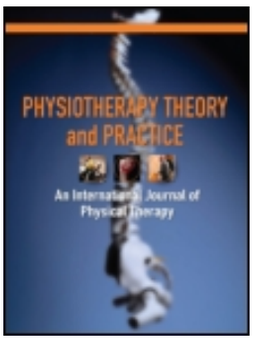

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SYSTEMATIC REVIEW

The clinical effects of Kinesio® Tex taping: A systematic review

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ABSTRACT

Kinesio® Tex tape (KTT) is used in a variety of clinical settings. The purpose of this study was to investigate the effect of KTT from randomized controlled trials (RCTs) in the management of clinical conditions. A systematic literature search of CINAHL; MEDLINE; OVID; AMED; SCIENCE DIRECT; PEDRO; www.internurse.com; SPORT DISCUS; BRITISH NURSING INDEX; www.kinesiotaping.co.uk; www.kinesiotaping.com; COCHRANE CENTRAL REGISTER OF CLINICAL TRIALS; and PROQUEST was performed up to April 2012. The risk of bias and quality of evidence grading was performed using the Cochrane collaboration methodology. Eight RCTs met the full inclusion/exclusion criteria. Six of these included patients with musculoskeletal conditions; one included patients with breast-cancer-related lymphedema; and one included stroke patients with muscle spasticity. Six studies included a sham or usual care tape/bandage group. There was limited to moderate evidence that KTT is no more clinically effective than sham or usual care tape/bandage. There was limited evidence from one moderate quality RCT that KTT in conjunction with physiotherapy was clinically beneficial for plantar fasciitis related pain in the short term; however, there are serious questions around the internal validity of this RCT. There currently exists insufficient evidence to support the use of KTT over other modalities in clinical practice.

INTRODUCTION

Taping is a commonly used intervention in the management of a number of clinical conditions such as patellofemoral pain and shoulder impingement syndrome (Callaghan, Selfe, Bagley, and Oldham, 2002; Copping and O'Driscoll, 2005). Taping is purported to: facilitate and inhibit muscle activity (Alexander et al, 2003); reposition joints (Zanella, Willey, Seibel, and Hughes, 2001); prevent injury (Kneeshaw, 2002); and improve proprioception (Callaghan, Selfe, Bagley, and Oldham, 2002; Kneeshaw, 2002). Despite conflicting evidence regarding its efficacy, taping continues to be a widely used therapeutic intervention (Alexander et al, 2003).

Kinesio® Tex tape (KTT) is a brand of kinesthetic tape commonly used in clinical practice, which purports to mimic the thickness and flexibility of the skin. KTT claims to aid the muscle and lymphatic systems and provide mechanical support without restricting movement in contrast with standard rigid taping techniques. According to the manufacturers of KTT, the tape causes micro convolutions, or folds, in the skin which causes a lifting of the skin away from the tissue beneath. This facilitates a release in pressure on tender tissues underneath and provides space for lymphatic fluid movement. It is claimed that this can help relieve pain, prevent over-contraction, facilitate lymphatic drainage, and improve joint position and kinesthetic awareness.[1] According to the manufactures, over 4,000 UK-based clinicians have been trained in this treatment method.[2]

The use of KTT has spread from the treatment of musculoskeletal conditions to a variety of clinical

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[1] Kinesion UK (http://www.kinesiotaping.co.uk/tapingmethod.jsp) (website accessed on 12.03.12).
[2] Kinesion UK (http://www.kinesiotaping.co.uk/history.jsp) (website accessed on 12.03.12).

settings including: the management of lymphedema (Hardy, 2006; Lawrence, 2009; Linnitt and Young, 2007) and neurological rehabilitation (Jaraczewska and Long, 2006). A number of case studies have provided early evidence supporting KTT use in a range of conditions and outcome measures such as: pain-free range of motion (ROM) in those with myofascial shoulder pain (Garcia-Muro, Rodriguez-Fernandez, and Herrero-de-Lucas, 2010) and pain in meralgia paresthetica patients (Kalichman, Vered, and Volchek, 2010). The results of all these reports suggest that KTT 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.

Bassett, Lingman, and Ellis (2010) carried out a high-quality systematic review investigating the effectiveness of KTT. The review included three randomized controlled trials (RCTs) and found little evidence to support the effectiveness of the intervention. However, the review was limited to musculoskeletal conditions omitting recent research on lymphedema and neurological conditions which are areas of current KTT clinical use. As such, there is a need for an up-to-date systematic review to investigate the effect of KTT in all populations where it is being used in order to guide clinical practice.

The aim of this study was to investigate the effects of KTT in the management of any clinical condition in relation to any relevant outcome measure including side-effects, compared to any non-KTT-based comparison.

METHODS

Inclusion and exclusion criteria

Only RCTs published before April 2012 were included in this review. Studies were discarded if the full research document was not published in the peer-reviewed scientific literature or if the study was not available in English. The quality of the RCT was used as additional inclusion/exclusion criteria. RCTs that met all the initial inclusion/exclusion criteria but were found to be of a low methodological quality (i.e., have a high risk of bias) were excluded from the final review. The inclusion of such studies can erroneously overestimate the effectiveness of an intervention when included in systematic reviews and meta-analysis (Moher, Pham, and Jones, 1998). Randomized crossover designs were not included as such studies are usually restricted to very short-term interventions and outcomes reducing their clinical relevance for investigating a treatment modality. Studies were also excluded if the participants were <18 years of age or if the study included animals. Studies on asymptomatic populations were also excluded.

