Influence of elastic and non-elastic banding on patellofemoral pain

Influência da bandagem elástica e não elástica na dor patelofemoral

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Abstract

Introduction: Patellofemoral pain, characterized by pain in the anterior region of the knee that is exacerbated by activities increasing compressive load on the patellofemoral joint, is a multifactorial condition predominantly affecting women between 18 and 35 years of age. Once the condition is diagnosed, an adhesive elastic bandage is recommended as one of the treatment options. **Objective:** To examine the evidence on the effectiveness of elastic and non-elastic taping in postural control, functionality, pain reduction, and muscle activation in women with patellofemoral pain. **Methods:** A systematic review was conducted using indexed electronic databases, including MEDLINE, PubMed, LILACS, SciELO, and PEDro. The study selection utilized the terms: "Patellofemoral Pain", "Women," "Elastic Taping," "Muscle Performance," and "Quadriceps." **Results:** A total of 183 studies were identified, of which 142 were excluded based on the title and 19 due to duplication. This left 22 studies for evaluation, but 15 were excluded for not meeting the inclusion criteria. Ultimately, seven articles were included, with two showing positive results in postural control, three in lower limb muscle performance, and two in pain and functionality. **Conclusion:** Of the seven articles that were analyzed, six obtained improvements in relation to postural control, pain, functionality and muscle activation, while only one had no significant difference with the use of bandages in muscle activation. Importantly, some of the positive effects were observed when bandaging was combined with other interventions, such as strengthening or mobilization techniques, indicating that the benefits cannot be attributed exclusively to taping.

Keywords: Knee. Women. Muscle. Patellofemoral pain syndrome. Systematic review.

Resumo

Introdução: *A dor patelofemoral, caracterizada por dor na região anterior do joelho exacerbada por atividades que aumentam a carga compressiva sobre a articulação patelofemoral, é uma condição multifatorial que afeta predominantemente mulheres entre 18 e 35 anos de idade. Uma vez diagnosticada, a bandagem elástica adesiva é recomendada como uma das opções de tratamento.* ***Objetivo:*** *Examinar as evidências sobre a eficácia da bandagem elástica e não elástica no controle postural, funcionalidade, redução da dor e ativação muscular em mulheres com dor patelofemoral.* ***Métodos:*** *Uma revisão sistemática foi conduzida utilizando bases de dados eletrônicas indexadas, incluindo MEDLINE, PubMed, LILACS, SciELO e PEDro. A seleção dos estudos utilizou os termos: "Dor Patelofemoral", "Mulheres", "Taping Elástico", "Desempenho Muscular" e "Quadríceps".* ***Resultados:*** *Um total de 183 estudos foram identificados, dos quais 142 foram excluídos com base no título e 19 por duplicação. Restaram 22 estudos para avaliação, mas 15 foram excluídos por não atenderem aos critérios de inclusão. Ao final, sete artigos foram incluídos, dois apresentando resultados positivos no controle postural, três no desempenho muscular dos membros inferiores e dois em dor e funcionalidade.* ***Conclusão:*** *Dos sete artigos analisados, seis obtiveram melhora em relação ao controle postural, dor, funcionalidade e ativação muscular, enquanto apenas um não apresentou diferença significativa com o uso de bandagens na ativação muscular. É importante ressaltar que alguns dos efeitos positivos foram observados quando a bandagem foi combinada com outras intervenções, como técnicas de fortalecimento ou mobilização, indicando que os benefícios não podem ser atribuídos exclusivamente à bandagem elástica.*

Palavras-chave: *Joelho. Mulheres. Músculo. Síndrome da dor patelofemoral. Revisão sistemática.*

Introduction

Among the most diverse conditions that affect the knee complex, one of the most relevant is patellofemoral pain (PFP) – also referred to as patellofemoral pain syndrome (PFPS) - due to its incidence and functional disability.[1] PFP is characterized by pain in the frontal region of the knee, which worsens during activities that increase compressive forces on the patellofemoral joint.[2,3] With a multifactorial cause and mostly affecting women aged between 18 and 35 years,[4,5] PFP is one of the most common musculoskeletal conditions observed in orthopedic practice.[6-8] PFP corresponds to 25 to 40% of conditions that affect the knee,[3] affecting about 25% of the general population.

