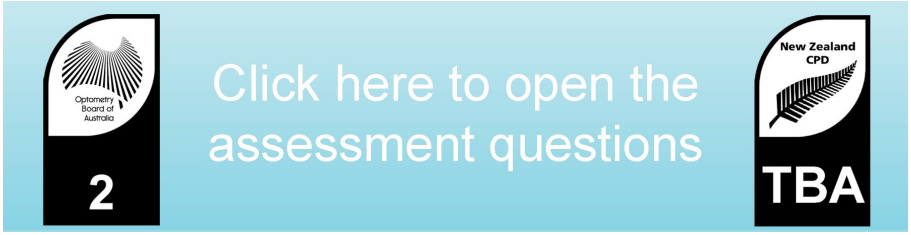
Myopia Control with Contact Lenses in Practice

2 CPD in Australia | 0.75G in New Zealand | 27 June 2016



By Kate Gifford

Taking a proactive approach to manage the progression of myopia will benefit the present and future eye health of your patients… but first you need to feel confident about the strategy you are taking.

Around the world, the incidence of myopia is increasing. A recent Sydney study found that the incidence of myopia in 12-year-old children of European Caucasian ethnicity has almost doubled over the past half-decade.[1] Once myopic, European Caucasian and East Asian children tend to progress at a similar rate,[1] which is less than the latter's counterparts in East Asia and likely due to the influence of environment.[2] The incidence of myopia in some East Asian countries is over 90 per cent in young adulthood.[3,4] Myopia in the 12–54 year old population of the US has almost doubled in 30 years, reaching over 40 per cent last decade, and recent statistics indicate that almost 30 per cent of 12–13 year old children in urban Britain are myopic.[5,6]

Myopia means much more to your paediatric patient and their parents than a pair of glasses or a discussion about contact lenses. Myopia of even 1D brings with it an increased lifetime risk of glaucoma, posterior subcapsular cataract (PSCC), retinal detachment and myopic macular degeneration of at least double compared to the emmetrope. A patient that progresses to 3D of myopia will carry a triple risk of PSCC, quadruple risk of glaucoma and ten-fold increased risk of retinal detachment and myopic macular degeneration. For your patient that manages to cross into the 'high myopia' range of 5–6D and above, the lifetime risk of retinal detachment is 16 times higher and the risk of macular damage 40 times higher than an emmetropic sibling or schoolfriend.[7] These risks are described in Table 1. The late Professor Brien Holden forecast that almost one billion people around the world are likely to be at risk of ocular pathology due to high myopia by 2050 – increasing from 200 million in 2010 – due to increasing frequency of myopia and progression to high levels.[8] In China the incidence of adult blindness increased almost 150 per cent in the past decade with the largest cause of new blindness being due to myopic macular degeneration, with glaucoma and age-related macular degeneration following second and third.[9] The threat of myopic macular degeneration is largely unrecognised in the optometric landscape, despite it being the lead cause of blindness in the highly myopic population.[8]

	Glaucoma	Cataract (PSCC)	Retinal detachment	Myopic Maculopathy
-1.00 to -3.00	2.3	2.1	3.1	2.2
-3.00 to -5.00	3.3	3.1	9.0	9.7
-5.00 to -7.00	3.3	5.5	21.5	40.6
<-7.00	-	-	44.2	126.8

TABLE 1: Odds ratios of increased risk of ocular pathology with increasing levels of myopia, summarised from Flitcroft, 2012.

Optometry can fulfil a key role in reducing this burgeoning risk of eye disease because of the primary care nature of our profession, in both raising awareness and ensuring best practice management of each progressing myope in clinical practice. A recent survey of almost 1,000 eye care practitioners in a dozen countries revealed that the majority are concerned about progressing myopia in their practice, and believe that myopia controlling contact lenses are most effective in reducing progression, yet around 50 per cent of progressing myopes are still prescribed single vision spectacles,[10] which have repeatedly shown no beneficial effect for myopia control.[11] Practitioner barriers to prescribing myopia control strategies include safety concerns and a sense of inadequate information available to guide best practice approaches.[10]