Considering the broad scope of clinical conditions, which could have been included in this review, it was decided not to restrict the work to any specific outcome measures. Included in the assessment of outcomes were side-effects. Outcome measurement follow-up times were defined as either: short-term (~3 months); medium-term (~6 months); or long-term (≥12 months).

There are a variety of different kinesthetic tapes used in clinical practice that use various materials within the tape and recommend applying them in different ways. Grouping these tapes together and considering them as one form of intervention may not be appropriate. Thus, it was decided to focus specifically on KTT as this particular brand is used commonly within clinical practice and it is claimed that over 4,000 UK-based practitioners use this technique.[3]

If a study stated that it used a different brand of tape or a different application method, it was excluded.

Finally, any comparison group that did not include KTT was considered acceptable for this review. This included trials against sham tape or some other form of placebo intervention, waiting list controls, usual tape interventions, or non-tape interventions.

Search strategy

A total of 13 electronic databases were searched. These databases included: CINAHL; MEDLINE; OVID; AMED; SCIENCE DIRECT; PEDRO; BRITISH NURSING INDEX, PROQUEST; www.internurse.com; SPORT DISCUS; and COCHRANE CENTRAL REGISTER OF CLINICAL TRIALS. The Kinesio Kinesio® Taping Method and Kinesio® Tex Tape UK and International websites (www.kinesiotaping.co.uk; www.kinesiotaping.com) were also searched for additional relevant research not identified by the mainstream search engines.

The search terms used were: KINESIO; KINESIO TAPE; KINESIO TAPING; KINESIOTAPING; KINESIO-TAPING; KINESIO TEX; and KINESIO TEX TAPE. These keywords were identified during preliminary literature searches. The search terms were applied individually and then combined using the Boolean operators "or" and "and." The reference lists of the studies identified were hand searched to identify any further relevant research papers.

[3] http://www.kinesiotaping.co.uk/history.jsp (website accessed on 12.03.12).

The study titles of the articles identified were screened and for those that were deemed appropriate the abstract was obtained. For all abstracts, which appeared relevant, the full article was retrieved. At this point, any articles that did not meet the inclusion/exclusion criteria were discarded and the remaining articles were assessed for risk of bias. Those studies that were considered of poor methodological quality following risk of bias assessment (i.e., had a high risk of bias) were not included in the final review.

Methodological quality assessment

The methodological quality of individual trials was assessed using the Cochrane criteria checklist (Furlan, Pennick, Bombardier, and van Tulder, 2009). Studies that scored <6/12 were considered to be of poor methodological quality and have a high risk of bias. Such studies were excluded from any further analysis within the review. The quality assessment of each trial was further broken down into high, moderate, and low (Table 1). The overall quality of evidence for each body of evidence was assessed against an adapted version of the grading system of van Tulder, Furlan, Bombardier, and Bouter (2003) (Table 2). This review was aligned to the PRISMA statement for reporting systematic reviews that evaluate healthcare interventions (Liberati et al, 2009; Moher, Liberati, Tetzlaff, and Altman 2009).

Data abstraction

Two members of the team independently reviewed each selected article for risk of bias using the Cochrane criteria checklist. When agreement could not be made between the two reviewers on the quality of the trial, a third reviewer was used in accordance with Cochrane methodology (Furlan, Pennick, Bombardier, and van Tulder, 2009). The initial agreement between reviewers was good (k-statistic = 0.71, $p < 0.01$).

TABLE 1 The criteria for assessing the quality of individual trials.

High	>75% of the criteria have been fulfilled [≥10/12]. Where they have not been fulfilled the conclusions of the study or review are thought very unlikely to have been altered
Moderate	50–75% of the criteria have been fulfilled [6–9/12]. Those criteria that have not been fulfilled or not adequately described are thought unlikely to have altered the conclusions
Low	Less than 50% of the checklist criteria were fulfilled [<6/12]. The conclusions of the study are thought likely or very likely to alter had those criteria been fulfilled.

Note: This table is adapted from Clarke, Ryan, and Martin (2011).

TABLE 2 The levels of evidence grading system.

Strong	Consistent findings from multiple high-quality RCTs
Moderate	Consistent findings among multiple moderate quality RCTs and/or one high-quality RCT
Limited	One moderate quality RCT
Conflicting	Inconsistent findings among multiple RCTs
No evidence	No RCTs were identified

Notes: This table shows the 2003 Cochrane level of evidence grading system that was applied to each body of evidence. This table is adapted from van Tulder, Furlan, Bombardier, and Bouter (2003).

Data synthesis

Studies were combined using qualitative best evidence synthesis. Where the data from individual papers allowed, the differences between groups were presented as the mean difference and 95% confidence intervals.

RESULTS

Description of studies

The search process identified 716 documents. Eighty of the results were duplicate publications. Twenty-three were discarded because the participants were <18 years of age (n = 22) or animals (n = 1). Three hundred and nine studies were excluded because they did not use KTT in the method. Two hundred and fifteen studies were not RCT's and 62 papers were not available in English. The full text articles for the 27 remaining trials were obtained.

