Effectiveness of Manual Therapy Combined With Physical Therapy in Treatment of Patellofemoral Pain Syndrome: Systematic Review

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ABSTRACT

Objectives: The purpose of this study was to conduct a review of randomized controlled trials (RCTs) to determine the treatment effectiveness of the combination of manual therapy (MT) with other physical therapy techniques.

Methods: Systematic searches of scientific literature were undertaken on PubMed and the Cochrane Library (2004-2014). The following terms were used: “patellofemoral pain syndrome,” “physical therapy,” “manual therapy,” and “manipulation.” RCTs that studied adults diagnosed with patellofemoral pain syndrome (PFPS) treated by MT and physical therapy approaches were included. The quality of the studies was assessed by the Jadad Scale.

Results: Five RCTs with an acceptable methodological quality (Jadad ≥ 3) were selected. The studies indicated that MT combined with physical therapy has some effect on reducing pain and improving function in PFPS, especially when applied on the full kinetic chain and when strengthening hip and knee muscles.

Conclusions: The different combinations of MT and physical therapy programs analyzed in this review suggest that giving more emphasis to proximal stabilization and full kinetic chain treatments in PFPS will help better alleviation of symptoms. (J Chiropr Med 2017;16:139-146)

Key Indexing Terms: *Patellofemoral Pain Syndrome; Physical Therapy; Manual Therapy; Manipulation*

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is one of the most common disorders of the lower limb. It affects both the general population and highly active groups, such as athletes.¹ It has a higher incidence in women than in men,² especially between 15 and 30 years old,³⁻⁷ and it represents 25% to 40% of all treated disorders in sports medicine.⁸⁻¹³

Patellofemoral pain syndrome often is referred to as patellofemoral chondritis, chondropathy, chondromalacia, anterior knee pain, patellar subluxation, patellar dislocation, or external overpressure syndrome. However, Patellofemoral pain syndrome is different from the patellar chondromalacia. The latter is characterized by a degeneration of hyaline cartilage of the back of the kneecap.¹ Patellofemoral pain syndrome is usually caused by imbalances of the forces that control patellar

movement during knee flexion and extension, in particular when overloading the joint.⁸

Furthermore, there are various physical characteristics related to the development of PFPS, such as femoral anteversion,¹ internal rotation of the femur,¹ patellar malalignment,^{1,11} or patellar hypermobility.^{1,11} Patellofemoral pain syndrome can also be related to genu recurvatum,¹ valgus knee,¹ lateral tibial torsion,¹ quadriceps weakness,^{11,14} and other dysfunctions.^{11,14}

Most authors agree that in the absence of direct trauma, the etiology of pain in PFPS is multifactorial and involves a combination of intrinsic and extrinsic factors. Extrinsic factors include the type of activity, the practice of aggressive and repetitive sport or change in the intensity of a physical activity. Also irregularities in sports activity, environmental conditions, or the surface and equipment used can be considered extrinsic factors.^{1,11} Intrinsic risk factors are related, on one hand, to individual characteristics, such as malalignment of the lower limb or the joint or abnormal stresses on the patella and, on the other hand, to psychological factors, such as high levels of anxiety and fear-avoidance beliefs.^{1,7,8,11}

Patellofemoral pain syndrome is characterized by an unclear retropatellar or anterior pain in absence of other disorders.^{15,16} This pain appears during or after performing physical activities like running, squatting, walking up or down stairs, cycling, or jumping, and it is increased by such activities.^{1,2,4,6-8,17,18}

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Paper submitted July 27, 2016; in revised form September 18, 2016; accepted October 7, 2016.

1556-3707/\$36.00

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<http://dx.doi.org/10.1016/j.jcm.2016.10.003>

People who suffer from PFPS often describe the pain being in the “back” or below or around the kneecap, and it is often hard to localize. Symptoms usually appear gradually and may be bilateral.^{6,8} Inflammation of the knee is not characteristic of PFPS, although patients may report a feeling of stiffness, especially with knee flexion. Crepitation and functional disorders are characteristic of PFPS,^{5,7} but not joint tie-up.^{6,8}

According to the World Confederation for Physical Therapy, physical therapy “provides services to individuals and populations to develop, maintain and restore maximum movement and functional ability throughout the lifespan.”¹⁹ It includes different physical techniques (strengthening exercises, proprioceptive neuromuscular facilitation [PNF], electric stimulation, or manual therapy [MT]). Manual therapy provides a conservative treatment option for PFPS, which consists of different techniques (manipulation, joint mobilization, and soft tissue mobilization), thus achieving pain reduction and improving functionality and mobility of the joint.²⁰ The combination of MT and other physical therapy techniques may enhance such improvements.

