Introduction: Previous fluoroscopic studies have revealed non normal kinematic patterns for subjects having a CR TKA. The objective of this study was to determine if the kinematic patterns for subjects with a CR TKA, having a single sagittal radius, is similar to those subjects having a traditional, multi radii CR TKA.

Methods: In vivo kinematics were derived for 47 patients. Twenty-two subjects were implanted with a single radius CR TKA and 25 with a multi radii CR TKA. Fluoroscopic videos were captured for the patients while they performed two activities using a state-of-the-art mobile fluoroscopy unit. Subjects performed a weight bearing deep knee bend (DKB) activity from full extension to maximum knee flexion (Figure 1), followed by walking down a ramp with a -10° incline (Figure 2). Each video was corrected for distortion, and analysed to determine kinematic patterns using a 3D to 2D image registration technique. The method is validated to have an error of less than 0.5° for rotational values and 0.5 mm for in-plane translation. DKB data was analysed in 30° increments from full extension (0°) to maximum knee flexion. Ramp down data was analysed at four instances from heel strike to toe off. Statistical analysis was conducted at 95% confidence level to detect kinematic differences between the two groups.

Results: The average weight bearing range of motion (ROM) for the single radius CR TKA and multi radii CR TKA was 107.1°±8.7° and 107.2°±11.0° respectively. On average, subjects implanted with a single radius CR TKA experienced 5.9°±3.4° of normal axial rotation, while subjects implanted with a multi radii CR TKA achieved only 0.8°±5.1° of axial rotation from 0° to maximum flexion (Figure 3). This was found to be a statistically significant difference (p=0.002). Subjects implanted with the single radius CR TKA exhibited a more neutral orientation of 1.4°±3.3° at full extension when compared to the 2.44°±3.0° orientation of the multi radii counterpart. The most intriguing difference was that 56% of subjects having a multi radii CR TKA experienced a reverse axial rotation pattern, while no subjects having a single radius CR TKA had this pattern of rotation.

Subjects having a single radius CR TKA experienced less motion of both condyles during the ramp down maneuver. On average, subjects having a single radius CR TKA experienced -0.5 (-6.7 to 3.7) and 0.2 (-4.8 to 3.2) mm of motion of their lateral and medial condyles, respectively. Subjects with a multi radii CR TKA, on average, experienced -1.9 (-8.8 to 4.1) and -1.2 (-7.3 to 5.3) mm of lateral and medial condyle motion, respectively. Neither the difference in motion of the lateral nor medial condyle between the two groups was found to be statistically significant.

Discussion: Subjects in this study having a single radius CR TKA experienced more normal axial rotation patterns than subjects having a multi radii CR TKA during the DKB activity. The high incidence of subjects having a multi radii CR TKA that experienced a reverse axial rotation pattern raises concerns (Figure 3). It
is hypothesized that this reverse axial rotation pattern could lead to patella complications as the anteriorized lateral condyle could lead to patella subluxation during knee flexion. No statistically significant kinematic differences between the two patient samples was seen during the ramp down activity.

**Significance:** The results of this data sample suggests that the femoral design differences of single radius and multi radii CR TKAs can cause different kinematics patterns during a weight bearing deep knee bend activity.
Average Tibio-Femoral Axial Rotation

- Single Radius CR TKA
- Multi Radii CR TKA

Figure 3: Average tibio-femoral axial rotation comparison during DXB.