



## **PROLOTHERAPY COMBINED WITH PHYSICAL THERAPY IN A RECREATIONALLY ACTIVE MIDDLE-AGED MAN WITH CHONDROMALACIA PATELLA**

**Kristin Bowne<sup>1</sup>,**

**Joshua Prall<sup>2</sup>,**

**Michael Ross<sup>3i</sup>**

<sup>1</sup>PT, DPT;

Kristin Bowne Physical Therapy,

Scotts Valley, CA, USA

<sup>2</sup>PT, EdD;

University of Scranton,

Scranton, PA, USA

<sup>3</sup>PT, DHSc;

Daemen College,

Amherst, NY, USA

### **Abstract:**

The purpose of this case report is to describe the use of physical therapy combined with prolotherapy in a recreationally active, middle-aged man with knee pain and chondromalacia patella. The patient was a 50 year-old male triathlete presenting with a chief complaint of persistent left knee stiffness and anterolateral knee pain. The patient's symptoms began insidiously 9 months prior after an increase in his triathlon training activities. His knee pain progressed to the point that he could not perform any weight bearing exercise without significant discomfort. Previous treatments included management by a physical therapist, as well as corticosteroid and hyaluronic acid injections. Although these previous treatments provided minimal benefit, the patient sought further management by another physical therapist. Magnetic resonance imaging findings revealed moderate to severe chondromalacia at the lateral patellar facet. In addition to management by a physical therapist, the patient received a series of three prolotherapy injections to the knee. Physical therapy management consisted of manual therapy for the lower quarter, targeted therapeutic exercise to address strength deficits of the quadriceps and hamstring muscles, and a gradual return to weight bearing exercise and functional activity. At 4 months following the physical therapy and prolotherapy injections, the patient reported no pain during daily activities. Additionally, he had

<sup>i</sup> Correspondence: email Affiliation and mailing address: Department of Physical Therapy, Daemen College, 4380 Main St, Amherst NY, 14226, Email: [mross@daemen.edu](mailto:mross@daemen.edu)

returned to swimming, cycling, unlimited walking and hiking on various surfaces, and agility drills. In patients with knee pain and chondromalacia patella, especially those who have not responded to prior interventions, physical therapy combined with prolotherapy may serve as a treatment option.

**Keywords:** prolotherapy, physical therapy, chondromalacia patella

## 1. Introduction

Chondromalacia patella is defined as the softening, thinning, and degradation of articular cartilage due to repeated stress to the articular surface.<sup>1</sup> The breakdown of the articular cartilage within the patellofemoral and tibiofemoral joints leads to osteoarthritis of the knee.<sup>2-3</sup> The etiology of knee osteoarthritis is often multi-factorial and it is estimated that 10 to 15% of individuals who are 50 years of age will have knee osteoarthritis; this increases to 34% in individuals who are 65 years of age.<sup>2-3</sup> Anti-inflammatory medications, corticosteroid injections, activity modification, and physical therapy form the cornerstone of conservative management for chondromalacia patella.<sup>1</sup> Despite the reported benefits for chondromalacia patella, longer-term follow-up data indicates that more than 50% of individuals with chondromalacia patella continue to experience symptoms and unfavorable outcomes.<sup>4</sup> The development of a more targeted multimodal treatment approach could positively impact long-term treatment outcomes.

Recent evidence suggests that prolotherapy, which is an injection of a hypertonic irritating solution (usually dextrose) to intra- and extra-articular tissues, in the treatment of chondromalacia patella is associated with substantial gains in pain relief and functionality.<sup>5</sup> While the exact mechanism of prolotherapy treatment is not well understood, it is thought to induce a pro-inflammatory response that results in the release of cytokines and growth factors.<sup>6</sup> This results in a regenerative process within the affected joint. Additionally, Topol et al<sup>6</sup> determined that intra-articular prolotherapy injections were associated with chondrogenesis in areas of exposed subchondral bone in participants with symptomatic grade IV osteoarthritic knees. Since prolotherapy is considered a relatively simple, safe, and inexpensive treatment modality, it is something that could easily be performed in the primary care setting and should be considered a first-line conservative therapy for the management of patients with chondromalacia patella.<sup>5</sup>

The combination of physical therapy and prolotherapy has been shown to be effective in managing several other conditions including anterior cruciate ligament tear, sacroiliac joint dysfunction, Achilles tendinopathy, and metatarsophalangeal joint instability.<sup>7-10</sup> However, the use of physical therapy in combination with prolotherapy for patients with knee pain and chondromalacia patella has not been adequately described. Therefore, the purpose of this case report is to describe the use of physical therapy combined with prolotherapy in a recreationally active, middle-aged man with knee pain and chondromalacia patella.