The objective of the present study was to perform a systematic review to analyze and compare the scientific evidence supporting the effectiveness of the different combinations of MT with other physical therapy techniques. Moreover, this review aimed to determine the potential effectiveness of these combinations for reducing pain and improving functionality in adults diagnosed with PFPS.

METHODS

Search Strategy

From November to December 2014, systematic searches of scientific literature were undertaken on PubMed and Cochrane Library. The following MeSH terms were used: “patellofemoral pain syndrome,” “physical therapy,” “manual therapy,” and “manipulation.”

Study Selection

Clinical trials were considered if they included adult patients (≥ 18 years old) diagnosed with PFPS by an experienced practitioner based on clinical examination (pain and orthopedic tests) with any level of physical activity, and if they included MT techniques and physical therapy approaches. The search was limited to the period between September 2004 and September 2014 (last 10 years), and only full-text English or Spanish language articles were included.

Studies were excluded if they included animal research, individuals with other disorders, or management approaches involving non-MT or physical therapy techniques.

Data Extraction and Analysis

The selection of studies and data extraction was carried out by 2 reviewers (A.A.G. and M.B.B.). The title, abstract,

and keywords of each article were assessed to determine if they fulfilled the inclusion criteria outlined previously. Studies that met inclusion criteria were included for full-text review. The summary measure was determined by the statistical significance of the mean difference of pain and functionality variables.

The methodological quality of the randomized controlled trials (RCTs) included in the systematic review was assessed using the Jadad Scale to determine the risk of bias in each study. This is a scale containing 3 items describing randomization, blinding, and accountability (dropout and withdrawals). We assigned 1 point if randomization was mentioned and 1 additional point if the method of randomization was appropriate; also, we deducted 1 point if the method of randomization was inappropriate. Regarding blinding, we assigned 1 point if blinding was mentioned and 1 additional point if the method of blinding was appropriate, and again we deducted 1 point if the method of blinding was inappropriate. Finally, we assigned 1 point if the accountability was known; if there were no data, the reason should have been stated. The Jadad Scale ranges from 0 to 5. If the Jadad score was ≥ 3 points, the trial was considered high-quality research, whereas if the Jadad score was ≤ 2 points, the study was considered a low-quality trial.²¹

RESULTS

The search strategy initially identified 277 studies, 223 of which were excluded when limits were applied (clinical trials with humans, full-text English or Spanish language, and last 10 years). The remaining 54 articles were reviewed; of these, 25 were excluded for being duplicated. Therefore, a total of 29 studies were further analyzed and evaluated to determine if they met inclusion criteria.

After this assessment, a total of 24 clinical trials did not meet the criteria already mentioned earlier. Fourteen used another type of treatment, such as electrotherapy, orthotics application, bandage application, or stretching exercises at home. Another 8 were excluded because the patients were not diagnosed with PFPS, and 2 more articles had no relation to the study topic.

Finally, 5 articles met the inclusion criteria and had an adequate methodological quality and were therefore selected for the review and analysis of their results and conclusions. The procedure of the review is summarized in Figure 1.

Methodological Quality of the Studies

The 5 studies obtained an acceptable methodological quality (3/5 and 4/5 on the Jadad Scale). The quality of the each study design was assessed on the basis of parameters such as randomization and study method, type of blinding and its procedure, and tracking of the dropouts (Table 1).

Fig 1. Flow diagram of study selection procedure.

Characteristics of the Studies

The 5 studies involved 239 participants, with age most often ranging between 20 to 40 years. The 5 included studies (Table 2) aimed to assess the effectiveness of a MT treatment in samples of patients suffering from PFPS as summarized next. All of them were prospective RCTs and included a control or placebo group and 1 or more treatment groups (combining MT or manipulation with or in addition

to other conventional physical therapy modalities), with samples ranging from 30 to 74 participants.

