

Association Between Knee Compartmental Laxity on Post-Operative Step Counts, Gait Speed, and Gait Asymmetry

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INTRODUCTION:

The association between the intra-operative compartmental laxity and post-operative functional gait measures has not been adequately studied. This can inform robotic surgical decision-making and potentially impact patient care. This study aims to investigate the impact of compartmental joint laxity measures on post-operative step counts, gait speed, and gait asymmetry using a large commercial dataset.

METHODS:

After IRB exemption, anonymized data from a commercial database of 5009 patients using a single robotic system and cruciate retaining femurs were analyzed. Data were captured from the robotic system's logs and a digital care management platform using smartphone-based gait metrics. Laxity in the medial and lateral compartments were categorized for analysis according to the degree of robotically measured final gap laxities as follows: <0.5mm, 0.5 to < 1.5, 1.5 to < 2.5 mm, 2.5 to < 3.5mm, 3.5 to < 4.5mm, ≥4.5mm. Measurements were recorded in both the medial and lateral compartments at 0° and 90° of flexion. Similarly, the medial-lateral balance differences of the knee in extension and flexion were calculated as the lateral – medial compartment and grouped (<-2.5, -2.5 to < -1.5, -1.5 to < -0.5; -0.5 to < 0.5, 0.5 to < 1.5, 1.5 to < 2.5 & > 2.5). Differences between the pre-operative and post-operative gait metrics (steps, gait speed, and walking asymmetry) were calculated at days 15, 30, and 90 post-operative and analyzed using ANCOVA to account for differences in age, BMI, sex, and smartwatch usage. Significance was assessed at p<0.05.

RESULTS:

The mean age of patients was 66.5 ± 8.7; 56% were female. The mean BMI was 31.9 ± 6.4. These patient factors had significant effects on most metrics. For step counts, lateral compartment laxity in extension demonstrated significant differences between groups at d30 (Figure 1, p=0.02-0.04) while medial laxity gaps had significant differences between groups for both flexion and extension at d90 (p=0.02-.05). In all analyses, the laxity group <0.5mm had the greatest reduction in step counts from pre-operative values but watch usage had an even larger effect (p=0.00). Regarding gait speed, flexion balance was found to have significant differences between groups at d15 and d30 (Figure 2, p=0.01-0.04) with the greatest reduction in gait speed from pre-operative values occurring in <-2.5 mm (medially looser) group. For walking asymmetry, the medial flexion laxity and extension balance were significantly different at d90. The laxity group <0.5mm showed a higher increase in asymmetry while the >2.5 balance group (laterally looser) showed a greater decrease in asymmetry.

DISCUSSION AND CONCLUSION:

Our study demonstrates that medial and lateral laxity gaps measured using intra-operative robotic assessments are significantly associated with objectively measured post-operative gait metrics. The findings of this analysis suggest that tightness of the medial and lateral compartments and their balance may be associated with alterations in step counts, gait speed, and gait asymmetry post-operatively. Further research is needed to confirm these findings and determine if the differences are clinically relevant.

