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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| For a recreational runner with chronic unilateral patellofemoral pain syndrome, is knee and hip musculature strengthening more effective when compared to McConnell taping in decreasing patient-reported pain and increasing patient-reported function at 1-year follow-up? |

**AUTHOR**

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**CLINICAL SCENARIO**

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| Athletes both recreational and professional frequently suffer from anterior knee pain as a result of repetitive compression of the patella on the femur. Patellofemoral pain syndrome (PFPS) is classically described as pain in the knee with sitting, squatting, stair climbing, or increased activity levels. This debilitating condition alters individual’s activity levels and limits their physical function. Physical therapists often use conservative measures such as bracing, re-direction of activities, lower extremity strengthening, biofeedback, and non-steroidal anti-inflammatories (NSAIDs) to manage the pain experience by patients. Recently many physical therapists have used adhesive taping around the patella to manage PFPS symptoms. Theoretically a muscular imbalance (or inappropriate neuromuscular activation) could cause the patella to track laterally in the femoral groove, increasing contact forces while decreasing contact area. Patellar taping has been used to attempt to correct this dynamic mal-alignment. Patellar taping has been used in combination with exercise, biofeedback, NSAIDs, and other conservative treatments in the past. This review aims to investigate the effectiveness of patellar taping as a sole modality and what it contributes when used in combination with other modalities. |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| Ten studies were found that fulfilled the inclusion/exclusion criteria, including 5 systematic reviews or meta-analysis of randomized controlled trials (RCTs), 4 RCTs, and 1 Cochrane Review. Three of these articles are explored in detailed and discussed. Minimal improvements are noted in pain management and function using taping alone. Resistance exercise targeting hip and thigh musculature provides clinically and statistically significant improvements in pain management and functioning in recreationally active individuals with PFPS. Taping in combination with exercise provides improved outcomes statistically and clinically. Future research should include specific instructions for methodology of applying tape around the patella. Studies should include appropriate blinding procedures of assessors and therapists providing interventions. Standardized assessment and outcome measures should be included in the diagnosis and monitoring of PFPS and the progression of symptoms throughout the rehabilitation process.  |

**CLINICAL BOTTOM LINE**

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| Current evidence suggests that a physical therapy program consisting of quadriceps stretching, strengthening, and patellar taping is an effective treatment regimen in managing PFPS in recreational athletes. Taping alone is not a sufficient treatment modality to effectively manage the symptoms experienced by individuals with PFPS. A home exercise program performed daily for 2-4 weeks depending on pain level at assessment, along with taping, and exercise progressions appear to be the best evidence for treatment of this condition. Future research needs to investigate the specific lower extremity muscle groups that need to be strengthened and/or stretched. Furthermore, open chain versus closed chain kinetic exercises needs to be explored further to elucidate the most effective choices for patients. Lastly, band resisted, bodyweight, multi-joint, and resistance machines need to be explored for the best strengthening modality in a population of individuals with PFP |

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| ***This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor*** |

*The above information should fit onto the first page of your CAT*

**SEARCH STRATEGY**

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| **Terms used to guide the search strategy** |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| Patellofemoral pain syndromeAnterior knee pain syndromeRun\*Active adult\* | Resistance Train\*Strength Train\*ExerciseQuad Strength\* | McConnell Tap\*Taping | PainFunctionDistance |

**Final search strategy:**

*Show your final search strategy from one of the databases you searched. In the table below, show how many results you got from your search from each database you searched.*

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| **PubMed****CINAHL****PEDro**  | **3 (74)****97****16** | **Initial search:**  (Patellofemoral pain syndrome OR Anterior knee pain syndrome OR Run\* OR Active Adult\*) AND (Resistance Train\* OR Strength Train\* OR Exercise OR Quad Strength\*) AND (McConnell Tap\* OR Taping) AND (Pain OR Function OR Distance) **Removed syndrome from PFPS, removed active adult, expanded Run\* to Runner’s knee. Added resistance exercise, removed quad for quad strength\* removed progressive exercise. – 28 Results.** **Added recovery to outcomes.****Final search – P-runner’s knee OR patellofemoral pain\* OR anterior knee pain OR knee pain****I – resistance\* OR resistance train\* OR exercise\* OR resistance exercise\* OR strength\*****C-McConnell Tap\* OR Taping****O-recovery OR pain OR function OR distance****Tallied 74 results** |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| Published in EnglishPublished up to September 2014Studied a population of working age adults (18-50 years old).Studied a population with diagnosed Patellofemoral Pain Syndrome.A protocol that includes a control group that does not receive the intervention.  |
| **Exclusion Criteria** |
| Case studiesStudies that utilize whole body vibration training as an intervention.Studies that utilizes only aerobic exercise as an intervention.Studies involving adults with concurrent neurologic, cardiopulmonary, or other orthopaedic diagnoses. |

**RESULTS OF SEARCH**

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| A total of  | 10 | *(insert number)* relevant studies were located and categorised as shown in the following table (based on Levels of Evidence, Centre for Evidence Based Medicine, 2011) and (insert name of) quality assessment rating scale |

**Summary of articles retrieved that met inclusion and exclusion criteria**

*Note that this table is arranged differently from the example CAT on Sakai. For each article that meets your inclusion and exclusion criteria, score for methodological quality on an appropriate scale, categorize the level of evidence, and note the study design (e.g., RCT, systematic review, case study). Add more rows as necessary.*

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| **Author (Year)** | **Study quality score** | **Level of Evidence** | **Study design** |
| **Wittingham (2004)** | **8/11 (PEDro)** | **1b** | **RCT** |
| **Mason (2011)** | **7/11 (PEDro)** | **1b** | **RCT** |
| **Collins (2012)** | **7/11 (AMSTAR)** | **1a** | **Systematic Review & Meta-Analysis** |
| **Loudon (2004)**  | **6/11 (PEDro)** | **1b** | **RCT** |
| **Kowall (1996)** | **7/11 (PEDro)** | **1b** | **RCT** |
| **Callaghan (2012)** | **11/11 (AMSTAR)** | **1a** | **Cochrane Review** |
| **Aminaka (2005)** | **6/11 (AMSTAR)** | **1a** | **Systematic Review** |
| **Bolgla (2011)** | **5/11 (AMSTAR)** | **1a** | **Systematic Review** |
| **Crossley (2001)** | **5/11 (AMSTAR)** | **1a** | **Systematic Review** |
| **Barton (2014)** | **7/11 (AMSTAR)** | **1a** | **Systematic Review & Meta-Analysis** |
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**BEST EVIDENCE**

The following 3 studies were identified as the ‘best’ evidence and selected for critical appraisal. Reasons for selecting these studies were:

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| * **Callaghan 2012 – This Cochrane review presented the most detailed and thorough review of patellar taping I could find.**
* **Wittingham 2004 – This study examined taping with exercise, placebo taping and exercise, and exercise alone. This is one of 2 RCTs I found that involved both taping and exercise with a control group.**
* **Mason 2011 – This study examined the effects of taping and quadriceps strengthening, both individually and combined. This is one of 2 studies that I found in my searches to compare my intervention and comparison from my PICO. It is the only study I found comparing the two and combining the two in separate groups.**
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**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of (study title) by (authors, Year) (Effects of Taping on Pain and Function in Patellofemoral Pain Syndrome: A Randomized Controlled Trial) (Wittingham M., Palmer S., Macmillan F. 2004)**

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| **Aim/Objective of the Study/Systematic Review:** |
| This study explored the pain relief effectiveness of using patellar taping in addition to exercise to manage the symptoms and limitations as a result of patellofemoral pain syndrome (PFPS) in a series of army recruits. |
| **Study Design**[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| Study design- Randomized Controlled Trial. After evaluation patients chose a numbered envelope, which placed them in one of 3 groups. Envelopes were distributed in a series of 3, so if envelope 2 was chosen, 1 and 3 must be chosen prior to all 3 being available again (block randomization). Patients were instructed to wear long pants to outcome testing to conceal their group assignment by not letting the assessor see whether tape was present or not. One PT was used to confirm a diagnosis of PFPS. A second PT had knowledge of the group allocation, so as to use placebo taping or therapeutic taping. This same therapist demonstrated and oversaw the exercise program for all groups as well. A third PT evaluated outcome scores. A score was taken initially (at the same time as group allocation) and then once a week for the next 4 weeks.  |
| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| This study took place in a United Kingdom Army medical facility. The study appeared to be conducted in an outpatient setting.  |
| **Participants**[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| 30 United Kingdom Army recruits met the inclusion criteria. All were referred to the clinic by a Medical Officer of their respective unit. The authors used non-probabilistic, convenience sampling. 24 males and 6 females were included in the study. Mean (±SD) age of participants was 18.7±1.2 years. No description of symptom duration was provided aside from the referring medical officer diagnosing “acute PFPS”. No dropouts were described; all 30 participants were present for follow up. Each group had similar allocation of males and females (8 males-2 females), and no statistical difference between height, weight, age, Visual Analogue Scale (VAS) -pain, Functional Index Questionnaire (FIQ), and VAS pain for step down test with and without therapeutic taping on.  |
| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| A second PT, not involved in the initial assessment/study inclusion evaluation treated all patient. One control group received “sham” or placebo taping, which was arbitrarily placed around the patella. Placebo taping was not intended to correct any mal-alignments or aberrant muscle firing patterns. The placebo-taping group also received the “standard” exercise protocol, which was the same for all 3 groups. An exercise group also served as a control, and completed only the exercises. For all 3 groups exercises were completed daily in the clinic. If taping was received, the exercises were completed immediately after being taped for that day. The “standard” exercise program was progressive in nature. Once activities could be completed without pain, more challenging exercises were provided. Initially non-weight bearing isometric, isotonic, and long arc quad exercises were performed for 3 sets of 10 repetitions. Once the patient could complete these without pain, isometric quadriceps activities were completed at 90-degrees of flexion, bilateral mini-squats, and finally unilateral mini-squats. Additional exercises included: step-down activities forward, backward, and laterally. External rotators were strengthened by making a right angle at the knee (in a squat position) and rotating against the wall (which was lateral to the leg) and contracting isometrically. 3 sets of 10 repetitions were completed for all exercises aside from the hip ER isometrics, performed 10 times total, while holding the contraction for 20 seconds. As part of the exercise program 4 sets of a 20-second hold stretching each of the IT band, quadriceps, and triceps surae were performed individually.  |
| *Experimental* |
| The second PT mentioned in the control section also provided therapeutic McConnell taping, aimed at correcting mal-alignments of the patella. This group also received the “standard” exercise program in the clinic daily just after tape was applied. These participants also performed the exercise program daily in clinic.  |
| **Outcome Measures** (Primary and Secondary)[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| A third PT not involved in the assessment/evaluation process or the interventions provided administered outcome measure assessment. No specific details are given about the location of where this was conducted, though given that participants wore sweatpants to cover their entire leg, it can be reasonably inferred that these tests were done in the same clinic treatments were provided in. Visual Analogue Scale (average of the last 24 hours, during a step test with tape, during a step test without tape). For these last two, the exercise group did not have tape on for either and completed the step down twice. For the placebo-taping group their tape score was with placebo tape applied. Meanwhile for the therapeutic taping group, therapeutic tape was applied. The VAS is a 10cm line with 1 cm intervals. A score of 0 corresponds to “no pain” and a score of 10 corresponds to “worst pain possible”. Functional Index Questionnaire (FIQ) – a subjective questionnaire completed by patients with 3 scores possible for 8 questions. A score of 2 indicates the activity is completed without limitations. A score of 1 indicates the activity can be completed, but is challenging. A score of 0 corresponds to not being able to complete the activity. Thus 0 is the lowest possible score and 16 is the highest. Questions include: “walking up to a mile”, “going up 2 flights of stairs”, “squatting”, “kneeling”, “sitting for a long period of time with your knee bent in the same position”, “going up 4 flights of stairs”, “running 100m”, “walking one quarter mile”.  |
| **Main Findings**[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided – if you need to calculate these data yourself, put calculations here and add interpretation later, under ‘critical appraisal’ on next page] |
| **VAS pain in the last 24 hours.** At baseline therapeutic taping and exercise group reported a VAS of 7.5±1.0 (mean ± SD). The sham taping and exercise group reported 7.5±0.8. Exercise group alone reported 7.5±0.8. After 4 weeks of therapy the Therapeutic Taping and Exercise group reported 0.0 ± 0.0, the sham taping and exercise group reported 0.9 ± 0.7, and the exercise group reported 1.8 ± 0.9. The therapeutic taping and exercise group reported significantly lower VAS scores compared with the sham taping and exercise group and exercise only group at 2, 3, and 4 weeks of therapy. (P<0.01)**VAS pain with step test**VAS pain completing a step test without tape applied. At baseline the therapeutic taping and exercise group reported a VAS of 7.4 ± 1.0, the sham taping and exercise group reported 7.5±0.6, and the exercise group reported 7.4±0.8. The therapeutic taping and exercise group reported a VAS of 4.3±0.6 after 1 week of treatment, 2.4±0.7 after 2 weeks, 0.7±0.5 after 3 weeks and 0.0±0.0 after 4 weeks. The sham taping and exercise group reported a VAS of 5.7±1.2 after 1 week of treatment, 4.1±1.3 after 2 weeks, 2.5±1.2 after 3 weeks, and 1.2±0.5 after 4 weeks. The exercise group reported a VAS of 5.0±1.2 after 1 week of treatment, 3.8±1.2 after 2 weeks, 2.9±1.0 after 3 weeks, and 1.7±0.9 after 4 weeks.After 1 week of treatment the therapeutic exercise group reported a VAS score significantly lower than the sham taping and exercise group. (P<0.01) After weeks 2, 3, and 4 the therapeutic exercise group reported a VAS score significantly lower than both the sham taping and exercise group and the exercise group. (P<0.01)**VAS pain completing a step test with tape applied.