INTRODUCTION:
Prevention of debilitating osteoarthritic changes and restoration of knee joint stability following an anterior cruciate ligament (ACL) rupture remains a subject of immense importance in sports medicine research. Recently, anatomic double bundle ACL reconstruction has been introduced to better simulate the ACL anatomy. However, such a reconstruction is a technically challenging procedure associated with longer operation time, higher cost and complications with revision surgery. Reproducing the ACL anatomy by using a single tibial and femoral tunnel could potentially overcome these limitations. The objective of this study was to investigate the effectiveness of double bundle ACL reconstruction using a single tibial and femoral tunnel in restoration of ACL intact knee kinematics and to compare these results to single bundle (SB) ACL reconstruction. We hypothesized that the single tunnel-double bundle (STDB) ACL reconstruction can mimic the ACL intact knee kinematics more closely than SB ACL reconstruction.

METHODS:
We investigated the kinematic responses of eight fresh-frozen human cadaveric knee specimens under three external loading conditions using a robotic testing system. Each knee was subjected to an anterior tibial arthrotomy with the knee flexed to 30°. The ACL deficient knee was simulated by resecting the ACL through a small medial parapatellar arthrotomy. Within-subjects one-way repeated measures analysis of variance (ANOVA) and Student-Newman-Keuls tests were used to determine significant differences between the four knee conditions. Differences were considered statistically significant at \( P < 0.05 \).

RESULTS:
STDB ACL reconstruction was able to closely restore the intact knee anterior tibial translation (ATT) at low flexion angles (<30°) in response to anterior tibial load and simulated quadriceps load \( (P < 0.05) \). Both SB and STDB ACL reconstructions were capable of closely restoring ATT at all flexion angles. The results of the present study support our initial hypothesis that the STDB ACL reconstruction is capable of restoring intact knee kinematics under the three external loadings conditions more closely than SB ACL reconstruction. The STDB technique introduced in this study is capable of reproducing both the functional bundles of the ACL by creating a single femoral and tibial tunnel as well as overcoming the limitations of double tunnel-double bundle ACL reconstruction. Based on this investigation, we conclude that the STDB ACL reconstruction is capable of restoring the knee stability close to the ACL intact knee. This technique could be an alternative option for both SB and double tunnel-double bundle ACL reconstructions to reproduce intact knee kinematics and native ACL anatomy. Patient follow-up studies need to be performed to analyze the long term benefits of STDB ACL reconstruction.

REFERENCES: