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Kinesio taping in the treatment of anterior cruciate ligament injury

Literature review

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Abstract

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Anterior cruciate ligament is one of the two cruciate ligaments that helps to stabilise the knee joint. It is a solid band composed of collagenous fibres, and its main purpose is to avoid the tibia from moving forward in relative to the femur. Anterior cruciate ligament can be over stretched or tear off during athletic activities, at work or in an auto accident. The most frequent mechanism of injury is a sudden pivoting or cutting manoeuvre. Diagnosing methods such as anterior drawer test, Lachman test, pivot shift test are used in acute injury while severe injuries are diagnosed using plain radiographs and magnetic resonance imaging. c Kinesio taping functions as a therapeutic modality that employs elastic tapes to provide support to muscles and joints without creating a restriction of the range of motion.

The purpose of the bachelor's thesis was to investigate how kinesio taping assists in recovery following injury to the anterior cruciate ligament.

This modified literature review search was performed across scholarly articles, which out of 262 articles collected from PubMed, CINAHL, ProQuest Central, and Sage Journals within 2014–2024, five articles were selected for the bachelor's thesis. The study methods used on the result articles were. from double blind placebo-controlled study, randomised controlled trial, systematic review, and case report.

In conclusion, kinesio taping provides many advantages in the rehabilitation process in anterior cruciate ligament, including the effects on pain, oedema, proprioception, gait pattern, muscle strength, knee flexion, and range of motion.

Keywords	kinesio taping, anterior crucial ligament, ACL

The originality of this thesis has been checked using the Turnitin Originality Check service.

Contents

1 Introduction

The Anterior cruciate ligament, shortened as ACL, located in the knee joint, plays a key role in maintaining stability during active and high impact activities. It prevents the tibia from moving forward excessively and rotating relative to the femur which is crucial for actions, such as walking, running, jumping, and sudden direction changes. Anterior cruciate ligament injuries are common and can have serious consequences, comprising long-term disability, a decreased quality of life, and an increased risk of developing osteoarthritis in the affected joint. The impact of an anterior cruciate ligament injury often extends besides physical damage, requiring prolong rehabilitation and, in several instances, surgical interference to restore knee stability and functionality. (Kacprzak, Stańczak, Surmacz and Hagner-Derengowska 2024.)

Since anterior cruciate ligament affects the proprioceptors in the knee, it compromises proprioception to restore balance to the injured musculature, kinesio tape (KT), a thin, elastic tape, is put to the skin's surface and has the effect of toning or detonating the muscles underlying. It has been proposed that kinesio taping reduce the need for analgesics while improving proprioception, blood circulation, lymph flow, movement stability and enhance range of motion. (Liu, Qian, Gao and Ruan 2019.)

The Most relevance of kinesio taping for anterior cruciate ligament injury is that reduces early postoperative discomfort and oedema after the reconstruction of the anterior cruciate ligament. It has been hypothesised that kinesio taping lifts the skin, providing space for better lymphatic flow, to reduce tissue pressure. This in turn lessens discomfort, oedema and pain. (Labianca et al. 2021.)

The aim of the present bachelor’s thesis is to investigate how kinesio taping assists in recovery following injury to the anterior cruciate ligament.

2 Theoretical Background

The application of kinesio tape aids with ACL injuries through joint stabilization while improving body sensing abilities and pain reduction attributes without restricting motion range. Because the tape is stretchy, it raises the skin, increasing lymphatic and blood flow, which could promote healing. (Kase, K., Wallis & Kase 2003.)

2.1 Overview of kinesiology taping

Kinesiology tape has been used by trainers, professionals and athletes, and is commonly used during sports practice for treating sports injuries. It is claimed that it supports and engages muscles, enhances blood flow, lessens pain, minimises swelling and helps prevent injuries. These strips of elastic, permeable tape appear to provide therapeutic benefits when applied to afflicted areas of the body, based on anecdotal evidence. (Lopes et al. 2022.)