## **2. Patient Case**

The patient was a 50-year old male triathlete presenting with a chief complaint of persistent left knee stiffness and anterolateral knee pain. The patient's symptoms began insidiously 9 months prior after an increase in his triathlon training activities. His knee pain progressed to the point that he could not perform any weight bearing exercise without significant discomfort and it was influencing his ability to perform routine activities of daily living. More specifically, the patient's knee pain was aggravated by ascending/descending stairs, sitting with knees bent, and squatting. The patient's morning stiffness did not last longer than 30 minutes. Previous treatment included corticosteroid and hyaluronic acid injections, as well as physical therapy focusing on quadriceps strengthening and modality use to address pain, with minimal benefit. The patient's past medical history was unremarkable.

Physical therapy examination revealed an antalgic gait characterized by decreased stance phase on the left. Although knee range of motion was within normal limits, the patient reported stiffness at end range knee flexion and extension. Additionally, patellofemoral joint crepitus and tenderness to palpation along the medial aspect of the patella were noted. Hypomobility was noted with arthrokinematic assessment of the left tibiofemoral and patellofemoral joints. Tightness was noted for the quadriceps femoris, hamstrings, gastrocnemius, and iliopsoas muscles. Quadriceps and hamstring muscle weakness was also noted. Ligamentous and meniscal testing was normal. Magnetic resonance imaging findings revealed moderate to severe chondromalacia along the lateral patellar facet (Figure 1).

## **3. Management**

Physical therapy management consisted of manual therapy for lower quarter soft tissue and joint mobilization, muscle stretching, targeted therapeutic exercise to address strength deficits of the quadriceps and hamstring muscles, and a gradual return to weightbearing exercise and functional activity (Tables 1-3). One of the main goals of this physical therapy treatment approach was to promote proper lower kinetic chain biomechanics and resolve compensatory mechanisms. To minimize deconditioning, daily cardiovascular training through swimming was emphasized.

During each session, the physical therapist would implement manual, hands-on techniques immediately before the patient performed reinforcing exercises to help the patient perform the movements with little or no pain (Table 1). Manual therapy techniques (excluding stretching) were introduced as gentle, graded mobilizations in an effort to familiarize the patient with the techniques and ensure the interventions were well tolerated. The interventions were then progressed as tolerated by the patient. The physical therapist continually evaluated the patient's response to treatment and altered aspects of the techniques accordingly. For example, when the patient initially reported stiffness with knee flexion and extension, the physical therapist would use mobilizing techniques for

the patellofemoral and tibiofemoral joints to reduce stiffness while altering the mechanics of the technique to avoid pain. The patient would then perform repeated active knee movements to reinforce the manual therapy techniques. As the patient progressed, more functional activities such as squatting or stair climbing were used to assess response to treatment. If an intervention was delivered and the patient did not demonstrate immediate improvement in these functional activities, manual techniques were then delivered with more vigor or for a longer duration to achieve the desired effects. Similarly, the physical therapist would perform manual muscle stretching before the patient would perform in-clinic stretching exercises, which would then be done as part of a home exercise program. Soft tissue mobilization in the suprapatellar and medial and lateral peripatellar regions was also performed.

The therapeutic exercise component was designed to reinforce the manual therapy interventions as well as address strength impairments (Tables 2-3). Both non-weight-bearing and weight-bearing lower extremity exercises were utilized at first, and exercises were progressed by adding resistance and/or increased repetitions. For some exercises, like partial squats, the exercise was progressed by moving from a double leg to a single leg partial squat. The physical therapist also instructed the patient in a home exercise program to reinforce the manual therapy interventions and address strength impairments.