Although patellofemoral disorders occur in a wide range of individuals, PFP is particularly prevalent in younger and more active people,[8] with women being affected about twice as often as men.[4,5,9] While earlier studies suggested an association between structural biomechanical changes in the lower limbs – such as femoral neck anteversion, increased hip adduction and medial rotation, and hip and knee muscle imbalances[10-12] – more recent evidence does not support a consensus regarding structural biomechanical factors as isolated causes of PFP. Instead, PFP is currently understood as a multifactorial condition influenced by mechanical, neuromuscular, and psychosocial factors.[13]

The signs and symptoms of this syndrome are exacerbated mainly during the performance of functional activities, among which stair climbing/descending and walking on inclined surfaces are particularly noteworthy.[14-16] These alterations in locomotor patterns may lead to changes in lower limb muscle strength, especially in the quadriceps, which is considered the primary stabilizer of the knee during gait, particularly in response to load.[15-17] Once PFP is diagnosed, interventions targeting specific elements of the patient's condition, such as pain and muscle imbalance, can be initiated. Physiotherapy offers several treatment modalities, including kinesiotherapy, manual therapy, taping techniques, and orthoses.[18-20] Among these, taping techniques are widely used as adjunctive strategies in clinical practice.

Bandages are often used as a treatment for conditions with unclear or limited curative options. Two techniques are widely used for anterior knee pain, such as the McConnell technique and the elastic bandage (EB).[20] EB is a thin, elastic band that can be stretched to 55-60% of its original length and is intended to increase proprioception by providing constant afferent stimulation through the skin. The McConnell taping method is designed to correct abnormal lateral displacement of the patella and promote proper patellar alignment through the use of a rigid, highly adhesive tape that can remain in place for up to 18 hours.

According to the evidence gathered, researchers have been interested in discovering the effects of the bandage and unraveling its physiological mechanisms

in the search for clear and coherent answers. Thus, the aim of this study was to verify in the literature evidence on the influence of elastic and non-elastic bandage on postural control, functionality, pain and muscle activation in women with PFP.

Methods

This is a systematic review, conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which served as the primary framework for its development.[21,22] The study was built respecting the following steps: a) elaboration of the guiding question; b) search in the literature; c) data collection; d) critical analysis of the included studies; e) discussion of the results; f) presentation of the review.

The included studies were randomized clinical trials, original and full-text, published in peer-reviewed national or international journals, written in Portuguese, English, or Spanish, that investigated women with a clinical diagnosis of PFP and evaluated the application of elastic and/or non-elastic taping (e.g., Kinesio Taping, femoral rotational taping, McConnell technique) as a primary or adjunct therapeutic intervention. Eligible designs were clinical trials (randomized or non-randomized) that included a comparison group (another intervention, sham/placebo, or no intervention) and reported at least one outcome of interest — postural control, functionality, pain, and/or lower-limb muscle activation — using quantitative measures and validated instruments when applicable. Studies with mixed samples (men and women) were included only when results for women were disaggregated or when the female sample predominated and allowed an effect interpretation specific to the target population.

Narrative or systematic reviews, editorials, dissertations, and theses not published in peer-reviewed journals were excluded. Publications that did not specifically investigate women with a clinical diagnosis of patellofemoral pain were also excluded, as well as studies that did not use elastic or non-elastic taping as a primary or adjunct therapeutic intervention. Likewise, studies without a comparison group, those that did not adequately describe the taping application protocol, or that failed to report quantitative results related to the outcomes of interest — postural control, functionality, pain, and/or muscle activation — were excluded.