A thin, flexible tape called kinesiology tape was created to facilitate muscle movement and improve sports performance. It is frequently used to support muscles and joints, lessen oedema and inflammation, and relieve pain. Kinesiology tape's elasticity, or stretchiness, permits mobility. This distinguishes it from support adhesives or more stiff rehabilitative tape that lacks elasticity. These are used to support and immobilise muscles and joints following sports-related injuries, as well as for individuals with conditions that impair muscular activation or contraction control. (Lee and Lim 2020.)

Kinesiology tape is mostly used to assist individuals with muscle activation following an injury. It feels quite natural because the thin, elastic tape mimics the flexibility of the skin. The skin tells the nerves to engage the muscles when the tape is applied. Upon receiving that information, the muscles contract in response to the stimulation. In addition to creating movement, muscle contractions maintain the position and posture of the body and aid in joint stabilisation. Kinesiology tape is also used to treat lymphoedema and inflammation-related pain. By pulling the skin upward, it creates a gap beneath the skin that enhances lymphatic flow in that location. Although there is no evidence to support this, it may also help avoid flare-ups of arthritic inflammation. It is much less helpful if the condition is persistent if mobility is an issue. (Castro 2023.)

2.2 Overview of anterior cruciate ligament

2.2.1 Anatomy of anterior cruciate ligament

Anterior cruciate ligament also shortened as ACL is one of the two cruciate ligaments that assists to stabilise the knee joint. It is a firm band composed of collagenous fibres and connective tissue that begins at the anteromedial aspect of the tibial plateau's intercondylar region and extends posterolateral to attach to the medial aspect of the lateral femoral condyle. There are two major landmarks in it. The bifurcate ridge separates the two anterior cruciate ligament bundles, and the lateral intercondylar ridge

establishes the anterior boundary of the anterior cruciate ligament. The anterior cruciate ligament is 7 to 12 mm wide and 32 mm long. The structure comprises two distinct bundles known as the anteromedial and posterolateral bundles. The posterolateral bundle functions as a secondary stabiliser and exhibits variable length during motion, reaching maximum tightness during knee extension to control rotational and medial-lateral stability. Contrarily, the anteromedial bundle exhibits greater isometric properties and reaches peak tension when flexed. The primary role of this structure involves stopping anterior tibial translation which positions it as the main obstacle against forward tibial movement. Together, the anterior cruciate ligament and posterior cruciate ligament create a cross, or "x," inside the knee that limits the tibia's excessive forward or backward motion in relation to the femur during flexion and extension. According to histology, type I and type III collagen make up the anterior cruciate ligament. The middle geniculate artery provides most of its blood supply. Neurological innervation is provided by the posterior articular nerve which is a branch of the tibial nerve. (Evans, Mabrouk and Nielson 2023.)

2.2.2 Anterior cruciate ligament injury

There are several ways that the anterior cruciate ligament can be injured or torn. During athletic activities, the most frequent mechanism is a sudden pivoting or cutting manoeuvre, which is frequently observed in basketball, soccer, volleyball, lacrosse and tennis players. Injuries are prominent at work sites, or in auto accidents as they can potentially cause the ligament to rip. At the location of the damage, a "pop" or "snap" may occasionally be heard or felt followed by immediate pain and swelling of the knee. The degree of pain experienced at the time of the accident might vary greatly, although it can be rather severe. The person is usually unable to play or participate in other activities and feels as though a serious injury has occurred. The knee will expand immediately in the first few hours after an accident, however this swelling can be reduced if the knee is iced or splinted immediately. When the knee was hurt, there was a "pop" swelling in the knees Although some people experience little to no discomfort, in-stability of the knee and an inability to bear weight on the leg are the main symptoms of an anterior cruciate ligament injury. (Rodriguez et al. 2021.)

For the diagnosis a history and physical examination can be used to identify an anterior cruciate ligament tear. During a physical examination, medical professionals can assess range of motion and clearly identify the anterior cruciate ligament as injured. Because anterior cruciate ligament tears are frequently linked to injuries to other knee

structures such the cartilage and collateral ligaments, assessment of other knee tissues is also carried out. To determine whether there are any fractures, X-rays are done. A Magnetic resonance imaging (MRI) of the knee may be prescribed for many patients. If determining the best course of action for a particular patient requires knowledge about the knee's cartilage or meniscus tissue, the scan can also be helpful in that regard. (Kopkow, Lange, Hoyer, Lützner and Schmitt 2018.)

