Patellofemoral Pain Case Study

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**Introduction**

Patellofemoral pain is one of the most commonly reported conditions by athletes, in fact, as many as 30% of all cases that are referred to sports medicine clinics have some sort of patellofemoral involvement (Ingersoll, 1998). Also females tend to develop the condition much more frequently than males (Baldon, et al., 2009). Dealing with patellofemoral pain can be complicated. One of the biggest reasons for this being that patellofemoral pain is a multifaceted problem (Ingersoll, 1998). According to Ingersoll (1998) “numerous predisposing factors have been identified and even more approaches to rehabilitation have been described” (p. 45). Another reason that can make dealing with patellofemoral pain difficult to treat is that it goes by so many names that include patellofemoral pain and anterior knee pain. There have been twenty terms used to describe conditions relating to patellofemoral pain with some referred to clearly identifiable conditions, general terms, and many of the terms were synonymous (Ingersoll, 1998).

 Factors that can contribute to patellofemoral pain include muscle weakness, such as the vastus lateralis oblique, lateral retinaculum tightness, excessive Q angle, and malalignment of the lower extremity kinetic chain (Faltus, 2009). Abnormal tracking of the patella can be attributed to static or dynamic lower extremity malalignment, altered muscle activation of the surrounding knee musculature, decreased strength of the hip musculature, or combinations of all of these (Clark & Lucett, 2011). According to Baldon, et al. (2009) “the symptom most frequently reported is diffuse peripatellar and retropatellar pain associated with activities that load the patellofemoral joint, such as ascending and descending stairs and squatting and sitting with flexed knees for prolonged periods” (p. 490). The most commonly accepted cause of patellofemoral pain syndrome is abnormal tracking of the patella within the femoral trochlea (Clark & Lucett, 2011). An underlying cause of this malalignment may be abnormal transverse or frontal plane motion of the femur during functional movements and activities (Boling, Padua, & Creighton, 2009). When the patellar is not properly aligned within the femoral trochlea the stress area on the patellar cartilage increases which makes the contact area smaller between the patella and the trochlea (Clark & Lucett, 2011).

 It has recently been suggested that poor hip adduction and internal rotation control during weight-bearing activities is directly related to patellofemoral pain syndrome in female athletes. This can increase the dynamic Q angle and lead to greater lateral patellar contact pressure (Baldon, et al., 2009). Boling, Padua, and Creighton (2009) stated, “hip musculature plays an important role in controlling transverse plane and frontal plane motions of the femur. More specifically, weakness of the gluteus medius muscle is believed to increase adduction and knee valgus angles” (p. 7). Weakness of the piriformis, obturator internus, and externus, superior and inferior gemellus, and the quadratus femoris has also been thought to increase hip internal rotation and knee valgus angles (Boling, Padua, & Creighton, 2009).

 Previous research has also shown that individuals with patellofemoral pain have shown a decrease with isometric strength of the hip abductors, external rotators, and extensors. Also females with patellofemoral pain have been shown to be up to 36% weaker than healthy females when isometric strength for hip abduction and hip external rotation was tested (Boling, Padua, & Creighton, 2009). According to Baldon et al. (2009) “diminished capacity to generate eccentric hip abduction torque may lead to an impaired capacity to prevent excessive femoral adduction during repetitive activities, causing excessive lateral stress on the patellofemoral joint” (p. 495).

 When dealing with patellofemoral pain it is important base decisions on the literature and throw out all preconceived notions that one may have with the injury. Four basic principles that need to be used when evaluating for possible patellofemoral pain include to not always assume that pain is due to maltracking as there are many patients who complain of patellofemoral pain but have normal tracking. The clinician should also realize that there is not one factor that predicts patellofemoral pain, as there as not been any consistency in literature with factors that deal with patellofemoral pain. Third, a physical assessment may not be sufficient and it is vital to get a physicians diagnosis because x-rays or other special tests may be needed. Finally, the whole kinetic chain must be examined because deficits up and down the kinetic chain can be at least partly responsible for the symptoms (Ingersoll, 1998).

