Systematic Review and Meta-Analysis

Medicine

OPEN

Effectiveness of Kinesio tape in the treatment of patients with patellofemoral pain syndrome

A systematic review and meta-analysis

Yuan Luo, MD[a], Xiao Chen, MD[b,*], Xiaocong Shen, MD[a], Li Chen, MD[a], Haibo Gong, MD[a]

Abstract

Objective: To evaluate the clinical effectiveness of the Kinesio tape in the treatment of patellofemoral pain syndrome (PFPS) by meta-analysis.

Methods: Two investigators independently conducted an electronic literature search to assess the outcomes of intramuscular patches for PFPS. Electronic databases included PubMed, Embase, Web of Science, Cochrane Library, Wanfang Database, Chinese Journal Full Text Database (CNKI), and Wipo Database from November 2023. Extracted inclusion indicators included pain score VAS or NRS, knee function assessment knee pain syndrome (Kujala) score, and knee symptom score Lysholm knee score scale. Data were extracted and then meta-analyzed using Review Manager 5.3 software and Stata 17.0 software.

Result: Fourteen studies were included, all of which were randomized controlled studies. The results showed that short-term pain relief was superior in the Kinesio tape (KT) group compared with the control group, with a statistically significant difference in the results (MD = −1.54, 95% CI [−2.32, −0.76], $P = .0001$); medium-term pain relief was superior in the KT group compared with the control group, with a statistically significant difference in the results (MD = −0.84, 95% CI [−1.50, −0.18], $P = .01$); long-term pain relief in the KT group was better than the control group, with statistically different results (MD = −0.56, 95% CI [−0.98, −0.13], $P < .00001$). In contrast, there was no significant difference between the KT group and the control group in the assessment of knee function (MD = −0.98, 95% CI [−4.03, 2.06], $P = .03$), and there was no significant difference between the KT group and the control group in the Lysholm knee score scale score of knee symptoms (MD = 4.18, 95% CI [−6.70, 15.05], $P = .45$).

Conclusion: Kinesio taping can effectively relieve the pain of PFPS, but has no significant effect on the improvement of knee joint function and symptoms.

Abbreviations: CI = confidence interval, KPS = knee pain syndrome, KT = Kinesio tape, LKSS = Lysholm knee score scale, NRS = numerical rating scale, PFPS = patellofemoral pain syndrome, RR = relative risk, VAS = visual analog scale.

Keywords: Kinesio tape, meta-analysis, patellofemoral pain syndrome, systematic review

1. Introduction

Patellofemoral pain syndrome (PFPS) is a prevalent condition affecting the musculoskeletal system. Its primary symptom is a diffuse anterior knee pain that accompanies activities such as squatting, climbing stairs, and rising from a seated position.[1] There are several designations for this ailment, including runner's knee, anterior knee pain, chondromalacia patella, or patellofemoral pain.[2] PFPS is a common condition in individuals who engage in regular sports participation and demonstrates higher incidence in women in comparison to men. Numerous studies propose that PFPS contributes to 25 to 40 per cent of all knee problems. It is worth noting that roughly a quarter of recreational athletes diagnosed with PFPS quit their athletic endeavors due to knee pain.[3] The pathogenesis of PFPS remains incompletely understood but may be linked to aberrations in shear and compression forces acting on the patellofemoral joint.[4,5] Likewise, muscle imbalances affecting the internal and external femoral obliques are posited as crucial factors in the development of PFPS.[6] Conservative treatment forms the basis for addressing PFPS. This typically involves physiotherapy aimed at enhancing functionality and mitigation of PFPS-related dysfunction and pain. Such physiotherapy can include knee joint exercises, braces, manipulative techniques, and electrical stimulation.[7–10] The principal

The authors have no funding and conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

The review did not involve primary data collection from patients so ethical approval was not necessary.

[a] Department of Rehabilitation, The First People's Hospital of Neijiang, Neijiang, China, [b] Department of Orthopedics, The First People's Hospital of Neijiang, Neijiang, China.

** Correspondence: Xiao Chen, Department of Orthopedics, The First People's Hospital of Neijiang, Neijiang 641000, China (e-mail: 342918992@qq.com).*

How to cite this article: Luo Y, Chen X, Shen X, Chen L, Gong H. Effectiveness of Kinesio tape in the treatment of patients with patellofemoral pain syndrome: A systematic review and meta-analysis. Medicine 2024;103:23(e38438).

Received: 12 December 2023 / Received in final form: 3 May 2024 / Accepted: 10 May 2024

http://dx.doi.org/10.1097/MD.0000000000038438

objective is to ease anterior knee discomfort and improve knee function.

The Kinesio tape (KT) is a thin, breathable and flexible tape that stretches with the muscle but does not restrict joint movement. The technique of Kinesiology Tape (KT) was originally developed by Dr Kenso Kase in Japan. In present times, orthopedic and rehabilitation physicians, as well as physiotherapists, have been using KT to both prevent and treat musculoskeletal injuries.[11,12] The therapeutic benefits of KT comprise augmenting proprioception, facilitating or suppressing muscle excitability, ameliorating muscle function, encouraging blood and lymphatic circulation, alleviating pain, and realigning subluxated joints.[13–15] However, the precise mechanism of action of KT remains unclear and may be associated with normalizing the affected fascia and muscles by reducing abnormal muscle tone.[13] Additionally, some literature suggests that its efficacy is due to the interference of pain intensity via tactile stimulation.[16]

The therapeutic efficacy of KT as an adjunctive treatment for PFPS has been somewhat controversial.[17–20] There was no dependable evidence that Kinesiology tape (KT) effectively diminished pain and improved other functional conditions in PFPS patients. Thus, this study performed a meta-analysis of randomized controlled trials to evaluate KT's therapeutic efficacy for PFPS.

2. Methods

2.1. Literature search strategy

Two researchers carried out an electronic literature search to evaluate the effectiveness of intramuscular patches for the treatment of PFPS. The search included electronic databases such as PubMed, Embase, Web of Science, Cochrane Library, Wanfang Database, China Journal Full Text Database (CNKI), and Wikipedia, with Chinese and English being the only limited languages. The results were analyzed as of November 2023. Search terms included: "KT," "Tape Athletic," "Tapes, Kinesio," "Tape," "PFPS," "anterior Knee Pain," "patellofemoral pain," "chondromalacia patellae," "random."

2.2. Inclusion and exclusion criteria

Inclusion criteria: The participants were 15 years old and above; participants diagnosed with PFPS, anterior knee pain, patellofemoral arthralgia, or chondromalacia patellae; pain in the posterior or peripheral area of the patella during activities that increase stress on the knee joint (running, squatting, jumping, kneeling, prolonged sitting, etc); patellar tenderness on palpation or pain when stepping down or squatting in the lower extremities; voluntary participation and signing of an informed consent. Exclusion criteria: non-randomized controlled studies; duplicated publications; reviews, meta-analyses, case reports, theses, conference papers, and other similar articles; inappropriate interventions; studies without available full text data.

2.3. Literature review and data extraction

Two researchers, the first and corresponding author, conducted an electronic literature search to eliminate duplicate studies. Studies were then independently screened based on their titles and abstracts, and irrelevant studies were excluded. The full text was also screened, and any discrepancies during this process were resolved through discussion until agreement was reached. If agreement could not be reached, a third researcher made the final decision after a group discussion. All screening was conducted based on predetermined inclusion and exclusion criteria. After identifying the literature for inclusion, 2 researchers autonomously gathered the subsequent information: initial author, publication year, nation, participant's age, sample size, intervention and treatment period, and outcome assessment.

