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Time of the day influences the response to optical defocus in human eyes

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Footnotes

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Abstract

Purpose : Axial length in young adult human eyes exhibit small axial changes in response to short-term exposure to hyperopic and myopic defocus. This study aimed to investigate the effects of the time of the day on optical defocus response in human subjects.

Methods : A series of axial length and anterior chamber depth (ACD) measurements were obtained for 13 emmetropic young adults (mean age, 23 ± 2 years) over three consecutive days, using the IOL Master 500. Day 1 (no defocus) examined the baseline axial length in the morning (10 am and 12 pm) and in the evening (5 and 7 pm), day 2 investigated the effects of hyperopic (n=7) and myopic defocus (n=6) on ocular

parameters in the morning (subjects wore a +3 or -3 DS spectacle lens over the right eye between 10 am and 12 pm), and day 3 examined the effects of defocus in the evening (+3 or -3 DS spectacle lens over the right eye between 5 and 7 pm). The left eye was treated as control. All data are expressed as mean ± standard error of mean.

Results : On day 1, the axial length was significantly shorter in the evening (mean change between 5 and 7 pm, +2.43 ± 2.70 µm) than in the morning (mean change between 10 am and 12 pm, +11.01 ± 2.14 µm) in both right and left eyes (p=0.011). The effects of myopic and hyperopic defocus were significantly different at different times of the day (p=0.031). Introduction of monocular myopic defocus in the evening resulted in a significantly greater reduction in axial length (-13.33 ± 8.25 µm) compared to when imposed in the morning (+3.94 ± 2.76 µm); whereas exposure to hyperopic defocus led to a much smaller increase in axial length in the evening than in the morning (+3.26 ± 2.84 vs +20.00 ± 7.57 µm). Induction of hyperopic defocus in the evening resulted in a significant reduction of axial length in the left eye by 24.50 ± 3.42 µm (p<0.001). Under no defocus conditions (day1), ACD decreased significantly in the morning (-23.93 ± 5.81 µm), but increased in the evening (+19.87 ± 8.49 µm) (p<0.001) in both eyes. There was no effect of defocus on ACD changes (p>0.05).

Conclusions : Ocular response to optical defocus significantly varies depending on the time of the day. The differences in optical defocus response at different times of the day may be influenced by natural diurnal fluctuations in axial length of human subjects. Future studies are required to investigate potential mechanisms underlying these axial changes (e.g. choroidal thickness).

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