PTK
Physical Therapy Korea
https://doi.org/10.12674/ptk.2022.29.3.171
pISSN: 1225-8962 eISSN: 2287-982X
Phys Ther Korea. 2022;29(3):171-179

Review Article

Effects of Kinesio Taping on Edema Control in Patients With Musculoskeletal Injuries: A Literature Review

Joon-hyoung Yong[1,2] PT, PhD, Jin-seok Lim[2], PT, MSc, Il-young Moon[2], PT, MSc, Chung-hwi Yi[3], PT, PhD

[1]Department of Physical Therapy, Hallym Polytechnic University, Chuncheon, [2]Department of Physical Therapy, The Graduate School, Yonsei University, [3]Department of Physical Therapy, College of Software and Digital Healthcare Convergence, Yonsei University, Wonju, Korea

Article Info
Received July 18, 2022
Revised August 10, 2022
Accepted August 11, 2022

Corresponding Author
Chung-hwi Yi
E-mail: pteagle@yonsei.ac.kr
https://orcid.org/0000-0003-2554-8083

Key Words
Athletic tape
Edema
Musculoskeletal diseases
Swelling

Background: The application of Kinesio tape (KT) has become an alternative treatment for the reduction of edema owing to its distinct characteristics that mimic skin behavior. Although many studies have found that KT application has a positive effect on edema related to breast cancer and rehabilitation following mandibular third molar surgery, there is little evidence to support the use of KT for musculoskeletal injuries.

Objects: The purpose of this study was to review the literature related to KT application for reducing edema caused by musculoskeletal disorders.

Methods: A literature search (July 2022) was performed on PubMed for articles published between January 2012 and June 2022. The following keywords were used: "Kinesio taping," "Kinesio tape," "swelling," and "edema," with different combinations and derivations. Only articles available in English were included in this study.

Results: Among 68 identified studies, seven met our search strategy and criteria and were included in the literature review. Five of these studies investigated musculoskeletal disorders of the knee joint; two of them reported that KT application had a positive effect on edema measured using perimetry following total knee replacement and anterior cruciate ligament reconstruction. However, the KT application did not improve swelling in patients with acute lateral ankle sprains. Pediatric patients with acute proximal phalangeal joint sprain experienced a more significant improvement in the reduction of swelling than the group using a splint.

Conclusion: This literature review found discrepant evidence to support using KT for edema control in musculoskeletal disorders. Further research is needed to determine the effectiveness of KT for controlling edema following musculoskeletal injuries.

INTRODUCTION

Kinesio tape (KT) is an elastic therapeutic taping technique for the rehabilitation of sports injuries and various other diseases [1,2]. As a Japanese chiropractor, Dr. Kenso Kase developed KT techniques in the 1970s; the use of KT has become popular, especially among athletes and practitioners [3]. Kase et al. [3] proposed that the unique design of KT mimics the thickness and weight of the skin and that it has various benefits such as protecting and supporting the joint or muscle, improving proprioception, decreasing pain and inflammation, and reducing edema [4-6].

One of the distinct roles of KT compared with traditional tapes is to increase blood and lymphatic flow [4]. The conventional lymphatic treatment recommended by the International Society of Lymphology is complete decongestive therapy, including elastic compression and lymphatic drainage, to increase lymphatic flow by eliminating excessive lymphatic fluid, resulting in sustaining a reduced circumference of the region [7,8]. KT causes the target skin to lift and wrinkle, meaning that lifting increases the space between the skin and muscles [4,9]. As a result, taping improves microcirculation and reduces swelling [4]. Furthermore, KT creates in a constant low pressure on the target skin so that lymphatic flow is increased. When KT stimulates cutaneous mechanoreceptors, it facilitates sensory and mechanical stimulation. This reduces the conges-

tion of lymphatic fluid and decreases the circumference of the target area by its active elastic performance [7,10,11].

As the application of KT in clinical conditions has increased, numerous clinical studies have examined its effects on lymphedema. In 2018, Kasawara et al. [7] performed a meta-analysis of clinical trials that reported the effects of KT on breast cancer-related lymphedema. They concluded that KT application positively affected lymphedema in patients after mastectomy. Moreover, Firoozi et al. [12] revealed in their recent systematic review and meta-analysis that KT application resulted in a significant decrease in swelling scores after mandibular third molar surgery.