Crossley et al²² conducted a 6-week study among men and women with PFPS, dividing participants into 2 groups: a physical therapy group and a placebo group, both of which received treatment once per week. The physical therapy group was treated with a combination of physical therapy techniques, including an MT (mobilization of the

Table 1. Quality Analysis of the Included Studies by the Jadad Quality Scale

Authors	Was the Study Randomized?	Was the Method of Randomization Described and Appropriate?	Was the Study Double-Blind?	Was the Blinding Method Described, and Appropriate?	Was There a Description of Withdrawals and Dropouts?	Total
Crossley et al, 2005 ²²	1	1	1	0	1	4
Avraham et al, 2007 ²³	1	0	0	1	1	3
Moyano et al, 2012 ²⁴	1	1	1	0	1	4
Brantingham et al, 2012 ²⁵	1	1	1	0	1	4
Grindstaff et al, 2012 ²⁶	1	0	0	1	1	3

Table 2. Summary of Characteristics of Included Studies

Study (y)	Study Design	Participants	Intervention Groups	Outcome Measures	Results
Crossley et al, 2005 ²²	RCT Double-blinded	N: 40 G1: 21; G2: 19 Age: <40 y M/F: 13/27	G1: patellar corrective taping, vasti retraining, stretching, isometrics, patella mobilization, home exercises G2: Placebo taping and inoperative ultrasound	Pain: VAS Disability: AKPS Knee motion: PEAK movement analysis system	Baseline: No differences between the 2 groups during walking up and down stairs ($P > .05$). After 6 wk: G1 improved in pain, disability and knee motion ($P < .05$).
Avraham et al, 2007 ²³	RCT Single-blinded	N: 30 Mean age: 35 y M/F	G1: conventional knee program (quadriceps strengthening and electric stimulation) G2: hip program (stretching, hip strengthening, and electric stimulation) G3: combination of both knee and hip programs	Pain: VAS Function: Patellofemoral evaluation test	After 3 wk: The significance of the G2 and G3 were higher than the G1, although found insignificant.
Moyano et al, 2012 ²⁴	RCT Double-blinded	N: 74 G1: 26; G2: 35; G3: 33 Age: 40 y M/F: 40/32	G1: control group; educational intervention G2: knee and hip classic stretching G3: proprioceptive neuromuscular facilitation stretching	Pain: VAS Function: AKPS Knee motion: range of motion (goniometer)	Baseline: no differences ($P > .05$). After 4 mo: both G3 and G2 had significant changes in pain, function, and knee motion ($P < .001$).
Brantingham et al, 2009 ²⁵	RCT Double-blinded	N: 47 G1: 25; G2: 22 Age: 18-45 y M/F: 25/6	G1: local treatment; manipulative therapy, soft tissue treatment, and local knee stretching and strengthening exercises G2: local and full kinetic chain treatment (lumbosacral, sacroiliac and lower-extremity manipulative therapy)	Pain: VAS Function: AKPS Patient satisfaction: PSS	Baseline: no significant differences ($P > .05$). After the sixth treatment: AKPS and VAS—G1 (71.85-81.31 and 2.56-1.56, $P < .05$) and G2 (75.83-81.89, $P < .05$, and 3.06-1.89, $P > .05$). After 2 mo: AKPS and VAS—G1 (71.85-85.08, $P < .05$, and 2.56-1.80, $P > .05$) and G2 (75.83-88.88 and 3.06-1.58, $P < .05$). In PSS, 73% for G1 and 64% for G2.
Grindstaff et al, 2012 ²⁶	RCT Single-blinded	N: 48 G1: 16; G2: 16; G3: 16 Age: 20-30 y	G1: lumbopelvic joint manipulation G2: lumbar passive range of motion G3: prone extension	Load cell QFO BST	No significant differences. The output force and activation decreased at 20, 40, and 60 minutes.

AKPS, Anterior Knee Pain Scale; BST, burst superimposition technique; G1, group 1; G2, group 2; G3, group 3; PSS, Patient Satisfaction Scale; QFO: quadriceps force output; RCT, randomized controlled trial; VAS, visual analog scale.

patella). After 6 weeks, the physical therapy intervention resulted in significantly greater outcomes in knee motion compared with the placebo group, and these changes in knee motion were partly related to improvements in pain (mean changes in visual analog scale of physical therapy group 3.5 ± 1.5 cm vs placebo group 2.0 ± 1.5 cm) and changes in onset timing of the vasti.