2.4. Evaluation of the quality of the literature

The methodological bias and quality of the randomized controlled trials included were evaluated using the Cochrane Collaboration's Risk of Bias Assessment Tool in accordance with the Cochrane Handbook for Systematic Review of Interventions. Seven specific domains were evaluated, including generating randomization sequences, allocation concealment, blinding of participants and outcome assessors, incomplete outcome data, selective outcome reporting, and sources of other bias.

2.5. Statistical analyses

The data were analyzed and processed by employing RevMan 5.3 and Stata 17.0 software. The heterogeneity of all studies was initially checked by conducting the chi-square test, and the degree of heterogeneity was measured by I^2. When the heterogeneity was small with $P \geq .05$ and $I^2 \leq 50\%$, we implemented the fixed effect model (FEM). However, if the heterogeneity was large with $P < .05$ or $I^2 > 50\%$, we used the random effect model (REM) to further investigate the sources of heterogeneity. This involved conducting subgroup analysis, sensitivity analysis and meta-regression.[21] The relative risk (RR) and its corresponding 95% confidence interval (CI) were used to express the count data, while the mean difference (MD) and its 95% CI were utilized to express the measurement data. Statistical significance was defined as $P < .05$.

3. Results

3.1. Results of the literature search

The methodology for identifying and selecting relevant studies in this meta-analysis is depicted in Figure 1. At the outset, a total of four English databases and 3 Chinese databases were searched, yielding 406 studies (PubMed: 128, EMBASE: 597, Cochrane Library: 152, Web of Science: 85, CNKI: 14, Wanfang: 19, VPCS: 8). After exclusion criteria were applied, 14 randomized controlled trials (RCTs) investigating the efficacy of intramuscular patches for treating PFPS were ultimately included.[22–35] Additional studies were not found through reviewing articles and references included in the study. Both researchers concurred during the literature search and inclusion process.

3.2. Basic characteristics and quality assessment of included studies

The features of the investigations included are presented in Table 1. A sum of 14 randomized controlled studies[22–35] were integrated, comprising 9 in English and 5 in Chinese. In the experimental group, 4 studies utilized KTs alone,[27,29,31,35] while 6 studies combined KTs with exercise therapy.[22–25,28,30] Two studies combined KTs with other physiotherapies,[32,34] and 1 study used KTs in combination with sodium vitrate.[26] Lastly, 1 study combined KTs with electroacupuncture.[33] In the control group, only 3 studies[27,29,30] used adhesive tape without tension while 4[22–25] underwent exercise therapy, 2[32,34] received other physiotherapy, 1[28] underwent electrostimulation combined with exercise therapy, 1[26] received sodium vitrate, 1[35] used McConnell patch, 1[33] underwent electroacupuncture, and 1[31] was in the blank control group. Five studies assessed efficacy over 0 to 3 days, 6 studies assessed efficacy over 1 to 3 weeks, and 9 studies assessed efficacy over 4 to 6 weeks. Table 1 displays the characteristics of the included studies. Randomized controlled trials were evaluated for 7 factors related to risk of bias using the guidelines outlined in the Cochrane Handbook for the Systematic

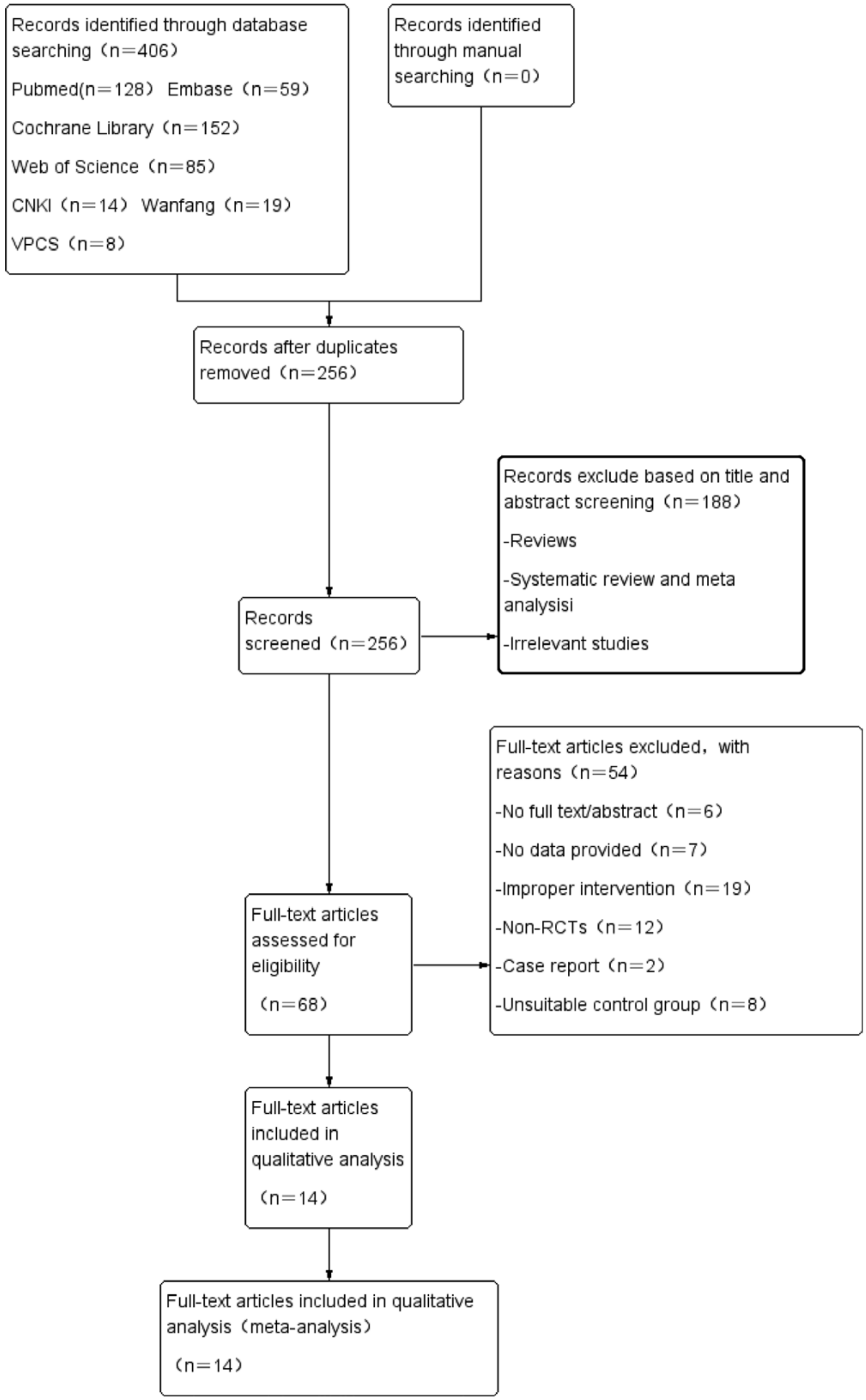

Figure 1. Literature screening flowchart.

Evaluation of Interventions[36] (Figs. 2 and 3). All studies were randomized controlled studies, utilizing either computer-generated random sequences or allocation concealment via sealed envelopes for randomization. Five studies[22,25,26,30,35] employed the computerized table of numbers method, and 1[23] used the sealed envelope method, and the remaining 8 did not specify the randomization method used. Three RCTs[22,23,29] reported double blinding of patients, investigators, and assessors.