Of the full text articles that were obtained, 12 further studies were excluded as they were found not to be RCTs (note the full text was required to make this decision for these articles; Chang, Chou, Lin, and Wang, 2010; Chen, Hong, Huang, and Hsu, 2007; Firth et al, 2010; Fu et al, 2008; Halseth et al, 2004; Hsu et al, 2009; Kalichman, Vered, and Volchek, 2010; Onoda, 2002; Paoloni et al, 2011; Slupik, Dwornik, Bialoszewski, and Zych, 2007; Vithoulka et al, 2010; Yoshida and Leamor, 2007). One study was excluded as it did not investigate a symptomatic population (Soylu, Irmak, and Baltaci,

TABLE 3 The quality assessment of individual trials.

Methodological quality review of individual studies

	Internal validity													
	1	2	3	4	5	6	7	8	9	10	11	12	Score	Quality
Castro-Sanchez et al (2012)	+	+	+	−	+	+	+	+	+	+*	−*	+	10	High
Akbas, Atay, and Yuksel (2011)	+	−*	−	−	−	+	−*	+	+	+	−	+	6	Moderate
Kaya, Zinnuroghlu, and Tugeu (2011)	−	−	−	−	−	+	−*	+	+*	+	−	+	5	Low
Aytar et al (2011)	−	−	+	−	+	+	+	+	+	+	+	+	9	Moderate
Karadag-Saygi, Cubukcu-Aydoseli, Kablan, and Ofluoglu (2010)	−	−	+*	−	+	+	+	+	+	+	+	+	9	Moderate
Tsai, Chang, and Lee (2010)	+	+	−	−	+	−	+	+	−	+	−	+	7	Moderate
Tsai et al (2009)	+	+*	−	−	+	+	+	+*	+	+	+	+	10	High
Gonzalez-Iglesias et al (2009)	+*	+	+	−	+	+	+	+	+	+*	−*	+	10	High
Bialoszewski, Wozniak, and Zarek (2009)	−	−	−	−	−	−	+*	+	−*	+*	+	+	5	Low
Thelen, Dauber, and Stoneman (2008)	+	+	+	−*	+	+	+	+	+	+*	+*	+	11	High
Szczegielniak et al (2007)	−	−	−	−	−	+	+	−	−	+	−	+	4	Low

Notes: The studies adjudged to be of low quality were removed at this stage and not included in the final review.
1. Was the method of randomization adequate?
2. Was the treatment allocation concealed?
3. Was the patient blinded to the intervention?
4. Was the care provider blinded to the intervention?
5. Was the outcome assessor blinded to the intervention?
6. Was the dropout rate described and acceptable?
7. Were all randomized participants analyzed in the group to which they were allocated?
8. Are reports of the study free of suggestion of selective outcome reporting?
9. Were the groups similar at baseline regarding the most important prognostic indicators?
10. Were co-interventions avoided or similar?
11. Was the compliance acceptable in all groups?
12. Was the timing of the outcome assessment similar in all groups?

+, criterion achieved; –, criterion not achieved; *, assessors initially disagreed.

2011). Three further studies were excluded because they were only published as abstracts and not full peer-reviewed journal articles and so much of the necessary information to judge the quality of the study were not provided (De la Motte, Arnold, and Ros, 2010; Llana-Belloch et al, 2010; Yamamoto, 2011).

Eleven studies were assessed for the risk of bias (Table 3). Following the risk of bias assessment, three articles were excluded from any further analysis as they were deemed to be of low methodological quality (Bialoszewski, Wozniak, and Zarek, 2009; Kaya, Zinnuroghlu, and Tugeu, 2011; Szczegielniak et al, 2007).

Thus, eight studies were included in the final review (Table 4). The results of the selection process are shown in Figure 1. Six of these studies included patients with musculoskeletal conditions (Akbas, Ataya, and Yuksel, 2011; Aytar et al, 2011; Castro-Sanchez et al, 2012; Gonzalez-Iglesias et al, 2009; Thelen, Dauber, and Stoneman, 2008; Tsai, Chang, and Lee, 2010). One study looked at breast-cancer-related lymphedema (Tsai et al, 2009), while the remaining study looked at plantar flexor muscle spasticity in stroke patients (Karadag-Saygi, Cubukcu-Aydoseli, Kablan, and Ofluoglu, 2010).

Shoulder impingement syndrome

One high-quality RCT (11/12) compared the effects of KTT to sham KTT for pain, pain-free ROM, and function in shoulder pain patients diagnosed with impingement syndrome/rotator cuff tendonitis of <6 months duration (Thelen, Dauber, and Stoneman, 2008). An 11-point numerical rating scale (NRS) was used to assess the pain intensity at the point it limited active ROM. ROM was measured using a goniometer and function was measured using the Shoulder Pain and Disability Index (SPADI). For this review, clinical importance was defined as a change of 2 points on the pain scale (Farrar et al, 2001); a change of 15° in ROM (Thelen, Dauber, and Stoneman, 2008) and a change of 10 points (0–100 scale) on the SPADI (Williams, Holleman, and Simel, 1995).

Outcomes were assessed immediately, 3 and 6 days post-taping. Although immediately after taping the

TABLE 4 Description of the eight studies that were included in the final review.

