Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

# The latest on myopia control

*October 30, 2014*

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Myopia control is of growing importance to the eye care sector, owing to the dramatic increases in the prevalence of myopia in children and young adults over the past few decades.[1,2] An earlier age of onset is linked to faster myopic progression, which in turn contributes to increased severity and higher risk of ocular complications like cataract, glaucoma and retinal degeneration.[3-5]

The complexity of myopia control put into clinical practice is that it sits across multiple disciplines, including paediatric and contact lens practice, as well as requiring consideration of the individual patient's visual environment. Using pharmacological and optical means to slow myopia progression is well accepted in the scientific literature, yet gaining the full picture on myopia control requires understanding of diverse research topics, including visual optics, epidemiology and animal and human clinical studies.

Atropine has enjoyed strong scientific support for myopia control,[6-8] but the side effects makes this clinically unpopular. A recent study on the effect of 0.01% Atropine found a promising 64% reduction in axial elongation over two years, with minimal effects on accommodation and pupil size.[9] This treatment is not yet commercially available but is likely to be included in our future myopia control arsenal, especially if further research confirms these results.

Spectacles and contact lenses designed to slow progression of myopia have shown variable results, with spectacle lenses only showing positive effect in specific patient groups. The desired change in optics of the myopic eye required to possibly reduce myopic progression seems difficult to achieve with spectacle lenses.[10,11] Contact lenses, however, overcome these difficulties through close alignment with the eye, which allows more consistent retinal focus. The mechanisms of contact lens options for myopia control are partially understood, and can be separated into modifying the peripheral or central optics of the eye.

**Modifying peripheral optics**

Relative peripheral hyperopia in human myopes has been demonstrated numerous times, in comparison to emmetropes and hyperopes who typically exhibit peripheral myopia.[12-15] When compared to age-matched emmetropes, it has been shown that children who become myopic demonstrate a higher relative peripheral hyperopic refraction from two years prior to the onset of myopia, which is maintained through to five years of post-myopia follow up.[14,16] This has led to the presumption that shifting the peripheral optics of the myopic eye from being relatively hyperopic to being relatively myopic should slow axial elongation.

Orthokeratology (OK) has shown positive results for myopia control across several studies, slowing myopia progression by 32 to 100% over study periods of 12 to 60 months.[17-24] OK has been shown to induce the desired myopic peripheral refraction profile,[25-27] which is assumed to be its primary mechanism for this myopia controlling

effect. A handful of recent studies using dual focus and multifocal soft contact lenses (MFSCLs) have shown myopia control results ranging from 29 to 50% over 6 to 24 months.[28-30] While presumed that a distance centred peripheral 'add' MFSCL would create an optical effect on the retina analogous to OK, this has yet to be proven, with Ticak and Walline demonstrating high variability in this effect across different eyes and no significant change made to peripheral optics.[31]

There is also growing conjecture as to how consistently relative peripheral hyperopia (RPH) influences myopia development and progression. The relationship between RPH and myopia development does not hold across all ethnicities,[32] and does not appear to change with increasing axial length or time from myopia onset, indicating that other mechanisms are involved in both the onset and progression of myopia.[14,16] More of the myopia control picture is revealed when considering on-axis optics of the eye.

**Modifying central optics**

The quality of the foveal retinal image in myopia is known to be affected by inaccurate accommodative and convergence behaviour, along with demonstrated lower levels and more variability in spherical aberration (SA).[33-35] Although conjecture exists,[36,37] there is a reported association between higher levels of esophoria and accommodative lag at near in myopic children when compared to emmetropes.[38,39] Progressing myopes in young adulthood have been shown to have more near esophoria, an increased accommodative lag, and greater variability in accommodative responses with closer near demands.[40-42] Variable and lower levels of SA in myopes could reduce accuracy and contribute to accommodation errors, increasing overall hyperopic retinal defocus at near,[43] which could augment the effects of peripheral hyperopia to signal increased axial eye growth.

It is generally held that accommodation brings about a negative shift in spherical aberration (SA), with large intersubject variability.[34,44-46] Moreover, negatively powered contact lenses induce negative SA,[47] which in theory could additionally increase accommodative demand in the myope. While a modest correlation between manifest aberrations and accommodative lag or lead has been debated,[33,48] the ability to induce positive spherical aberration in the myopic visual system could counteract accommodation errors which may contribute to refractive progression.

OK is known to modify on-axis spherical aberration (SA), shifting it in the positive direction by a factor of four to eight,[49-51] which could theoretically reduce accommodative demand at near and prove to be beneficial to the inaccurate myopic accommodative system.[33,34,44-46,48] A recent study investigating a 'positive spherical aberration' soft contact lens yielded an impressive 69% myopia control effect over six months.[52] There is some data in the literature indicating that both OK and MFSCL could improve accommodative accuracy in the myope.[53,54] Clinical measurement of spherical aberration is not currently widespread, and the form of a 'beneficial' aberration profile is yet to be answered in the literature, but it would appear that improving binocular vision behaviour and accuracy of foveal focus is part of the myopia control solution.

**The visual environment of the myope**

In 2008 the landmark Sydney Myopia Study demonstrated that lower outdoor activity (less than 1.5 hours per day) in combination with high near work (greater than three hours per day) resulted in a two-and-a-half times increased risk of myopia development in children.[55] Studies since have confirmed the association between less outdoor activity and myopia, and even the complex interaction between genetics and environment where children of myopic parents spend significantly less time outdoors than children of non-myopes.[56,57] Near work activity as a singular risk factor for myopia development and progression is not supported in the literature and the influence of outdoor time appears stronger for younger children compared to teens.[58] Evidence-based myopia management in clinical practice must also include some advice on these environmental risk factors, as they present an opportunity for modification which is relatively simple to achieve in most people.

**The clinical conundrum and the call to action**

It is clear that there is no panacea for myopia control, and there are limitations in translating scientific research into clinical practice. Differing age and ethnic groups; variation in scientific results for the same modality across similar studies; short duration of myopia controls studies; and understanding the gulf between 'statistically significant' and 'clinically meaningful' results all complicate the eye care practitioner's ability to understand and communicate the options to patients. We also currently have little to offer the child at-risk of developing myopia, despite some understanding of genetic, optical and environmental risk factors. However the research is now strong enough to support the stand that myopia management inaction is no longer acceptable.

Prescribing single vision correction to progressing myopes is simply not evidence-based practice. We must also take action as the lifetime risks of myopic pathologies such as myopic maculopathy, cataract, glaucoma and retinal detachment frequently outweigh the immediate concerns of paediatric contact lens wear.[59] Myopia control is going to remain a hot topic for the foreseeable future, and requires a combined approach through research and practice to ensure better patient outcomes.

**Acknowledgements**

Dr Paul Gifford PhD for editorial assistance.

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