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Changes in Ocular Biometrics and Refraction during Near Work in Downward Gaze over Time

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Abstract

Purpose: To investigate changes in the characteristics of the corneal optics, total optics, anterior biometrics and axial length of the eye during a near task, in downward gaze, over 10 min.

Methods: Ten emmetropes (mean - 0.14 ± 0.24 DS) and 10 myopes (mean - 2.26 ± 1.42 DS) aged from 18 to 30 years were recruited. To measure ocular biometrics and corneal topography in downward gaze, an optical biometer (Lenstar LS900) and a rotating Scheimpflug camera (Pentacam HR) were inclined on a custom built, height and tilt adjustable table. The total optics of the eye were measured in downward gaze with binocular fixation using a modified Shack-Hartmann wavefront sensor. Initially, subjects performed a distance viewing task at primary gaze for 10 min to provide a "wash-out" period for prior visual tasks. A distance task (watching video at 6 m) in downward gaze (25°) and a near task (watching video on a portable LCD screen with 2.5 D accommodation demand) in primary gaze and 25° downward gaze were then carried out, each for 10 min in a randomized order. During measurements, in dichoptic view, a Maltese cross was fixated with the right (untested) eye and the instrument’s fixation target was fixated with the subject’s tested left eye. Immediately after (0 min), 5 and 10 min from the commencement of each trial, measurements of ocular parameters were acquired in downward gaze.

Results: Axial length exhibited a significant increase with downward gaze and accommodation over time (p<0.05). The greatest axial elongation was observed in downward gaze with 2.5 D accommodation after 10 min (mean change from baseline 23±3 µm). Downward gaze also caused greater changes in anterior chamber depth (ACD) and lens thickness (LT) with accommodation (ACD mean change -163±12µm at 10 min; LT mean change 173±17 µm at 10 min) compared to primary gaze with accommodation (ACD mean change -138±12µm at 10 min; LT mean change 131±15 µm at 10 min). Both corneal power and total ocular power changed by a small but significant amount with downward gaze (p<0.05), resulting in a myopic shift (~0.10 D) in the spherical power of the eye compared with primary gaze.

Conclusions: The axial length, anterior biometrics and ocular refraction change significantly with accommodation in downward gaze as a function of time. These findings provide new insights into the optical and bio-mechanical changes of the eye during typical near tasks.
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