In applying a myopia control strategy and making sense of its reported efficacy in clinical terms, a recent epidemiological analysis found that reducing the rate of myopia progression by 33 per cent could result in a 73 per cent reduction in the frequency of myopia over 5D. Reducing myopia progression by 50 per cent would translate into 90 per cent less high myopia.[12] When considering options for myopia control, the clinician should not just think about reducing the frequency of refractive change, but more importantly, consider controlling the risk of their patient's future ocular health. This must be balanced against the immediate risks associated with paediatric contact lens wear, as contact lens options have shown the strongest research results for consistent myopia control.[13-15]

Contact Lenses for Myopia Control

Spectacle, contact lens and pharmacological options exist for myopia control, and standard single vision spectacles, rigid contact lenses and soft contact lenses do not offer any useful myopia control effect.[11,16,17] Theories of mechanisms for myopia control include alteration of the relative peripheral optics of the eye, binocular vision function and inherent spherical aberration. Relative peripheral optics were first highlighted in the 1970s as a feature of myopia – the myopic eye tends to show relative peripheral hyperopia (RPH) along the horizontal visual field, with the emmetropic and hyperopic eye showing relative peripheral myopia.[18,19] There is conjecture about whether RPH is a myopia feature or cause, as it may be stable after myopia onset,[20] but both animal and human studies have shown that altering the peripheral optics of the eye from relative hyperopia to relative myopia can diminish eye growth.[21] This is supported by research demonstrating substantial myopia control effects of orthokeratology (OK) and novel soft contact lenses, which modify RPH towards relative peripheral myopia.[13,22,23]

Meta-analysis indicates that OK slows axial elongation in progressing myopes by an average of 45 per

cent.[13] The corneal profile created by OK is analogous to a distance centred multifocal soft contact lens (MFSCL), where the peripheral 'add' (myopic shift) is equivalent to the central myopic correction (hyperopic shift).[24-26] The peripheral 'add' effect is evaluated through measurement of a change in peripheral refraction, indicating that the corneal change induced by OK translates through to a modification of the peripheral retinal image shell. For practitioners without access to OK lenses, but concerned about providing myopia control corrections to their paediatric patients, the equivalent multifocal soft contact lens is appealing. A -3D myope fitted with OK lenses, if likened to a multifocal, would be comparable to fitting a -3D distance centred lens with a +3D add. The peripheral 'add' of MFSCL, though, does not translate through to a modified retinal image shell in the same manner as OK, with most retinal eccentricities showing a minimal relative change.[27] It does provide a more beneficial peripheral retinal image shell than a single vision SCL of the same power,[28] affirming MFSCLs over single vision as the better evidence based management choice.

Scientific evaluation of distance centred MFSCL myopia control showed a 29 per cent reduction in axial elongation over two years.[14] More effective results have been demonstrated in myopes with near point esophoria, where a greater than 70 per cent reduction in axial elongation was found after one year of bifocal soft contact lens wear, compared to single vision soft contact lens wearing controls. The bifocal lenses were distance centred, with the adds selected to neutralise the near esophoria.[15] As for presbyopes, the peripheral 'add' effect in a MFSCL provides some accommodative support, and OK delivers similarly – both bifocal SCLs and OK have demonstrated capacity to reduce accommodative lags in young myopes.[29,30] Since esophoria, accommodative lag and increased accommodative convergence (AC/A ratio) have been repeatedly associated with myopia development and progression,[31-35] remediation of these binocular vision disorders is a key part of a myopia management strategy individualised to your patient. Children with high accommodative lag or reduced accommodative amplitude have shown greater myopia control results with progressive addition lenses[36] and orthokeratology[37] than myopes with normal accommodative function. While the traditional choice to correct esophoria and/or accommodative lag is a near add provided with spectacles,[38] evidence indicates MFSCL and OK have some propensity to do the same, which may be part of their mechanism for myopia control.

