RESEARCH PAPER

Effect of Kinesio Taping vs. Rigid Taping on Pain and Performance in Patellofemoral Pain in Runners

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Abstract—*Background:* Patellofemoral pain (PFP) is a leading cause of anterior knee pain in runners, and taping is widely used to relieve pain so that training can continue. Rigid (McConnell-type) taping and elastic Kinesio taping rest on different rationales and are often used interchangeably, but their relative effects on pain and running performance are unclear. *Objective:* To synthesise the evidence relevant to both techniques and to present a fully specified protocol for a randomised crossover trial comparing rigid taping, Kinesio taping, and no tape in runners with PFP. *Methods:* Twenty-four runners with PFP will complete three sessions in randomised order, at least 72 hours apart. After tape application, each runner performs single-leg squat and step-down tests, a 20-minute treadmill run with pain rated every five minutes, a 3-km self-paced time trial, and a single-leg hop test. The primary outcome is mean pain intensity (numerical pain rating scale, 0–10) during the run. Secondary outcomes are pain during functional tests, the Anterior Knee Pain Scale, time-trial performance, hop distance, comfort, and skin reactions. Data will be analysed with linear mixed models. *Anticipated findings:* Both tapes are expected to reduce pain relative to no tape; rigid taping is hypothesised to give greater pain relief, and Kinesio taping greater comfort with no performance penalty. This paper reports no trial data. *Conclusion:* The protocol offers a transparent framework for generating head-to-head evidence on taping in running-related PFP.

Keywords—*patellofemoral pain, runners, Kinesio taping, McConnell taping, rigid tape, pain, running performance, crossover trial*

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1. INTRODUCTION

1.1 Background

Patellofemoral pain is defined as pain around or behind the patella that is aggravated by at least one activity loading the patellofemoral joint during weight bearing on a flexed knee, such as squatting, stair climbing, jogging, running, hopping, or jumping [1]. A systematic review and meta-analysis of incidence and prevalence studies confirmed that PFP is common, particularly in adolescents and active adults [2]. Among runners, a retrospective case-control analysis of more than 2000 running injuries identified patellofemoral pain syndrome as the most frequent diagnosis [3]. The condition often becomes persistent, restricts training volume, and can lead runners to stop running altogether.

The aetiology is multifactorial. A systematic review of factors associated with PFP found that they are varied and that their relative contribution is uncertain [4], and a consensus pathomechanical model proposes that pain arises when load on the patellofemoral joint exceeds the tissue's capacity, with local, proximal, and distal factors all contributing [5]. Runners with PFP show altered hip and knee biomechanics compared with pain-free runners, and some of these alterations can be modified by targeted interventions [6]. Because running repeats the same loading cycle thousands of times per session, even small changes in patellofemoral loading or in pain perception may be meaningful for runners.

1.2 Rationale and Problem Statement

Exercise therapy forms the foundation of PFP management, while taping, bracing, and foot orthoses are positioned as adjuncts [7]. Clinicians commonly use taping for rapid pain relief, for example before a race or during rehabilitation, so that running can be maintained while strength and movement are retrained. The most widely used approaches are rigid patellar taping, derived from the McConnell concept, and Kinesio taping with elastic cotton tape. Both are popular among runners, yet they are chemically, mechanically, and conceptually different, and they are rarely compared head to head in a running-specific context. Existing trials mostly assess pain during

stairs or squatting rather than during running, and they seldom measure running performance, which matters to the runner who wishes to train or compete.

Evidence summaries remain cautious. A Cochrane review of patellar taping in adults concluded that the quality of evidence did not allow firm conclusions on effectiveness [8], and systematic reviews of Kinesio taping across musculoskeletal conditions have been similarly guarded [9], [10]. A study design that places both tapes, plus a no-tape reference, in the same runners under standardised running conditions would clarify whether either technique reduces running pain, whether they differ, and whether either one affects performance.

1.3 Objectives and Hypotheses

The objective is to synthesise the evidence for both techniques and to specify a randomised crossover trial to test the following hypotheses:

(1) **H1:** Both rigid taping and Kinesio taping reduce pain during a standardised treadmill run compared with no tape.
(2) **H2:** Rigid taping produces a larger pain reduction during running than Kinesio taping.
(3) **H3:** Neither tape impairs 3-km time-trial performance or hop distance relative to no tape, and Kinesio taping is rated as more comfortable than rigid taping.

