A systematic review of the effects of therapeutic taping on patellofemoral pain syndrome
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CRD summary
This review evaluated the effects of patellar taping in patients with patellofemoral pain syndrome. The authors concluded that patellar taping appeared to reduce pain and improve function, but evidence was limited and further research is required. Given that only one of four randomised controlled trials reported that patellar taping alone significantly improved pain, the conclusion about the need for further research seems reasonable.

Authors' objectives
To evaluate the effects of patellar taping on pain, patellar alignment and neuromuscular control in patients with patellofemoral pain syndrome (PFPS).

Searching
MEDLINE, SPORTDiscus and CINAHL were searched from inception to present for studies published in the English language. The search terms were reported.

Study selection
Study designs of evaluations included in the review
The inclusion criteria for study design were not explicitly reported. The reported studies included both randomised and non-randomised studies.

Specific interventions included in the review
The inclusion criteria for interventions were not explicitly reported, but it was clear that the review focused on patellar taping. The included studies used taping alone or in conjunction with other components such as exercise, education and biofeedback. Control treatments, where these existed, included exercise, education and no taping. The studies evaluated the effects of taping during various rehabilitation programmes and specific activities. Rehabilitation programmes included home strengthening and exercise, exercise programme monitored by a physiotherapist, and a physiotherapist-directed programme. Specific activities included repetitive maximum isotonic quadriceps contraction, single-leg squat exercises, stair ambulation, maximal isotonic leg presses, step-down, stair stepping, walking, fast walking, ramp walking, single-leg vertical jump and knee extension.

Participants included in the review
Studies of participants described as having or who had been diagnosed with PFPS or anterior knee pain syndrome were eligible for inclusion. Studies only in healthy patients or patients with knee osteoarthritis, patellar tendonitis or tendinopathy, patellar subluxation or dislocation, or other knee conditions were excluded. One of the studies included healthy people as a control group. Some of the included studies were in women only, while others included both men and women.

Outcomes assessed in the review
Studies that assessed pain, patellar alignment and neuromuscular control were eligible for inclusion. The included studies assessed pain and function using various scores and questionnaires: visual analogue scales (VAS), Functional Index Questionnaire, clinical change score and Patellofemoral Function Score. They also assessed neuromuscular control by evaluating quadriceps strength, onset of vastus medialis oblique (VMO) activity relative to vastus lateralis (VL) using electromyographic activity (EMG) and knee joint biomechanics during activity. Some studies assessed patellar positioning using computed tomography or magnetic resonance imaging.

How were decisions on the relevance of primary studies made?
The authors did not state how the studies were selected for the review, or how many reviewers performed the selection.
Assessment of study quality
Studies were assessed and scored using the following criteria of the PEDro scale: eligibility criteria specified; random allocation to treatment groups or random order of treatments in crossover studies; baseline similarity of treatment groups on prognostic factors; blinding of the participants, therapists and outcomes assessors; key outcomes measures for more than 85% of participants with key measures for at least one key outcome; all patients received allocated treatment, or intention-to-treat analysis used for at least one key outcome; between-group statistical comparisons reported for at least one key outcome; and point estimates and measures of variability reported for at least one key outcome measure. The maximum possible score was 10 points.

At least two reviewers independently assessed validity and resolved any disagreements through discussion. Three studies had been rated and were listed in the PEDro database, and these ratings were accepted by the authors.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction. The extracted data included values for outcome measures together with levels of statistical significance.

Methods of synthesis
How were the studies combined?
The studies were grouped by outcome and individual studies were described.

How were differences between studies investigated?
Differences between the studies were discussed with respect to study design, outcome measures and patellar taping technique.

Results of the review
Sixteen studies (n=431) were included: 4 parallel-group RCTs (n=249), 1 crossover RCT (n=14) and 11 non-randomised studies, most of which used patients as their own controls (n=168).

The studies scored between 3 and 9 out of 10 for quality on the PEDro scale (mean 4.25).

Pain (4 RCTs and 7 other studies).
One RCT (n=81; PEDro score 7) reported no significant difference between (1) exercise, taping plus education, (2) exercise plus education, (3) taping plus education, and (4) education alone in VAS pain, Western Ontario and McMaster lower limb function scores, Hospital Anxiety and Depression scores at 3 or 12 months. One RCT (n=113, PEDro score 5) reported that a taping plus biofeedback plus a physiotherapist-directed programme (that included McConnell taping, biofeedback and exercise) significantly improved scores on various pain scales and questionnaires (VAS, Functional Index Questionnaire, clinical change score and Patellofemoral Function Score) during a step test at 1 month compared with an exercise programme monitored by a physiotherapist (P<0.05), but there was no statistically significant difference between the physiotherapist-directed programme (that included taping) and a home strengthening and flexibility exercise programme.

