INTRODUCTION

The functionality of a mobile bearing total knee replacement (TKR) is centered around the mobility of the polyethylene (PE) inlay. It has been suggested that the inlay mobility may decrease over time, due to in-growth of fibrous tissue. The results of previous, retrospective studies are conflicting: The percentage of patients with loss of mobility ranged between 0% and 50% at 0.5 - 24 years post-op (Bradley et al. 1987, Stiehl et al. 1997, Hartford et al. 2001). Therefore, the purpose of this study was to assess the inlay mobility with respect to the post-op time in a longitudinal, prospective study with a high number of subjects.

METHODS

96 mobile bearing TKRs (SAL, Centerpulse Orthopedics) in 93 patients were included in this study. The SAL allows 6-9 mm anteroposterior (AP) inlay motion (size dependent), whereas the rotation is not limited by the implant design. To assess inlay mobility, sagittal radiographs at 0°, 30°, 60° and maximum flexion were taken 3, 12, and 24 months post-op. A complete follow-up is available for 75 knees.

![Figure 1: Required Landmarks. PE Inlay: Embedded radio-opaque contrast beads (PA: anterior; PS: small posterior; PL: large posterior). Tibial baseplate: Stem axis and the two posterior rotational stabilizers (TS: small tip; TL large tip). The center of the contrast beads was determined by a shape matching algorithm. The other landmarks were selected manually.](image)

The X-rays were scanned with a resolution of 300 dpi and analyzed with a program written in Matlab (The MathWorks, Inc.). On each X-ray, the relative inlay position with respect to the tibial baseplate, expressed by the AP position $x$ and the angle of rotation $\phi$, was determined by:

$$x = \frac{2a}{b+c} p_0 - p_1$$

$$\phi = \arctan\left(\frac{d-e}{d+e} t_0\right) - \arctan\left(\frac{c-b}{c+b} t_1\right)$$

where $a$, $b$, $c$, $d$, $e$ are distances measured on the X-ray as illustrated in figure 1; and $p_0$, $p_1$, $p_4$, $t_0$, $t_4$ are parameters that depend on the implant geometry. The accuracy of the method was determined by a dummy experiment and a computer simulation. It was ± 0.2 mm for the AP position and ± 1.7° for the angle of rotation.

The range of motion of the inlay in the AP translation (AP ROM) and in the rotation (Rot. ROM) was calculated by a comparison of the 0°, 30°, 60° and maximum flexion X-ray. An inlay was classified as mobile if its AP ROM exceeded 1 mm or its Rot. ROM exceeded 5°. The change of the ROM with time was analyzed by one-way analysis of variance (ANOVA).

RESULTS AND DISCUSSION

At 3 months post-op we found a mobile inlay in 91%, 12 months post-op in 93%, and 24 months post-op in 89% of the knees. The average range of inlay motion did not change significantly with time. At 24 months post-op, the average AP ROM was 3.2 mm (SD 1.9 mm) and the average Rot. ROM was 7.8° (SD 4.5°). The majority of inlays that displayed no AP motion were located at the most anterior position, which might indicate a function loss of the posterior cruciate ligament. 24 months post-op, the average passive flexion of the knees with an AP mobile inlay was 122°. The average passive flexion of the knees that showed no AP movement of the inlay was 104° (p < 0.001, Wilcoxon rank sum test).

The method developed for this study is independent of the image magnification factor, the machine specification, and the position of the X-ray source on the film. Therefore it is a suitable method for multicentre or long-term studies where no special equipment is available.

SUMMARY

In average the inlay stayed mobile in 90% of the cases. The mean range of motion of the inlay didn’t change significantly with time. 2 years post-op, no evidence of an in-growth of fibrous tissue was found. Knees with an AP mobile inlay had a significantly higher maximum passive flexion than knees where the inlay showed no AP movement.

REFERENCES