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CASE REPORT

TIBIOFEMORAL JOINT MOBILIZATION IN THE SUCCESSFUL MANAGEMENT OF PATELLOFEMORAL PAIN SYNDROME: A CASE REPORT

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ABSTRACT

Background and Purpose: Patellofemoral pain syndrome (PFPS) is a common source of anterior knee pain. Controversy exists over the exact clinical findings which define PFPS, thus, diagnosis and management can be challenging for clinicians. There is paucity in the literature concerning joint mobilization as treatment for PFPS, particularly at the tibiofemoral joint, as standard management is currently focused on therapeutic exercise, orthotics, bracing and taping. Therefore, the purpose of this case report is to describe the effects of tibiofemoral joint mobilization in the successful treatment of an individual with chronic PFPS as it relates to pain, function and central processing of pain.

Study Design: Case Report

Case Description: The subject was a 28-year-old female with a two year history of left anterior, inferior patellar knee pain consistent with chronic PFPS. She demonstrated diminished pressure pain threshold (PPT) and allodynia at the anterior knee, suggesting a component of central sensitization to her pain. She met several common diagnostic criteria for PFPS, however, only tibiofemoral anterior-posterior joint mobilization increased her pain. Subsequent treatment sessions (Visits 1-6) consisted of solely joint mobilization supplemented by instruction in a home exercise program (therapeutic exercise and balance training). As outcomes improved, treatment sessions (Visits 7-8) consisted of solely therapeutic exercise and balance training with focus on return to independent pain free functional activity.

Outcomes: Improvements consistent with the minimally clinically important difference were noted on the Kujala Anterior Knee Pain Scale, Numeric Pain Rating Scale, Global Rating of Change (GROC). Scores on the Fear Avoidance-Belief Questionnaire (6/24 to 2/24 PA, 31/42 to 5/42 W), PPT (119 to 386 kPa) and Step Down Test (11 to 40 steps) also demonstrated improvement. At a two month follow up, the subject reported continued improvement in functional activity, 0/10 pain and GROC = +5.

Discussion: This case describes the successful use of tibiofemoral joint mobilization in a subject with chronic PFPS and supports the use of joint mobilization as management in PFPS, particularly in cases where a centrally mediated component of pain may be present.

Level of Evidence: Therapy, Level 5

Keywords: Central sensitization, manual therapy, patellofemoral pain syndrome, pressure pain threshold

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BACKGROUND AND PURPOSE

Patellofemoral pain syndrome (PFPS) is a common source of anterior knee pain which accounts for 25-40 percent of all knee problems seen in sports medicine centers once other potential sources of pain are excluded.[1,2] Direct and indirect medical costs of PFPS were approximately $1500 per subject during 2010 in Scandinavian countries and can be assumed to be even higher in North America.[3,4] PFPS is commonly described as sharp or dull pain in the anterior or retropatellar knee that can be aggravated by sustained sitting ("theater sign"), kneeling, stair ambulation, and squatting.[5] Due to notable design and reporting bias in the studies evaluating the diagnostic accuracy of clinical tests for PFPS, no single test has been identified as particularly useful in the diagnosis of PFPS.[6,7] Clinical diagnosis of PFPS is primarily one of exclusion due to the high variability of risk factors that can produce similar pain and symptoms at the knee (Table 1). While the etiology is unknown and controversy exists over the exact clinical findings which define PFPS,[2,8] it is not surprising that diagnosis and management can be challenging for clinicians.[8] PFPS often becomes a chronic condition that may fail to respond to conservative measures[9] and is more common in the female population.[9,10]

Therapeutic exercise,[11-16] bracing,[17,18] taping,[19,20] and orthotics[21,22] have all shown some level of benefit in the treatment of PFPS; however, there is paucity in the literature regarding the effects of joint mobilization in the treatment of chronic PFPS. As a result, joint mobilization may be less considered in routine physical therapy care in those with chronic PFPS as there is little evidence to support its effectiveness in managing pain and function in this population. Patellar mobilization alone demonstrated no significant improvement in pain [23,24] while manual therapy combined with multimodal treatment or exercise resulted in only fair treatment outcomes in the short term and long term for PFPS.[25] Lumbar manipulation has been shown to be beneficial in a small population of subjects with PFPS for pain reduction, however, more research is needed to explore the efficacy of this treatment approach.[26] There is also conflicting evidence as to whether lumbar manipulation is beneficial in increasing knee extensor strength and force output.[27-29]