** The exercise group completed the test without tape. The sham taping group, received sham taping prior to completing the test. At baseline the therapeutic taping and exercise group reported a VAS of 3.6 ± 0.4, the sham taping and exercise group reported 7.6±1.2, and the exercise group reported 7.9±1.0. The therapeutic taping and exercise group reported a VAS of 2.3±0.4 after 1 week of treatment, 1.3±0.4 after 2 weeks, 0.4±0.4 after 3 weeks and 0.0±0.0 after 4 weeks. The sham taping and exercise group reported a VAS of 5.1±1.2 after 1 week of treatment, 3.6±1.1 after 2 weeks, 2.0±1.0 after 3 weeks, and 1.1±0.5 after 4 weeks. The exercise group reported a VAS of 5.5±1.4 after 1 week of treatment, 3.8±1.5 after 2 weeks, 2.7±1.1 after 3 weeks, and 1.4±0.7 after 4 weeks.The taping and exercise group reported significantly lower pain than sham taping and exercise group after 1 week of treatment and significantly lower pain than both exercise alone and sham taping and exercise groups after weeks 2, 3, and 4 of treatment. (P<0.01)**FIQ Scores**Functional Index Questionnaire scores (mean ± SD) were also reported for each group. At baseline the therapeutic taping and exercise group reported a score of 7.6± 1.0, the sham taping and exercise group reported a score of 7.8±0.8, and the exercise group reported a score of 7.7±0.8.The therapeutic taping and exercise group reported scores of 11.3±1.2 after 1 week of treatment, 14.0±0.8 after 2 weeks, 15.5±0.7, and 16.0±0.0 after 4 weeks. The sham taping and exercise group reported a score of 10.3±1.1 after 1 week of treatment, 11.6±1.0 after 2 weeks, 12.5±1.3 after 3 weeks, and 13.5±1.1 after 4 weeks. The exercise group reported a score of 10.0±0.8 after 1 week of treatment, 11.3±0.8 after 2 weeks, 12.7±0.9 after 3 weeks, and 13.5±1.0 after 4 weeks. After 1 week of treatment the therapeutic taping and exercise group reported significantly higher scores than the exercise group. (P<0.01) After weeks 2, 3, and 4 the therapeutic taping and exercise group reported significantly higher scores than the exercise group and the sham taping and exercise group. (P<0.01) |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| The authors concluded that McConnell taping in conjunction with an exercise program was more effective in managing anterior knee pain and function associated with patellofemoral pain syndrome than a sham taping and exercise protocol or exercise alone. All groups made significant decreases in pain and significant over the course of the 4 weeks of treatment. The authors concluded that the above results indicate that directed McConnell taping provides some benefit that sham taping does not, though they did not delve into the mechanisms behind this. The authors note that while immediate pain reduction was noted in the step test upon utilization of therapeutic taping, there seems to be a combined effect of both therapeutic taping and exercise. They reached this conclusion as both the exercise group and the sham taping and exercise group experienced significant pain decreases and functional increases over the course of the study. The authors noted that they did not find any differences between the placebo taping group and exercise only group throughout the study regarding pain or function. Limitations noted by the authors were that this is a unique population both in age, gender, and health care benefits. These individuals were able to see a therapist daily for 4 weeks to receive supervised exercise and taping.  |
| **Critical Appraisal** |
| **Validity**[Methodology, rigour, selection, sources of bias, quality score on methodology quality rating scale (indicate the quality assessment tool used and the maximum possible score on that scale, e.g., 7/10 on PEDro scale), appropriateness of analytical approach (e.g., adjustments for confounding variables, management of missing data).]Comment on missing information in original paper. |
| PEDro scale – Eligibility criteria defined – Yes. Random Allocation – Yes. Concealed Allocation – Yes. Groups similar at baseline for important prognostic factors – Yes. Blinding of Subjects- No. (While the authors were able to blind participants with sham versus therapeutic taping, an exercise group did not receive any tape). Blinding of therapists administering treatment – No. Blinding of assessor(s) – Yes. Measures of key outcomes for > 85% of the starting sample – Yes. All subjects used in outcome measures received treatment or control – Yes. Reports of between group statistical comparisons reported for at least one key outcome- Yes. Point measures and variability provided for at least one outcome measure – Yes. 9/11 total score. 8/10 PEDro score. Sources of bias – all patients were referred by “the Unit Medical Officer” (page 505). All 30 subjects referred to the physical therapist were included in the study. This could be indicate selection bias (diagnostic criteria) by the Unit Medical Officer, though it appears that all subjects met the inclusion and exclusion criteria which are consistent with other PFPS criteria I have found. No timeline is given for how long the patients were experiencing symptoms prior to enrolling in the study. This could lead to prognostic bias. In some cases it would be reasonable to expect that if subjects enrolled in a study in the acute phase for management as opposed to a chronic phase, their symptoms would resolve at a different rate and magnitude of change. Block assignment was appropriate in this case to provide equal numbers of participants and equal distribution of genders in each group. Block randomization is a method in which a pre-determined number of participants will be in each group prior to randomization. Groups were similar at baseline regarding gender, age, weight, and height. Thus we can be reasonably certain that changes observed in the study are not a result of physical characteristics. One PT was used to provide therapeutic taping, sham taping, and exercise supervision to all three groups. All participants came to the clinic at the same time for taping and exercise every day. This is a potential source of bias as patients in the exercise group may have different perceptions or expectations, seeing that they did not receive tape. Additionally it is not clear if the therapist would provide exercise corrections (for technique) or progression. |
| **Interpretation of Results**[Favourable or unfavourable, specific outcomes of interest, size of treatment effect, statistical and clinical significance, minimal clinically important difference. You may calculate effect size or confidence intervals yourself from the data provided in the article.] Describe in your own words what the results mean. |
| The MCID for the VAS is 3 cm in a population of acute care patients in the ER. (Lee et al.) There are no established MCID values for VAS in this population, but given that the group receiving exercise and tape reported full function and no pain at 4 weeks we can assume that this group met or exceeded a clinical difference.The results of this study indicate that directed exercises are effective in managing the symptoms of PFPS, both in terms of restoring function and reducing pain. Directed exercise and therapeutic taping however, resolved all symptoms in this population within 4 weeks of daily treatment. Effect sizes were rather large as participants scored themselves at roughly 8/16 on the FIQ initially and improved to 16/16 in the combined taping and exercise group after 4 weeks of treatment. Additionally, pain was dramatically reduced from roughly 7.7/10 on the VAS for stepping without tape and in the last 24 hours to 0/0 pain with 4 weeks of treatment. This is more than double the MCID for the VAS, indicating that a treatment including both taping and exercise are clinically meaningful. While pain and function were not totally resolved in the exercise group, significant improvements were facilitated through an exercise only intervention. The effects of targeted taping appeared to be realistic as well. The therapeutic taping and exercise group was significantly improved in FIQ and pain on step down test compared with the exercise group and placebo taping and exercise group, which were similar in all pain and functional scores. Since the two groups (exercise only and sham taping plus exercise) received a similar exercise program, it would be expected that their outcomes would be similar. Furthermore, since the therapeutic taping group had significantly better outcomes than the placebo group, we can determine that taping in addition to exercise does produce some form of beneficial response from the patient that is more than a placebo provides. References: 1. Lee J., Hobden E., Stiell I., Wells G. Clinically important change in the Visual Analog Scale after Adequate Pain Control. ACAD EMERG MED. (2003) 10(10): 1128-1130 |

