[IMAGE]

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Patellar Malalignment -- Part I

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Although there are a variety of diagnoses that we use with regards to the spine, our basic treatment is to restore function. No matter what the diagnosis, our main approach is to treat the spinal dysfunction by conservative methods.

Patellofemoral (PF) problems have been categorized as patellar malalignment syndromes, lateral compression syndrome, patellar arthralgias, chondromalacia patellae, patelllar subluxation, etc. No matter what the diagnosis, we still must treat the patellofemoral dysfunction.

Malalignment of the patella, especially as it tracks up and down the femoral trochlea during knee flexion and extension, represents the functional key in understanding patellar dysfunction. As in the spine, we must consider not only the spinal function but also involvement of related areas and their effect on the spine. The concept of treating related areas, i.e., all the soft tissue from the pelvis to the foot, is especially important in PF problems.

When discussing knee problems it is important to realize that we are dealing with two joints: the patellofemoral and the tibiofemoral. Each has distinguishing peculiarities pertaining to clinical findings and treatment, and each is also related. This first article will deal with the patellofemoral joint function, which happens to be a more common cause of knee pain.[1] The next article will discuss conservative treatment of PF type problems.

As with any part of the human anatomy it is essential to understand the normal function of the particular structure. We must understand the structure from a static and dynamic point of view. Conservative treatment of PF problems must take into account the static and dynamic stabilizers of the patella in order to devise effective treatment. Because the patella is a link between the pelvis, hip, and foot, we also must take into account how these structures and the tissues extending from these structures also relate to the PF function.

The patella is part of the extensor mechanism of the lower extremity. This extensor mechanism is composed chiefly of the quadriceps femoris (rectus femoris, vastus lateralis, vastus intermedius, vastus medialis),

quadriceps tendon, patella, and patellar tendon. The patella acts as a fulcrum (central tent pole effect[2]) which by displacing the quadriceps anteriorly provides a mechanical advantage which increases the extension force of the leg by about 30 percent.[3] The extensor mechanism's chief function is to act as a stabilizer or effect a momentum change (decelerate the knee) on the tibiofemoral joint in varying knee-joint positions.[4]

In order for the patella to function (normal tracking) there must be a balance between the lateral and medial patellar tissues. Statistically, there must be a normal track, i.e., a normally developed medial and lateral femoral condyle and sulcus; and normal wheels, i.e., normal medial and lateral patellar facets. The leg is normally oriented about 7 degrees valgus because the medial femoral condyle extends distally farther than the lateral femoral condyle. Anteriorly, the lateral femoral condyle is more prominent than the medial femoral condyle and acts as a lateral buttress to prevent the patella from shifting too far literally due to the naturally stronger lateral patellar stabilizers. The main lateral forces are the lateral retinaculum, vastus lateralis and iliotibial tract. One of the insertions of the iliotibial band is into the lateral patella and patellar ligament. The resisting medial forces are mainly the vastus medialis obliquus (VMO) and the medial retinaculum. The VMO is the lower portion of the vastus medialis. The vastus medialis angles into the patella at 15 to 18 degrees while the VMO angles in at 50-55 degrees. It is thought that the function of the VMO is to act solely as a medial stabilizer of the patella rather than as an extender,[5] especially during the last 30 degrees of knee extension.[6] The VMO should function throughout knee movement from extension to flexion.[5] Due to the prevalence of lateral tightness (usual direction of patellar subluxation) and the importance of the VMO in PF problems, the next article on treatment will pay particular attention to this muscle.

