Effective Management of Patellofemoral Joint Dysfunction

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Patellofemoral joint (PFJ) pain is a common complaint among athletes. Contributing interrelated factors often include muscle weakness, lateral retinaculum tightness, excessive Q-angle, and malalignment of the lower extremity kinetic chain. The purpose of this report is to present a comprehensive clinical approach to management of soft tissue imbalance around the PFJ.

Basic Biomechanical Function

The patella, which is the largest sesamoid bone in the body, increases the mechanical advantage of the quadriceps muscles at the knee. Its stability within the trochlear groove is attributable to the reciprocally configured articular surfaces of the PFJ, ligamentous restraints, and muscle tension. The lateral facet in the patella is larger than that of the medial facet, which accommodates the larger surface area of the lateral femoral condyle. The fiber orientations of the vastus lateralis, rectus femoris, vastus intermedius, vastus medialis, and vastus medialis obliquus (VMO) muscles determine the force vectors that act on the patella when the quadriceps muscle group is activated. The supero-lateral pull on the patella produced by vastus lateralis tension should be balanced by a supero-medial pull produced by VMO tension. If activation of the respective portions of the quadriceps muscle group is well coordinated, the cumulative effect of the muscle-generated tensile forces acting on the PFJ will evenly distribute compressive load across its articular surfaces. However, since numerous factors influence patellar alignment within the trochlear groove, dynamic balance of forces is difficult to achieve.

Evaluation

Evaluation of the PFJ should include assessment of patellar alignment within the trochlear groove, lower extremity alignment, and periarticular soft tissue tightness. The evaluation should determine how the patella moves, and the factors contributing to its movement pattern should be identified. A treatment plan for management of PFJ dysfunction should address the underlying causes of the condition, rather than having a focus on administration of therapeutic procedures to areas of symptom presentation. PFJ dysfunction is typically associated with lateral displacement of the patella during quadriceps contraction, which is caused by poor activation of the VMO and lateral extensor retinaculum tightness. A functional movement
assessment may identify lateral patellar displacement during activities such as squatting and stair-climbing. An excessive Q-angle and/or hip muscle weakness may also contribute to a mechanical imbalance.2

The fibers of the VMO have an oblique orientation that pulls the patella in a medial direction when the muscle contracts, but this fiber arrangement limits the contribution of the VMO to eccentric dissipation of vertical ground reaction force at the knee joint. The more vertical orientation of the fibers of the vastus lateralis and rectus femoris make them more effective in this regard, but the lateral component of the force vector that is generated tends to induce lateral displacement of the patella. Following knee surgery, the VMO is the first muscle to atrophy and the most difficult muscle in which to restore a normal level of strength.3 The VMO appears to be highly susceptible to arthrogenic inhibition, which results from joint afference that activates inhibitory interneurons within the spinal cord.

Management

A treatment plan for PFJ dysfunction in the presence of VMO weakness and lateral retinaculum tightness should address both mechanical factors that contribute to development of the condition. Manual therapy can improve PFJ mechanics during knee movement from flexion to extension. Soft tissue mobilization can decrease stiffness within the retinaculum at the distal end of the vastus lateralis and adjacent fascia of the iliotibial band. The soft tissue mobilization technique involves the application of manual pressure in a direction that is perpendicular to the longitudinal orientation of the vastus lateralis muscle and iliotibial band to release adhesions between adjacent tissues, which affects patella tracking during activities such as running, jumping, or squatting. Manual patella mobilization from 30 degrees of flexion to full extension can improve the extensibility of the lateral retinaculum, thereby restoring a more normal patella gliding pattern within the trochlear groove. The mobilization involves the application of a medially-directed force on the lateral aspect of the patella (applied at a point that is just above the lateral femoral condylar ridge) while maintaining a distally-directed stabilization force on the medial portion of the patella to prevent it from tilting in response to the medially-directed force. Taping may be temporarily utilized to facilitate maintenance of patellar stability during activity, but restoration of optimal VMO function should not be neglected.4 A stretching program should be implemented to improve the flexibility of the vastus lateralis, rectus femoris, iliotibial band, and the hamstring muscle group. Hamstring tightness increases resistance to knee extension, which may increase compressive loading between the patella and the femur near the end-range of knee extension.

When developing a strengthening program to address VMO weakness, anatomic relationships may be worthy of consideration. Research findings suggest that a double-leg semi-squat exercise produces greatest VMO activation when combined with maximum isometric contraction of the hip adductors.5 The observed enhancement of VMO activation could be related to its attachment to the adductor magnus tendon. Therefore, a stretched elastic exercise band that produces a medial to lateral pull on the thigh segment may facilitate a co-contraction of the hip adductors and the VMO near the end-range of either open-chain or closed-chain knee extension (Figures 1 & 2). Strengthening within the 10- to 30-degree range of knee flexion-extension should be emphasized, since lateral tissue tension is greatest within this arc of motion. Open-chain short-arc knee extension should be introduced early in the treatment program, with emphasis on the importance of VMO activation for control of patella tracking within the trochlear groove. Once the patient demonstrates