1.4 Organisation of the Paper

Section 2 reviews the pathomechanics of PFP in runners and the mechanisms and evidence for each taping approach. Section 3 describes the methodology, following SPIRIT [11] and CONSORT [12] recommendations where applicable. Section 4 presents anticipated findings and discussion, and Section 5 concludes.

2. LITERATURE REVIEW

2.1 Patellofemoral Pain in Runners

The proposed pathway from running load to pain is summarised in Fig. 1. Running generates repeated, high knee flexion moments and patellofemoral joint stress, and runners with PFP have been reported to show altered kinematics of the hip, knee, and foot together with differences in muscle function [6]. Pain may therefore reflect an interaction between excessive load, altered tracking, and sensitised peripatellar tissues [5]. This view is important for taping because it implies that a tape could act through at least two broad routes: a mechanical route, by changing patellar position or load distribution, and a neurophysiological or perceptual route, by altering sensory input, motor behaviour, or expectation.

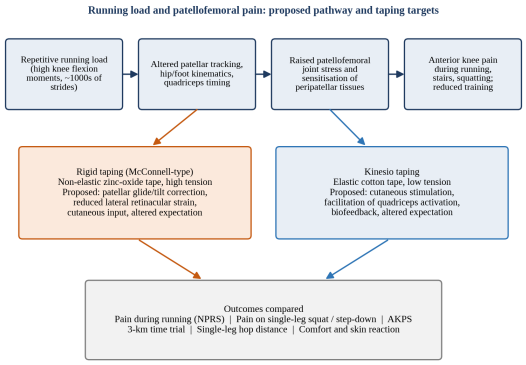

Fig. 1. Proposed pathway from running load to patellofemoral pain and the hypothesised targets of rigid and Kinesio taping.

Evidence on interventions specific to runners is still developing. A randomised trial in runners with PFP compared education alone with education combined with gait retraining or an exercise programme [13]; taping was not among the compared interventions. This leaves a gap for running-specific data on taping, a low-cost and immediately available option.

2.2 Rigid (McConnell-Type) Taping

2.2.1 Principle

Rigid patellar taping was popularised as part of a broader management concept in which non-elastic tape is applied to the knee to correct the position of the patella through glide, tilt, and rotation components [14]. The tape is applied under tension over a protective underlay, and the practitioner selects the component that reduces symptoms during a provocative task such as a single-leg squat. A placebo-controlled trial showed that a physiotherapy programme that included patellar taping was superior to placebo for pain, although the contribution of the tape alone could not be isolated [15].

2.2.2 Mechanisms and evidence

The mechanical explanation is not firmly established. A dynamic magnetic resonance imaging study found that McConnell taping shifted the patella inferiorly in patients with PFP, a finding that questions whether the effect is limited to the intended medial correction [16]. A meta-analysis of patellar taping examined both clinical outcomes and biomechanical mechanisms, supporting short-term pain reduction in some analyses while the mechanism remained uncertain [17]. An immediate-effect cohort study likewise reported pain reduction with taping in PFP and explored which patients respond [18]. Cutaneous input is another plausible contributor, since stimulation of the skin may modulate nociceptive transmission, as originally proposed in gate-control theory [19]. Rigid taping therefore may relieve pain through combined mechanical, sensory, and expectation effects.

2.3 Kinesio Taping

2.3.1 Principle

Kinesio tape is a thin, elastic, cotton-based adhesive tape that can stretch longitudinally and is applied with low tension. Its proposed effects include stimulation of cutaneous mechanoreceptors, facilitation of muscle activation, and improved proprioceptive awareness, but these claims have limited experimental support. In PFP the tape is commonly applied over or around the patella and the quadriceps, a pattern that is more comfortable and less restrictive than rigid tape.

2.3.2 Evidence

A meta-analysis of Kinesio taping for treating and preventing sports injuries concluded that the evidence supporting its use was limited [20]. A systematic review concluded that current evidence did not support routine clinical use of Kinesio taping [9], and another analysis reported that pain reductions were small and that methods of tape application, including tension, varied widely between studies [10]. These reviews cover mixed conditions rather than PFP. For PFP specifically, a systematic review and meta-analysis comparing Kinesio with McConnell taping found a small and heterogeneous evidence base [21], and a review of taping techniques for PFP highlighted heterogeneity in technique and outcome measurement [22]. Running performance was rarely reported.

2.4 Comparative Synthesis and Research Gap

Table 1 summarises the contrast. Rigid taping has a mechanical rationale and relatively consistent, though low-certainty, short-term pain data [8], [17], while Kinesio taping offers comfort and ease of use but a more uncertain evidence base [9], [10]. Few trials compared the two directly, and none known to the authors did so during running, with performance measured. A controlled within-participant design is therefore warranted. Fig. 2 shows the make-up of the sources used in this paper: the evidence base is dominated by reviews, consensus statements, and measurement papers, and only a small number of primary studies address taping directly, which reinforces the need for new running-specific trials.

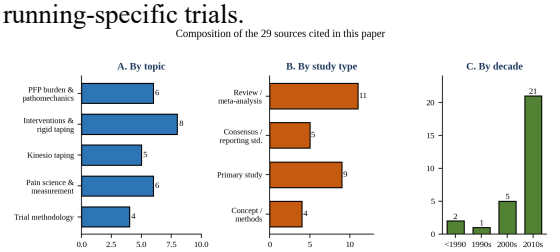

Fig. 2. Composition of the 29 sources cited in this paper by (A) topic, (B) study type, and (C) publication decade.

Table 1. Conceptual comparison of rigid and Kinesio taping for patellofemoral pain.

Feature	Rigid (McConnell-type) taping	Kinesio taping
Material	Non-elastic zinc-oxide tape over hypoallergenic underlay	Elastic cotton tape with acrylic adhesive
Application tension	High; applied to correct patellar position	Low; tails applied with light stretch
Proposed mechanism	Patellar glide or tilt correction, cutaneous input, expectation [16], [19]	Cutaneous stimulation, muscle facilitation (limited support), expectation [10]
Restriction of movement	Moderate; may feel tight in prolonged running	Minimal
Wear time and skin risk	Shorter; greater risk of skin irritation	Longer; lower irritation risk
Evidence in PFP	Short-term pain relief in some reviews, low certainty [8], [17]	Small, heterogeneous evidence base [21]

3. PROPOSED METHODOLOGY

3.1 Study Design

The study is a single-centre, randomised, three-condition crossover trial with within-participant comparisons of rigid taping, Kinesio taping, and no tape (Fig. 3). Each participant attends one familiarisation visit and three test sessions separated by at least 72 hours. A crossover design was chosen because pain intensity differs greatly between runners, and each participant therefore acts as their own control, reducing the sample size required. The effects studied are acute (single-session) effects; the trial is not designed to evaluate long-term outcomes. The protocol follows SPIRIT [11], and participant flow will be reported according to CONSORT [12]. The trial will be prospectively registered.

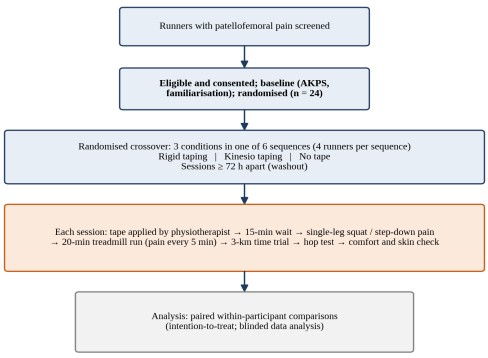

Fig. 3. Planned flow of the randomised crossover trial (three conditions, six sequences).

3.2 Participants

Participants will be recruited from running clubs and from physiotherapy and sports-medicine clinics. Eligibility criteria are shown in Table 2. The symptomatic knee will be the test knee; if both knees are symptomatic, the more painful knee at baseline will be tested.

Table 2. Eligibility criteria.