3.3. Meta-analysis results

3.3.1. Pain assessment was conducted in 13 studies that included patients with PFPS. Of these, the NRS scale was utilized in 2 studies, while the VAS scale was implemented in the remaining 11 studies to quantify the intensity of pain. Since all scores ranged from 0 to 10, they were aggregated for analysis. Moreover, there was a significant temporal gap between posttreatment evaluations in the studies examined. To account for this, the period was categorized into short, medium, and long-term pain for analysis, respectively defined as 0 to 3 days, 1 to 3 weeks, and 4 to 6 weeks.

3.3.1.1. Comparison of KT treatment for short-term pain (0 to 3 days). The assessment period for this analysis was between 0 and 3 days, utilizing evaluation metrics of VAS or NRS. The studies included a total of 298 patients, and upon heterogeneity analysis, significant heterogeneity was observed between the studies ($P < .00001$, $I^2 = 94\%$). To explore the source of this heterogeneity, subgroup analyses were conducted for different interventions, including the group treated with KT in combination with other therapies versus those treated with KT alone. The subgroup analyses pooled outcome measure differences and were examined using a random effects model. The findings suggest that KTs provide better short-term pain relief compared to controls, with statistically significant outcomes (MD = −1.54, 95% CI [−2.32, −0.76], $P = .0001$). The subgroup analyses indicate that in terms of short-term pain relief, KT combined with other treatments was superior to the control group with a statistically significant difference in the results (MD = −1.62, 95% CI [−2.67, −0.56] $P = .003$). Additionally, the KT treatment alone was superior to the control group in terms of short-term pain relief, with a statistically significant difference in the results (MD = −1.54, 95% CI [−2.15, −0.93], $P < .00001$). Figure 4 illustrates the findings.

3.3.1.2. Comparison of pain in the middle of KT treatment (1 to 3 weeks). The evaluation metrics were VAS or NRS, and the assessment time was 1 to 3 weeks. Six studies with a total of 267 patients were included. Heterogeneity analysis showed heterogeneity between studies ($P < .00001$, $I^2 = 92\%$), and in order to explore the source of heterogeneity, subgroup analyses were performed for the different interventions, including the KT in combination with other treatments group versus treatment with KT alone. The subgroup analyses combined differences in outcome measures and were analyzed using a random effects model. The results showed that mid-term pain relief was better in the KTs group than in the control group, with statistically different results (MD = −0.84, 95% CI [−1.50, −0.18], $P = .01$). The results of subgroup analysis showed that the KT combined with other treatment groups had better mid-term pain relief than the control group, and the results were not statistically different (MD = −0.45, 95% CI [−1.02, 0.11], $P = .12$). As shown in Figure 5:

3.3.1.3. Comparison of KT for long-term pain (4 to 6 weeks). The study's evaluation index was VAS or NRS, and the assessment

Table 1

The general date of the included studies.

Inclusion study	Yr	Country	Nex / Ncg	Intervention measure EX/EG	Period	Patch mode EX	Patch mode EG	Age EX/EG	Outcome index
Akbas et al[22]	2011	Turkey	15/16	KT + EX/EX	3 wk, 6 wk	Y-shaped thigh strips	–	41.0 ± 11.26 44.88 ± 7.75	②④
Arrebola et al[23]	2020	Brazil	13/16	KT + EX/EX	6 wk, 12 wk	Outer patella I tape	–	30.38 ± 8.40 30.31 ± 7.91	①②③
Basbug et al[24]	2022	Turkey	15/15	KT + EX/EX	6 wk, 12 wk	Patellar fixation pad	–	34.1 ± 8.9 39.0 ± 6.4	④
Cheng et al[25]	2023	China	33/33	KT + EX/EX	3 d, 5 d, 5 wk	Patella I patch	–	15 to 24	④⑥⑧
Hu et al[26]	2018	China	25/25	KT + SH/SH	1 d, 1 wk, 2 wk, 5 wk	Y-shaped thigh strips	–	–	④⑦
Kurt et al[27]	2016	Turkey	45/45	KT/PG	48 h	Patellofemoral correction Y	Horizontal sticker	31.6 ± 6.9 30.9 ± 7.2	②④⑤
Kuru et al[28]	2012	Turkey	15/15	KT + EX/ES + EX	6 wk	Patellar fixation thigh Y strap	–	32.93 ± 12.11 40.93 ± 10.57	②④
Melo et al[29]	2020	Brazil	18/18	KT/PG	72 h	Y-shaped thigh strips	No tension thigh Y	23.7 ± 3.8	①②
Sahan et al[30]	2023	Turkey	12/14	KT + EX/PG + EX	6 wk	Patellar star patch	Patellar star patch	25 ± 6.23 26.91 ± 9.02	④
Song et al[31]	2017	China	20/20	KT/–	2 wk	Patella I patch	–	34.16 ± 8.11	④
Tang et al[32]	2013	China	20/20	KT + PAT/PAT	2 wk, 4 wk	Patella O, thigh I	–	60.2 ± 10.1 59.7 ± 9.8	④⑥
Tang et al[33]	2021	China	32/30	KT + EA/EA	4 wk	Y-shaped thigh strips	–	48.67 ± 8.13 48.32 ± 6.8	④⑥
Xiao and Pang[34]	2014	China	20/20	KT + PAT/PAT	1 d, 5 d, 10 d	Y-shaped thigh strips	–	16 to 23 15 to 25	④
Yoon and Son[35]	2022	Korea	26/26	KT/MT	At once	Y-shaped thigh strips	Patella transverse	27.13 ± 6.02 26.41 ± 5.36	②

① NRS; ② KPS (Kujala); ③ SJHT; ④ VAS; ⑤ TSSK; ⑥ LKSS (Lysholm); ⑦ Trrgang; ⑧ FAM-LE.
CG = control group, EA = electroacupuncture, EG = experiment group, ES = electrical stimulation, EX = exercise, MT = McConnell taping, PAT = physical agents therapy, PG = placebo group, SH = sodium hyaluronate.

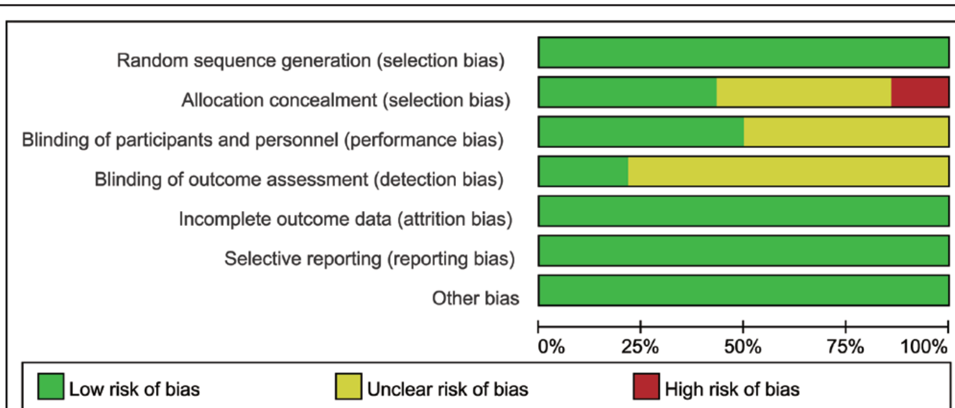

Figure 2. Proportionate risk of bias graph for the included literature.