Once we looked up the review articles on KT published over the past 5 years through the Medical Literature Analysis and Retrieval System Online (MEDLINE) (accessed via PubMed), a total of 52 studies were identified. Most of 52 studies are on cerebral palsy [13-15], low back pain [16-23], ankle functional performance [24-26], knee osteoarthritis (OA) [27-33], shoulder pain and disability [34-38], breast lymphedema [7,39], rehabilitation after stroke [40-42] and so on; however, there are only four studies related to edema [43-46]. Therefore, the purpose of this study was to review the literature on KT for reducing edema caused by musculoskeletal disorders and investigate whether the use of KT have any effects on controlling edema.

MATERIALS AND METHODS

1. Search Strategy and Eligibility Criteria

A search of scientific articles was performed using the MEDLINE from 2012 to June 2022. The studies were included in the first and second quartiles of the Journal Citation Report and selected for the present review. The search strategies for screening the literature published in the scientific database are shown in Table 1.

Of the 68 identified articles, we selected seven studies for the literature review using the following inclusion/exclusion criteria: (1) clinical studies on patients with edema following musculoskeletal complaints except for any cancer-related disorders and teeth surgery; (2) the article reported data on edema (e.g., volumetry, perimetry); (3) the study presented a comparison group (e.g., placebo taping, no taping, KT applied without tension); and (4) the full text was written in English.

2. Study Selection and Data Extraction

First, two authors independently searched the literature in the databases and reviewed the titles and abstracts of the articles identified after performing the searches. Articles were then identified according to their titles and abstracts to determine whether they provided sufficient data for the purpose of this study. Next, the same authors independently confirmed that the full texts of the articles adhered to the inclusion and exclusion criteria.

The same two reviewers independently performed the

Table 1. Search terms for screening studies in PubMed

#1	"Swelling" OR "Edema" AND "Kinesio Taping"
#2	"Swelling" OR "Edema" AND "Kinesio Tape"
#3	"Swelling" AND "Kinesio Taping"
#4	"Swelling" AND "Kinesio Tape"
#5	"Edema" AND "Kinesio Taping"
#6	"Edema" AND "Kinesio Tape"

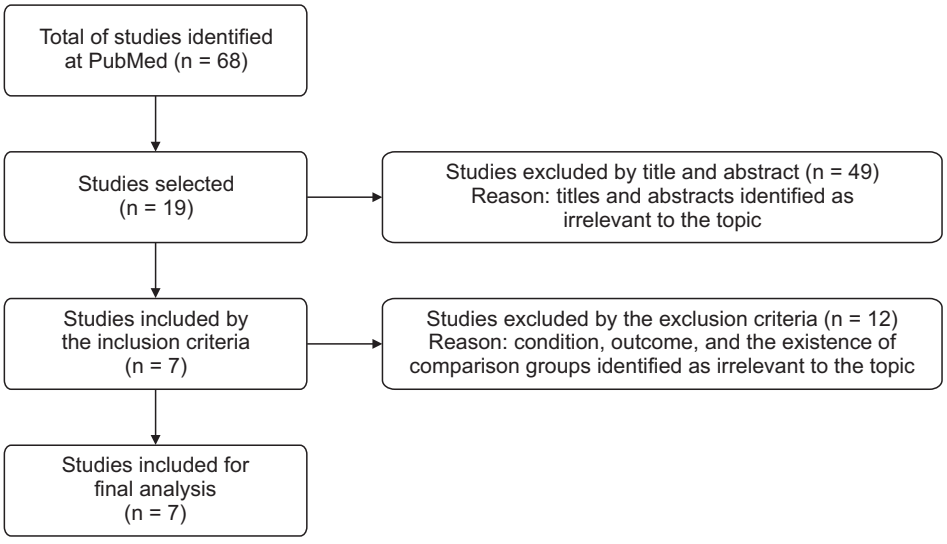

Figure 1. Flowchart of the study selection process for this literature review.