Grades 1, 2, or 3 are frequently used to categorise anterior cruciate ligament injuries. Anterior cruciate ligament with minor damage, such as those that are slightly strained but still give the knee joint sufficient stability, are classified as grade 1 injuries. Grade 2 injuries are uncommon and are characterised by a partially torn and strained ligament. Grade 3 injuries occur when the knee joint loses all stability due to the ligament being entirely ripped in half. (Li, Jhonatan, Liu, Huang, Yang and Du 2023.)

2.2.3 Kinesio taping in the conservative treatment of anterior cruciate ligament injury

The aim of conservative treatment is to heal a torn anterior cruciate ligament without following up the surgical procedure. Conservative or non-surgical method is applicable for grade 1 injuries, lower activity levels, or contradicted for surgical procedure. Kinesio taping functions as a therapeutic modality that employs elastic tapes to provide support to muscles and joints. However, it achieves this without restricting movement. (Jia, Greven, Hildebrand, Kobbe and Eschweiler 2024; Liu, Qian, Gao and Ruan 2019.)

Kinesio taping has numerous benefits in the conservative treatment of anterior cruciate ligament injuries, including improved proprioception, static stability, and functional performance, but with certain restrictions. The analysts argue that using kinesiology tape can be of an advantage for a limited number of parameters only within the early period following anterior cruciate ligament reconstruction surgery but not in the long-term rehabilitation process. (Balki, Göktaş and Öztemur 2016; Chen, Wang, Zhou and Wang 2024.)

In static stability, kinesio taping users have shown significant improvements in stability and postural adjustment parameters which highlights its role in stability enhancement (Ogrodzka-Ciechanowicz, Głąb, Ślusarski, Gądek and Nawara 2021). The effectiveness of kinesio taping on an individual with anterior cruciate ligament injury needs to be further evaluated to determine the outcomes thoroughly (Karimijashni, Ghanbaril, Rezaei and Abbasnia 2020).

2.2.4 Kinesio taping in the non- conservative treatment of anterior cruciate ligament injury

Non-conservative method is applicable for grade 3 injuries, and athletes that need fast and effective recovery. Kinesio taping has been explored as a conservative treatment in anterior cruciate ligament injury, but recent studies over the last decade have given conflicting outcomes. Anterior cruciate ligament injuries are common, especially in athletes, and effective rehabilitation programs are important in recovery and return to sport. The application of elastic therapeutic tape to the skin provides support and stability to the muscles and joints without creating a restriction of the range of motion. The efficacy of kinesio taping in anterior cruciate ligament reconstruction on clinical outcomes has shown that kinesio taping showed a statistically significant improvement in flexion strength compared with the control group but was not different in extension strength or pain. The authors of the study recommended that kinesio taping showed limited benefit after anterior cruciate ligament reconstruction and suggested that more rigorous trials assessing the utility in rehabilitation be undertaken. (Elrosasy et al. 2024.)

Gholami, Kamali, Mirzeai, Motealleh and Shamsi (2020) have shown the effects of kinesio taping on kinesiophopbia, which is fear of movement, along with balance and functional performances on athletes post anterior cruciate ligament reconstruction. The results have not shown any significant variations between the kinesio taping and th placebo group in terms of the factors mentioned above. Even though the results did not give a positive output.

Gong, Li, Weng, Cheng and Min (2022) have shown that kinesio taping had a significant outcome on pain and swelling within two weeks post anterior cruciate ligament reconstruction surgery, unfortunately the effects reduced after two weeks.

3 Aim and data collection

The aim of the bachelor’s thesis is to investigate how kinesio taping assists in recovery following injury to the anterior cruciate ligament.

The inclusion and exclusion criteria for the selection of articles according to publication type, study type, date range, language, and content are shown in the following table. (Table 1)

Criteria	**Inclusion**	**Exclusion**
Publication type	Scientific articles	Non-scientific articles.
Study type	All types of studies included	N/A
Date range	Articles published within the last 10 years (2014–2024)	Articles published outside the 10-year range or outdated findings.
Language	English-language publications	Articles published in languages other than English
Content	Kinesio taping application on acute, chronic, pre and post operative anterior cruciate ligament injury	Kinesio taping application on injuries other than anterior cruciate ligament.

