Article

CLINICAL REHABILITATION

Clinical Rehabilitation
2019, Vol. 33(4) 596–606

DOI: 10.1177/0269215518817804
journals.sagepub.com/home/cre
SAGE

Effects of kinesiotape on pain and disability in individuals with chronic low back pain: a systematic review and meta-analysis of randomized controlled trials

Yuejie Li[1], Ying Yin[1], Gongwei Jia[1], Hong Chen[2], Lehua Yu[1] and Dandong Wu[1]

Abstract

Objective: To explore the effects of kinesiotape on pain and disability in individuals with chronic low back pain.

Data sources: PubMed, Embase and the Cochrane Central Register of Controlled Trials were searched for English language publications from inception to 13 February 2018.

Review methods: This study was registered in PROSPERO (CRD42018089831). Our key search terms were ((kinesio taping) OR (kinesiotaping) OR (kinesiotape)) AND (low back pain). Randomized controlled trials evaluating the effects of kinesiotape published in English language were included in this review. The reference lists of retrieved studies and relevant reviews were also searched. Quality of the included trials was assessed according to 2015 updated Cochrane Back and Neck Review Group 13-Item criteria.

Results: A total of 10 articles were included in this meta-analysis. A total of 627 participants were involved, with 317 in the kinesiotape group and 310 in the control group. The effects of kinesiotape on pain and disability were explored. While kinesiotape was not superior to placebo taping in pain reduction, either alone ($P=0.07$) or in conjunction with physical therapy ($P=0.08$), it could significantly improve disability when compared to the placebo taping ($P<0.05$).

Conclusion: Since kinesiotape is convenient for application, it could be used for individuals with chronic low back pain in some cases, especially when the patients could not get other physical therapy.

Keywords

Kinesiotape, chronic low back pain, pain, disability

Received: 10 June 2018; accepted: 16 November 2018

[1]Department of Rehabilitation, The Second Affiliated Hospital of Chongqing Medical University, Chongqing, China
[2]Department of Orthopedics, The First Affiliated Hospital of Chongqing Medical University, Chongqing, China

Corresponding author:
Dandong Wu, Department of Rehabilitation, The Second Affiliated Hospital of Chongqing Medical University, 76 Linjiang Road, Yuzhong District, Chongqing 400010, China.
Email: facia2010@126.com

Introduction

In recent years, kinesiotape, which is a kind of an elastic tape, has been applied for treating a number of musculoskeletal conditions.[1–3] In contrast to traditional athletic tape, kinesiotape allows the joint to move through its full range of motion. It has also been reported to increase blood circulation and lymphatic drainage, which leads to a reduction of pain.[4] Some other studies found that kinesiotape deforms and stimulates large-fibre cutaneous mechanoreceptors that may inhibit proprioceptive impulses in the spinal column and decrease pain via an ascending pathway.[5,6]

Previous studies provided controversial and inconclusive results regarding the effects of kinesiotape in chronic low back pain patients. In his systematic review, Nelson[7] found very limited evidence to suggest that kinesiotape was more effective than sham taping or conventional physical therapy in improving pain and disability. Likewise, Vargas Batista et al.[8] stated that, in their systematic review, there was no effectiveness of kinesiotape in low back pain. However, since there are some new well-designed and large-numbered randomized controlled trials being published, we believe that current result would be different from previous ones. The aim of this study was to critically examine and evaluate the evidence of recent randomized controlled trials regarding the effectiveness of kinesiotape on chronic low back pain. The hypothesis was kinesiotape application would be effective in pain reduction and disability improvement in patients with chronic low back pain.

Methods

This study was registered in PROSPERO (CRD42018089831). Two researchers (Y.L. and G.J.) independently searched PubMed, Embase and the Cochrane Central Register of Controlled Trials for literature on the use of kinesiotape for low back pain from inception to 13 February 2018. Our key search terms were ((kinesio taping) OR (kinesiotaping) OR (kinesiotape)) AND (low back pain). Randomized controlled trials evaluating the effects of kinesiotape published in English language were included in this review. After a preliminary search, the reference lists of retrieved studies and relevant reviews were also searched. Only published studies include all participants and with the latest outcomes were included.

The inclusion criteria for screening eligible studies were as follows: (1) studies evaluating the effects of kinesiotape application on pain or disability in individuals with a diagnosis of chronic low back pain and (2) control group including either sham/placebo-taping or some other intervention.

The exclusion criteria were as follows: studies were non-randomized controlled trials, non-peer reviewed publications, opinion articles and articles which were not written in English. Two researchers performed the search process and screened the articles according to the criteria independently. Disagreements between reviewers at each stage were resolved by discussion to reach a consensus.

