ABSTRACT

THE EFFECTS OF CONSERVATIVE THERAPY WITH KINESIO TAPING VERSUS CONSERVATIVE THERAPY ALONE IN ADULTS WITH CHRONIC NON-SPECIFIC LOW BACK PAIN ON DISABILITY AND PAIN: A META-ANALYSIS

Objectives: Determine the effects of Kinesio taping (KT) with a conservative therapy program versus conservative therapy program alone in patients age 18-75 with chronic nonspecific low back pain on pain and disability.

Methods: Studies analyzing a conservative therapy program with KT compared to a conservative therapy program alone standard were investigated. These studies contained similar treatments, outcome measures, and follow-up periods. Studies were analyzed to determine the treatment effect and homogeneity among studies.

Results: Kinesio tape when added to a conservative therapy program did not result in superior outcomes compared to those who received conservative therapy alone.

Conclusion: The use of conservative therapy with KT has not been shown to be more effective in patients with CNSLBP than conservative therapy alone in improving pain and disability. Continued research is needed with higher-level evidence in the treatment of pain and disability in individuals with CNSLBP.

Study Design: A meta-analysis of clinical studies examining the effects of a conservative therapy program with KT versus a conservative therapy program alone in adults 18-75 with CNSLBP on pain and disability.

Brittney Bailey
May 2017
THE EFFECTS OF CONSERVATIVE THERAPY WITH KINESIO TAPING VERSUS CONSERVATIVE THERAPY ALONE IN ADULTS WITH CHRONIC NON-SPECIFIC LOW BACK PAIN ON DISABILITY AND PAIN: A META-ANALYSIS

by
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A project submitted in partial fulfillment of the requirements for the degree of Doctor of Physical Therapy in the Department of Physical Therapy College of Health and Human Services California State University, Fresno May 2017
APPROVED

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BACKGROUND

Low back pain (LBP) is a significant problem affecting nearly 70-85% of all people in the United States at some point in their lifespan.\textsuperscript{1,2} The cost of healthcare for management of LBP in the US was estimated to be 50 to 100 billion dollars annually in 1991 by 2007 it had risen to an estimated 84 to 624.8 billion dollars.\textsuperscript{3-5} LBP is the fourth most expensive health care condition and the third leading cause of poor health in the United States.\textsuperscript{3} The prevalence of low back pain increases after the age of 65, with the burden of low back pain often beginning between 20-40 years of age and becoming increasingly more common in people 40 to 80 years of age.\textsuperscript{1,2} Although research states women are more effected by low back pain than men, 9-12\% of all people have low back pain at any given point in time.\textsuperscript{1}

Low back pain is defined as pain or discomfort that is confined below the costal margin and above the inferior gluteal folds, with or without radicular involvement into the lower extremities.\textsuperscript{6} Low back pain can be divided into 3 subcategories including acute, sub-acute and chronic low back pain. Acute low back pain (ALBP) is correlated with tissue damage or the warning of damage and can last a few days to 6 weeks, with no residual loss of function. Acute low back pain may progress into sub-acute low back pain. Sub-acute low back pain can last 4 to 12 weeks. Similar to acute low back pain, sub-acute low back pain (SLBP) can resolve or progress into chronic low back pain (CLBP). Chronic low back pain is low back pain with symptoms lasting longer than 12 weeks.\textsuperscript{7} The majority of individuals with ALBP or SLBP are successfully treated in primary care settings; however, 10-15\% of individuals with ALBP or SLBP will not respond to treatment. This results in low back pain symptoms that progress to a chronic stage.
of healing, meaning that the healing phase has been completed, yet there is persistent pain.\textsuperscript{8,9}

\textbf{Chronic Non-Specific Low Back Pain}

Chronic low back pain is long lasting persistent pain past the normal connective tissue healing, affecting an individual’s function, well-being and quality of life.\textsuperscript{7,10,11} Chronic low back pain begins as an acute injury, disease or stress to one or multiple structures of the spine including muscles, ligaments, joints, nerves, or the spinal cord.\textsuperscript{12} Individuals with CLBP experience prolonged nociception in spite of timelines that indicate the injury is healed. Pain signals are carried along axons into the spinal cord and relayed to neurons into the brain. The nerve pathways carrying pain signals from the spinal cord to the brain become hyper reactive. In other words, the brain is being sent signals that no longer reflect the accurate health of the tissue because neurons now send faulty information. For example, light touch or gentle massage may be perceived as painful.\textsuperscript{13} This change in perception can create neuroplastic changes in the central nervous system. This misperception results in the fear that certain movements cause damage and should be avoided. This is turn reinforces a negative feedback cycle that may drive the patient to move less and become fearful of moving in a normal manner in patients with CLBP.\textsuperscript{12-16}

Chronic low back pain can be further subdivided based on causation based on categories of radiculopathy, specific spinal impairment or non-specific etiologies. Low back pain related to inflammation or irritation of the nervous system which produces radiating pain from the low back into the buttock and down the leg in a dermatomal pattern is called radiculopathy.\textsuperscript{17} Spinal impairments
related to CLBP are caused by known structural deformities to the spine such as scoliosis.