Study	Participants	Intervention	Comparison	Length of follow-up	Outcome measure
Thelen, Dauber, and Stoneman (2008)	Shoulder impingement/rotator cuff tendonitis <6/12 duration KTT (n = 21); comparison (n = 21)	Standardized KTT application to shoulder protocol for rotator cuff tendonitis/impingement as outlined by Kase, Wallis, and Kase (2003). 2 applications, 48–72 hours	Sham KTT (2 strips, 1 over ACJ, one over deltoid insertion. No tension)	Day 1; Day 3; Day 6	ROM: pain-free active ROM Pain: 11-point NRS Function: SPADI
González-Iglesias et al (2009)	Neck pain post-MVA ≤40 days duration KTT (n = 20); comparison (n = 20)	KTT cervical spine. y-strip over cervical extensors, dorsal spine to upper cervical, "paper off" tension Horizontal "space tape" C3–C6	Sham KTT (single vertical strip, single horizontal strip. No tension)	24 hours	Pain: 11 point NRS ROM: active cervical ROM
Tsai, Chang, and Lee (2010)	Plantar fasciitis ≤10/12 duration KTT (n = 29); comparison (n = 28)	KT Y-tape to gastrocnemius, distal to proximal, 133% stretch. Plantar fascia, 4 strips, proximal to distal) and traditional physiotherapy programme	Traditional Physiotherapy Programme (ultrasound + TENS for 1 week)	1 week	Pain: components of the MPQ and FFI. Ultrasonography: plantar fascia thickness; structural change
Tsai et al (2009)	Unilateral breast-cancer-related lymphedema ≥3/12 duration KTT (n = 20); comparison (n = 21)	KTT and 4-week intervention DLT, PC, exercise	Short-stretch-bandage (usual care bandage) and 4-week intervention. DLT, PC, exercise	3 months	Oedema: volumetric measurement; circumference measurements. Water composition analysis. Lymphedema-related symptoms, e.g., side effects. Function: EORTC QLQ-C30 and QLQ-BR23
Karadag-Saygi, Cubukcu-Aydoseli, Kablan, and Ofluoglu (2010)	Post-stroke, plantar flexor muscle spasticity ≥6/12 duration KTT (n = 10); comparison (n = 10)	KTT [4 strips, 2 over muscle (tibialis anterior and gastrocnemius, with stretch, distal to proximal)] and BTX-A	Sham KTT (2 strips – *ineffective* part of the muscle) and BTX-A	2 weeks; 1 month; 3 months; 6 months	ROM: passive ROM Muscle tone: Modified Ashworth Scale). Gait parameters: step length, velocity
Akbas, Atay, and Yuksel (2011)	PFPS. Female 17–50; KTT (n = 15); comparison (n = 16)	KTT (5-day intervals 6/52) and muscle strengthening exercises and soft tissue stretches over 6/52	Muscle strengthening exercises and soft tissue stretches over 6/52	3 weeks (half way through treatment period); 6 weeks (immediately posttreatment)	Pain: VAS ROM: Patella position ITB/TFL length Popliteal angle Function: AKPS
Aytar et al (2011)	PFPS (>6/12); females 24.1 ± 3.2 years; KTT (n = 12); comparison (n = 10)	Y-shaped KTT over quadriceps	Sham tape: sticking plaster, no stretch, similar area covered as in experimental group	45 minutes after application	Pain: VAS Muscle strength: isokinetic dynamometer 60̊ and 180°/sec) Joint position sense Balance
Castro-Sanchez et al (2012)	CLBP (≥3/12) and inability to achieve Flexion relaxation as defined by EMG; ≥4 RMDQ score; age range 18–65; N = 60	Star-shaped KTT application over area of greatest pain in situ for 7 days	Sham KTT – 1 transverse strip across painful area in situ for 7 days	1 week; 4 weeks	Function: ODI, RMDQ Pain: VAS Fear: TSK ROM: Trunk flexion ROM Strength: Isometric endurance of trunk muscles.

Notes: KTT, Kinesio Tex tape; ACJ, acromio-clavicular joint; SPADI, Shoulder Pain and Disability Index; ROM, range of movement; NRS, Numerical Rating Scale; MVA, motor vehicle accident; FFI, Foot Function Index; MPQ, McGill Pain Questionnaire; DLT, deep lymphatic drainage; PC, pneumatic compression; EORTC QLQ-C30 and QLQ-BR23, European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire; BTX-A, Botox®; U/S, ultrasound; TENS, Transcutaneous Electrical Nerve Stimulation; PFPS, Patellofemoral Pain Syndrome; ODI, Oswestry Disability Index; RMDQ, Roland Morris Disability Questionnaire; TSK, Tampa Scale of Kinesiophobia; ROM, range of motion; CLBP, chronic low back pain; EMG, electromyography; AKPS, Anterior Knee Pain Scale; DASH, disability of the arm, shoulder and hand scale.