**(2) Description and appraisal of (study title) by (authors, Year) (The Effect of Taping, Quadriceps Strengthening and Stretching Prescribed Separately or Combined on Patellofemoral Pain.) (Mason M., Keays S., Newcombe P. 2011)**

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| **Aim/Objective of the Study/Systematic Review:** |
| This study examined the effects of one week of quadriceps strengthening, knee extensor stretching, and patellar taping individually then in combination on the outcomes of patients with patellofemoral pain syndrome.  |
| **Study Design**[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| This was a double-blinded randomized controlled trial. One physical therapist performed the assessments and a second therapist provided treatments to patients included in the study. After patients were included in the study, they were assigned to a group by a pre-numbered envelope. At this point patients were instructed in a home compliance program (either stretching or strengthening). Patients in the taping group were instructed to return to the clinic if their initial tape came off during the week, for a re-application. Participants were assessed by a separate therapist at the initial encounter, after 1 week of treatment and after 2 weeks (one week of individual treatment and one week of combined treatment). |
| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| Outpatient physical therapy clinic. Patients were referred by doctors and surgeons in the area. Queensland Australia. The lead author was involved in private practice. It appears this was in a metropolitan/suburban area.  |
| **Participants**[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| 41 subjects participated in the study (n=41). A total of 19 subjects (5 male, 14 female) had bilateral symptoms and 22 subjects (10 male, 12 female) had symptoms in one knee only. 25 doctors and orthopaedic surgeons in the area were informed of the study and asked to refer relevant patients to the group. Patients were between the ages of 13 and 82 years of age. Patients had a mean duration of 71 months for presenting symptoms. The mean age was 45 ± 17 years old.The average height of subjects was 1.71 m, while the average weight was 80 kg. Average BMI was 27. The control group reported less pain at baseline in going up and down stairs than the quadriceps-stretching group. All participants completed the study and followed up at the 2-week mark.  |
| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| The control group received education about the functional anatomy of the knee. This group was told to avoid painful movements and activities. Patients in this group were also educated about the importance of knee extensor strength in managing patellofemoral pain syndrome.  |
| *Experimental* |
| This study included 3 experimental groups for 1 week. After this initial treatment, all patients received a combination of all 3 modalities and were pooled together. Quadriceps Strengthening – Participants in this group performed 10 repetitions of towel extensions in long sitting, holding for 10 seconds. Next subjects performed isometric quadriceps contractions holding for 10 seconds for a total of 10 repetitions in long sitting. Following this were 10 “heel lifts” in long sitting. Lastly 10 repetitions of partial straight leg raises, without letting the foot touch the floor. Patients were instructed that exercises were not to be painful and to monitor for contraction of the medial quadriceps. A biofeedback system was used in the initial treatment session if the participant was unable to produce or adequately monitor a medial quadriceps contraction. All exercises were to be completed 3 times a day. Quadriceps Stretching – Patients were provided with an “individualized” quadriceps stretch in either prone, standing, “side-lying on affected side”, supine with affected leg dangling over the edge of a bed, or seated on the side of a bed or chair. Using a strap, subjects brought their calcaneus towards the ipsilateral gluteal region and held for 15 seconds. This was performed for 3-5 repetitions 3-4 times a day. Patellar Taping – Patients received a single application of “Therafix” tape inferior to the patella. Taping was performed in the long sitting position. Patients also received 3 layers of sports tape.Combination – After the first week of treatments, patients were evaluated. After the evaluation all 3 modalities were given to all participants in the same manner as described above.  |
| **Outcome Measures** (Primary and Secondary)[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| Primary outcome measures were pain reported on a visual analogue scale (VAS) while walking up stairs, walking down stairs, performing a step down, and during “self-selected activity”. The VAS is an 11-point Likert scale measure, where 0 represents no pain and 10 represents the worst pain imaginable.Knee extensor strength – Using a Cybex, seated knee extension dynamometer patients were assessed for knee extension strength at 60 degrees of motion per second. Patients were directed to perform 5 separate repetitions, while generating maximal force that was pain free. Quadriceps length – Patients were assessed in prone. The assessor passively plantar flexed the foot of the affected leg and moved the heel towards the gluteals until “the subject reported the first sensation of stretch”. The assessor then held the leg in this position and measured the distance (via a tape measure) from the gluteals to the foot. No specific landmarks were provided for measurement. Patients were also assessed for the degree of knee flexion performed in an eccentric step down that was pain free. Patients stood on a 23 cm step, and while maintain neutral trunk position and the knee aligned over the 2nd metatarsal the patient lowered themselves by flexing at the affected knee. The other knee was allowed to dangle. A goniometer was used to assess the pain free ROM reported by the subject.  |
| **Main Findings**[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided – if you need to calculate these data yourself, put calculations here and add interpretation later, under ‘critical appraisal’ on next page] |
| Taping group – A significant decrease in pain reported via VAS in a self-selected activity from baseline (3.43±2.4) to 1 week of intervention (1.83±1.6). p=0.002 using a Day x Group ANOVA. Quadriceps length increased as measured by heel to gluteal distance in cm at 1 week from 25.67±11 cm at baseline to 20.27±9 cm at one week follow up. p= 0.006 While the authors did not consider the increase in pain free controlled eccentric knee flexion significant, they reported it as strongly trending towards increased ROM from 53.87±12 degrees to 59.13±14 degrees at 1 week follow up, p=0.017. Pain going up stairs as measured by VAS did not significantly change from baseline 1.55±1.7 to 1.0±1.1 at 1 week follow up, p=0.075. Pain going down stairs as measured by VAS did not significantly change from baseline 1.56±1.2 to 1.09±1 at 1 week follow up, p=0.224. In the step down test pain decreased from 1.1±1.8 at baseline to 0.85±1.3, though this was not significant p=0.398. Quadriceps strength measured at 60 degrees/second ft/lbs. did not change from baseline 72.2±32 to 71.67±32 at 1 week follow up, p=0.831.Strengthening group – A significant decrease in pain ascending stairs was reported from 1.73±1.7 at baseline to 0.53±0.8, p=0.000. Similarly a decrease in pain descending stairs was reported from 2.32±2.4 at baseline to 0.99±1.8 at 1 week follow up, p=0.001. The authors report a trend towards significance for the step down test as pain decreased from 1.41±1.7 at baseline to 0.72±1.6 at follow up, p=0.021. Pain decreased in a self-selected activity from 3.25±2.1 at baseline to 1.74±1.7 at 1 week follow up, p=0.003. Quadriceps strength increased (measured at 60 degrees/second ft./lbs.) from 65.4±28 to 76±27, p=0.000. Quadriceps length as measured by heel to gluteal distance in cm did not significantly change from 22.57±8 cm at baseline to 19.8±7 at follow up, p=0.151. Pain free ROM in an eccentric lowering test significantly increased from 51.47±15 degrees to 59.87±14 degrees at follow up, p=0.000.Stretching group – Pain going up stairs was reported to trend toward significant decrease at follow up from 2.15±2.2 at baseline to 1.39±2 at 1-week follow up, p=0.017. Pain descending stairs significantly decreased from 3.43±3.5 at baseline to 2.1±2.2 at follow-up, p=0.001. Pain reported in the step down test significantly decreased from 2.82±3.2 at baseline to 1.85±2.8, p=0.001. Pain reported in a self-selected activity significantly decreased from 4.97±2.4 at baseline to 2.65±2 at follow up, p=0.000. Quadriceps strength was reported to trend toward increasing (measured at 60 degrees/second ft./lbs.) from 57.87±29 at baseline to 63.93±24 at follow up, p=0.018. Heel to gluteal length significantly decreased from 32.47±10 cm at baseline to 21.33±9 cm at follow up, p=0.000 indicating increased quadriceps length. Finally, pain free ROM measured in an eccentric lowering test increased from 48.5±22 degrees at baseline to 59.07±18 at follow up, p=0.000.Control group – There were no significant changes noted in the control group. Pain ascending stairs did not change from baseline 0.81±0.8 at baseline to 0.7±0.9 at 1-week follow up, p=0.728. Pain descending stairs did not change