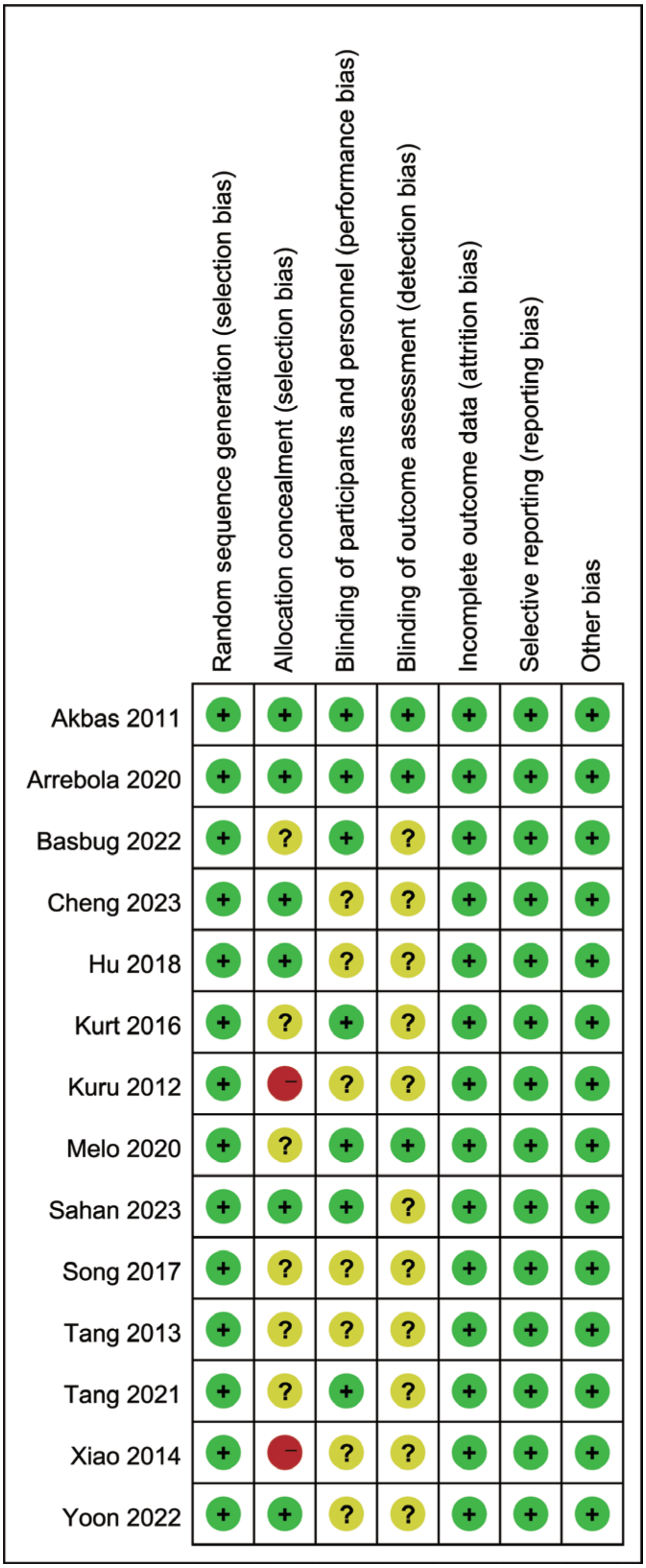

Figure 3. Summary chart of risk of bias for the included literature.

period was 4 to 6 weeks. The review encompassed 9 individual trials, including a total of 362 patients. A heterogeneity analysis revealed disparity among the various studies ($P < .00001$, $I^2 = 85\%$), which was scrutinized using a random-effects model. The findings suggested that the KT group attained superior long-term pain relief results compared to the control group, and this difference was statistically significant (MD = −0.56, 95% CI [−0.98, −0.13], $P < .00001$). Figure 6 depicts these results.

3.3.2. Comparison of KPS (Kujala) score of knee function. The KPS evaluation metric was utilized to assess the results of six studies involving 282 patients. Analysis of heterogeneity demonstrated significant differences between the studies ($P = .03$, $I^2 = 61\%$). To investigate the causes of such heterogeneity, subgroup analyses for various temporal interventions, such as short-term (0–3 days) KPS scores and long-term (6 weeks) KPS scores were conducted. The subgroup analyses were analyzed via a random effects model and in combination with variations in outcome measures. The study findings indicate no statistically significant distinction between the KT cohort and the control group (MD = −0.98, 95% CI [−4.03, 2.06], $P = .03$). The subgroup analysis results indicate that there were no significant differences between the KT group and the control group for short-term KPS scores (MD = −1.75, 95% CI [−5.85, 2.36], $P = .4$) or long-term KPS scores (MD = 0.83, 95% CI [−3.33, 4.99], $P = .7$). These findings are visually illustrated in Figure 7.

3.3.3. Comparison of LKSS scores for knee symptoms. The evaluation index was the LKSS, which was assessed over a period of 4 weeks. Inclusion of 3 studies with a total of 166 patients, heterogeneity analysis showed that there was heterogeneity between studies ($P < .00001$, $I^2 = 96\%$)., which was analyzed using a random-effects model. The results showed that the LKSS score in the KT group was not significantly different from the control group (MD = 4.18, 95% CI [−6.70, 15.05], $P = .45$). As shown in Figure 8.

3.4. Sensitivity analysis

Sensitivity analyses were conducted to assess the long-term effectiveness of intramuscular patches for treating PFPS. The findings were consistent after excluding individual studies that had no significant impact on the overall outcomes. Figure 9 displays the results.

3.5. Publication bias

The study analyzed the long-term effectiveness of the intramuscular effect patch in treating pain related to PFPS. The Egger and Begg tests were used to assess publication bias, and the results of the Egger test showed $P = .715$, while the Begg test showed $P = .754$. These results indicate a small publication bias, with a P value > .05. As shown in Figures 10 and 11.

4. Discussion

The use of KTs in treating PFPS has generated controversy. Nevertheless, there is a lack of systematic studies that have evaluated and meta-analyzed this treatment's effectiveness for PFPS. Therefore, this research conducted a meta-analysis of all randomized controlled trials using KT to treat PFPS and concluded that both long-term and short-term KT had a significant therapeutic impact on pain alleviation in PFPS. Nevertheless, there was no significant differentiation in knee function and symptom amelioration.

The effectiveness of KT in treating PFPS patients was analyzed in this study with regard to pain, knee function and symptoms, although data for certain other indicators could not be compiled. Prior to treatment, there was a substantial enhancement in soft-tissue flexibility and functional performance compared to week 6, as demonstrated by Akbas et al.[22] Sinaei et al[37] concluded that KT improved balance function in PFPS patients as well. Kurt et al[27] found that Kinesio Taping (KT) not only reduced pain in PFPS, but also had a beneficial impact on enhancing joint proprioception and reducing fear of movement, as well as improving functional activities of daily living. Kuru et al[28] demonstrated that both Kinesio taping and electrical stimulation were equally effective in reducing pain, improving functional status, increasing muscle strength, and enhancing quality of life for patients with PFPS. The study assessed patients' pain levels (using a visual analoge scale), range of motion (using a goniometer), muscle strength (using manual muscle testing), functional status (via a step test and a triple-jump test), and quality of life (using SF-36) before and after treatment. Yoon and Son[35] conducted a comparison of the therapeutic effects of McConnell Taping and Kinesio taping on pain and gait parameters in patients with PFPS. The results illustrate that both McConnell and KTs were efficacious in enhancing knee pain and gait parameters while walking in this patient cohort. Importantly, the use of the McConnell patch significantly reduced pain, leading to further improvements in gait variables. In conclusion, the KT is advantageous when used as a supplementary treatment for PFPS and may not have a beneficial effect when used alone, which aligns with Logan et al[38] research findings.

