

Clinical Decision-making Considerations for the Integration of Manual Therapy as an Intervention for Patellofemoral Pain

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ABSTRACT

Background and Purpose: Patellofemoral pain syndrome (PFPS) is a common condition seen in the orthopaedic and sports physical therapy settings. Despite the emergence of high-quality evidence and clinical practice guidelines, a substantial percentage of individuals with PFPS have persistent symptoms and functional impairment at long-term follow-up. The purpose of this commentary is to review and discuss current evidence related to manual therapy for PFPS and guide specific prescription decision-making regarding the use of manual therapy in this population. **Methods:** Narrative literature review. **Findings:** While manual therapy is not typically useful in isolation, manual therapy appears to have an additive effect on outcomes when coupled with other interventions. **Clinical Relevance:** Soft tissue and joint mobilization/manipulation can be effective in down regulating pain and nervous system sensitization. Beyond describing current evidence, this article attempts to hasten knowledge translation through offering clinical decision-making considerations. **Conclusion:** Manual therapy can be helpful in decreasing pain and improving self-reported function for individuals with PFPS. Matching the mode of delivery to the patient's specific presentation including modified positions of application may assist in optimizing effects of manual therapy for PFPS.

Key Words: clinical reasoning, manipulation, mobilization, patellofemoral pain syndrome

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is one of the most common conditions of the lower extremity characterized by diffuse anterior retropatellar and/or peripatellar pain, affecting adolescent and young active women more than men.^{1,2} The condition is associated with pain with prolonged sitting and

with functional activities such as squatting, stair negotiation, running, kneeling, and jumping.³ It has been suggested that some individuals with PFPS experience persistence of anterior knee pain for 2 years following initial onset.⁴ Recurrence of PFPS is high, and it was reported that patients with PFPS demonstrate unfavorable outcomes 5 to 8 years following initial onset of symptoms.⁵ The high incidence of the condition coupled with a persistent and recurrent nature suggests further investigation into best practice is warranted.

Though there are many interventions that target PFPS, there is no universally-accepted treatment approach for patients with PFPS. A recently published clinical practice guideline (CPG) on PFPS suggests that effective interventions include exercises targeting the hip and knee, patellar taping, foot orthoses, running gait retraining, manual therapy as an adjunct to treatment, and patient education.⁶ The CPG prioritizes the use of therapeutic exercises combined when necessary with additional interventions to address PFPS. However, selecting appropriate treatment for PFPS can be challenging due to varied response to aforementioned interventions across individuals. While high-quality evidence continues to emerge to guide interventions, in excess of 50% of individuals with PFPS report persistent knee pain at long-term follow up.^{5,7,8} It is possible that the ongoing fair outcomes despite high-quality evidence regarding PFPS could be related to challenges with clinical decision-making and intervention selection.

Four impairment-based classifications of PFPS, based on expert opinion have been proposed: (1) overuse/overload without other impairment, (2) muscle performance deficits, (3) movement coordination deficits, and (4) mobility impairments.⁶ Rarely do patients fit discretely into a single classification, leading to multimodal treatment approaches. The CPG emphasizes that while manual therapy may enhance outcomes for

PFPS, it should not be used as a stand-alone intervention to promote recovery and that it should not take away time from exercise interventions.⁶ The recommendation is supported with Grade A evidence, described as a preponderance of level I and/or level II studies.⁶ However, if mobility deficits are present it stands that restoring joint mobility and range of motion (ROM) should be a priority of treatment, as persistence of mobility deficits could theoretically lead to altered biomechanics, persistence of symptoms, and lack of improvement. Manual therapy can have a positive influence on joint motion, pain and self-reported function in a variety of musculoskeletal conditions⁹ including PFPS.^{10,11} Despite the classification of PFPS with mobility deficits, recommendations and decision-making assistance for implementation of manual therapy for PFPS is limited.

In addition to mobility deficits, increased pain sensitization has been associated with PFPS and may contribute to longevity of symptoms and functional decline. Central sensitization has been recognized in patients with osteoarthritis, suggesting that despite a localized peripheral report of pain, numerous pain mechanisms could be at fault.¹² A recent systematic review demonstrated that patients with PFPS may have local and widespread hyperalgesia compared to healthy controls.¹³ Additionally, PFPS has been correlated to a number of psychological impairments such as higher levels of mental distress, lower levels of self-perceived health, anxiety, depression, catastrophizing, and fear of movement.^{14,15} Bialosky et al suggested that manual therapy modulates pain by initiating a neurophysiological cascade at the peripheral, spinal, and supraspinal levels,⁹ thus reasoning to incorporate manual intervention in patients with PFPS.

