INTRODUCTION: Injuries to the posterior cruciate ligament (PCL) account for 4-20% of all acute ligamentous knee injuries. Currently there is no consensus on how to optimally reconstruct the PCL. A variety of surgical techniques for PCL reconstruction have been described which have yielded inconsistent clinical results and have failed adequately to restore normal knee laxity. Controversy exists concerning the precise position of the femoral tunnel for the PCL graft. The PCL is composed of two functional bundles (the anterolateral PCL bundle which is the primary restraint to posterior tibial translation from 60 to 120 degrees of knee flexion and the posteromedial bundle which shares restraint of posterior tibial translation from 0 degrees to 60 degrees of knee flexion). The anatomy of the femoral origin of the PCL is complex as the diameter of the footprint is more than twice the midsubstance diameter of the ligament.

As the native PCL femoral footprint will typically be larger than the graft used to reconstruct the PCL, the surgeon must choose which portion of the PCL to reconstruct. While some biomechanical and clinical studies have demonstrated successful reconstructions using a tunnel placed centrally within the PCL footprint or at an isometric point within the footprint, others have advocated positioning the tunnel in the distal and anterior portion of the femoral footprint to optimally reconstruct the anterolateral bundle. Still others have advocated using a two-bundle reconstruction to restore normal laxity and graft force profiles.

The objective of this study was to determine the effect of changes in femoral tunnel position on the intra-articular graft force in single bundle bone-patellar tendon-bone tibial inlay PCL reconstructions. Two femoral tunnel orientations were tested: 1) A centrally placed tunnel (central) within the femoral PCL footprint reconstructing a portion of both the anterolateral and posteromedial ligament bundles and 2) An eccentrically placed tunnel (eccentric) in the distal and anterior portion of the PCL femoral footprint reconstructing only the anterolateral ligament bundle.

MATERIALS & METHODS: 12 cadaver knees had a load cell attached to a bone cap containing the femoral origin of the PCL. Bench loading tests were performed under 6 constant tibial loading conditions (unloaded, 100 N posterior load, 5 N-m varus-valgus moments, and 5 N-m internal/external torques) and the resultant PCL force was measured.

A posterior incision was made and the PCL was excised. A tibial inlay reconstruction was performed using a B-PT-B graft. The proximal end of the B-PT-B graft was attached to a load cell and was oriented in a central position (central) within the native PCL’s femoral footprint (recreating a portion of both the anterolateral and posteromedial PCL bundles). A pre-tension was found which reproduced intact AP laxity within 0.5 mm at 90 degrees of knee flexion. The bench loading tests were repeated while the graft force was measured. The graft was then repositioned at the femoral side to an eccentric position within the femoral footprint (eccentric) and testing was repeated.

RESULTS: During passive knee flexion, the graft forces were higher for the central femoral tunnel position between -5 and 0 degrees of knee flexion. Both femoral tunnel positions resulted in higher graft forces than the native PCL beyond 85 degrees of knee flexion as shown in Figure 1. During constant tibial loading with a 100 N posterior force, the central tunnel position generated higher graft forces than the eccentric tunnel from -5 to 35 degrees as showing in Figure 2. During constant tibial loading with a 5 N-m varus moment, both positions yielded higher than intact graft forces between 105 and 120 degrees; there was no difference between the tunnel locations. During constant tibial loading with a 5 N-m valgus moment, the central tunnel generated higher than intact forces from -5 to 120 degrees while the eccentric tunnel generated higher forces from 80 to 120 degrees. The central tunnel forces were greater than the eccentric tunnel forces from -5 to 65 degrees.

DISCUSSION: With passive knee flexion, the central femoral tunnel position generated statistically higher graft forces only between -5 to 0 degrees (although forces were higher from -5 to 90 degrees) when compared with the eccentric hole. Under 100 N posterior tibial load, the central tunnel resulted in higher than eccentric graft forces between 80 and 120 degrees; there was no difference between the tunnel locations.

REFERENCES:
4) Pearsal et al CORR 327: 264-271, 1996