**Article:**

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**Title:**

# Changes in knee joint kinetics of transfemoral amputee's intact leg: An osteoarthritis indication?

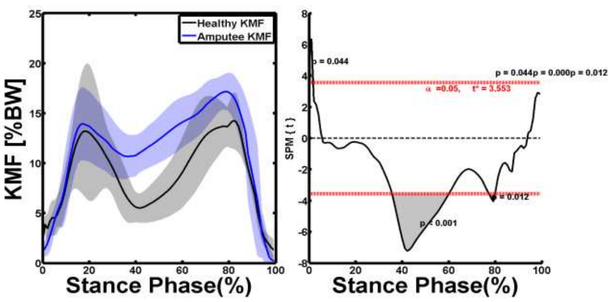
**Abstract:** **(Your abstract must use 10 point New Times Roman style and must fit into the box. Do not enter author details)**

**Introduction**: The prevalence of lower limb amputation is increasing significantly all around the world. Knee osteoarthritis (KOA) is one of the secondary physical conditions that occur because of altered knee mechanical loading in the intact limb. Esposito et al. reported, the increase rate of KOA in transfemoral intact limb is 10 times more than non-amputees [1].

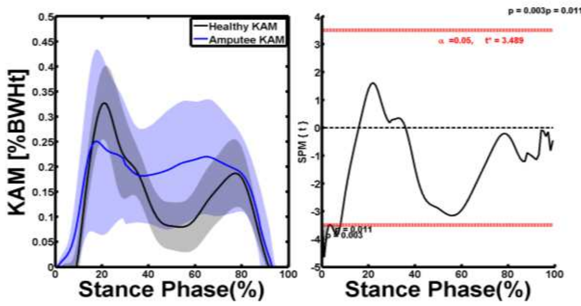
**Research Question**: Using an inverse dynamics-based musculoskeletal model in AnyBody™ (v6.1, AnyBody Technology A/S, Aalborg, Denmark), we aimed to investigate the difference in knee medial force (KMF) and knee adduction moment (KAM) between non-amputee's dominant leg and amputee's intact leg.

**Methods**: 4 healthy subjects (mean (SD): age 21.3 (0.4) years, body weight (BW) 72.2 (5.9) kg, height (Ht) 175.7 (6.0) cm) and 3 transfemoral amputees (mean (SD): age 52.7 (11.14) years, BW 80.0 (16.8) kg, Ht 169 (7.1) cm) participated in this study. Motion and ground reaction data were captured during self-selected walking speed. Musculoskeletal analysis was performed using the anatomically scaled model set up [2]. Prior to performing inverse dynamics, there were three steps to generate subject-specific model: 1) First, a stick-figure model was generated based on a standing reference; 2) Over-determinate kinematic analysis was performed over the dynamic trial and the joint angles were calculated over the entire trials; and 3) The stick-figure model and the base musculoskeletal Twente Lower Extremity Model (TLEM) were loaded together and the TLEM morphed to match the size and joint morphology of the stick-figure model using radial basis functions. Subsequently, the inverse dynamic analysis can be performed by driving the joint angles using those obtained in step 2) and the kinetic boundary conditions. The obtained KMF and KAM were compared between healthy and amputee subjects by a two-sample t-test statistical parametric mapping (SPM). In the SPM analysis, the t-value is zero when there is no difference between the mean KMF and KAM of the two groups. The critical value then was calculated through inference based on random field theory.

**Results**: Figs. 1-A and 2-A illustrate healthy (black) and amputee (blue) KMF and KAM, respectively. In Figs. 1B and 2B, positive t-value means healthy > amputee and vice versa when it is negative. Furthermore, where t-curve exceeds the threshold (red lines) shows the statistically significant difference in KMF and KAM. At maximum 1st and 2nd peaks of KMF and KAM in healthy and amputee subjects, statistical difference was not observed (p – value > 0.05). However, KMF showed to be significantly different (p – value < 0.05) at early (0% - 5%), mid (36% - 60%) and terminal (78%-80%) stance. The statistical difference in KAM occurred only in early stance phase (0% - 7%).




**A** **Fig. 1** **B**




**A** **Fig. 2** **B**

**Discussion**: These results suggest the main differences between the two groups were during loading response, weight acceptance and single limb support of the intact leg. This could be due to changes in muscle synergies of amputees during various tasks [3-5]. Therefore, modifications in gait and orthopaedic interventions (laterally wedged shoes and valgus braces) may alter either of the KAM variables i.e. ground reaction force and lever arm which directly influence the KAM hence KMF.

**References**:

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