PFPS is assumed to be multifactorial in nature; it is necessary to thoroughly examine and broadly hypothesize potential contributing factors and structures for successful management. To the authors' knowledge, only one study has ever researched the effects of joint mobilization directed at the tibiofemoral joint in this subject population; the study's main focus being normalization of biomechanics and movement patterns.[30] Therefore, the purpose of this case report is to describe the effects of tibiofemoral joint mobilization in the successful treatment of an individual with chronic PFPS as it relates to pain, function and central processing of pain.

CASE DESCRIPTION

Subject History and Systems Review

The subject was a 28-year-old female with two year history of left anterior knee pain, significant functional limitations, without significant findings on magnetic resonance imaging (MRI). Intermittent

Table 1. *Differential Diagnoses for Anterior Knee Pain*[69]

Articular Cartilage Injuries	Intra-articular Hip Referral
Pes anserine Bursitis	L2-3 Referral
Hoffa's Disease	Symptomatic Bipartite Patella
Patellar Instability	Chondromalacia Patellae
Osteoarthritis	Intra-articular Loose Bodies
Plical Synovitis	Osteochondritis Dessicans
Quadriceps Tendinopathy	Patellar Tendinopathy
Sindig Larsen-Johansson Disease	Saphenous Neuritis
Bone Tumors	Pre-patellar Bursitis
Iliotibial Band Syndrome	Osgood-Schlatter Disease
VMO Trigger points	Meniscal Tear
Patellofemoral Arthritis	Patella stress fracture
Slipped Capital Femoral Epiphysis	Legg-Calve Perthes Disease

pain began after a fall on her anterior knee two years prior while moving boxes at work, only to be reaggravated by another fall, 20 months later, onto the same location of the knee. After the initial injury, the subject underwent physical therapy consisting of therapeutic exercise, pain education, and a graded motor imagery program. She ultimately failed to show progress and stopped attending physical therapy secondary to external family issues. After the second trauma, her intermittent knee pain progressively worsened and the subject sought medical assistance from her sports medicine physician. She was referred her to outsubject physical therapy for the second time with a diagnosis of PFPS.

At the time of her initial evaluation, the subject presented with an antalgic gait and was wearing a soft neoprene brace on the left knee. The subject's main complaints included diffuse left anterior, inferior patellar-region pain (Figure 1.) during activities of squatting, stair ambulation, prolonged walking and kneeling. Her symptoms were described as sharp with initial activity and a dull ache after prolonged activity which could be further accentuated by cold weather. At times, she felt pain radiating to the posterior knee and anterior lower leg with prolonged exposure to the aforementioned aggravating activities. She reported left leg instability and weakness which she also attributed to pain. Symptoms had progressively worsened until she was ultimately laid-off from work because she was unable to accomplish her job duties of heavy lifting. Her pain was alleviated by medication and frequent sitting breaks. She denied any history of back pain, cancer, cardiovascular involvement, paresthesias, or contralateral lower extremity (LE) symptoms. She had no previous occurrences of anterior knee pain and was very active in sports as a teenager.