While the CPG for PFPS provides a strong recommendation against using manual therapy in isolation, it does not recognize clinical circumstances in which manual therapy may be a preferred intervention, such as in the

presence of mobility deficits or pain sensitization. The purpose of this commentary is to review and discuss current evidence related to manual therapy for PFPS and guide specific prescription decision-making regarding the use of manual therapy in this population.

SOFT TISSUE MOBILIZATION

Authors suggest that tissue restrictions surrounding the knee joint may contribute to altered compressive load at the knee.¹⁶ Piva et al described decreased muscle length or inhibition of the hamstring, gastrocnemius, iliotibial band, and/or quadriceps as factors that can direct or indirectly increase compressive forces at the joint.¹⁷ Soft tissue mobilization (STM) is a commonly used intervention for improving soft tissue restrictions,¹⁸ willingness to move,¹⁹ and muscle activity, all of which may enhance an individual's capacity to perform functional activities without dysfunction. Common STM techniques include myofascial release, trigger point release, and transverse friction. Although there is a paucity of literature describing the use of STM in the management of PFPS, given the common soft tissue mobility restrictions and related impairments associated with PFPS, STM may be a logical and appropriate intervention for the condition.

Current Evidence Related to STM for PFPS

Restrictions in the lateral knee, such as the lateral retinaculum or iliotibial tract, may contribute to excessive lateral loading of the patellofemoral joint (PFJ). van den Dolder et al used transverse friction to the lateral retinaculum as a part of a multimodal manual therapy program for individuals with anterior knee pain.²⁰ This intervention was performed with the patient in supine, both with the knee fully extended and fully flexed for 6 sessions. When compared to the control group, the manual therapy group demonstrated significantly greater improvements in active knee flexion ROM, ability to perform step ups/down, and decreased pain.

In addition to mobility restrictions, muscle inhibition is commonly associated with PFJ dysfunction.²¹ Specifically, literature highlights the contribution of a dysfunctional vastus medialis obliquus (VMO) muscle^{16,21} and its relation to abnormal patellar tracking and resultant PFPS.²² In a double-blind randomized trial, Behrangrad et al compared ischemic compression to the VMO with lumbopelvic manipulation for individuals with PFPS.²³ At each session, ischemic compression was performed 3 times

with a 30-second rest break between applications. The amount of pressure was standardized using a pressure algometer and VAS, aiming to keep pain level at target value of 70/100. While both groups demonstrated significant improvements in pain, function, and pressure pain thresholds, the ischemic compression group attained better outcomes immediately and at follow-up.

Clinical Considerations for STM for PFPS

Clinically, muscle inhibition, pain, and/or muscle stiffness related to PFPS are indications for use of STM. Trigger point release and cross friction massage can be aggressive techniques, which may be appropriate for individuals with a low symptom irritability and a localized location of pain or dysfunction. For individuals with heightened pain, it may be necessary to start with a desensitization technique or gentle effleurage/petrisage to improve tolerance and effectiveness of additional rehabilitative interventions (Figure 1). These gentler techniques help with the down regulation/modulation of pain.^{19,24} In the presence of mobility deficits, STM aimed to improve soft tissue extensibility may be appropriate before strengthening exercises. Incorporating these interventions may allow individuals to improve their motor performance through their new ROM, rather than strengthening muscles in a limited range. Techniques should be modified for patient comfort and, if tolerable, performed at the end limits of their existing ROM. Clinicians may also perform instrument-assisted techniques that can decrease clinician burden and effort.

PATELLAR MOBILIZATION

Similar to STM, PFJ mobilizations may be beneficial as part of a larger comprehensive plan of care.⁶ Joint mobilization performed locally at the PFJ is suggested to assist with mobility and maltracking issues, in addition to pain modulation when combined with therapeutic exercise.^{25,26} As previously stated, individuals with PFPS may present with mobility deficits and peripheral or central sensitization.^{6,13} Recent systematic reviews found joint mobilizations to improve pain and function for individuals with PFPS.^{10,11} One review noted that joint mobilization performed locally at the PFJ can be more effective than lumbar manipulation or soft tissue mobilization.¹⁰ Patellofemoral joint glides can include superior, inferior, lateral, medial, and tilting motions of the patella on the femur.²⁷ Mobilizations can be performed

in various positions, with differing grades of mobilization to target specific interventional goals. While there is some evidence to support the use of joint mobilization to improve outcomes in PFPS, there are also studies suggesting manual therapy is not additive in treatment plans for the condition.^{28,29} In the presence of conflicting evidence, clinicians must rely more heavily on the specific patient needs to inform decision-making.

