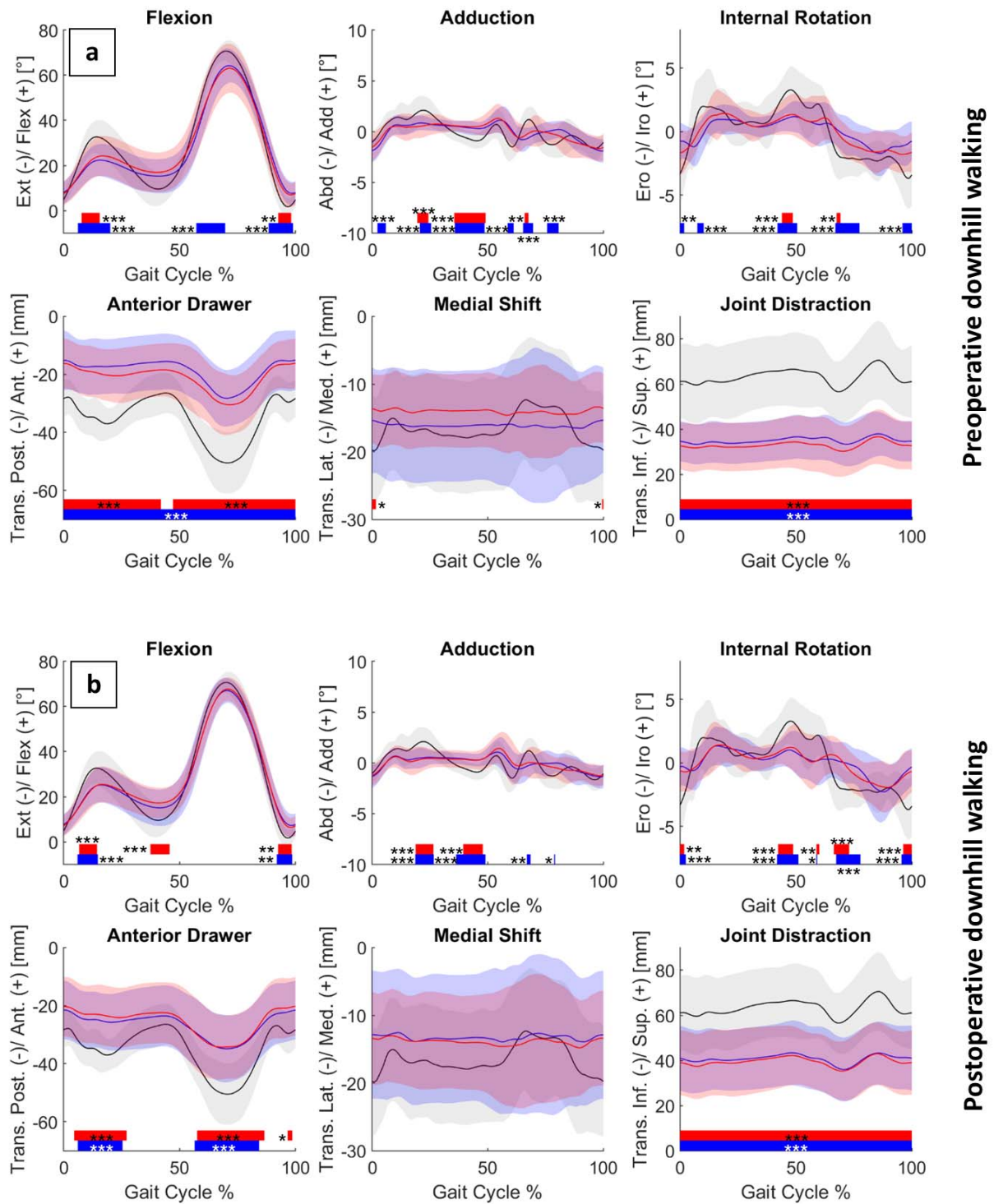
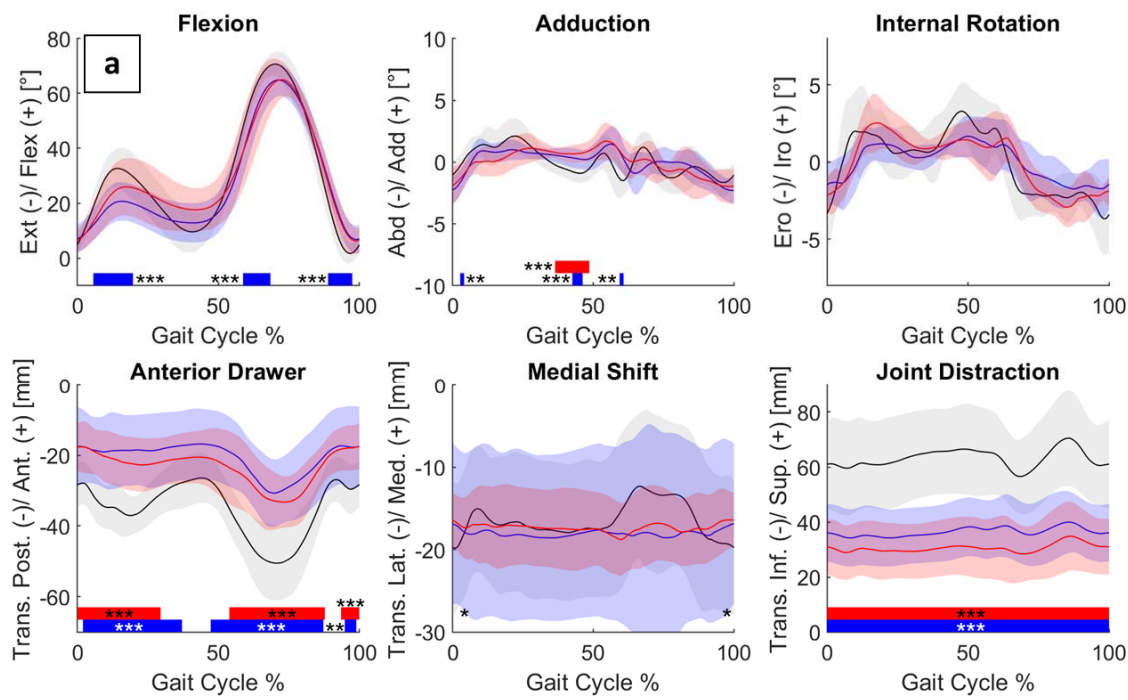




