Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

Is a dose-dependent response common among a number of myopia control treatments?

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In the current times of the COVID-19 pandemic, as countries around the world struggle with controlling the spread of coronavirus, one of the more successful stories has been that of New Zealand's strategy, where hard temporary lockdown was implemented early and swiftly, successfully flattening the curve of coronavirus cases for the safety and welfare of their population.

A similar analogy can be said for myopia management. If the goal of prescribing a child with myopia control intervention is to flatten the curve of their myopia progression, so that the end point of the child's myopia is kept as low as possible, it is prudent to be decisive in choosing an effective intervention strategy. Successfully slowing myopia progression, particularly in regards to axial elongation, reduces an individual's lifelong risks of myopia-related complications such as myopic maculopathy, retinal detachment, glaucoma and cataract.[1] The question is not only *which* intervention is most suitable for each individual child, but also *what* is the appropriate dose or strength to give? Philip Cheng reviews a number of recent papers to address this point.

Dose-dependent response of myopia control treatments

The newly published paper from the Bifocal Lenses in Nearsighted Kids (BLINK) study,[2] has demonstrated that with centre-distance multifocal soft contact lenses (MFSCLs), a high add power (+2.50D) significantly reduces the rate of myopia progression compared with medium add power (+1.50D) MFSCLs or single-vision contact lenses. Over 3 years, high add power lenses slowed eye growth by a clinically meaningful 0.23 mm compared with single-vision lenses, while medium add power lenses slowed eye growth by only 0.07mm – a statistically insignificant amount.

This finding confirms that with MFSCLs for myopia control, a dose-response relationship exists between the add power prescribed and the amount of slowing of myopia progression. It is hypothesised that MFSCLs work by modifying the optical profile of the eye, namely by focusing peripheral light rays in front of the peripheral retina, which in turns acts as a 'stop signal' for eye growth. In theory, high add multifocal lenses focus peripheral light further in front of the retina than medium add lenses.

We also see a dose-dependent response with atropine treatment. In the Low-Concentration Atropine for Myopia Progression (LAMP) study, 0.05% atropine was observed to be twice as effective as 0.01% atropine in slowing refractive change over 2 years. In terms of slowing axial elongation, 0.01% atropine was found to be ineffective in the first year and slightly improved in the second year, perhaps due to a cumulative effect over time. The side effects of atropine – pupil dilation, photosensitivity and reduced amplitude of accommodation – are also concentration-dependent; while higher doses of atropine (0.1% and above) can better slow axial elongation during

treatment, they are also associated with reduced patient tolerability and greater rebound effect upon ceasing treatment.[3]

Orthokeratology (OK), overnight corneal reshaping with reverse geometry rigid lenses, is an established treatment for myopia management. A meta-analysis of seven OK studies in the literature found that OK slows axial elongation by approximately 45% over 2 years.[4] Several studies have suggested that the effectiveness of OK is correlated with the amount of baseline myopia. The LORIC study reported slower axial elongation in subjects with moderate baseline myopia (-2.00 to -4.00D) than those with low initial myopia (below -2.00D).[5]

The exact mechanism of OK in suppressing eye growth is not yet known. To our best current knowledge, it involves the role of relative peripheral myopic defocus and that of significantly increased higher-order aberrations (HOAs) caused by the mechanical effect of OK in flattening the central cornea and steepening of the mid-periphery via redistribution of corneal epithelial cells.[6] The amount of peripheral myopic defocus and increase in HOAs generated by OK is proportional to the amount of corneal flattening to correct myopia. Hence higher myopia corrections with OK create a potentially greater 'dose' of myopia control effect than low myopia.

Conclusion

While we don't have all the answers right now, current evidence suggests a dose-dependent response is common among optical and pharmaceutical myopia control interventions. When prescribing a patient with myopia control treatment, practitioners should determine both a suitable *type* of treatment and an appropriate dose to best slow the patient's myopia progression, as every dioptre matters. Future research will hopefully provide further guidance on how to optimise individual treatment outcomes.

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