Entry point of tibial tunnel for trans-tibial techniques in anatomical double bundle ACL reconstruction

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INTRODUCTION:
The outcomes of single-bundle (SB) anterior cruciate ligament (ACL) reconstruction have generally been satisfactory, however there is still room for improvement. Several biomechanical studies have shown that anatomical double-bundle (DB) ACL reconstruction restores knee kinematics more closely to normal than SB ACL reconstruction. Although the trans-tibial drilling technique, in which the femoral tunnel is drilled through the tibial tunnel, is the most common technique in ACL reconstruction, a cadaveric study using the technique showed that the femoral tunnel tended to be placed high in the notch, outside the anatomical insertion site. Therefore the authors have been concerned, when using this trans-tibial drilling technique in anatomical DB ACL reconstruction, to ensure that both anteromedial (AM) and posterolateral (PL) tunnels are placed in their anatomical footprints. The purpose of the present study was to determine the optimal initial drilling point to produce AM & PL tunnels in their respective footprints in anatomical DB ACL reconstruction using the trans-tibial drilling technique.

MATERIALS AND METHODS:
Eight cadaveric knees (three male and five female, mean age, 81.9 years; range, 49-102 years) without ligament injury or significant arthritis were used for this study. The skin, muscles, and extensor mechanism were removed. The capsule, collateral ligaments, cruciate ligaments, and menisci were left intact. The lower leg was placed on a special leg holder to maintain original position. The ACL was identified and dissected from both tibial and femoral insertions, leaving 1- to 2-mm of soft tissue at the footprints.

The central points of each AM and PL bundle in the tibial and femoral footprints were chosen (total 4 points; 2 points on the tibia and 2 points on the femur) as the center of each bundle insertion site. These points were at the midpoint of each attachment, halfway along the length and width of each bundle footprint. After marking the center of the anatomical footprints of each bundle, measurement of the angles in which the guide pins were to be drilled through both the femoral and tibial insertion sites of each bundle was performed using a previously described technique.

After these 4 points were marked with ink, a small-fragment, a one-third tubular 2-hole plate (Zimmer, Inc. Warsaw) was fixed with 3.5-mm cancellous screws (Zimmer, Inc.) on both the tibia and femur, with an empty hole over the center of the PL bundle anatomical insertion sites. After a guide pin was drilled through both femoral and tibial PL bundle insertion sites (through the empty hole of both plates) at 90 and 120 degrees of knee flexion, the distances between the entry point of guide pin and joint line (Fig.1-A) and the distance between the entry point of guide pin and medial co-lateral ligament (MCL) (Fig.1-B) were measured. The same technique was used for the measurement of the AM bundle. Statistical analysis was performed using the t-test. Statistical significance was defined as P < .05.

RESULTS
The distance between the entry point and joint line was 9.5 ± 2.6 mm for AM bundle and 20.1 ± 5.7 for PL bundle at 90 degrees knee flexion and 5.3 ± 3.8 mm for AM bundle and 13.1 ± 6.6 for PL bundle at 120 degrees knee flexion (Fig.2). The distance between the entry point and MCL was 12.0 ± 4.2 mm for AM bundle and 3.3 ± 4.0 for PL bundle at 90 degrees knee flexion and 10.6 ± 3.0 mm for AM bundle and 2.4 ± 5.3 for PL bundle at 120 degrees knee flexion (Fig.2).

DISCUSSION
Several studies have shown the anatomical limitations of the trans-tibial technique for SB ACL reconstruction. This study was undertaken to evaluate the entry points of tibial drilling required to perform anatomical DB ACL reconstruction using the trans-tibial technique. Our results for the distances between the entry points of pins and the joint line at 90 degrees knee flexion are in agreement with a previous cadaveric study which evaluated the distances from the entry point of pins drilled through both tibial and femoral centers of the whole ACL insertion sites to the joint line. However, the distances to the joint line for the AM bundle was slightly shorter and the distance to the joint line for the PL bundle was slightly longer in our study. Furthermore, in our study, the distances from the entry points of pins to the joint line for both the AM and PL bundles decreased significantly at 120 as compared to 90 degrees knee flexion. Our results indicate that the trans-tibial technique for the AM bundle in anatomical DB ACL reconstruction requires an entry point close to the joint line. Moreover, an entry point closer to the joint line may be needed when the knee is flexed 90 to 120 degrees. Our results indicate that drilling of the AM bundle to perform DB ACL reconstruction should be carefully undertaken when using the trans-tibial technique, with an entry point closer to the joint line, and furthermore, that flexing the knee deeply for drilling requires greater caution.

REFERENCES: