Evaluation of Kinesiotaping Technique Efficacy across Multiple Domain of Knee Osteoarthritis: A Critical Review of Current Literature

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Abstract: Kinesiotaping (KT) has been increasingly acknowledged in the treatment of knee osteoarthritis (KOA), in which there is constant pain, reduced ranges of motion, and muscle weakness, despite its unclear physiological basis and lack of efficient methods for its standard implementation. While recent research suggests a short-term benefit for KT in pain, ranges of motion, and neuromuscular activity, findings remain inconclusive due to large variations in methods implemented. In our critical review of existing randomized controlled trials, several issues were identified, including conflicts of interest, large risk of bias in study setting, and discrepancies in tape stretching force, methods of application, and duration of application and reapplication in kinesiotaping. Together, these factors make it challenging to replicate KT's methods and outcomes in the treatment of KOA, as well as to maintain its long-term efficacy. Therefore, even while the current body of research supports the potential for some significant short-term pain and joint function symptom reduction when using KT, the method's overall significance is still quite low. In order to comprehend the true therapeutic effect of KT and provide appropriate guidelines for the therapy of knee osteoarthritis, this review has highlighted the need for future high-quality research investigations.

Keywords: Athletic Tape, Chronic Pain, Muscle Strength, Osteoarthritis Knee, Range of Motion.

Introduction

Knee osteoarthritis (KOA) is a long-term degenerative joint condition marked by pain, synovial inflammation, subchondral bone remodeling, and gradual cartilage

degradation. It is one of the main causes of impairment in the globe, especially for elderly people.[1]The quality of life is eventually impacted by the disorder, which causes joint stiffness, reduced range of motion (ROM), muscular weakness, and diminished functional mobility. The development of KOA is influenced by a number of risk factors, including age, obesity, joint injury, genetic susceptibility, and mechanical stress.[2]

Management strategies for KOA

Pharmacological and non-pharmacological therapy are frequently used in combination to treat KOA. Nonsteroidal anti-inflammatory drugs (NSAIDs) and corticosteroid injections are examples of pharmacological treatments that attempt to reduce pain but do not slow the course of illness. Patients with severe grades of KOA are the only ones eligible for surgical therapies like total knee replacement. Physical therapy, exercise, weight control, and assistive technology are examples of non-pharmacological therapies that are proving to be extremely successful in managing symptoms and postponing the onset of disease.[3]Kinesiotaping (KT) is one of these methods that has lately gained attention as a possible additional treatment for osteoarthritis of the knee.[4]

Kinesiotaping: Mechanisms and Applications

Kinesiotaping (KT) is the application of an elastic, adhesive tape to the skin in order to enhance neuromuscular function, improve circulation, and offer structural support. KT is believed to improve proprioceptive feedback and reduce pain by activating the senses mechanoreceptors, and adjust muscle activity to maximize joint alignment.[5]The tape uses an acrylic adhesive that is triggered by body heat and doesn't include latex it is composed of elastic polymer strands encased in 100% cotton fibers. Its characteristics surpass those of standard bandage tapes, as it enables rapid drying, prolonged usability, and features a thinner, more flexible material (with a resting stretch/longitudinal stretch of 55-60% and overall elasticity of 120-140%), allowing for precise wrapping around tissues and joints.[6]

Clinical use and evidence of Kinesiotaping in Knee OA

KT is used to enhance lymphatic drainage in the treatment of circulatory disorders by helping to remove excess amounts of fluid. Therefore, KT treatment acts like a great stabilizing agent and reduces heat produced by excess friction to lift the skin and relieve pressure from subcutaneous nociceptors.[7]

KT has been widely used as an adjunct therapy for patients with KOA to alleviate pain and enhance joint stabilization and function. Evidence from research supports that taping may improve patellar tracking; enhance muscle recruitment; and reduce mechanical load on the knee joint.[8]In addition to its use in rehabilitation, KT is often used alongside therapeutic exercise in order to enhance the effectiveness of the rehabilitation process. However, there is still no consensus among clinical researchers

about the effectiveness of KT; some studies report statistically significant increases in function and decrease in pain levels, while other studies indicate no significant improvement when compared to either a placebo or conventional PT.[9,10]