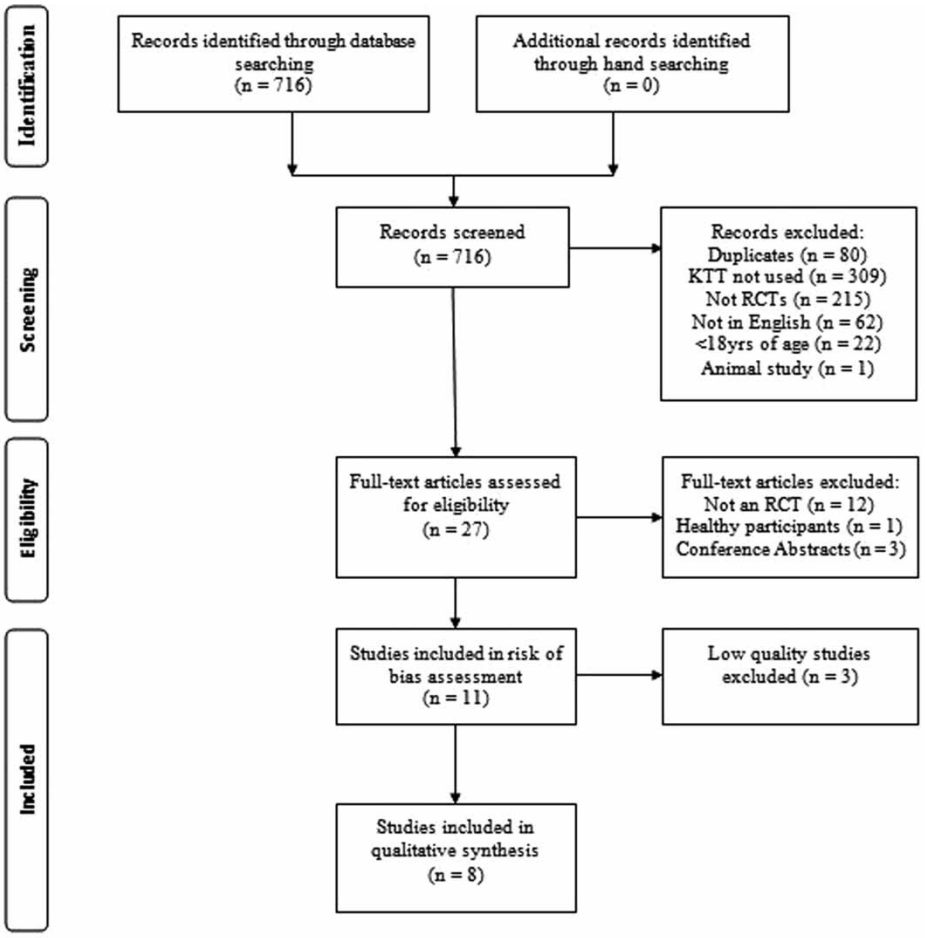

FIGURE 1 Study identification and selection flow diagram.

KTT group demonstrated statistically and clinically greater pain-free shoulder abduction ROM (19.1, 95% CI 1.7–36.5 [mean difference (95% confidence interval)]), this effect was lost within 3 days. There was no statistical or clinically important difference between groups for any of the remaining outcome measurement points.

Overall, there was moderate evidence from one high-quality RCT that in the short-term there are no clinically beneficial effects of KTT above sham taping for pain, pain-free ROM, or function in individuals with shoulder impingement syndrome.

Neck pain

One high-quality RCT (10/12) investigated the effect of KTT on pain and ROM in patients with neck pain for ≤40 days following a motor vehicle accident (MVA; Gonzalez-Iglesias et al, 2009). Pain was measured using an 11-point NRS and active ROM was measured using a cervical ROM device similar to a goniometer. For this review, a difference of 20% (Farrar et al, 2001) for pain and 10–19° (Cleland, Childs, Fritz, and Whitman, 2006) for ROM were considered clinically important. A statistically greater reduction in pain was identified for the intervention group compared to the control group immediately (−1.0, 95% CI −1.2, −0.8, $p < 0.01$) and 24 hours (−1.1, 95% CI −1.5, −0.9, $p < 0.01$) after tape application. However, these results were not clinically important.

The KTT group obtained a statistically greater improvement than the sham group for active ROM ($p < 0.01$). Between-group mean difference in change scores immediately following application of the tape were: flexion (6.6° [95% CI: 5.3, 7.9]); extension (8.2° [95% CI: 6.2, 10.2]); right lateral flexion (5.4° [95% CI: 3.9, 7.0]); left lateral flexion (3.1° [95% CI: 1.0, 5.5]); right rotation (5.5° [95% CI: 3.7, 7.4]); and left rotation (5.2° [95% CI: 3.5, 6.9]). The between-group difference in change scores 24 hours following the application of the tape were: flexion (7.4° [95% CI: 5.3, 9.6]); extension (8.5° [95% CI: 6.1, 10.9]); right lateral flexion (5.8° [95% CI: 3.9, 7.6]);

left lateral flexion (2.3° [95% CI: 0.2, 4.8]); right rotation (6.1° [95% CI: 4.0, 8.3]); and left rotation (4.1° [95% CI: 2.4, 5.9]). In relation to the criteria applied, these results were not clinically important.

Overall, there was moderate evidence from one high-quality RCT that in the short-term there are no clinically beneficial effects of KTT above sham taping for pain or ROM in individuals with neck pain following an MVA.

Plantar fasciitis

One moderate quality RCT (7/12) compared KTT and usual care ($n = 26$) to usual care alone ($n = 26$) in the management of plantar fasciitis of <10 months duration (Tsai, Chang, and Lee, 2010). Pain was assessed using the number of descriptors chosen (range 0–20) component of the McGill Pain Questionnaire (MPQ; Melzack, 1975) and a modified version of the pain subscale of the Foot Function Index (FFI; Budiman-Mak, Conrad, and Roach, 1991). There is no information on what is a clinically important difference for these scales. Ultrasonographic assessment of fascia thickness was measured at the plantar facia insertion at the calcaneus and 0.5 cm distal to the anterior calcaneal margin. There are no data on what is a clinically important change on ultrasound thickness, but a reduced thickness is considered a beneficial effect.