There is no known relationship between RPH and accommodative and convergence function. However spherical aberration is known to alter with accommodative demand[39] and OK has been shown to increase positive SA in the order of four to eight times after just one night of wear, which is stable after one week,[40-42] and improves accommodative response in young adult wearers.[30] Positive spherical aberration (SA) can be imagined as a distance centred multifocal, where peripheral rays are focussed more myopically than central rays, along the primary axis. A recent study evaluating a SCL designed with enhanced positive SA showed a 65 per cent myopia control effect over six months, in children primarily of East Asian ethnicity who were aged 8–11 years. After 12 months of wear the overall myopia control effect was 39 per cent.[43] While it is yet to be learnt what the ideal level of induced positive SA may be for myopia control, and how specific this is to the individual, this is a promising pilot result.

Other soft disposable lens options investigated for myopia control, not yet commercially available, include a dual focus concentric design with a central distance zone and simultaneous +2D of peripheral 'add' for both distance and near viewing. This design showed a myopia control result of over 30 per cent in the majority of the paediatric wearers, and a 50 per cent reduction in axial elongation over two 10 month periods.[23] A contact lens specifically designed to reverse RPH achieved a 33 per cent reduction in axial elongation over 12 months.[22] Generally, myopia control studies tend to show reduced results with longer time periods,[44] so longer duration studies are required to see the volume of soft lens myopia control research match that of OK. Nevertheless, the evidence exists, and increased practitioner confidence with, and access to, disposable contact lenses means that we can expect future developments

in contact lens myopia control to occur in this modality.

Measuring accommodative lag with near retinoscopy.

Myopia Control Without Contact Lenses

Other options for myopia control include atropine and progressive addition or bifocal spectacle lenses. Atropine has enjoyed strong scientific support for myopia control,[45] but a high side effect profile makes this clinically unpopular. A recent study on the effect of 0.01 per cent atropine found promising results of a 64 per cent reduction in axial elongation over two years, with minimal effects on accommodation, pupil size and a lower adverse event profile. On cessation for one year, there was a much lower rebound effect (accelerated axial growth) that has been shown with higher concentrations, and the total myopia control efficacy over five years was greatest with children treated throughout with 0.01 per cent atropine compared to those treated with higher concentrations who were then switched to the low dose later.[46] While not yet commercially available, 0.01 per cent atropine can be prepared by compounding pharmacies, although Australian regulation and supply of this treatment across all jurisdictions is under evaluation. Once readily available, 0.01 per cent atropine is likely to be included in the future myopia control arsenal, alongside suitable refractive correction which, in the form of the appropriate contact lens, could summate the myopia control effect. Future research investigating such combinations will prove incredibly useful in directing clinical practice.

For myopic children not suitable or not ready for contact lens wear, there is evidence that applying bifocal or progressive lenses to progressing myopes demonstrating esophoria and large accommodative lag (>1.00D) at near will yield a myopia control effect of 38 to 47 per cent.[47,48] For the child with normal binocular vision function though, the same spectacle lenses have no clinically significant effect,[47] and efforts are best concentrated on providing recommendations on visual environment[2,7] – children who spent less than 90 minutes outdoors per day and more than three hours on near vision tasks outside of school time are at highest risk for development and progression of myopia.[2]

Translated into practice, an average reduction of myopia progression shown in a scientific study means that some children may still progress and some may entirely halt in their progression, and we are yet to learn what factors may influence better treatment success or otherwise. The evidence based position would indicate that actively managing all young myopes as potential progressors will lead to better clinical outcomes, especially across populations.[12] As described above, there are strong indications that binocular vision function[49] and time spent outside[2] factor in both predicting those young myopes who are more likely to progress, as well as targets for successful management.[15] A management flow chart is provided in Figure 1.