Domain	Inclusion criteria	Exclusion criteria
Demographics	Age 18–45 years; men and women	Pregnancy; age outside range
Running	Running at least twice weekly for 6 months or more; able to run 20 minutes continuously	Unable to run because of pain; recent change in running habits
Pain	Anterior knee pain for at least 4 weeks, with pain of 3/10 or more during running in the last week	Pain from other sources, such as low back or hip pain, that limits running
Clinical signs	Pain on at least two of squatting, stair climbing, kneeling, prolonged sitting [1]	Patellar instability or dislocation; knee ligament or meniscal injury; knee surgery
Treatment history	No taping or injection for the knee in the last 3 months	Allergy to adhesive tape or skin disease at the knee; new treatment started during the study

3.3 Sample Size

The sample size was derived for paired comparisons between conditions [23]. We assumed a mean between-condition difference of 1.5 points on the 0–10 numerical pain rating scale with a standard deviation of the paired differences of 2.0 points, giving a standardised paired effect (d_z) of 0.75. This difference is smaller than the roughly two-point change that is commonly regarded as clinically important in pain studies [24]; the values are planning assumptions, not estimates taken from a previous trial. With three pairwise comparisons, the two-sided significance level was Bonferroni-adjusted to 0.0167, and 22 participants provide 80% power (Fig. 4). Allowing for dropouts and balancing the six treatment sequences, 24 runners (four per sequence) will be enrolled. If the true effect were as small as d_z = 0.5, 45 participants would be required, which the study would not reach; this is acknowledged in the limitations.

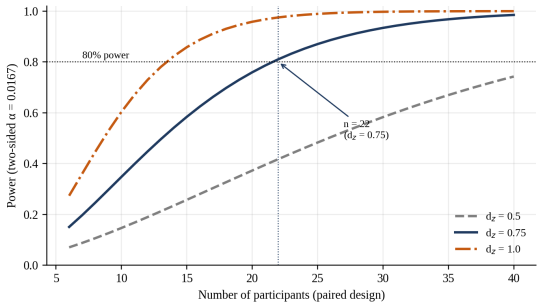

Fig. 4. Power for paired comparisons as a function of sample size (two-sided α = 0.0167; d_z denotes the standardised paired difference). The planned study assumes d_z = 0.75.

Because the planning values are assumptions, Fig. 5 shows how the required sample size would change if the true difference or the variability differed from them. The requirement ranges from 9 participants (a 2.0-point difference with an SD of 1.5) to 98 (a 1.0-point difference with an SD of 3.0). For example, if the standard deviation of the paired differences were 3.0 rather than 2.0, about 45 participants would be needed to detect the planned 1.5-point difference. The grid will be revisited after the first six participants, using only the variability of the pain ratings and not the between-condition effect, so that the blinded analysis is not compromised.

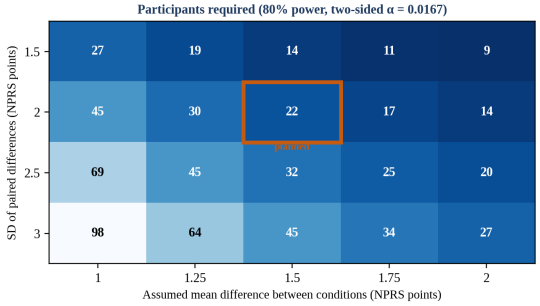

Fig. 5. Sensitivity of the required sample size to the assumed mean difference and the standard deviation of paired differences (the outlined cell is the planned scenario).

3.4 Randomisation, Allocation Concealment, and Blinding

The six possible condition sequences will be allocated in random permuted blocks of six by an independent researcher using a computer-generated list, concealed in sequentially numbered opaque envelopes opened after the familiarisation visit. Participants and the taping therapist cannot be blinded to tape type. To limit bias, (a) every participant is told the same neutral script, namely that both tapes are being studied and that it is not known which is better; (b) the knee is covered by an opaque sleeve during all tests so that the outcome assessor is unaware of the condition; and (c) the time-trial and hop outcomes are objectively measured. Participants will rate their expectation of

benefit (0–10) before testing, and this rating will be used as a covariate because expectation can influence pain ratings.

The six sequences cover every possible order of the three conditions (Fig. 6), so each condition appears equally often in each session position, and four runners are assigned to each sequence. This balance allows period effects, such as familiarisation or changes in training load over the study, to be separated from condition effects.