The patient was seen for a total of 12 physical therapy sessions over the 8-week rehabilitation period. In addition to management by a physical therapist, the patient received a series of prolotherapy injections in the anterior knee (40 cc solution of 15% dextrose, 0.1% procaine, and 10% sarapin), with each of the three sessions 3 to 4 weeks apart. This frequency was selected to maximize the body's inflammatory and proliferative repair phases of healing in an effort to increase the amount of collagen regeneration. The first prolotherapy injection occurred 1 week prior to initiating physical therapy.

### **3.1 Outcome**

At 4 months following the physical therapy and prolotherapy injections, the patient reported no pain during daily activities. He was satisfied with the current status of his knee, especially when compared to outcomes of prior interventions. He had a normal gait, no complaints of stiffness, and full strength of the quadriceps and hamstrings muscles. Additionally, he had returned to agility drills, cycling, unlimited walking and hiking on various surfaces. He was aware of the need to minimize high impact activities, such as long distance running. The patient felt that this knowledge was giving him reasonable control over his pain and was responsible for reducing his painful episodes.

## **4. Discussion**

This case report described a 50-year old male triathlete who had a chief complaint of persistent left knee stiffness and anterolateral knee pain which had started insidiously 9 months prior after an increase in his triathlon training activities. Magnetic resonance

imaging findings revealed moderate to severe chondromalacia along the lateral patellar facet. Previous treatments, which provided minimal benefit, included corticosteroid and hyaluronic acid injections, as well as physical therapy. The results of this report suggest that this patient responded positively to a combined approach of physical therapy and prolotherapy. Unfortunately, we are unable to determine what part each of the treatments (physical therapy or prolotherapy) played in his recovery. However, we believe that both management components were equally critical for the successful outcome. The combination of physical therapy and prolotherapy has been shown to be effective in managing several other conditions including anterior cruciate ligament tear, sacroiliac joint dysfunction, Achilles tendinopathy, and metatarsophalangeal joint instability.<sup>7-10</sup>

Recently, Hauser and Sprague<sup>5</sup> studied the effectiveness of prolotherapy for patients with chondromalacia by evaluating pain and physical activity. Sixty-nine knees in 61 patients (33 females, 36 males; average age: 47.2 years) with chondromalacia received a series of prolotherapy injections. Knee evaluations were performed at baseline and at 6 weeks. Following the intervention, patients experienced statistically significant decreases in pain at rest and during activities of daily living after prolotherapy. Additionally, during exercise and before prolotherapy, 61.8% of patients had severe knee pain and 23.5% had moderate pain. After prolotherapy, only 2.9% of patients had severe pain and 13.2% had moderate pain upon exercise. The vast majority of patients (83.8%) had no pain or minimal pain during exercise after prolotherapy. The researchers concluded that prolotherapy can be effective in reducing chondromalacia patella symptoms and improving physical ability. Given the effects of prolotherapy seen in the study by Hauser and Sprague<sup>5</sup>, perhaps exercises prescribed by a physical therapist may be performed more easily by a patient following prolotherapy, thus a greater training effect and better outcome may be appreciated.

While functional and symptomatic benefit has been associated with prolotherapy in patients with knee osteoarthritis, the exact mechanism of prolotherapy treatment is not well understood. It has been traditionally thought that prolotherapy initiates a brief inflammatory cascade stimulating healing and subsequent tissue growth; clinical improvement then results from a restoration of tissue integrity.<sup>11</sup> It has also been hypothesized that prolotherapy elicits a pain-modulating effect. More recent work has evaluated the direct effect of prolotherapy on articular cartilage. In patients with advanced knee osteoarthritis, Topol et al.<sup>6</sup> determined that intra-articular prolotherapy injections were associated with chondrogenesis and clinical improvement compared with baseline status, as assessed through arthroscopy before and after treatment, post-treatment biopsy, and a disease-specific outcome questionnaire. While these results provide important insight, further study is needed to determine the mechanism of action of prolotherapy and its relationship to clinical outcome.

## 5. Conclusion

Prolotherapy has been shown to be an effective treatment for patients with numerous musculoskeletal pathologies, including chondromalacia patella. In patients with chondromalacia patella, especially those who have not responded to prior interventions, physical therapy combined with prolotherapy may serve as an effective treatment option. This case report describes a successful multimodal treatment approach including physical therapy combined with prolotherapy in a recreationally active, middle-aged man with knee pain and chondromalacia patella who had not responded to prior interventions. Future research should be done to assess the efficacy of physical therapy combined with prolotherapy in patients with chondromalacia patella.

