When Patellofemoral Pain Meets Conservative Care

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Patellofemoral pain is one of the most common gait-related disorders, affecting more than 25% of the running community (1). Despite the high prevalence, identifying the cause for this condition has been enigmatic. Early research based on an off weight-bearing model of knee function suggested the most likely biomechanical cause for patellofemoral pain syndrome was a lateral shifting of the patella between the femoral condyles. The most frequently cited causes for this include an increased Q-angle and/or weakness of the vastus medialis obliquus muscle (VMO). Both of these conditions allow the patella to displace laterally into the lateral femoral condyle. As a result, various treatments were designed to correct faulty movement of the laterally displacing patella, with standard treatment programs emphasizing taping, soft tissue mobilization and quadriceps strengthening. Unfortunately, these treatment protocols have been proven to be relatively ineffective in the management of chronic retropatellar pain.

To get a better understanding of patellofemoral biomechanics in a weight-bearing environment, Powers et al. (2) utilized dynamic MRI as subjects performed closed kinetic chain knee flexion. Surprisingly, these authors discovered the primary cause of lateral patellar displacement was not a shifting of the patella into the femoral condyle, but a shifting of the lateral aspect of the distal femur into the patella. Powers et al. (2) confirmed that contrary to popular belief, the patella does not shift into the stable lateral femoral condyle, but rather, the lateral femoral condyle rotates into the stable patella. Recent CT and functional MRI evaluations support this observation, confirming the most likely cause of patellofemoral pain during weight-bearing is abnormal motion of the femur, not altered motion of the patella (3,4).

Hip weakness has been cited as the most probable mechanism for the exaggerated internal femoral rotation. In a 3-dimensional evaluation of runners with and without patellofemoral pain syndrome, Dierks et al. (5) proved that runners with weak hip abductors have greater ranges of internal femoral rotation during stance phase, and the degree of rotation increases when runners become fatigued. Although the authors state that it is unclear whether hip weakness is a cause or an effect of patellofemoral pain syndrome, comprehensive conservative treatment should include exercises that target these specific muscles. A clinically important test to help identify individuals in which hip weakness is affecting femoral rotation is the dynamic single-leg squat test (Fig. 1). Developed by Crossley et al. (6), this extremely useful test has excellent interrater reliability and a positive test has been correlated with delayed recruitment times in the hip abductor musculature. Simple pre- and post-treatment evaluations allow the practitioner to observe changes in motor recruitment patterns.

Besides hip weakness, another frequently cited cause of retropatellar pain is excessive pronation. Since too much pronation may allow the lower extremities to internally rotate through greater ranges of motion (displacing the lateral femoral condyle into the lateral patellar facet), controlling excessive pronation with orthotic intervention

