Investigation of a Novel Saccade-Based Diagnostic for Rapid Concussion Detection

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In the United States, athletes suffer roughly 3.8 million concussions per year. Unfortunately, many current concussion diagnostics are subjective, placing athletes in potentially dangerous situations. This research addresses the need for a rapid and accurate method to quantify concussion symptoms by evaluating a custom-built, field-deployable electrooculogram. This study takes the first step in validating the electrooculogram as a potential concussion screening tool by determining whether it has the capacity to accurately identify saccades during a previously validated concussion diagnostic, the King-Devick Test. An electrooculogram was constructed with a bio-amplifier consisting of four stages: an input stage, a broad-band amplifier, a gain controller, and a final band pass amplifier. Electrodes placed on the subjects' temples fed impulses through the bio-amplifier and into an oscilloscope, which transferred the data to a computer for post-processing. Ten healthy adult subjects were asked to complete two trials of the King-Devick Test while monitored by the electrooculogram. Time to test completion and error rate were recorded during the test, and saccadic amplitude and total number of saccades were isolated post-processing. The average number of oblique saccades (7.291± 0.622) and total saccades (41.958 ± 4.546) recorded among test subjects during each King-Devick Test card correlated with the expected number of oblique saccades and total saccades. Additionally, the electrooculogram was able to sensitively detect the directionality and differentiating amplitude of these saccades. These results indicate that the electrooculogram is sensitive enough to accurately detect saccades, and therefore has the potential to act as a concussion diagnostic.