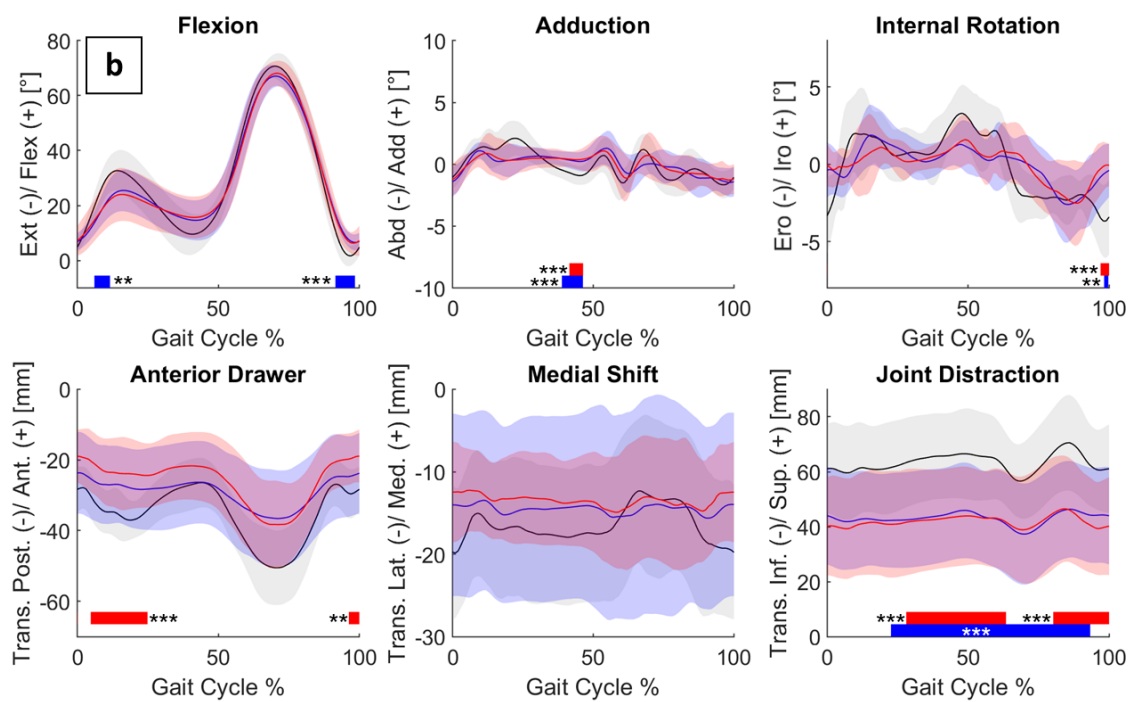
Supplementary Figure S1: Experimental 12% downhill walking setup using the treadmill (created with Nano Banana (March 27th 2026, nanobanana.org)).