Avraham et al²³ developed a 3-week RCT to compare different rehabilitation protocols for PFPS. Participants were allocated into 3 treatment groups: conventional knee rehabilitation program, hip rehabilitation program (which included a MT technique such as stretching), and another group with combined treatment of the 2 previous programs. The intervention program lasted 30 minutes and was performed twice a week. Authors found that all 3 groups had similar efficiency in pain and function ($P < .0001$), with stronger improvements in the groups combining hip strengthening and stretching exercises.

The investigation by Moyano et al²⁴ consisted of a 16-week RCT exploring 3 treatment options in patients suffering from PFPS: PNF (MT), stretching (MT), and a control group. Participants attended 3 sessions of 20 to 60 minutes' duration per week. This study concluded that both classic stretching and PNF lead to an improvement in knee pain, function, and range of motion after 4 months of intervention, although the PNF group had better outcomes than the classic stretching group. Interestingly, after treatment participants had increased function, reduced pain, and an increased range of motion of the knee. Mean changes of Anterior Knee Pain Scale between groups (stretching group vs PNF group vs control group) were -24.05 (95% confidence interval [CI] -30.19 , -17.90), $P \leq .001$; vs -39.03 (95% CI -42.5 , -35.5), $P \leq .001$; vs -0.238 (95% CI -1.2 , 0.726), $P = .621$, respectively. Mean changes of visual analog scale score between groups were 2.10 (95% CI 1.21 , 2.99), $P \leq .001$; vs 5.50 (95% CI 4.98 , 6.01), $P \leq .001$; vs -0.14 (95% CI -0.7 , 0.41), $P = .602$, respectively. Mean changes of knee range of motion between groups were -9.05 (95% CI -13.34 , 4.75), $P \leq .001$; vs -39.33 (95% CI -43.47 , -35.19), $P \leq .001$; vs 1.095 (95% CI -0.329 , 2.52), $P = .124$, respectively.

Brantingham et al²⁵ assessed short-term and mid-term outcomes of 2 different chiropractic interventions. The study included a local treatment group and a full kinetic chain group. Intervention was applied 1 to 3 times per week for 2 to 6 weeks; participants received a total of 6 sessions each. Both interventions improved knee function in both the short-term (immediately after treatment) and mid-term (2 months) follow-ups. In the local treatment group, pain decreased (1.0 cm, $P = .41$) in the short term (post-treatment), whereas in the full kinetic chain group, pain decreased (about 1.5 cm, $P = .21$) at the mid-term follow-up (2 months after treatment).

Grindstaff et al²⁶ aimed to investigate quadriceps activation changes in men and women with PFPS after 3

different lumbopelvic manipulations. For this purpose, participants were allocated into 1 of 3 intervention groups: lumbopelvic joint manipulation group, lumbar passive range of motion, or prone extension. None of the lumbopelvic manipulations was effective in changing quadriceps activation over the course of 1 hour after intervention. There were no significant changes ($P > .05$).

Table 2 shows the main characteristics and results of the included studies.

DISCUSSION

In the present review, all the studies assessed the effectiveness of MT in combination with other physical therapy techniques (strengthening, electric stimulation, taping, aerobic exercise, and home exercise protocols). In relation to the MT techniques used in the selected studies, the following have been applied: manipulative MT, such as high-grade manipulation, and nonmanipulative MT, such as soft tissue and articular techniques.

The overall findings of this review suggest that MT combined with physical therapy techniques has some effect on reducing pain and improving function in PFPS. However, our results suggest that when applied on the full kinetic chain and not only on the knee, better outcomes may be achieved.

Brantingham et al²⁵ have found that full kinetic chain MT (including the lumbosacral, sacroiliac, and all lower extremity joints) combined with therapeutic exercises produces better results on both pain and function than the isolated performance of this treatment on the knee. Although Crossley et al²² have obtained positive results on patients with PFPS when applying combined MT only on the knee, their results indicate greater benefits on knee function than on pain.

