# Greater tibial varus and femoral valgus increase the knee adduction moment during single leg stance in TKA patients

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**INTRODUCTION**: Modern coronal alignment in total knee arthroplasty (TKA) aims at restoring the orientation of the native joint surfaces, resulting in varus/valgus deviations from the mechanical axes of the bones. Despite promising early clinical results, concerns with implant longevity remain, primarily due to the potential increase in loads in the medial compartment, which could result in aseptic loosening, the second most common cause for TKA failure.[1-3] In this way, while prior research suggests that alternative TKA alignments do not increase the knee adduction moment (KAM),[4] the most important marker of the force distribution between the medial and lateral compartments of the knee, little is known about the relationship between TKA alignment and KAM. Therefore, our goal was to quantify the changes in KAM due to surgery and in the early recovery period and relate them to TKA alignment. We hypothesized that KAM will be lower postoperatively than preoperatively, will remain relatively constant postoperatively, and the magnitude of KAM will be correlated with tibial varus and femoral valgus alignment.

**METHODS**: We include the first 29 patients (12 women, ages: 38-76 years; BMI: 22.1-32.6 kg/m²) from an institutional review board approved prospective study with a target enrollment of 42 patients who have completed at least six months follow-up. All patients received primary TKA using restricted kinematic alignment. Patients underwent biplane radiographs (EOS Imaging) preoperatively and at six weeks, six months, and one year postoperatively during bipedal stance and while standing only on the operated leg. The radiographs were synchronized spatially and temporally with force plate measurements of the ground reaction force of the operated leg. We previously demonstrated that the KAM measured radiographically during single leg stance is an adequate surrogate of the peak dynamic KAM obtained through gait analysis.[5] At each timepoint, the KAM was calculated from the single leg stance radiograph as the product of the ground force vector and its perpendicular distance to the knee center in the frontal plane and expressed in % bodyweight times height (%BW·Ht). Implant alignment was measured preoperatively and at six weeks postoperatively on the bipedal radiographs. We measured the medial proximal tibial angle (MPTA) as the angle between the tibial baseplate and the axis connecting the knee center to the ankle center and the lateral distal femoral angle (LDFA) as the angle between the distal-most point of the femoral condyles and the axis connecting the knee center to the hip center. We calculated the arithmetic hip knee ankle angle (aHKA) as the difference between the MPTA and the LDFA. We assessed the changes in KAM with paired t-tests and related the static radiographic KAM with the MPTA and LDFA and aHKA cthrough Pearson's correlation analysis with a significance level of 0.05.

**RESULTS**: The KAM was 2.5% BW·H (range:-3.7% BW·H to 7.7% BW·H) preoperatively, 2.2% BW·H (range:-0.2% BW·H to 6.2% BW·H) at 6 weeks postoperatively, 2.7% BW·H (range:-0.9% BW·H to 6.2% BW·H) at 6 months postoperatively, and 3.1% BW·H (range:-1.6% BW·H to 6.4% BW·H) at 1 year postoperatively (Fig. 1). Patients with varus alignment preoperatively experienced a reduction in KAM (p=0.0012). Postoperatively, KAM increased between six weeks and six months (p=0.02) but did not change between six months and 1 year. Preoperatively, KAM showed a weak correlation with LDFA ($r^2$=0.32, p<0.001) and a moderate correlation with MPTA ($r^2$=0.46, p<0.001) and aHKA ($r^2$=0.53, p<0.001) (Fig. 2). Postoperatively, KAM showed weak to moderate correlation with LDFA ($r^2$=0.28-0.64, p<0.001) and MPTA ($r^2$=0.19-0.42, p≤0.01) and moderate-to-strong correlations with aHKA ($r^2$=0.60-0.88, p<0.001).

**DISCUSSION:** the preoperative KAM decreased between preoperatively and postoperative timepoints. While KAM increased postoperatively, it never reached the preoperative values. We observed moderate-strong correlations of KAM with the arithmetic HKA, suggesting that the preoperative to postoperative change in KAM was caused by the correction of limb alignment during surgical intervention.

**SIGNIFICANCE/CLINICAL RELEVANCE**: Our results suggest that KAM, the most important indicator of load distribution between the medial and lateral compartments of the knee, is primarily influenced by the alignment of the TKA and can thus be altered through surgical intervention to avoid mechanical failures of TKA, which are often caused by varus subsidence of the tibial baseplate.[2]

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**REFERENCES**: [1] AJRR Annual Report, 2023; [2] Li, CORR 2017; [3] Ritter, JBJS 2013; [4] Niki, KSSTA 2 2018; [5] Quevedo González, JOA 2025

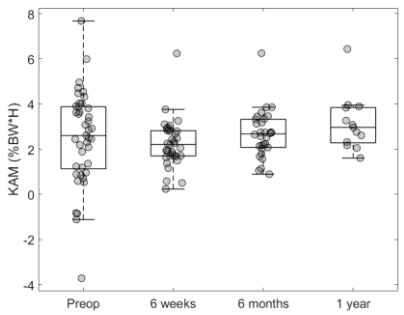


Fig. 1 – Changes in radiographic KAM

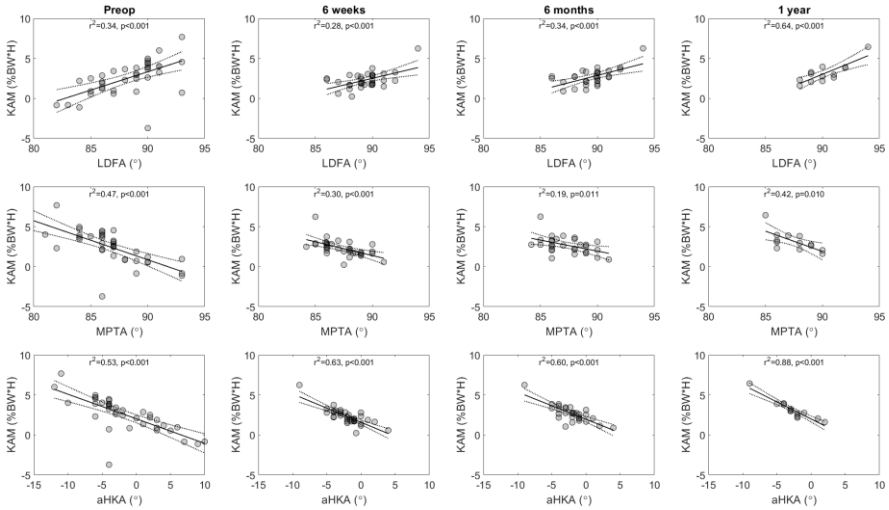


Fig. 2 – Correlation between radiographic KAM and implant alignment.