Although KT has rapidly gained interest among physical agents used to treat pain, muscle strength and range of motion (ROM) associated with knee osteoarthritis (KOA), there remain unanswered questions regarding the best methods of applying KT, how long to use KT, and how long KT continues to help after treatment stops. This review analyzed the evidence supporting KT from published literature to determine if KT could be used as a practical treatment option for KOA-related symptoms.[4]

Numerous research have produced contradictory results about the medicinal advantages of KT. About 38 KT systematic evaluations assessing the usefulness for particular ailments have been published since 2010. The reviews discovered conflicting data about the knee and shoulder.[11]

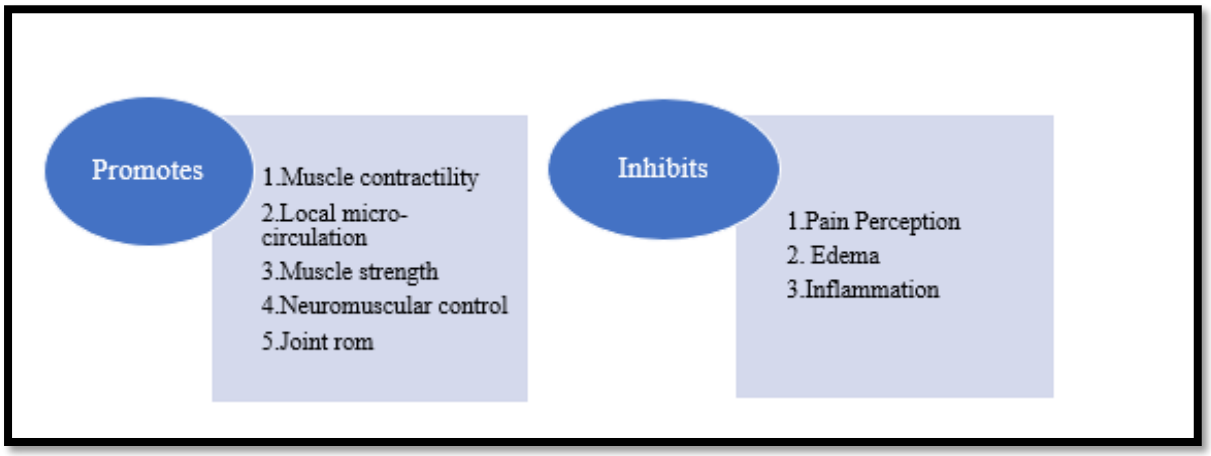

Figure 1. Physiological Impact of Kinesiotapping

Critical Analysis of Findings

A review was conducted of randomized controlled trials from the previous ten years regarding kinesiotaping (KT) for treating knee osteoarthritis (KOA). Many studies indicated a short-term improvement in pain, range of motion (ROM), and muscle strength when KT was used as an adjunct with manual or traditional therapy, however, the overall findings were inconsistent..

Methodology

The results of RCTs published within the past ten years are compiled in this review. The Cochrane Library, PEDro, and PUBMED are among the databases that were searched. The following were the requirements for inclusion:

- Research looking into KT for OA of the knee.
- RCTs with precise outcome measures.
- Research evaluating muscle strength, range of motion, and discomfort.

Case studies, pilot studies, and research on KT for ailments other than knee OA were among the exclusion criteria.

Effectiveness on Pain Reduction

Four studies that evaluated the kinesiotaping tape effect with other forms of exercise or traditional therapy produced contradictory findings. Oguz et al (2021) study, which included 22 female participants, found no significant difference in discomfort between the groups following a 6-week (three times per week) combination of kinesiotaping and exercise training as opposed to exercise training alone. In this investigation, KT was applied to the rectus femoris muscle in the I-form with the knee at a 60-degree angle and another y-shaped position close to the superior patellar border. There was no tension at the base of the KT application, however there was 40% tension between the anchor and the superior patellar area. There were contradictory findings on the response of kinesiotaping to pain. The article suggested that various KT application techniques, assessments, KT taping times, and patient characteristics might have contributed to it.[12]