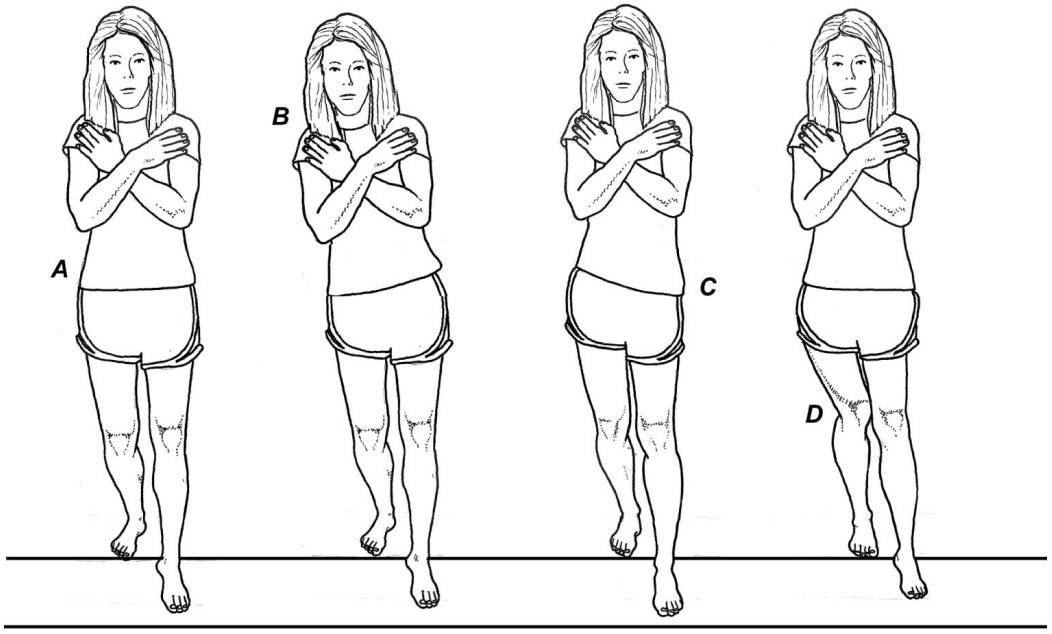

Fig. 1. The dynamic single-leg squat test. When the hip abductors are working properly, the lower extremity, pelvis, and spine remain well-aligned while stepping off a 4-inch platform (**A**). When the hip abductors are weak, the individual accomplishes the step-down by tilting the torso ipsilaterally (**B**), lowering the contralateral pelvis (**C**), or by valgus collapse of the ipsilateral leg (**D**). Modified from Crossley et al. (6).

is a popular treatment protocol for managing patellofemoral pain syndrome. In an extremely thorough randomized controlled trial, Collins et al. (7) confirm that individuals with patellofemoral pain syndrome treated with prefabricated foot orthotics have significantly better outcomes compared to individuals treated with flat inserts. Although it is tempting to assume the orthotics are effective because they lessen pronation and hence internal rotation of the lateral femoral condyle into the patella, studies correlating improved outcomes with reduced ranges of pronation have found conflicting results: Sutlive et al. (8) report that people who pronate through small ranges of motion are more likely to have successful outcomes when treated with orthotics, while the Vicenzino et al. (9) note that individuals with greater midfoot mobility are more likely to have a favorable response to orthotic intervention. More recently, Crossley et al. (10) found no correlation between excessive foot pronation and improved clinical outcomes following orthotic intervention. This is consistent with 2- and 3-dimensional studies confirming no correlation between patellofemoral pain and pronation (11,5).

The main reason orthotic intervention produces such variable clinical outcomes when prescribed to alter pronation is most likely explained by arch-related variation in the location of the subtalar axis. As demonstrated by Williams et al. (12), although people with low arches present with greater ranges of pronation during stance phase, they convert a much smaller percentage of frontal plane motion into tibial rotation. Conversely, individuals with high arches move through stance phase with smaller ranges of calcaneal eversion, but they convert a larger percentage of this motion into tibial rotation. The end-result is that people with high and low arches move through the gait cycle with almost identical ranges of tibial rotation (12). This is consistent with a growing body of research showing a limited connection between arch height and patellofemoral pain syndrome.

This is not to say that orthotics should not be used in the management of this common disorder. Because orthotic intervention is associated with excellent outcomes in 25-40% of a patellofemoral pain population (7,13), the clinical challenge lies in identifying the individuals most likely to have favorable outcomes. To address this issue, Collins et al. (7) performed a clinical prediction rules study and made the important observation that when individuals with patellofemoral pain report less discomfort when performing single-leg squats while wearing prefabricated orthotics, the potential that orthotic intervention will produce a marked reduction in symptoms after 12 weeks of regular use increases from 25% to 45%. According to Collins et al. (7), the patients most likely to respond to orthotic intervention typically claim the prefabricated devices make it easier to balance while performing the squat and frequently report an increased ability to complete pain-free step-downs from a 20 cm high platform. Rather than functioning to reduce tibial rotation, orthotics may diminish retropatellar pain by enhancing proprioception thereby improving motor control of the lower extremity.

The final consideration in the nonsurgical management of patellofemoral pain syndrome relates to the evaluation of alternate biomechanical factors that may increase the range of internal tibial rotation present during stance phase. The most common factor affecting tibial rotation is ankle equinus, in which an early heel lift causes the talus to adduct and plantarflex thereby twisting the tibia inward. It is also important to evaluate the integrity of the ankle ligaments following ankle sprain, because laxity of the anterior talofibular ligament significantly increases the transfer of calcaneal eversion into internal tibial rotation (14). Treatment of ankle laxity should include rock boards and closed kinetic chain exercises to stabilize the lower kinetic chain.

Manual therapies applied to the spine, hip, and knee should also be considered. In a recent randomized controlled trial, van den Dolder and Roberts (15) confirm that transverse friction massage and patellar mobilization produce significant reductions in a functional step-down task compared to a control group. Spinal manipulation should also be considered, since it may improve neural drive to the quadriceps muscle (16). Finally, because running amplifies ground-reactive forces 5-fold, overweight individuals should be encouraged to reduce body mass index, and even small reductions in weight may significantly lessen discomfort. In almost all situations, individuals with patellofemoral pain syndrome should walk and/or run with shorter stride lengths, and consider switching to mid or forefoot strike patterns, which lessen the transfer of ground-reactive forces through the knee by as much as 50% (17).

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