**How Patellofemoral Pain Relates to Corrective Exercise Training**

 Research regarding the cause of patellofemoral pain is limited but the common theme found in the literature is that cause of the pain is not necessarily at the patellofemoral joint. There can be muscular imbalances found in the hip and ankle that can cause dysfunction at the patellofemoral joint. It is important for the clinician to realize each case is unique and that each is going to have be handled on a case-by-case basis. Proper treatment depends on correctly identifying the cause of patellofemoral pain. The assessment by the athletic trainer as well as a clear diagnosis by a physician should be used together to formulate a plan to rehabilitate the injury for the individual (Ingersoll, 1998). It is important to look at the entire kinetic chain and note any muscle that may be overactive or underactive as this can have an effect on joints both above and below the muscular dysfunction.

 Research that has been published tends to show that the muscles that affect patellofemoral pain include the hip internal rotators and the hip abductors being overactive while the hip external rotators and the hip adductors are underactive. With this muscle imbalance at the hip the kinematics of the patellofemoral joint can be altered and thus cause the patella to not track properly causing pain. Although most of the literature supports the idea that the main cause of the problem is at the hip, it is important to look at other areas within the kinetic chain that could potentially be a cause to the injury as well. Overactive muscles that could potentially lead to patellofemoral pain include the gastrocnemius, soleus, adductors, tensor fascia latae and IT band, short head of the biceps femoris, and piriformis. The underactive muscles can include the anterior and posterior tibialis, gluteus medius, gluteus maximus, adductors, and the medial hamstrings (Clark & Lucett, 2011). It is important to find muscular imbalances like this to properly treat the cause of the injury.

 Corrective exercise training allows the athletic trainer to develop a sound rehabilitation program that inhibits, lengthens, activates, and integrates the proper muscles to control the dysfunction at the patellofemoral joint. Corrective exercise training allows the athletic trainer to set up safe programs that consider the functional capacity of the individual. Corrective exercise training also allows the individual to train in different planes of motion (Clark & Lucett, 2011). This is particularly important for patellofemoral pain as the individual typically has pain when performing functional activity in the frontal and transverse plane (Boling, Padua, & Creighton, 2009). Corrective exercise training allows the individual to work with muscular imbalances and joint dysfunctions in these planes in a safe, controlled manner and allows them to properly rehabilitate injuries and pain that is caused in the frontal and transverse plan when performing functional activities.

**Assessing for Human Movement Dysfunction with Patellofemoral Pain**

Clark and Lucett (2001) stated, “movement assessments, based on sound human movement science, are the cornerstone of a comprehensive and integrated assessment process” (p. 105). Movement assessments allow the athletic trainer to look for human movement system impairments that include muscle imbalances and altered recruitment strategies (Clark & Lucett, 2011). Assessments that need to be performed to assess for dysfunction at the patellofemoral joint would include a static assessment, which is how individuals physically present themselves while standing. Next, a transitional movement assessment should be performed, which is an assessment that will involve a movement without changing an individual’s base of support. The final assessment that should be performed is a dynamic movement assessment. The dynamic movement assessment is an involvement that changes the individual’s base of support (Clark & Lucett, 2011).

The static assessment should be used first. With patellofemoral pain the athletic trainer should be assessing to determine if lower crossed syndrome and pronation distortion syndrome is present in the individual. Lower crossed syndrome is a postural distortion syndrome that is usually caused by an anterior pelvic tilt and lower extremity muscle imbalances. Pronation distortion syndrome is a postural distortion syndrome characterized by foot pronation and lower extremity muscle imbalances (Clark & Lucett, 2011). When performing a static posture assessment the athletic trainer should follow the kinetic checkpoints up the individual. The checkpoints are the foot and ankle, knee, lumbo-pelvic-hip complex (LPHC), shoulders, and the head and cervical spine.

