

Exercise and Neuroplasticity

Title: Injury-Related Reductions in Skilled Visuomotor Learning Revealed by Single Trial Analysis and Response Time Variability

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Classical psychometric tests emphasize measures of central tendency as it relates to response times, contact times, and errors. More sophisticated techniques, however, may complement neurophysiological measures of neuroplasticity in response to behavioral interventions or changes in intrinsic state. **PURPOSE:** To determine whether learning on a skilled lower extremity visuomotor task was affected by prior ACL injury. **METHODS:** Eighteen healthy women between 18 and 32 yr participated. Nine women served as controls; nine others had unilateral ACL reconstruction between 6 months and 5 years from the start of the investigation. All participants completed 120 trials of a choice reaction test with a Stroop-like effect and randomly-ordered stimulus presentation order (3 sets of 40 repetitions with 30 sec rest between sets and 1 sec intertrial interval) (The Quick Board, LLC Memphis TN). Response time, contact time, and error count was recorded for each leg during each trial. **RESULTS:** In total, controls performed 525 trials with the dominant leg and 555 trials with the non-dominant leg. ACLs performed 550 trials with the injured leg and 530 trials with the uninjured leg. Average time to set completion, response time, contact time, and error count did not differ by group or leg or measurement (mean or median). ACLs displayed better initial response times but failed to improve to the same extent as controls (6.1% improvement, $y = -1.51x + 1110.2$, $R^2=0.74$ for non-injured; 2.7% improvement, $y=-0.97x + 1004.8$, $R^2=0.62$ for ACL). Greater improvements in response time were generally observed in the (initially worse performing) non-dominant leg. In the less frequently injured (3/9) dominant leg, virtually no improvement (1.4%) in response time was observed in ACLs overall, resulting in a 341.5% relative improvement in controls. The variability of single trial response time increased from the dominant to the non-dominant leg and from the healthy to injured leg. **CONCLUSION:** Single trial analysis revealed injury-related deficits in skilled visuomotor learning years after ACL rupture and rehabilitation despite the apparent recovery of the musculoskeletal system. This suggests a central neurological association with musculoskeletal injury that may affect neuroplasticity in the affected and unaffected extremity.

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