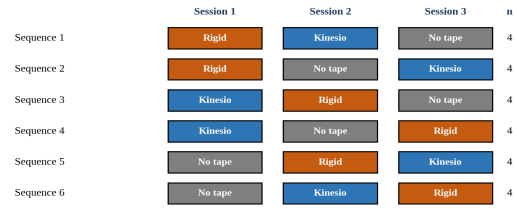

Fig. 6. Complete counterbalancing of the three conditions across six sequences (R = rigid taping, K = Kinesio taping, N = no tape).

3.5 Interventions

3.5.1 Common procedure

All taping is applied by one physiotherapist with at least five years of experience who is trained in both techniques. The skin is cleaned and dry-shaved if necessary. The tape is applied with the participant standing relaxed with the knee in about 20° of flexion (rigid) or with the knee flexed (Kinesio). All tape is removed at the end of each session, and the skin is checked. The three conditions are illustrated schematically in Fig. 7.

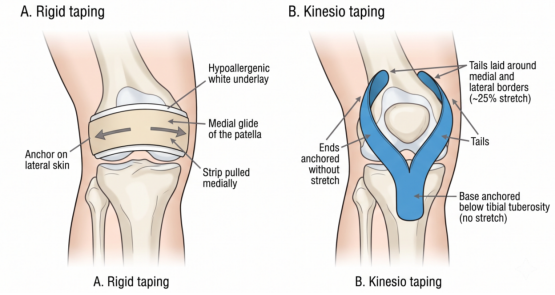

Fig. 7. Schematic of the two taping applications compared in this study.

3.5.2 Rigid taping

A hypoallergenic underlay is applied over the knee. A 38-mm non-elastic zinc-oxide tape is then applied with a medial glide of the patella, with the anchor on the lateral skin and the strip pulled medially under firm tension. A medial tilt or an anteroposterior tilt is added only if the first component does not reduce pain by at least 50% on a single-leg squat; a maximum of two components is allowed, and the components used are recorded [14], [15].

3.5.3 Kinesio taping

A 5-cm elastic Kinesio tape is cut as a Y-strip. The base is anchored just below the tibial tuberosity with no stretch, and the two tails are laid around the medial and lateral borders of the patella with approximately 25% stretch while the knee is flexed, with the ends anchored without stretch. The standard tension and strip lengths are fixed in a study manual to avoid the application variability that has complicated earlier reviews [10].

3.5.4 No-tape reference

The knee is covered with the same opaque sleeve and no tape is applied, so that the reference condition retains the same testing context and visual cover.

3.6 Test Procedures

Each session follows the same sequence (Fig. 8). After tape application and a 15-minute wait, participants perform a single-leg squat and a step-down task, rating pain on the numerical scale. They then run for 20 minutes on a motorised treadmill at a self-selected comfortable speed, determined at the familiarisation visit and held constant in all sessions, with the same footwear, and rate pain every five minutes. Immediately afterwards they perform a 3-km self-paced time trial on the treadmill, seeing only the distance covered. A single-leg hop-for-distance test (best of three) follows. Running is stopped and the time recorded if pain reaches 7/10 or participants request to stop; incomplete time trials will be handled in a sensitivity analysis. Participants avoid running for 24 hours before each session.

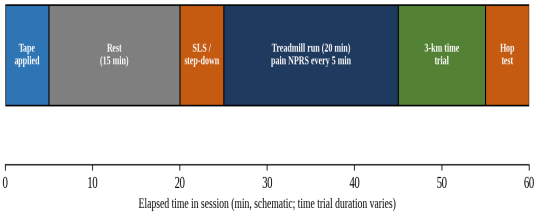

Fig. 8. Sequence of test events within each session.

3.7 Outcome Measures

The primary outcome is the mean pain intensity during the 20-minute run, calculated from four ratings (at 5, 10, 15, and 20 minutes) on the 11-point numerical pain rating scale (NPRS), a valid and responsive pain measure [25], [26]. Secondary outcomes are the pain during single-leg squat and step-down tasks, the Anterior Knee Pain Scale (AKPS) [27] recorded at baseline and recalled for the preceding week at each session, the 3-km time and mean speed, the single-leg hop distance, tape comfort (0–10), and any skin reaction or tape slippage. The AKPS has been evaluated for reliability and validity in people with PFP [28]. Examiners will practise the hop and squat procedures before the study, and intra-rater reliability will be assessed using the intraclass correlation coefficient and interpreted with published guidance [29]. Table 3 lists the outcomes, and Table 4 gives the schedule.