One-week posttreatment, pain intensity was reduced significantly more in the KTT group compared to the control groups for both outcome measures used ([MPQ]; −5.14 SD 3.81 vs. −2.75 SD 2.55, $p < 0.05$; [FFI] −4.29 SD 17.03 vs. −43.05 SD 34.22, $p < 0.05$). It should be noted that statistically lower pain scores in the KTT group compared to the control group at baseline ([MPQ] 9.29 SD 2.69 vs. 14.63 SD 2.61, $p < 0.05$) may have contributed to this finding. It is unclear if the between-groups difference was clinically important. Reduction in plantar fascia thickness at the insertion was significantly more in the KTT group than the control group (−0.06 cm SD 0.04 vs. −0.01 cm SD 0.03, $p < 0.05$). It is unclear if the difference was clinically important. No significant differences were noted between groups at the site 0.5 cm distal to the insertion (−0.08 cm SD 0.07 vs. −0.05 cm SD 0.02, $p > 0.05$).

Overall, there was limited evidence from one moderate quality RCT that in the short-term KTT in conjunction with physiotherapy produced statistically greater improvements in pain and fascia thickness compared to physiotherapy alone 1-week posttreatment. However, it is unclear if the differences were clinically important.

Lymphedema

One high-quality (10/12) RCT compared KTT and usual care ($n = 20$) to the standard short-stretch-bandage (SSB) usually used to address unilateral breast-cancer-related lymphedema and usual care ($n = 21$; Tsai et al, 2009). The interventions lasted 4 weeks. Outcome measures were obtained immediately and 3 months posttreatment. Outcomes included: limb size; water composition of the upper-limb; lymphedema-related symptoms; and health-related quality of life. No data exist regarding what is a clinically important change for these outcomes. No significant differences were observed between the two groups for any of the outcome measurements at either time point.

There was moderate quality evidence from one high-quality RCT that in the short-term KTT is no more effective than usual care SSB for breast-cancer-related lymphedema outcomes.

Stroke-related muscle spasticity

One moderate quality (9/12) RCT compared KTT combined with botulinum toxin (BTX-A) injection to sham tape combined with BTX-A injection for the management of plantar flexor spasticity in stroke patients ($n = 20$) (Karadag-Saygi, Cubukcu-Aydoseli, Kablan, and Ofluoglu, 2010). Outcome measures were obtained at 2 weeks, 1-, 3-, and 6-month follow-up points. Outcome measures included: the modified Ashworth Scale; passive ankle dorsiflexion; gait velocity; and step length. There are no data regarding what is a clinically important change for these outcomes. There was no significant difference between groups for any of the outcome measures at any time point with the exception of passive ankle dorsiflexion at week 2, which was superior for the KTT group (5° vs. 0°, $p = 0.02$). The clinical importance of this finding was questionable as passive ROM is difficult to measure especially at joints with relatively small ROM (Gajdosik and Bohannon, 1987).

There is limited evidence from one moderate quality RCT that in the short- and moderate-term KTT combined with BTX-A is no more clinically effective than sham tape combined with BTX-A for stroke-related plantar flexor spasticity.

Chronic low back pain

Castro-Sanchez et al (2012) (high quality: 11/12) compared the effects of KTT to sham KTT for function, pain, ROM, and muscle endurance in patients with chronic low back pain (CLBP) of ≥3 months

duration. Pain was assessed using a 10-cm VAS. Trunk flexion ROM was measured using a Fleximeter. Function was measured using Roland Morris Disability Questionnaire (RMDQ) and the Oswestry Disability Index (ODI). Muscle endurance was measured using the McQuade test, where patients hold their trunk off the floor isometrically until fatigue. For this review, clinical importance was defined as a change of 30% on the pain VAS, 6 points on the ODI, and 2 points on the RMDQ (Fritz and Irrgang, 2001; Furlan, Pennick, Bombardier, and van Tulder, 2009). No literature indicating a clinically important change for trunk flexion or McQuade test could be found.

Outcomes were assessed after 1 week of wearing the tape (with the tape still in situ) and 4 weeks later. At 1 week, the KTT group demonstrated statistically but not clinically greater improvements in function (1.2, 95% CI 0.4–2.0 [RMDQ]; 4, 95% CI 2–6 [ODI]). There was no difference in function at week 4. At 1 and 4 weeks, the KTT group demonstrated statistically but not clinically greater improvements in pain (1.1 cm, 95% CI 0.3–0.9 cm; 1.0 cm, 95% CI 0.2–1.7 cm). Muscle endurance improvement was statistically greater in the KTT group at weeks 1 (23 sec, 95% CI 14–32 sec) and 4 (18 sec, 95% CI 9–26 sec). The clinical relevance of this change is unclear. There was no statistical difference between groups for the remaining outcome measures.

Overall, there was moderate evidence from one high-quality RCT that in the short-term there are no clinically beneficial effects of KTT above sham taping for pain, ROM, or function in individuals with CLBP. There is moderate evidence of improved muscle endurance for KTT compared to sham taping in the short term for individuals with CLBP but the clinical relevance of this change is unclear.

