Patellofemoral Pain Syndrome (PFPS) — Pathophysiology and Risk Factors

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Patellofemoral pain syndrome (PFPS) is a common condition that is characterized by anterior knee pain. The condition is more commonly seen in young women. Patellofemoral pain syndrome is characterized by the absence of any significant structural changes and with normal articular cartilage. PFPS is a diagnosis of exclusion.

Overview

Image: "Knee Anatomy," by Blausen.com staff (2014), "Medical
PFPS, known as “runner’s knee” in layperson terms, can be associated with other symptoms in addition to pain, including crepitus and functional deficit. The functional deficit can be severe enough to limit professional athletes’ activity, though the condition can occur in non-athletes as well. PFPS can be thought of as a precursor to osteoarthritis since most patients eventually develop osteoarthritis.

PFPS incidence is high, estimated to be around 22 per 1000 per year. The condition is twice as common in women than men.

**Epidemiology of the Patellofemoral Pain Syndrome**

PFPS occurs very frequently in physically active people. The age range for the frequent incidence of PFPS is 15 to 30. Even though the condition is common, there is little research on its occurrence.

**Pathophysiology of the Patellofemoral Pain Syndrome**

There are different hypotheses concerning PFPS pathophysiology. Recent research on PFPS pathogenesis has focused on patella maltracking, an imbalance in the action of the vastus lateralis and vastus medialis muscles, patellar malalignment, hip instability, rear-foot aversion, hamstring imbalance, knee-spine syndrome, and psychological factors. Therefore, most scholars agree that PFPS is a multifactorial disease where multiple factors cause a patella tracking problem.

**Patellar Mal-tracking in Patellofemoral Pain Syndrome**

The patella in patients with PFPS is more dynamic and poorly aligned to the adjacent structures. For instance, dynamic magnetic resonance imaging studies of the knee in patients with PFPS show the patella is localized more laterally than would be expected in a healthy individual. The patella is also found to be hypermobile in patients with PFPS.

When the patient goes from a standing to a squatting position, the patella glides more in patients with PFPS. These findings suggest a patella tracking issue, which is thought to play a key role in PFPS pathogenesis.

**Vastus Lateralis and Vastus Medialis Role in the Pathogenesis of PFPS**

For the patella to be hypermobile and more laterized, one would expect the muscles attached to it to be abnormally active and imbalanced. This hypothesis was confirmed in a recent study showing an imbalance between the vastus medialis and vastus lateralis in patients with PFPS. The vastus medialis is activated later than expected; hence, the patella is pulled laterally by the vastus lateralis muscle.

When patients climb upstairs or downstairs, both the vastus lateralis and medialis are expected to be activated equally and simultaneously so the patella remains in the correct position. The imbalance between the two muscles is a crucial pathological finding in patients with PFPS and is linked to abnormal patellar tracking.
Joint Malalignment in PFPS

Patients with PFPS usually do not have a malalignment problem with the femoral and tibial bones in the knee. On the other hand, patients with a malalignment that manifested as an increased Q-angle are more likely to develop knee problems, including PFPS. Therefore, athletes with increased Q-angles should be followed more closely to exclude the emergence of osteoarthritis or PFPS and treat knee pain as early as possible.

On the other hand, some physicians have noticed an abnormal dynamic alignment of the knee joint during walking in patients with PFPS. For instance, the dynamic valgus alignment was seen more often in female athletes who have PFPS than in those who did not. Dynamic magnetic resonance imaging of the patellofemoral joint in patients with PFPS showed abnormal joint kinematics. As expected from the mal-tracking hypothesis of pathogenesis, the femur was found to be excessively medially rotated in patients with PFPS, while the patella was laterally rotated.

These abnormal dynamic valgus alignments can be confirmed with the patient doing one-legged squats. The knee joint is found to collapse during one-legged squats.