Finally, studies with mixed samples that did not allow isolated interpretation of effects in the female population were also excluded from the review.

The PICO method was used to structure the literature search and data extraction: P (population) = women with PFPS; I (intervention) = elastic and non-elastic bandages; C (comparison) = other intervention techniques, sham or no intervention; O (result) = postural control, functionality, pain and muscle activation.

Databases and research strategies

The search was performed in the following databases: National Library of Medicine (MEDLINE), PubMed, Latin American and Caribbean Health Science Literature (LILACS), Scientific Electronic Library Online (SciELO), and Physiotherapy Evidence Database (PEDro) on the subject of interest, published in the period from 2000 to 2020. We also manually reviewed the reference lists of included studies to identify additional sources.

As a search strategy, the following keywords were selected: ("patellofemoral syndrome") OR ("patellofemoral pain syndrome") OR ("patellofemoral pain") AND ("athletic tape") OR ("kinesiotape") OR ("kinesiotaping") OR ("kinesio") OR ("kinesiology taping") OR ("elastic bandage") AND ("muscle performance") OR ("muscle activation") OR ("quadriceps") OR ("vast medialis") OR ("vast lateral") OR ("vast intermediate") OR ("rectus femoris") AND ("women"). The search strategy was adapted for each database when necessary.

Selection of studies

Two reviewers performed the initial search strategy in the databases, extracting titles and abstracts. Subsequently, study selection, evaluation, and data extraction were independently conducted by two authors, based on reading titles and abstracts. Potentially eligible articles were read in full. A manual search was performed in the reference lists of all eligible articles, in an attempt to find new references. Disagreement between the authors' ratings was resolved through discussion or by consulting a third review author.

Data extraction

The following data were extracted from each study: a) name of the first author, year of publication and country where the study was carried out; b) sex and

number of volunteers allocated to each group; c) treatment performed and duration; d) activities of comparison groups; e) instrument used to check muscle activation and pain; f) intra- and inter-group results for the result of interest; g) adverse events.

Evaluation of the methodological quality of the studies and risk of bias

Methodological quality was assessed using the PEDro scale by two independent reviewers.[23] This scale takes into account the internal validity and sufficiency of statistical information of the studies, and presents 11 questions, with three items of the Jadad scale and nine Delphi list items.[24] The first question is not scored (related to the external validity of the study), and the other ten questions are scored. Each item that meets the required criteria receives a point, making it possible to classify each study as: excellent (9–10), good (6–8), fair (4–5) or poor (< 4). Studies with a score ≥ 6 are considered to be of high quality. In addition, the risk of bias of the included studies was evaluated using the Cochrane Risk of Bias 2 (RoB 2) tool, which considers five domains: the randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selective reporting. Two independent reviewers conducted this evaluation, and disagreements were resolved through discussion or consultation with a third reviewer.[25]

Results

Qualitative synthesis of studies

It was possible to identify 183 potentially relevant titles and abstracts. After removal by titles (n = 142) and duplicates (n = 19), 22 studies with inclusion potential remained. At this stage, most of the excluded studies were due to the fact that they did not use bandages as an intervention and they were not studying quadriceps muscle activation. Of the 22 studies remaining to be read in full, 15 were excluded because they did not meet the inclusion criteria.[26-33] Therefore, only seven studies were included for subsequent qualitative analysis (Figure 1), which met all eligibility criteria and were included in the final analysis for this review.[26-31,33]

The main characteristics and outcomes of the seven studies are summarized in Table 1. The researched literature shows that the application of EB was performed with different outcomes and always compared with a control group that performed or not another intervention. Postural control in women was one of the outcomes evaluated in two studies involving 40 women aged between 18 and 35 years with a diagnosis of patellofemoral pain. After treatment with patellar taping (compared to the placebo group)[26] and femoral rotational taping (compared to the control group),[22] both studies[26,22] reported improvements in postural control and pain reduction.

