

Changes in limb loading asymmetry and knee function before and after total knee arthroplasty

Authors:

Purpose / Hypothesis: There are several potential factors resulting in lower limb loading asymmetry for patients early after unilateral total knee arthroplasty (TKA). The purpose of this study was to test for loading asymmetry 1 month following unilateral TKA during transitions between sitting and standing. In addition, relationships between changes in loading asymmetry and changes in clinical measures of pain, strength, and function before and 1 month after TKA were evaluated.

Subjects: Twenty two patients (aged 64.8 ± 8.9 years, 10 males and 12 females) with end-stage osteoarthritis undergoing primary unilateral TKA.

Materials / Methods: Individuals with unilateral TKA were tested at two time points; 1) within 2 weeks prior to surgery, 2) 1 month following surgery. Lower limb loading asymmetry was assessed as the ratio of average vertical ground reaction force (v-GRF) for each foot during a Five Times Sit-to-Stand Test (FTSST). Knee pain was assessed using a Numerical Pain Rating Scale (NPRS) immediately following the FTSST. Quadriceps strength asymmetry was assessed as the ratio of involved to non-involved peak isometric knee extension torque. Function was assessed using a 6 minute walk test (6MW) and stair climbing test (SCT).

Results: Participants demonstrated limb loading asymmetry at 1 month after TKA ($p < 0.01$) with involved and non-involved limb average v-GRF values 2.46 ± 0.49 N/kg and 4.09 ± 0.68 N/kg (mean \pm SD), respectively. Twenty-one of the 22 participants had lower v-GRF values on the involved limb. The change in loading asymmetry from before to 1 month after TKA was 0.21 ± 0.23 (mean \pm SD), indicating an average increase in asymmetry of 21%. As lower limb loading asymmetry increased; NPRS increased ($r = 0.40$), quadriceps strength asymmetry increased ($r = 0.50$), 6MW distance decreased ($r = -0.46$), and SCT time increased ($r = 0.55$) ($p < 0.05$).

Discussion: Participants demonstrated limb loading asymmetry during transitions between sitting and standing 1 month after TKA. The limb loading asymmetry was greater one month after TKA compared to before TKA. The increase in loading

asymmetry was correlated with change in perception of pain, quadriceps strength asymmetry, and functional performance.

It has been suggested that lower limb loading asymmetry following TKA is a response to pain, quadriceps weakness, habitual unloading, and/or apprehension. Results from this study support the idea that loading asymmetry may be accentuated at 1 month following TKA due to pain and quadriceps weakness.

Clinical Relevance: Change in lower limb loading asymmetry one month after TKA is correlated with pain and knee extension strength. In addition, correlations between changes in loading asymmetry and function indicate loading asymmetry may negatively influence functional performance after TKA. Further investigation is necessary to determine whether targeted interventions to improve limb loading symmetry improve knee strength and function after TKA.

Keywords: Total Knee Arthroplasty, Loading, Biomechanics, Strength, Function

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