Anatomy and Function of the Popliteus Muscle.

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The PMTC contributes to both static and dynamic poterolateral knee joint stabilization. During concentric actication, the popliteus internally rotates the tibia on the femur. During eccentric activation, it serves as a secondary restraint to tibial external rotation on the femur. Based on the work by Versalius, Fuss confirmed that in the sagittal plane the popliteus muscle is not a knee flexor, but instead provides a small extensor function through the flexion-extension ROM. These findings suggest that the PMTC serves a more functional role in the transverse plane.

Anatomy:

The PMTC originates from the lateral femoral condyle near the LCL and inserts along the proximal 10-12cm of the posteromedial tibial surface forming the floor of the popliteal fossa. Some of its distal fibers are interconnected with fascial fibers attached to the distal region of the MCL. By attaching into their tendon at an angle oblique to the resultant line of pull, PMTC fibers enable uniform force distribution over a greater area. The PMTC has major attachments to the lateral femoral condyle, the fibula and the posterior horn of the lateral meniscus, and smaller attachments to the arcuate ligament complex, the oblique popliteal ligament and the ligaments of Wrisberg and Humphrey, and the PCL. Tria et al in a dissection of 40 knees reported that 82.5% of the knees evaluated failed to show any attachment of the PMTC to the lateral meniscus. This suggests that the ability of the PMTC to affect the meniscus is variable between subjects. At the popliteus musculotendinous junction there are two popliteofibular ligament divisions that course laterally and distally, attaching on the posteromedial aspect of the fibular styloid. In addiation to providing non-contractile restraint to tibial external rotation, the PFL serve as a pulley, helping to tether the tendon during popliteus activation. The popliteus is under maximum tension during flexion, possibly taking over the noncontractile knee joint stabilization function of the LCL which is not taught in most flexion positions.

Harner et al reported that an addiation of 44N of force to the PMTC reduced PCL forces by 9% and 36% at 90 degress and 30 degrees of knee flexion, respectively. Shahane and Harner et al reported that the PFL was the main noncontractile restraint to tibial external rotation and the LCL was the secondary restraint.

During the initial 30 degrees of knee flexion, the LCL provides a greater contribution to resisting tibial varus and the PMTC provides greater contributuion to resisting tibial external rotation and posterior translation. As the posterolateral knee joint capsule slackens with increasing knee flexion, it contributes less to resisting tibial external rotation. Due to the influence of the knee joint angle on the capsuloligamentous tightness, the contractile component of the PMTC subsumes a greater dynamic responsibility for providing knee joint stability as knee flexion angles increase.

Poplteus Muscle Function:

Non-Weight Bearing – During seated isometric knee extension with the tibia maintained in full internal rotation, the greatest popliteus muscle activation were observed between 60 and 20 degrees of knee flexion and decreased as full extension was reached. Ith subjects positioned prone – beginning with the knee in full extension, popliteus activation markedly increased over the initial 20 degrees of knee flexion with the tibia maintained in full internal rotation. Levels gradually increased as 90 of flexion was reached. During isometric testing, popliteus activation remained constant with low amplitudes with the tibia in external rotation.

With patients who have posterolateral knee instability and capable of volitional tibial subluxation, Shino et al reported that the biceps femoris created the major tibial subluxation force and the popliteus provided the major reduction force. They concluded that the popliteus was the dynamic key to the treatment of posterolateral knee joint instability.

Weight Bearing – The popliteus displays its maximum moment arm at 30 – 50 degrees of knee flexion, essentially when the LCL, PFL and ITB were no longer capable of providing optimal noncontractile knee joint postural control. Farraz et al reported that the popliteus was ost active during standing, when the ACL and PCL became uncrossed and relaxed during internal tibial rotation and particularly when the knee was flexed between 30 – 50 degrees. This relaxed position of the cruciates brings the knee joint to a crtical point of poor noncontractile tissue contributions to joint stability. At this stage the PMTC activation serves as a dynamic knee joint guidance substitution for the action of the crossed and tensed cruciate ligaments. This 30 – 50 knee joint alignment correlates with the position commonly assumed with sudden stopping during running and stopping activities. Barnett et al observed consistent popliteus activation when subjects assumed a crouching standing posture. This activation was believed to assist the PCL with preventing anterior femoral dislocation on a fixed tibia.

Musculotendinous Kinesthesia:

McIntyre et al confirmed the presence of slowly adapting popliteus muscle spindles that discharge tonically when the knee joint was positioned in intermediate flexed positions or during passive tibial external rotation. They suggested that the kinesthesia provided by the popliteus muscle spindles compensated for the comparative paucity of capsuloligamentous joint mechanoreceptors that could be activated at intermediate knee joint flexion angles due to reduced capsuloligamentous tension.