Supplementary Figure S2: Mean $\pm$ SD (shaded areas) of pre- (a) and postoperative (b) level walking for MA (red), KA (blue), and control (black) groups. Joint rotations are shown in the upper row and translations in the lower row. Bars indicate significant differences between groups. Red: MA vs. C, blue: KA vs. C (* p = 0.02; ** p = 0.01; *** p < 0.01).

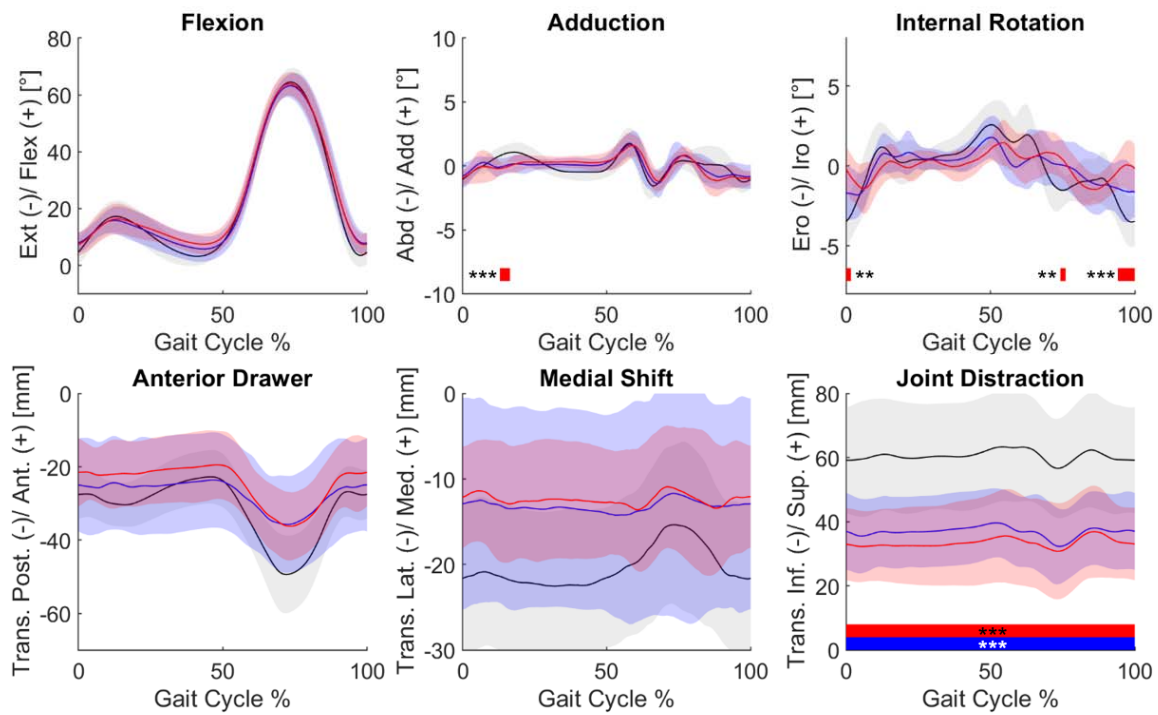


Preoperative downhill walking of CPAK1 patients



Postoperative downhill walking of CPAK1 patients

Supplementary Figure S3: Mean $\pm$ SD (shaded areas) of pre- (a) and postoperative (b) downhill walking for MA (red), KA (blue), and control (black) groups. Joint rotations are shown in the upper row and translations in the lower row. Bar indicate significant differences between groups. Red: MA vs. C, blue: KA vs. C (* $p = 0.02$; ** $p = 0.01$; *** $p < 0.01$).



Postoperative level walking of CPAK1 Patients at 4km/h

Supplementary Figure S4: Mean $\pm$ SD (shaded areas) of postoperative (b) level walking for CPAK1 MA (red), CPAK1 KA (blue), and control (black) groups at 4 km/h. Joint rotations are shown in the upper row and translations in the lower row. Bars indicate significant differences between groups. Red: MA vs. C, blue: KA vs. C (* $p = 0.02$; ** $p = 0.01$; *** $p < 0.01$).