When looking the anterior view the foot and ankles should be straight and parallel. They should not be flattened or externally rotated. The knees should be inline with the toes and forced into a valgus or varus force. The LPHC should show that the pelvis is level with the anterior iliac spines in the same transverse plane. The shoulders should be level and not elevated or rounded. Finally the head should be in a neutral position and not tilted or rotated (Clark & Lucett, 2011). When looking the at the lateral view the foot and ankle should again be in a neutral position with the leg vertical at a right angle to the sole of the foot. The knees should be in a neutral position and not flexed or hyperextended. The LPHC should be in a neutral position and not anteriorly or posteriorly rotated. The shoulders should have a normal kyphotic curve and not excessively rounded. Finally the head should be in a neutral position and not in excessive rotation (Clark & Lucett, 2011). Finally the individual should be viewed posteriorly. When looking at the posterior view of the foot and ankle the heels should be straight and parallel and not pronated. The knees should be in a neutral position and in valgus or varus. The LPHC should be level with the posterior iliac spines in the same transverse plane. The shoulders and scapulae should be level and not elevated or protracted. The head should be in a neutral position and not tilted or rotated (Clark & Lucett, 2011).

The next assessment that should be done is the transitional movement assessment. The two transitional movement assessments that should be performed for patellofemoral pain are the overhead squat and the single leg squat. The overhead squat should be performed with the individual standing with the feet shoulder-width apart and pointed straight ahead. The foot and ankle should be in a neutral position and the shoes should be off. Finally, have the individual raise his or her arms overhead with the elbows fully extended. The individual should then squat to the height of a chair and return to the starting position. The movement should be repeated five times for both the anterior, lateral, and posterior position. From the anterior view the feet should be looked at and determine if the feet pronate or turn out and the knees should be assessed to see if they move into an inward or outward. When looking at the lateral view with the overhead squat the LPHC should be assessed to see if the low back arches or rounds and also if the torso leans forward excessively. Finally with the posterior view the feet should be assessed to see the feet go into pronation or if the heels rise off the floor and the LPHC should be assessed for an asymmetrical weight shift (Clark & Lucett, 2011).

Problems that can arise with the overhead squat that can cause or predispose an individual to patellofemoral pain is if the feet turn out or pronate, if the knees go into a valgus or varus force, if there is excessive forward lean, if the low back arches, if the low back rounds, if the heel of the foot rises, and finally if there is an asymmetrical weight shift. This will mean that there are overactive and underactive muscles that are causing dysfunction not only at the knee but also at the ankle and hip that can have an affect on the patellofemoral joint.

The second transitional movement assessment that should be performed is the single leg squat. This assessment assess for dynamic flexibility, core strength, balance, and overall neuromuscular control (Clark & Lucett, 2011). The individual should stand with the hands on the hips and the eyes focused straight ahead. The foot should be pointed straight ahead and the foot, ankle, knee, and the LPHC should be in a neutral position. The individual should squat to a comfortable level and return to the starting position and the individual should perform five repetitions before switching feet. An anterior view assessment should be performed. The knees should track inline with the foot and should not move inward. The LPHC and shoulder should remain level and face straight ahead and the hip should not hike or drop and the torso should not rotate inward or outward (Clark & Lucett, 2011). It is important to look at all compensations with the single leg squat assessment as all can cause or predispose an individual to patellofemoral pain.

The final assessment that should be performed is a dynamic movement assessment. The dynamic movement assessment that should be performed is treadmill walking to assess gait. This will assess an individual’s posture with walking. The individual should walk on a treadmill at a comfortable pace with a zero degree incline. The athletic trainer should assess the anterior, lateral, and posterior views. When looking at the anterior view the feet should be assessed to see if they pronate or turn out and the knees should be assessed to see if the knees move inward. With the lateral view the LPHC should be assessed to see if the low back arches, if the shoulders round, and if the head migrates forward. Finally with the posterior view the feet should be assessed to see if they pronate or turn out, if there is excessive pelvic rotation, and if the hip hikes (Clark & Lucett, 2011). Again, this assessment will allow the athletic trainer to observe for any muscle imbalances that should be addressed with corrective exercise training.

Other movement, or functional activities, that should be assessed are big strides, walking on heels, walking everted, walking inverted, steps, single leg stance, and single leg stance with hip rotation. These tests should be progressively more difficult and the athletic trainer should note pain, abnormal movement patterns, and fluidity of movement. Also instead of observing for patellar movement lower extremity mechanical abnormalities should be assessed for including, femoral rotation, knee positions, and compensatory changes in the knee, hip, and ankle (Ingersoll, 1998).