Non-specific low back (NSLBP) pain is defined as low back pain not attributable to a distinguishable, known specific pathology, e.g. an infection, tumor, osteoporosis, fracture structural deformity, inflammatory disorder, ankylosing spondylitis, radicular syndrome or cauda equina syndrome. The prevalence of people identified as having NSLBP is between 85 to 90%. According to the American Physical Therapy Association’s (APTA) “Move Forward” Low Back Pain Survey, two-thirds of Americans experience low back pain, with 37 percent of those cases leading to chronic problems. Chronic non-specific low back pain (CNSLBP) is not a clinical diagnosis, but rather a syndrome to describe individuals with persistent low back pain resulting varying levels of disability, physical impairments and chronicity.

**Biopsychosocial Model**

Every person experiences pain differently. There is a range of psychological and socioeconomic factors that interact with an individual’s physical pathology and modulate a patient’s report of symptoms and disability. For example, anxiety, depression and stress can increase psychological distress and lengthen the duration of CLBP symptoms. Once LBP becomes chronic, it can be a significant source of slowed recovery leading to disability, absence from work, activity limitation, and substance abuse all of which subsequently put a high burden of cost on the health-care system.

As a result of socioeconomic and psychological factors influencing pain behaviors, models were designed to describe the multifaceted nature of chronic low back pain. One such model is the Biopsychosocial Model of chronic low back
pain. The Biopsychosocial Model of chronic pain views CLBP as a dynamic and complex interaction among biological, psychological, and social factors that perpetuate and even worsen the clinical presentation. According to the Biopsychosocial Model, CLBP requires a multi-factorial treatment because individuals with chronic pain are at a risk for emotional disorders, maladaptive cognitions, functional deficits, physical deconditioning and nociceptive deregulation. One study by Vlaeyen, et.al., suggests that individuals with chronic pain associate activity as harmful and therefore they avoid physical activities in order to avoid pain, which in turn increases disability. Therefore, treatments to reduce CNSLBP are vital to stop the progressive disability and pain experienced by an individual.

Treatment Options

Commonly prescribed treatments for CNSLBP consist of medical management, pharmacological intervention, and conservative therapies. Due to poor association between pain, low back symptoms, pathology and imaging findings, it is difficult to determine the exact cause of the symptoms. For this reason, imaging and surgery are not recommended to treat CNSLBP. Typical pharmacological drugs including the use of non-steroidal anti-inflammatories, weak opioids (short term use), corticosteroids, antidepressants and muscle relaxants can be useful in the short term to resolve pain and muscle spasms.

Several interventions commonly used by physical therapists for CNSLBP are acupuncture, traction, transcutaneous electrical nerve stimulation, laser therapy, therapeutic ultrasound, lumbar supports, Kinesio taping (KT), and conservative therapy. The evidence regarding the effects of these techniques is low to moderate, despite the wide variety of research studies that assess the
effectiveness of KT. The purpose of this meta-analysis was to compare the effect of KT added to conventional physical therapy compared to conservative physical therapy alone in the treatment of CNSLBP.

Conservative therapy is defined as stretching, manual therapy, and exercise and joint mobilization. Conservative therapy has been globally endorsed as the gold standard treatment for reducing pain and disability in people with CLBP. Airaksinen et al. suggests exercise therapy as the first-line of treatment in the management of CNSLBP. Active exercise is the first line of treatment because it helps to improve impairments in function (reduced flexibility, strength and cardiovascular endurance), reduce back pain intensity, and improve back pain-related disability (less excessive fear and stifling pain attitudes/beliefs). According to Searle et al. intervention groups using strength, resistance, coordination and stabilization had the greatest effect in reducing pain associated with CLBP.

Kinesio Taping

Kinesio taping is one intervention that has been proposed for use in clients with CNSLBP. It has been around for 25 years, but became popular following the 2008 Olympics Games, when many of the athletes adorned the neon tape to various body parts. Kinesio taping was developed by Dr. Kenzo Kase. It was developed to mimic the qualities of the skin, replicate the effects of a therapist’s hand placement on a patient’s skin, and stretch approximately 55-60% of the tape’s resting length. Additionally, the adhesive in KT is designed to be effective for 3-5 days before the elastic components of the tape breaks down. The tape is made up of elastic strands wrapped by 100% cotton fibers to allow for evaporation of body moisture, to allow for quick drying, and to allow unrestricted movement.
The adhesive is heat activated and 100% acrylic. It is applied in a wave-like pattern in order to mimic the qualities of the fingerprint on the fingertips.\textsuperscript{27}

Kinesio Taping can be applied to the skin in a variety of different specialized shapes and patterns, including “Y”, “I”, “H”, “X”, “Fan”, Web” and “Donut” patterns. Dr. Kase designed KT to help assist in improvement of muscle function, gather fascia to align tissue in the desired position, activate the circulatory system by lifting the skin over the areas of inflammation and edema, and to reduce spasms and deactivate the pain system by stimulating cutaneous mechanoreceptors. For individuals with CNSLBP, the application patterns recommended are the “Y”, “I” and “H” patterns.\textsuperscript{27} The benefits of KT, explicit to LBP, are purported to include a decompression effect on the skin and superficial/deep facial layers beneath, and stimulation of multiple sensory receptors resulting in a mechanical reduction in pain and swelling. These benefits are purported to increasing physiologic range of motion and improve the quality of motion.\textsuperscript{28} For the purpose of this meta-analysis studies that used the “I” application on both sides of the erector spinae with and without an additional “I” strip down the lumbar spinous processes were compared. The “I” application method was chosen because it has the best benefit over the area of injury to the back and is most commonly used throughout the body.\textsuperscript{27}

