

Long Term Inlay Mobility In A Mobile Bearing Total Knee Replacement

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Introduction: In contrast to fixed-bearing total knee replacements (TKRs), mobile-bearing TKRs allow for unconstrained kinematics while providing a high congruency between the femoral component and polyethylene inlay. The concept of a mobile-bearing TKR is based on the mobility of the inlay. It has been suggested that inlay mobility may decrease due to the in-growth of fibrous tissue³. Previous studies report a loss of inlay mobility between 0% and 50% at an average follow-up time between 1.5 and 6 years post-op^{1,2,4}. However these studies are retrospective and do not define a threshold for inlay mobility. Thus, inlay mobility with respect to time and the inlay motion patterns during knee flexion were analyzed in a prospective study with 60 subjects. Complete data 5 years post-op is available.

Methods: 61 mobile-bearing TKRs (SAL, Zimmer GmbH, Switzerland) in 60 patients were analyzed. The implant design allows for 6-9 mm (size dependent) inlay translation in the anteroposterior direction while the rotation is not constrained. In all cases the PCL was retained. The patients were followed up at 3, 12, 24 and 60 months post-op. At each follow-up the knees were X-rayed under weight-bearing at 0°, 30°, 60° and maximal flexion. The range of inlay motion in translation (AP ROM) and in rotation (Rot. ROM) was calculated by comparing the 4 X-rays from each follow-up. An inlay was classified as mobile, if it translated more than 1 mm or rotated more than 5°. Group means were compared using one-way ANOVA with a significance level of 5%.

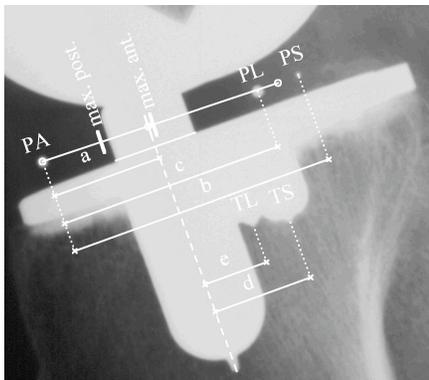


Figure 1: Required landmarks for the image analysis: *Inlay:* Embedded radio-opaque contrast beads: anterior (PA); small posterior (PS); large posterior (PL). *Tibial tray:* Stem axis and the two posterior rotational stabilizers: small tip (TS); large tip (TL).

To classify the intra-subject repeatability of the inlay motion patterns, the translation and rotation curves were interpolated and averaged at increments of 5° of flexion, and the root mean square (RMS) of the deviations from the mean curve was calculated. The repeatability was defined as 'high' if the RMS in the translation was less than 0.5 mm and the RMS in the rotation was less than 2.5°. It was defined as 'medium' if the RMS in the translation was less than 1 mm and the RMS in rotation was less than 5°. In the other cases the repeatability was defined as 'low'.

Results: Of the 61 TKRs analyzed, a complete 60 month follow-up of 56 knees was available. The results of the mobility analysis are summarized in Table 1. No significant change in AP ROM and Rot. ROM was found over time. At the 5 year follow-up, an average ROM in translation of 3.3 mm (0 mm - 8 mm) and an average ROM in rotation of 8.5° (2° - 20°) was observed. At all follow-ups the inlay was classified as mobile in ≥93% of the cases. In 86% (48 of 56) of the knees the inlay was classified as mobile at every single follow-up; in the remaining 14% (8 of 56) of the knees the classification changed between follow-ups; no inlay was classified as non-mobile at every single follow-up. The majority of the inlays that displayed no translational motion were located at, or close to, the most anterior position relative to the tibial tray.

Follow-up [months]	AP ROM ± SD [mm]	Rot. ROM ± SD [°]	Mobile Inlays	
			[%]	[N]
3	2.5 ± 1.8	6.8 ± 3.5	93	52
12	3.0 ± 1.8	7.2 ± 4.0	96	54
24	3.3 ± 1.9	7.9 ± 4.1	95	53
60	3.3 ± 2.1	8.5 ± 4.0	93	52

Table 1: Average inlay range of motion and number of mobile inlays with respect to time after surgery.

It was found that the intra-subject repeatability of the motion patterns was higher than the inter-subject repeatability. The mean RMS of the individual translation curves (0.9 mm ± 0.5 mm) was significantly lower than the overall RMS in translation (1.7 mm, $p < 0.01$); and the mean RMS of the individual rotation curves (2.3° ± 1.0°) was significantly lower than the overall RMS in rotation (6.1°, $p < 0.01$). In 26% of the cases the intra-subject repeatability of inlay motion was classified as 'high'; in 40% of the cases as 'medium'; and in 34% of the cases as 'low'.

Conclusion: In 56 mobile-bearing TKRs that were prospectively examined 3, 12, 24, and 60 months post-op, no significant change in average inlay motion or percentage of mobile inlays was found. The results do not support the hypothesis that inlay mobility is reduced due to in-growth of fibrous tissue for the time periods investigated. Substantial variations between subjects with respect to inlay range of motion and motion patterns were found. However, the intra-subject variations were significantly lower than the inter-subject variations. Thus, each knee found its own kinematic fingerprint.

References:

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