Table 2. Descriptions of studies included in this literature review

Study (year)	Study design	Subject characteristic	Treatment protocol	Measurement	Result
Donec and Krišči̇ūnas [49], 2014	RCT in inpatient rehabilitation facility	94 patients who underwent primary TKA surgery divided intotwo groups KT group (n = 44) No-taping group (n = 50)	All groups: early mobilization and physical therapy twice a day, occupational therapy once a day, intermittent pneumatic compression, massage, TENS, laser therapy, paraffin therapy.	Perimetry measured before surgery and afterwards at four levels (cm): 10 cm above the superior pole of the patella; at the middle line of the knee articular space; in the calf (25 cm above the lateral malleolus inferior pole); and 2 cm above the medial malleolus.	Postoperative edema was less severeand regressed quicker in thigh, knee, and calf ($p < 0.05$, $\beta \leq 0.2$).
Windisch et al [50], 2017	Clinical study, prospective study with a historical control group	84 subjects with a cemented TKA due to primary OA KT group (n = 42) Control group (n = 42)	Control group were fitted with an A-V Impulse System™ on both lower limbs immediately p.o in the recovery system. KT group was treated immediately p.o with kinesiotaping.	Leg circumference measured at eightpoints daily during 7 p.o. day: on the thigh (20 and 10 cm above the inner knee joint gap), knee (joint gap midline), lower leg (15 cm below the inner knee joint gap), smallest circumference of lower leg and foot (ankle, dorsum of the foot and ball of the foot) of both lower limbs.	No significant difference between both groups at any point in time.
Yuksel et al [47], 2022	Prospective, RCT with concealed allocation	111 patients with total knee arthroplasty Control group (n = 38) KT group (n = 37) Cold-therapygroup (n = 36)	All groups received the same standard postoperative rehabilitation including passive, active-assistive, and active range of motion exercises, strengthening exercises and gait training for two times/day. Weight-bearing, as tolerated, was allowed for all patients on the fist postoperative day.	Volumetry was calculated by Volume Frustum formula and circumferential measurements at fourpoints: the midpoint of the patella, 10 cm above the patella, 15 cm above the patella, 10 cm below the patella, and 15 cm below the patella.	Cold therapy was effiient in reducing p.o. swelling but KT had no signifiant effects on swelling control.
Wageck et al [51], 2016	RCT with concealed allocation, intention-to-treat analysis, and blinded assessment	74 older people with knee OA divided in two groups KT group (n = 38) Sham-taping group (n = 38)	All groups kept the taping on for 4 days to treat pain, strength, and swelling.	Volumetry by water displacement and perimetry measured at threepoints: the fold at the popliteal fossa, 5 cm above that fold, and 5 cm below.	At day 4 and the follow-up assessment (day 10), there were no signifiant between-group differences for volumetry (MD: 0.05 ml, 95% CI: –0.01 to 0.11) andperimetry at any measured point.
Baltaci et al [52], 2021	Clinical study, prospective analysis, RCT with concealed allocation	76 patients with anterior cruciate ligament reconstruction, with discharge 24 hours after surgery KT group (n = 28) Control group (n = 28)	All groups received standard postoperative care including compression bandages, ice packing, elevation, and continuous passive motion.	Circumferential measurements at five levels: incision level, upper part of incision (5 cm above and 10 cm above) and lower part of incision (5 cm below and 10 cm below). Moreover, the non-operated side was also assessed at the 3-day assessment.	There was a significant difference in edema between the groups for incision level and upper part measurements for all 3 days (all $p < 0.05$), but no difference was found for lower part measurements (all $p > 0.05$).

Table 2. Continued

Study (year)	Study design	Subject characteristic	Treatment protocol	Measurement	Result
Nunes et al [48], 2015	RCT with concealed allocation, intention-to-treat analysis, and blinded assessment	36 athletes who participated regularly in one of sevendifferent sports and suffered an acute ankle sprain KT group (n = 18) Quasi-KT group (n = 18)	Both groups removed the tape before the assessment on day 3. Along with the taping application, both groups received instructions on how to apply ice and elevate the lower limb.	Volumetry by water displacement and perimetry measured in a figure-eight fashion.	There were no differences between groups for swelling in volumetry (MD: −2 ml, 95% CI: −28 to 32), perimetry (MD: 0.2 cm, 95% CI: −0.6 to 1.0), and relative volumetry (MD: 0.0 cm, 95% CI: −0.1 to 0.1). At day 15 of follow-up, there were no signifiant between-group differences in outcomes.
Serbest et al [53], 2020	Retrospective cohort study	42 pediatric patients with PIP joint sprain KT group (n = 21) Splint group (n = 21)	Each group wastreated with the application for 10 days.	Circumference of the PIP joint was measured before and after treatment.	Both groups had significantly improvedswelling after treatment (p < 0.001). The KT group displayed a better outcome compared with the splint group (p = 0.021).

