Using virtual reality to measure deficits in perception and action coupling post-concussion

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Objective: Can a dynamic decision-making task, presented in Virtual Reality (VR), detect deficits in sensorimotor control post-concussion?

Design: Case-control study.

Intervention: Two categories of VR test that objectively measure balance/gait and decision-making abilities post-concussion.

Main Outcome measures: Tandem balance (left and right) tests measured differences in sway amplitude (cm), tandem gait measured accuracy (%) and time (s), decision-making measured accuracy (%) and magnitude of error (cm). All measures were compared to the individual athlete's average baseline measures captured prior to the concussive event.

Setting: In-field testing at elite sports clubs (rugby, ice-hockey, Gaelic Football) in the UK and Ireland.

Intervention: Balance/gait and decision-making tasks were presented inside an Oculus Quest 2 VR headset. Motion controllers captured the athletes' responses in realtime (50Hz). The speed and accuracy of the test responses were then calculated.

Participants: Elite male athletes (n=23; age: 27 +/-4.4) were tested between 3 and 5 days post-concussion when following the appropriate return to play protocol.

Main Results: Nine athletes (39%) showed no significant deficits in either the balance/gait or decision-making measures compared to their own average baseline scores (P>0.05). Eleven (52%) athletes showed significant decrements (P<0.025) in decision-making (accuracy and/or error) with three of those athletes also presenting deficits in balance/gait. Three athletes were found to have significant deficits in the balance/gait tasks (P<0.05) but not in the decision-making tasks.

Conclusions: A dynamic decision-making task presented in VR provides a robust, low-cost, innovative solution for capturing deficits in sensorimotor control that persist post-concussion.