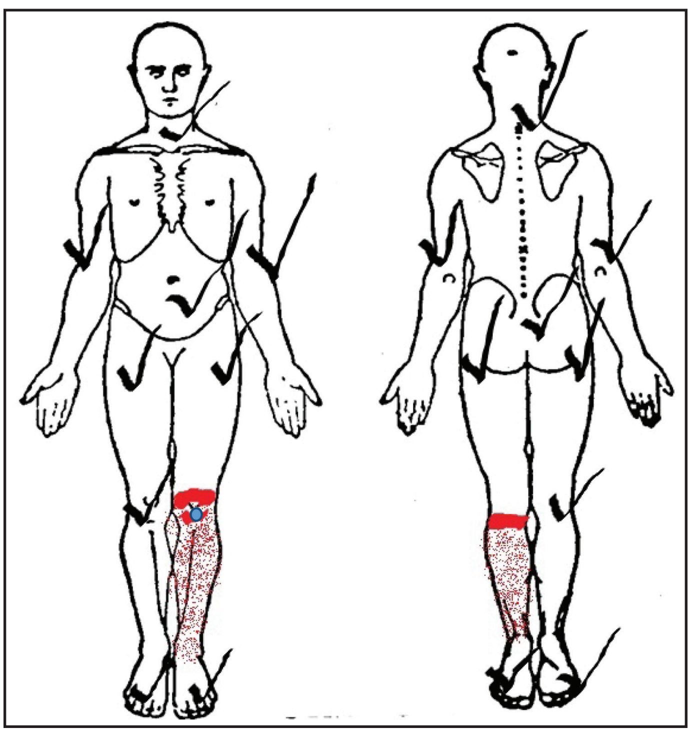

Figure 1. *Pain Diagram of symptoms at initial evaluation + Pressure Pain Threshold testing site (circle).*

Past medical history was significant for the subject being overweight (height 158 cm, weight 66.8 kg, BMI = 26.76 kg/m^2) , an unspecified left LE surgery for "club foot" at three months of age and pelvic inflammatory disease secondary to infected pelvic intrauterine device which was removed one year prior to the initial physical therapy evaluation. The subject was no longer employed, was a single parent and part-time student. The subject's primary goal was to be able to resume her previous functional activities, which included exercising, dancing, and prolonged walking with less pain.

Clinical Impression I

Based upon the results of the subjective examination, signs and symptoms were most consistent with a clinical working diagnosis of chronic PFPS; however, there was concern about some aspects of her clinical presentation. While the subject met common subjective diagnostic criteria for PFPS such as anterior knee pain during squatting, stair ambulation, prolonged walking and kneeling,[6,27] intra-articular tibiofemoral pathology or lumbar/hip referral of symptoms were also considered. It was also hypothesized that the persistent nature of her condition may have resulted in central sensitization of nociceptive mechanisms. With a significant noxious event, repetitive noxious stimuli, and/or the influence of biopsychosocial factors, central processing changes can be demonstrated months past the expected healing time of the injury and resolution of the inflammatory state.[31] These central changes can potentially lead to chronic pain, sensory disturbances and further functional impairments.[31] Subjective findings supporting the possible presence of central sensitization were her complaints of knee instability, chronicity of symptoms, previous failed conservative management, cold thermal hypersensitivity, and her report of several external emotional stressors (recent lay-off and current unemployment, single parent).[31-34] Due to the above subjective findings, it was necessary to not only provide a thorough physical examination locally at the knee, but to also screen out referral of symptoms and objectively examine the subject for signs of central sensitization.

Examination

The subject demonstrated mild forward head posture, an increased thoracic kyphosis and decreased lumbar lordosis. She presented with decreased weight acceptance on the left LE in stance and gait and bilateral decreased hip extension, hip flexion, dorsiflexion, and plantarflexion during gait. She had a compensated positive Trendelenberg sign on left LE, as well as bilateral pes planus, genu valgum and genu recurvatum throughout the stance phase of gait. Cardiopulmonary, integumentary, and neurological screens were negative for pathology.

A lumbar screen consisting of active ROM and overpressure was within normal limits (WNL) in all planes of motion without reproduction of her symptoms. Hip, knee and ankle active and passive ROM measurements were measured (Table 2). Measurements of lower extremity ROM were assessed using a standard goniometer, which has been shown to be reliable and valid.[35]

Manual muscle testing (MMT) was used to assess gross strength of the lower extremity on a 0-5 rating scale with symptom response recorded.[36] MMT has been demonstrated to be a reliable measure of muscle strength.[37]

Palpation revealed pain to dynamic light touch at the anterior knee. The pain was in no specific dermatomal pattern and indicative of allodynia.[38] She demonstrated cutaneous tenderness to both the anterior and inferior patella. She denied specific tenderness to palpation along the tibiofemoral joint line, anterior tibia, popliteal fossa, patellar tendon or triceps surae.