Table 1. Inclusion and Exclusion criteria

Initially search terms were employed to gather information from specific articles needed for the study. Data were collected through a search across four databases, including PubMed, Cumulative Index of Nursing & Allied Health Literature (CINAHL), ProQuest Central and Sage Journals. The search covered all types of study methods, and the results were filtered to gather studies published between 2014 and 2024. All the articled gathered were published in English language, while the publications in other languages were excluded.

Literature search was conducted in PubMed using the search terms "anterior cruciate ligament" OR "ACL" AND "kinesio* tap*". The search returned numbers over ten articles in total, of which eight were finalised after a comprehensive review, while the rest of the articles were opted out based on the topic and abstract.

Literature search was performed in Cumulative Index of Nursing & Allied Health Literature (CINAHL) using the search terms “anterior cruciate ligament” AND “kinesio* tap*” to narrow down the search best articles out of many searches. Out of the 13 results, one supportive article was found while eight articles being duplicates, and four articles were opted out based on topic and abstract.

ProQuest Central served as the basis for the literature search, which produced a total of two hundred and nine articles. The search terms utilised were “anterior cruciate ligament” AND “kinesio* tap*”. After a thorough inspection seven duplicates were found, and the rest were eliminated due to being irrelevant to the thesis topic.

Literature search was conducted in Sage Journals using the search terms "anterior cruciate ligament" AND "kinesio taping". The database gave a total of sixteen results which included one supportive result to the study topic, while the rest were excluded after a search