Original data from each study were extracted using a standard data recording form which included first author, year of publication, clinic condition, number of participants, participant characteristics, intervention protocol, duration of intervention, outcome measures and final results. Quality of the included trials was assessed according to 2015 updated Cochrane Back and Neck Review Group 13-Item criteria.[9] In order to truly depict the function of kinesiotape, either alone or in combination, two sets of comparisons were performed in this meta-analysis. On one hand, kinesiotaping group was compared with sham/placebo taping group. On the other hand, kinesiotape in conjunction with traditional physical therapy or exercise was compared with traditional physical therapy or exercise (with or without sham/placebo taping). If there were three-intervention arms in a single study, only the kinesiotape and sham/placebo taping data were extracted for meta-analysis.

The effects of taping on pain and disability were explored. If pain was assessed under various conditions (e.g. actual pain, average pain, the best pain and the worst pain), the worst pain was the first choice for the meta-analysis. Because in all included studies, disability was evaluated with Roland Morris Disability Questionnaire and/or the Oswestry Disability Index; these two measurements were employed in our meta-analysis.

Data analysis in this study was performed using RevMan5.2 (Cochrane Collaboration) and Stata 15.0. The weighted mean differences with 95% confidence intervals for continuous outcome were applied to estimate the pooled effects. Heterogeneity was assessed with chi-square based Q test and I^2. $P < 0.1$ or $I^2 > 0.5$ was considered as significant heterogeneity. The fixed-effect model was used at first. When significant heterogeneity was found, random-effect model was selected. The Egger's linear regression test was used to assess the publication bias by using Stata 15.0.

Results

A total of 85 articles were identified in the primary search. After removing irrelevant studies and duplicates, 19 articles that met our inclusion criteria were carefully identified. Articles which did not use pain or disability as outcome measure[10–12] or were not randomized controlled trials[13–16] were removed. Follow-up study[17] (further study of Parreira in 2014) or study with non-comparable baseline parameters were excluded.[18] Finally, 10 randomized controlled trials were included in this meta-analysis[19–28] (Figure 1).

Characteristics of included patients

Characteristics of 10 included studies were shown in Table 1. A total of 627 participants were involved, with 317 in the experimental group and 310 in the control group. Among these trials, five randomized controlled trials compared kinesiotape to sham taping,[20–24] another five randomized controlled trials compared traditional physical therapy or exercise with kinesiotape to interventions without kinesiotape.[19,25–28] Particularly, two studies had three-intervention arms.[22,26] Three trials explored the effects of kinesiotape in individuals with low back pain caused by lumbar disc herniation.[19,24,26] The characteristics of the included studies were summarized in Table 1. Supplemental Table 1 provided details about study design and methodological quality.

Intervention

The kinesiotape techniques differed in different studies. In addition, various pain locations such as erector spinae muscle, most painful point, paravertebral region, lumbosacral junction or dimples were focussed on by different investigators. This was also true for traditional physical therapies and exercises.[21,25–28] The intervention duration also differed among the included studies, from 24 hours to 12 weeks.

Outcome measures

Four studies measured pain intensity using a Visual Analogue Scale,[20,23,24,27] while the others used a Numerical Rating Scale.[19,21,22,25,26,28] Four studies used the Roland Morris Disability Questionnaire.[21,22,24,25] Five investigations used the Oswestry Disability Index,[19,23,26–28] and one study used both.[20]

Effect on pain relief

Figures 2 and 3 demonstrated standardized mean differences between treatment and control groups regarding the effects of kinesiotape on pain. Figure 2 revealed the treatment effect of kinesiotape alone. It was suggested that there was a non-significant standard mean difference on pain ($P = 0.07$), with high heterogeneity ($I^2 = 82\%$). When exploring the effects of kinesiotape in conjunction with physical therapy, it also revealed a non-significant standard mean difference on pain ($P = 0.08$), with high heterogeneity ($I^2 = 83\%$; Figure 3).

Effect on disability

Figures 4–6 demonstrated the effects of kinesiotape on disability. It was suggested that kinesiotape alone could significantly improve disability, with no heterogeneity. This was both true for Oswestry Disability Index ($P < 0.00001$, $I^2 = 0\%$) and Roland Morris Disability Questionnaire ($P = 0.01$, $I^2 = 0\%$). Nevertheless, when physical therapy was added, the effect of kinesiotape was becoming non-significant ($P = 0.05$), with a high heterogeneity ($I^2 = 82\%$).