Current Evidence Related to Patellar Mobilization for PFPS

Few studies have investigated the use of PFJ mobilization for PFPS. Rowlands and Brantingham performed a randomized controlled trial (RCT) to determine the efficacy of PFJ mobilization in the treatment of PFPS.²⁶ An intervention group receiving PFJ mobilization was compared to a group receiving detuned ultrasound. The interventions were performed 8 times within 4 weeks. Participants receiving PFJ mobilizations demonstrated statistically significant differences in all subjective and objective measures compared to the control group. Though PFJ glides were used in isolation, this study demonstrates the benefit of the manual therapy intervention in comparison to a placebo in the management of pain related to PFPS.

As compared to the previous study evaluating PFJ mobilizations in isolation, PFJ mobilizations can be part of a comprehensive treatment plan. In an RCT, Crossley et



Figure 1. Soft tissue mobilization of the quadriceps.

al investigated the use of a comprehensive therapy program of PFJ mobilization with quadriceps strengthening, daily home exercises, and patellar taping in comparison to a placebo, which consisted of taping and sham ultrasound.²⁵ Patellofemoral joint mobilization included mediolateral glides/tilting and was performed for 60 seconds, 3 times. Both groups received treatment for 6 sessions, over 6 weeks. At the end of the study, researchers found significantly greater improvements in pain, self-reported disability, physical impairment, and function for the intervention group as compared to the placebo group. As noted by the outcomes of Crossley et al, when used as part of a comprehensive plan of care, PFJ glides may be beneficial in improving body-structure function, activity, and participation impairments.

Clinical Considerations for Patellar Mobilization for PFPS

Abnormal movement and decreased mobility of the patella on the femur may increase load on the PFJ, potentially leading to increased pain. Patellofemoral joint mobilizations may assist with these stated impairments, and suggestions for mobilization prescription are presented in Table 1. Patellofemoral joint mobilization is typically performed in full knee extension where mobility is most easily assessed. Patellofemoral joint glides can be performed in both open and closed packed positions, from full knee extension to varying degrees of knee flexion, and in both weight-bearing and non-weightbearing positions (Figure 2). Grade I and II joint mobilizations are typically used for pain reduction, whereas grades III and IV are typically used to improve mobility of a hypomobile joint. Grade I-II mobilizations may be useful for individuals with high symptom irritability, decreased willingness to move, and greater pain sensitization.²⁷ In comparison, grade III-IV mobilizations may be used to improve mobility for individuals with altered functional movements and typically less pain irritability. For PFPS, higher grade mobilizations could theoretically decrease load on the PFJ and improve mobility to normalize functional movement.

Similar to STM, mobilizations used to improve mobility should be followed by therapeutic exercise to optimize muscle performance within the new ROM. When individuals are able to perform normal activities but higher-level functional tasks remain difficult, PFJ mobilization may still be relevant with modification. As an example, performing a medial or lateral glide as a patient per-

forms a squat could be useful for impaired patellar tracking related to PFPS. Although manual therapy in isolation is not indicated as recommended by the recent clinical practice guideline,⁶ when combined as part of a comprehensive rehabilitation program, mobilizations may be efficacious.

LUMBOPELVIC THRUST MANIPULATION

A number of studies have examined the effects of lumbopelvic manipulation for patients with PFPS. Joint manipulation has been suggested to affect peripheral and central systems to decrease pain and spasm, enhance descending pain modulation, and improve muscle performance and ROM.⁹ Individuals with PFPS may present with mobility deficits,⁶ widespread hyperalgesia,³⁰ impaired pain modulation,³¹ pain sensitization,¹³ decreased quadriceps activation, and atrophy;⁶ all of which may benefit from the described effects of joint manipulation. Based on available literature, spinal manipulation for PFPS is most commonly used to decrease pain or sensitivity, to increase output of the muscles surrounding the knee and/or hip, and to improve functional outcomes. Despite the theoretical effects of manipulation, recent systematic reviews reported mixed results on the use of spinal manipulation for pain and function related to PFPS.^{10,11}

