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Operative Techniques in
Orthopaedics

Patellofemoral Rehabilitation

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Patellofemoral syndrome is one of the most common conditions encountered by orthopedic surgeons and physical therapists. These patients present with a complex syndrome of multiple findings. Many, if not all, of these findings are related to biomechanical abnormalities in the lower extremity. Secondary changes in strength and flexibility frequently occur as the result of untreated malalignment. A physical therapy evaluation encompassing an assessment of functional biomechanics, patellar alignment, flexibility, and strength is crucial in developing an exercise program designed to address the specific deficits of each individual patient. A physical therapy program of closed chain therapeutic exercise designed to correct the underlying biomechanical deficits and subsequent malalignment of the lower extremity has been effective with excellent results and low recurrence of symptoms.
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Patellofemoral syndrome (PFS) is one of the most common conditions encountered by physicians and therapists.[1] It has been estimated to afflict 25% to 36%[2] of the population and account for 25%[3] of knee injuries and 10% of all injuries.[4] Other terminology used and relevant to PFS include chondrolmalacia patella, runner's knee, anterior knee pain, and retropatellar pain syndrome. PFS can significantly limit routine activities of daily living and more demanding athletic activities. Many patients with PFS present with chronic symptoms.

Many authors report successful management with conservative therapy whereas Tyler states results have been mixed.[5] Wilk and coworkers state that PFS is one of the "most vexatious clinical challenges in rehabilitative medicine." There have been many documented programs designed to conservatively manage PFS, with most emphasizing flexibility and quadriceps strengthening.[1,6] Although Post reports high success for patients in the short term, longer-term recurrence of symptoms appear to be questionable.[7]

Most health care providers agree that treatment is best initiated nonoperatively, which usually involves activity modification and a course of physical therapy. The therapy program should directly address the causes of common objective findings rather than focus on the symptoms themselves. In my experience, most findings are the result of biomechanical deficiencies as opposed to random findings with no underlying cause. The treatment program outlined in this chapter has produced excellent results with minimal recurrence over the course of 2 decades.

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Anatomy

Please refer to articles earlier in this issue of the journal for a thorough review of the anatomy. However, 2 structures that have significant clinical relevance in the treatment of PFS deserve further discussion: the vastus medialis obliquus (VMO) and distal iliotibial band (ITB)/lateral retinaculum. The distal ITB blends together with the lateral retinaculum to form a direct attachment to the lateral aspect of the patella. Tightness of this structure will lead to a lateralized patella with a concomitant lateral tilt.[1] This tightness induced malposition leads to a stretch weakness of the VMO caused by biomechanical inefficiency secondary to excessive length. It is important to note that the VMO attaches to the superomedial corner of the patella at an oblique angle. Studies have shown the VMO to have no extension moment and, therefore, it cannot be stimulated in the sagittal plane.[8,9] Its primary function is dynamic medial stabilization especially in terminal extension as the patella loses its bony support.[8,10]

A review of lower-extremity biomechanics is necessary to understand the basis of the etiology of these conditions and

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the therapy program designed to address the causes of the symptoms. The biomechanics will be reviewed from distal to proximal as the ground reaction force is the origin of stress ascending the loaded limb. The loading response of gait will be the reference as pain most commonly occurs at this time. Squats and stair climbing are simply variations of the same load.

Loading response occurs from the moment of impact at heel strike until just after foot flat. The purpose of this phase is for the foot to accommodate to the supporting surface and for the limb to accept the load of body weight. To accommodate this load, the hindfoot everts and the forefoot inverts. This movement creates a more parallel alignment of the planes of the hindfoot and forefoot allowing for a more supple structure. Eversion of the hindfoot allows the navicular to drop inferomedially. The ankle dorsiflexes, and the tibia rotates medially as it follows the navicular. The internal rotation of the tibia induces the internal rotation of the femur. Knee flexion is occurring as the knee assumes a valgus position. Hip flexion, adduction, and internal rotation also occur as the reaction force travels up the chain. The pelvis subsequently protracts and rotates anteriorly.[11,12]

