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Differences in saccade dynamics between spinocerebellar ataxia 2 and late-onset cerebellar ataxias

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The cerebellum is implicated in maintaining the saccadic subsystem efficient for vision by minimizing movement inaccuracy and by learning from endpoint errors. This ability is often disrupted in degenerative cerebellar diseases, as demonstrated by saccade kinetic abnormalities. The study of saccades in these patients may therefore provide insights into the neural substrate underlying saccadic motor control. We investigated the different extent of saccade dynamic abnormalities in spinocerebellar ataxia type 2 and late-onset cerebellar ataxias, genetically undefined and with prevalent cerebellar atrophy. Reflexive and voluntary saccades of different amplitude (10°–18°) were studied in seven patients with spinocerebellar ataxia 2, eight patients with late-onset cerebellar ataxia and 25 healthy controls. Quantitative analysis of saccade parameters and measures of saccade accuracy were performed. Detailed neurological, neurophysiological and magnetic resonance imaging assessment was obtained for each patient. Genetic and laboratory screening for spinocerebellar ataxias and other forms of late-onset cerebellar ataxias were also performed. A lower peak saccade velocity and longer duration was observed in patients with spinocerebellar ataxia 2 with respect to those with late-onset cerebellar ataxia and controls. Unlike subjects with spinocerebellar ataxia 2, patients with late-onset cerebellar ataxia showed main sequence relationships to similar saccades made by normal subjects. Saccades were significantly more inaccurate, namely hypometric, in late-onset cerebellar ataxia than in spinocerebellar ataxia 2 and inaccuracy increased with saccade amplitude. The percentage of hypometric primary saccades and of larger secondary corrective saccades were consistently higher in late-onset cerebellar ataxia than in spinocerebellar ataxia 2 and controls. No other significant differences were found between groups. Two different mechanisms were adopted to redirect the fovea as fast and/or accurately as possible to peripheral targets by the two groups of cerebellar patients. Patients with spinocerebellar ataxia 2 maintained accuracy using slow saccades with longer duration. This reflects prevalent degenerative processes affecting the pontine burst generator and leading to saccade velocity failure. On the other hand, patients with late-onset cerebellar ataxia reached the target with a number of fast inaccurate, mostly hypometric saccades. Different degrees of cerebellar oculomotor vermis involvement may account for differences in optimizing the trade-off between velocity and accuracy in the two groups. In addition, as suggested by spinocerebellar patients having slow saccades that are no longer ballistic, visual feedback might be continuously available during the movement execution to guide the eye to its target.

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