Patellofemoral Pain Syndrome and the Pilates Client

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Abstract

This paper considers the common knee problem of patellofemoral pain syndrome. It begins with a generalized discussion of the anatomy of the knee joint followed by an overview of patellofemoral pain syndrome, including its symptoms, causes and medical treatment. Patellofemoral pain is further addressed in the context of a Pilates exercise program. A case study of a client suffering from knee pain medically diagnosed as patellofemoral pain syndrome is used to develop an appropriate rehabilitation and conditioning program selected from the Pilates repertoire. It is concluded that Pilates, as one component of a complete program of care, can be an effective and valuable aid in the treatment of patellofemoral pain.
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The Anatomy of Patellofemoral Pain

As suggested by its name, *patello* for kneecap and *femoral* for femur or thighbone, patellofemoral pain syndrome affects the knee joint. The largest joint in the body, the knee acts primarily as a hinge for flexion and extension of the leg although it also allows limited rotation. These actions are accomplished by the complex interplay of the knee’s component parts, including the bones, connective tissue such as ligaments and cartilage and muscles and tendons.

The bones of the leg provide the basic structure of the knee joint (Figure 1). Extending from the hip to the knee is the longest and strongest bone in the body, the thighbone or *femur*. Attached to the femur is a small, oval bone called the kneecap or *patella*. The patella not only protects the joint from external impact, it also glides up and down, facilitating movement of the joint. Below the patella, running from the knee to the ankle, is the second-longest bone in the body, the shinbone or *tibia*. Adjacent to the tibia on the outside of the leg is the *fibula*. While the fibula helps to stabilize the knee, it does not directly participate in the joint.

Connecting these bones to one another are four major ligaments (Figure 2). The ligaments of the knee act as brakes, maintaining the alignment of the joint by restricting motion in all four directions. Attaching the femur to the fibula on the outside of the knee is the *lateral collateral ligament*. On the inside of the knee, the *medial collateral ligament* attaches the femur to the tibia. Together, the collateral ligaments prevent excessive movement from side to side. Crossing one another inside the knee joint and also connecting the femur and tibia are the *anterior* and *posterior cruciate ligaments*. The cruciate ligaments limit movement front and back. In the context of a discussion of patellofemoral
pain syndrome, it is worth observing that the knee’s major ligaments have attachments to and stabilize exclusively the femur, tibia and fibula and not the patella.

Padding the knee joint are two types of cartilage, meniscal and articular (Figure 2). Each knee has a medial and lateral meniscus, both of which provide a cushion between the femur and tibia, distributing weight and absorbing pressure. Articular cartilage shields the ends of the bones from grinding one against another. Its smooth surface allows the bones to glide easily during movement.

It is the muscles surrounding the knee joint that make movement possible. These muscles can be divided into two main groups, the muscles that straighten or extend the knee known as the quadriceps and the muscles that bend or flex the knee known as hamstrings (Figures 3a and 3b). The quadriceps run across the front of the thigh and are actually composed of four distinct muscles: the rectus femoris, vastus lateralis, vastus medialis and vastus intermedius. Each of these muscles attaches to the quadriceps tendon, which encapsulates the patella. The patellar tendon is an extension of the quadriceps tendon that in turn attaches to the front of the tibia. On the back of the thigh, the three muscles that make up the hamstrings are the biceps femoris, semitendinosus, and semimembranosus. The tendons of these muscles attach to the back of the tibia and fibula.
Simply put, patellofemoral pain syndrome is pain in or around the knee joint. The most common source of chronic knee pain, it typically manifests as a general discomfort or vague sense of tightness inside the knee. Discomfort may be further aggravated by activities such as running, jumping, ascending or descending stairs as well as prolonged sitting. Because patellofemoral pain syndrome is also associated with repetitive use, it is often referred to as “runner’s knee.”

Abnormal tracking of the kneecap over the thighbone has been identified as the cause of patellofemoral pain. During extension and flexion of the knee, the patella typically glides in the groove of the femur just between the bone’s two knobby ends, or condyles. If the patella drifts outward, toward the lateral condyle, the underside of the patella scrapes against the femur, creating chronic inflammation and pain. Left untreated, patellofemoral pain can develop into a more serious
condition called chondromalacia, in which rubbing causes the cartilage under the patella to soften and erode.

A qualified physician should diagnose patellofemoral pain syndrome. Prescribed treatment for pain management may include rest, icing and anti-inflammatory medications such as ibuprofen. Less commonly, treatment requires bracing or arthroscopic surgery. The best option for long-term relief, however, is rehabilitation through physical therapy. Abnormal tracking of the patella has traditionally been associated with an imbalance of local musculature. If the muscles of the outer thigh are significantly stronger than those of the inner thigh, they may contribute to a lateral pull on the kneecap. Physical therapy therefore focuses on strengthening of the medial quadriceps, specifically vastus medialis, as a means to improve the pathway of the patella during quadriceps contraction. Moreover, extreme tightness of opposing musculature such as the hamstrings can also contribute to patellofemoral pain syndrome and appropriate stretching exercises are often useful.