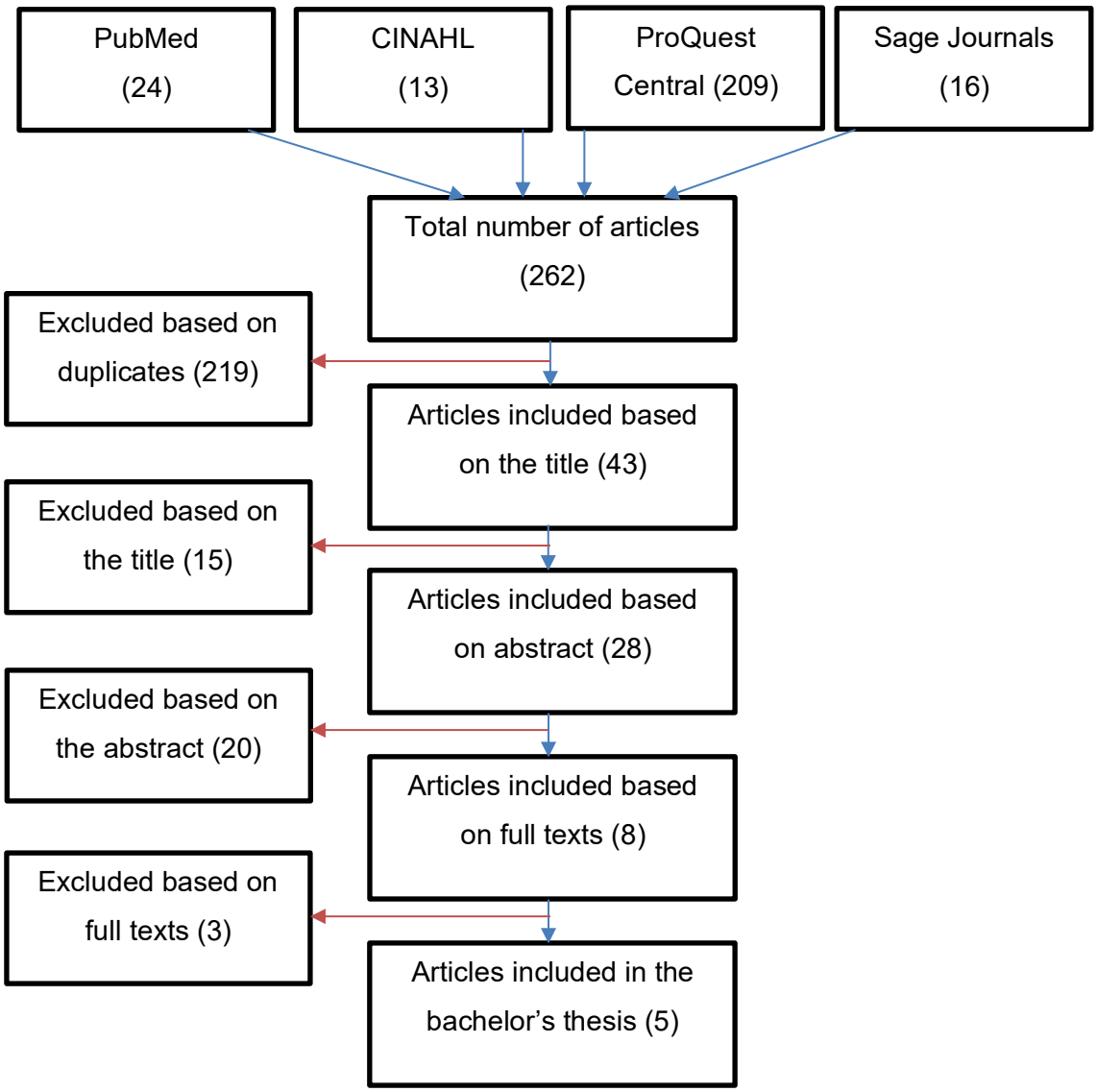

Figure 2. The flow chart

4 Results

This literature review focuses on kinesio taping for the management of anterior cruciate ligament injuries from both conservative and non-conservative perspectives. Data were collected through searching the following four academic databases: PubMed, Cumulative Index of Nursing & Allied Health Literature (CINAHL), ProQuest Central, and Sage Journals filtering out other publications to extract publications in be-tween 2014 and 2024. Out of the 262 articles collected, 5 articles were selected in the final analyses after eliminating 219 articles based on the title, 15 based on duplicates, 20 based on abstract, and 3 based on full text.

Table 2. Summarised descriptions of selected studies

Authors and Year	Purpose of Study	Methodology	Participants	Intervention	Results	Conclusion
(Bischoff et al. 2018)	Assess supportive effects of kinesio taping on proprioception after anterior cruciate ligament rupture.	A pilot study. gait analysis, International Knee Documentation Committee (IKDC) score, Lysholm score, Rolimeter, and angle reproduction test.	48 patients (39 men, 9 women) with anterior cruciate ligament rupture.	Gait analysis performed on the knee before and after applying kinesio taping.	Significant improvements in gait parameters, IKDC and Lysholm scores, and angle reproduction test.	kinesio taping positively affects proprioception and improves gait pattern and subjective knee joint function.

(Balki, Göktaş and Öztemur 2016)	Investigate effects of kinesio taping in acute postoperative rehabilitation phase of anterior cruciate ligament reconstruction.	Double-blind, placebo-controlled study.	30 male patients with anterior cruciate ligament reconstruction.	Experimental group received kinesio taping, control group had sham kinesio taping. Both received the same rehabilitation program.	Significant improvements in swelling, pain, hamstring strength, and knee range of motion showed in the experimental group.	kinesio taping techniques are beneficial in reducing pain, swelling, and improving knee function post-anterior cruciate ligament reconstruction.
(Valladares et al. 2023)	Evaluate kinesio taping effects on pain and oedema reduction post-anterior cruciate ligament reconstruction.	Randomised controlled study	38 individuals (19 intervention, 19 control).	kinesio taping applied at hospital discharge and on 7th post-operative day; control group received physiotherapy	Significant reduction in oedema and increase in nociceptive threshold on 7th and 14th post operative days in kinesio taping group.	kinesio taping treatment reduces oedema and increases pain threshold post-anterior cruciate ligament reconstruction.