Functionality and pain were analyzed in two additional studies. In the study by Demirci et al.,[27] 35 women with PFP were divided into a group treated with mobilization techniques and another group treated with taping, both showing significant improvements in pain and function. Similarly, Sanchez et al.[28] observed pain improvement in 32 women treated with Kinesio Taping combined with conventional physiotherapy, compared with those who received physiotherapy alone.

Regarding the muscle activation outcome, Begum et al.[29] analyzed 51 women aged between 25 and 45 years with PFP, who were divided into McConnell taping and vastus medialis oblique (VMO) strengthening exercises group and VMO strengthening exercises group, and found that the McConnell bandage combined with strengthening exercises is more effective in reducing pain and functional activities. Araújo et al.[30] divided 40 women who had PFP into a McConnell taping group and proprioception exercises and a placebo group and proprioception exercises and didn't find significant difference between the groups.

Song et al.[31] analyzed the kinematics and muscle activation of lower limbs in 16 women with PFP compared to 8 women without PFP divided into femoral rotational bandage, sham and control groups. The femoral rotational bandage altered patellofemoral kinematics and decreased the participants' pain.

It is worth mentioning that of the seven articles selected, five obtained improvements in relation to pain in the PFP after the intervention performed with the application of a bandage; therefore, pain is a secondary outcome that showed improvements in the analyzed studies, together with our primary outcome, which obtained positive results in six articles.

