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No Brain No Game? Altered Sensorimotor and Fronto-Limbic Circuitry in Individuals with ACL Rupture

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Sensorimotor deficits and kinesiophobia are prevalent after anterior cruciate ligament ruptures (ACLR). Nevertheless, current research and rehabilitative practices generally focus on peripheral rather than central aspects of injury, leaving the cortical contributions to ACLR less understood. **PURPOSE:** To determine differences in sensorimotor and fronto-limbic circuitry between healthy individuals (CON) and those with a history of unilateral ACLR. **METHODS:** Nineteen age- and physical activity-matched women (9 ACLR, Age: 21±3yrs, BMI: 24.3±2.6kg/m^2) completed surveys of fear of movement (TSK), readiness to return to sport (ACL-RSI), and knee function (IKDC-S). Participants completed brain imaging with T1-weighted and diffusion sequences. Voxel-based cortical thickness and quantitative anisotropy (QA) were derived using cortical morphometry and diffusion connectometry, respectively. Between-group comparisons were made using a one-way ANOVA and bootstrapped permutation tests with FDR-correction (diffusion MRI). Associations between brain imaging outcomes and questionnaires were made using Pearson correlations. **RESULTS:** Mean duration since ACLR was 3.2±2.6yrs. ACLR reported greater TSK (ACLR:0.46±0.06, CON:0.39±0.07, p=0.04), worse ACL-RSI *(*ACL:61.92±22.01, CON:91.37±7.30, p<0.001) and lower IKDC-S *(*ACLR:0.90±0.06, CON:0.99±0.02, p<0.001). Voxel-based analysis revealed reduced cortical thickness in the pre- and postcentral gyrus in ACLR. RSI positively correlated with cortical thickness in sensorimotor and fronto-limbic areas (r range: 0.47-0.80, p<0.05). In alignment, ACLR demonstrated reduced QA in the corticospinal tract, cerebellar peduncle, anterior corpus callous, cingulum, and inferior-fronto-occipital fasciculus. **DISCUSSION:** Years after injury, individuals with ACLR reported worse knee function, readiness, and fear of movement, which corresponded to alterations in sensorimotor and fronto-limbic circuitry. These findings further support the involvement of the central nervous system in ACLR and encourage the consideration of brain structure and function in the rehabilitation process.