from baseline 1.1±1.6 to follow up 0.82±1.2, p=0.464. Pain did not change with step down test from baseline 0.69±1.2 to follow up 0.22±0.47, p=0.113. No change in pain was noted with self-selected activity from baseline 3.36±1.9 to 1-week follow up 2.26±1.5, p=0.035, though this did show a small trend toward a significant decrease. Quadriceps strength (measured at 60 degrees/second ft./lbs.) did not change from 66.13±28 at baseline to 67.87±27 at 1-week follow up, p=0.489. Quadriceps length measured by distance from heel to gluteal did not change, but trended toward increased length from baseline 25.3±12 cm to 20.8±11 cm, p=0.021. Pain free ROM in an eccentric knee flexion test did not change from baseline 59.47±13 degrees to 62.53±13 degrees at 1-week follow up, p=0.158.Pooled results for week 2 – Pain ascending stairs significantly decreased from week 1 (0.91) to week 2 (0.59), p=0.002. Pain descending stairs decreased significantly from 1.25 to 0.7, p=0.000. Pain with the step down exercise decreased from 0.91 to 0.63, p=0.007. Pain with a self-selected activity decreased from 2.1 to 1.4, p=0.000. Quadriceps strength measured for 60 degrees/second ft/lbs. Increased from 69.87 to 77.76, p=0.000. Heel to buttock distance (measuring quadriceps flexibility) decreased from 20.55 to 15.03, p=0.000 indicating lengthening/increased flexibility of the quadriceps. Finally, pain free ROM for eccentrically controlled knee flexion increased from 60.17 to 67.41, p=0.000.  |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| The authors conclude that 1 week of taping distal to the patella significantly decreased pain reported during a self-selected activity and significantly increased quadriceps length. They determined that the quadriceps strengthening group reported significantly less pain with going up or down stairs, during a self-selected activity, quadriceps strength as measured by the dynamometer, and pain free range of motion during eccentric lowering. Quadriceps stretching was found to lead to decreased pain going down stairs, increased quadriceps torque at 60 degrees per second, quadriceps length, and pain free ROM during the step down test. The authors concluded that the strength improvement noted might be due more to improved motor control/motor programming as opposed to hypertrophy or other physiologic adaptations. The authors concluded that both quadriceps stretching and strengthening were more effective individually in managing PFPS symptoms than taping inferior to the patella. Combining all three treatment modalities was very effective in significantly decreasing all pain scores and leading to improved quadriceps length, strength, and pain free ROM. The authors state that while they are surprised by the improvement noted in only 2 weeks, it is important to continue to address other issues that may be contributing to symptoms. The authors also noted that when all three modalities were combined, an adherence rate of roughly 70% was noted, meaning that most stretches/strengthening exercises were performed twice daily as opposed to three times daily. The authors were surprised by the minimal response to patellar taping, as they claim these results to be different than their experience. They concluded that taping benefit could be linked to combining it to other modalities or in select patient populations.  |
| **Critical Appraisal** |
| **Validity**[Methodology, rigour, selection, sources of bias, quality score on methodology quality rating scale (indicate the quality assessment tool used and the maximum possible score on that scale, e.g., 7/10 on PEDro scale), appropriateness of analytical approach (e.g., adjustments for confounding variables, management of missing data).]Comment on missing information in original paper. |
| PEDro scale – Eligibility criteria defined – Yes Random Allocation – Yes Concealed Allocation – Yes Groups similar at baseline for important prognostic factors – No (pain in down stairs and step down test less in the control group) Blinding of Subjects – No Blinding of therapists administering treatment – Yes Blinding of assessor(s) - Yes Measures of key outcomes for > 85% of the starting sample – Yes. All subjects used in outcome measures received treatment or control – Yes. Reports of between group statistical comparisons reported for at least one key outcome- Yes. Point measures and variability provided for at least one outcome measure – Yes. PEDro scale – 8/10 The authors do not specify how many “knees” they allocate to each of the groups. We could assume that of the 60 total knees included in the study that each group received 15 allocations. However, 19 of the 41 subjects had bilateral pain, which more than likely meant that their knees received similar treatments. This was not specifically discussed in the paper, and would lead to significant issues if a patient received taping on one knee and control on the other for example. No activity level was documented before or during the trial, to provide insight into whether patients were displaying weakness or pain due to overuse or underuse. No landmarks were provided for the quadriceps tightness assessment. Only “heel to buttock distance”. Though they did sufficiently justify their choice of tape measure vs. goniometer in their methods section. No rationale was provided for utilizing an angular velocity of 60 degrees per second for quadriceps strength assessment on the dynamometer. This seems odd as no duration of contraction for the open chain exercises was provided (some studies indicate that the concentric phase of an exercise may be performed for a target of 2-3 seconds). No mention of long-term effects or return to activity are provided, both of which are critical components of a treatment program selection. The concept of the “pain with a self-selected activity” was not well explained, and seemed rather subjectively biased. Most people recall extremely painful activities, yet the scores indicated for this outcome were similar to those measured in the step down/ascending/descending stairs tests. It also seems that this measure changed (though not significantly) in the control group, indicating that it may not be a reliable outcome measure to base the impact of the treatments.  |
| **Interpretation of Results**[Favourable or unfavourable, specific outcomes of interest, size of treatment effect, statistical and clinical significance, minimal clinically important difference. You may calculate effect size or confidence intervals yourself from the data provided in the article.] Describe in your own words what the results mean. |
| This study explored the short-term effects of common physical therapy modalities on PFPS. Classically we think of strength development to occur over the course of weeks and months of progressive resistance training. In this case, participants were given open chain exercises targeting quadriceps strength for one week. No information is provided regarding the activity level of the individuals in this study, but it is likely that pain limited their activity level significantly prior to the start of this study. One of the requirements for inclusion in the study was pain consistent with PFPS for at least 1 month before the study, which is a significant amount of time for individuals to not be active. This could lead to significant atrophy and weakness of lower extremity musculature and explain the significant increase in quadriceps strength measured at one week. Interestingly, the stretching group displayed similar increases in strength and quadriceps flexibility, while also demonstrating significant reductions in pain with going up or down stairs, the step down test, and the pain free ROM with eccentrically controlled knee flexion. Taping seemed to facilitate quadriceps flexibility and pain management with self-selected activities. Effect sizes for outcomes for the strengthening group ranged from minimal to large. Pain going up stairs decreased with an effect size of 0.96, pain going down stairs decreased with an effect size of 0.63, pain with a step down test decreased with an effect size of 0.42, and quadriceps strength increased with an effect size of 0.39. The stretching group displayed minimal effect sizes for strength gains and pain decreases. Pain going up stairs decreased with an effect size of 0.36, pain going down stairs decreased with an effect size of 0.47, pain during a step down test decreased with an effect size of 0.32, and quadriceps strength increased with an effect size of 0.23. I was not able to calculate effect sizes for the pooled results as no standard deviations were provided. No mention of MCID was provided by the authors for this population, and it is unlikely that the results of this study would achieve these levels, as there appeared to be floor effects. Mean pain ratings for many of the scales were between 1-2 out of 10 on the VAS at baseline. Clinically this indicates that in cases of mild-moderate PFPS (mean pain scores of 1-3 on VAS), can be managed quite well with a combination of open chain exercises, quadriceps stretching, and infra-patellar taping in 1-2 weeks. In the first study I reviewed, patients reported VAS scores over 7 for some of these measures. It is difficult to compare these two studies due to the significant difference in reported pain during some of the tests (such as the step down and ascending/descending stairs).  |