**How Corrective Exercise Training Relates to Patellofemoral Pain**

 Corrective exercise training allows the health care professional to systematically identify a neuromuscularskeletal dysfunction. Corrective exercise allows the professional to identify dysfunction develop a plan and implement an integrated corrective strategy (Clark & Lucett, 2011). When dealing with patellofemoral pain relief of pain and correction of postural or structural malalignment are necessary for an optimal restoration of flexibility and strength, that an athlete needs to be successful in their endeavors (Houglum, 2004). Corrective exercise allows the athletic trainer to properly assess for muscular imbalances and possible joint functions above or below the patellofemoral joint and properly devise a plan that will target muscles or muscle groups that are underactive and overactive.

 The corrective exercise continuum will allow the athletic trainer the ability to take the athlete through the four phases of the continuum to allow for optimum rehabilitation of patellofemoral pain. The four phases of the exercise continuum are inhibit, lengthen, activate, and integrate. When looking at the first phase, inhibit, it is important to realize which muscles are tight or overactive. The muscle then must be inhibited to allow the tension to released or decrease the activity of the overactive neuromyofascial tissues (Clark & Lucett, 2011). This can be accomplished through self-myofascial release by using a foam roll on muscles such as the lateral gastrocnemius, IT band, and the short head of the biceps femoris that can potentially be overactive in an individual suffering from patellofemoral pain. The second phase of the, lengthen, allows the individual to use static stretching to increase the extensibility, length, and range of motion of neuromyofascial tissue (Clark & Lucett, 2011). In the case of patellofemoral pain it is important to stretch the gastrocnemius, soleus, tensor fascia latae, and the short head of the biceps femoris to allow for proper tracking of the patella in the femoral trochlea.

 The third phase, activate, will allow the individual to re-educate or increase activation of underactive tissues. In this phase isolated strengthening and positional isometrics should be used to accomplish this. It is important to activate the gluteus medius, gluteus maximus, adductors, and the medial hamstrings as well as the anterior and posterior tibialis in some instances. The fourth and final phase, integration, is used to retrain the collective synergistic function of all muscles through functionally progressive movements (Clark & Lucett, 2011). This will allow the individual to use total body, sport specific, and functional movements to re-train the muscles that are being targeted and treated. With patellofemoral pain a potential exercise that can be used would ball squats, step-ups, and lunges.

**Corrective Exercise Strategies for Patellofemoral Pain**

A sound corrective exercise program for patellofemoral pain has to start with proper evaluation for any possible muscle imbalances and joint dysfunctions. When moving up the kinetic chain the feet should be looked at first. When looking at the feet it should be noted if the feet turn or pronate. If the feet turn out, or evert, the probably overactive muscles can include the soleus, lateral gastrocnemius, the short head of the biceps femoris, and the tensor fascia latae. The probable underactive muscles include the medial gastrocnemius, medial hamstrings, gluteus medius and maximus, gracilis, popliteus, and the sartorius. If the fee pronate, or flatten, the probably overactive muscles include the peroneals, lateral gastrocnemius, biceps femoris, and the tensor fascia latae. The probably underactive muscles include the anterior tibialis, posterior tibialis, medial gastrocnemius, and the gluteus medius.

 Moving up to the knee it should be noted if the knee moves into a valgus or varus force. If the knee moves into a valgus force the probable overactive muscles include the adductors, short head of the biceps femoris, tensor fascia latae, lateral gastrocnemius, and the vastus lateralis. The probable underactive muscles include the medial hamstrings, medial gastrocnemius, gluteus medius and maximus, vastus mediailis oblique, anterior tibialis, and the posterior tibialis. If the knee moves into a valgus force the probable underactive muscles include the piriformis, biceps femoris, tensor fascia latae, and the gluteus maximus. The probable underactive muscles include the adductors, medial hamstrings, and the gluteus medius.

