Effect of Tibial Slope on Knee Mechanics for Posterior Cruciate Ligament Deficient Cruciate-Retaining Total Knee Arthroplasty

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INTRODUCTION:

Continuing debate exist over the optimal tibial slope for a cruciate-retaining (CR) total knee arthroplasty (TKA) versus a cruciate-sacrificing TKA. Recently introduced CR-TKA systems accommodate both posterior cruciate ligament (PCL) retention or sacrifice, thus further compounding the debate; specifically, how to address the tibial slope if bone cuts were already performed for a CR-TKA and the PCL becomes compromised during the surgical procedure. The objective of this study was to determine the effect of tibial slope on knee mechanics during CR-TKA with a deficient PCL with the intention of informing surgical decisions regarding whether the tibial slope should be adjusted.

METHODS:

A robotic simulator performed passive laxity tests and simulated lunge on ten fresh-frozen cadaveric knee specimens in the natural state and following TKA with both intact PCL and completely resected PCL at various tibial slopes of 0°, 3°, 5° and 7°. Knees were balanced to 5° of posterior tibial slope by robotic assistance. Rapid prototyped tibial bearings were used to modify the various tibial slope without the need to perform additional bone cuts or rebalancing of the knee. Laxity assessments were performed at 15°, 30°, 45°, 60°, and 90° knee flexion by applying ±6 Nm internal-external (IE) torque, ±12 Nm varus-valgus (VV) torque, ±100 N anterior-posterior (AP) force, and ±100 N medial-lateral (ML) force in each direction. Two-way ANOVA (α=0.05) with post-hoc pairwise multiple comparison was used to compare laxities between the different tibial slopes at each knee flexion angle tested.

RESULTS:

The tibial slope overall did not have a significant effect (α=0.05) on IE, VV, AP or ML knee laxity over the entire arc of knee flexion. VV laxity decreased slightly with increased slope, but the overall maximum laxity difference between slopes was only 1.4°. There was no clear trend in AP laxity with a change in tibial slope; however, the joint shifted posteriorly by an average of 2.2mm with each incremental slope increase. The tibial slope also did not have a significant effect on lunge kinematics.

DISCUSSION AND CONCLUSION:

Increasing tibial slope did not significantly affect laxity throughout flexion suggesting that slope should not be adjusted to correct for flexion/extension gap balancing. An increase in tibial slope shifts the dwell point of the knee slightly posteriorly, but without an intact PCL, had no significant effect on knee laxity or joint kinematics. In conclusion, in the event the PCL is compromised during a CR-TKA procedure, it is not necessary to recut the tibial slope.