The relationship between PTA and knee flexion angle (KFA) was being 92 (objective) and 90 (functional).

The average age of the patients was 72.4 years (64-78) with average AKSS patients (average age: 28.2 years) during a step-up.

The cam-post mechanism of Posterior stabilized total knee arthroplasty (PS-TKA) should provide a constraint that limits anterior translation of the femur on the tibia in flexion and ensures femoral roll-back with progressive knee flexion. Femoral roll-back has a potential advantage of improved knee flexion and increased quadriceps function.

In a previous fluoroscopic study we have shown that the sagittal plane kinematics of a PCL retaining (Scorpio CR) and a PCL substituting (Scorpio PS) TKA were similar, although both designs had abnormal kinematics in flexion. This suggested that the Cam-Post mechanism was ineffective (1). In this study, we assessed the movement of the femur relative to the tibia using the patella tendon angle (PTA). PTA is the angle between patellar tendon and tibial axis and has an approximately linear relationship with knee flexion angle in normal knees. The PTA is positive in extension. As the knee flexes it decreases and becomes negative.

The aim of the current study was to investigate why the cam-post mechanism was ineffective by assessing not only PTA, but also contact point movement and the distance between the Cam and Post.

Method:

Eight patients with Scorpio PS TKA performed by a single surgeon for an underlying diagnosis of osteoarthritis and excellent clinical performance at least one year after TKA, as assessed by the American Knee Society scoring system (AKSS), were included. For kinematic assessment, patients underwent fluoroscopic assessment of the knee during a step up exercise and a weight bearing deep knee bend. 2D fluoroscopic images were recorded on a videotape. The image distortion was corrected using a global correction method and the data was analysed using a 3D model fitting technique (2, 3). Having determined the component position, the relative position of the cam and the post were identified as a point cloud (post: 15,000 points, cam: 10,000 points). Subsequently, using a closest point algorithm, the minimum distance between the cam and the post were identified as a point cloud (post: 15,000 points, cam: 10,000 points). Thereafter both condyles rolled back (10 mm).

Between extension and 60º flexion there was slide forwards of both medial (11 mm) and lateral (5 mm) femoral condyles (Fig 2). Thereafter both condyles rolled back (10 mm).

The cam-post mechanism failed to engage in one case (patient 2) while in all others it engaged between 70 to 100 degrees (Fig 3).

Discussion:

The PTA data confirms that during functional activity the kinematics are abnormal, and that in flexion the Femur is too far anterior on the Tibia. This is surprising as we have shown that in flexion in all but one of the knees the Cam and Post have engaged. We therefore conclude that although the Cam and Post have engaged they are not very effective in that they do not generate normal roll back.

Between 0º and 60º flexion there is paradoxical anterior movement of the contact points. Rollback begins at about 60º flexion which is about 20º less than the angle at which most cams are engaging. Therefore the initial rollback cannot be explained by the cam. The Cam may contribute to rollback above 80º.

Conclusions:

For the PS design we studied, although the Cam engages in flexion, it does not result in normal knee kinematics. Improvements to the Cam/Post design would be expected to result in improved kinematics and quadriceps function in flexion, with the associated risk of increased wear.

Kinematic studies based on contact points alone provide limited information. The additional analysis of PTA and Cam-Post distance provide a much greater insight.

References:


Figure 1: Average PTA vs. KFA (with SEM)

Figure 2: Average AP Contact Points Vs. KFA

Figure 3: Cam-Post Distance Vs KFA