In 20-plus years of clinical experience, I have consistently observed that many, if not all, of these motions are excessive in the pathological state. Excessive foot pronation occurs as the hindfoot continues to evert past neutral in the quest to have the first ray arrive firmly on the ground. This compensation is usually the result of a varus deformity of the forefoot. The compensatory force then triggers excessive motions further up the kinetic chain. All or most of the aforementioned motions increase in their magnitude producing many possible pathologies, especially patellofemoral malalignment. This compensatory pronation is responsible for many of the "causes" of PFS found in the literature, such as ITB and lateral retinaculum tightness, VMO weakness, and lateralized patella.[3,5,7] Looking up the kinetic chain, it becomes apparent that the malalignment is a medialization of the femoral groove as opposed to lateralization of the patella. Long-term malalignment of the lower extremity leads to tightness of the ITB, lateral retinaculum, hip flexors and adductors, among others. Not addressing restrictions in the flexibility of these tissues will inhibit a clinician's ability to achieve proper realignment of the lower extremity and patellofemoral joint.

Physical Examination

Common findings associated with PFS noted in the literature include excessive foot pronation, lateral patellar tilt and glide, tightness of the ITB and lateral retinaculum, compromised patellar mobility, atrophy and weakness of the VMO, as well as other weaknesses in the involved lower extremity.[3,5,7] It has been my experience that biomechanical deficiencies are the underlying cause of many of these findings.

Biomechanics

An assessment of a patient with PFS begins with a biomechanical evaluation of the lower extremity. I believe that lower-extremity malalignment is the main cause of many of the findings associated with PFS. A biomechanical examination begins with an assessment of foot alignment as the ground reaction force initiates all compensations in the loaded limb. Foot alignment offers a predictive value of other findings as one progresses proximally up the kinetic chain.

Assessment of foot alignment should be performed with the limb in the open chain with the foot maintained in subtalar neutral, which is the position of maximum congruence of the talonavicular joint. Subsequently, the foot also should be evaluated in the closed chain to assess the associated compensations. Neutral alignment in this position presents with the forefoot perpendicular to the hindfoot and the hindfoot aligned parallel to the distal leg.[11,12] Most patients with PFS will present with a varus deformity of the forefoot, where the forefoot is inverted in relation to the hindfoot. During loading response, this varus position forces the subtalar joint into greater eversion as the forefoot seeks contact between the first ray and the ground for stability. This movement will present as a valgus position of the calcaneus in standing.

This compensatory pronation will allow the navicular to excessively drop inferiomedially, with the talus following suit. This inferomedial motion of the talus forces the tibia to rotate internally while subsequently flexing the knee and inducing a valgus force at the knee. Internal rotation of the femur positions the femoral condyles and femoral groove medially. The hip exhibits increased flexion, adduction and internal rotation while the ipsilateral pelvis protracts and rotates anteriorly.

Although this series of events occurs during a normal loading response, these motions are excessive in the overpronator because of the excessive eversion occurring at the subtalar joint. However, these excesses will not present symmetrically. The joint or joints that display the greatest deviation from normal will typically be the location of the symptoms. In this case, malalignment of the foot and hip create the greatest effect on the knee as it receives the excessive force ascending from the foot and decreased control descending from the hip.

Observation

The most common physical examination finding on observation is atrophy of the VMO. The VMO loses much of its mechanical advantage and efficiency due to its excessive length. This length is the result of lateralization of the patella which also causes painful tension on the medial structures. Patients also frequently present with femoral anteversion. Femoral anteversion, an increase in the angulation of the femoral neck as it attaches to the femoral shaft, displaces the femoral groove in a medial direction as it produces internal rotation of the limb. This, combined with excessive foot pronation, creates a significant medial rotation of the femur.

ITB/Lateral Retinculum Tightness

Malalignment of the lower extremity allows tightening of the ITB as it is chronically shortened because of the positions of the pelvis, hip, and knee as listed previously. ITB tightness