

#1258 - Experimental Study / Posters

Bi-Cruciate Retaining Total Knee Arthroplasty Does Not Restore Native Knee In-Vivo Kinematics During Strenuous Activities

Orthopaedics / Knee & Lower Leg / Joint Replacement - Primary

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Background

Bi-Cruciate retaining (BCR) total knee arthroplasty (TKA) design allows preservation of both anterior and posterior cruciate ligaments (ACL and PCL) which provides the potential to restore normal posterior femoral rollback, replicate near-normal knee joint kinematics, reproduce medial pivot rotation and preserve normal proprioception. To date, no study has examined these proposed advantages in terms of in-vivo kinematics, articular contact kinematics and anterior stability.

Objectives

The aim of this study was to compare (1) in-vivo kinematics (2) articular contact kinematics and (3) clinical anteroposterior stability between BCR TKA and contralateral non-operated knees during strenuous flexion activities.

Study Design & Methods

29 unilateral BCR TKA patients (14 male; 65.7 ± 7.7 years; BMI 29.8 ± 4.0) were evaluated. Mean follow-up time after BCR TKA was 12.7 ± 5.1 months. All patients received a CT scan for the creation of 3D knee surface models. All patients performed single leg deep lunges and sit-to-stand under dual fluoroscopic imaging system surveillance. Each patient's 2D dynamic fluoroscopic images and corresponding 3D surface models were imported into a dual fluoroscopic imaging system environment. An optimization procedure was utilized to perform matching. In-vivo 6 degree of freedom (6DOF) kinematics of the BCR TKA knees and contralateral non-operated side were quantified and analyzed. Clinical anterior laxity was performed using standardized arthrometer testing.

Results

BCR TKA knees demonstrated significantly less femoral rollback and medial translation during lunge (3.5 ± 3.6 mm, $p < 0.05$) and STS (2.9 ± 4.2 mm, $p < 0.05$) when compared to the contralateral non-operated knee. BCR TKA knees demonstrated significantly reduced internal rotation. Normal medial pivoting pattern was observed in only 56% of knees. There was no significant difference in clinical anterior laxity between groups (6.4 ± 3.3 mm vs 6.3 ± 3.3 mm, $p = 0.96$).

Conclusions

Despite maintaining anteroposterior stability, BCR TKA knees demonstrated asymmetric femoral rollback, medial translation and an inability to replicate the "screw home" mechanism. In addition, pronounced pivot position variability was observed with only 56% of patients demonstrating normal medial pivot, indicating that in-vivo tibiofemoral kinematic parameters are not fully restored in BCR patients.