Table 3. Outcome measures.

Outcome	Instrument	Procedure	Domain
Primary: pain	NPRS, mean of 4	0 = no pain, 10 = worst	Pain

during running	ratings	imaginable; rated at 5, 10, 15, 20 min	
Pain on functional tests	NPRS	Single-leg squat and 20-cm step-down	Pain
Knee symptoms	Anterior Knee Pain Scale (0–100)	13-item questionnaire; higher is better	Symptoms
Running performance	3-km time trial	Time (s) and mean speed on treadmill	Performance
Functional performance	Single-leg hop for distance	Best of three trials (cm)	Performance
Tolerability	Comfort score and skin check	Comfort 0–10; reaction none, mild, moderate; slippage yes/no	Safety

Table 4. Schedule of enrolment and assessments for each participant.

Activity	Familiarisation	Session 1	Session 2	Session 3
Consent, eligibility, AKPS	✓			
Randomisation	✓			
Expectation rating		✓	✓	✓
Tape application (assigned condition)		✓	✓	✓
Squat and step-down pain	✓	✓	✓	✓
20-min run with NPRS	✓	✓	✓	✓
3-km time trial, hop test		✓	✓	✓
Comfort, skin check		✓	✓	✓

3.8 Statistical Analysis

Analysis follows the intention-to-treat principle. The primary outcome will be analysed with a linear mixed-effects model with condition, period, and sequence as fixed effects, expectation rating as a covariate, and a random intercept for participant. Carry-over will be explored through the period and sequence terms. Three pairwise contrasts (rigid vs. no tape, Kinesio vs. no tape, rigid vs. Kinesio) will be reported as adjusted mean differences with 95% confidence intervals, using Bonferroni-adjusted p-values. Secondary continuous outcomes will be analysed similarly and treated as exploratory. The proportion of participants whose pain reduction relative to no tape reaches two points will be reported descriptively. Normality of residuals will be checked, and non-parametric alternatives will be used if the assumptions are violated.

3.9 Ethical Considerations

The study will follow the Declaration of Helsinki and will be approved by the institutional ethics committee before enrolment. All participants will give written informed consent. Skin integrity will be monitored, tape will be removed on any sign of irritation, and participants may withdraw at any time. Data will be de-identified.

3.10 Study Timeline and Feasibility

The study is planned over 12 months (Fig. 9). Ethics approval and registration, preparation of the tape manual, examiner training, and reliability testing precede recruitment. In total the protocol requires 24 familiarisation visits and 72 test sessions, which is feasible within roughly four to five months at two to three test sessions per week. Provision is made for dropouts, injuries that interrupt the washout period, and re-testing when a session is lost to illness or equipment faults. Data cleaning and the blinded analysis follow completion of testing.

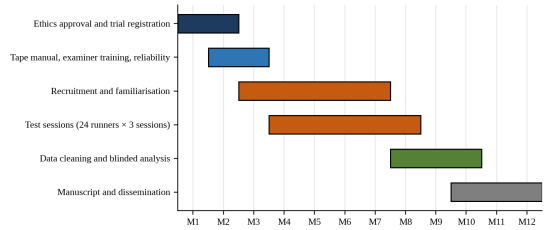

Fig. 9. Proposed 12-month study timeline (M = month).

4. ANTICIPATED FINDINGS AND DISCUSSION

4.1 Hypothesised Outcome Profile

As this paper presents a protocol and literature synthesis, no efficacy data are reported. Table 5 states the pattern that the hypotheses predict. An outcome in which Kinesio taping equals rigid taping, or in which neither tape beats no tape, would be equally informative.

Table 5. Hypothesised direction of effect relative to no tape (predictions, not observed data). ↓ = lower, ↓↓ = much lower, ↔ = no meaningful change, ↑ = higher.