Current Evidence Related to Lumbopelvic Manipulation for PFPS

A number of studies have considered the efficacy of spinal manipulation for PFPS. Nambi et al suggested that spinal manipulation may be appropriate in reducing pain for individuals with chronic PFPS.³² This RCT divided participants into 3 groups: group 1 received lumbopelvic manipulation and exercise, group 2 received PFJ mobilization and exercise, and group 3 received exercise alone. Manipulation was performed ipsilateral to the painful knee, with a posterior-inferior force delivered through the opposite ilium (Figure 3). Manipulation was performed 3 times per week for 6 weeks. Results demonstrated significantly greater improvement in pain and self-reported functional disability in the lumbopelvic manipulation and patellar mobilization groups. The article suggests that both lumbopelvic manipulation and local PFJ mobilization may modulate pain perception in those with PFPS.

Suter et al found that manipulation decreased muscle inhibition and increased knee extensor torques and muscle activation in individuals with anterior knee pain.³³ Sac-

roiliac joint manipulation was performed in a sidelying position. Quadriceps inhibition, activation, and torque was measured pre- and post-manipulation. Following manipulation, a decrease in muscle inhibition and increases in quadriceps torque and muscle activation were observed. However, while results demonstrated positive effects of manipulation, the lack of a control group limits the generalizability of the findings.

Though the above articles point towards the use of spinal manipulation for PFPS, there is research to suggest it may not be additive. Stakes et al compared PFJ mobilization alone to PFJ mobilization and spinal manipulation via sidelying lumbar thrust technique.³⁴ Pain outcomes were assessed both subjectively with self-reported outcome measures and objectively with pain algometry. Significant improvements in pain outcomes were reported for both groups, with no significant between-group differences. Based on this study, spinal manipulation may not be additive towards a comprehensive treatment plan for PFPS related pain.

Grindstaff et al examined the impact of lumbopelvic joint manipulation on quadriceps activation for individuals with PFPS.³⁵ Manipulation was compared to 2 groups, one receiving passive lumbar flexion/extension ROM for one minute, and the other performing static prone extension on elbows for 3 minutes. The lumbopelvic manipulation was performed on the ipsilateral side of the affected knee (Figure 3). Quadriceps maximum isometric force output and activation was assessed with a load cell and with a burst superimposition technique on a maximal voluntary isometric contraction (MVIC). Researchers found no differences between groups across all time points for quadriceps force output and activation, suggesting quadriceps function may not immediately be altered by lumbopelvic manipulation.

Clinical Considerations for Lumbopelvic Manipulation

Increased pain, heightened sensitivity, and quadriceps inhibition may all be associated with PFPS. Muscle inhibition and pain may lead to excess use of surrounding structures, including the PFJ, resulting in aberrant movement patterns. Spinal manipulation requires a high velocity, low amplitude thrust, requiring clinician experience and comfort with the intervention. As authors suggest, manipulation can be considered for patients with heightened pain responses or for patients with quadriceps inhibition.^{32-34,36} If the goal is to improve muscle output, it

Table 1. Joint Mobilization Prescription Considerations

Indication	Patient Position	Grade	Dosage	Example
Pain	Position of comfort Commonly NWB, open-packed position	Grade I and/or II joint mobilizations	Short duration bouts Rest between bouts	Patient case: 4/10 resting pain, 8/10 pain with stairs, unable to assess full knee ROM due to pain Possible mobilization: patient supine, knee bent on pillow to 20°, 4 x 15" PFJ grade I medial glides, 30" rest between bouts
Mobility deficits	Position of restriction, often end-ranges of available motion Commonly NWB or WB positions, end ranges when tolerated	Grade III and/or IV joint mobilizations	Performed until therapist perceives improvement in tissue resistance	Patient case: 1/10 resting pain, 2/10 pain with stairs, flexion limited to 115° Possible mobilization: knee flexed to 115°, grade IV inferior PFJ glide x 3 min (or when less restriction to glide is noted)
Impaired functional movement	Position of functional restriction Commonly performed in WB positions	Grade III and/or IV joint mobilizations	Can be performed as MWM	Patient case: 0/10 resting pain, 2/10 pain at 75° flexion into deep squat, normal knee ROM Possible mobilization: sustained medial PFJ glide while patient performs squat to make the task pain free. Perform 3 sets x10 repetitions

Abbreviations: MWM, mobilization with movement; NWB, nonweight bearing; PFJ, patellofemoral joint; ROM, range of motion; WB, weight bearing

is suggested that treatment sessions are initiated with thrust manipulation techniques and then followed by quadriceps targeted therapeutic exercise to increase muscle control and strength to capitalize on the newly improved muscle capacity.³⁶ Increasing output of the surrounding musculature could possibly improve strength of surrounding musculature and PFPS symptoms, making manipulation a viable option in managing the condition.

