Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

Use of contact lenses in myopia control: A case study

November 16, 2011

Paul Gifford, PhD, MOptom conducts research at the University of New South Wales, Australia. His primary research interest is the visual optics of orthokeratology, particularly in relation to the correction of hyperopia and presbyopia, and use in myopia control. He also has research interests in contact lens and surgical correction of presbyopia.

Kate Johnson BAppSc(Optom), GradCertOcTher is the current president of the Optometrists Association Australia (Queensland/Northern Territories Division) and operates an independent practice in Brisbane, Australia and works as a clinical supervisor and visiting lecturer at the Queensland University of Technology. She has interests in contact lens fitting, binocular vision and paediatric optometry.

The following case report on a myopic family reveals how use of orthokeratology lenses has resulted in less myopia compared to siblings wearing single vision glasses and contact lenses.

The prevalence of myopia has increased over the past few decades, intensifying research interest into reducing myopic progression in children.[1-3] Earlier onset of myopia is linked to faster progression and greater severity with higher risk of ocular complications such as glaucoma, cataract and retinal detachment.[4-6] In many parts of East Asia myopia has become the most common refractive error once a population reaches their teenage years.[7] In Australia, 5% of Caucasians and 40% of East Asian children from 11-15 years of age are myopic, further demonstrating greater prevalence in Asian populations.[8]

There is considerable published research on attempts to halt or slow the progression of myopia using glasses or contact lenses, with a number of different approaches reporting limited effect. Inducing monovision with single vision glasses, by correcting the dominant eye for distance and creating myopic defocus with a +2.00D add in the non-dominant eye, has been shown to create a myopic control effect of 49% (0.55D) over 18 months, but only in the add-corrected non-dominant eye.[9] Cheng et al. dispensed bifocal and prism bifocal spectacle lenses to Asian children with demonstrated myopic progression and found a reduction in the rate of axial length elongation and myopia over two years in comparison to eyes dispensed single vision lenses.[10] Progressive addition lenses (PAL) have also been researched extensively, but to date clinically relevant effects have only been reported for children with near esophoria and accommodative lag.[11,12]

The role of peripheral refraction

Current research interest is centered heavily around the influence of peripheral refraction on myopic progression. First reported by Hoogerheide et al., in their investigation of myopic pilots,[13] Smith et al. have since provided compelling evidence in primates that manipulation of peripheral retinal focus can dramatically affect the eye's axial elongation.[14-16] Peripheral refraction refers to the focal point of off-axis light rays incident to the eye when on-axis light rays are focused on the fovea (Fig 1).

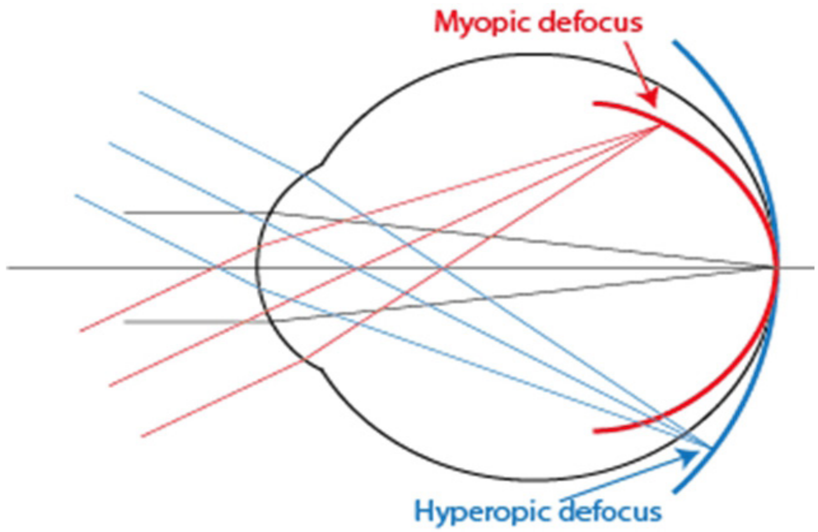


Figure 1: Location of myopic (red lines) and hyperopic (blue lines) off axis defocus image shells when foveal fixation (black lines) is maintained for on-axis distant objects.