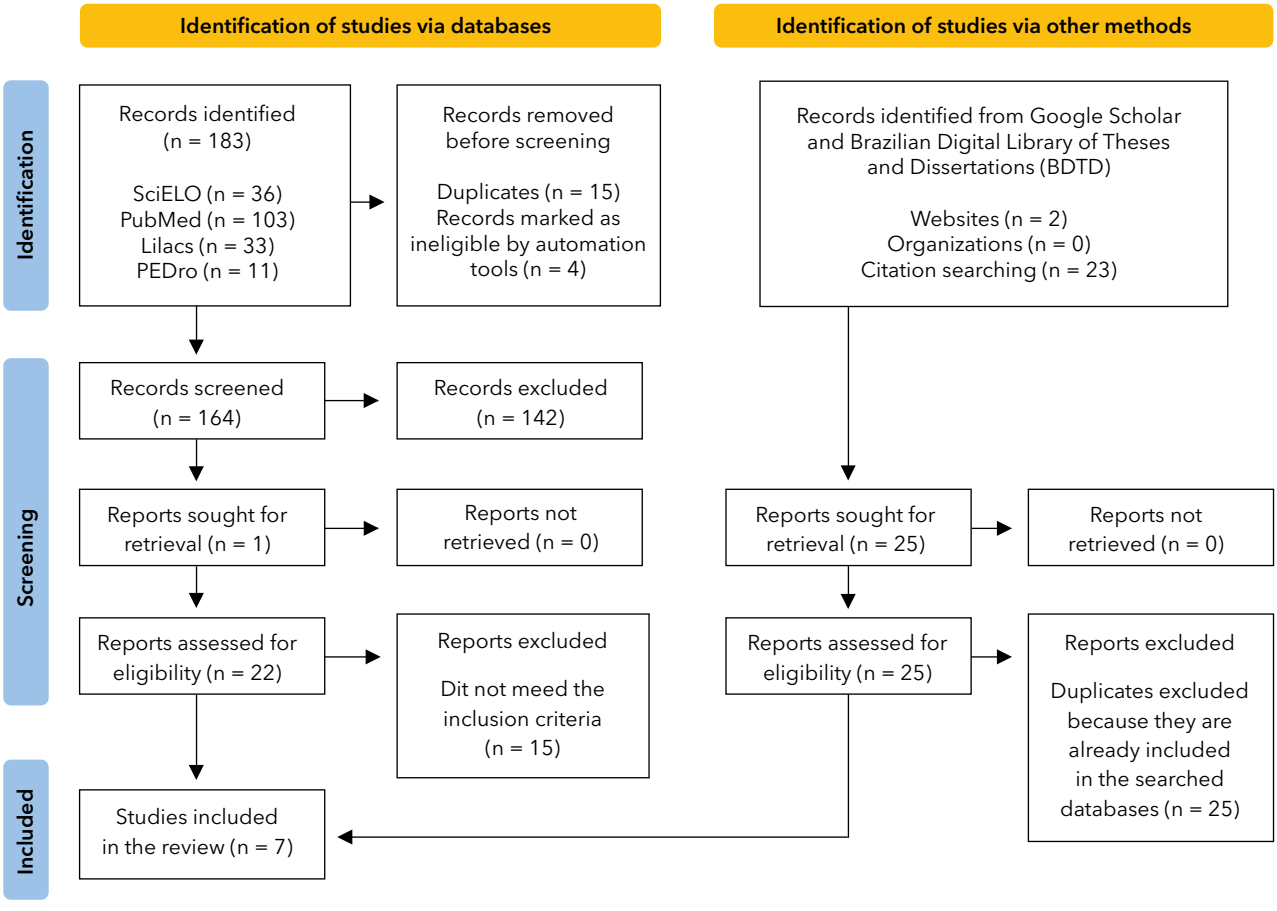

Figure 1 - PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 flow diagram.

Table 1 - Data extracted from articles included in the systematic review

Study/Year	Sample	Outcome	Intervention	Application	Results
Ferreira et al.[33] 2020	40 women aged between 18 and 35 years who had patellofemoral pain	Postural control	McConnell patellar taping group and Placebo taping group	A: Lateral border of the patella and tensioned up to the medial condyle of the fêmur. B: applied vertically on the knee flexed at 90° (placebo taping)	Improved postural control during the single leg squat
Begum et al.[29] 2020	51 women aged between 25 and 45 years who had patellofemoral pain	Vastus medialis oblique (VMO) muscle strengthening	McConnell taping group and VMO strengthening exercises. VMO strengthening exercises group	Non especified; McConnell taping	McConnell bandage combined with VMO strengthening exercises is most effective in reducing pain and functional activities
Araújo et al.[30] 2016	40 sedentary women who had patellofemoral pain	Muscle activation of the knee and hip muscles	McConnell taping group and proprioception exercises. Placebo group and proprioception exercises	A: Lateral border of the patella and tensioned up to the medial condyle of the femur. B: applied vertically on the knee flexed at 90° (placebo taping)	There was no significant difference between the groups

Table 1 - Data extracted from articles included in the systematic review (continued)

Study/Year	Sample	Outcome	Intervention	Application	Results
Song et al.[31] 2015	16 women with patellofemoral pain syndrome and 8 healthy women without patellofemoral pain	Kinematics and muscle activation of lowew limbs	Group with femoral rotational bandage, sham group and control group.	A: inferior-medial aspect of the thigh spiraling up the thigh (20% stretch). B: to the thigh without tension.	Femoral rotational taping can alter patellofemoral kinematics and decrease pain
Sanchez et al.[28] 2017	32 women with patellofemoral pain	Functionality and pain	Kinesio taping and conventional physiotherapy group. Conventional physiotherapy group.	Quadriceps technique	The application of Kinesio taping associated with physiotherapeutic treatment provides greater pain comfort to patients
Demirci et al.[27] 2017	35 women with patellofemoral pain	Pain, function and balance	Group with mobilization techniques. Group with application of Kinesio taping.	Proprioceptive stimulation in quadriceps using technique "Y"	Both groups had significant improvements in pain, function and balance
Song et al.[26] 2017	16 women with patellofemoral pain and 8 healthy women without patellofemoral pain	Dynamic postural stability	Femoral rotational bandage group. Control group.	A: inferior-medial aspect of the thigh spiraling up the thigh (20% stretch). B: to the thigh without tension.	Femoral rotational bandage can improve dynamic postural control and reduce pain

Methodological quality of studies

Table 2 shows the methodological quality of the studies. Of the seven studies included in the systematic review, all showed methodological quality (PEDro score ≥ 6). Regarding risk of bias, the same can be observed in the Cochrane Collaboration tool represented in Figure 2.