\textbf{Literature}

Chronic non-specific low back pain continues to be a problem in the US, with an overwhelming high prevalence leading to a huge financial burden on the healthcare system.\textsuperscript{2,3} Chronic non-specific low back pain has responded positively to conservative physical therapy treatment. Kinesio taping is considered one of the conservative physical therapy treatment options however; it lacks substantial
evidence to date in the treatment of CNSLBP. Kinesio taping is used among other populations with controversial findings. Thus, a meta-analysis to assess the efficacy of KT as an adjunct to conventional physical therapy is an important endeavor in order to determine if KT added to a conventional physical therapy program is more beneficial than conventional therapy alone.

**Purpose**

Based on the lack of strong evidence with regards to the treatment of CNSLBP as well as a lack of evidence that compares conservative therapy with KT to conservative therapy alone in the treatment of CNSLBP, evidence to determine the efficacy of KT in conjunction with conservative therapy is essential. The purpose of this meta-analysis was to compare the effects of conservative therapy with KT to conservative therapy alone in adults with CNSLBP pain as assessed by pain and disability. The hypothesis is that conservative therapy with KT will improve pain and disability when compared to conservative therapy alone in people with CNSLBP, between the ages of 18-75 years old, as measured by reduction in visual analog scale (VAS), Numerical Pain Rating Scale (NPRS) and Rolland Morris Disability Questionnaire (RMDQ). The null hypothesis is there will be no difference between groups treated with conservative therapy and groups treated with conservative therapy and KT in adults with CNSLBP, measured by change in the VAS, NPRS and RMDQ.
METHODS

The study design was generated using the framework presented by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines. Beginning in August 2016, an electronic search was conducted utilizing the following databases: Cinahl, Cochrane Library, and the U.S National Library of Medicine National Institutes of Health (Pubmed). The following search terms were used for each database: low back pain OR chronic low back pain OR chronic non-specific low back pain OR Kinesio taping OR conservative therapy. The search was limited to randomized controlled trials (RCT) published from 2007 to 2016 and written in the English language. Review of references of suitable papers provided secondary searches.

Eligibility Criteria and Study Selection

A single reviewer performed assessment of eligibility for this meta-analysis in a standardized method. Studies were excluded if inclusion/ exclusion criteria were not met, or if the study was not from a peer reviewed journal. Initial screenings of articles included reviews of titles and abstracts. Once studies were narrowed down, they were examined and analyzed in detail based on content and statistical data.

Inclusion criteria of the studies included an intervention of conservative therapy with KT, a comparison of conventional therapy, and the use of the VAS, NPRS and RMDQ outcome measures. To be eligible, studies had to include subjects (of either sex) between ages 18-75, that had experienced CNSLBP for more than 3 months, and who sought physical therapy treatment. Exclusion criteria included pregnancy or contradictions to physical exercise according to the
American College of Sports Medicine\textsuperscript{30}, serious spinal pathologies, nerve root compromise, and contraindications to KT due to intolerance or allergy to tape.

**Data Collection Process**

Data was collected from tables, figures and graphs for each study and further assessed individually regarding VAS, NPRS and RMDQ. The means and standard deviations were collected and used in the data analysis portion of this meta-analysis. The studies were statistically examined for homogeneity or heterogeneity as well as effect size of treatment outcomes.

**Operational Definitions**

Severity of pain was measured using the VAS and NPRS. The VAS determines subjective pain intensity using a 100 mm line, where 0 represents no pain and 100 signifies the worst possible pain.\textsuperscript{31,32} The NPRS assesses pain intensity on an 11 point scale ranging from 0 (no pain) to 10 (most severe pain).\textsuperscript{33} The RMDQ evaluates an individual’s disability level by assessing disability related to low back pain. The questionnaire consists of 24 questions that describe daily activities, which may be limited as a result of low back pain. The score range is from 0 to 24, where a higher score indicates greater disability.\textsuperscript{34-38} The VAS, NPRS and RMDQ have all been proven to have a high reliability and internal reliability for assessing acute and chronic pain.\textsuperscript{31-33,39,40}

**Quality Assessment**

Quality of the article selected for the meta-analysis were scored using the 11-point Physiotherapy Evidence Database (PEDro) scale (see Appendix). The PEDro scale identifies rank articles as strong or weak based on areas of validity, reliability and risk for bias. One point is awarded for each criteria met. The first
criterion is not counted in the scoring of the PEDro score, therefore the total score is out of 10 points. The separate items have a moderate to significant reliability with good reliability for the overall score. See Table 1 for the complete article quality assessment.