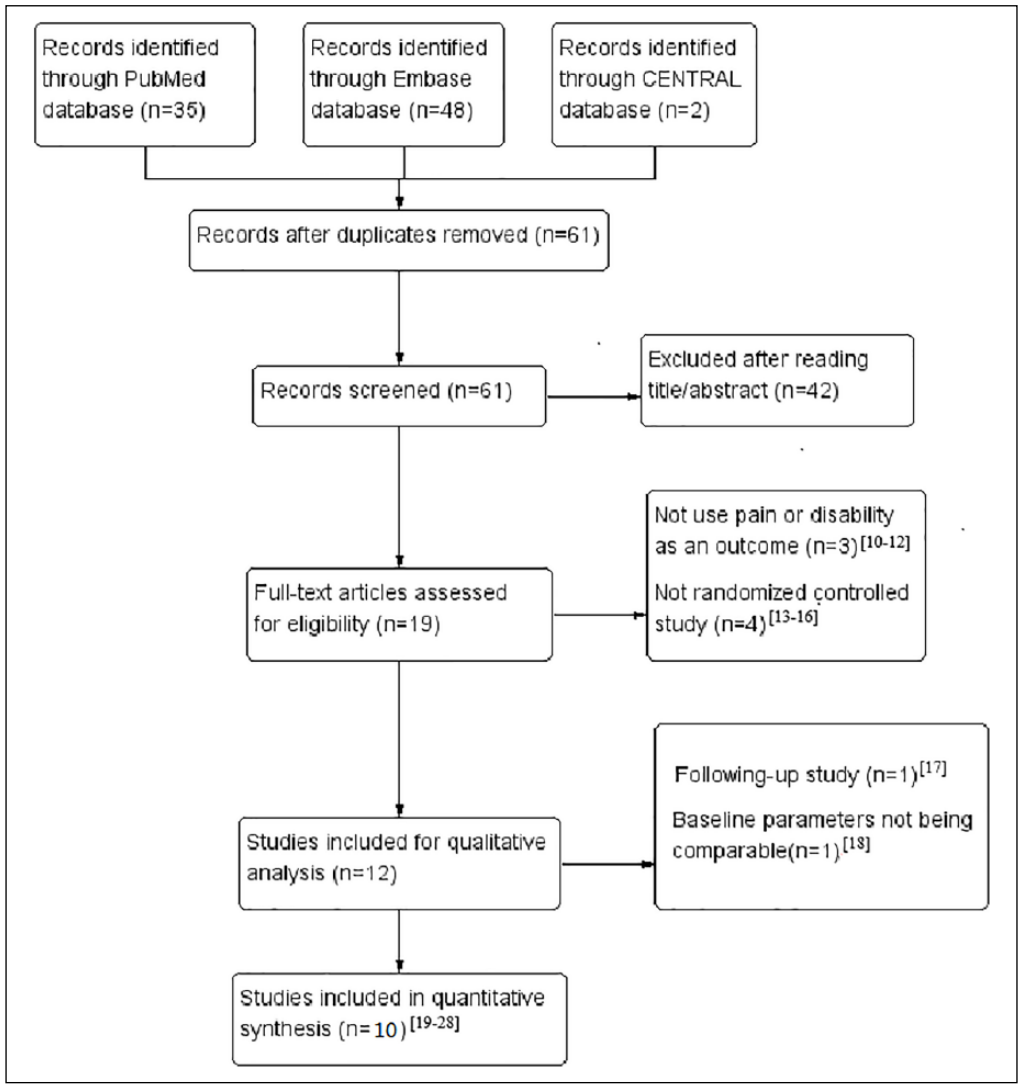

Figure 1. Flow diagram of the evaluation process for the inclusion or exclusion of studies.

Publication bias

Egger's linear regression test showed no evidence of publication bias for the included studies on each parameter (Table 2).

Discussion

Based on this meta-analysis, kinesiotape could not provide significantly more pain relief to chronic low back pain patients when compared with sham/placebo control. This is in contrary to our initial hypothesis. Interestingly, however, those same patients experience significantly less disability after kinesiotape application. Meanwhile, our results suggest that physical therapy/exercise is efficient in pain reduction, and disability improvement for chronic low back pain individuals, the addition of kinesiotape does not lead to extra effect on these outcomes.

Table 1. Characteristics of studies using kinesiology to treat chronic low back pain.

