Introduction:

As many as 20% of all patients following total knee arthroplasty (TKA) are not satisfied with the result. With an ever increasing number of younger and more demanding patients this outcome is not satisfactory. Various factors are thought to affect clinical outcome, such as leg alignment, rotational alignment, soft tissue-balancing, the femoro-patellar joint, and patient-related factors. It also has been suggested that knee kinematics associated with specific prosthesis designs affect patient satisfaction after TKA. Knee kinematics during weight-bearing activities are different after TKA compared to the normal knee. While evaluation of alignment and ligament balancing are routinely included in the intraoperative surgical procedure, quantitative measures of knee kinematics are rare. Furthermore, there are no reports linking intraoperative kinematic performance of TKA with subsequent functional outcome.

Methods:

The purpose of this IRB approved study was to assess relationships between prosthesis rotational alignment, Knee Society score, quality of live and knee kinematics after TKA. It was hypothesized that differences in rotational alignment of the femoral and tibial components and associated altered kinematics would correspond to differences in functional outcomes.

From an initial 80 patients with a cemented, unconstrained, cruciate-retaining TKA with a rotating platform (Scorpion16 PCS, Stryker Orthopaedics, Mahwah, NJ) without patellar resurfacing, 73 patients were available for post-operative physical and radiological examination after a median of 20 months. Two patients had died, one patient had been revised and 4 patients declined to return for a follow-up visit. The remaining 73 patients were assessed using the Knee Society Score and the EuroQol questionnaire.

Rotational alignment of the femoral and tibial component in the transverse plane (axial alignment) was measured (ID.PACS 3.6, Image Devices) from postoperative computed tomography scans. Rotational mismatch was defined as the angle between the femoral component (line through fixation pegs) and the tibial component (line at the posterior border of the stem).

Results:

Nine patients had more than 10° rotational mismatch between the femoral and tibial component in the postoperative CT-scans. These patients were not significantly different from the remaining 64 patients in the Knee score (both groups 89 points at follow-up) and EQ 5D VAS (65 points vs 70 points at follow-up) but showed significantly worse results in the Function score. While the normal patients with less than 10° rotational mismatch improved from a median preoperative 55 points to a median 70 points at follow-up, the group with more than 10° mismatch deteriorated from a median 60 points preoperatively to a median 50 points at follow-up (p = 0.001).

For seven of these nine patients, kinematic analysis was available during passive flexion from approximately 0° to 120°. There were no substantial differences in the average range of total axial rotation achieved in this group compared to the normal group, but the pattern of motion during that range was quite different. While external rotation steadily increased with knee flexion in the normal group, there was internal rotation between 30° and 80° of flexion in the group with more than 10° rotational mismatch.

Discussion:

Previous studies have demonstrated a link between component alignment and outcome, but there are no data documenting acceptable ranges of rotational mismatch between the femoral and tibial component. Furthermore, there are no quantitative studies linking intraoperative kinematic performance of TKA with subsequent functional outcome. In the current study, TKA with greater than 10 degrees of mismatch between femoral and tibial component experienced significantly poorer functional outcomes, with worsening in the Knee Society Function Score. Knee kinematics during passive flexion were significantly different in patients with mismatch, corresponding to the subsequent poor outcomes. While it is recognized that absolute alignment of the femoral and tibial component relative to bony landmarks is important, this data suggests that the coupled alignment of the femoral and tibial component are critical for a good functional outcome.

While all TKA showed no differences in total axial rotation during knee flexion the patterns of motion were considerably different between both groups, with significantly less femoral external rotation achieved in the patient group with greater than 10° rotational mismatch.

This is of particular interest as mobile-bearing TKA has been developed to allow rotational freedom. The ability to self-align according to soft-tissue strains is thought to compensate for rotational malalignment. This seems to be applicable only within certain ranges (in this study 10°), which might be dependent on the prosthesis design. However, our patients confirm many other reports that a mobile bearing does not necessarily support a better clinical outcome and improved kinematics.

References: