscle tension, (iii) creating more space for improving circulation of blood and lymph flow by eliminating extra fluid, edema, or bleeding beneath the skin, (iv) correcting muscle function by strengthening muscle weakness, (v) decreasing pain through neurological suppression.

There is scant evidence to support kinesiotaping techniques as a successful means of affecting athletic-based performance outcomes such as improved strength, proprioception and range of motion, in healthy persons. Regardless of the heterogeneity of the study methods there is some evidence showing KT can improve certain athletic-based performance outcomes. Results from this literature review give pause to chiropractors and other healthcare practitioners looking to justify using KT for improving athletic performance in healthy athletes. Although it does not seem to further hinder athletic performance, additional research is needed before any conclusive statements can be made with regard to the recommended use of KT and its effects on athletic-based performance outcomes.

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