Article/country/ number	Clinic condition	Participant characteristics	Intervention and duration	Outcome measures	Result
Castro-Sánchez et al.[20]/Spain ($n = 59$)	Non-specific low back pain for at least three months. VAS: kinesiotape group: 5.6 ± 1.8; Placebo group: 5.4 ± 1.3	Kinesiotape group ($n = 30$): 21 females; mean age = 50 ± 15 years; Placebo group ($n = 29$): 19 females; mean age = 47 ± 13 years	Kinesiotape was applied over the point of maximum pain in the lumbar area for one week	Pain (VAS); Disability (ODI, RMDQ); one week, follow-up four weeks	The kinesiotape group had greater improvement in ODI and RMDQ, and a greater decrease in pain
Parreira et al.[21]/ Brazil ($n = 148$)	Chronic low back pain for at least three months. NRS: kinesiotape group:7 ± 2; Placebo group 6.8 ± 2	Kinesiotape group ($n = 74$): 56 females; mean age = 51 ± 15 years; Placebo group ($n = 74$): 59 females; mean age = 50 ± 15 years	Kinesiotape was applied over each erector spinae muscle with 10%–15% of tension in the stretched position twice per week for four weeks	Pain (NRS); Disability (RMDQ); four week, follow-up 12 week	Kinesiotape did not have a significant effect on pain or disability
Luz et al.[22]/ Brazil ($n = 60$)	Chronic non-specific low back pain (back pain of mechanical origin, apparently without a defined cause, for at least 12 weeks duration). NRS: kinesiotape group: 6.6 ± 1.2; Placebo group: 6.7 ± 1.6; Control group: 6.1 ± 2.1	Kinesiotape group ($n = 20$): 11 females; mean age = 44.3 ± 15 years; Placebo group ($n = 20$): 13 females; mean age = 50.1 ± 17.5 years; control group ($n = 20$): 17 females; mean age = 48.1 ± 13.4 years	Kinesiotape was applied over the erector spinae muscle with 10%–15% of tension in the stretched position for 48 hours	Pain (NRS); Disability (RMDQ); 48 h, follow-up one week	There was a significant difference in disability between kinesiotape group versus the control group, but no difference when compared to the placebo group
Al-Shareef et al.[23]/Saudi Arabia ($n = 40$)	Non-specific low back pain for at least three months. VAS: kinesiotape group: 5.9 ± 1.2; Placebo group: 6.45 ± 0.76	Kinesiotape group ($n = 20$): 9 females; mean age = 37.55 ± 9.82 years; placebo group (n = 20): 11 females; mean age = 35.55 ± 8.04 years	Kinesiotape was applied over the skin in the paravertebral region up to the T12 vertebra at 10%–15% stretch twice per week for two weeks (total of four sessions)	Pain (VAS); Disability (Arabic ODI); two week, follow-up four week	The kinesiotape group had greater decrease in pain and disability after intervention

(Continued)

Table 1. (Continued)

Article/country/ number	Clinic condition	Participant characteristics	Intervention and duration	Outcome measures	Result
Grześkowiak et al.[24]/Poland ($n = 38$)	Lumbar or lumbosacral pain for at least three months (with or without referring to leg), confirmed in MRI unilateral or central disc herniation at L4/L5 and/or L5/S1 vertebra levels. NRS: kinesiotape group: 8.5 ± 1.1; Placebo group: 7.9 ± 1.8	Kinesiotape group ($n = 19$): 15 females; mean age = 36.4 ± 10.5 years; Placebo group ($n = 19$): 13 females; mean age = 36.5 ± 8.9 years	Kinesiotape was applied over the lumbosacral junction with 15%–25% of tapes stringing for one week	Pain (VAS); Disabiltiy (RMDQ); one week, no follow-up	Kinesiotape and placebo tape comparably decreased disability level, average pain and the worst pain. Kinesiotape was not superior to placebo in reducing pain and disability in patients with LDH
Added et al.[25]/ Brazil ($n = 148$)	Chronic non-specific low back pain for at least three months. NRS: PT + kinesiotape group:7.5 ± 1.72; PT group:7.4 ± 1.69	PT + kinesiotape group ($n = 74$): 53 females; mean age = 44.6 (11.7) years; PT group ($n = 74$): 53 females; mean age = 45.6 (11.6) years	30–60 minutes, twice a week of manual therapy, general exercise, specific spinal stabilization exercises plus kinesiotape. Kinesiotape was applied on the paravertebral muscles with 10%–15% tension twice per week for five weeks	Pain (NRS); Disability (RMDQ); five week, follow-up three and six months	Patients who received a physical therapy programme consisting of exercise and manual therapy did not get additional benefit from the use of kinesiotape
Köroğlu et al.[26]/ Turkey ($n = 60$)	Mechanical low back pain caused by a herniated disc and mechanical low back pain for at least three months. NRS: PT + kinesiotape group: 8.0 ± 2.2; PT + placebo group: 6.5 ± 3.0; PT group: 6.4 ± 2.4	PT + kinesiotape group ($n = 20$): 12 females; mean age = 47.2 ± 14.7 years; PT + placebo group ($n = 20$): 12 females; mean age = 50.3 ± 11.5 years; PT group ($n = 20$):8 females; mean age = 47.9 ± 15.2 years	Therapeutic ultrasound, a hot pack, transcutaneous electrical nerve stimulation was applied five times a week for two weeks. Therapeutic exercises was applied the second week. Kinesiotape was applied over the dimples of the back for two weeks	Pain (NRS); Disability (ODI); two week; no follow-up	A statistically significant improvement demonstrating the superiority of the kinesiotape in pain and disability

Table 1. (Continued)

