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Effectiveness of Physical Therapy Intervention to the Proximal Tibiofibular Joint for a Marathon Runner with Lateral Knee Pain

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Abstract

Background & Purpose: The knee is the most common site of injury in running athletes. An often overlooked contributor to lateral knee pain is the Proximal Tibiofibular Joint (PTFJ). There is a paucity of literature regarding physical therapy management of those with PTFJ dysfunction. The purpose of this case study is to report the physical therapy management for a patient with lateral knee pain.

Case Description: A 26-year-old female marathon runner presented with right lateral knee pain after slipping on ice while running. The patient presented with difficulty running, squatting, descending stairs, sitting greater than 30 minutes, and walking on uneven surfaces. After two weeks of rest, foam rolling, and hip abductor strengthening, the patient had reduced pain with all functional activities, but was still unable to run without pain. Oscillatory Grade III anterior to posterior mobilizations were performed to the PTFJ. Following this addition to her plan of care, the patient was able to return to running pain free.

Discussion: When examining a patient with lateral knee pain, the PTFJ should be considered in the differential diagnosis as a source of pain and the mechanisms regarding manual therapy-induced hypoalgesia.

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Background and Purpose

The knee is the most common site of injury in running athletes, with a prevalence of 42.1% [1]. It consists of three primary joint articulations including the tibial femoral, patellofemoral, and the proximal tibiofibular joint. Most running injures can be categorized as overuse injuries [1]. Runners that present with lateral knee pain are typically diagnosed with iliotibial band friction syndrome or lateral meniscal injuries; with less common injuries including a lateral plica, fabella syndrome, biceps femoris tendinopathy, or popliteus tendinopathy [1-5].

An often overlooked contributor to lateral knee pain is the Proximal Tibiofibular Joint (PTFJ). The PTFJ articulates with the lateral tibia stabilized laterally by the fibular collateral ligament, anteriorly by the anterior ligament of the fibular head, and posteriorly by the posterior ligament of the fibular head. The only muscular attachment is the biceps femoris. Dysfunction of the PTFJ can present as a hypomobility, subluxation, hypermobility, or dislocation [5-10]. There have been reports of hypermobility of the PTFJ and/or hypomobility of the distal tibiofibular joint that may contribute to lateral knee pain [5-10]. Proximal tibiofibular dislocations are classified based on the direction of the positional fault including anterolateral, posterior medial, and superior [11]. Proximal tibiofibular hypermobility has been described in the literature with several case studies. Horst and LaPrade [7] described the case of a 16-year-old female with a 6 month history of lateral knee hypermobility during squatting activities after falling on a flexed knee during volleyball. Horst and LaPrade [7] additionally reported on a 45-year-old female with a 3 month history of lateral knee pain after being thrown from a horse and landing with her knee flexed underneath her. Another case study by Morrison et al. [9], described mechanisms of injury contributing to PTFJ hypermobility as a twisting, hyperextension (contact and non-contact), an anterior blow to a flexed knee, and a valgus force on a flexed knee. Typical surgical management of a dislocated PTFJ includes Open Reduction Internal Fixation (ORIF), resection of fibula head, arthrodesis, and reconstruction of the PTFJ [6-9,11]. Surgical management of instability and some cases of subluxations include a stabilization

Table 1: Interventions provided.

Interventions Provided	Visit 1	Visit 2	Visit 3	Visit 4
Bridges on exercise ball, side planks, hamstring stretch	X			
Exercise ball core strengthening, BOSU squats and lunges, and single leg proprioceptive training		X		
Grade III oscillatory AP glide of the PTFJ			X	X

Figure 1: The patient is in a supine position with the right knee flexed. The treating therapist's left thenar eminence is on the right fibula head with the therapist's right hand stabilizing the tibia. An anterior-lateral to posterior-medial force was applied with an oscillatory Grade III mobilization.

Figure 2: The patient is in a prone position with the right knee flexed to 90°. The femur is internally rotated to bias a contraction of the lateral hamstrings. An isometric contraction is performed for 5 seconds with the therapist stabilizing the patient at the pelvis and the ankle. The patient relaxes for 5 seconds and repeats this 3 times.

ligamentoplasty, which involves use of a gracilis, semitendinosus, or biceps femoris tendon graft to reinforce the superior, medial, and inferior tibiofibular ligaments [5-9,11]. Conservative management of PTFJ hypermobility includes physical therapy for strengthening and stability exercises, bracing, and activity modification [9]. In cases of subluxation, a manual technique of the PTFJ includes a posterior or anterior mobilization depending on direction of the positional fault [3]. It is theorized that a positional fault results in abnormal force attenuation through a joint thus resulting in pain or subsequent tissue breakdown due to abnormal stress placed on the joint and or surrounding tissues [12].