Whereas emmetropes and hyperopes typically exhibit peripheral myopia (off-axis peripheral rays focused in front of the retina), children who become myopic have been shown to demonstrate relative peripheral hyperopia (peripheral rays focused behind the retina) from two years prior to the onset of myopia, and maintained through to five years of post-myopia follow up. Based on research findings, the current theory is that peripheral hyperopia is a driving factor towards myopic progression. If this is the case, then correcting or inducing peripheral myopia should lead to a reduction in the rate of myopic progression.

Spectacle control of peripheral refraction

Although it has been reported that reducing peripheral hyperopia is difficult to achieve with glasses,[17-18] there are reports of limited success. Sankaridurg et al. used a novel single vision lens designed to reverse peripheral hyperopic defocus in myopic children (up to -4.00D) to show an effect, but only in 6-12 year old children with parental myopia.[17] The authors reported reduction in progression of 0.29D (30%) over one year, less than that reported by Cheng et al. with bifocal and prism bifocal lenses.[10]

Contact lens control of peripheral refraction

Contact lenses rotate with the eye to provide a consistent retinal focus, so overcome a number of the problems associated with spectacle lenses. The literature reveals two different soft contact lens designs specifically aimed at reducing the rate of myopic progression. The daily disposable Coopervision MiSight™, manufactured in omafilcon A (Proclear®) is designed with ActivControl™ technology to present concentric distance and +2D near add zones of vision. The lens is available from -0.25 to -6.00 sphere powers and has been reported to reduce progression of myopia by 45% (0.25D) over ten months.[19] The Brien Holden Vision Institute has developed a novel silicone hydrogel lens designed to reduce peripheral hyperopia. Published data reveals a reduction in myopic progression of 0.34D (54%) over six months of lens wear;[20] however, the lens is yet to be commercially released.

Orthokeratology (OK) is an alternative approach that a number of practitioners have been adopting based primarily on anecdotal reports, but more recently supported by case controlled studies that reveal around 50% reduction in myopic progression over a two-year period compared to matched single vision glasses or contact lens wearers.[21,22] In a crossover study design, Swarbrick et al. reported a complete halt in myopic progression over a six-month period in eyes wearing OK lenses compared to fellow eyes wearing standard single vision rigid lens designs.[23] OK lenses have also been shown to induce a myopic shift in peripheral refraction, providing further evidence towards the theory that peripheral refraction profiles may be influential on the progression of myopia.

Given the benefit that contact lenses offer over glasses for controlling peripheral refraction profiles, and the investment worldwide in ongoing research, we can expect an increasing number of products to enter the marketplace, specifically developed to reduce progression of myopia. However, current research provides compelling evidence that a reduction in progression of myopia can be achieved with currently available contact lens designs.

Patients are not going to stop growing in age or myopia while we wait for new products or further evidence of effect. Given the increased risk of ocular disease with high myopia we owe a duty to our young myopic patients to provide them with the latest products that have been shown to reduce the rate of myopic progression. The following case report on a myopic family reveals how use of OK has resulted in less myopia relative to single vision glasses and contact lens wearing siblings.

Case report

A mother and father have seven children, aged 8 to 18 years. Both mother and father are high myopes in the order of -8.00 dioptres, wearing a mixture of spectacles and contact lenses themselves. Five of their seven children are myopic and both parents have been motivated to pursue active management of their childrens' myopia.