**Data Collection and Statistical Analysis**

Data was collected from tables, figures and graphs for each study and further assessed individually regarding VAS, NPRS, and RMDQ. The means and standard deviations were collected and used in the analysis portion of this meta-analysis. The studies were statistically examined for homogeneity or heterogeneity among studies and effect size of treatment outcomes.

Pain and disability, based on VAS, NPRS and RMDQ, was attained from chosen studies and assessed further individually. Each article was analyzed to obtain the effect size and confidence intervals based on given mean and standard deviations. The effect size was examined to determine the magnitude of the treatment effect. The effect size is categorized as small, medium or large with the set values of <0.30, 0.30-0.60, >0.60 respectively. The Q-value was calculated to conclude homogeneity or heterogeneity between studies and the P-value was used to determine significance of the intervention’s effect size. A P-value of <0.05 was considered to indicate a statistically significant effect size. Grand effect size was determined with use of forest plots. In regards to VAS, NPRS and RMDQ, a decrease in score signifies a reduction in pain and disability and therefore a negative effect-size represents a positive treatment affect.
RESULTS

Study Selection

Studies were screened for RCT’s between the years 2007 to present (2016). An initial search of the aforementioned databases yielded a total of 405 studies. After a removal of duplicate articles, 393 studies remained. A review of abstracts and titles, irrelevant articles were excluded. A total of 21 studies were appropriate for thorough review to determine if eligibility was met for inclusion in this meta-analysis. Following in-depth reviews, 15 studies were eliminated as they did not meet all inclusion criteria, study design, or have the appropriate intervention comparisons. Three studies were deemed eligible for this meta-analysis. The study by Added et al., the study by Kachanathu et al., and the study by Paoloni et al. remained because they compared conservative physical therapy with KT to conventional physical therapy alone in the treatment of CNSLBP.45-47 The studies included in this meta-analysis were published between 2011 and 2016 (see Table 3).

Characteristics of Included Studies

One evaluator assessed the quality of each study using the PEDro scale. For the studies included, the PEDro scores ranged from 3-8 out of a 10-point scale. The PEDro scale and scores are presented in Table 2. PEDro scores must be considered in order to interpret the results of this meta-analysis.

All 3 studies selected for review were RCT’s examining the effects of KT with conservative therapy versus conservative therapy alone on pain and disability using the VAS, NPRS and RMDQ on CLBP in adults. The population ranged from 18-75 years of age.
The interventions varied slightly between the taping techniques, durations of treatment and types of conservative care given. The durations ranged 4 to 5 weeks that included 2-3 intervention sessions per week. Conservative therapy ranged from stretching/exercise with or without manual therapy. The outcomes all included VAS or NPRS and RMDQ assessed at 4 to 5 weeks (see Table 3).

**Synthesis of Results**

Outcomes from Added et al., Kachanathu et al., and Paoloni et al., were pooled and analyzed in order to assess the effects of KT plus conservative therapy to conservative therapy alone in measures of pain and disability in the treatment of CNSLBP.\(^{45-47}\) The means and standard deviations from Added et al., Kachanathu et al., and Paoloni et al. were compared using Open Meta-Analysis software. A two-group random effects model was used to extract the effect size (ES), the upper and lower confidence intervals (CI), the grand effects size, P value, \(I^2\) value and Q statistic for pain using the VAS or NPRS (see Table 4) and for disability using the RMDQ\(^{45-47}\) (see Table 5).

Results of the statistical analysis for the two-group random effects model for pain demonstrated heterogeneity between the studies (\(Q = 9.357, P<0.05, I^2 = 78.82\)), no statistical difference between treatment groups (CI = -0.307, 1.141), and a grand effect size of 0.417 (medium effect). Results of the statistical analysis for the two-group random effects model for disability also demonstrate heterogeneity (\(Q =4.652, P >0.05, I^2 = 55.09\)), no statistical difference between taping groups (CI = -0.156, 0.810), and a grand effect size of 0.327 (medium effect).
DISCUSSION

The purpose of this meta-analysis was to compare the effectiveness of conservative therapy with KT versus conservative therapy alone in adults aged 18-75 with CNSLBP. It was hypothesized that conservative therapy with KT would demonstrate a greater treatment effect on reducing pain and disability in patients with CNSLBP when compared to conservative therapy alone. The results from the meta-analysis reject the alternate hypothesis and therefore must accept the null hypothesis. Kinesio tape added to conservative therapy did not result in superior outcomes when compared to those who received conservative therapy alone. Based on these findings, this discussion will review the outcomes and heterogeneous findings; as well provide further literature support and clinical implications for addressing pain and disability related to CNSLBP.