The purpose of this case study is to present the effect of a posterior mobilization of a hypothesized anteriorly subluxed fibula at the PTFJ in a runner with persistent lateral knee pain. Partly demonstrated by the lack of literature, the PTFJ is often overlooked as a mechanism of lateral knee pain.

Case Description

The patient was a 26-year-old female doctoral student, with a normal body habitus, that was referred to physical therapy from a sports medicine physician. The patient reported an onset of right lateral knee pain after slipping on a patch of ice when running 12 days before the physical therapy evaluation. She did not fall during the event, but states she felt her right leg abduct and extend in an effort to prevent a loss of balance. The patient dismissed her right knee pain after the slip and continued to finish her run however, later that day after sitting down in a chair for lunch; she stood up and experienced sharp, severe right (R) knee pain. She noticed swelling in her right knee three to four days after the slip, which eventually subsided over the next day. The patient denied any buckling, clicking, popping, or locking in her knee. At that time of injury, she was running 20 miles as part of her training for a marathon the following weekend but was unable to return to training, running about 4 days a week, after the injury. The patient had run several marathons and half marathons prior to this injury occurring without previous lower extremity injuries.

The patient described her right lateral knee pain as a constant, dull ache, rating it a 1/10 on the NRPS (Numerical Rating Pain Scale) and a 4/10 with activity. At the time of initial evaluation, her chief functional limitations and aggravating factors were pain with sitting over 30 minutes, squatting, descending stairs, and having to walk on icy sidewalks. She had not attempted running at this point due to fear of further injury. Her alleviating factors included ibuprofen and ice. She rated a 76% (61/80) on the Lower Extremity Functional Scale (LEFS).

Her past medical history was unremarkable. She was evaluated by a sports medicine physician prior to physical therapy that administered a patellofemoral brace and scheduled a Magnetic Resonance Image (MRI) the following week after her physical therapy evaluation. No further treatment was provided by the physician. The patient sought no other medical intervention. The main goal the patient sought from physical therapy was to return to running marathons scheduled throughout the upcoming spring.

Examination

The patient's static posture was assessed in standing. She demonstrated symmetrical genu recurvatum. Functional movements assessed included single leg squats, single leg balance, and visual observation of the patient running on a treadmill. The patient was able to perform single leg squats pain free with equal repetitions bilaterally. She exhibited good eccentric control symmetrically without aberrant mechanics. The patient's balance and proprioception was assessed with single leg stance balancing. She was able to maintain balance for greater than 30 seconds bilaterally.

Strength, range of motion, and joint mobility

The patient's knee range of motion (ROM) was assessed with the patient in supine. Both active and passive ROM was full without limitations, and pain free for bilateral lower extremities. Muscle performance was assessed employing manual muscle tests described by Kendall and Kendall [13]. The patient demonstrated 5/5 ankle, knee, and hip flexor/extensor strength, and 4/5 hip abductor strength bilaterally. Hamstring muscle length was assessed using the 90/90 test which indicated decreased flexibility of bilateral hamstrings at 155°. Flexibility of her iliotibial band was assessed utilizing the Modified Ober test. She measured 2 inches greater in distance from the table on the right knee compared to the left. Joint mobility of the patella, patellar tendon, and tibiofemoral joint were determined normal, symmetrical, and pain free. Lumbar and hip screening were negative did not reproduce patient's described pain.

Palpation and special tests

The patient's knee structures were palpated including the joint line, patellar tendon, hamstring insertions, quadriceps tendon, lateral patellofemoral ligament, iliotibial band, infrapatellar fat pads, Hoffman's bursa, and the iliotibial bursa. The only significant finding was minimal tenderness to the iliotibial bursa. She did not exhibit joint line tenderness medially or laterally (Sens 0.76, Spec 0.77, +LR 3.3, -LR 0.31) [14]. Ligamentous special tests were all negative and included the following: Lachman's (Sens 0.85, Spec 0.94, +LR 1.2, -LR 0.20), Varus stress (Sens 0.91, Spec 0.49), Valgus stress (Sens 0.91, Spec 0.49, +LR 2.3, -LR 0.30), and posterior drawer. Her meniscus was assessed with McMurray's (Sens 0.55, Spec 0.77, +LR 2.4, -LR 0.58), Apley's (Sens 0.22, Spec 0.88, +LR 1.8, -LR 0.89), and overpressure into knee flexion and extension (Sens 0.77, Spec 0.41) [14]. A slight increase in her described pain was noted with knee flexion and external rotation of the tibia during the McMurray's test.