**(3) Description and appraisal of (study title) by (authors, Year) (Patellar taping for patellofemoral pain syndrome in adults) (Callaghan MJ, Selfe J., 2012)**

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| **Aim/Objective of the Study/Systematic Review:** |
| This study focused on the long-term effects of peri-patellar taping on PFPS symptoms and function of involved lower extremities.  |
| **Study Design**[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| Cochrane review (Systematic review with meta-analysis). Search strategy – Databases utilized include: “MEDLINE, CINAHL, PEDro, EMBASE, SPORTDiscus, AMER, Cochrane Bone, Joint and Muscle Trauma Group Specialised Register, the Cochrane Central Register of Controlled Trials and reference lists of articles, trial registers, and conference proceedings up until August 2011.Selection Criteria- Randomized controlled trials and quasi-randomized controlled trials that involved using peri-patellar taping to reduce pain and improve function. Only studies with adults aged 18 or older were included. There must be a primary diagnosis of patellofemoral pain syndrome (or a synonym like retropatellar pain, anterior knee pain syndrome, etc.). Trials were excluded if they treated dislocation or fracture of the patella, or other neurological, cardiovascular, or rheumatological conditions. Any study that included taping as a form of treatment was included, so long as it was patellar taping. Studies that compared taping to other interventions of that used multi-factorial interventions and included taping compared to a control were excluded. The authors used a double extraction process to collect data from included studies. Any missing data was sought from the author prior to publication of this article. Mean differences and 95% confidence intervals were collected for continuous data, while risk ratios and 95% confidence intervals were used for “dichotomous outcome measures.”Studies that included outcome measures such as pain, functional questionnaires or assessments, questionnaires regarding activity level, and/or quality of life were considered in this study.  |
| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| Studies took place in Turkey, the US, Australia, or the UK. Two of the included studies were performed on military bases.  |
| **Participants**[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| The pooled sample included N=216 total knees. All subjects met the inclusion criteria for PFPS, which typically includes over 1 month of pain in the anterior knee along with reporting pain in two of the following: “ascending stairs, descending stairs, squatting, demanding physical activity, or extensive duration of sitting.” Patients included in most of the studies had mean symptoms duration of over 1 year. Participants in the studies were not homogenous in male vs. female as one study included 32% males and another included 80% males. Age discrepancy was also noted as one study in a military population included patients with a mean age of just over 18 years old while another study included patients with an average age of over 45 years old. The authors report that 25 studies were not included as no evaluation of symptoms was performed immediately after application of tape. The authors state 7 other studies were excluded as a control group was not present to adequately compare taping intervention with.  |
| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| Control groups in the included studies received: no tape, education, ice, sham taping, or some combination of these. |
| *Experimental* |
| The study by Clark 2000a involved 6 treatments in a 3-month time frame. Tape was applied around the lateral patella surface and directed in a line of pull medially and cephalically. One group received tape, exercise, and education while another group received tape and education. A third group received education and exercise while a control group received only education. The study by Mason 2011 involved taping distal to the patella. This was compared to a group receiving education alone.The study by Tunay et al involved daily treatment for 3 weeks (15 sessions in total) consisting of taping around the patella, ice, and a home exercise program. This was compared to a group that received a home exercise program and ice. The Whittingham 2004 study groups received: patellar taping plus an exercise program, sham patellar taping with an exercise program, or just an exercise program. Exercises included both weight bearing and non-weight bearing lower extremity movements. The Kowall 1996 study used 8 treatment sessions over the course of 4 weeks. One group received typical physical therapy, a home exercise program, and taping. The other group received typical physical therapy and a home exercise program (HEP). The HEP consisted of stretching and strengthening movements targeting the quadriceps.  |
| **Outcome Measures** (Primary and Secondary)[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| Outcome measures included:Visual Analogue Scale for climbing stairs, walking, with activities of daily living, self-selected activity, previous 24-hours, and step-down test. The Functional Index Questionnaire (FIQ) was used in one study.Cincinnati knee activity score was reported in one study. WOMAC score was reported in one study.Additional physical therapy visits or other referrals after the completion of the study were assessed in one study for the following year after the intervention was provided.  |
| **Main Findings**[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided – if you need to calculate these data yourself, put calculations here and add interpretation later, under ‘critical appraisal’ on next page] |