The study did not find any advantage of KT therapy in terms of improving knee function and symptoms. However, it is important to note that KT can alleviate pain in patients with PFPS when used in conjunction with exercise training as an adjunctive therapy. Numerous studies have shown that exercise therapy may alleviate pain and activity limitations in individuals with PFPS.[39–41] Furthermore, incorporating KT therapy throughout exercise could potentially decrease an individual's pain perception, allowing clinicians to implement proper rehabilitation and shorten the recovery cycle.[42]

KT may offer pain relief by promoting healing at the injury site through increasing the force exerted on the skin, improving the gap between the epidermis and dermis, and facilitating blood and lymphatic return. Additionally, by providing continual sensory input to skin receptors and inhibiting pain signals perception, KT can assist with pain management. Nevertheless, the precise mechanism of action remains ambiguous. The aforementioned is solely potential mechanisms of action, and further research and clinical trials are necessary to verify the tangible impacts on pain relief.[20,43]

An increasing amount of research has affirmed that PFPS patients may encounter muscle mechanical imbalances, notably in the form of atrophy of the quadriceps and gluteus medius muscles. A decrease in quadriceps strength displays a direct correlation

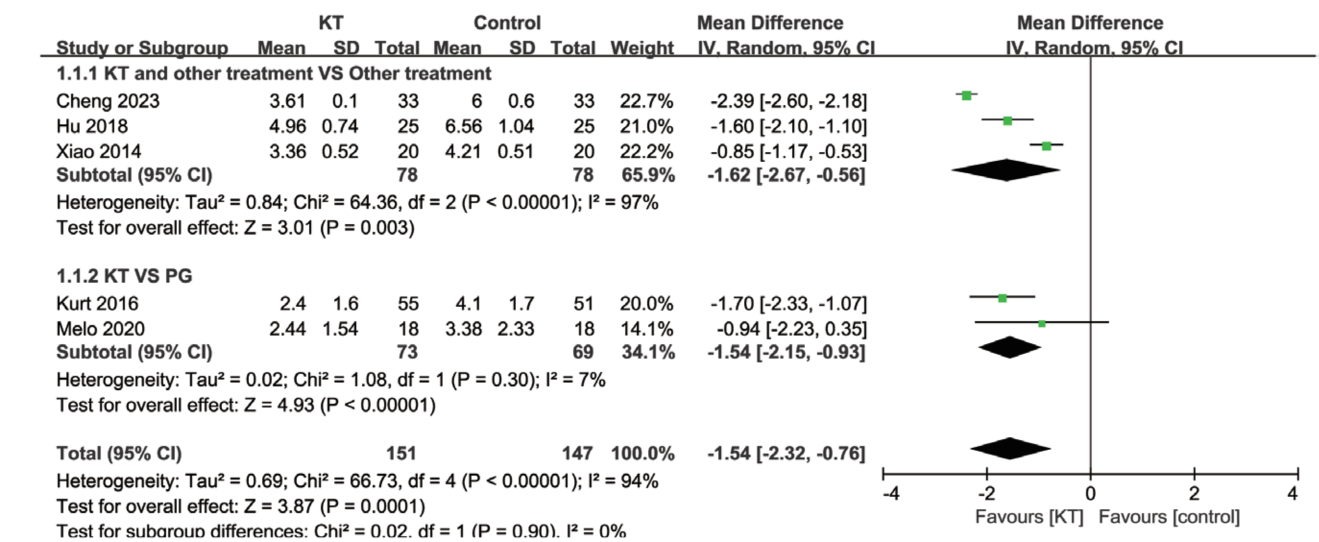

Figure 4. Forest plot comparing short-term pain in KT-treated PFPS. KT = Kinesio tape, PFPS = patellofemoral pain syndrome.

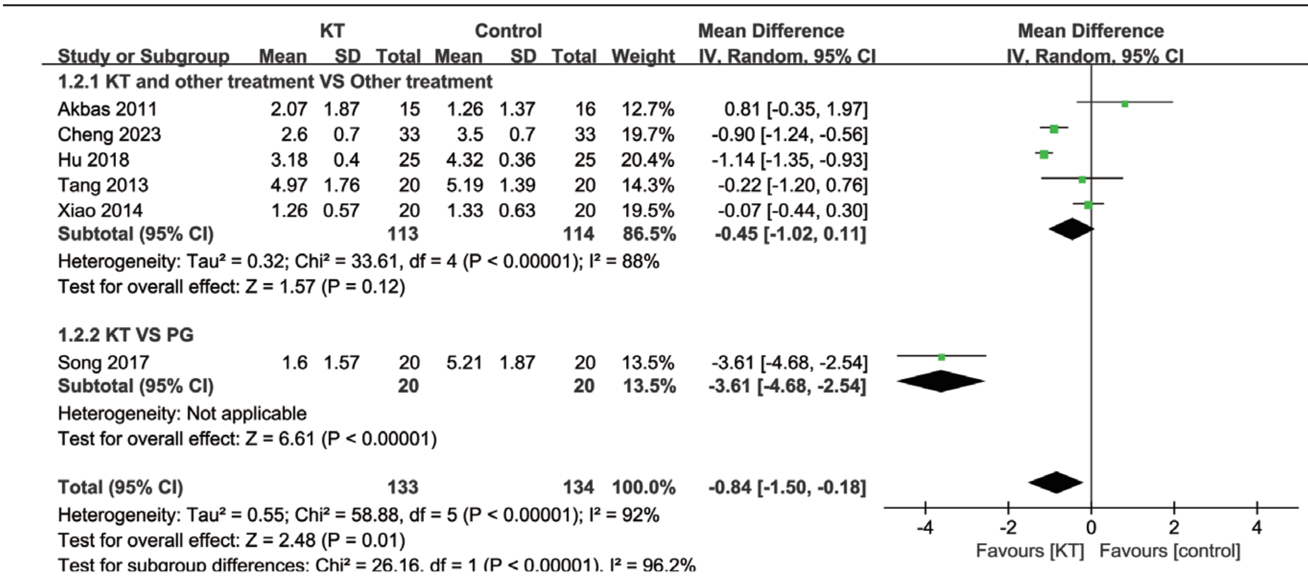

Figure 5. Forest plot comparing mid-term pain in PFPS treated with KT. KT = Kinesio tape, PFPS = patellofemoral pain syndrome.