RCT, randomized controlled trial; TKA, total knee arthroplasty; KT, kinesio taping; OA, osteoarthritis; TENS, transcutaneous electrical nerve stimulation; p.o., post-operative; MD, mean difference; CI, confidence interval; PIP, proximal interphalangeal.

searches and selected the evaluated studies. Finally, all authors agreed on the studies that were included in the analysis, with seven studies meeting all established eligibility criteria. All authors performed the analysis. The flowchart of study selection is shown in Figure 1.

RESULTS

Seven clinical studies were analyzed. Of the seven studies, five were related to knee disorders, including total knee arthroplasty (TKA), OA, and anterior cruciate ligament reconstruction (ACLR). One study investigated acute ankle sprain, and another focused on proximal interphalangeal (PIP) joint sprain.

The seven clinical studies included in this literature review are summarized in Table 2. The total number of participants included in the analysis was 517, with 73.9 subjects per study on average. The largest study analyzed 111 patients [47], whereas the smallest number of participants was 36 [48].

Regarding treatments for knee complaints, Donec and Kriščiūnas [49] investigated the effectiveness of KT in decreasing postoperative edema after TKA compared with no taping. Windisch et al. [50] compared KT and A-V impulse systems, which are the conventional devices for lymphatic therapy. In 2022, one study compared no taping with cold therapy in patients with TKA [47]. Wageck et al. [51] evaluated whether KT could be beneficial in patients with knee OA compared with sham taping. Baltaci et al. [52] assessed the effect of KT on the perimetry of the knee within 3 days after ACLR. Two of the seven studies investigated joints other than the knee. Nunes et al. [48] investigated whether KT reduces swelling in athletes with acute lateral ankle sprains. Serbest et al. [53] compared KT with classic finger splint treatment in pediatric patients with PIP joint sprains.

Three of the seven studies reported positive outcomes when using perimetry to assess the swelling [49,52,53]. Donec and Kriščiūnas [49] revealed that the application of KT led to a more rapid decrease in edema in the thigh, knee, and calf ($p < 0.05$; $\beta \leq 0.2$) during rehabilitation compared with no taping. Baltaci et al. [52] found that incision level and upper knee measurements of KT group were significantly different with no taping group on all 3 days following ACLR ($p < 0.05$). Serbest et al. [53] reported a better outcome regarding the circumference of the PIP joint with KT application than with splint treatment ($p < 0.021$). However, KT did not significantly improve swelling

in four studies compared with other interventions or no intervention [47,48,50,51].

DISCUSSION

In this literature review, we investigated the effectiveness of KT for reducing edema caused by various musculoskeletal disorders. We finally analyzed seven studies, related with knee, ankle, and hand joints.

The proposed mechanism of KT for relieving edema is through constant tension on the skin, resulting in folds under the taped region. These folds could enhance the interstitial space between the skin and the underlying connective tissue, resulting in increased lymphatic flow [12]. Another theory is that the application of KT provides a suitable environment for lymphatic fluids in the tissue area to move from a higher to lower pressure, leading to reduced congestion of lymphatic fluid and swelling [3,7].

In this literature review, the outcomes of studies differed according to the location of KT application or the purpose of the treatments. Of the three studies on TKA, only the study by Donec and Kriščiūnas [49] reported significant results using knee perimetry. This study revealed that the use of KT had a positive effect on reducing lymphatic fluid compared with no taping and could decrease the risk of edema from the second postoperative week [49]. Windisch et al. [50] reported that there were no significant differences between the KT group and the group using the A-V impulse system, concluding that KT appeared to be just as effective as the A-V impulse system for reducing soft tissue swelling. However, this study had some limitations and lacked control conditions, meaning that it could not determine a significant improvement in swelling when using KT as lymphatic therapy [50]. A recent study investigated the effectiveness of KT in patients with TKA compared with a standard rehabilitation program (control) and cold therapy, which are traditional treatments for controlling swelling [47]. Although KT application resulted in a significant improvement in pain compared with the control group, it did not significantly control swelling; furthermore, cold therapy was statistically superior to both the control treatment and KT regarding alleviating lymphatic fluids [47].