| Search results produced 280 references. Forty-five of which were examined more closely for inclusion/exclusion criteria. 5 studies met the inclusion/exclusion criteria and totalled 216 knees among the studies. These studies showed a high risk of bias as a result of not adequately blinding patients and treatment/assessment staffs. **Taping versus no taping or sham taping**4 studies with a total of 161 participants showed an effect size of -0.15±1 for pain management at the end of treatment. 2 of the above studies did not provide an exercise intervention and included 62 participants. In this subgroup an effect size of -0.10±0.81 was found. This indicates that it is unlikely that the intervention (therapeutic taping) had any effect on the pain levels at the end of treatment. 3 of the above studies explored giving exercises to all participants, totalling 99 participants. An effect size of -0.16±1.5 was found. This indicates that it is unlikely that the intervention (therapeutic taping) had any effect on the pain levels at the end of treatment. In a subgroup without “acute” cases, 2 studies totalling 62 knees found an effect size of -0.1±0.8 when no exercise program was given. In this same subgroup when an exercise program was given (2 studies, 79 knees) an effect size of 0.48±0.7 was found. Individually, of the 5 studies included, only Whittingham 2004, found results that favoured using tape that did not include 0 on a forest plot. Both in acute and total cases, the subtotals included 0 on a forest plot, indicating that it is unlikely that taping had any therapeutic effects. **FIQ** (16 points = no complaints)Whittingham 2004 reported that in a case of 20 participants, the mean difference (in the FIQ) reported was 2.5±0.68 in favour of taping. **Cincinnati Knee Score** (100 points = can participate fully in activities)Tunay 2003 reported a mean difference of 8.1±5.17 in favour of taping for a population of 40 participants. Participants were also given a standard exercise program. **WOMAC** (0-96 scoring scale. 96 = the worst possible problems caused by the condition)Clark 2000a explored both taping only and taping with exercise conditions. In 39 participants in the taping only group the mean difference was 7.10±9.85. Since a higher score means more issues at the end of treatment, this would indicate that taping led to a worse outcome. However, given that 0 is included in the 95% confidence intervals, we assume that this means the treatment had no significant effect on outcome. In a group of 32 participants, the mean difference was 1.5±7.74, in favour of not taping. However, like in the case above since 0 was included in the 95% confidence intervals, we assume no change in outcome as a result of the treatment. **Referrals after treatment during the next year**Clark 2000a found that in a group of 41 patients, there was a slightly higher risk (1.42±1.2) of having more referrals in the next year in individuals that received tape. The group discussed received no exercises along with the taping. **Additional physical therapy in the next year**Clark 2000a found in the group above that there was a slight favouring of tape 0.69 (95% CI 0.19-2.53) for reducing the number of physical therapy visits in the next year in the case of not taping. However, in the plot given, the line intersects 0 in the risk ratio component, indicating that it is unlikely that taping had any effect on the outcome (number of subsequent visits).  |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| The authors concluded that there is a lack of evidence that indicates that taping is an effective intervention to improve function and reduce pain in patients with PFPS. The authors could only identify 5 studies that met their inclusion criteria, which they described as containing heterogeneous populations. Part of this is due to the nature of PFPS being a diagnosis of exclusion rather than a diagnosis of inclusion. Currently there are no consensus outcome measures or special tests to track the progression of treatment in patients with PFPS. The authors concluded that all 5 studies reviewed in this article had high risk of bias. Randomization was not described sufficiently in several; assessors were not blinded in several studies as well. The studies had small sample sizes and did not differentiate between patients with one involved knee or two involved knees. Many studies also looked at co-interventions or multiple modalities to investigate the overall treatment efficacy in managing PFPS. Additionally study populations were heterogeneous in age (which could complicate treatments due to osteoarthritic changes) as well as duration of symptoms (chronic vs. acute). No standardization of taping frequency, duration, or orientation was provided by the authors of the studies reviewed.  |
| **Critical Appraisal** |
| **Validity**[Methodology, rigour, selection, sources of bias, quality score on methodology quality rating scale (indicate the quality assessment tool used and the maximum possible score on that scale, e.g., 7/10 on PEDro scale), appropriateness of analytical approach (e.g., adjustments for confounding variables, management of missing data).]Comment on missing information in original paper. |
| The authors limited their search to quasi-randomized or randomized controlled trials. The authors searched acceptable literature sources and used a dual extraction method. Unpublished literature and references were included in the search strategy. Both included and excluded studies were provided. All included studies contained characteristics of their populations, interventions, etc. Excluded studies included a rationale for why they did not meet the inclusion criteria. The risk of bias was assessed for all studies included in the trial. The high risk of bias was appropriately noted in the discussion section of the paper. Chi-squared testes were used to assess for homogeneity of the patient populations. The authors stated their funding sources and provided rationale for a lack of publication bias on their end.  |
| **Interpretation of Results**[Favourable or unfavourable, specific outcomes of interest, size of treatment effect, statistical and clinical significance, minimal clinically important difference. You may calculate effect size or confidence intervals yourself from the data provided in the article.] Describe in your own words what the results mean. |
| Results of this review did not show any significant to patients with PFPS by adding patellar taping to their treatment program. Effect sizes were only moderately significant for outcome in managing acute cases of pain in conjunction with exercises. Even in this isolated case, the confidence interval contains 0, indicating that the result could be chance and should be interpreted with caution. Taping did not seem to improve function or follow up care required by the patients. From this analysis, while taping does not seem to make things worse, it does not seem to improve outcomes either. It may be more beneficial for the clinician as well as the patient to focus on exercise selection and technique/progression as opposed to applying tape. Effect sizes on pain at the end of the intervention were negligible for using tape individually (-0.15±1) or in combination with exercise (-0.1±0.81) across all of the studies. Exercises in combination with taping showed an effect size of (0.48±0.7) in acute cases. No effect was seen for referral of further treatments or physical therapy, improvement in WOMAC, FIQ, or Cincinnati knee scale scores. Taping did not have any effect on pain at 12-month follow up in the one study that explored this question.  |