Rehabilitation of patellofemoral pain syndrome can also be considered from the perspective of a malalignment of the knee joint. For example, a person with knock-knees, or genu valgus, is more likely to develop patellofemoral pain syndrome. The knee is not, however, a discrete unit, but one part of kinetic chain that begins at the foot and extends through the hip. People who are flat-footed tend to pronate, or allow the ankles to sink inward, which can translate to the knee as patellofemoral pain syndrome. Orthotic shoe inserts as prescribed by a doctor or physical therapist are an immediate and common means to address alignment issues of the foot and ankle. At the other end of the chain, anteversion, or inward rotation, of the femur can also manifest as patellofemoral pain syndrome. In recent years, this malalignment of the hip has been given more attention, and strengthening exercises for the abductors, particularly the glutus medius, have become a typical component of rehabilitation programs.
Patellofemoral Pain Syndrome and the Pilates Client: A Case Study

It bears emphasizing that a Pilates teacher is not qualified to diagnosis patellofemoral pain syndrome nor is a Pilates program a substitute for professionally-supervised physical therapy. Fortunately the focus of Pilates on functional movement and the inclusion in the Pilates repertoire of exercises that strengthen the quadriceps, stretch the hamstrings and recruit the gluteus medius make it an excellent complement to medical treatment. The following case study documents the development of a Pilates program for a client diagnosed with patellofemoral pain syndrome.

Client History

Alex, a 41-year old male, came to Pilates complaining of a generalized pain in his right knee, which was aggravated by long periods of sitting. After an X-ray to rule out other issues, Alex’s doctor diagnosed the problem as patellofemoral pain syndrome and prescribed rest and anti-inflammatory medications to treat pain as well as physical therapy.

Though a former professional tennis player and an active swimmer, Alex had no prior experience of Pilates. His objective in beginning a Pilates program was rehabilitation of his knee, and conversation with his physical therapist confirmed the suitability of exercises for strengthening the quadriceps with emphasis on the vastus medialis, stretching the hamstrings and strengthening the gluteus medius. Further review of Alex’s medical history also revealed a percutaneous discectomy to treat two herniated discs in the lumbar and sacral spine in 1987. As a result, flexion of the spine from a supine to sitting position such as a full sit-up is contraindicated. At present, Alex continues to treat occasional lower back pain with anti-inflammatory medication.

Developing a Pilates Program

As Alex’s instructor, my first goal was to introduce him to the principles of Pilates with a particular emphasis on centering. By teaching Alex to connect movement to core musculature and introducing him to concepts such as trunk and pelvic lumbar stabilization, I wanted both to facilitate
rehabilitation of his knee and potentially ease discomfort in his lower back. Thus, I began his sessions with a warm up of fundamental Mat exercises including Pelvic Curl, Spine Twist Supine, Chest Lift and Chest Lift with Rotation.

In the next section of Alex’s program, performing the Foot Work exercises on the Reformer provided an ideal means to directly address his patellofemoral pain. Foot Work not only served to strengthen the quadriceps, but it also created an opportunity to develop Alex’s awareness of ankle, knee and hip joint alignment. In the first sessions, giving Alex a small ball to squeeze between his legs just above his knees enabled him to identify the role of vastus medialis in quadriceps contraction. Once Alex was able to control the recruitment of the inner thighs during Foot Work, the ball was removed to further challenge his proprioception. Within the Foot Work exercises, special focus was also given to Open V-Position Toes in which the vastus medialis can be more distinctly felt. Stretching of the hamstring muscles was explicitly incorporated into Alex’s program as well with the inclusion of the Standing Lunge exercise on the Reformer. Hamstring flexibility was further challenged implicitly by several exercises executed in a seated position with the legs extended in front of the body, such as the Arms Sitting Series on the Reformer and the Spine Twist and Saw on the Mat. Alex modified all seated exercises with a slight bend at the knee in order to accommodate tightness of the hamstrings and avoid a compensatory posterior tilt of the pelvis and flexion of the lumbar spine. Alex concluded his session with the Gluteals Side Lying Series on the Mat, a sequence of exercises all targeting the gluteus medius muscle.

While consideration of patellofemoral pain syndrome played a crucial role in the development of Alex’s Pilates program, it was also my aim embrace the Pilates principle of balance. Using the Body Arts and Science International Block System, I constructed an hour-long progression of exercises that addresses the body as a whole (Table 3). Completing exercises in the Abominal Work, Hip Work, Arm Work, Lateral Flexion/Rotation and Back Extension Blocks
required Alex to use all of the body’s muscles in every plane of motion. (The Spinal Articulation and Full Body Integration Blocks were not included in Alex’s program as they are not appropriate for a Pilates student working at a Fundamental level.) These exercises also presented an opportunity to add challenge to the program. In consideration of Alex’s background as an athlete as well as the upper body strength of men in general, intermediate level exercises involving the upper extremities such as the Arms Sitting Series on the Reformer were incorporated. Swimming on the Mat, another intermediate exercise, requires upper body strength and was also an opportunity to test Alex’s coordination.