Passive accessory joint mobility testing revealed coxafemoral joint anterior-posterior, tibiofemoral posterior-anterior, patellofemoral (medial, lateral, caudal, cephalic), and talocrural posterior-anterior mobility to be equal bilaterally with no reproduction of pain. Talocrural anterior-posterior mobility was deemed hypomobile bilaterally, with more restriction noted in the left lower extremity and no reproduction of pain. Patellofemoral mobility was examined with the subject in supine, and found to be equal and pain free bilaterally. Interestingly, while only subtle hypomobility was noted bilaterally at the tibiofemoral joint, posterior translation of the left tibia on the femur into approximately fifty percent of the joint resistance reproduced her anterior knee pain

Table 2. *Initial examination findings*

Joint Active/Passive Range of Motion†			
Hip	*Left*	*Right*	*Pain Response*
Flexion	WNL	WNL	--
External Rotation	WNL	WNL	--
Internal Rotation	WNL	WNL	--
Knee			
Flexion	135º/140º	135º/140º	anterior knee
Extension	0º/+5º	0º/+10º	--
Ankle			
Dorsiflexion	-10º/0º	10º/20º	--
Plantarflexion	40º/60º	40º/60º	--
Manual Muscle Testing[36]			
Hip			
Flexion	4/5	5/5	_
Abduction	3+/5	4/5	--
Adduction	4/5	5/5	_
Knee			
Flexion	4/5	5/5	anterior knee
Extension	4/5	5/5	anterior knee

† *tested in supine*
WNL= within normal limits

while anterior translation of the femur on tibia did not. Knee special tests including the Lachman's test, Anterior drawer test (for ACL deficiency), Varus/Valgus stress tests and Mcmurray's test were all negative bilaterally.

Subjective outcomes were measured using the Kujala Anterior Knee pain Scale (Kujala Scale),[39] Numeric Pain Rating Scale (NPRS),[40] Global Rating of Change (GROC),[41] and the Fear Avoidance-Belief Questionnaire (FABQ).[42] The Kujala Scale is a tool used to measure the function and amount of pain that a subject experiences while performing everyday activities. This outcome measure, used in both male and female populations 18-40 years old in an non-specific knee diagnostic,[43] population, has been demonstrated to be both reliable and valid.[44] The thirteen question, self-administered questionnaire, scores from 0-100, with higher scores signifying lower levels of pain during functional activity. [39] An increase of at least 8-10 points on the Kujala scale represents clinically meaningful improvements in the subject's perceived pain during functional activity.[44] The NPRS is an 11 point scale that has shown to be a valid and reliable assessment of self-reported pain in chronic pain populations.[40] The subject reported the NPRS for current, worst and best pain in the last 24 hours, as well as pain after completing each trial of the step down test. A decrease of at least 1.2 points on the NPRS in subjects with PFPS represents clinically meaningful improvement in the subject's perceived level of pain.[45] The GROC score was used to determine the subject's perception of overall improvement. This is a 15 point likert scale ranging from -7 (a very great deal worse) to +7 (A very great deal better). The GROC has high face validity and is used as a reference standard for many other outcome measures[41] and demonstrates correlations to subject satisfaction, other self-reported functional scales, and physical performance testing.[41] An increase in three points is estimated to represent a clinical meaningful improvement using the GROC.[46] The FABQ was used to quantify the level of fear in relationship to pain at work (W) and during physical activity (PA). Higher scores indicate higher levels of fear avoidance-belief and the FABQ demonstrated good reliability in chronic low back pain populations.[42] With modification (substituting "knee" for "back"), the FABQ and has shown to be a strong predictor of pain and functional outcomes in subjects with a patellofemoral diagnosis.[47] While there is no current minimal clinically important difference (MCID) for the FABQ in subjects with PFPS, lower scores indicate a reduction in fear avoidance-beliefs.