One of the most important functional aspects of the PF joint is an understanding of the dynamics of patellar tracking. As a sitting patient flexes and extends his knee, there should be a smooth, longitudinal trajectory. During this motion, the examiner should be palpating the medial and lateral sides of the patellar and observing its motion. Normally, starting from the extended position, the patellar is hypermobile because it is proximal to the troclear groove, and not in contact with the femoral condyles. As knee flexion begins the patellar moves distally and medially and near 20 degrees contacts the trochlear groove. At this point the inferior portion of the patellar is making contact. During this range as the patellar enters the groove (or exits the groove during extension) any abrupt movement is abnormal.[7] At 45 degrees flexion the middle portion of the patella is in contact. At 90 degrees of flexion the superior portion of the patella is in contact while the

patella glides slightly lateral. After 90 degrees the quadriceps make contact with the trochlea and the patella continues to move laterally. At full flexion the medial femoral condyle can be easily palpated since the patella has moved laterally (also tilts laterally) to cover the lateral femoral condyle. The patella should slide distally a total of about 8 cm. Due to the screw-home mechanism, the tibia internally rotates on the femur during the first 15 to 20 degrees of flexion and externally rotates during the last 15 to 20 degrees of terminal extension. In the last 10 degrees of extension the patella should deviate slightly laterally as it leaves the trochlear groove. Extreme terminal lateral movement may indicate patellar subluxation.

Therefore, the dynamic balance between the medial and lateral sides of the patella should control patellar tracking (providing the bony structures are normal) throughout the range of motion. This dynamic balance is especially important during the last 20 degrees of extension where the patella loses its static bony stabilization in the femoral sulcus and where the quadriceps is extremely important as a knee decelerator.[8]

The dynamic and static stabilizing forces of the patella cause the patella to compress (joint reaction force) against the femur. If a PF problem exists, it is important to know what angles of knee flexion create the most compression so that exercises can be prescribed which do not aggravate the PF joint. The angle of flexion where the quadriceps create the most stress is also essential. There is also the thought that exercising the knee loaded from above (as normal function provides) rather than exercising with distal weights on the lower legs is more beneficial. These topics will be discussed in the April "Soft Tissue" article.

During active knee extension of the seated patient, if the knee cannot be extended actively to 0 degrees (full extension), but can be extended passively to 0 degrees, an extensor lag is present. This may be due to pain and weakness resulting from quadriceps or patellar tendon rupture, fracture of the patella, avulsion of the tibial tubercle, intra-articular pathology, hamstring spasm, or just general quadriceps weakness.[9] Abnormal patella tracking creates abnormal shear stresses that may damage the patellar articular surface.

References

1. Ellison, A.E. Athletic Training and Sports Medicine. Chicago: American Academy of Orthopedic Surgeons 1985.

2. Ficat, P.R., D.S. Hungerford. Disorders of the Patellofemoral Joint. Baltimore: Williams & Wilkins 1977.

3. Nordin, M., V.H. Frankel. Basic Biomechanics of the Musculoskeletal System. 2nd ed. Philadelphia: Lea & Febiger 1989.

4. Terry, G.C. "The Anatomy of the Extensor Mechanism." Clin in Sports Med. 1989; 8 (2): 163-177.

5. Lieb, F.J., Perry, J., "Quadriceps Function: An Anatomical and Mechanical Study Using Amputated Limbs." J Bone Joint Surg. 1968; 50A: 1535-148.

6. Bose, K., Kanagasuntherman R., Osman, M.B.H., "Vastus Mediialis Oblique: An Anatomical and Physiological Study." Orthopaedics 1980; 3: 880-883.

7. Carson, W.G., James, S.L., Larson, R.L., et al. "Patellofemoral Disorders; Physical and Radiographic Evaluation, Part I." Clin Orthop Relat Res. 1984; (185): 165-177.

8. Brunet, M.E., Stewart, G.W., "Patellofemoral Rehabiliation." Clin in Sports Med. 1989; 8(2): 319-329.

9. Hammer, W.I. Functional Soft Tissue Examination and Treatment by Manual Methods: The Extremities. Gaithersburg, Maryland: 1991.

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Editor’s Note:

Dr. Hammer will conduct his next soft tissue seminar on March 23-24 in Boston. You may call 1-800-327-2289 to register. Dr. Hammer's new book, Functional Soft Tissue Examination and Treatment by Manual Methods: The Extremities, is available. Please see the Preferred Reading and Viewing list on page xx to order your copy.

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