Review of Results

The results from this meta-analysis reject the hypothesis that a conservative physical therapy program accompanied with KT demonstrates a larger treatment effect on reducing pain and disability in individuals with CNSLBP when compared to a conservative physical therapy program alone. In relation to combined effect size, the conservative therapy group showed a favorable grand effect size for pain and disability. A positive effect size for pain and disability indicates the control group (conservative therapy) is more favorable than the experimental group (conservative therapy with KT). A Q statistic analysis was performed between studies for pain (Q= 9357) and disability (Q= 4.652). The results indicate heterogeneity in the studies, therefore, the treatment effect may be altered. Thus an understanding of the possible sources of heterogeneity within the studies is needed.
There are multiple potential causes contributing to the heterogeneity for this meta-analysis, which may be explained by the varied PEDro scores, sample sizes and treatment durations. The PEDro scores ranged from 3-8 out of 10, revealing a moderate to high risk for bias. The study by Kachanathu et al. had a PEDro score of 3/10 because it lacked results of between group statistical comparisons of one key outcome measure, concealed allocation and measures of variability for at least one key outcome, which the studies by Added et al. and Paoloni et al. accounted for. Additionally, sample sizes differed among the studies. A large variation between sample sizes was noted and ranged from 13 to 74. For example, Added et al. had 74 subjects whereas Paoloni et al. had only 13 subjects. The difference in number of subjects may have skewed the results of this meta-analysis, with the study comprised of more subjects providing unusual weighting to the statistical analysis. Along with different sample sizes, wide ranges of standard deviations were found in all studies demonstrating the participants varied greatly. Lastly, another possible contribution to heterogeneity is the varied treatment durations. For example, subjects in Added et al. were treated for 2 times a week for 5 weeks, whereas Kachanathu et al. and Paoloni et al. treated patients for 3 times a week for 4 weeks. Existing literature must be reviewed in order to further understand the research concerning KT.\footnote{45-47}

**Existing Literature Regarding KT**

Despite the copious amount of literature on KT, there is conflict regarding the efficacy of KT in different populations. Kenzo Kase, the creator of KT, claims “KT can improve muscle function, activate the circulatory system, reduce spasms and deactivate the pain system.” However, there is no literature to support Dr.
Kase’s claims.\textsuperscript{27} Significant gaps exist in regards to the support of KT, which warrants further review.

The efficacy of KT is controversial. A systematic review by Nelson et al. found little evidence that supports the use of KT in patients. Results from this systematic review found that for CLBP, KT is not superior to sham taping in improving pain and disability. Further findings stated that KT is no more effective than sham taping in improving range of motion and global perceived effect in the short term, and KT is no more effective than conservative therapy in improving anticipatory postural control of the transverse abdominus muscle and improving cerebral cortex potential.\textsuperscript{48} In addition to the findings of this meta-analysis, a randomized controlled trial by Akbas et al. and a pilot study by Llopis et al. also found no significant improvement in pain and disability with the addition of KT to a conventional exercise program when compared to conservative exercise program alone in patients with patellofemoral pain syndrome and chronic neck pain.\textsuperscript{49,50} However, there is literature that supports KT that also warrants further review.

In contrast to the number of studies stating that KT has no effect on CNSLBP, there are an equal number of randomized controlled trial results that find KT to be beneficial. For example, a RCT by Simsek et al. found improvements in night pain, pain with movement, an increase in shoulder external rotation strength, and improvements in painful shoulder abduction range of motion with the addition of KT to an exercise program. Results of these studies were conducted at the twelfth day follow up in patients with subacromial impingement syndrome.\textsuperscript{51}
Kinesio Tape and Musculoskeletal Injuries

To add to the confusion regarding the efficacy of KT, gaps in the literature exist with regards to the effectiveness of KT in preventing and/or improving musculoskeletal and sport injuries other than CNSLBP. A systematic review by Parreira et al. found KT either provided no significant benefit or its effect was too small to be clinically significant in people with musculoskeletal conditions (neck, low back and patellofemoral pain) compared to sham taping or no intervention. Two systematic reviews, one by Mostafavifar et al. and one by Kalron et al. both found KT provides short term to immediate term pain relief with pain in patients with musculoskeletal disorders; however, there is insufficient evidence to support the use of KT in the lower extremities for producing a long term effect. Lastly, Williams et al. conducted a meta-analysis using KT for prevention of sport injuries, which demonstrated KT had a small beneficial effect in improving strength and range of motion but little quality evidence supported KT over other elastic tapes in the management and prevention of sport injuries.

Conservative and Multidisciplinary Program

There is moderate quality evidence to support the use of conservative therapy with a multidisciplinary program as a primary intervention for CNSLBP as opposed to conservative physical therapy with KT. According to Middlekoop et al., exercise therapy and a multidisciplinary treatment lead to a reduction in pain intensity, disability and long term function with moderate quality of evidence compared to no treatment or usual primary care. Additionally, a systematic review by van Tulder et al. found conservative therapy/exercise increased CLBP patients’ to return to normal daily activities and work. Lastly, a systematic review by Guzman et al. found that intensive multidisciplinary biopsychosocial
rehabilitation combined with functional restoration reduced pain and improved function in patients with CLBP.\textsuperscript{58}

**Clinical Implications**

Based on this meta-analysis, the implication for clinical practice suggests that conventional therapy is a more effective treatment for CNSLBP compared to conventional physical therapy with KT. Although KT is commonly used in clinical practice, this meta-analysis and current evidence does not support the efficacy of this intervention. Kinesio taping became a popular modality in physical therapy practices after marketing campaigns tied to the 2008 Olympic Games; however, there is little evidence to support the efficacy of KT. Clinicians should cautiously consider the effectiveness of KT when using it as an intervention. Moreover, due to the moderate level evidence in support of conventional therapy, CNSLBP patients should promote conservative physical therapy and a multidisciplinary program to reduce pain and disability. Future research could help fill the existing literature gaps and add to the current clinical implication.