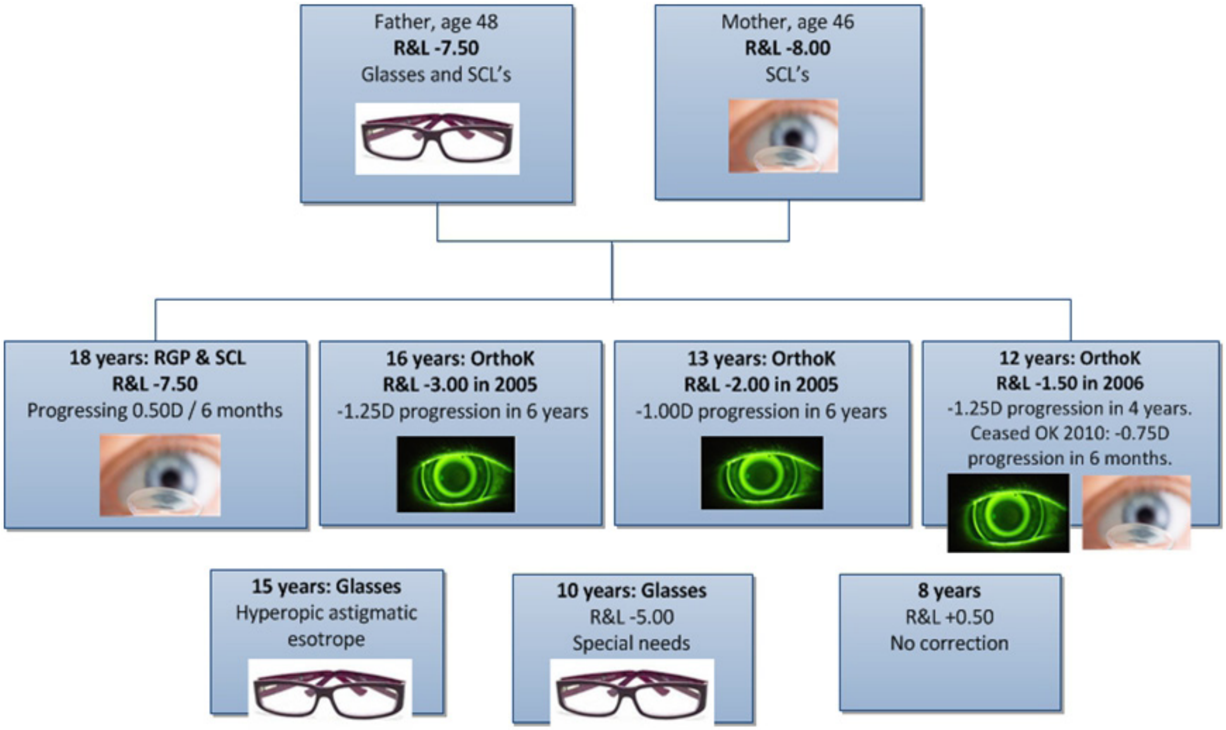
The eldest child, now 18, has reached the same level of myopia as her parents. Orthokeratology treatment was attempted when she was -5.00D, but optimum treatment was not obtained and she suffered an inflammatory reaction to lens wear. She has been wearing alignment fit rigid gas permeables and disposable soft contact lenses, and has steadily progressed by an average of 1.00D per year over the past several years.

The three next myopes in the family wear OK. As these children commenced OK wear on initial presentation to the practice, pre-treatment myopia progression data is unavailable. The annualised average myopia progression of these three children is 0.21, 0.17 and 0.31D per year respectively. Two of these three children continue to wear orthokeratology lenses after passing their sixth anniversary of lens wear.

In 2010 the youngest of these three children began demonstrating lens decentration in her left eye, which was unable to be resolved with modification of lens fit. This has lead to slightly reduced acuity of 6/7.5 (20/30) and parental dissatisfaction with treatment. She discontinued wear of orthokeratology lenses in 2010 and after six months had progressed by 0.75D. She has now been wearing Coopervision MiSight® myopia control soft contact lenses for six months and has not shown further myopic progression; the effect of this new treatment on her refractive stability will be evident with time.

The remaining three children in this family include one further myope, now -5.00 at age 10, who is unsuitable for contact lens wear due to intellectual impairment. Her myopia has increased by at least 1.00D per year; however, she has had periods of variable and under-correction of her myopia. This child suffers accommodative dysfunction and demonstrates obvious discomfort with her full correction.

All quantifications of myopic progression are based on refractive rather than biometric measures. This places some limitations on the data; nevertheless, this family demonstrates that OK shows anecdotal potential to counteract strong genetic influence for high myopia.