Although the evidence is conflicting, in the presence of pain or arthrogenic muscle inhibition, commonly present in persistent PFPS, manipulation could be incorporated. The manipulation technique and position may be best determined by patient comfort in end range positions, in addition to clinician comfort with specific techniques. Many studies used a supine lumbopelvic manipulation. While neurophysiological effects are possible with this technique, some would argue the segmental level of neurologic involvement (in this case, L2-4) should be targeted to localize a treatment effect. If this is the case, a sidelying lumbar manipulation may be

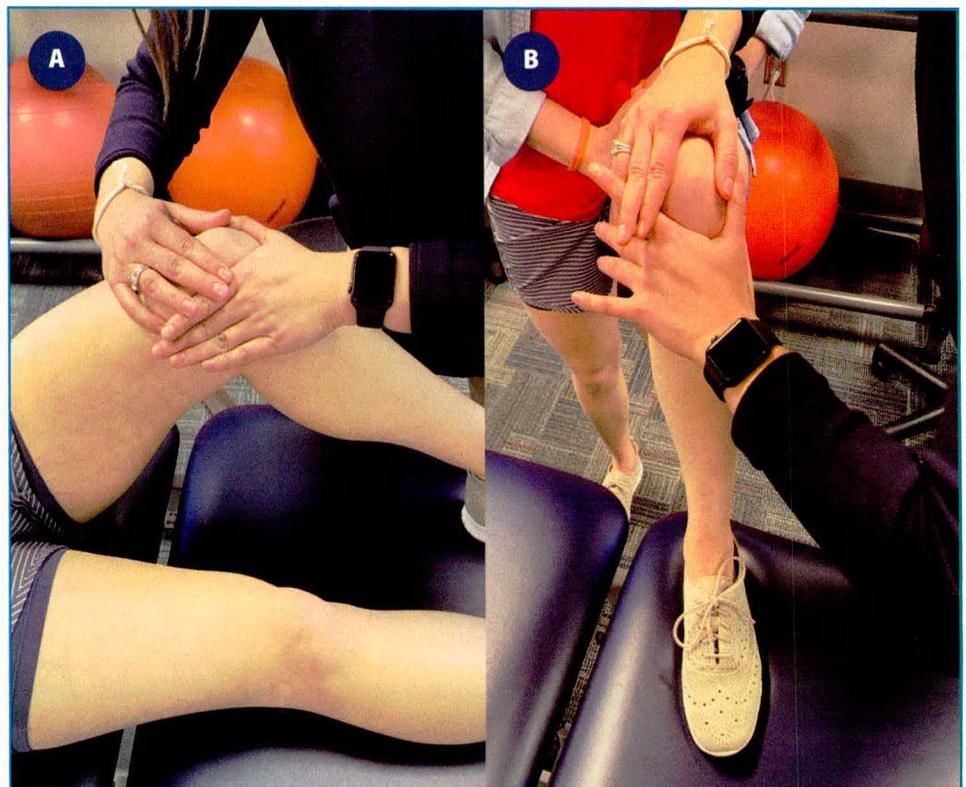


Figure 2. Patellofemoral joint mobilization in A, nonweight-bearing knee flexion. B, weight-bearing knee flexion.