Pressure pain threshold (PPT) was assessed utilizing a pressure algometer (Wagner FPX Series, 1 centimeter $[cm]^2$ rubber tip) to determine change in mechanical deep tissue sensitivity pre and post-treatment. The subject was asked to identify the most painful site, which was one cm inferior to the patella which was used as a standard reference at each subsequent session for measurement (Figure 1). PPT was measured as previously described.[44] Specifically, each measure was taken three times with 30 second intervals between each measurement, with the average of the three measures recorded.[48] While not studied specifically in PFPS populations, pressure algometry has shown good reliability in assessing treatment effect in subjects with knee osteoarthritis,[48] myofascial pain,[49] and patellar tendinopathy.[50] There is currently no published MCID for pressure pain threshold in subjects with PFPS. Lowered PPT is a measure of deep tissue hyeralgesia indicating a facilitation of nociceptive pathways[51] and is a common finding in other chronic conditions such as patellar tendinopathy,[50] osteoarthritis of the knee[52,53] and whiplash disorder.[54]

In the Step Down Test, to record functional performance, the subject was instructed to step down from a six-inch step, with the descending limb contacting the floor with the heel and then returning to the step. While the test formally uses an eight- inch step, this subject was tested on a six-inch step secondary to availability in the clinic. The number of repetitions were recorded bilaterally in a 30 second time period along with a subjective report of pain reproduction (using the NPRS) after the completion of the 30 second step down interval. This test has demonstrated high specificity[5] along with good intra-rater reliability[55] for subjects with patellofemoral pain. The subject held onto the railing bilaterally for support and was cued to not push-off through the upper extremities in order to standardize this procedure each time. While an MCID for the step down test does not currently exist to this author's knowledge, the NPRS was used for subjective complaints of pain after the step down test was completed, and as previously mentioned it has a MCID of 1.2 points.[45]

Clinical Impression II

While the subject met common physical diagnostic criteria for PFPS such as hip/quadriceps weakness and diffuse tenderness at the anterior and inferior patella,[6,27] she demonstrated no increase in pain with passive accessory mobility testing of the patellofemoral joint. Due to the history of pain with low load activity (i.e. walking) and absence of localized patellar tendon tenderness, a diagnosis of patellar tendinosis was deemed unlikely. Tibiofemoral anterior-posterior translation did reproduce her pain, thus implicating the tibiofemoral joint as a potential source of pain in this subject. Alternatively, tibiofemoral joint kinematics have been shown to directly affect the patellofemoral joint,[56,57] potentially serving as a contributing source of PFPS. Posterior translation of the tibia on the femur has been shown to increase the posterior orientation of the patellar tendon and patellar flexion, thus increasing patellofemoral compression.[58] As contact of the patella on the femur begins at 20 degrees of knee flexion and increases as the knee is flexed,[56] it can be argued that the tibia on femur posterior translation at 45 degrees of knee flexion would affect the patellofemoral joint resulting in increased anterior knee pain during examination. Due to the presence of anterior knee allodynia and decreased PPT, it was hypothesized that a component of her pain may have also been centrally mediated.[59,60] Due to the above findings, there appeared to be an indication for joint mobilization as it has been shown to modulate the central and peripheral effects of pain and function in chronic pain populations.[61,62]

Intervention

Subsequent treatment sessions focused on (1) pain reduction with an increase in PPTs and (2) correction of biomechanical deficits (strength deficits, joint mobility, and neuromuscular control) in order to normalize functional mobility. Pain reduction and an increase in PPT was achieved by using a Grade III tibiofemoral anterior-posterior (A-P) oscillatory mobilization on the LLE (Figure 2).[63] Grade III accessory joint mobilizations are large amplitude movements performed into firm resistance or up to the limit of available joint range; they are used to treat hypomobility and modulate pain.[63] A Grade III mobilization was warranted in this case as the subject presented with subtle hypomobility at the tibiofemoral joint along with pain at approximately fifty percent of the joint resistance. The subject was supine with knees in approximately 45 degrees of flexion. The subject was treated with two, eight minute bouts of joint mobilizations during visits 1-5. This mobilization dosage is similar to that used in two previous studies of subjects with chronic knee osteoarthritis.[61,62] Supplemental instruction in therapeutic exercise and neuromuscular re-training was used to correct biomechanical impairments and given for her home exercise program (HEP) visits 1-5. On visit six, a Grade III A-P talocrural mobilization was used to target ankle hypomobility bilaterally and instruction in her HEP was again progressed to focus on therapeutic exercise and neuromuscular re-training. The talocrural mobilization was intended to target dorsiflexion limitations found at the initial evaluation as this may have contributed to altered biomechanics and influenced her pain. However, the mobilization resulted in no change in her pain upon functional re-assessment. No joint mobilization was used visits 7-8 and subject was progressed to balance and neuromuscular re-training both in the clinic and at home for HEP.