Table 2 - Study scores according to the Physiotherapy Evidence Database (PEDro) scale criteria

Study	1	2	3	4	5	6	7	8	9	10	11	Score
Ferreira et al.[33]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10/10
Begum et al.[29]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10/10
Araújo et al.[30]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10/10
Song et al.[31]	Y	N	N	Y	N	N	N	Y	Y	Y	Y	06/10
Sanchez et al.[28]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10/10
Demirci et al.[27]	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	08/10
Song et al.[26]	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	07/10

Note: 1 = eligibility criteria were specified; 2 = subjects were randomly allocated to groups; 3 = allocation was concealed; 4 = the groups were similar at baseline regarding the most important prognostic indicators 5 = there was blinding of all subjects 6 = there was blinding of all therapists who administered the therapy; 7 = here was blinding of all assessors who measured at least one key outcome 8 = measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups 9 = all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat"; 10 = the results of between-group statistical comparisons are reported for at least one key outcome; 11 = the study provides both point measures and measures of variability for at least one key outcome. N = no; Y = yes.

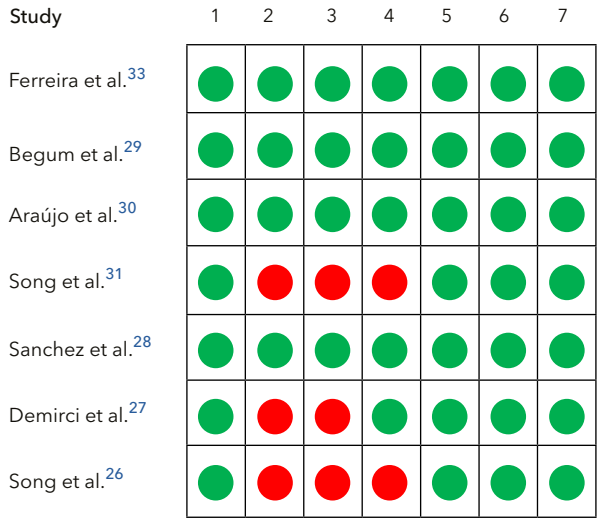

Figure 2 - Study scores according to the Physiotherapy Evidence Database (PEDro) scale criteria.

Note: 1 = Random sequence generation (selection bias). 2 = Allocation concealment (selection bias) 3 = Blinding of participants and personnel (performance bias). 4 = Blinding of outcome assessment (detection bias). 5 = Incomplete outcome data (attrition bias). 6 = Selective reporting (reporting bias). 7 = Other bias. Green = low risk. Red = high risk.

Discussion

This systematic review aimed to analyze the effects of elastic and non-elastic taping on postural control, pain, functionality, and muscle activation in women with PFP. The overall findings suggest that taping techniques, particularly McConnell and elastic taping, were effective in improving postural control, which emerged as the primary outcome. Secondary benefits were also reported in terms of pain reduction, functionality, and quadriceps activation. Importantly, however, some of the positive effects were observed in trials where taping was combined with strengthening exercises or mobilization techniques,[27,29] which indicates that the benefits cannot be attributed exclusively to taping.

Previous researches have emphasized that PFP is multifactorial, resulting from the interaction of biomechanical, neuromuscular, and psychosocial factors.[1,13] Structural dysfunctions such as excessive hip adduction, femoral internal rotation, and patellar malalignment have been linked to abnormal patellofemoral joint loading.[11,12] Electromyographic studies corroborate these findings, showing delayed and reduced recruitment of the VMO relative to the vastus lateralis,[32] which compromises patellar tracking and increases joint stress.