Another randomized clinical trial with 40 male participants examined kinesiotaping in addition to traditional physical treatment, with a control group getting traditional physical therapy. Y-cut strips were positioned along the rectus femoris muscle belly in order to apply kinesiotaping. The splits were then transferred to the medial and lateral sides of the patella in the vastus medialis and lateralis muscles. The y-cut strips are positioned in the patellar tendon toward the MCL and LCL ligament with 100% tension and 20–30 with the knee extended, with tension applied at 0% for the first and last 5 cm and 10–15% for the middle portion. The outcome revealed a negligible meaningful impact on pain at various time intervals.[13]

The findings of a 40 participant study from 2021 also showed improvement in all participant's pain levels with the assistance of kinesiotape. It was applied using a Y strip wrapped around the patella from the medial sides and the lateral sides of the patella, and with 25% of the tension applied at the base of the Y and paper off tension toward the ASIS; a second Y strip was placed in knee flexion of 90% and was applied similarly to the Y strip that was wrapped around the patella, with 25% of the tension placed between the tibial tuberosity, anteriorly located inferior pole of the patella and an I strip located laterally to the patella at 30 degrees of flexion and with 75% tension being applied..[14]

After a 4-week intervention with KT and coupled chain exercise, the fourth study found a significant improvement in pain, but the other group that had simply KT application exhibited a less significant impact. The KT was administered using the Y-strip and I-strip approach for two treatment sessions per week for four weeks to 34 subjects with grade 2 knee OA.[15]

Author ,year	KT application method	Tension/stretch	Knee position
Oguz et al., (2021)	**I-form** : rectus femoris **Y-form**: proximal patellar region	40% mid 0% at base	60 degree flexion
Danazumi et al.,(2021)	**Y-strip**: medial and lateral side of patella Tibial tuberosity **I-strip**: patella	25-75% variable stretch	90 degree flex
Kavitha et al.,(2024)	**Y-strip**: rectus femoris Medial and lateral vastus Patellar tension	0-15% with variable stretch	Knee full extended
Maqbool et al.,(2024)	Y-strip and I-strip applied to knee region not specified	Not specified	Not specified

Table 1: Variation of Kinesiotaping Application

Influence on Range of Motion (ROM)

Although there is variation in the effects of KT on both joint mobility, studies have indicated that a combination of KT with exercise treatment will significantly improve ROM by improving proprioception of the joint and reducing the mechanical stress placed on them.[13] However, studies such as Pinheiro et al. (2020) indicate that using KT alone does not provide a significant or consistent improvement in ROM.[16] Therefore, the inconsistencies found in the research due to differences in goniometric methods used to measure ROM, as well as tape application methods, limit our ability to compare results between studies.

Effects on Muscle Strength

The weakening of muscles is a key factor in progressing knee OA.[17] There have been a number of studies like Oğuz et al, which show that using KT in combination with resistance training exhibits a greater increase in quadriceps strength than exercise alone.[12]Other investigations, such as Kawaguchi et al. (2024), did not find any substantial rise in strength that could be credited only to KT.[18]

These variances could be caused by changes in workout regimens, sample sizes, and the different approaches used to measure muscle strength (isometric versus isokinetic testing).

Kinesiotaping as an adjuvant therapy in KOA.

A study conducted on recommendations of non-pharmacological management of knee osteoarthritis by the French physical medicine and rehabilitation advocated based on expert opinion that kinesiotaping has a overall short term effect with no lasting benefit along with low level of evidence of it being significant.[19]

A systematic review of 2018 noted significance in patient reported pain during activity, flexibility and muscle strength compared with that of other treatments but no significant difference was found between group of muscle strength with overall finding being inconclusive due to methodological limitation and data quality issue. [20]
Another review of 2020 pronounced that there is inconclusive short term effects of KT along with other physiotherapy for KOA.[21]
Consistent with previous research, a 2025 systematic review and meta-analysis of kinesiotaping without physical therapy discovered short-term effects on knee KOA pain and function, but the long-term results were unclear.[22]

Issues with Kinsesiotaping quality and application

Methodological Considerations and Heterogeneity

KT research presents an interpretation challenge because of the significant difference between study designs and interventions. Tape tension, application patterns, frequency and length of application, and the kind of concurrent treatment given are important variables that can vary. Due to the variability of these factors, KT research will have limitations in terms of reproducibility, and inability to synthesize results across studies. In addition, a number of KT studies are limited due to their methodology. Examples of this include small sample sizes, inadequate randomization, and problems with blinding, all of which raise the possibility of bias and over reporting of results.