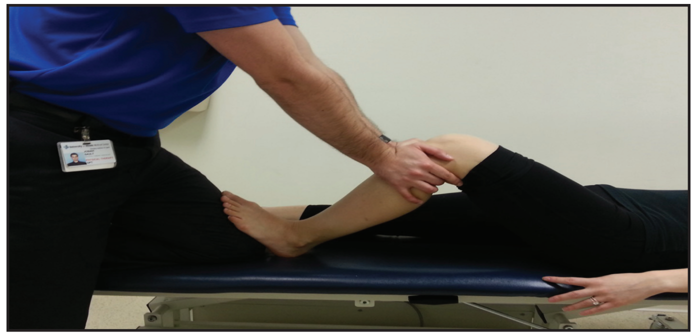

Figure 2. *Grade III tibiofemoral anterior-posterior mobilization.*

OUTCOMES

The subject attended eight physical therapy sessions over the course of eight weeks. Self-reported outcome measures (GROC, NPRS, Kujala scale, FABQ) were recorded at the initial evaluation and prior to intervention at every return appointment (Table 3). PPTs and the Step Down test (number of steps and NPRS after completion of the test) were recorded

Table 3. *Patient-reported Outcome measures*

Outcome Measure	GROC	NPRS	Kujala	FABQ(PA)	FABQ(W)
Initial Evaluation	--	6	53	6/24	31/42
Visit 2	+2	6	53	6/24	13/42
Visit 3	+4	2	63	3/24	12/42
Visit 4	+5	2	53	5/24	3/42
Visit 5	+5	2	65	4/24	5/42
Visit 6	+5	2	68	2/24	5/42
Visit 7	+5	2	67	2/24	5/42
Visit 8	+5	2	67	--	--
Follow up (2 months)	+5	0	--	0/24	6/42

GROC= Global Rating of Change (scale = -7 to +7)
NPRS= Numeric Pain Rating Scale (Current; 0-10)
Kujula= Kujala Anterior Knee Pain Scale; higher score is better
FABQ= Fear Avoidance and Belief Questionnaire (PA) = Physical Activity
FABQ= Fear Avoidance and Belief Questionnaire (W) = Work

pre-joint mobilization treatment and post-joint mobilization treatment for Visits 1-6 and pre-therapeutic exercise and post-therapeutic exercise for Visits 7-9 (Figure 3, 4 and 5.). The subject demonstrated positive post-treatment responses in pain (NPRS), function (Step Down Test), and central processing of pain (PPT). However, post-joint mobilization within session improvements (sessions containing solely joint mobilization) appeared greater in comparison to sessions which contained exercise alone. With the combination of both joint mobilization and therapeutic exercise, this subject demonstrated improvements in PPTs (119 kPa to 386 kPa), steps (11 to 40), FABQ (6/24 to 2/24 PA, 31/42 to 5/42 W), Kujala scores, GROC scores, and NPRS from initial evaluation to discharge, all of which met the MCID. At the conclusion of physical therapy care, the subject demonstrated improvements in her Kujala scores,

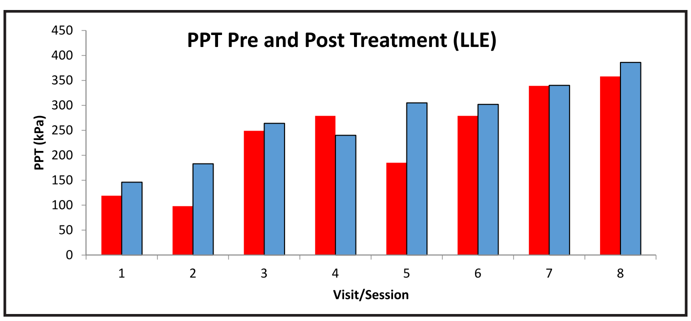

Figure 3. *Pain Pressure Threshold (PPT) in kilopascal (kPa) Pre and Post Treatment Left Lower Extremity (LLE). Red: Pre-Treatment PPT Measurement Blue: Post-Treatment PPT Measurement.*