Article/country/ number	Clinic condition	Participant characteristics	Intervention and duration	Outcome measures	Result
Bae et al.[27]/ Republic of Korea ($n=20$)	Low back pain for more than 12 weeks. VAS: PT + kinesiotape group: 7.83 ± 0.38; PT + placebo group: 7.71 ± 0.61	PT + kinesiotape group ($n=10$): 5 females; mean age = 53.6 ± 2.1 years; PT + placebo group ($n=10$): 6 females; mean age = 51.3 ± 3.7 years	A hot pack, ultrasound and transcutaneous electrical nerve stimulation was applied three times a week for 12 weeks. The tape was applied on the lumber area with the maximum pain three times a week for 12 weeks	Pain (VAS), Disability (ODI); 12 week; no follow-up	After the application of kinesiotape, VAS and ODI scores significantly decreased
Kamali et al.[28]/ Iran ($n=42$)	Chronic low back pain for at least three consecutive months. NRS: PT + kinesiotape group: 5.17 ± 1.02; PT group: 4.95 ± 0.88	PT + kinesiotape group ($n=21$): 11 females; mean age = 27.14 ± 6.04 years; PT group ($n=21$): 10 females; mean age = 25.14 ± 3.66 years	Lumbar rotational manipulation was applied. Kinesiotape was applied with 25% stretch on the most painful point of the lumbar region for 24 h	Pain (NRS), Disability (ODI) immediately, one day, follow-up one week and one month	Adding kinesiotape to SM did not appear to have a significant extra effect on pain and disability
Keles et al.[19]/ Turkey ($n=52$)	Chronic low back pain for at least three months due to lumbar disc herniation. NRS: PT + kinesiotape group: 6.17 ± 1.85; PT group: 6.33 ± 2.22	PT + kinesiotape group ($n=29$): 19 females; mean age = 39.1 ± 6.9 years; PT + placebo group ($n=23$): 15 females; mean age = 35.7 ± 6.5 years	Exercise was performed once a day. Kinesiotape was applied to the point that is most painful once a week for three months	Pain (NRS), Disability (ODI), baseline, one week, two week, three week, six week, 12 week	Compared with placebo taping, no significant differences regarding pain, disability and lumbar flexion were detected between groups

VAS: Visual Analogue Scale; NRS: Numerical rating scale; ODI: Oswestry Disability Index; RMDQ: Roland Morris Disability Questionnaire; PT: physical therapy; MRI: magnetic resonance imaging; SM: spinal manipulation: LDH: lactate dehydrogenase.

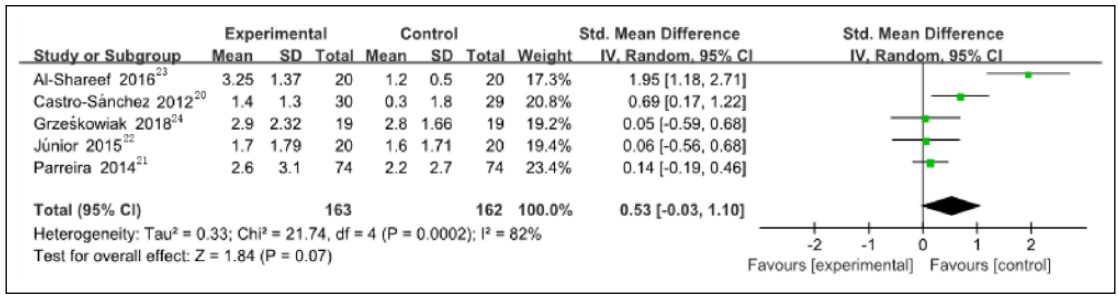

Figure 2. Forest plot: effects on pain.

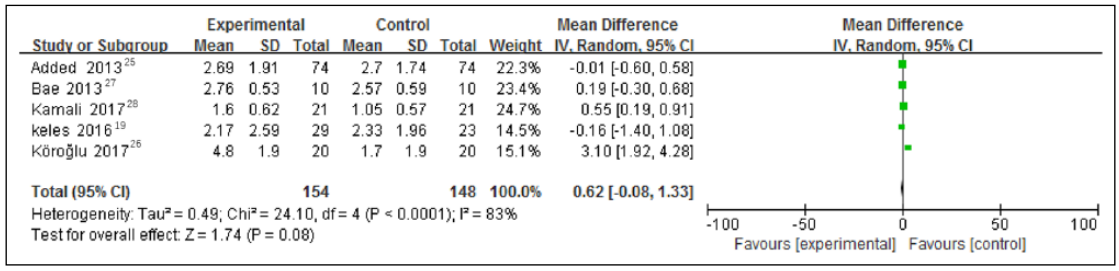

Figure 3. Forest plot: effects of combined kinesiotape/physical therapy on pain.

