

Defocus Incorporated Multiple Segments (DIMS) Spectacle Lens Use Enhances Pupil Dynamic Range in Myopic Children

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Purpose

Defocus Incorporated Multiple Segments (DIMS) spectacle lenses have a proven efficacy controlling myopia progression, but the precise elements of myopic defocus effect are still unclear. This study investigates the effect of DIMS spectacle lenses on resting (scotopic) and daytime (photopic) pupil diameters and their potential link to myopia progression in a Hungarian pediatric cohort.

Methods

A retrospective, interventional, non-randomized clinical trial included 57 progressive myopic patients, aged 4–23 y (mean±SD: 10.60±3.09), no ocular pathology, Spherical Equivalent Refraction (SER) between –1.00 to –10.00D (–3.68±1.78) and astigmatism up to –1.75DC. Participants were recruited from a private clinic and prescribed DIMS spectacle lenses for myopia management. Static pupillometry was measured under scotopic and photopic conditions using the Topcon Myah topographer (Topcon, Tokyo, Japan). Key outcome measures included cycloplegic SER (reported in Domsa et al., 2024), axial length (AL), average pupil diameter under different lighting conditions, and pupil constriction amplitude (i.e. scotopic-photopic diameter) at baseline, 6M and 12M. Participants' left eyes were analyzed and divided into subgroups based on baseline pupil diameter, constriction amplitude (below vs. above average), and SER increase (progressors: ≥0.50 D/year vs. non-progressors).

Results

Mean AL elongation was 0.06±0.09 mm and 0.14±0.13 mm at 6M and 12M, respectively. Photopic pupil diameter decreased, whereas scotopic pupil diameter increased overall during DIMS treatment, increasing pupil constriction amplitudes, especially at 6M. However, these changes were not uniform across subgroups: photopic diameter decreased significantly only in individuals with above-average

baseline photopic pupil diameters, and remained constantly small in those with below-average photopic diameters ($p < 0.0001$). Similarly, scotopic pupil diameter and constriction amplitude increase was only significantly present in those having below-average scotopic diameters/amplitudes, while remained constantly large in the above-average scotopic diameters/amplitudes subgroup ($p = 0.002$ and $p = 0.0002$, respectively). Thus, DIMS spectacle lenses appear to equalize pupil size in the given luminance condition. Multiple regression analyses revealed that pupil size (baseline and change in pupil contraction amplitude) was significantly related to AL progression at 6M (baseline: $p = 0.011$, change: $p = 0.003$) but not at 12M. This conforms to pupil diameter changes predominantly taking place by 6M.

Conclusions

DIMS spectacle lenses induce rapid changes in pupil size, working towards standardization under given luminance conditions, while simultaneously enhancing the pupils' dynamic range. Absolute constriction amplitude (ACA), a similar measure, predominantly reflects parasympathetic activity, and has been shown to be decreased in moderate to high autonomic nervous system dysfunction (Muppidi et al, 2012) as well as in myopia (Poudel et al, 2024). Further research is needed to explore the causal relationship of changes that may be linked to DIMS spectacle lens efficacy.