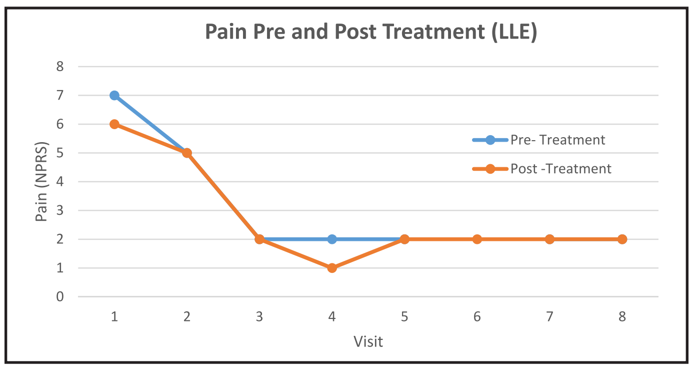

Figure 4. *Pain (Numeric Pain Rating Scale (NPRS)) Pre and Post Treatment in Left Lower Extremity (LLE).*

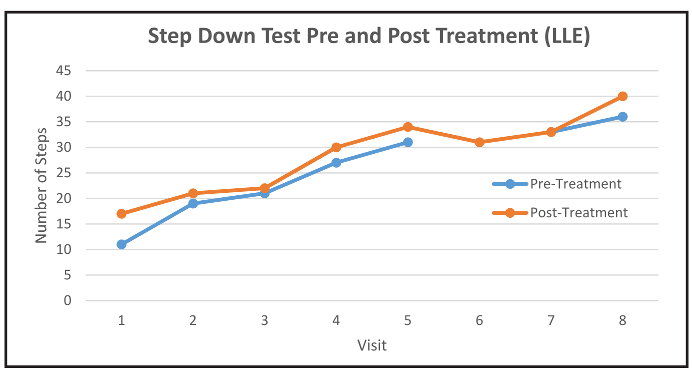

Figure 5. *Step Down Test Pre and Post Treatment in Left Lower Extremity (LLE).*

NPRS, GROC, FABQ, PPTs and step down test when compared to the initial evaluation. At two months follow up, the subject was called and reported she was satisfied with her current state and continued to have improvement in functional activity concerning dancing and walking with a reported NPRS of 0/10, GROC of +5, and FABQ PA of 0/24 and W 6/42.

DISCUSSION

This case describes the successful use of tibiofemoral joint mobilization in a subject with chronic PFPS. The findings in this case highlight the fact that tibiofemoral dysfunction may be a source of PFPS and thorough examination of articulations adjacent to the patellofemoral joint may be critical for best management. The case also supports the notion that joint mobilization can be successfully used for the treatment of chronic LE pain in those with PFPS who may have a component of central sensitization to their pain. Similar results were demonstrated in previous research concerning subjects with chronic knee OA.[61,62]

The current results may be attributed to biomechanical correction, modulation of neurophysiological pain mechanisms and/or a combination of both as the subject's pain presentation was suspected to be multifactorial. Biomechanically, an anterior-posterior mobilization of the tibiofemoral joint can be assumed to have an effect on the motion of the patella as kinematics of the lower extremity have been thought to influence the patellofemoral joint [57] resulting in decreased anterior knee irritation. Targeting structures that needed to be stretched and strengthened (i.e. joint capsule, muscles, adjacent tissues) may have also led to a correction of biomechanical imbalance and decreased anterior knee pain as therapeutic exercise has already been shown to be effective in the treatment of PFPS for pain and function.[11-16] Alternatively, the source of pain may have been the tibiofemoral joint masquerading as patellofemoral joint dysfunction. Of note, factors implicating PFPS do not necessarily require patellofemoral passive accessory joint findings nor exclude tibiofemoral joint impairments.[8,57] While PFPS is thought to be largely due to biomechanical deficits (Table 4), emerging evidence has also suggested a neurophysiological component to PFPS.[64-66] Expanded pain sensitivity both locally and at distal sites[66], have been identified in adolescent females with PFPS using PPT, possibly indicating the presence of central sensitization of nociceptive pathways.[59,60] Similar findings have been found in subjects with chronic knee osteoarthritis and these findings are theorized to have an effect on the subject's