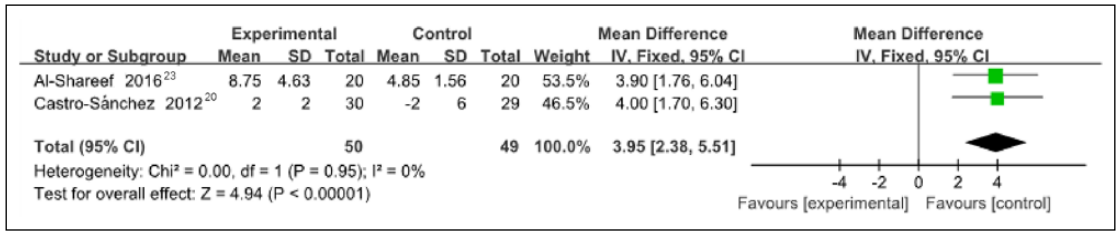

Figure 4. Forest plot: effects on disability (Oswestry Disability Index).

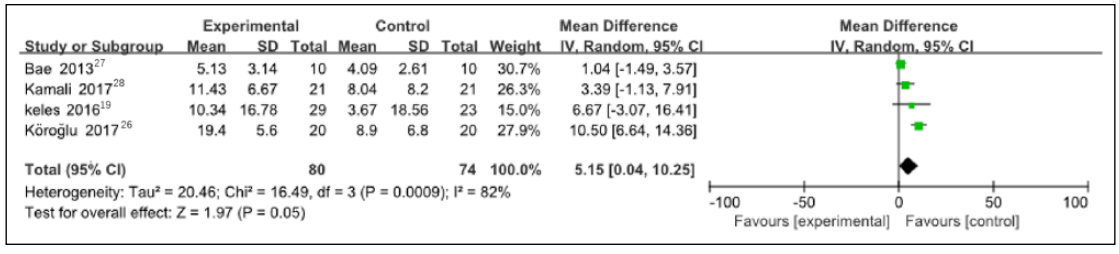

Figure 5. Forest plot: effects of combined kinesiotape/physical therapy on disability (Oswestry Disability Index).

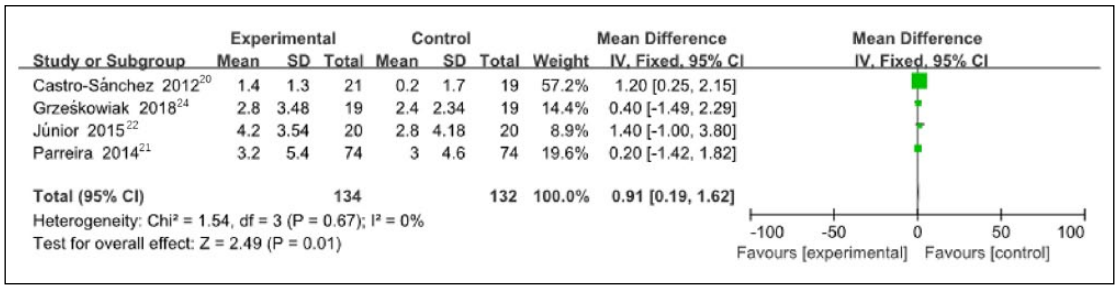

Figure 6. Forest plot: effects on disability (the Roland Morris Disability Questionnaire).

Table 2. The results of Egger's linear regression test.

Parameters	*t* value	*P*-value
VAS	2.13	0.066
ODI	0.42	0.696
RMDQ	0.44	0.693

VAS: Visual Analogue Scale; ODI: Oswestry Disability Index; RMDQ: Roland Morris Disability Questionnair.

Various mechanisms have been suggested for the pain relief effect of kinesiotape. According to Kase et al.,[29] kinesiotape accelerates the blood circulation and stimulates the neurological system, thus leading to reduced pain and improved function. However, some other researchers have questioned the therapeutic effect of elastic tape application, indicating that wrinkling the skin does not increase local blood flow.[30,31] Nevertheless, it is still somewhat surprising that our meta-analysis reveals the kinesiotape is not superior to placebo taping regarding pain reduction. One possible explanation is the use of non-elastic tape as placebo in some of the included studies.[20,21,23] Since non-elastic tape could also help to realign surrounding structures and modulate muscle activities, it is possible that placebo taping already provides enough neurological stimuli and pain relief.[32] As a result, the finding of our meta-analysis could be biased by the improper selection of placebo taping and future researchers should be aware of this.

Based on our results, it seems that the disability-improving effects of kinesiotape may not be attributable to pain relief. The application of elastic tape has been postulated to enhance proprioception by stimulating cutaneous mechanoreceptors. Konishi[33] confirmed that kinesiotape could counter quadriceps femoris weakness due to attenuated la afferent activity. Other studies have reported that kinesiotape is effective in increasing muscular strength.[34,35] Thus, kinesiotape could be useful for increasing muscle strength in individuals with low back pain, which leads to the function improvement. Meanwhile, combined kinesiotape/physical therapy does not seem to be more effective for disability than physical therapy alone. Previous study found that manipulation for patients with chronic neck pain was helpful for the improvement of proprioception,[36] which could probably increase muscle strength and improve disability.[37] Therefore, it is possible that addition of kinesiotape could only produce limited extra effects through tactile stimulation and proprioception improvement.