**Future Research**

Chronic non-specific low back pain is the leading cause of activity limitation and work absence throughout the majority of the world, making it an important topic for future research. Chronic non-specific low back pain is a complex condition affecting not just the physical but emotional state of the person. CNSLBP pain can be experienced for months to years; complete symptom reduction may be unachievable. Due to this, further studies are needed to determine the most efficient and cost effective method of reducing CNSLBP while simultaneously producing high quality evidence.
In the treatment of CNSLBP there is low to moderate quality evidence to direct efficacious interventions. This is a concern for this population of individuals. Future research needs to include higher quality evidence with little risk for bias by potentially including blinding of patients and instructors. A multitude of studies, including the 3 studies in this meta-analysis, lack the proper blinding of participants as well as the blinding of the treating clinicians. Higher quality studies need to consider the multiple factors that facilitate CNSLBP and include the biopsychosocial components that facilitate pain.

Limitations of this Meta-Analysis

One of the main limitations of this meta-analysis was the lack of blinding in all 3 studies. Due to the proper application technique of KT, it was difficult for studies to blind therapists or subjects, resulting in a potential risk for bias in all 3 studies. Another limitation was the lack of similar patient populations and baseline characteristics. The 3 studies used in this meta-analysis had varying patient populations ranging from young, to middle, to older aged adults. Additionally, Paoloni et al. examined a sub category of CNSLBP individuals who could not achieve flexion relaxation. This was not included in the other studies used for this meta-analysis. Lack of consistent subject characteristics in the studies can affect the overall results of this meta-analysis because varying patient populations have differing symptom durations, motivation, physical function levels, and base line pain and disability levels.47

Thirdly, conservative therapy programs differed in the studies analyzed. Added et al. defined conservative therapy as a program including exercise and manual therapy with a home exercise strengthening program to be completed 1 time per day.45 Conversely, Kachanathu et al. implemented a stretching and
strengthening program of the back and abdomen without a home exercise program.46 Paoloni et al.’s definition of a conservative therapy program was with non-specific stretching, active exercise, and relaxation techniques combined with encouragement to perform a home exercise program.47 Of final note, all 3 studies varied in KT application style, amount tension applied and amount of time the tape stayed on.

**Conclusion**

The use of conservative therapy with KT has not been shown to be more effective in patients with CNSLBP than conservative therapy alone in improving pain and disability in adults aged 18 to 75 years old. Continued research is needed with moderate to higher-level evidence in the treatment of pain and disability in individuals with CNSLBP.
REFERENCES
REFERENCES


46. Kachanathu SJ, Alenazi AM, Seif HE, Hafez AR, Alroumim MA. 
Comparison between Kinesio Taping and a Traditional Physical Therapy 

muscles influences clinical and electromyographic characteristics in chronic 


49. Akbas E, Atay AO, Yuksel I. The effects of additional kinesio taping over 

50. Llopis GL, Aranda CM. Phyiotherapy intervention with kinesio taping in 

51. Simsek H, Balki S, Keklik S, Ozturk H, Elden H. Does Kinesio taping in 
addition to exercise therapy improve the outcomes in subacromial 
impingement syndrome? A randomized, double blind, controlled clinical 

52. Parreira Pdo C, Costa Lda C, Hespanhol LC, Jr., Lopes AD, Costa LO. 
Current evidence does not support the use of Kinesio Taping in clinical 

53. Mostafavifar M, Wertz J, Borchers J. A systematic review of the 
effectiveness of kinesio taping for musculoskeletal injury. Phys Sportsmed. 

54. Kalron A, Bar-Sela S. A systematic review of the effectiveness of Kinesio 

55. Williams S, Whatman C, Hume PA, Sheerin K. Kinesio taping in treatment 
and prevention of sports injuries: a meta-analysis of the evidence for its 

56. van Middelkoop M, Rubinstein SM, Verhagen AP, Ostelo RW, Koes BW, 
van Tulder MW. Exercise therapy for chronic nonspecific low-back pain. 

