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## Development of a Portable Eye-tracking Tool for Unrestricted Return to Activity Clearance After a Concussion

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### PURPOSE

Determining when an individual is cleared for unrestricted return to activity after concussion is a critical decision that is heavily dependent on subjective symptom self-report. The purpose of this research was to develop a portable tool to provide objective data to support the rapid determination of clearance for unrestricted return to activity.

### METHODS AND STUDY DESIGN

We recruited 92 concussed participants (42.4% Female) ages 18-23 years (mean 19.4, SD 1.1). Eye movement metrics, collected with a 167 Hz infrared eye-tracker while participants viewed a 90-second video, and symptom severity were collected within 72 hours of concussive injury and at clinical clearance for unrestricted return to activity. A separate sample was reserved for model development (116 concussion, 998 uninjured).



### RESULTS

Average eye movement score for participants within 72 hours of injury was 6.5 (SD 3.1) vs. 5.4 (SD 3.1) for participants cleared for unrestricted return to activity. Average symptom severity score was  $25.9 \pm 16.7$  for participants within 72 hours of injury vs.  $0.4 \pm 1.1$  for participants cleared for unrestricted return to activity. The model based on both eye movement metrics and symptom severity was 92.4% sensitive for concussion (95% confidence interval (CI) 84.9 – 96.9%) while being 94.6% specific (95% CI 87.8 – 98.2%) for clearance for unrestricted return to activity. The proportion of participants classified as concussed decreased over time from 92.4% to 5.4% from 72 hours post-injury to clearance for unrestricted return to activity (McNemar's  $\chi^2(1) = 78.01$ ,  $p < .001$ ). Over this same time period, predicted probabilities from the model decreased for 90/92 participants (97.83%,  $p < .001$ , 95% CI [0.93, 1.00]).

### CONCLUSION

A rapid portable eye-tracking device provides objective data that is highly specific to support the clinical determination of clearance for unrestricted return to activity after concussion using eye movement metrics captured with an assessment that takes less than two minutes to administer.

### SIGNIFICANCE

Determining unrestricted return to activity after concussion is challenging and highly dependent on subjective symptom self-report. Adding a brief objective eye-tracking assessment contributes valuable data to support that decision, while adding minimal additional assessment time.