One study investigating the effects of KT on knee OA revealed that KT intervention did not show any improvement compared with sham taping [51]. However, when KT was used in people who had undergone ACLR, KT resulted in a significant improvement in swelling 72 hours after KT application [52]. Considering previous studies, all subjects developed acute tissue swelling or lymphedema after surgery, but not subjects with OA because their symptoms had been present for at least 6 months [51]. In addition, participants in the sham taping study used taping alone without any physical therapy [51]. Therefore, KT may assist in reducing edema that occurs after surgery, rather than swelling associated with chronic knee joint disorders. Additionally, KT with standard postoperative rehabilitation appears to be more effective than the application of KT alone.

We reviewed only two studies related to joints other than the knee. Nunes et al. [48] evaluated the effects of KT application in athletes with acute lateral ankle sprains. Their study reported no significant improvement in acute swelling with KT [48]. Some studies reported that KT reduces the extracellular liquid resulting from hydrostatic pressure changes and having a low level of protein or transudate such as chronic venous insufficiency [54,55]. They asserted that considering the structural differences of the swelling, KT did not influence the active inflammatory phase because high levels of protein or transudate were exuded during the healing process of acute inflammation [48]. Regarding the effectiveness of KT in pediatric patients with acute PIP joint sprains, both the KT and splint groups had some positive effects on the circumference compared with before treatment [53]. Although splinting is a conventional treatment for acute sprain, the use of KT significantly reduced the congestion of lymphatic fluids compared with splinting [53]. Furthermore, KT also had positive effects on range of motion [53]. We speculate that KT restricts the joint structures less than splinting and, along with muscle activation during the healing process of inflammation, the use of KT could facilitate the movement of lymphatic fluid, consequently improving lymphatic flow. Conversely, a decrease in swelling could improve joint mobility [51].

The present review has several limitations. Only seven studies met the search criteria, which limited the clinical research that evaluated musculoskeletal complaints. Although these studies aimed to investigate the overall effects of KT by measuring outcomes such as pain, mobility, and strength, the purpose of the present review was to examine and compare edema only. In addition, it was difficult to generalize the effect of KT on swelling owing to the different taping techniques and primary

causes of edema among the reviewed studies. Another limitation of this literature review includes a search strategy in which only one database was searched and articles in other languages were excluded. Our literature review did not include an explicit definition of musculoskeletal disorders. A clearer definition of this term is required to generalize the findings to a broad range of musculoskeletal injuries.

CONCLUSIONS

Our literature review found insufficient evidence for or against the application of KT in improving lymphatic flow and reducing swelling following various musculoskeletal complaints. Despite the lack of evidence to demonstrate the clinical benefits of KT for edema, this study presents a comprehensive review of the swelling relief effect of KT on different types of musculoskeletal injury. KT can be used as a low-cost complementary intervention for swelling control in postoperative treatment after TKA and ACLR. Furthermore, KT could be a useful modality in rehabilitation following acute PIP joint sprains. Further research is needed to clarify the use of KT in reducing edema in musculoskeletal injuries.

FUNDING

This study was supported by the "Brain Korea 21 FOUR Project" and the Korean Research Foundation for the Department of Physical Therapy at the Graduate School of Yonsei University.

ACKNOWLEDGEMENTS

None.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

AUTHOR CONTRIBUTIONS

Conceptualization: JY, IM, JL. Data curation: JY, IM, JL. Formal analysis: JY, IM, JL. Funding acquisition: JY, CY. Investigation: JY, IM, JL. Methodology: JY, CY, IM, JL. Project administration: CY. Resources: JY, CY. Supervision: CY. Validation: JY, CY. Visualization: JY, IM, JL. Writing - original draft: JY, IM, JL. Writing - review & editing: JY, CY, IM, JL.

ORCID

Joon-hyoung Yong, https://orcid.org/0000-0001-8664-5392
Jin-seok Lim, https://orcid.org/0000-0002-9965-9619
Il-young Moon, https://orcid.org/0000-0001-6457-8125

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