TABLES
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Added</th>
<th>Kachanathu</th>
<th>Paoloni</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Eligibility Criteria</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2. Random allocation</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>3. Concealed allocation</td>
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<td></td>
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</tr>
<tr>
<td>4. Baseline comparability</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5. Blind subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Blind therapists</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>7. Blind assessors</td>
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<tr>
<td>8. Adequate follow-up</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>9. Intention-to-treat analysis</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>10. Between-group comparisons</td>
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<tr>
<td>11. Points estimates and variability</td>
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<td></td>
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</tr>
<tr>
<td>Total of 2-11</td>
<td>8/10</td>
<td>3/10</td>
<td>7/10</td>
</tr>
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<td>Table 2. Description of Studies</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Author/ Study</strong></td>
<td><strong>Sample Size</strong></td>
<td><strong>Intervention</strong></td>
<td><strong>Frequency/ Duration</strong></td>
</tr>
<tr>
<td>Kinesio Taping Does Not Provide Additional Benefit in Patients with Chronic Low Back Pain Who Receive Exercise and Manual Therapy: A Randomized Controlled Trail Added et al., 2016</td>
<td>K/C: 74, C: 74</td>
<td>Individualized manual therapy (joint mobilizations, myofascial release) and exercise (aerobic exercise and strengthening of rectus abdominus, glute maximus, transverse abdominis and lumbar multifidus) K/C: Kinesio tape applied in addition to bilateral erector spinal muscles parallel to spinous processes of lumbar vertebrae: 48 hours HEP: Strengthening exercise 1x a day (3 sets of 10 repetitions for each exercise)</td>
<td>30-60 minute sessions 2 x 5 weeks</td>
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<tr>
<td>Comparison Between Kinesio Taping and a Traditional Physical Therapy Program in Treatment of Nonspecific Low Back Pain Kachanathu et al., 2014</td>
<td>K/C: 20, C: 20</td>
<td>Conventional Therapy: stretching exercise (back, iliopsoas and hamstring), strengthening (abdominal muscles) Stretches: 3 sets of 3 repetitions; 30 second hold and 30 second rest Strengthening: 1 set of 10 repetitions; 5 second hold K/C: In addition two I- strips of Kinesio Tape applied from the origin of the lumbar erector spinae (iliocostalis lumborum) to its insertion</td>
<td>3 x 4 weeks</td>
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Table 2 (cont.)

<table>
<thead>
<tr>
<th>Author/ Study</th>
<th>Sample Size</th>
<th>Intervention</th>
<th>Frequency/ Duration</th>
<th>Outcome Measure</th>
<th>Results</th>
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<tr>
<td>Kinesio Taping Applied to Lumbar Muscles Influences Clinical and Electromyographic Characteristics in Chronic Low Back Pain Patients Paoloni et al., 2011</td>
<td>K/C: 13 C: 13 K: 13</td>
<td>Intervention: Relaxation techniques, stretching, active exercises (back extensors, psoas, ischiotibial and pelvic muscles) HEP: Encouraged to perform exercises at home.</td>
<td>30 minutes 3 x 4 weeks</td>
<td>VAS RMDQ FR</td>
<td>Kinesio Tape had both immediate and short term pain relief for CLBP patients Therapeutic exercise with and without Kinesio Tape lead to a greater reduction in pain-related disability and better muscle function restoration, measured by FR.</td>
</tr>
</tbody>
</table>

Abbreviations: K, Kinesio Taping; C: Conventional Therapy; K/C, Kinesio Taping with Conventional Therapy; HEP, Home Exercise Program; ROM, Range of Motion; NPRS, Numerical Pain-Rating Scale; RMDQ, Roland Morris Disability Questionnaire; VAS, Visual Analogue Scale; FR, Flexion Relaxation
Table 3. Meta-Analysis Results: Two Group Random Effect for Pain

<table>
<thead>
<tr>
<th>Study</th>
<th>Effect Size</th>
<th>CI Lower</th>
<th>CI Upper</th>
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<tr>
<td>Added et al. 2016</td>
<td>0.055</td>
<td>-0.267</td>
<td>0.377</td>
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<tr>
<td>Kachanathu et al. 2014</td>
<td>1.185</td>
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<td>1.857</td>
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<td>Paoloni et al. 2011</td>
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<td>Total ES</td>
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<tr>
<td>P Value</td>
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<td>I² Value</td>
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Table 4. Meta-Analysis Results: Two Group Random Effects for Disability

<table>
<thead>
<tr>
<th>Study</th>
<th>Effect Size</th>
<th>CI Lower</th>
<th>CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Added et al. 2016</td>
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<td>0.327</td>
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<tr>
<td>Kachanathu et al. 2014</td>
<td>0.718</td>
<td>0.079</td>
<td>1.358</td>
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<tr>
<td>Paoloni et al. 2011</td>
<td>0.490</td>
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<td>1.270</td>
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<tr>
<td>Total ES</td>
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<td>Q Value</td>
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<td>P Value</td>
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<tr>
<td>I² Value</td>
<td>55.09</td>
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</tr>
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</table>
FIGURES
Figure 1. Consort
Figure 2. Pain Forest Plot

Figure 3: Disability Forest Plot
APPENDIX: CONSORT
### PEDro scale

1. Eligibility criteria were specified
2. Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated as order in which treatments were received)
3. Allocation was concealed
4. The groups were similar at baseline regarding the most important prognostic indicators
5. There was blinding of all subjects
6. There was blinding of all therapists who administered the therapy
7. There was blinding of all assessors who measured at least one key outcome
8. Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups
9. All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by “intent to treat”
10. The results of between-group statistical comparisons are reported for at least one key outcome
11. The study provides both point measures and measures of variability for at least one key outcome

The PEDro scale is based on the Delphi list developed by Verhagen and colleagues at the Department of Epidemiology, University of Maastricht (Verhagen AP et al, 1998). The Delphi list is a criteria list for quality assessment of randomised clinical trials for conducting systematic reviews developed by Delphi consensus. Journal of Clinical Epidemiology, 51(12):1235-41. The list is based on “expert consensus” not, for the most part, on empirical data. Two additional items not on the Delphi list (PEDro scale items 8 and 10) have been included in the PEDro scale. As more empirical data comes to hand it may become possible to “weight” scale items so that the PEDro score reflects the importance of individual scale items.