Overall Synthesis

In conclusion, although there is some indication that kinesiotaping may help patients with knee OA in the short term by lowering pain and enhancing joint function, the results of various trials are conflicting. The limitations in methodological factors, such as blinding issues, applicability, and parameter heterogeneity, reduce the strength of the data that is currently accessible. Future independently funded research that employ strict methodology and standardize KT techniques are desperately needed to address these problems. Only with such improved study designs is it possible to measure and analyze the genuine therapeutic efficacy of KT in controlling KOA.

Methodological Limitations of Kinesiotaping Research

Potential Conflicts of Interest

Conflicts of interest (COI) occur when an investigator's professional assessments of the integrity of their research are impacted by secondary interests, such as financial gain, institutional advancement, or business connections (Lo & Field, 2009).[23]COI is a significant issue in kinesiotaping (KT) research since many studies are funded by KT manufacturers or written by people connected to KT manufacturing and sales. This calls into doubt the accuracy of the statistics and the possibility of biased reporting.
There may be some biases because some of the research that were reviewed for the paper declared their funding origins. Oğuz et al. (2021), for example, received funding from research grants.[12] Meanwhile, funding from kinesiotape producers backed the

findings of Donec & Kubilius (2020).[24] Furthermore, Kawaguchi et al. (2024) did not explicitly reveal the sources of their funding, making it impossible to identify any financial biases that might have influenced their findings.[18] Because of publication bias or the researcher's implicit prejudices, manufacturing-funded studies are more likely to produce good results.

Risk of Bias in KT Clinical Trials

There are five key areas for the identification of risk of bias in clinical trials, according to the guidelines proposed by the Cochrane Collaboration: bias caused by the process of randomization, bias caused by departures from the planned intervention, bias caused by the lack of outcome data, bias in the measurement of the outcome reported, and bias in the selection of the outcome to be reported.[25,26] These biases are common in kinesiotaping studies, and it casts doubts on the results.

Several KT studies reviewed in the present study appeared to have some methodological flaws. Bias in participant selection could be a potential issue due to the incomplete description of randomization procedure in some trial studies. For instance, it was difficult to determine whether the groups were equivalent at the start of the study because Pinheiro et al. (2020) and Kawaguchi et al. (2024) failed to provide specific details concerning the concealment of the randomization procedure.[16,18]

Usage of subjective or non-standardized outcome measures is a second critical issue. Some studies used self-reported pain scores without any stringent assessment processes, while others employed more conventional tools like VAS and WOMAC. The point of concern here is the unpredictability of some of these studies in possibly introducing measurement bias and rendering inter-study comparisons a bit tougher to come by.

Moreover, many KT trials show the presence of outcome reporting bias. It can be seen that studies sponsored by kinesiotape manufacturers often report positive findings but neglect insignificant or poor data. Progressions of functional outcomes were reported to be most substantial findings by Oğuz et al. (2021) and Donec & Kubilius (2020), but discussions of non-responsive patients to KT treatments were minimal.[12,24]

Sham Credibility and Blinding

The main challenge of blinding in kinesiotaping studies is that active KT and sham KT applications are both physically and sensorially different. Participants and clinicians commonly perceive if the tape was applied with tension or not. This creates problems of placebo effects, which might influence the actual outcome. By this mere recognition it is quite hard to differentiate between real physiological benefits and perceived improvement.

Kawaguchi et al. (2024) discovered that KT studies failed to investigate the credibility of sham interventions effectively, thus preventing any accurate determination of the effectiveness of blinding.[18] As long as there is no proper validation, expectations of participants and psychological aspects might affect the outcome effectiveness.