 Finally at the LPHC it is important to note if there is an excessive forward lean present, if the low back arches, if there is an asymmetrical weight shift, and if the low back rounds. If there is excessive forward lean in the LPHC the probable overactive muscles include the soleus, gastrocnemius, hip flexors, piriformis, and the abdominal complex. The probable underactive muscles include the anterior tibialis, gluteus medius, erector spinae, and the intrinsic core stabilizers. If the low back arches the probable overactive muscles include the hip flexors, erector spinae, and the latissimus dorsi. The probable underactive muscles include the gluteus maximus, hamstrings, and the intrinsic core stabilizers. If the low back rounds the probable overactive muscles include the hamstrings, adductor magnus, rectus abdominis, and the external obliques. The probable underactive muscles include the gluteus maximus, erector spinae, intrinsic core stabilizers, hip flexor complex, and the latissimus dorsi. Finally, if there is an asymmetrical weight shift present the probable overactive muscles include the adductors, tensor fascia latae on the same side of the shift, gastrocnemius, soleus, piriformis, bicep femoris, and the gluteus medius on the opposite side of the shift. The probable underactive muscles include the gluteus medius on the same side of the shift, anterior tibialis, and the adductors on the opposite side of the shift.

As is seen it is extremely important to take into account in potential muscle imbalances and joint dysfunctions as they can potentially be one of the causes of the pain at the patellofemoral joint or they can predispose an individual to patellofemoral pain. When looking at corrective exercise strategies for patellofemoral pain the first step is to inhibit tight or overactive muscles. This is going to be accomplished by using self-myofascial release techniques, primarily with the foam roll. The muscles that need to be inhibited include the gastrocnemius, soleus, adductors, tensor fascia latae, the short head of the biceps femoris, and the piriformis if the knee moves out with the overhead squat. To accomplish this the with the foam roll the individual will roll over each muscle and hold over tender areas for thirty seconds.

The second step would be lengthen muscular that is tight or overactive. This can be accomplished by static stretching with a thirty second hold, or NMS with a seven-ten second isometric contraction followed by a thirty second hold. The muscles that need to be lengthened include the gastrocnemius, soleus, adductors, tensor fascia latae, biceps femoris, and the piriformis if the knee moves out with the overhead squat. The third step would be to activate underactive muscles by using positional isometrics with four reps of increasing intensity of 25, 50, 75, and 100%. The individual can also use isolated strengthening will performing ten-fifteen reps with a two second isometric hold and a four second eccentric contraction. The muscles that would need to be activated include the anterior and posterior tibialis, gluteus medius, gluteus maximus, adductors, and the medial hamstrings if the knee moves out with the overhead squat. The final phase, integration, allows the individual to move through a total body functional activity. Functional activities would include the jump progression, and a functional movement progression that includes ball squats, step-ups, lunges, and single-leg squat. The individual would perform ten-fifteen reps slow and under control.

The corrective exercise program allows the athletic trainer to take the individual through all phases of the corrective exercise continuum and allows all muscular imbalances to be rehabilitated and corrected. The program would look very similar to the chart below for patellofemoral pain.

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| --- | --- | --- | --- |
| **Phase** | **Modality** | **Muscle(s)/Exercise** | **Acute Variables** |
| Inhibit | Self-Myofascial Release | Gastrocnemius/soleus, adductors, tensor fascia latae, short head of the biceps femoris, piriformis (knee moves out during overhead squat) | Hold on tender area for 30 seconds |
| Lengthen | Static stretching or NMS | Gastrocnemius/soleus, adductors, tensor fascia latae, biceps femoris, piriformis (knee moves out during overhead squat) | 30-second hold OR 7-10 second isometric contraction, 30-second hold |
| Activate | Positional isometrics and/or isolated strengthening | Anterior/posterior tibialis, gluteus medius, gluteus maximus, adductors and medial hamstring (knee moves out during overhead squat) | 4 reps of increasing intensity 25, 50, 75, 100% OR 10-15 reps with 2-second isometric hold and 4-second eccentric contraction |
| Integrate | Integrated dynamic movement | Jumping progressionFunctional Movement Progression:Ball SquatsStep-upsLungesSingle-leg Squat | 10-15 reps under control |

Taken from NASM Essentials of Corrective Exercise, (Clark & Lucett, 2011)