Patellofemoral pain syndrome

Akbas, Atay, and Yuksel (2011) (moderate quality: 6/12) investigated the effects of KTT combined with an exercise programme compared to a home exercise programme only, delivered over a 6-week period, for function, pain, and ROM (patellar position and flexibility) in patients with patellofemoral pain syndrome (PFPS). Pain was assessed using a 10-cm VAS for nine different positions/tasks. ROM of the iliotibial band/tensor fasciae latae (ITB/TFL) hamstrings and patella positioning were assessed using a range of clinical tests. Function was measured using the Anterior Knee Pain Scale (AKPS). For this review, clinical importance was defined as a change of 2 cm on the pain 10 cm VAS and 10 points on AKPS (Crossley, Bennell, Cowan, and Green, 2004).

Outcomes were assessed at weeks 3 and 6 of the 6-week intervention. Hamstring flexibility was significantly better in the KTT group at week 3 (13.00° vs. 10.33° tension), but this was no longer significant at week 6. The clinical relevance of this finding is questionable. There was no statistical or clinical difference between groups for any of the other outcome measures.

Aytar et al (2011) (moderate quality: 9/12) compared the immediate effects of a single application of KTT to a sham tape for pain, strength, joint position sense, and balance. Pain was assessed using a 10-cm VAS for three different positions/tasks with a change of 2 cm considered clinically relevant (Crossley, Bennell, Cowan, and Green, 2004). Muscle strength and joint position sense were assessed using an isokinetic dynamometer while balance was measured using a Kinaesthetic Ability Trainer. There are no clinically important differences defined for these measures.

Outcomes were assessed 45 minutes after tape application. Neither the KTT group nor the sham group statistically improved for pain or joint position sense. Improvements were seen in both groups for strength and balance, but an appropriate statistical comparison between groups was not made.

There was limited evidence from one moderate quality RCT that in the short-term a course of KTT combined with exercise is no more clinically effective than exercise alone for pain, function, and ROM in patients with PFPS. There was limited evidence from one moderate quality RCT that in the short term, a single application of KTT is no more clinically effective than sham tape for pain, joint position sense, strength, and balance in patients with PFPS.

Side-effects

Of the eight studies included, five made no statements regarding side-effects (Akbas, Atay, and Yuksel, 2011; Aytar et al, 2011; Castro-Sanchez et al, 2012; Gonzalez-Iglesias et al, 2009; Tsai, Chang, and Lee, 2010). Only one study stated that there were "no serious side-effects" (Karadag-Saygi, Cubukcu-Aydoseli, Kablan, and Ofluoglu, 2010). One study reported two participants (out of $n = 42$) demonstrated mild, non-pruritic rashes at the taping site after 6 days of use. The rashes resolved 24–48 hours post-tape removal.

Only one study investigated the side-effects in a systematic manner (Tsai et al, 2009). This study compared KTT to SSB for breast-cancer-related lymphedema management. The side-effects measured included: discomfort; difficulty; inconvenience; itch; and wound development on a 0–10 scale (0 = no

issues, 10 = worst possible issues). Some acceptance measures (discomfort, difficult, and inconvenience) were superior for the KTT group ($p < 0.01$). In contrast, wound development was significantly greater for the KTT group (0.05 SD 0.22 vs. 0.55 SD 0.83, $p < 0.02$).

DISCUSSION

The aim of this systematic review was to investigate the effect of KTT in the management of any condition. Only eight RCTs met the inclusion/exclusion criteria and were of satisfactory methodological quality to be included. Six studies included patients with musculoskeletal conditions, specifically, shoulder impingement, neck pain, CLBP, PFPS, and plantar fasciitis. One study looked at breast-cancer-related lymphedema while another looked at plantar flexor muscle spasticity in stroke patients. Of the six studies that included a sham or usual care tape/bandage group, there was limited-to-moderate evidence that KTT is no more clinically effective than sham or usual care tape/bandage in the short term. There was limited evidence from one moderate quality RCT, which did not include a sham tape condition, that KTT in conjunction with physiotherapy produced statistically greater reductions in pain and fascia thickness 1 week after treatment compared to physiotherapy alone in patients with plantar fasciitis. However, it was unclear if the improvement was clinically important. There was limited evidence from one moderate quality RCT, which did not have a sham tape group, that KTT combined with exercise was no more effective for pain or function than exercise alone for patients with PFPS, though faster improvements in hamstring flexibility may have been evident in the KTT group (Akbas, Atay, and Yuksel, 2011). There was moderate evidence from one high-quality RCT that in the short-term, there are no clinically beneficial effects of KTT above sham taping for pain, ROM, or function in individuals with CLBP (Castro-Sanchez et al, 2012).

The findings of this review are in general agreement with the systematic review of Bassett, Lingman, and Ellis (2010), which reported no substantial evidence for the treatment efficacy of KTT. The current study builds upon the work of Bassett, Lingman, and Ellis (2010) by adding four musculoskeletal articles published after that review was completed and by widening the review beyond musculoskeletal conditions. This was important because promising anecdotal evidence exists supporting the use of KTT with patients presenting with neurological and circulatory conditions (Hardy, 2006; Lawrence, 2009; Linnitt and Young, 2007). The current study excluded one article (Hsu et al, 2009) that was included in the Bassett, Lingman, and Ellis (2010) trial as *Hsu et al (2008)*. The paper was excluded from this review because this review excluded randomized crossover trials. Randomized crossover trials were excluded as they tend to include short-term treatments and short-term outcomes limiting their clinical applicability. The fact that the results of Bassett, Lingman, and Ellis (2010) are in agreement with those of the current review adds confidence to our findings.