REFERENCES

1. Lin LL, Shih YF, Hsiao CK, et al. Prevalence of myopic in Taiwanese school children: 1983 to 2000. Annals Acad Med 2004;33:27-33.
2. Goh WS, Lam CS. Changes in refractive trends and optical components of Hong Kong Chinese aged 19–39 years. Ophthalmic Physiol Optics 1994;14:378-82.
3. Lam CS, Goh WS, Tang YK, et al. Changes in refractive trends and optical components of Hong Kong Chinese aged over 40 years. Ophthalmic Physiol Optics 1994;14:383-88.
4. Saw SM, Gazzard G, Shih-Yen EC, et al. Myopia and associated pathological complications. Ophthalmic Physiol Optics 2005;25:381-91.
5. Mitchell P, Hourihan F, Sandbach J, et al. The relationship between glaucoma and myopia: The blue mountains eye study. Ophthalmol 1999;106:2010-15.
6. Lin LL, Shih Y, Tsai Cet al. Epidemiological study of ocular refraction among schoolchildren in Taiwan in 1995. Optom Vis Sci 1999;76:275-81.
7. Morgan IG, Rose KA, Ellwein LB. Is emmetropia the natural endpoint for human refractive development? An analysis of population-based data from the refractive error study in children (RESC). Acta Ophthalmologica 2010;88:877-884.
8. Ip JM, Huynh SC, Robaei D, et al. Ethnic differences in refraction and ocular biometry in a population-based sample of 11-15-year-old Australian children. Eye 2008;22:649-56.
9. Phillips JR. Monovision slows juvenile myopia progression unilaterally. Bri J Ophthalmol 2005;89:1196-1200.
10. Cheng D, Schmid KL, Woo GC, et al. Randomized trial of effect of bifocal and prismatic bifocal spectacles on myopic progression: Two-year results. Arch Ophthalmol 2010;128:12-19.
11. Gwiazda J, Hyman L, Hussein M, et al. A randomized clinical trial of progressive addition lenses versus single vision lenses on the progression of myopia in children. Invest Ophthalmol Vis Sci 2003;44:1492-1500.
12. Gwiazda J, Hyman L, Norton TT, et al. Accommodation and related risk factors associated with myopia progression and their interaction with treatment in COMET children. Invest Ophthalmol Vis Sci 2004;45:2143-51.
13. Hoogerheide J, Rempt F, Hoogenboom WP. Acquired myopia in young pilots. Ophthalmologica 1971;163:209–15.
14. Smith EL III, Kee CS, Ramamirtham R, et al. Peripheral vision can influence eye growth and refractive development in infant monkeys. Invest Ophthalmol Vis Sci 2005;46:3965–72.
15. Smith EL III, Ramamirtham R, Qiao-Grider Y, et al. Effects of foveal ablation on emmetropization and form-deprivation myopia. Invest Ophthalmol Vis Sci 2007;48:3914–22.
16. Smith EL III, Hung LF, Huang J. Relative peripheral hyperopic defocus alters central refractive development in infant monkeys. Vision Res 2009;49:2386–92.
17. Sankaridurg P, Donovan L, Varnas S, et al. Spectacle lenses designed to reduce progression of myopia: 12-month results. Optom Vis Sci 2010;87:631-41.

18. Atchison DA. Third-order theory of spectacle lenses applied to correction of peripheral refractive errors. Optom Vis Sci 2011;88:227-33.
19. Phillips JR, Anstice NS. Myopic retinal defocus with a simultaneous clear retinal image slows childhood myopia progression. Invest Ophthalmol Vis Sci 2010;51:E2232
20. Holden BA, Sankaridurg P, Lazon de la Jara P, et al. Reduction in the rate of progress of myopia with a contact lens designed to reduce relative peripheral hyperopia. Invest Ophthalmol Vis Sci 2010;51:E2220
21. Cho P, Cheung SW, Edwards M. The longitudinal orthokeratology research in children (LORIC) in Hong Kong: a pilot study on refractive changes and myopic control. Curr Eye Res 2005;30:71-80.
22. Walline JJ, Jones LA, Sinnott LT. Corneal reshaping and myopia progression. Brit J Ophthalmol 2009;93:1181-5.
23. Swarbrick HA, Alharbi A, Watt K, et al. Overnight orthokeratology lens wear slows axial eye growth in myopic children. Invest Ophthalmol Vis Sci 2010;51:E1721