 Although exercise is the standard when dealing with patellofemoral pain, other modalities such as modification of exercise, biofeedback, neuromuscular electric stimulation, ultrasound, thermotherapy, bracing, patellar taping, and foot orthotics have been shown to be effective with pain control and treatment of patellofemoral pain (Aminaka & Gribble, 2008). Another protocol that has been used by athletic trainers and physical therapists to treat patellofemoral pain was developed by Jenny McConnell that was built off using a taping procedure to reposition the patella while performing exercises that re-educate the vastus medialis oblique (Houglum, 2004). The basis behind the tape job is to reposition the patella and allow the individual to work through a pain free range of motion with exercises. The hope is that by re-educating the vastus medialis oblique with the McConnell tape job the individual will eventually be able to work through a pain free range of motion functionally (Houglum, 2004).

**Conclusions**

Patellofemoral pain is one of the trickiest injuries that I have dealt. It seems like each one that encounter is different and requires a different mindset when dealing with the injury. This information that I covered helped me realize that I need to ensure that each athlete is properly evaluated and I have realized that I cannot treat the injury the exact way from athlete to athlete. It is important to look at each case individually and find muscle imbalances and joint dysfunctions up and down the kinetic chain that can be causing or predispose the athlete to patellofemoral pain.

 The information that I covered also gave me the background to write a corrective exercise program for an athlete that is suffering from patellofemoral pain. My mindset before the assignment was that most of the pre-existing conditions that led to patellofemoral pain came from the quadriceps, specifically the vastus medialis oblique and the IT band. It really helped me understand just how important the muscular at the hip is and can be to helping a person with patellofemoral pain or lessening the risk of developing patellofemoral pain.

 Typically during the school year with my women’s sports the number one injury that I see is patellofemoral pain and overall I have had a very difficult time helping the athletes decrease the pain. I would work with them on quadriceps strengthening and also McConnell taping, but that is typically where the rehabilitation ended. It would help initially, but after they returned to full participation with functional activities the pain would come right back. I now have an understanding of just how important the muscle imbalances at the LPHC and lower leg and foot are to the injury. I would say overall, I was very unsuccessful in treating the injury, but after the research and using the corrective exercise continuum I feel I am must more prepared to help my athletes rehabilitate the injury and help them continue their sport pain free.

 Athletic trainers must use the literature and research that has been done in regards to patellofemoral pain. So many times athletic trainers have preconceived notions of the injury and they think that there is really only one way to treat the injury (Ingersoll, 1998). It is important for athletic trainers to use the information that is presented to them and use the information about muscular imbalances to help their athletes to the best of their abilities.

 It is also important for athletic trainers to realize that the problem is not just at the patellofemoral joint, like so many believe. It is important for athletic trainers to realize that the injury can be caused by muscle imbalances and joint dysfunctions up and down the kinetic chain, especially at the foot and ankle and LPHC. Athletic trainers must be prepared to set up rehabilitation protocols for athletes that may be experiencing the pain from another group of muscles or another joint. The athletic trainer must know how to deal with these imbalances and they must have the knowledge to know what to look for when looking at possible problems that can cause patellofemoral pain.

 The literature that can be found concerning patellofemoral pain allows the athletic trainer to set up sound and safe corrective exercise programs for each individual athlete. These programs are meant to correct muscular imbalances for each individual athlete. That athletic trainer has to realize that protocols can change depending on the assessment for each individual. If the athletic trainer uses sound assessment tools and sound judgment they can set up a corrective exercise plan that can greatly reduce the risk of patellofemoral pain and greatly reduce the amount of time the athlete is held out of competition due to pain and discomfort.

 Patellofemoral pain can be difficult to treat, just because of the different muscles up and down the kinetic chain that can be causing the pain at the patellofemoral joint. It is important that the athletic trainer not treat each injury exactly the same. It is vital for the athletic trainer to take the time to properly assess the injured individual and come up with a corrective exercise program that targets the muscles that need to be inhibited, lengthened, activated, and integrated for that particular individual. If the athletic trainer uses the assessments and corrective exercise protocols that are discussed at length in the literature they will be much more successful in correcting the problem and save the athlete from having continuous pain and discomfort that is associated with patellofemoral pain.

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