Additionally, even in low-tension KT sham intervention trials, there might still occur some significant biomechanical effects, thus preventing differentiation between placebo and true effect. Research in the future must be focused towards standardization of sham procedures in regard to KT.

Parameter Heterogeneity

Kinesiotaping is used with a range of parameters in published studies, which results in significant variations in clinical outcomes. The heterogeneity restricts the generalization of the findings from these studies and makes it impossible to compare outcomes across investigations. Important factors include:

Tape Tension and Stretch: The degree of tension used to apply the tape differs amongst KT studies; as a result, this discrepancy may change the mechanical support that the tape provides as well as the sensory feedback that is used to reduce pain and enhance muscular performance.

Application Patterns and Placement: A variety of taping techniques, including fan patterns, Y-strips, and I-strips, are being employed to target various anatomical locations, such as the quadriceps, patellofemoral region, or the entire knee joint. A particular taping pattern was used by Danazumi et al. (2021) to encourage appropriate patella tracking. Kawaguchi et al. (2024), on the other hand, applied the tape on the knee in a less accurate manner.[14,18]

These differences have generated different results with regard to pain relief and improvement of function.

Duration and Frequency of Reapplication: The amount of time that the tape is kept on the patient and reapplication frequency also varies widely across studies. Studies like, Pinheiro et al., (2020) had their patients use KT for several days without removing the tape while Oğuz et al., (2021) had their patients remove the tape and apply it multiple times during their six-week treatment regimen.[12,16]

To increase the reproducibility of kinesiotaping (KT) research and for significant cross-study comparisons, defined rules governing KT use must be established. It is challenging to draw conclusions about the clinical efficacy of kinesio-tape as a therapy intervention for knee osteoarthritis in the absence of these established recommendations.

Future Research Directions

The future study needs to consider a number of parameters in the light of current varieties in KT methods and conflicting clinical findings.

Describe the Basic Mechanisms

According to one study in 2021, one of the major gaps in KT research is the complete understanding of the proprioceptive and neuromuscular mechanisms underlying its clinical effects. Characterization of neuromuscular and proprioceptive changes, in future studies, should be done by investigating how different KT application techniques

would influence or alter muscle activation patterns and joint biomechanics using the most advanced imaging modalities such as ultrasound, MRI, and electromyography.[27]
Dose Response Relationships: Analysis of tape tension variation to identify ideals of tape tension, taping, and patterns of taping, as well as duration of taping, to maximize muscle strength gain and to a lesser intensity to minimize pain and maximize range of movement.[28]
Enhancing the Accuracy of the methodology
To advance the current state of evidence in KT studies, some crucial aspects of methodology should be further explored in future studies. To characterize more comprehensively the differences in pain reactions of patients suffering from KOA, large-scale studies should be conducted. 2) Protocol Standardization By dealing with methodology problems and concerns regarding mechanisms, future studies will help establish the real effect of kinesiotaping on KOA treatment.

Conclusion

Among others, one of the most popular methods for treating symptoms of OA of the knee without invasive techniques is kinesiotaping. In view of available data, it appears that KT can exert short-term benefits, particularly in alleviating pain relief as well as in conjunction with exercise therapy. With regard to long-term effectiveness as well as superiority over other well-established methods of physiotherapeutic treatments, there are conflicting data.
There is a considerable degree of parameter variability in the studies, from variations in the concurrent treatments and outcomes to variations in the tension and application rate and duration. This not only results in a lack of reliability in the reproducibility of the results, but it is even harder to reliably pool the data that has been generated in the studies.
In conclusion, while a current state of evidence appears to indicate that kinesiotaping does provide a degree of significant short-term symptomatic relief for those with knee OA, definitive conclusions regarding its relative advantages and overall effectiveness cannot be ascertained due to its heterogeneity and limitations among those studies that have been performed. Future studies regarding the appropriate utilization and application of KT, relative to its various pharmacologic and nonpharmacologic counterparts within a broad treatment regimen for knee osteoarthritis, will likely benefit from this approach.

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