# MEASUREMENT OF THE POSTERIOR FEMORAL OFFSET: NAVIGATION IS MORE PRECISE THAN STANDARD X-RAYS.

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**INTRODUCTION**

Appropriate reconstruction of the bone anatomy is necessary to obtain a good functional outcome after total knee replacement (TKR) (1, 2). Restoration of the native posterior femoral offset has been described as a significant prognostic factor, mainly for completion of a good range of motion in flexion (3). The measurement of the posterior offset prior to the TKR on standard X-ray or CT-scan may be inaccurate because the thickness of the remaining cartilage cannot be assessed. The measurement of the posterior offset prior to the TKR on MRI is not routinely performed. The post-operative evaluation of offset restoration may also be inaccurate, as the rotational positioning of the femur may impact the 2D image of the implant and the measure performed. We hypothesized that the measurement of the restoration of the posterior femoral offset by a navigation system during the implantation is more precise than the conventional post-operative measurement on post-operative standard X-rays.

**METHODS**

100 cases of navigated TKR have been analyzed. The native offset was measured on pre-operative standard sagittal X-rays with a conventional technique (distance between the distal anterior femoral cortex and the most posterior point of the femoral condyles) (Figure 1). The thickness of the bone ± cartilage resection performed was measured intra-operatively by the navigation system (Figure 2).

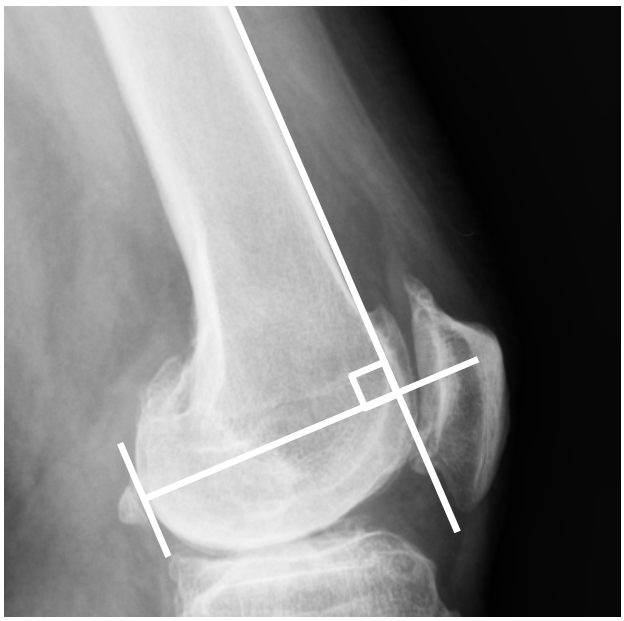

**Figure 1: technique of femoral offset measurement on the pre-operative X-rays**

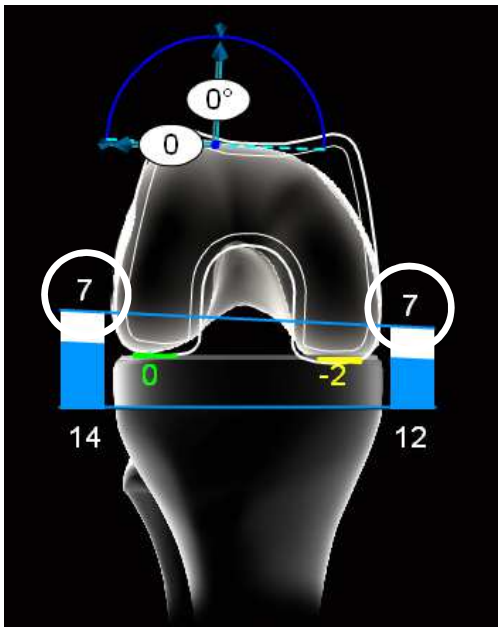


**Figure 2: intra-operative navigated measurement of the femoral offset**

The thickness of the femoral implant at the level of the posterior femoral resection was recorded. The final offset was measured on post-operative standard sagittal X-rays with the same conventional technique as above. The actual offset change (thickness of resection – thickness of the implant) was compared to the measured offset change (pre-operative – post-operative X-ray offset). Both measures were compared by a paired Wilcoxon test and calculation of the Spearman correlation coefficient at a 5% level of significance.

**RESULTS**

The mean pre-operative measured offset was 61.4 ± 5.2 mm. The mean pre-operative actual offset was 57.5 ± 4.5 mm. The mean post-operative measured offset was 62.8 ± 6.6 mm. The mean post-operative actual offset was 56.5 ± 4.0 mm. The mean actual offset change was -0.9 ± 2.6 mm (range, -7 to +5 mm). The mean measured offset change was +1.4 ± 5.3 mm (range, -25 to +13 mm). The mean difference between the paired measurements of the pre-operative actual and measured offsets was 3.9 mm ($p<0.001$). There was a moderate correlation between the two paired pre-operative measurements ($r^2 = 0.41$, $p<0.001$). The mean difference between the paired measurements of the post-operative actual and measured offsets was 6.3 mm ($p<0.001$). There was a poor correlation between the two paired pre-operative measurements ($r^2 = 0.27$, $p<0.001$).

**DISCUSSION**

We observed a significant difference between the actual offset and the measured offset. This may be explained by several biases: 1) rotational malposition of the femur which may be different between pre- and post-operative views (4); 2) uncertainty between the definition of the contours of both medial and lateral condyles; 3) uncertainty about the thickness of the remaining cartilage (5); 4) uncertainty about the amount of bone loss to be corrected.

According to the present study, the pre-operative X-ray measurement of the femoral offset cannot be used reliably to plan the expected bone resection. Furthermore, the post-operative standard X-ray cannot be used as a quality control to assess the reconstruction of the femoral offset. We suggest using a navigation system as a more accurate tool for pre- and post-operative femoral offset.

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**DISCLOSURE**


JYJ receives royalties from the Company Aesculap.