**IMPLICATIONS FOR PRACTICE and FUTURE RESEARCH**

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| **Current Implications for practice**The literature reviewed in this critique suggests that an exercise program targeting the lower extremities combined with quadriceps stretching and directed patellar taping is an effective treatment regimen for patellofemoral pain syndrome. A daily home exercise program along with education to avoid painful activities and application of therapeutic patellar taping significantly reduced knee pain in several patient populations. The evidence in the reviewed studies supports a combination of modalities to treat patellofemoral pain syndrome, to be used daily for 2-4 weeks. Exercises targeting the lower extremities were found to be significantly more effective in isolation than taping alone. However, the two modalities combined to be significantly more effective in managing symptoms than separately. Taping is generally taught in continuing education courses and is extremely cheap (usually 1-5 dollars per application). Taping is generally easy to do and takes a few minutes at either the beginning or end of a therapy session. Taping has been postulated to influence neuromuscular firing patterns. However, Kowall et al. found that taping around the patella did not significantly increase the internal extension torque moment produced by the quadriceps compared to not applying tape. Crossley et al. suggest in their systematic review that foot orthotics and standard physical therapy interventions (exercise and pain management) are more effective than placebo. They suggest that patellar mobilizations and taping have minimal evidence to support their inclusion in a therapy regimen. The vastus medialis oblique (VMO) is commonly cited as a muscle that needs both strengthening and “re-training” to manage pain noted by PFPS patients. Crossley et al. advocate for VMO training and biofeedback as effective modalities in pain management. Bolgla et al. reviewed five separate studies that found hip strengthening exercises were effective in managing patellofemoral pain. One study in this review found a large effect size of 0.96, while most were moderate. Bolgla and Loudon found quadriceps directed strengthening exercises to produce clinically significant reductions in pain as well. Loudon et al. utilized stretching of major lower extremity musculature, holding 20 seconds for 3 repetitions. The group also included closed chain exercises such as lunges and leg press to target lower extremity strength. At a conference a therapist suggested that in his experience he had not found many patients that had ever demonstrated less than a 5/5 on quadriceps strength (unless pain limited). Without an isokinetic dynamometer it is difficult to detect differences in quadriceps strength in individuals, even with PFPS. Based on the conclusions of this review, it may be prudent to utilize strengthening and stretching exercises regardless of manual muscle test score. **Current Implications for research**Callagahan et al suggest that future research for patellofemoral pain syndrome would benefit from more standardized outcome measures and inclusion criteria. The existing research has heterogeneous populations and small sample sizes. Additionally no study has compared interventions for individuals with bilateral patellofemoral pain symptoms with interventions for unilateral patellofemoral pain symptoms. Callaghan et al also suggest that blinding of assessors and patients need to be blinded in a more systematic and appropriate fashion. Loudon et al., found that closed-chain exercises were effective in managing pain, though they did not investigate open chain exercises as did Mason et al. Bolgla et al. suggest a lack of high quality evidence in support of patellar taping alone or in conjunction with exercise. Combination treatments such as that presented by Mason et al., but floor effects make these conclusions difficult to generalize. Documenting function prior to treatment and function during and after treatment would provide additional generalizability to this regimen. Furthermore, long-term follow-ups are needed as this study explored pain outcomes only at 2 weeks. |

*Notes on Implications Section*

* *This section synthesizes your comments from the appraisal of your articles, and may mention other related research that you have read or that supports your interpretation and discussion*
* *Comment on whether the intervention is used in practice in your region/country, cost of that treatment, need for education of local therapists/students about this intervention and/or outcome measures used in the CAT*
* *Students may wish/need to discuss implications with clinicians or peers for suggestions -- use the discussion board!*
* *This section should be ¾-1 page*
* *Be sure to address both implications for clinical practice and future research (separately)*

**REFERENCES**

[List all references cited in the CAT]

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| References:Kowall M., Kolk G., Nuber G., Cassisi J., Stern S. Patellar taping in the treatment of patellofemoral pain: A prospective randomized study. (1996) The American Journal of Sports Medicine. 24(1): 61-66Loudon J., Gajewski B., Goist-Foley H., Loudon K. The Effectiveness of Exercise in Treating Patellofemoral-Pain Syndrome. (2004) J. Sport Rehabil. 13:323-342Bolgla L., Boling M. An Update for the Conservative Management of Patellofemoral Pain Syndrome: A systematic review of the literature from 2000 to 2010. (2011) The International Journal of Sports Physical Therapy. 6(2): 112-125Crossley K., Bennell K., Green S., McConnell J. A Systematic review of physical interventions for patellofemoral pain syndrome. (2001) Clinical Journal of Sport Medicine. 11:103-110Callaghan MJ, Selfe J. Patellar taping for patellofemoral pain syndrome in adults. *Cochrane Database of Systematic Reviews* 2012, Issue 4. Art. No.: CD006717. DOI: 10.1002/14651858.CD006717.pub2.Lee J., Hobden E., Stiell I., Wells G. Clinically important change in the Visual Analog Scale after Adequate Pain Control. ACAD EMERG MED. (2003) 10(10): 1128-1130Whittingham M., Palmer S., Macmillan F. Effects of taping on pain and function in patellofemoral pain syndrome: a randomized controlled trial. (2004) JOSPT. 34(9): 504-510Mason M., Keays S., Newcombe P. The effect of taping, quadriceps strengthening and stretching prescribed separately or combined on patellofemoral pain. (2010) Physiother. Res. Int. 16: 109-119 |