The studies included in this review add nuance to this discussion. For muscle activation, Begum et al.[29] showed that combining McConnell taping with VMO strengthening optimized outcomes compared to exercise alone, whereas Araújo et al.[30] found no significant effect of taping during proprioceptive training. For postural control, Ferreira et al.[33] and Song et al.[31] demonstrated improvements with taping, aligning with previous evidence suggesting that cutaneous stimulation enhances proprioceptive feedback and alters motor strategies during dynamic tasks.[7,9] Regarding functionality and pain, Sanchez et al.[28] and Demirci et al.[27] reported significant improvements, but in contexts where taping was not the sole intervention, reinforcing the multifactorial nature of therapeutic benefit.

The potential mechanisms underlying taping effects are multifaceted. First, the mechanical effect involves patellar realignment or control of lateral displacement, as in McConnell taping, which may reduce contact pressure on the patellofemoral joint surfaces.[10,14] Second, the sensorimotor effect results from continuous cutaneous stimulation, which increases proprioceptive input and modifies motor recruitment patterns of quadriceps and hip stabilizers.[7,9] Third, a pain modulation effect has been suggested, whereby stimulation of cutaneous mechanoreceptors may influence nociceptive processing through spinal or supraspinal mechanisms, reducing perceived pain during functional activities.[16] Finally, when taping is associated with exercise or stretching protocols, as observed in several trials, synergistic effects may arise by combining mechanical/proprioceptive support with long-term neuromuscular adaptations.

The findings reinforce that taping can be a valuable adjunct in the management of PFP, particularly to improve postural control and reduce pain in the short term. However, clinicians should be aware that the beneficial effects observed in some studies were enhanced by concomitant interventions such as strengthening or mobilization,[27,29] indicating that taping should not be viewed as a stand-alone treatment but as part of a multimodal strategy. Individual assessment remains essential to tailor interventions to each patient's biomechanical and functional profile.

Future investigations should address methodological inconsistencies by standardizing protocols for taping application, control groups, and outcome measures. Studies with larger samples and long-term follow-up are necessary to determine the sustained effects of taping. Furthermore, it is critical to isolate the effects of taping alone versus combined interventions to better delineate its specific contribution to PFP management. Advanced biomechanical and neurophysiological analyses may also help elucidate the underlying mechanisms of action.

Regarding possible biases in the review process, our search strategy did not include all available databases, which may have limited the comprehensiveness of the evidence retrieved. However, the inclusion of PubMed, LILACS, SciELO, and PEDro ensured coverage of major international and regional sources. On the other hand, the review protocol was not registered in PROSPERO, which reduces methodological transparency, and the search was restricted to the period between 2000 and 2020, potentially excluding earlier or more recent relevant publications.

Another limitation relates to the heterogeneity of study methodologies, including differences in taping techniques, comparators, and outcome measures, which complicates the synthesis of results and precludes meta-analysis. The number of studies evaluating all quadriceps components remains limited, and methodological variability across trials weakens the strength of conclusions. Finally, some included studies combined taping with exercise or stretching interventions,[27,29] which may confound the attribution of effects solely to taping. These limitations highlight the need for more rigorously designed and transparently reported clinical trials.

Conclusion

Elastic bandaging appears to be a valuable complementary intervention in the management of PFPS, particularly among women. The reviewed evidence indicates beneficial effects on postural control, pain, functionality, and muscle activation. However, further studies with higher methodological rigor are necessary to confirm these findings and to guide broader clinical implementation.

Authors' contributions

IGGS was responsible for the study conception, literature search, data selection and extraction, table organization, and initial drafting of the manuscript. MRS, for scientific supervision, methodological design, critical analysis of the included studies, interpretation of results, manuscript revision, and approval of the final version. RACA, for definition of descriptors, development of the search strategy, methodological assessment of articles (PEDro and Cochrane RoB2), data analysis, and final text revision.

Data availability statement

Research data is not available.

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