Some limitations of this meta-analysis should be addressed. First of all, due to the paucity of eligible randomized controlled trials, the quality of some included studies is low, thus one should use caution when interpreting the results. Second, the intervention protocols varied a lot among the included studies, making the comparison impossible or inaccurate.

Clinical message

- Although no significant difference in pain relief has been found between kinesiotape and placebo taping, individuals with chronic low back pain experienced statistically significant improvements in disability through the sole application of kinesiotape.

Acknowledgements

Y.L. initiated the study, searched the literature and screened the article. Y.Y. and H.C. performed the data analysis. G.J. searched the literature and screened the article. D.W. designed the study and wrote the paper. L.Y. monitored the progress.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

ORCID iD

Dandong Wu https://orcid.org/0000-0001-8128-0611

Supplemental material

Supplemental material for this article is available online.

References

1. Akbas E, Atay AO and Yuksel I. The effects of additional kinesio taping over exercise in the treatment of patellofemoral pain syndrome. *Acta Orthop Traumatol Turc* 2011; 45(5): 335–341.
2. Gonzalez-Iglesias J, Fernandez-de-Las-Penas C, Cleland JA, et al. Short-term effects of cervical kinesio taping on pain and cervical range of motion in patients with acute whiplash injury: a randomized clinical trial. *J Orthop Sports Phys Ther* 2009; 39(7): 515–521.
3. Kaya E, Zinnuroglu M and Tugcu I. Kinesio taping compared to physical therapy modalities for the treatment of shoulder impingement syndrome. *Clin Rheumatol* 2011; 30(2): 201–207.
4. Pop TB, Karczmarek-Borowska B, Tymczak M, et al. The influence of kinesiotape on the reduction of lymphoedema among women after mastectomy – preliminary study. *Contemp Oncol* 2014; 18: 124–129.
5. Cho HY, Kim EH, Kim J, et al. Kinesio taping improves pain, range of motion, and proprioception in older patients with knee osteoarthritis: a randomized controlled trial. *Am J Phys Med Rehabil* 2015; 94(3): 192–200.
6. Lin JJ, Hung CJ and Yang PL. The effects of scapular taping on electromyographic muscle activity and proprioception feedback in healthy shoulders. *J Orthop Res* 2011; 29(1): 53–57.
7. Nelson NL. Kinesio taping for chronic low back pain: a systematic review. *J Bodyw Mov Ther* 2016; 20(3): 672–681.
8. Vargas Batista C, Ruaro JA, Boeing Ruaro M, et al. Kinesio taping on low back pain: systematic review. *Conscient Saúd* 2014; 13: 147–152.
9. Furlan AD, Malmivaara A, Chou R, et al. 2015 updated method guideline for systematic reviews in the Cochrane Back and Neck Group. *Spine* 2015; 40: 1660–1673.
10. Velasco-Roldan O, Riquelme I, Ferragut-Garcias A, et al. Immediate and short-term effects of kinesio taping tightness in mechanical low back pain: a randomized controlled trial. *PM R* 2018; 10(1): 28–35.
11. Hagen L, Hebert JJ, Dekanich J, et al. The effect of elastic therapeutic taping on back extensor muscle endurance in patients with low back pain: a randomized, controlled, crossover trial. *J Orthop Sports Phys Ther* 2015; 45(3): 215–219.
12. Fong SS, Tam YT, Macfarlane DJ, et al. Core muscle activity during TRX suspension exercises with and without kinesiology taping in adults with chronic low back pain: implications for rehabilitation. *Evid-Based Compl Alt* 2015; 2015: 910168.
13. Abbasi S, Rojhani-Shirazi Z, Shokri E, et al. The effect of kinesio taping on postural control in subjects with nonspecific chronic low back pain. *J Bodyw Mov Ther* 2018; 22: 487–492.
14. Chang NJ, Chou W, Hsiao PC, et al. Acute effects of kinesio taping on pain, disability and back extensor muscle endurance in patients with low back pain caused by magnetic resonance imaging-confirmed lumbar disc degeneration. *J Back Musculoskelet Rehabil* 2018; 31(1): 85–93.
15. Toprak Celenay S and Ozer Kaya D. Immediate effects of kinesio taping on pain and postural stability in patients with chronic low back pain. *J Bodyw Mov Ther* 2019; 23(1): 206–210.
16. Paoloni M, Bernetti A, Fratocchi G, et al. Kinesio taping applied to lumbar muscles influences clinical and electromyographic characteristics in chronic low back pain patients. *Eur J Phys Rehabil Med* 2011; 47(2): 237–244.
17. Araujo AC, do Carmo Silva Parreira P, Junior LCH, et al. Medium term effects of kinesio taping in patients with chronic non-specific low back pain: a randomized controlled trial. *Physiotherapy* 2018; 104(1): 149–151.
18. Kachanathu SJ, Alenazi AM, Seif HE, et al. Comparison between kinesio taping and a traditional physical therapy program in treatment of nonspecific low back pain. *J Phys Ther Sci* 2014; 26(8): 1185–1188.
19. Keles BY, Yalcinkaya EY, Gunduz B, et al. Kinesio taping in patients with lumbar disc herniation: a randomised, controlled, double-blind study. *J Back Musculoskelet Rehabil* 2017; 30(3): 543–550.
20. Castro-Sánchez AM, Lara-Palomo IC, Mataran-Penarrocha GA, et al. Kinesio taping reduces disability and pain slightly in chronic non-specific low back pain: a randomised trial. *J Physiother* 2012; 58(2): 89–95.
21. Parreira PC, Costa Lda C, Takahashi R, et al. Kinesio taping to generate skin convolutions is not better than sham