Clinical Impression

Despite her inability to return to running immediately, the patient's chief functional loss was negotiating stairs. Differential diagnosis after subjective history included a lateral meniscal lesion or iliotibial band syndrome due to her mechanism of injury, delay of swelling, and self-reported inability to perform dynamic knee flexion activities due to pain (stairs and squatting if she had been in static standing or sitting more than 30 minutes; and ambulating on uneven surfaces). Based on this information, her examination should include special tests McMurray's and Ober's, and palpation to lateral joint line and length of the Iliotibial Band (ITB) to differentiate between the aforementioned diagnoses.

Upon completion of the examination, the differential diagnosis included Iliotibial Band Friction Syndrome (ITBFS) or less likely a possible lateral meniscal lesion due to her mechanism of injury and slight pain with McMurray's [2,3]. Ligamentous injuries were ruled out from the comprehensive special test examination and after subjective history. The significant examination findings were hip abductor weakness, decreased mobility of her right ITB, and tenderness to palpation along her iliotibial bursa. The initial impression after her subjective history changed following the objective examination to an ITBFS bias due to lack of concurrent positive findings for a meniscal lesion. Her plan of care at the time was focused on soft tissue mobilization of her ITB as well as closed chain gluteus maximus and minimus strengthening.

Intervention

The initial intervention included patient education about active rest incorporating alternatives to distance running for cardiovascular fitness including the elliptical trainer, swimming or stationary bicycle as long as her knee pain was not present. The patient's home exercise program consisted of single leg bridges on an exercise ball with two sets of 10 repetitions, once a day; side planks and a hamstring stretch with three sets of 30 second holds; and to continue rolling her ITB with a foam roll for 2-3 minutes; all consistent with gluteus maximus and medius strengthening and neuromuscular re-education along with ITB tissue mobility as current standard of ITB treatment [2,4,15-17]. She was encouraged to maintain these exercises without progression until follow up, but was reassured to continue her regular strengthening routine exercises if they were pain free.

Second visit

The patient was seen two weeks after the initial evaluation to allow for establishment of her home exercise program and tissue healing from activity modifications. During the second visit, the results of her MRI were released which ruled out a meniscal tear. The MRI did reveal early chondromalacia of the medial patellar facet which did not correlate clinically with the patient's reported lateral knee pain. A video running analysis was performed that did not reveal any significant aberrant mechanics. Interestingly, the patient was able to run on the treadmill for 20 minutes at an incline of 2% grade; however running without an incline reproduced her right knee pain during loading response and mid-stance after running only two minutes.

Third visit – 4 weeks following initial visit

The patient had resumed running outside every other day using pain as a guide. She was able to tolerate approximately 30 minutes of running before developing lateral knee stiffness that required 2-3 days' rest before subsiding. Despite objectively demonstrating improved hip abductor strength (5/5) bilaterally, the patient was not improving as expected with treatments of ITBFS after a month, thus prompting a thorough re-evaluation. Prior to her re-evaluation, a literature review of lateral knee pain was conducted resulting in the PTFJ being considered as a possible source of her symptoms [2,3,18,19]. Upon palpation, the patient's right fibula head appeared to be positioned anteriorly in comparison to contralateral side. Mobility of the right PTFJ was assessed with posterior and anterior glides while in the hook lying position (Figure 1). An anterior to posterior (AP) force applied by the therapist reproduced her symptoms of right lateral knee pain. Based on these findings, the therapist proposed the patient was presenting with an apparent positional fault of an anteriorly displaced fibular head. An AP oscillatory Grade III mobilization was performed, for five minutes in five sets of 60 seconds with the patient in a hook lying position with care not exceed pain greater than 5/10 [3]. Using running on the treadmill at a 2% grade as her concordant sign, her right knee pain before mobilization was a 6/10 after running 2 minutes, and 2/10 post mobilization after running for two minutes. A contract/relax PNF technique was used to the lateral hamstring to reinforce the AP mobilization applied to the fibula (Figure 2) [20].