Hip Stability and PFPS

The functional or dynamic malalignment of the knee joint explained in the previous paragraph may be caused by impaired hip stability rather than an internal knee problem. Patients with PFPS are found to have increased the internal “medial” rotation of the femur. This is caused by a weakness of the hip external rotators and abductors “gluteus medius and gluteus minimus muscles.”

Therefore, in the physical examination of a patient with PFPS, one expects to find a decrease in the strength of hip abduction and external rotation. Another examination technique is to ask the patient to stand on one leg for one minute. If the patient cannot stabilize the pelvis while standing on one leg, the leg the patient is standing on is affected and may have weak hip muscles.

Rear-foot Eversion and PFPS

Patients with PFPS also have abnormal foot mechanics. The tibia is also rotated internally when patients are standing and walking, which again gives the impression of a more lateralized patella. The internal rotation of the tibia is caused by rear-foot aversion; therefore, rear-foot aversion is associated with a higher risk of PFPS.

Hamstring Imbalance in PFPS

Most of the previous evidence about the pathology of PFPS was concerned with abnormal frontal plane knee motion. Patients with PFPS also have abnormal hamstring tightness. Patients with PFPS have a more pronounced and earlier contraction of the lateral hamstring muscle than the medial one. An imbalance between the hamstring muscles is associated with increased stress on the patella, patellar tracking, and, eventually, PFPS.

Knee-Spine Syndrome

Older patients with PFPS might have a decreased sacral inclination angle. This finding is not seen in younger patients with PFPS; therefore, the role of spinal abnormality in younger female patients with PFPS is not established.
Psychological Factors and PFPS

Anxious patients are more likely to complain of knee pain and PFPS compared to healthy subjects. Additionally, patients with PFPS are more likely to avoid sports and daily activities because of the fear of pain, which can have drastic effects on the patient’s general well-being.

Trigger of PFPS

Patients with the previous abnormal patellofemoral mechanics develop pain and PFPS when they overuse the knee joint. This can happen when the patient undergoes high-intensity training.

Risk Factors of the Patellofemoral Pain Syndrome

Factors that may lead to PFPS include the following:

- **Sex of The Person:** Patellofemoral pain is twice as common in women than it is in men. The reason for greater occurrence in women may be the angle between the bones meeting at the knee joint. This angle is greater in women because of the wider pelvis.
- **Age of The Person:** PFPS is usually associated with young adults and adolescents. Arthritis is the common cause of knee-related conditions in older people.
- **Some Types of Sports:** Partaking in certain sports can also cause PFPS. Running sports, for example, can result in additional stress on the knees, particularly after one has recently increased training levels.

Treatment of the Patellofemoral Pain Syndrome

When a patient is diagnosed with PFPS, the treating physician usually faces a dilemma. Since this is a diagnosis based on exclusion, should one go for surgical intervention or simple conservative management? The answer to this question can be obtained from the current literature about the different treatment options for PFPS. Recent research indicates that adding surgical intervention to the physiotherapy program does not achieve better outcomes than physiotherapy or conservative therapy alone; therefore, surgery is not recommended for patients with PFPS.

Non-steroidal anti-inflammatory drugs are usually ineffective in managing PFPS. Taping is helpful since it can prevent lateral patellar tracking, but it should be combined with physiotherapy and rehabilitation. Patella braces might be useful for managing PFPS, but more research is needed. Patients with foot disorders, in combination with PFPS, might benefit from foot orthosis in addition to taping and physiotherapy.

The only treatment that is proven very effective in managing PFPS is strengthening exercises for the hip muscles, trunk stability, quadriceps, and hamstrings. This treatment is evidence-based and supported by our current understanding of PFPS pathogenesis.

Prognosis of the Patellofemoral Pain Syndrome

Most patients respond well to suitable physiotherapy. Patients usually require many weeks to return to normal levels of functionality, and rehabilitation time may be
considerably longer in some cases. Early physiotherapy plays a significant role in reducing recovery time for all PFPS patients.

References


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