Purpose/Hypothesis: Athletes who undergo anterior cruciate ligament reconstruction (ACLR) have known gait-related deficits and compensations which persist after completing a rehabilitation program. Even as an athlete nears return-to-play (RTP) six months after ACLR, knee extensor (ext) moments are significantly decreased in the surgical limb and these deficits may persist up to five years. Hip ext moments during walking are also increased in ACLR patients, but how the hip compensates during running is less known. Our study assessed hip ext, knee ext, and ankle plantarflexor (PF) moments during running in ACLR patients and healthy controls to determine if joint moments differed between groups and limbs. We theorized those who had an ACLR would exhibit deviations in joint moments and symmetry.

Subjects: 11 participants (female, 3; age, 20.6±1.4 yrs; BMI, 25.8±2.7 kg/m²) who underwent an ACLR in the prior 6-8 months and 11 gender and age matched healthy controls (BMI, 21.9±2.3 kg/m²).

Materials/Methods: Whole body kinematics and ground reaction forces were measured during treadmill running at each ACLR participant’s preferred speed with controls assessed at matching speed. The involved limb of the ACLR participant was compared to the same side limb of the control participant. Joint moment impulse ratios normalized to body mass were calculated for knee ext:hip ext and knee ext:ankle PF and compared between limbs and groups using repeated measures ANOVAs. Bilateral moment symmetry was calculated for the hip, knee, ankle and total lower extremity impulse and compared between groups using t-tests.

Results: A significant group x limb interaction was observed for knee ext:hip ext (p<0.05) and knee ext:ankle PF (p<0.01). The ACLR group exhibited significantly lower knee ext:hip ext (p<0.001) and knee ext:ankle PF (p<0.01) on both limbs compared to the control group. The ACLR group also demonstrated significantly increased bilateral moment asymmetry at the hip (p<0.05) and knee (p<0.001) and across all joints (p<0.001). The involved limb of the ACLR group exhibited greater hip ext impulse, less knee ext impulse, and less total lower extremity impulse than the uninvolved limb.

Conclusions: Following ACLR, patients displayed elevated hip ext and ankle PF moment 6-8 months post-surgery, which appear to be a compensation for persistent deficits in knee ext moment. ACLR patients also demonstrated increased total moment asymmetry between limbs and particularly at the knee, with the involved limb consistently demonstrating decreased moments. Future research should investigate these differences within a larger population and determine how these ratios change throughout the rehabilitation process and with graft type.

Clinical Relevance: Working toward bilateral symmetry should be a goal during rehabilitation after an ACLR. Based on healthy controls, target moment impulse ratios during running are 3:1 for knee ext:hip ext and 0.8:1 for knee ext:ankle PF.