Fourth visit – 5 weeks following initial visit

During the past week, the patient had returned to her running program of 60 minutes a day with minimal occurrences of right knee pain. She reported pain 2/10 with running on the treadmill at the beginning of the visit, and a 0/10 after another anterior to posterior grade III mobilization was performed as described previously.

Fifth and final visit – 7 weeks following initial visit

The patient had come into the clinic and reported she had run a marathon the weekend before this last visit. She was planning on running a half marathon, but decided to try for the full marathon and had achieved a personal best. She did not experience any of her right lateral knee pain during the race. She also did not experience any of her pain with the anterior-posterior glide of the right proximal fibula. Her LEFS was measured at 80/80 compared to 61/80 upon her initial evaluation and she rated her improvement as +7 (very great deal better) on the Global Rating of Change scale.

Long term follow-up

The patient was followed up three months after discharge *via* phone. The patient reported completing four half marathons without any right lateral knee pain. She was planning on running a marathon in the fall. Training, sport activities, and functional mobility had all been pain free.

Discussion

Currently, there is not a consensus of the arthrokinematics of the PTFJ, particularly in relation to concurrent motion at the foot and ankle. The PTFJ has been described as a near plane joint with slight convexity [21]. Beazell et al. [3], proposes the fibula glides in an anterior direction with external rotation during ankle dorsiflexion. In addition, Soavi et al. [22], also reports an anterolateral displacement during dorsiflexion in the cadaver study in an open kinetic chain system. Alternatively, Kapandji describes the fibula medially rotating during dorsiflexion allowing for a posterior-medial glide [23]. The discrepancy between closed and open kinetic chain motion of the PTFJ reported in literature may be contributing to the lack of consensus that would warrant further research to establish normative values at this joint.

A study performed by Scott et al. [24], focuses on the torsional movement of the PTFJ during various angles of knee flexion. This study reports the fibula translating anteriorly with an externally rotated tibia and the fibula translating posteriorly with an internally rotated tibia in a closed kinetic chain system [24]. Neumann [25] described a fixed foot with forefoot supination and rearfoot pronation having relative internal rotation of the tibia. Gait mechanics of the tibia are described as internally rotating upon loading response and the talus is everting with a supinated foot during loading response as well [25].

Theoretically, at the moment of her injury, the patient's knee was extended leading to an externally rotated tibia and an anteriorly translated fibula. Following this injury, the patient was unable to tolerate running unless it was on a treadmill with 2% incline. The patient would have most pain during the loading response and mid-stance phase of her running gait. Based on the previously proposed mechanics, theory suggests her knee would have been more flexed than on a flat surface with relative tibial internal rotation upon loading response with a supinated foot possibly leading to a more posterior glide of the fibula.

The intervention of the posterior glide applied to the PTFJ may have yielded a similar effect as evidence by her similar reduction in pain with running. The analgesic effects of the manual therapy intervention may have provided short term pain relief for the patient, however manual therapies are suggested to have the capability to restore normal joint forces [3,26]. Once the normal joint forces of the PTFJ were possibly restored after two treatments with the fibular joint mobilization, the patient was able to return to running on flat surfaces with normalized joint arthrokinematics of all the joints that affect the PTFJ. The patient did have relief of symptoms before the accepted 6-8 weeks of tissue healing time. However, since the interventions were not initially focused on the PTFJ, a definitive cause and effect association cannot be concluded with the interventions provided and the resolution of the patient's symptoms (Table 1).

The results of this case report should be applied with caution due to multiple limitations. This is a single subject case without substantial literature on subject presentation or interventions of similar cases with different patient populations. The examination and manual technique employed in this study have also not been well validated or demonstrated adequate reliability warranting further research of the assessment and treatment of the PTFJ.

Summary

The PTFJ should be considered in the initial examination as a source of pain when examining a patient with lateral knee pain. This case presentation reports a patient with lateral knee pain who responded successfully to mobilization of the PTFJ. A treating clinician should be aware of manual techniques that can be utilized to treat this condition. Other considerations regarding the proximal tibiofibular joint include examination of distal PTFJ mobility as well as rearfoot and forefoot static and dynamic posturing. Further research is needed to further clarify the arthrokinematics of the PTFJ particularly in closed kinetic chain and identify characteristics of patients with lateral knee pain who may respond positively to mobilization of the PTFJ.

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