Table 4. *Biomechanical Contributors to PFPS*

Proximal	*Local*	*Distal*
Decreased hip abductor, extensor, external rotator strength	Excessive Q angle	Gastrocnemius flexibility/weakness
Altered gluteus medius and maximus neuromuscular activity	Quadriceps weakness and decreased knee extension strength	Delayed peak rearfoot eversion, greater amounts of rearfoot eversion at heel strike and rearfoot eversion range of motion during running
	Muscle strength imbalances between the vastus medialis and lateralis	Greater midfoot mobility and navicular drop when measured from non-weightbearing to static relaxed stance
	Dysfunction in VMO-VL onset timing and strength	Decreased medial longitudinal arch, measured via navicular height respective to the ground
	Hamstring and quadriceps flexibility/strength deficits	
	Iliotibial band tightness	

subsequent knee stability and function.[53] As the subject met all of the subjective and functional diagnostic requirements of PFPS[5] and other potential pathologies were ruled out through imaging and physical examination, the authors hypothesized that this subject presented with PFPS along with a component of central sensitization. As subjects with anterior knee pain have also been shown to have significant quadriceps inhibition assumed to be secondary to pain,[67] manual therapy interventions have been proposed for improving activation.[28] Since peripheral and central effects on pain have been demonstrated following graded mobilization of the knee,[61,62] the authors hypothesized that local joint mobilization of the tibiofemoral joint may have decreased subject pain and quadriceps inhibition. As therapeutic exercise has already been shown to be effective in the treatment of PFPS for pain and function,[11-16] the authors selected specific exercises for her HEP to maintain within session carryover and increase functional activity.

Regardless of the exact mechanism of our subject's results, improvements in both biomechanical and neurophysiological outcome measures were observed. While within session changes have been shown to lead to between session changes,[68] it has recently been shown that positive within session and between session results are also important for prognostic carryover concerning pain and function.[69] Sessions consisting of joint mobilization appeared to have significant reductions in pain and a greater increase in steps taken during the step down test along with greater change in PPTs when compared to sessions that only included the use of therapeutic exercise (Figure 3, 4 and 5.). Concerning the NPRS, FABQ, and Kujala scores, similar trends in the data applied. While the NPRS and Kujala scores demonstrated improvements in patellofemoral pain and function, the FABQ revealed an improvement in the subject's self-reported fear avoidance over the course of treatment. Her PPT also improved. As increased fear avoidance has been correlated to centrally mediated pain among subjects with chronic pains,[33] the positive improvement both on the FABQ and the PPT score indicate a modulation in the central processing of her pain.

There were several limitations regarding this case report. The findings from a case report cannot be generalized to all subject populations and high quality randomized control trials are needed to examine the purported mechanisms suggested for improvement following the use of joint mobilization in those with chronic PFPS. While the subject was blinded to the PPT algometer readings, she was not blinded to the purpose of recording the data. This could have led to the subject trying to endure more pain in order to please the clinician and achieve better outcomes. However, it should be noted that these positive results demonstrated carry-over throughout the eight treatment sessions. The subject was informed that the data concerning the case would be submitted for publication.

CONCLUSION

This case report highlights the successful management of an individual with chronic PFPS using mobilization of the tibiofemoral joint supplemented by a therapeutic home exercise program. While there is paucity in the literature concerning the use of tibiofemoral joint mobilization for chronic PFPS, it should be considered as this case highlights the positive effects on both immediate and long term pain, function, and central processing of pain in a case where a central mediated component of pain may be present.

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