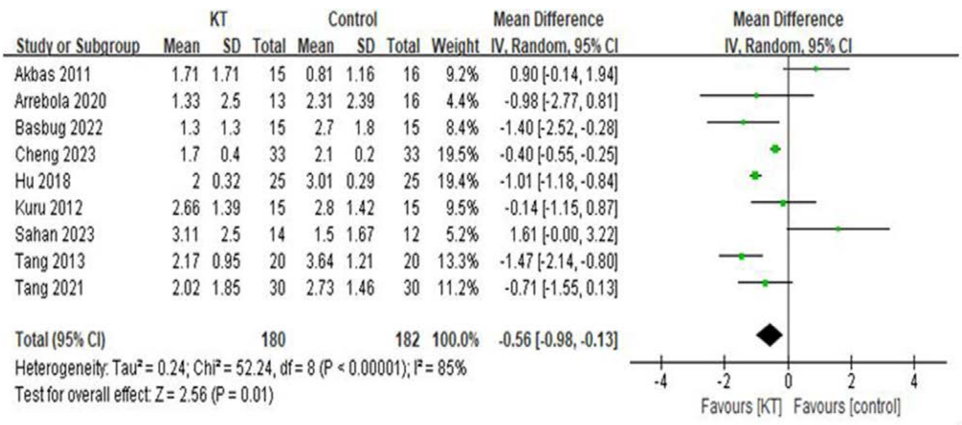

Figure 6. Forest plot comparing long-term pain in PFPS treated with KT. KT = Kinesio tape, PFPS = patellofemoral pain syndrome.

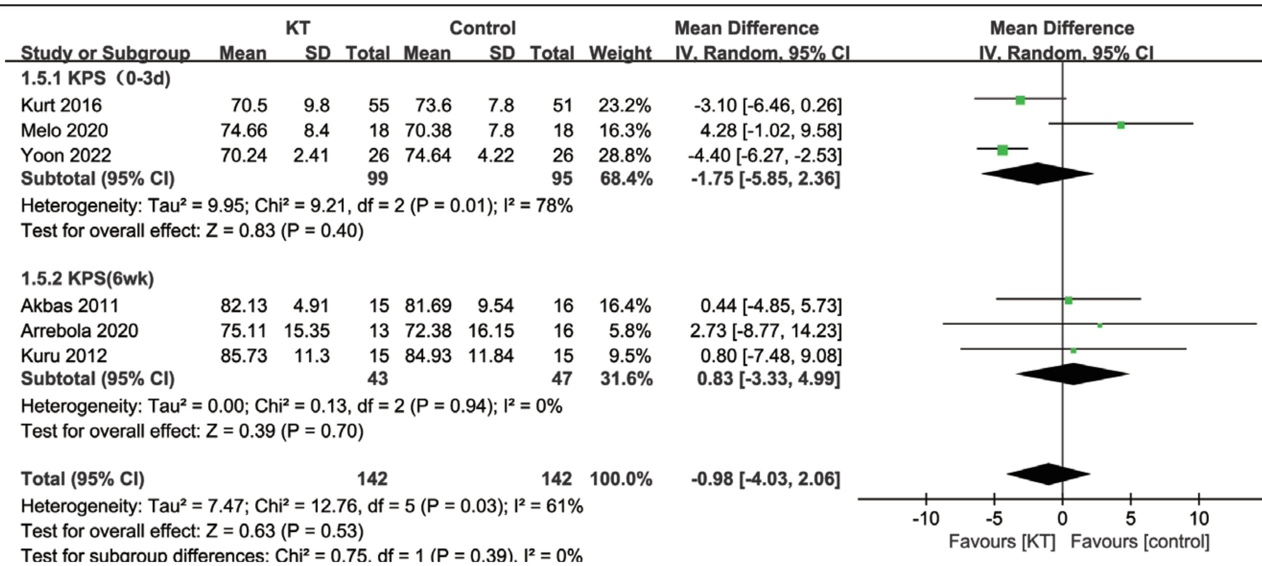

Figure 7. Forest plot comparing KPS of knee function in KT-treated PFPS. KT = Kinesio tape, PFPS = patellofemoral pain syndrome.

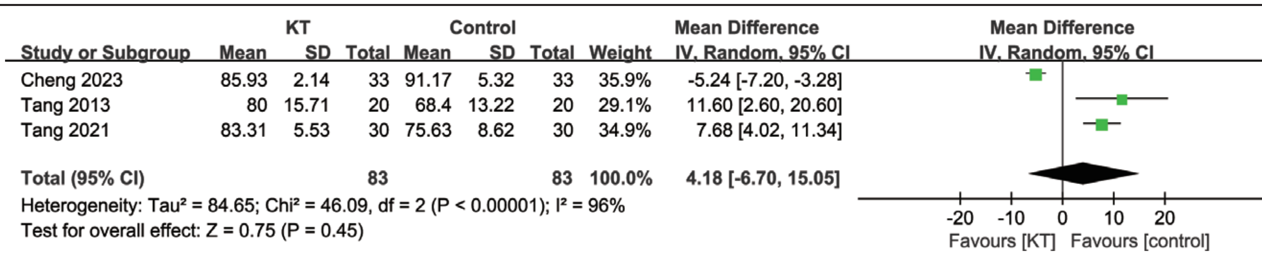

Figure 8. Forest plot comparing LKSS for PFPS knee symptoms in KT treatment. KT = Kinesio tape, LKSS = Lysholm knee score scale, PFPS = patellofemoral pain syndrome.

with the patients' proprioception and joint function, while a deficiency in gluteus medius strength negatively impacts their gait function.[1,2,6] Aghapour et al[20] showed that KT provides pain relief for PFPS patients. Miller et al[44] analyzed the range of extension in the affected limb and the range of motion of squatting in PFPS patients. They found that KT can enhance the activation of the gluteus medius muscle and improve postural stability. Thus, the application of KT for treating PFPS patients is not only restricted to pain relief but also has the potential to activate other relevant muscles.

This study has some limitations. Only a small number of the studies included placebo control, and the blinding method's design requires improvement; just 1 publication offered information on follow-up, and the majority of the studies lacked long-term follow-up and failed to provide descriptions of complications; despite carrying out subgroup analyses of pain and time to functional improvement in the present investigation, the sources of heterogeneity were not fully eliminated, and another analysis of other sources of heterogeneity was not performed, which could have affected the results of the meta-analysis; variations exist in the way Kinesiology Taping (KT) is applied, and this study only briefly summarizes the different methods used in the included literature. Future studies could furnish additional analyses of these application methods; the sample sizes of the included literature were generally low, warranting the need for more rigorously designed, multi-center, large-sample, high-quality randomized controlled trials to offer evidence on

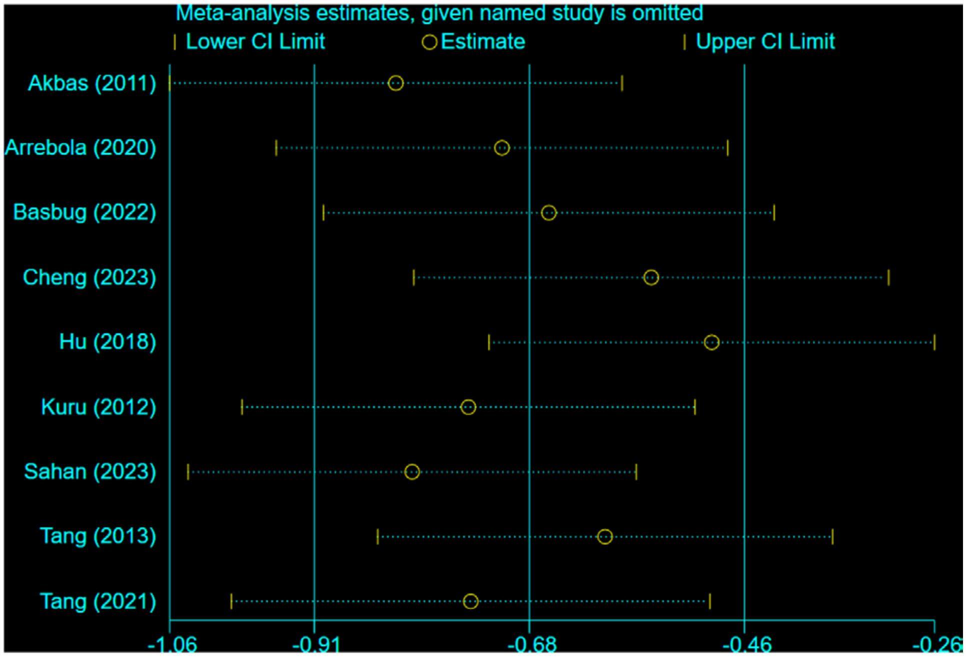

Figure 9. Sensitivity analysis of long-term pain in PFPS between 2 groups. PFPS = patellofemoral pain syndrome.