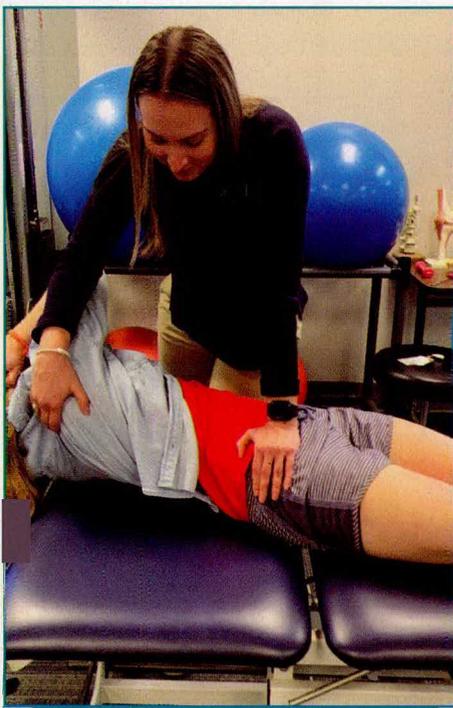


Figure 3. Supine lumbopelvic thrust manipulation.



Figure 4. Sidelying lumbar thrust manipulation.

more appropriate (Figure 4). It is important to note that in some studies, researchers performed the manipulation until cavitation was heard or felt by the clinician or patient for up to 4 times. Several other studies have suggested that cavitation is not necessary for an effective manipulation.^{37,38} Therefore, if spinal manipulation is deemed appropriate for the patient, when performed correctly, the intervention can be completed once per session.

DISCUSSION

Patellofemoral pain syndrome is a common condition frequently associated with substantial self-reported functional disability. Recent high-quality publications have attempted to identify best-practices in evaluation and treatment for PFPS.^{6,39} As is frequently the case, evidence does not easily become implemented into clinical practice, and as such, knowledge translation has become a priority for many researchers. One challenge with knowledge translation in physical therapy particularly is the limited capacity to apply general or wide-ranging conclusions to specific patients, who have vague and complex clinical characteristics, psychosocial, personal, and environmental factors impacting their activity level. Subsequently, attempts to bridge the gap between the laboratory and the clinical settings are necessary.

As noted previously, a recent CPG pro-

vided grade A level evidence recommendation suggesting manual therapy could be used as a useful adjunctive intervention, but should not be used in isolation. While the authors agree that plans of care using single interventions are infrequently effective for complex presentations, the recommendation does highlight important gaps in the evidence. For example, many PFJ mobilizations are performed in the open-packed position of knee extension, where the patella most easily moves through its motion but is less relevant to functional limitations (typically a knee flexion position). Resultantly, it was recently suggested that PFJ mobilizations be matched either to the position of mobility restriction, functional position of pain, or both, to optimize effectiveness of manual therapy.⁴⁰ Additionally, if recommendations suggest which interventions should not be used in isolation rather than which interventions may be useful in some cases, readers are left with fewer options to guide decision-making. Although the recommendation for manual therapy is not strong, using manual therapy for individuals with PFPS and mobility deficits is appropriate.

Evidence suggests that when manual therapy is provided for treating patients with PFPS, local joint mobilization is likely to be most effective.¹⁰ In the presence of mobility deficits, knee joint or soft tissue mobilization would be the most appropriate to potentially enhance the arthrokinematics motion of rel-

evant joint complexes. Based on theoretical mechanisms and available evidence, lumbopelvic manipulation appears most useful for PFPS in the presence of increased pain sensitivity or impaired quadriceps output. In order to enhance clinical utility, manual therapy needs to be prescribed based on the patient's specific presentation, rather than arbitrary incorporation. The suggested method to determine the efficacy of the interventions would be to perform an assessment, provide the intervention, and immediately perform a re-assessment. It is additionally expected that exercise interventions would follow manual therapy interventions to reinforce and optimize improvements in pain and/or mobility.

While a number of biomechanical faults may contribute to the development and persistence of PFPS, there may also be alterations in individuals' psychological variables and central pain processing. It was reported that anxiety, depression, catastrophizing, and fear of movement may be present in persons with PFPS, and may be correlated to increased pain and self-reported disability.¹⁴ Individuals with PFPS have been noted to demonstrate increased temporal summation of pain,³¹ impaired conditioned pain modulation,⁴¹ widespread hyperalgesia,³⁰ somatosensory alterations,⁴² and bilateral tactile sensitivity deficits.⁴³ Manual therapy has been reported to affect all of the noted impairments in pain processing.

Appropriate intervention selection for PFPS can be challenging, and the high rate of chronic PFPS is indicative of the need for ongoing investigation. To best treat these individuals, clinicians need to integrate best available evidence with patient specific decisions. It is the hope of the authors that this paper briefly presents the evidence and possible uses for manual therapy for PFPS, improves clinical decision-making and stimulates additional research for the challenging condition.

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