Although posterior cruciate ligament (PCL) tears are relatively rare in children, they are increasingly reported in adolescents with open physes and significant growth remaining. Recent research on double bundle PCL reconstruction using modern techniques has shown risk of significant damage to the peripheral femoral physis; damage in this region is associated with a high risk of growth disturbance. The purpose of this study was to determine whether damage to the physis, articular cartilage, medial collateral ligament (MCL), and medial patellofemoral ligament (MPFL) can be avoided during femoral tunnel drilling in an anatomic, all-epiphyseal double-bundle (DB) PCL reconstruction in the skeletally immature knee using 3-D reconstruction computer modeling.

Methods
Computed tomography scans of eight male skeletally immature cadaveric knee specimens between the ages 5 – 11 were used to create eight 3-D models of pediatric femurs. Using these 3-D models, 5, 6, and 7 mm tunnels were placed in the anatomic footprints of the anterolateral (AL) and posteromedial (PM) bundles to simulate DB PCL reconstruction drilling. The 7 and 6 mm AL tunnels, and the 6 and 5 mm PM tunnels, were directed to enter the footprints of the anterolateral/posteromedial bundles of the PCL, simulating an outside-in technique. Both full length tunnels and a partial length socket were utilized within the footprint of the PCL while avoiding damage to the femoral physis and surface ligament footprints.

Results

- In all 8 models, both tunnels could be placed in the PCL origin without damaging the physis, articular cartilage, MCL, or MPFL.
- There was an adequate bone bridge (≥2 mm) between the tunnels in ages 7-11 with a 6-7 mm AL tunnel and a 5-6 mm PM tunnel, as well as for the 5-year-old model, using a 6 mm and 5 mm AL and PM tunnel, respectively.
- Neither the AL nor the PM drill holes caused iatrogenic injury to the femoral physis.
- An angle of 10° for the PM tunnel/socket and 50° for the AL tunnel in the axial plane as viewed during arthroscopy starting in the PCL footprint yielded a safe tunnel trajectory.

Conclusion

- This computer-aided modeling study demonstrated that 5, 6 and 7 mm all-epiphyseal tunnels can be placed within the footprint of the PCL while avoiding direct injury to the femoral physis, articular cartilage, MCL and MPFL.
- By understanding the location and trajectory of tunnel and socket placement, DB PCL reconstruction may be performed in skeletally immature knees without causing damage to the distal femoral physis and surface ligament footprints.

References


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