## Conflict of Interest Statement

The authors declare no conflicts of interests.

## About the Authors

**Dr. Kristin Bowne**, PT, DPT is the founder and owner of KRISTIN BOWNE PHYSICAL THERAPY, Center for Rehabilitation & Clinical Rehabilitation in Scotts Valley, CA. Her clinical focus is in orthopedic and sports physical therapy. Her research focus is on regenerative rehabilitation, investigating how orthopedic injuries heal at the cellular level and in designing rehabilitation protocols for both before- and after-autologous biologic injections for musculoskeletal injuries.

**Dr. Joshua Prall**, PT, EdD is a physical therapist with extensive experience in occupational health, providing ergonomics education and workplace safety programs to family businesses and large corporations alike. His research interests include the effects of physical therapy delivered ergonomics in the industrial workplace.

**Dr. Michael Ross**, PT, DHSc is a physical therapist with research interests in pain management and physical therapy outcomes.

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## Appendix

**Table 1:** Knee impairments addressed by manual therapy

Impairment	Manual Intervention	Typical Delivery
Loss of patellar glides	Manual mobilization of the patella in 5 to 10 degrees of knee flexion to facilitate medial, lateral, caudal and cephalad glide	Mobilization performed in 3 to 5 bouts of 30 sec per manual technique
Stiffness at end range knee extension	Manual mobilization through range of motion and knee extension mobilizations at end range	Mobilization performed in 3 to 5 bouts of 30 sec per manual technique
Stiffness at end range knee flexion	Manual mobilization through range of motion and knee flexion mobilizations at end range	Mobilization performed in 3 to 5 bouts of 30 sec per manual technique
Muscle tightness	Manual stretches at end length of the muscle for quadriceps femoris, hamstrings, gastrocnemius, and iliopsoas	Sustained manual stretches of 30 sec duration repeated 3 times per muscle
Soft tissue tightness	Soft tissue mobilization in the suprapatellar and medial and lateral peripatellar regions	Circular fingertip and palm pressure mobilization at the depth of the capsule or retinaculum for 2 to 3 bouts of 30 sec per area