				instructions only.		
(Chen et al. 2024)	Evaluate efficacy of kinesio taping on knee function post- anterior cruciate ligament reconstruction.	Systematic review of 7 RCTs.	278 patient's post-anterior cruciate ligament reconstruction		Improvements in hamstring strength, knee swelling, and pain reduction.	kinesio taping may improve knee function post-anterior cruciate ligament reconstruction, particularly in hamstring strength and pain reduction.
Pinheiro Paulino, de Vasconcelos, da Rocha Pereira, Quintino Farias and Pinheiro Diógenes Bastos 2016)	Evaluate kinesio taping effects on knee extensor musculature strength post-anterior cruciate ligament surgery.	Case study	1 patient post-anterior cruciate ligament surgery.	kinesio taping applied to knee extensor musculature.	Decreased strength and power deficits; increased resistance deficit.	kinesio taping potentiates strength and power gains but may increase resistance deficits.

In a pilot study by Bischoff et al. (2024), a total of 48 individuals who had experienced an anterior cruciate ligament rupture for a minimum of three weeks underwent an assessment of their gait and functional outcomes. The researchers observed significant increases in hip extension; moreover, improvements were noted in various gait parameters, such as touchdown, un-rolling, cadence, stability and stance phase. Notably, there were enhancements in the Rolimeter and angle reproduction tests. Clinical scores exhibited substantial improvement, with the Lysholm score increasing from 79.3 to 85.8 and the International Knee Documentation Committee (IKDC) score rising from 60.2 to 71.3 ($p < 0.001$ for both).

Balki et al. (2016), performed a placebo-controlled randomized study to determine kinesio taping's effectiveness during acute anterior cruciate ligament reconstruction rehabilitation. Thirty male patients were randomly distributed into experimental and control groups whereby the experimental recipients received kinesio tape treatment by applying it through muscle and lymphatic correction methods. The patients in both groups demonstrated essential benefits in range of motion (ROM) and pain reduction and swelling reduction together with muscle strength development throughout the initial 10 days and at one and three months postoperatively ($p < 0.05$). Both patellar swelling and night pain reduced substantially more in the experimental group which utilized kinesio taping than in the control group. The experimental group experienced larger increases in hamstring muscle strength throughout the kinesio taping treatment period on days five and ten.

The experimental group received kinesio taping applications for a duration of seven days following their discharge from the hospital. A second application occurred on postoperative day 7, which was then removed on postoperative day 14. In contrast, the control group was provided with specific physiotherapy instructions, yet they did not receive any kinesio taping applications. All participants underwent evaluations at baseline, immediately post-surgery, as well as on the 7th and 14th postoperative days. The variables assessed included pain threshold (KgF) measured with an algometer, oedema (cm) gauged through perimetry measurements, and lower limb volume (ml) determined via the truncated cone test. The results showed that kinesio taping treatment reduced oedema and increased nociceptive threshold. (Valladares et al. 2023.)

A thorough review of seven randomised controlled trials (RCTs) involving 278 patients who underwent anterior cruciate ligament reconstruction (ACL) assessed the effects of kinesiology tape (KT) on rehabilitation and knee function. The findings revealed that one-third of the studies reported a notable enhancement in quadriceps strength compared to the control groups, while both studies that evaluated hamstring strength indicated significant improvements. Two out of five studies found out kinesio taping reduced swelling and increased the knee flexion angle. None of the three studies demonstrated an improvement in Lysholm knee function, but three out of four studies reported significant reductions in pain levels as measured by the Visual Analogue Scale (VAS). Overall, these studies imply that kinesio taping may aid in strengthening the hamstring muscles and in alleviating swelling and pain following anterior cruciate ligament reconstruction. Further research is needed to investigate its effectiveness in enhancing quadriceps strength and improving knee flexion angle. (Chen et al. 2024.)

A 24-year-old male professional indoor soccer player from Fortaleza, Brazil, sustained a right knee injury during practice, initially diagnosed as a minor medial ligament sprain. Following a more serious twisting injury to the knee, magnetic resonance imaging (MRI) indicated a completely ruptured anterior cruciate ligament, a partial lesion of the medial meniscus, and an inflamed medial collateral ligament (MCL). After the anterior cruciate ligament reconstruction surgery using a semitendinosus tendon graft and repair of the medial meniscus, the patient started physical therapy. In the beginning, he had limits of tibiofemoral joint motion, pain and swelling, and redness. In the isokinetic assessment performed before and after the application of kinesio taping, there was a relative weakness, power, and endurance weakness on the left quadriceps in relation to the right. In contrast, the application of kinesio tape did improve strength and power, but a decrement in muscle endurance was found. These results seem to indicate that kinesio taping could be an additive intervention in rehabilitation for improved muscle strength and power. (Pinheiro Paulino et al. 2016.)

