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BREAKING BARRIERS IN MS

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Eye Movement Biomarkers for Classification of Multiple Sclerosis Progression vs Non-Progression in a Cohort of Multiple Sclerosis Patients

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Abstract:
Background: Multiple sclerosis (MS) is characterized by subtle progression that is difficult to detect in clinical practice. Existing tools designed to help clinicians monitor progression may not be sensitive enough to detect early changes in disease. There is increasing evidence linking abnormal eye movements in people with MS to disease severity and cognition. We attempt to develop disease-specific biomarkers based on patterns of eye movement anomalies that could detect disease progression in PwMS.
Objectives: The objective is to determine if a mobile device tool that automatically extracts and combines multiple eye-movement metrics can detect with high accuracy whether PwMS are experiencing diseases progression.
Methods: PwMS in an ongoing longitudinal proof-of-concept study, are undergoing eye-tracking testing and clinical assessments every 6 months. Eye movements are recorded while performing oculomotor tasks using Innodem Neurosciences' patented eye-tracking technology for mobile devices, which outputs many eye movement metrics that can be used for analysis. This ad hoc analysis involves 56 patients who have completed at least 12 months of follow-up. In addition to eye tracking, each of these participants received full clinical assessments (EDSS+T25FW+BICAMS+MSFC) every 6 months and underwent analysis to determine if eye metrics could discriminate between patients who experienced disease progression and those that did not.
Results: 44% of the patients in this cohort had a clinically meaningful change (CMC+) in at least one of the scores measured (EDSS increase of 1.0, or 0.5 if higher EDSS, SDMT decrease of 4, BICAMS or MSFC decrease of 20%). In our dataset, we found 17 distinct eye metrics that had an average slope over time that was significantly different between CMC+ and CMC- patients. Employing a support vector classifier whose parameters were determined using a 5-fold cross-validated grid search and utilizing as inputs the 5 eye movement metrics providing the best model performance, we could separate progressors from non-progressors with a sensitivity to detect progression of 78%, a specificity of 68%, and balanced accuracy of 73%. Balanced accuracy was used as discriminatory measure in an exhaustive search of 1 to 5 features.
Conclusions: This ongoing study will assess the utility of eye movement biomarkers (EMBs) by improving physicians' access to a reliable, non-invasive, sensitive and accessible disease progression marker. In this early analysis, we are

already able to establish that select metrics can discriminate patients with progression from those without, with a relatively high sensitivity and specificity, as early as one year from baseline. These preliminary findings suggest that EMBs could potentially serve as a novel biomarker in MS to detect early progression before irreversible brain injury occurs, facilitating treatment optimization and improving patient outcomes.

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