ABSTRACT

Importance  Eyes of patients with glaucoma may be damaged during sleep.

Objective  To measure strains in glaucoma eyes and control eyes produced by mechanical force or deformation of the eye from contact when one side of the face rests against a pillow.

Design, Setting, and Participants  This study took place in a clinic-based setting among 22 patients with glaucoma and 11 age-matched controls. The research was conducted at Wilmer Eye Institute between February 4, 2014, and December 2, 2014. Data analysis was done from June 3, 2014, to June 30, 2015.

Main Outcomes and Measures  We used a contact lens sensor (CLS) to measure change in limbal strain associated with placing one side of the face down (FD) on a pillow in simulated sleep. Baseline intraocular pressure (IOP) was measured with a tonometer. The CLS data were collected every 5 minutes during intervals of up to 60 minutes in various positions, including sitting, lateral decubitus, FD (with the CLS-instrumented eye toward the pillow), and supine. Measured changes in limbal strain were related to estimated changes in IOP and to modeled strain produced by changes in IOP.

Results  Among 22 patients with glaucoma and 11 controls, 17 were female. The mean age for the glaucoma group was 62.6 years, while the mean age for the control group was 61.4 years ($P = .68$). Baseline IOP was also similar for the 2 groups. The mean IOP sitting at the start was 13.7 mm Hg for the glaucoma group and 13.8 mm Hg for the control group ($P = .73$), and the mean IOP lying at the start was 17.5 mm Hg for the glaucoma group and 16.0 mm Hg for the control group ($P = .88$). By multivariable linear regression, FD position was associated with an increase in limbal strain in glaucoma eyes (mean [SE], 44.1 [20.4] mV Eq; $P = .03$) but not in control eyes (mean [SE], 13.6 [13.9] mV Eq, $P = .33$). While FD, the increased CLS values in patients with glaucoma did not decrease over time (slope, 0.275 mV Eq/min; $P = .53$ by univariable linear regression). Magnitudes of measured changes in limbal strain were greater in glaucoma eyes with past visual field worsening ($P = .006$ by multivariable linear modeling). The mean limbal strain increase among patients with glaucoma in FD position was equivalent to strain expected for a mean (SE) IOP increase of 2.5 (1.1) mm Hg from a baseline IOP of 14.2 mm Hg.

Conclusions and Relevance  Contact with a pillow in FD position during simulated sleep produced a sustained strain increase in glaucoma eyes, particularly those eyes with past progressive visual field loss. The mean FD change in glaucoma eyes was equivalent to strain increase associated with a mean (SE) sustained IOP elevation of 2.5 (1.1) mm Hg. Further experiments are planned to determine if facial features or a protective eye shield prevents sleep position–induced limbal strains during a mean 8-hour sleep period.