taping for people with chronic non-specific low back pain: a randomised trial. *J Physiother* 2014; 60: 90–96.
22. Luz JMA, Sousa MV, Neves LA, et al. Kinesio Taping® is not better than placebo in reducing pain and disability in patients with chronic non-specific low back pain: a randomized controlled trial. *Braz J Phys Ther* 2015; 19: 482–490.
23. Al-Shareef AT, Omar MT and Ibrahim AH. Effect of kinesio taping on pain and functional disability in chronic nonspecific low back pain: a randomized clinical trial. *Spine* 2016; 41: E821–E828.
24. Grześkowiak M, Krawiecki Z, Labedz W, et al. Short-term effects of Kinesio Taping® on electromyographic characteristics of paraspinal muscles, pain and disability in patients with lumbar disc herniation. *J Sport Rehabil*. Epub ahead of print 6 February 2018. DOI: 10.1123/jsr.2017-0086.
25. Added MA, Costa LO, de Freitas DG, et al. Kinesio taping does not provide additional benefits in patients with chronic low back pain who receive exercise and manual therapy: a randomized controlled trial. *J Orthop Sports Phys Ther* 2016; 46: 506–513.
26. Köroğlu F, Çolak TK and Polat MG. The effect of Kinesio® taping on pain, functionality, mobility and endurance in the treatment of chronic low back pain: a randomized controlled study. *J Back Musculoskelet* 2017; 30: 1087–1093.
27. Bae SH, Lee JH, Oh KA, et al. The effects of kinesio taping on potential in chronic low back pain patients anticipatory postural control and cerebral cortex. *J Phys Ther Sci* 2013; 25(11): 1367–1371.
28. Kamali F, Sinaei E and Taherkhani E. Comparing spinal manipulation with and without Kinesio Taping® in the treatment of chronic low back pain. *J Bodyw Mov Ther* 2018; 22: 540–545.
29. Kase K, Wallis J and Kase T. *Clinical therapeutic applications of the kinesio taping method*. 2nd ed. Albuquerque, NM: Kinesio Taping Association, 2003.
30. Yang JM and Lee JH. Is kinesio taping to generate skin convolutions effective for increasing local blood circulation. *Med Sci Monit* 2018; 24: 288–293.
31. Woodward KA, Unnithan V and Hopkins ND. Forearm skin blood flow after kinesiology taping in healthy soccer players: an exploratory investigation. *J Athl Train* 2015; 50: 1069–1075.
32. Ouyang JH, Chang KH, Hsu WY, et al. Non-elastic taping, but not elastic taping, provides benefits for patients with knee osteoarthritis: systemic review and meta-analysis. *Clin Rehabil* 2018; 32: 3–17.
33. Konishi Y. Tactile stimulation with kinesiology tape alleviates muscle weakness attributable to attenuation of Ia afferents. *J Sci Med Sport* 2013; 16: 45–48.
34. Copurgensli C, Gur G and Tunay VB. A comparison of the effects of Mulligan's mobilization and kinesio taping on pain, range of motion, muscle strength, and neck disability in patients with cervical spondylosis: a randomized controlled study1. *J Back Musculoskelet Rehabil*. Epub ahead of print 27 May 2016. DOI: 10.3233/BMR-160713.
35. Balki S, Goktas HE and Oztemur Z. Kinesio taping as a treatment method in the acute phase of ACL reconstruction: a double-blind, placebo-controlled study. *Acta Orthop Traumatol Turc* 2016; 50(6): 628–634.
36. Yang J, Lee B and Kim C. Changes in proprioception and pain in patients with neck pain after upper thoracic manipulation. *J Phys Ther Sci* 2015; 27(3): 795–798.
37. Coulter ID, Crawford C, Hurwitz EL, et al. Manipulation and mobilization for treating chronic low back pain: a systematic review and meta-analysis. *Spine J* 2018; 18: 866–879.