Several mechanisms have been reported to improve symptoms in PFPS. Some authors have documented a reduction in distal muscle inhibition²⁷ and an increase in quadriceps muscle strength²⁸ after MT spinal techniques. These changes in quadriceps activation have been associated with symptomatic relief and successful outcomes on patients with PFPS.²⁹

Several investigators have suggested that proximal hip muscle weakness, particularly of the hip abductors and external rotators, may be associated with patellofemoral pain,^{2,30} and Tyler et al³¹ reported that improvements in hip flexor strength and flexibility were associated with symptomatic improvement in patients with PFPS.³¹

The implication of the findings of these studies is that addressing MT combined with physical therapy on the full kinetic chain may be an important element in the successful rehabilitation of patients with PFPS.

Strengthening has been previously reported to relieve pain and improve function in patients with PFPS.³²⁻³⁴ In the

present review, of all the physical therapy techniques that have been combined with MT, strengthening has been the most used. All of the studies include some strengthening modality, such as strengthening exercises of the vasti, gluteal, hip external rotators, or quadriceps.

Authors have stated that the isolated performance of quadriceps strengthening exercises with a weak extensor musculature in PFPS increases the pressure and force on the patellofemoral structures and might irritate them.³⁵ Some of the studies of our review have added exercises for the external rotators and abductor muscles^{23,24} and gluteal muscles²² to their PFPS treatment protocols. In a recent systematic review conducted by Alba-Martín et al,³⁶ the biomechanical influences of these muscles on femur alignment was described. A lack of motor control from the hip external rotators and abductor muscles would increase femur rotation under the patella while standing. This may suggest that giving more emphasis to proximal stabilization in PFPS treatment programs will help better alleviate symptoms. In fact, the results in our review indicate greater improvements in pain relief and knee function when patients performed a combination of hip exercises and quadriceps muscles compared with quadriceps exercises alone.

Our study, however, had several limitations. The first limitation was the dissimilar protocol designs employed in the trials. Another limitation is that it primarily investigated the immediate effects of manipulation techniques. Therefore, further high-quality investigations should be conducted to study mid-term and long-term effects of MT combined with physical therapy in PFPS. Furthermore, this review only includes PubMed and Cochrane Library databases. However, a number of relevant journals are not included in PubMed and may be in other databases, such as CINAHL, MANTIS, and the Index to Chiropractic Literature. This significant limitation must be addressed in future research.

Regarding the use of the Jadad Scale to assess the quality of the trials of this review, despite the concern that this tool may be too simple and short and thus may not provide the most comprehensive measure of methodological quality for physical therapy trials, it has been stated as one of the most commonly used tools for this purpose.³⁷ Furthermore, it has been proposed as a valid tool to be used by researchers to assess study protocols and to perform analysis based on the quality of trials.²¹ It has been tested for reliability in different settings (intraclass correlation coefficient = 0.98),³⁷ and it presented the best validity evidence when compared with other scales.

CONCLUSIONS

The implication of the findings of this literature review is that addressing MT combined with physical therapy on the full kinetic chain may be an important element in the

successful rehabilitation of patients with PFPS. Our results indicate that MT is combined mainly with strengthening. This combination produces greater improvements in pain relief and knee function when applied both on knee and hip muscles.

FUNDING SOURCES AND CONFLICTS OF INTEREST

No funding sources or conflicts of interest were reported for this study.

CONTRIBUTORSHIP INFORMATION

Concept development (provided idea for the research): G.V.E.-L.

Design (planned the methods to generate the results): G.V.E.-L., A.A.-G., M.B.-B.

Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): G.V.E.-L., A.A.-G., M.B.-B.

Data collection/processing (responsible for experiments, patient management, organization, or reporting data): A.A.-G., M.B.-B.

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Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): M.I.

Practical Applications

- Patellofemoral pain syndrome is one of the most common disorders of the lower limb.
- Manual therapy is a treatment option that can alleviate pain and improve function of the knee in this syndrome. Our study examined the effectiveness of the combination of MT with other physical therapy techniques.
- Addressing MT combined with physical therapy on the full kinetic chain may be an important element in the successful rehabilitation of patients with PFPS.
- This review indicated that MT was combined mainly with strengthening. This combination produces greater improvements in pain relief and knee function when applied both on knee and hip muscles.

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