Alex’s results were optimal. After just six weeks of medical treatment for patellofemoral pain syndrome including anti-inflammatory medication and physical therapy in combination with regular Pilates sessions, he experienced a return to full function with no pain. Although Alex did not continue with Pilates, it is reasonable to assume that an ongoing program that attends to the underlying causes of patellofemoral pain – including a muscular imbalance of the quadriceps, tightness of the hamstrings, weakness of the gluteus medius, and poor alignment of the joints of the lower extremities – would be beneficial in preventing a recurrence.
<table>
<thead>
<tr>
<th>Apparatus:</th>
<th>\textbf{BASI Block:}</th>
<th>Exercise:</th>
<th>Objectives:</th>
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</thead>
<tbody>
<tr>
<td>Mat</td>
<td>\textit{Warm Up}</td>
<td>Standing Roll Down&lt;br&gt;Pelvic Curl&lt;br&gt;Spine Twist Supine&lt;br&gt;Chest Lift&lt;br&gt;Chest Lift with Rotation</td>
<td>Postural assessment; warm up; introduce pelvic lumbar stabilization</td>
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<tr>
<td>Reformer</td>
<td>\textit{Foot Work}</td>
<td>Parallel Heels&lt;br&gt;Parallel Toes&lt;br&gt;V-Position Toes&lt;br&gt;Open V-Position Heels&lt;br&gt;Open V-Position Toes&lt;br&gt;Single Leg Heel&lt;br&gt;Single Leg Toe</td>
<td>Strengthen quadriceps; improve awareness of ankle, knee and hip joint alignment</td>
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<tr>
<td></td>
<td>\textit{Abdominal Work}</td>
<td>Hundred Prep&lt;br&gt;Hundred</td>
<td>Strengthen abdominals</td>
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<td></td>
<td>\textit{Hip Work}</td>
<td>Frog&lt;br&gt;Down Circles&lt;br&gt;Up Circles</td>
<td>Strengthen hip adductors; improve quadriceps control</td>
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<tr>
<td></td>
<td>\textit{Spinal Articulation}</td>
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<td>-</td>
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<tr>
<td></td>
<td>\textit{Stretches}</td>
<td>Standing Lunge</td>
<td>Stretch quadriceps; stretch hamstrings</td>
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<td>\textit{Full Body Integration 1}</td>
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<td></td>
<td>\textit{Arm Work}</td>
<td>Arms Sitting Series:&lt;br&gt;Chest Expansion&lt;br&gt;Biceps&lt;br&gt;Rhomboids&lt;br&gt;Hug-A-Tree&lt;br&gt;Salute</td>
<td>Strengthen latissimus dorsi, biceps, rhomboids, deltoids, pectorals and triceps; challenge trunk stabilization; stretch hamstrings</td>
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<td>\textit{Full Body Integration 2}</td>
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<td>-</td>
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<tr>
<td>Mat</td>
<td>\textit{Additional Leg Work}</td>
<td>Gluteals Side Lying Series:&lt;br&gt;Side Leg Lift&lt;br&gt;Forward and Lift&lt;br&gt;Forward with Drops&lt;br&gt;Adductor Squeeze</td>
<td>Strengthen gluteus medius; strengthen hip abductors; challenge pelvic lumbar stabilization</td>
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<td>\textit{Lateral Flexion/Rotation}</td>
<td>Side Lift&lt;br&gt;Spine Twist&lt;br&gt;Saw</td>
<td>Strengthen obliques; improve spinal mobility; stretch hamstrings</td>
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<td>\textit{Back Extension}</td>
<td>Back Extension&lt;br&gt;Swimming</td>
<td>Strengthen back extensors; challenge coordination</td>
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<td></td>
<td>\textit{Relaxation and Focus}</td>
<td>Rest Position</td>
<td>Stretch lumbar spine; relax</td>
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Conclusion

Rael Isacowitz, founder of the Body Arts and Science International program of Pilates, has expressed wonder at the role of the patella in the workings of the knee joint: “Besides protecting the knee joint, the patella creates a significant mechanical advantage for the quadriceps. If there were no patella, the quadriceps muscle would need to work approximately 30 percent harder and be much stronger (and larger) to create a force equivalent to that provided with the patella. And if the patella is out of alignment, knee function will be affected dramatically and chronic ailments may result” (Pilates, 14). The most common cause of chronic knee pain, patellofemoral pain syndrome is indeed a result of malalignment of the patella. As demonstrated by this case study, however, Pilates can be effective in encouraging correct alignment of the kneecap and aiding in the relief patellofemoral pain when combined with the care of a doctor or physical therapist. The Pilates repertoire, with its inclusion of strengthening and stretching exercises for the totality of the body, performed in accordance with Pilates principles such as centering, awareness, control, balance and coordination, is not only a source of rehabilitation for patellofemoral pain syndrome but also has the potential to help prevent further occurrences.
Bibliography


All images adapted from <http://aclsolutions.com/anatomy.php>