The role of the popliteal tendon and popliteofibular ligament in preventing knee external rotation

ZHANG H, FENG H, HONG L, WANG X, ZHANG J, LIU X, SHEN J

Beijing Jishuitan Hospital, China

zhui76@bbn.cn

Objective: Techniques for the selective cutting of ligaments in cadaver knees defined the static contributions of the posterolateral structures to external rotation instability from 0° to 120° of flexion under an external moment of 5 Nm with the lateral collateral ligament (LCL) intact. And 3 posterolateral corner reconstruction techniques were evaluated for the posterolateral rotation stability.

Methods: Section sequence of the Group 1 was that the popliteofibular ligament (PFL) was sectioned first in the fibular insertion, and then the popliteus tendon was sectioned in the muscle-tendon junction site. Group 2 was the popliteus tendon first, and then the PFL in the same manner. The external rotation was measured by the navigation system. Then the PFL reconstruction, popliteal tendon reconstruction and popliteal tendon + PFL reconstruction were performed with Tibialis anterior tendon respectively. A PCL femoral aimer (Arthrex Inc, Naples, Fla) was adapted for this portion of the reconstruction. For the fibular tunnel, a K-wire was drilled through the fibular head from the attachment site of the popliteofibular ligament on the posteromedial fibular styloid to the anterolateral aspect of fibular head using the PCL drill guide. A 7-mm tunnel was reamed over this guide pin. For the tibial tunnel, the guide was placed on the posterior popliteal tibial sulcus at the level of the popliteus musculotendinous junction (approximately 10 mm distal to the margin of the articular cartilage). A second K-wire was then drilled in an anterior-posterior direction through the drill guide from a point just distal and medial to Gerdy's tubercle to exit at the posterior tibial popliteal sulcus. A 7-mm reamer was used to prepare the tibial tunnel by reaming over the K-wire with a large curette protecting the neurovascular bundle posteriorly as the reamer was drilled.The external rotation was also evaluated after each reconstruction was performed and compared with each other. The femoral attachment site of the popliteal tendon was then identified according to the insertion of popliteal tendon, which was in the proximal part of the popliteal sulcus. An eyelet-tipped guide pin was drilled into the popliteus tendon attachment site on the femur, aiming anteromedially, through the distal femur. This guide pin exited the distal femur proximomedial to the medial epicondyle and adductor tubercle. A 9-mm femoral tunnel was then reamed over the guide pin to a depth of 30 mm. The tibialis anterior tendon grafts were then prepared as shape "Y". The fold end of graft was introduced into femoral tunnel and fixed with interference screw. Then the PFL or popliteal tendon was reconstructed with the both ends of the graft. For the second part of this study, according to the test protocol, the popliteal tendon graft was tightened on the tibia by applying an anterior traction load to the grafts at 60° of flexion and neutral position of the foot. The graft was fixed with 7x25mm cannulated bioabsorbable interference screw in the tibia tunnel. Then the biomechanical test was performed and the external rotation of tibia was measure by the navigation system with 5Nm external rotation moments applied. After that, the popliteofibular ligament graft was tightened and fixed in the same manner, and test again. Then the interference screw in the tibial tunnel was taken off to simulate the popliteofibular ligament reconstruction only, and test again. The data was analysised with SPSS 13.0 software.

Results: Section of the PFL or popliteus tendon produced no significant changes (only 1° to 3° in external rotation) from 30° to 120° flexion ($p>0.05$). Section of PFL combined with popliteus tendon produced 1° to 7° increase in external rotation, the difference was significant ($p=0.018$, $p=0.030$). In comparing both the intact knee and the different reconstructed knee to the injured condition, there was no significant difference in external rotation between the intact and PFL reconstructed knee at 30° to 90° of flexion ($P > 0.05$). And no significant difference in external rotation between the popliteal tendon reconstruction and popliteal tendon combined PFL reconstruction at 30° to 90° of flexion ($P <$

0.05). But comparing the intact and popliteal tendon reconstructed knee or popliteal tendon combined PFL reconstructed knee conditions, there were statistically significant difference between the intact and 2 reconstructed states at 30° to 90° of flexion ($P < 0.05$).

Conclusion Our findings show that the popliteus tendon and PFL was a function unit, which could be called popliteus muscle-tendon-ligament complex. Injury to this complex should results external rotation instability and should be reconstructed. The PFL reconstruction technique used in this study can restore the stability of the PLC injured knee. And the popliteal tendon reconstruction or popliteal tendon + PFL reconstruction techniques we used in this study will overstrain the posterolateral injured knees.