#1267 - In-Vivo Kinematics Of Asymmetrical Bearing Geometry Cruciate Retaining Total Knee Arthroplasty During High Knee Flexion Activities

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Background
The recently-introduced Asymmetrical Bearing Geometry cruciate retaining (CR) TKA was designed to preserve proprioception and kinematics of the native knee by retaining the PCL. The contemporary Asymmetrical Bearing Geometry CR TKA design introduces concave medial and convex lateral tibial components, with a posterior medial lip, in order to restore native knee kinematics such as lateral condyle rollback and rotation during deep knee flexion. However, little is known about the in-vivo kinematics of the contemporary CR TKA design during functional daily activities.

Objectives
As high knee flexion activities are essential for everyday life, this study aimed to investigate in-vivo 3D kinematics of CR TKA during step-ups and sit-to-stand utilizing a validated dual fluoroscopic imaging system (DFIS).

Study Design & Methods
Fifteen well-functioning unilateral asymmetrical bearing geometry CR TKA patients (6 males and 9 females) with no history of any surgical complication were included in this study with institution's Internal Review Board approval. The average patient age was 68.4 years (± 5.8, range 61 to 81). All fifteen patients received computer tomography (CT) scan for reconstruction of 3D knee models. The femoral and tibial local coordinate systems for the contralateral non-operated knee were constructed using anatomical bony landmarks, while the anatomical coordinate systems of the operated knee were obtained using a previously validated and published 3D mirroring technique. All unilateral CR TKA patients performed step-ups and the sit-to-stand test under dual fluoroscopic imaging system (DFIS) surveillance. The 2D fluoroscopic images and the 3D subject-specific knee models were imported into the virtual DFIS environment for determination of knee 6 DOF kinematics. Wilcoxon signed-rank test was performed to determine if there is a significant difference in knee motion during high knee flexion activities by comparing 6 DOF kinematics between the non-operated and operated knees ($\alpha = 0.05$).

Results
There are no significant differences in knee flexion between Asymmetrical Bearing Geometry CR TKA and the native knee during sit-to-stand (44.1 ± 10.7° vs 42.2 ± 12.9°) and step-ups (15.8 ± 6.4° vs 14.7 ± 7.1°). CR TKA knees demonstrated significantly larger proximal femoral translations than the non-operated knee during sit-to-stand (34.7 ± 4.5° vs 29.9 ± 3.1°) and step ups (34.1 ± 4.5 mm vs 30.8 ± 2.9 mm). CR TKA knees demonstrated significantly lower posterior femoral translations during stance phase, when compared to the non-operated knee, for sit-to-stand (-2.5 ± 2.9° vs -8.1 ± 4.4°) and step-ups (2.2 ± 3.2 mm vs -3.5 ± 4.5 mm). CR TKA knees demonstrated significantly lower knee valgus angles during sit-to-stand (-3.3 ± 2.6° vs -7.1 ± 3.2°) as well as significantly lower femoral internal rotation angles during step-ups (2.6 ± 5.8° vs 6.3 ± 6.6°), when compared to the native knee.

Conclusions
Although the contemporary asymmetrical bearing geometry CR TKA design with concave medial and convex lateral tibial inserts has the potential to restore knee kinematics, the results of the current study suggested that native knee kinematics during high knee flexion activities was not fully restored in patients with unilateral CR TKA.