Outcome	Rigid	Kinesio	Basis for the prediction
Pain during running	↓↓	↓	Mechanical, cutaneous, and expectation effects [17], [19]
Pain on	↓↓	↓	Tape was selected

squat and step-down			on pain response during squat [14]
3-km time trial	↔	↔	Pain relief may offset any restriction
Hop distance	↔	↔	Short-term effect on force output expected to be small
Comfort	↓	↑	Rigid tape is less compliant and may feel tight
Skin reactions	More	Fewer	Zinc-oxide tape and tension

Fig. 10 translates H1 and H2 into a conceptual pattern of pain over the 20-minute run: pain is expected to build with running time without tape, to build more slowly with Kinesio tape, and to remain lowest with rigid tape. The figure is a hypothetical illustration that shows what the planned primary outcome would look like if the hypotheses were true; it is not based on observed values, and the actual trajectories may differ in level and shape.

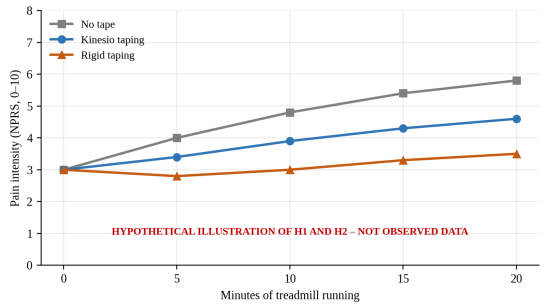

Fig. 10. Hypothetical pain trajectories during the standardised run if H1 and H2 are supported (illustration only, not trial data).

4.2 Mechanistic Interpretation

If rigid tape shows greater pain relief than Kinesio tape, this could reflect a mechanical effect on patellar position or load, but the evidence that tape shifts the patella in the intended direction is mixed [16], and a sensory or expectation contribution is at least as plausible [19]. The crossover design cannot separate these mechanisms, but three features give indirect information: the no-tape reference, the recorded expectation scores, and the Kinesio tape, whose mechanical action on the patella is minimal. A similar reduction in pain with both tapes, despite their very different mechanics, would favour a non-mechanical explanation and would be consistent with the cautious conclusions of reviews of the existing evidence [8], [9]. A pain reduction without change in time-trial performance would show that pain relief does not necessarily translate into faster running in the short term.

4.3 Clinical Implications

If both tapes reduce running pain, the choice could be guided by comfort, skin tolerance, cost, and wear time rather than by assumed mechanical differences. Because exercise therapy remains the foundation of PFP care [7], tape would be positioned as a short-term adjunct that allows a runner to keep running while load capacity is being built, not as a standalone treatment. If rigid tape provides clinically meaningful additional relief, it could be preferred for training or competition when skin allows, whereas Kinesio tape could be considered for runners who tolerate rigid tape poorly.

4.4 Strengths and Limitations

The strengths of the design include running-specific outcomes, a no-tape reference, within-participant comparison, concealed randomisation, standardised application, and objective performance measures. The limitations are the following. Participants cannot be blinded to tape, so expectation bias remains despite the script and covariate adjustment. Only acute effects are studied, and treadmill running may differ from running outdoors. The sample is modest and powered only for a fairly large effect. The single-therapist design improves consistency but limits generalisability. Pain ratings are subjective, and no kinematic or electromyographic data are collected, so mechanisms cannot be tested directly. Finally, the dose of tape tension is based on common practice rather than on definitive evidence.

4.5 Directions for Future Research

Subsequent work should combine tape with exercise in a multi-week field trial, add three-dimensional kinematics, muscle activity, and patellofemoral imaging to separate mechanisms, vary tape tension to test dose, and include runners at different performance levels and with longer follow-up.

5. CONCLUSION

Taping is widely used by runners with patellofemoral pain, yet the existing evidence does not establish whether rigid taping or Kinesio taping offers greater relief or whether either affects running performance. This paper synthesised the relevant literature and specified a randomised crossover protocol that compares the two tapes with a no-tape reference during standardised running, with pain as the primary outcome and time-trial and hop performance as secondary outcomes. The anticipated findings are stated as hypotheses rather than results. Completing the proposed trial would give clinicians and runners practical evidence on when taping is worth using and which type to choose.

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