The purpose of the PEDro scale is to help the users of the PEDro database rapidly identify which of the known or suspected randomised clinical trials (in RCTs or CCTs) archived on the PEDro database are likely to be internally valid (criteria 2-9), and could have sufficient statistical information to make their results interpretable (criteria 10-11). An additional criterion (criterion 1) that relates to the external validity (or “generalisability” or “applicability” of the trial) has been retained so that the Delphi list is complete, but this criterion will not be used to calculate the PEDro score reported on the PEDro website.

The PEDro scale should not be used as a measure of the “validity” of a study’s conclusions. In particular, we caution users of the PEDro scale that studies which show significant treatment effects and which score highly on the PEDro scale do not necessarily provide evidence that the treatment is clinically useful. Additional considerations include whether the treatment effect was big enough to be clinically worthwhile, whether the positive effects of the treatment outweigh its negative effects, and the cost-effectiveness of the treatment. The scale should not be used to compare the “quality” of trials performed in different areas of therapy, primarily because it is not possible to satisfy all scale items in some areas of physiotherapy practice.

Last amended June 21st, 1999
Notes on administration of the PEDro scale:

All criteria: Points are only awarded when a criterion is clearly satisfied. If on a literal reading of the trial report it is possible that a criterion was not satisfied, a point should not be awarded for that criterion.

Criterion 1: This criterion is satisfied if the report describes the source of subjects and a list of criteria used to determine who was eligible to participate in the study.

Criterion 2: A study is considered to have used random allocation if the report states that allocation was random. The precise method of randomisation need not be specified. Procedures such as coin-tossing and dice-rolling should be considered random. Quasi-randomisation allocation procedures such as allocation by hospital record number or birth date, or alternation, do not satisfy this criterion.

Criterion 3: Concealed allocation means that the person who determined if a subject was eligible for inclusion in the trial was unaware, when this decision was made, of which group the subject would be allocated to. A point is awarded for this criterion, even if it is not stated that allocation was concealed, when the report states that allocation was by sealed opaque envelopes or that allocation involved contacting the holder of the allocation schedule who was “off-site”.

Criterion 4: At a minimum, in studies of therapeutic interventions, the report must describe at least one measure of the severity of the condition being treated and at least one (different) key outcome measure at baseline. The rate must be satisfied that the groups’ outcomes would not be expected to differ, on the basis of baseline differences in prognostic variables alone, by a clinically significant amount. This criterion is satisfied even if only baseline data of study completers are presented.

Criteria 4, 7-11: Key outcomes are those outcomes which provide the primary measure of the effectiveness (or lack of effectiveness) of the therapy. In most studies, more than one variable is used as an outcome measure.

Criterion 5-7: Blinding means the person in question (subject, therapist or assessor) did not know which group the subject had been allocated to. In addition, subjects and therapists are only considered to be “blind” if it could be expected that they would have been unable to distinguish between the treatments applied to different groups. In trials in which key outcomes are self-reported (e.g., visual analogue scale, pain diary), the assessor is considered to be blind if the subject was blind.

Criterion 8: This criterion is only satisfied if the report explicitly states both the number of subjects initially allocated to groups and the number of subjects from whom key outcome measures were obtained. In trials in which outcomes are measured at several points in time, a key outcome must have been measured in more than 85% of subjects at one of those points in time.

Criterion 9: An intention to treat analysis means that, where subjects did not receive treatment (or the control condition) as allocated, and where measures of outcomes were available, the analysis was performed as if subjects received the treatment (or control condition) they were allocated to. This criterion is satisfied, even if there is no mention of analysis by intention to treat, if the report explicitly states that all subjects received treatment or control conditions as allocated.

Criterion 10: A between-group statistical comparison involves statistical comparison of one group with another. Depending on the design of the study, this may involve comparison of two or more treatments, or comparison of treatment with a control condition. The analysis may be a simple comparison of outcomes measured after the treatment was administered, or a comparison of the change in one group with the change in another (when a factorial analysis of variance has been used to analyse the data, the latter is often reported as a group × time interaction). The comparison may be in the form of hypothesis testing (which produces a “p” value, describing the probability that the groups differed only by chance) or in the form of an estimate (for example, the mean or median difference, or a difference in proportions, or number needed to treat, or a relative risk or hazard ratio) and its confidence interval.

Criterion 11: A point measure is a measure of the size of the treatment effect. The treatment effect may be described as a difference in experimental outcomes, or as the outcome in (each of) all groups. Measures of variability include standard deviations, standard errors, confidence intervals, interquartile ranges (or other quantile ranges), and ranges. Point measures and/or measures of variability may be provided graphically (for example, SDs may be given as error bars in a Figure) as long as it is clear what is being graphed (for example, as long as it is clear whether error bars represent SDs or SEs). Where outcomes are categorical, this criterion is considered to have been met if the number of subjects in each category is given for each group.