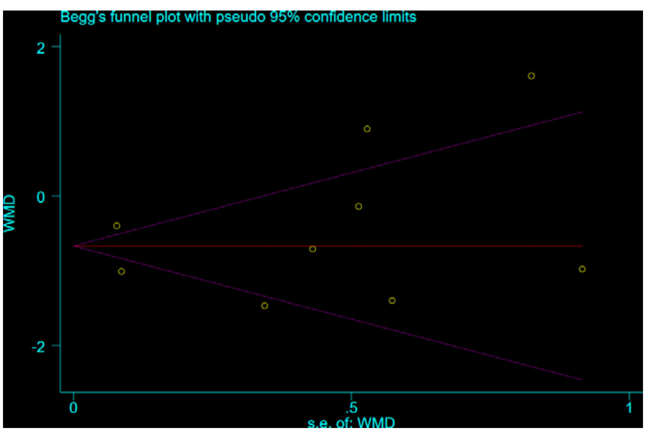

Figure 10. Begg publication bias plot of long-term pain in PFPS between 2 groups. PFPS = patellofemoral pain syndrome.

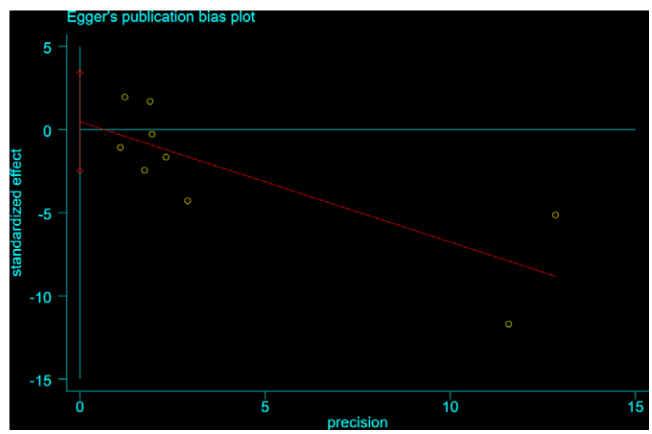

Figure 11. Egger publication bias plot of long-term pain in PFPS between 2 groups. PFPS = patellofemoral pain syndrome.

the effectiveness of intralesional patches for treating PFPS; the included literature had generally small sample sizes; hence, centered, large-sample, high-quality randomized controlled studies are required to validate the findings; the reason for the high heterogeneity of this study may be related to the different ways of attaching KT. And some studies included are in Chinese, and the quality score is relatively low, may cause high heterogeneity.

5. Conclusion

The KT has been shown to alleviate pain symptoms in individuals with PFPS. However, it does not effectively improve knee function or associated symptoms.

Author contributions

Conceptualization: Yuan Luo.
Data curation: Yuan Luo, Xiao Chen, Xiaocong Shen, Li Chen, Haibo Gong.
Formal analysis: Yuan Luo, Xiao Chen.
Investigation: Yuan Luo, Xiao Chen.
Methodology: Yuan Luo, Xiao Chen, Xiaocong Shen, Haibo Gong.
Software: Yuan Luo, Xiao Chen, Haibo Gong.
Validation: Yuan Luo.
Visualization: Yuan Luo.
Writing – original draft: Yuan Luo, Xiao Chen.
Writing – review & editing: Yuan Luo, Xiao Chen.
Funding acquisition: Xiao Chen, Xiaocong Shen, Li Chen.
Supervision: Xiaocong Shen, Li Chen.

References

[1] Payne K, Payne J, Larkin TA. Patellofemoral pain syndrome and pain severity is associated with asymmetry of gluteus medius muscle activation measured via ultrasound. Am J Phys Med Rehabil. 2020;99:595–601.
[2] Lobo P JÚNIOR, Barbosa IA NETO, Borges JHS, Tobias RF, Boitrago MVDS, Oliveira MP. Clinical muscular evaluation in patellofemoral pain syndrome. Acta Ortop Bras. 2018;26:91–3.
[3] Kasitinon D, Li W-X, Wang EXS, Fredericson M. Physical examination and patellofemoral pain syndrome: an updated review. Curr Rev Musculoskelet Med. 2021;14:406–12.

