Patterns of ocular growth in young children wearing Diffusion Optics Technology (DOT) spectacle lenses: a 3-year longitudinal study

Purpose

Slowing axial length growth to emmetropic eye levels is often considered a target for myopia control therapies. It has been hypothesised that even if this target is achieved, myopic refractive progression may still occur due to the inability of the crystalline lens to compensate for axial elongation in a myopic eye. The purpose of this research was to evaluate refractive and structural changes in children wearing Diffusion Optics Technology (DOT) spectacle lenses, and compare with ocular component growth in age-matched emmetropic eyes.

Method

At 14 North American sites, myopic children were enrolled in a 3-year randomised, controlled, double-masked clinical trial (NCT03623074). Spectacle lenses designed to modulate retinal contrast (DOT 0.2) and standard single-vision spectacle lenses (Control) were dispensed. Ocular biometry and cycloplegic SER were measured at baseline and annually for 3-years. Changes in Anterior Chamber Depth (ACD), Lens Thickness (LT), Vitreous Chamber Depth (VCD) and Axial Length (AL) were compared to age-matched emmetropic eye growth data modelled from the Orinda Longitudinal Study of Myopia (OLSM). The age range analysed was restricted to children aged 6 to 7 years at baseline (n=30 DOT 0.2, n=27 Control) due to the well-established changes in ocular component growth trajectory beyond age 9 to 10 years.

Results

After 3 years, least square mean (± SE) AL progression was slowed by 0.33mm in the DOT 0.2 group compared to the Control group (0.70±0.07mm vs 1.03±0.07mm, p=0.0011). Least square mean cSER progression was slowed by 0.84D in the DOT group compared to the Control group (-0.89±0.17D vs -1.72±0.17D, p=0.0008).

Despite lower VCD elongation in the DOT 0.2 group compared to the Control group (0.69±0.29mm vs 0.98±0.38mm, p<0.0001), changes in keratometry and anterior eye biometry (corneal thickness, ACD and LT) were similar between groups (all p>0.10).

Baseline modelled emmetropic eye LT (3.53±0.02mm) was significantly thicker than the DOT 0.2 (3.42±0.12mm, p=0.0006) and Control (3.44±0.13mm, p=0.0026) groups. Compared to modelled emmetropic eye growth, thinning of the crystalline lens over 3 years was approximately 60% less in the DOT and Control groups (p<0.0001): mean change in LT of modelled emmetropic group -0.12mm, DOT group -0.05±0.06mm, Control group -0.05±0.08mm. Compared to 3-year modelled emmetropic growth (0.48mm), AL growth was 46% greater in the DOT 0.2 group and 115% greater in the Control group.

Conclusions

Young children wearing DOT spectacle lenses demonstrated significantly less myopia progression than the Control group after 3-years of wear. Ocular biometric findings suggest posterior eye growth did not significantly impact anterior eye axial measures beyond a limit. Comparison to modelled emmetropic eye growth supports the hypothesis that crystalline lens structural changes are unable to compensate for ongoing AL elongation in myopic eyes.

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