ATELLAR INSTABILITY can be a difficult problem for clinicians to manage. Treatment for lateral patellar instability may involve conservative care or corrective surgery. Among patients treated conservatively, it has been reported that the frequency of patellar-instability episodes decrease as the patient gets older.¹

Whether the athlete is managed conservatively or surgically, treatment for patellar instability typically involves a progression from an acute phase to a sports-specific phase. Throughout the rehabilitation process, reducing the lateral displacement force vector on the patellofemoral joint is key to protecting and promoting healing of the medial stabilizing structures of the patella that are often damaged. Pain and inflammation should also be controlled. As swelling resolves and the athlete’s range of motion and strength improve, rehabilitation progresses from the acute phase to a functional phase. The functional phase consists of activities such as stair climbing and gait training. Individuals who do not participate in sports may be satisfied once they achieve full function with daily activities. Athletes, however, should be progressed beyond the functional phase to the sports-specific and return-to-sport phases. This article discusses how clinicians treating athletes with patellar instability can address biomechanical and anatomical factors during the functional activity and return-to-sport stages of rehabilitation to promote healing of damaged structures.

**Biomechanics of Patellar Instability**

Biomechanical factors contributing to patellar instability may be intrinsic or extrinsic. Intrinsic factors are those related to the anatomy of the patella, such as laxity of the medial patella-stabilizing ligaments or a shallow femoral trochlea. Extrinsic factors are those that are not part of the knee anatomy but contribute to lateral patellar displacement.

**Intrinsic Factors**

Knowledge of the anatomy of the patellofemoral joint is essential for the clinician to understand its biomechanics. The medial stabilizing ligaments of the patella, including the medial patellofemoral ligament (MPFL) and the medial patellomeniscal ligament (MPML), often undergo plastic deformation as chronic instability develops. The MPFL originates from the adductor tubercle and attaches to the superomedial portion of the patella and the undersurface of the quadriceps. The MPML originates from the inferomedial portion of the patella and superomedial portion of the infrapatellar tendon and indirectly attaches to the tibia through attachment to the coronary ligament anterior to the medial collateral ligament.² More than 50% of the restraint to excessive inferolateral patellar displacement is attributed to the MPFL, with the greatest restraint provided in knee flexion when the MPFL is most taut.³ In flexion, the medial femoral condyle also acts as a cam to accentuate elongation of the MPFL.⁴ In contrast, the MPML contributes up to 25% of the restraint to lateral patellar displacement, with its greatest restraining effect provided in extension.² ⁶

If the medial patellar ligaments are injured, therapeutic exercises should impose minimal stress on them. For example, avoiding high resistance in the 30–0° range of knee extension protects the MPML. Avoiding deep squats and other exercises involving
extreme knee flexion theoretically protects the MPFL. An understanding of the biomechanics of the patellofemoral joint should guide selection of therapeutic activities that will minimize stress on the anatomic structures that normally resist lateral displacement of the patella.

**Extrinsic Factors**

Extrinsic factors that contribute to lateral patellar instability include lower extremity malalignment, weakness, and inflexibility. Biomechanical factors that contribute to creation of a lateral force vector acting on the patella include subtalar pronation, genu valgus, internal femoral rotation, and hip adduction (Figure 1). Demands imposed by sports activities can accentuate the effects of biomechanical malalignments that contribute to patellar instability (Figure 2). For example, basic positions of dance, such as the plié and passé, increase the lateral force vector on the patellofemoral joint as the dancer attempts to achieve a turned-out position (Figure 3). Dancers with pronated feet, hip weakness, or other impairments commonly suffer patellofemoral instability. Rehabilitation focused on extrinsic factors may adversely affect healing of intrinsic structures.

**Advanced Rehabilitation Phases**

**Functional-Activity Phase**

The functional-activity stage of the rehabilitation program emphasizes restoration of general mobility, that is, normal gait and stair climbing, while protecting the patellofemoral joint from lateral displacement. Biomechanical deviations can be analyzed during closed kinetic chain activities involving single-leg stance, such as a lateral step-up or a single-leg squat, to identify extrinsic factors that stress the patellofemoral joint. Excessive subtalar pronation is an example of an extrinsic biomechanical deviation that a clinician might observe with these closed kinetic chain activities. Patients with excessive subtalar pronation often present excessive genu valgus. Weakness in the lower extremity and trunk can also contribute to these biomechanical deviations.

A multifaceted approach to management of the condition is needed to address factors contributing to lateral patellar instability occurring during functional activities. Passive restraints can be used to influence intrinsic and extrinsic factors. An orthotic with a medial heel wedge can be used to reduce foot pronation and rear-foot valgus. The orthotic can, thereby, indirectly correct more proximal deviations along the kinetic
chain associated with altered foot mechanics. A knee support with a lateral buttress can be used to directly reduce stress on the medial anatomic structures that restrain lateral patellar displacement. Such interventions can facilitate progression to functional activities while protecting the patellofemoral joint.

