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Visually Induced Postural Reactivity in Glaucoma

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Abstract

Purpose

To evaluate postural reactivity in glaucoma patients using a dynamic virtual reality environment.

Methods

Patients underwent evaluation of postural stability by a force platform (Figure 1) during presentation of static and dynamic visual stimuli on stereoscopic head-mounted goggles (Figure 2). The dynamic visual stimuli presented rotational and translational ecologically valid peripheral background perturbations. Postural stability was also tested in a completely dark field to assess somatosensory and vestibular contributions to postural control. History of falls was evaluated by a standard questionnaire. Torque moments around the center of foot pressure on the force platform were measured and the standard deviations (STD) of these torque moments were calculated as a measurement of postural stability and reported in Newton meters (Nm). The ability to predict history of falls was investigated with Poisson regression models. Age, gender, body mass index, severity of visual field defect, best-corrected visual acuity, and STD on dark field condition were included as confounding factors.

Results

Forty-two glaucoma patients with repeatable visual field defects on standard automated perimetry (SAP) and 38 control healthy subjects were included. Glaucoma patients had larger overall STD than controls during both translational (5.12 ± 2.39 Nm vs. 3.85 ± 1.82 Nm, respectively; P = 0.005) as well as rotational stimuli (5.60 ± 3.82 Nm vs. 3.93 ± 2.07 Nm, respectively; P = 0.022). Postural metrics obtained during dynamic visual stimuli performed better in predicting history of falls compared to those obtained in static and dark field condition. In the multivariable model that included STD values in the mediolateral direction during translational stimulus, each 1 Nm larger STD was associated with an increase of 87% in the incident rate of falls in glaucoma patients (incidence-rate ratio = 1.87; 95% CI: 1.31 - 2.66; P = 0.001).

Conclusions

The study presented and validated a novel paradigm for evaluation of balance control in glaucoma patients based on the assessment of postural reactivity to dynamic visual stimuli using a virtual reality environment. The newly developed metrics were able to predict risk of falls and may help to provide a better understanding of balance control in glaucoma patients.

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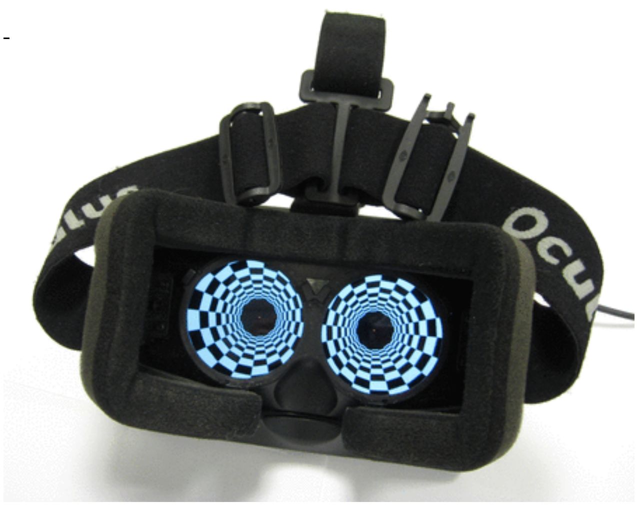

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