The results were taken from a pilot study, a double-blind placebo-controlled study, two randomised controlled studies, and one pilot study. According to one article based on conservative treatment, positive results were shown on proprioception, gait pattern, and knee joint function. The rest of the four articles were based upon non-conservative treatment, and they supported mainly towards reduction in pain and oedema, and improvements in hamstring strength. In addition to these findings, there was increased knee flexion, along with gains in both power and strength.

5 Discussion

Valladares et al. (2023) has reported significantly reduced knee oedema and increased nociceptive threshold when compared with control groups. Baltaci, Ozunlu Pekyavas and Atay (2023) noted similar meaningful reductions in oedema with concurrent improvement in knee range of motion and pain relief during the initial rehabilitation phase, thereby pointing out the potential of kinesio taping as an adjunct in pain relief following anterior cruciate ligament reconstruction.

Bischoff et al. (2024) has suggested functional outcomes have also shown that kinesio taping can significantly improve several gait parameters, for example, touchdown, cadence, and stability. The study showed that there were substantial improvements in the clinical measures such as the Lysholm and International Knee Documentation Committee (IKDC) scores that reflect an overall increase in functional capacity. These improvements may be attributed to the proprioceptive effects of kinesio taping that allows better motor control during rehabilitation.

Chen et al. (2024) reported that significant changes in hamstring strength were evident for kinesio taping groups. Whereas increase of quadriceps strength was achieved with knee bracing even though kinesio taping probably varies in its effects on different parameters such as muscle strength and endurance and quadriceps improvement was rather inconsistent. Harput et al. (2014) found that kinesio taping had no effect on strength in either hamstring or quadriceps. Such disparities warrant additional research to recommend use or otherwise use of kinesio taping in muscle recovery.

The results of Azimi et al. (2024) supports further evidence of kinesio taping managing pain and oedema. They also reported significant reductions in oedema and pain in their analysis of 16 randomised controlled trials (RCTs) during the first two to four weeks post-operation. They did not find significant influence on Lysholm scores or on oedema resolution in any area other than the knee, implying a localised effect of kinesio taping. Kinesio taping has been shown to help with functional recovery, pain and swelling, but its effect on muscle endurance can still not be determined. According to Pinheiro Paulino et al. (2016), kinesio taping may not be the best option for endurance focused rehabilitation because, although strength and power increased, muscle endurance decreased in patients receiving kinesio taping.

According to Harput et al. (2014), though resistance musculature increased during bracing exercise, kinesio taping was remarkably effective in enhancing both balance and jump performance. In fact, only 25% of participants reported greater comfort based on the statistical gain; indicating that psychological barriers may be preventing the wide adoption of kinesio taping. A study by Gholami et al. (2020) showed kinesio taping lacked significant effects on reducing movement fear as well as enhancing balance and hopping performance. Both kinesio taping and placebo groups exhibited progress after a period. Oliveira et al. (2015) showed that kinesio taping during anterior cruciate ligament surgery recovery failed to enhance muscle strength or balance and did not increase muscle activation compared to placebo taping or resting. Laborie et al. (2015) researched if kinesio taping offered relief from knee pain. The study found no significant variations in pain levels between individuals who used kinesio taping and those who did not.

Kinesio taping has many advantages in the rehabilitation process of anterior cruciate ligament. This modified literature review included five studies exploring the effects of kinesio taping in anterior cruciate ligament injury rehabilitation. Studies demonstrate that kinesio taping can play a role in pain reduction, oedema control, and increase in range of motion and muscle strength in both the pre-operative and post-operative phases. It may also help in proprioception, balance, and muscle activation. Although its disadvantages, such as the unpredictable effect on muscle strength and endurance require more investigation.

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