Therapeutic strengthening exercises can also address biomechanical deviations. For example, adequate hip-abductor and external-rotator strength are key to reducing lateral forces on the patellofemoral joint. Core strength should also be addressed. Foot strength is especially important for athletes who perform demanding weight-bearing activities, such as dancers and soccer players. Open kinetic chain exercises can be used to address weakness, but the emphasis in this stage is development of neuromuscular control that facilitates maintenance of proper mechanics during functional activities. Clinicians mainly use dynamic activities that require contribution from muscle groups acting on multiple joints in weight-bearing positions and that stress the core musculature. Proper technique during physical activities should be emphasized throughout rehabilitation. Proper technique and optimal extremity alignment can be promoted by using a mirror for visual feedback, as well as verbal and/or manual feedback from the clinician. Once mobility is restored and functional alignment is addressed, the athlete advances to the sports-specific phase.

**Sports-Specific Phase**

Baseline strength testing is important to determine the athlete’s readiness for functional rehabilitation. If isokinetic-strength measurements are not available, isotonic strength can be tested with lower extremity weight machines for the leg press, knee extension, and hamstring curl. The capability of the involved extremity to produce forces equivalent to 85% of the uninvolved extremity is a reasonable criterion for progressing an athlete to the sports-specific phase.

Progression during the sports-specific phase involves a gradual increase in demands, with continued emphasis on proper technique to minimize the lateral patellar-displacement force vector. For example, ballet dancers begin by performing the basic dance positions of a plié and passé in neutral and slowly progress to a turned-out position. Performance variables, such as speed, direction, and surface stability, are manipulated during this phase. Application of this concept may involve performing basic sport-specific positions at greater degrees of knee flexion and on unstable surfaces to provide further challenge. The athlete would then be progressed to more dynamic maneuvers, such as plyometric exercise. Although the basic concept of gradually increasing the demand of the activities applies to all sports, the activities chosen should relate to the demands imposed on the patellofemoral joint by the athlete’s specific sport.

**Return-to-Participation Phase**

Once the athlete is guided through a progression of sports-specific activities, and the clinician is comfortable with the athlete’s awareness of technique that minimizes the lateral-displacement force vector on the patella, functional tests can be used to determine whether the athlete is ready to progress to the return-to-participation phase. Examples of common functional tests for sport are the single-leg hop for distance and the 15-s lateral step-up test. Tests should be adapted to be as sport specific as possible. Cone drills in sport-specific formations are one example. A general guideline to assist the clinician in deciding whether to progress the athlete to limited or full participation is attainment of functional-test and strength scores for the involved extremity that are within 90% of those for the uninjured extremity.

Progression through the phases of rehabilitation often requires 8–12 weeks, with the length of time varying on the basis of sport demands, extent of injury, and the athlete’s preinjury condition. An isolated tear of the MPFL, for example, may only take 8 weeks to progress to the return-to-participation stage, whereas a combined tear of the MPML and MPFL would likely take closer to 12 weeks. Just as the demands of activities were gradually increased in the earlier phases of rehabilitation, return to full sports participation should involve a gradual progression. For example, a soccer player should participate in team practice sessions before competing in a game. Gradual progression in exposure to the demands of a sport or activity and emphasis on proper technique are key concepts that should guide rehabilitation from the acute phase to the return-to-participation phase.

**Indications for Surgical Referral**

Surgical repair may be necessary for full restoration of function in patients who have ligamentous laxity or osteochondral lesions that fail to heal with conservative care. Clinicians should assess the integrity of
these structures to determine whether or not referral is indicated. Clinical tests to detect laxity of the MPML and MPFL can be effectively performed with the knee in 20° of flexion, a position where there is less but-tressing effect provided by the lateral femoral condyle. Clinical testing for the MPFL involves an inferolateral displacement of the patella (Figure 4), whereas testing of the MPML is effectively performed with a direct lateral displacement of the patella (Figure 5).6,9 In addition, diagnostic imaging studies may be useful. Clinicians should be attentive to signs that the athlete is not responding to conservative care, in which case referral is appropriate.

**Conclusion**

Athletes with patellar instability may respond well to conservative care, particularly when clinicians address factors that minimize lateral-displacement forces acting on the patellofemoral joint. Awareness of sports-specific demands is crucial for development of an effective rehabilitation program for patellofemoral instability. The ultimate goal is to return the athlete to full sports participation as soon as possible, while minimizing the risk of recurrent patellar subluxation.

**References**


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