[4] Carlson VR, Boden BP, Sheehan FT. Patellofemoral kinematics and tibial tuberosity–trochlear groove distances in female adolescents with patellofemoral pain. Am J Sports Med. 2017;45:1102–9.
[5] Rabin A, Portnoy S, Kozol Z. The association of ankle dorsiflexion range of motion with hip and knee kinematics during the lateral step-down test. J Orthop Sports Phys Ther. 2016;46:1002–9.
[6] Dong C, Li M, Hao K, et al. Dose atrophy of vastus medialis obliquus and vastus lateralis exist in patients with patellofemoral pain syndrome. J Orthop Surg Res. 2021;16:128.
[7] Piva SR, Fitzgerald GK, Irrgang JJ, et al. Associates of physical function and pain in patients with patellofemoral pain syndrome. Arch Phys Med Rehabil. 2009;90:285–95.
[8] Petersen W, Ellermann A, Rembitzki IV, et al. Evaluating the potential synergistic benefit of a realignment brace on patients receiving exercise therapy for patellofemoral pain syndrome: a randomized clinical trial. Arch Orthop Trauma Surg. 2016;136:975–82.
[9] Jayaseelan DJ, Scalzitti DA, Palmer G, Immerman A, Courtney CA. The effects of joint mobilization on individuals with patellofemoral pain: a systematic review. Clin Rehabil. 2018;32:722–33.
[10] Martimbianco ALC, Torloni MR, Andriolo BN, Porfírio GJ, Riera R. Neuromuscular electrical stimulation (NMES) for patellofemoral pain syndrome. Cochrane Database Syst Rev. 2017;12:CD011289.
[11] Xue X, Hao Y, Yang X, et al. Effect of Kinesio tape and compression sleeves on delayed onset of muscle soreness: a single-blinded randomized controlled trial. BMC Musculoskelet Disord. 2023;24:392.
[12] Trofa DP, Obana KK, Herndon CL, et al. The evidence for common nonsurgical modalities in sports medicine, part 1: Kinesio tape, sports massage therapy, and acupuncture. JAAOS Glob Res Rev. 2020;4:e1900104.
[13] Alahmari KA, Reddy RS, Tedla JS, et al. The effect of Kinesio taping on cervical proprioception in athletes with mechanical neck pain–a placebo-controlled trial. BMC Musculoskelet Disord. 2020;21:648.
[14] Bohunicky S, Henderson ZJ, Simon N, Dacanay M, Scribbans TD. Acute effect of inhibitory Kinesio-tape of the upper trapezius on lower trapezius muscle excitation in healthy shoulders. J Bodyw Mov Ther. 2021;27:393–401.
[15] Mejías-Gil E, Garrido-Ardila EM, Montanero-Fernández J, Jiménez-Palomares M, Rodríguez-Mansilla J, González López-Arza MV. Kinesio taping vs. auricular acupressure for the personalised treatment of primary dysmenorrhoea: a pilot randomized controlled trial. J Pers Med. 2021;11:809.
[16] Snodgrass SJ, Farrell SF, Tsao H, et al. Shoulder taping and neuromuscular control. J Athl Train. 2018;53:395–403.
[17] Morris D, Jones D, Ryan H, Ryan CG. The clinical effects of Kinesio® Tex taping: a systematic review. Physiother Theory Pract. 2013;29:259–70.
[18] Parreira PDCS, Costa LDCM, Hespanhol Junior LC, Lopes AD, Costa LOP. Current evidence does not support the use of Kinesio Taping in clinical practice: a systematic review. J Physiother. 2014;60:31–9.
[19] Pelletier A, Sanzo P, Kivi D, Zerpa C. The effect of patellar taping on lower extremity running kinematics in individuals with patellofemoral pain syndrome. Physiother Theory Pract. 2019;35:764–72.
[20] Aghapour E, Kamali F, Sinaei E. Effects of Kinesio Taping® on knee function and pain in athletes with patellofemoral pain syndrome. J Bodyw Mov Ther. 2017;21:835–9.
[21] Chen Z, Wu J, Wang X, Ren Z. The effect of foot orthoses for patients with patellofemoral pain syndrome: a systematic review and meta-analysis. Heliyon. 2022;8:e09656.
[22] Akbaş E, Atay AO, Yüksel I. The effects of additional Kinesio taping over exercise in the treatment of patellofemoral pain syndrome. Acta Orthop Traumatol Turc. 2011;45:335–41.
[23] Arrebola LS, Teixeira CR, Lam PY, et al. Investigation of different application techniques for Kinesio Taping® with an accompanying exercise protocol for improvement of pain and functionality in patients with patellofemoral pain syndrome: a pilot study. J Bodyw Mov Ther. 2020;24:47–55.
[24] Basbug P, Kilic RT, Atay AO, Bayrakcı Tunay V. The effects of progressive neuromuscular exercise program and taping on muscle strength and pain in patellofemoral pain. A randomized controlled blind study. Somatosens Mot Res. 2022;39:39–45.
[25] Cheng ZT, Wei B, Liu Y. Observation on the efficacy of Kinesio tape combined with knee joint functional training in the treatment of chondromalacia patella in youth. Chin J Phys Med Rehabil. 2023;45:346–48.
[26] Hu XW, Xu X, Cai JH, Yao XM. Observation on the efficacy of Kinesio tape combined with sodium vitrate injection in the treatment of chondromalacia patella. Chin J Phys Med Rehabil. 2018;40:140–42.
[27] Kurt EE, Büyükturan O, Erdem HR, Tuncay F, Sezgin H. Short-term effects of Kinesio tape on joint position sense, isokinetic measurements, and clinical parameters in patellofemoral pain syndrome. J Phys Ther Sci. 2016;28:2034–40.
[28] Kuru T, Yalıman A, Dereli EE. Comparison of efficiency of Kinesio® taping and electrical stimulation in patients with patellofemoral pain syndrome. Acta Orthop Traumatol Turc. 2012;46:385–92.
[29] Melo SA, Macedo LDB, Borges DT, Brasileiro JS. Effects of Kinesio taping on neuromuscular performance and pain of individuals affected by patellofemoral pain: a randomized controlled trial. Physiother Theory Pract. 2020;36:709–19.
[30] Şahan TY, Vergili O, Oktaş B. Investigation of new application technique named star taping in patellofemoral pain: a randomized, single-blind, and placebo-controlled study. Somatosens Mot Res. 2023:1–8.
[31] Song WP, Zeng L, Song ZP. Immediate and shoet-term effects off Kinesio taping mechanics corrective taping to improve pain in patients with chondromalacia patella. Chin J Sports Med. 2017;36:817–19.
[32] Tang CZ, Xia Y, Ma M. Clinical efficacy of Kinesio tape combined with physiotherapy for patients with chondromalacia patella. Jiangsu Med. 2023;39:2477–8.
[33] Tang HC, Hu R, Tang LG, et al. Kinesio taping combined with electroacupuncture for the treatment of patellofemoral disorder in middle-aged and elderly exercise enthusiasts. Zhongguo Gu Shang. 2021;34:522–6.
[34] Xiao B, Pang J. Observation on short-time efficacy of Kinesio taping with physiotherapy in the treatment of chondromalacia patella in athletes. Chin J Sports Med. 2014;33:64–6.
[35] Yoon S, Son H. Effects of McConnell and Kinesio tapings on pain and gait parameters during stair ambulation in patients with patellofemoral pain syndrome. Medicina (Kaunas). 2022;58:1219.
[36] Higgins J, Green SE. Cochrane Handbook for systematic reviews of interventions version 5.1.0. The Cochrane collaboration. Naunyn Schmiedebergs Arch. Exp. Pathol. Pharmakol. 2011:382.
[37] Sinaei E, Foroozantabar V, Yoosefinejad AK, Sobhani S, Motealleh A. Electromyographic comparison of vastus medialis obliquus facilitatory versus vastus lateralis inhibitory Kinesio taping in athletes with patellofemoral pain: a randomized clinical trial. J Bodyw Mov Ther. 2021;28:157–63.
[38] Logan CA, Bhashyam AR, Tisosky AJ, et al. Systematic review of the effect of taping techniques on patellofemoral pain syndrome. Sports Health. 2017;9:456–61.
[39] Kölle T, Alt W, Wagner D. Effects of a 12-week home exercise therapy program on pain and neuromuscular activity in patients with patellofemoral pain syndrome. Arch Orthop Trauma Surg. 2020;140:1985–92.
[40] Motealleh A, Mohamadi M, Moghadam MB, Nejati N, Arjang N, Ebrahimi N. Effects of core neuromuscular training on pain, balance, and functional performance in women with patellofemoral pain syndrome: a clinical trial. J Chiropr Med. 2019;18:9–18.
[41] Clijsen R, Fuchs J, Taeymans J. Effectiveness of exercise therapy in treatment of patients with patellofemoral pain syndrome: systematic review and meta-analysis. Phys Ther. 2014;94:1697–708.
[42] Kakar RS, Greenberger HB, McKeon PO. Efficacy of Kinesio taping and McConnell taping techniques in the management of anterior knee pain. J Sport Rehabil. 2020;29:79–86.
[43] Sheng Y, Duan Z, Qu Q, Chen W, Yu B. Kinesio taping in treatment of chronic non-specific low back pain: a systematic review and meta-analysis. J Rehabil Med. 2019;51:734–40.
[44] Miller J, Westrick R, Diebal A, Marks C, Gerber JP. Immediate effects of lumbopelvic manipulation and lateral gluteal Kinesio taping on unilateral patellofemoral pain syndrome: a pilot study. Sports Health. 2013;5:214–9.