One RCT (n=25; PEDro score 3) reported no significant difference in pain between taping and no taping in patients who were instructed about physical therapy and a home exercise programme.

One RCT (n=30; PEDro score 9) reported that patellar taping plus exercise significantly reduced VAS scores for pain at 2, 3 and 4 weeks compared with placebo taping plus exercise and exercise alone (VAS: 1.1 versus 2.4 and 2.9 respectively, P<0.001). The RCT also reported that patellar taping plus exercise significantly reduced pain during a step-down task (VAS: 1.8 versus 3.4 and 3.4; P<0.001) and the mean Functional Index Questionnaire scores at weeks 2, 3 and 4 compared with the other two interventions. Patellar taping was administered daily.

The results of the 7 non-randomised studies (n=118) were also reported.
Neuromuscular control.

Quadriceps activity (3 studies): there were significant improvements in quadriceps power at 3 months after exercise, taping plus education, exercise plus education, taping plus education and education alone (1 RCT, n=81), significant improvements in quadriceps strength after physical therapy but no statistically significant difference between taping and no taping (1 RCT, n=25), and significantly increased quadriceps peak torque during isokinetic quadriceps contraction with taping (1 non-randomised study, n=14).

Onset of VMO activity relative to vastus lateralis (5 non-randomised studies): taping was associated with a significant decrease in the EMG ratio of VMO to VL (1 study, n=15, P=0.05), an earlier onset of VMO EMG activity during a step-up and step-down test (1 study, n=14, P=0.0008), increased VMO activity but no effect on VL activity (1 study, n=30; P<0.01 and P>0.05, respectively), and an increase in the EMG amplitude of the VMA for lateral stretch compared with other directions (P<0.001). The fifth study reported that VMO activity started earlier during stair ascent in 10 patients with PFPS compared with 12 healthy controls.

Knee joint biomechanics during activity (3 studies): taping was associated with increased cadence, knee flexion angles and knee extension movements but no effect on VL EMG activity (1 non-randomised study, n=10), increased stride length during ramp, ascent and increased loading response knee flexion but no effect on other stride characteristics (1 non-randomised study, n=15), and greater knee extensor movement (1 crossover RCT, n=14).

Patellar positioning (3 non-randomised studies): 2 studies reported no effect of patellar taping on patellar lateralisation or patellar tilt (1 study, n=16) or on patellofemoral congruency or patellar rotation angles (1 study, n=15). The third study (n=12) reported that patellar taping plus bracing significantly decreased patellofemoral congruence angle at 10 degrees of knee flexion compared with no taping; the study measured eight angles of knee flexion.

Authors' conclusions
Patellar taping appeared to reduce pain and improve function during activities of daily living and rehabilitation exercises, but the evidence was limited and further research is required.

CRD commentary
The review addressed a clear question that was defined in terms of the participants and outcomes; eligibility criteria were not explicitly reported for interventions and no criteria were reported for study design. Three relevant databases were searched but no attempts were made to minimise publication or language bias. Methods were used to minimise reviewer errors and bias in the assessment of validity, but it was unclear whether similar steps were taken in the study selection and data extraction processes. Validity was assessed and scored using specified criteria, and the results of this assessment were reported.

Some information on the included studies was provided, but the methods used to diagnose patients with PFPS and the severity of symptoms at baseline were not reported. The comparability of participants between studies could not, therefore, be assessed; the authors also mentioned that several studies did not report the characteristics of the participants. The narrative synthesis was appropriate given the differences between the studies but, although study quality was reported, evidence from higher quality studies was not highlighted in the text. In addition, individual studies were described rather than the evidence being synthesised. However, potential reasons for differences between the studies were discussed. Several studies assessed multiple outcomes, which increased the possibility of at least one positive result and made interpretation of the results difficult. Only one of the 4 RCTs reported that patellar taping alone significantly improved pain and this, albeit a high-quality RCT, contained only 30 patients. Hence, the conclusions about the effectiveness of taping may be overoptimistic given that the majority of the trials were small and used a non-randomised design. The authors are right to recommend that further research is required to confirm their findings.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.
Research: The authors stated that further research (such as placebo-controlled trials) is required to evaluate the short- and long-term effectiveness of multiple applications of patellar taping. They also suggested that future research could consider using standardised patellar taping techniques.

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