A study (Tsai, Chang, and Lee, 2010), which investigated the effects of KTT for plantar fasciitis, was the only RCT to provide evidence of a potential clinical benefit of KTT above a comparison group. While the study was considered to be of moderate methodological quality (7/12) using the Cochrane criteria, there are issues regarding the validity of the outcome measures used that were not fully captured by the Cochrane criteria. Within the study, two different questionnaires the MPQ (Melzack, 1975) and the FFI (Budiman-Mak, Conrad, and Roach, 1991) were used to measure pain. Only one component of the MPQ was used to measure pain, with no mention of the other pain measurement components. The pain subscale of the FFI did not include all the questions that exist within the validated index. Thus, how valid these two pain measurements were for assessing change in pain in plantar fasciitis patients is questionable. However, the percentage difference in change between groups was relatively large and consistent between the two measures ranging from 36% to 39% (control group before and after [14.6 SD 2.6 vs. 11.9 SD 2.4 (MPQ); 54.5 SD 22.0 vs. 51.2 SD 20.9 (FFI)) vs. KTT group before and after (9.3 SD 2.7 vs. 4.1 SD 3.0 (MPQ); 56.7 SD 14.5 vs. 31.8 SD 20.5 (FFI)]). It should be noted that Tsai, Chang, and Lee (2010) was one of the weakest quality studies included in the review, with questionable outcome measures and no sham tape comparison. Considering poorer methodological studies are more likely to show a beneficial effect (Ernst and Pittler, 2000), the findings of Tsai, Chang, and Lee (2010) should be considered with a degree of caution.

One high-quality study found immediate greater pain-free shoulder abduction ROM in patients with shoulder impingement syndrome with KTT taping compared to sham taping that was statistically and clinically relevant. Although this effect was lost within 3 days and thus we have considered there to be no real effect in the short-term, there may be an immediate effect of KTT for this condition that might be worthwhile in certain clinical situations (e.g., during sports activities) and should be investigated further.

Limitations of the review

This review was limited by the small number of articles included ($n = 8$) and the fact that, with the exception of PFPS, none of the studies investigated the same population. Thus, when grading the level of evidence there was generally only one study in each body of evidence limiting the strength of the evidence grading that could be made (Table 2). Of the studies that included a sham tape comparison, four used KTT as the sham but in a manner they deemed ineffective and not in keeping with the methods of Dr. Kenso Kase. It is possible that the therapeutic effects of KTT were brought about using these sham methods thus concealing the effect of the real KTT interventions. Another limitation is that studies not published in the English language were excluded from the review. This could have introduced bias by excluding important relevant research.

Clinical implications

The results of this review suggest limited-to-moderate evidence that KTT tape is no more clinically effective than sham/usual care tape for a range of outcomes for the following conditions: shoulder impingement; CLBP; PFPS; neck pain; breast-cancer-related lymphedema; and stroke-related spasticity. These findings question the clinical effectiveness of KTT in current clinical practice. Side-effects associated with the tape would appear to be few and relatively minor in nature though there is evidence of increased wound development compared to usual care SSB in breast-cancer-related lymphedema patients (Tsai et al, 2009). Cost-effectiveness should also be considered. While no official cost-effectiveness analysis has been performed by any of the included studies, Tsai et al (2009) noted that the reusable SSB would be more cost-effective over an extended treatment period compared to KTT for lymphedema.

Research implications

More high-quality RCTs are required to increase the evidence base allowing firm clinical recommendations to be made regarding KTT. Of the six studies investigating the effect of KTT on musculoskeletal conditions, none reported outcomes more than 4 weeks posttreatment and most were only 1 week or less posttreatment. Arguably, such effects could be considered immediate rather than even short-term outcomes. There is a need to investigate the immediate, short (~3 months), medium (~6 months), and long-term (≥12 months) effects of KTT for the different clinical conditions. None of the studies, regardless of the population included looked at long-term outcomes. Future RCTs should also include a cost-effectiveness analysis.

CONCLUSION

This is the first systematic review to investigate the effect of KTT in the management of different clinical conditions including, but not restricted to musculoskeletal conditions.

Only eight RCTs met the full inclusion/exclusion criteria for this review. Six of these studies included patients with musculoskeletal conditions, one included patients with breast-cancer-related lymphedema and one included stroke patients with muscle spasticity. Of the six studies that included a sham or usual care tape/bandage group, there was limited-to-moderate evidence that KTT is no more clinically effective than sham or usual care tape/bandage in the short term. There was limited evidence from one moderate quality RCT, which did not include a sham tape condition that KTT in conjunction with physiotherapy produced statistically greater improvements in plantar fasciitis related pain in the short term compared to physiotherapy alone. However, the clinical importance of the change was unclear and the methodological quality of the study from which this finding originates is questionable. Overall, there currently exists insufficient evidence to support the use of KTT over other modalities in clinical practice and more high-quality research with long-term outcomes is required.

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