**Table 2:** Patient exercise program: strengthening exercises

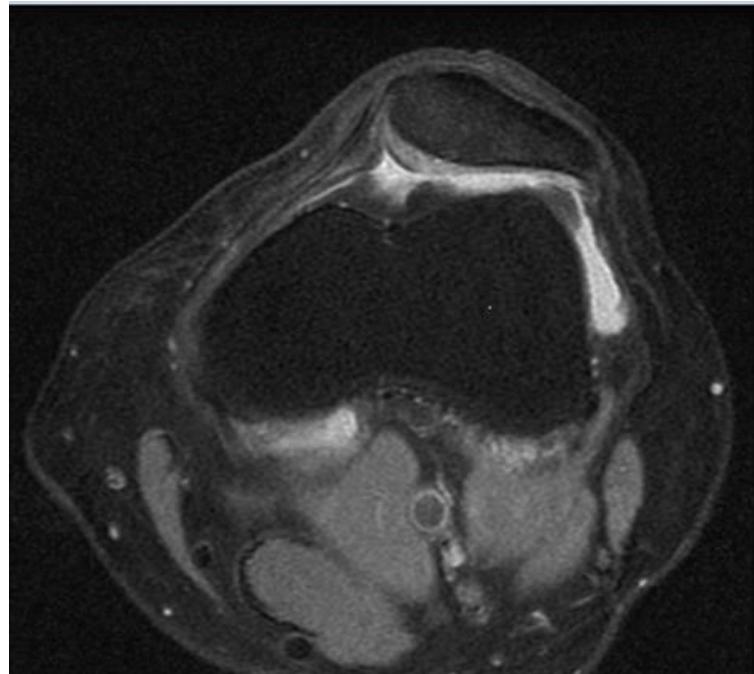
<b>Exercise</b>	<b>Performance</b>	<b>Repetitions</b>
Static quad sets in knee extension	Performed daily. Patient is positioned supine supported on elbows with a rolled towel placed behind the knee, which is in an extended position. The contralateral lower extremity is positioned in 90 degrees of flexion with the foot on the floor. Patient contracts the quadriceps femoris muscle while actively dorsiflexing their ankle and pushes the knee down into the rolled towel placed behind their knee.	Hold each contraction for 6 sec with a 10-s rest between repetitions Perform 12 to 15 repetitions for 3 to 5 sets.
Standing terminal knee extension	Performed 3 times per week. Patient stands with a resistive band behind a slightly flexed knee. Patient contracts the gluteal and quadriceps femoris muscles to fully straighten the hip and knee.	Hold each contraction for 3 sec. Perform 12 to 15 repetitions for 3 to 5 sets.
Seated leg presses*	Performed 3 times per week. Patient is seated holding a resistive band in both hands. Patient places his or her foot against the band, then straightens the knee by pushing the foot down and forward by contracting the gluteal and quadriceps femoris muscles. This exercise should be completed with minimal or no pain.	Hold each contraction 3 sec with knee as straight as possible. Perform 12 to 15 repetitions for 3 to 5 sets. Progress to exercise bands of increasing resistance.
Partial squats	Performed 3 times per week. Patient stands with head and back against a wall. Feet are shoulder width apart, about 45.7 cm from the wall. The patient squeezes a ball between his knees and lowers his body by performing a partial squat to no more than 60 degrees of knee flexion. The patient returns to standing by contracting the quadriceps femoris and gluteal muscles. This exercise should be completed with minimal or no pain.	Hold each contraction 3 sec while in the squatting position. Perform 12 to 15 repetitions for 3 to 5 sets.
Step-ups	Performed 3 times per week. Patient stands in front of a low step and places foot of involved leg on step and brings body over foot to stand on the step. Use as little push-off assistance from the contralateral foot as possible. Step down with the contralateral foot. These exercises should be completed with minimal or no pain.	Perform 12 to 15 repetitions for 3 to 5 sets. Progress by increasing the height of the step.
Banded side steps	Performed 3 times per week. With the patient in a standing position, a resistance band is placed just above both knees. With the knees slightly bent, the patient shifts their weight over one leg and takes a step sideways with the other leg while maintaining a low, forward-facing posture. Repetitions should be performed slowly and controlled, while keeping hips level and the back straight during the movement.	Perform 12 to 15 repetitions for 3 sets in each direction. Increase resistance as tolerated.

\*Leg presses on a machine were also performed in clinic

**Table 3:** Patient exercise program: stretching exercises

<b>Exercise</b>	<b>Performance</b>	<b>Repetitions</b>
Standing calf stretch	Performed daily. Patient stands on a step with the heel of the foot being stretched over the edge of the step. The patient then slowly lowers the heel toward the floor until a moderate pull is perceived in the calf musculature. The patient may use his arms for support against a wall as needed.	Hold for 30 sec and repeat 3 times with the knee in an extended and slightly flexed position
Supine hamstring muscle stretch	Performed daily. Patient is positioned supine with the contralateral lower extremity maintained as straight as possible. The ipsilateral hip is flexed to 90 degrees. The knee is straightened and the proximal lower leg supported with the hands until a moderate pull is perceived in the posterior thigh and calf. The ipsilateral ankle should be dorsiflexed.	Hold for 30 sec and repeat 3 times.
Prone quadriceps femoris muscle stretch	Performed daily. While lying prone with a strap around the ankle, the patient flexes his knee and he grasps the strap around his ankle. The knee is progressively flexed until a gentle stretch is perceived in the anterior thigh.	Hold for 30 sec and repeat 3 times.
Half kneeling iliopsoas muscle stretch	Performed daily. Patient is positioned in half-kneel position. For comfort, the patient can kneel on a towel or foam pad. While maintaining a posterior pelvic tilt, the hip of the lower extremity in the half-kneeling position is then extended by having the patient shift his center of mass anteriorly until a gentle stretch is perceived in the anterior hip.	Hold for 30 sec and repeat 3 times.

**Figure 1:** Magnetic resonance image revealing moderate lateral patellar tilt and subluxation. There is diffuse, grade III/grade IV chondromalacia along the entirety of the lateral patellar facet, extending across the medial patellar ridge.



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