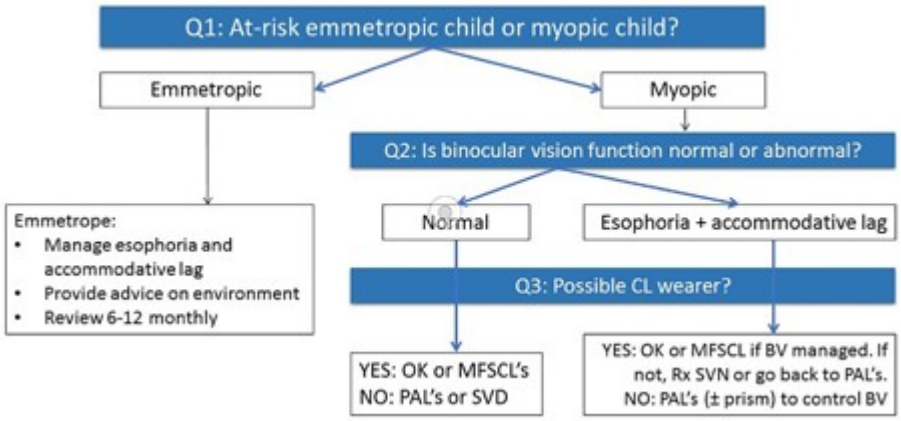


FIGURE 1: Myopia management flow chart.

The Perfect Myopia Controlling Contact Lens

Currently there is no spectacle, contact lens or pharmacological correction which has been approved by the USA Food and Drug Administration (FDA) for myopia control. Although not a requirement for practice outside of the USA, FDA approval is a globally recognised standard for product efficacy and safety. This affects practitioner confidence in myopia control prescribing across the world, as all treatments are considered 'off-label'. There is significant time and cost in achieving FDA approval. Practitioner recognition of the evidence and products currently available for myopia control will translate to better outcomes for patients as well as the impetus for industry to develop more products and achieve this approval.[50]

Given the diverse evidence, it is likely that the ideal myopia controlling contact lens involves some combination of modifying RPH, reducing esophoria and accommodative lag, and increasing positive SA. Customisation to the individual will be necessary, especially to beneficially modify binocular vision, and the inter-relationship of these optical factors is yet to be learnt. This ideal lens may also provide real time feedback and training on appropriate visual environments for the myope, such as activity alarms for near work and rewards for time spent outdoors. It would likely incorporate pharmacological delivery of low dose atropine, while also satisfying comfort and safety requirements. The duration and stability of effect, and results on cessation of wear, will also be important. Review of both the scientific and patent literature indicate that the majority of identified mechanisms and development targets for myopia control are most suited to the contact lens modality,[50] so confidence in paediatric contact lens fitting and management is essential for the practitioner actively managing myopia.

Safety and Compliance

The safety of contact lens wear in children is of utmost concern for both practitioners and parents. Wherever possible, prescribing daily disposable contact lenses to children minimises the risk of microbial keratitis (MK) to two per 10,000 wearers per year along with eliminating poor lens case hygiene and extended wear risk factors. Daily wear of a reusable silicone hydrogel appears to increase risk to 12 per 10,000, and extended wear approximately doubles this risk again.[51] The risk of MK with daily wear reusable silicone hydrogel lenses is similar to OK,[52] which is surprising given its overnight wear modality but likely owes to rigid gas permeable materials demonstrating the highest safety profile.[51]

Understanding parental expectation of their child's competence, along with observation for signs of poor hygiene, will help the practitioner to select suitable candidates. Some parents may be concerned that their

child will carry a higher risk for infection than an adult, however the scientific data does not affirm this. Children and teens demonstrate higher levels of compliance with lens disinfection and hand washing than their adult counterparts.[53,54] Children may require more reinforcement of lens care and maintenance instructions than teens – a small drop in the percentage of children answering contact lens care questions after three months of wear has been observed compared to their teenage counterparts.[55] For parents or practitioners unsure of the ideal age of commencement, data has shown that after 10 years of contact lens wear, no difference in the frequency of adverse events and objective assessment of ocular health has been found between those fitted as children compared to those fitted as teens.[56]

Clinical Communication and Strategies

Each parent and child will hold different attitudes, and often misconceptions, about contact lens wear. Safety, comfort, wearing time and maintenance routines all require discussion. There are optical and psychological benefits in paediatric contact lens wear,[57] and when viewed in terms of the future risk of high myopia-associated ocular pathology, the myopia control message is compelling. The earlier a child becomes myopic, the faster they will progress,[11] and the biggest risk factor for high myopia (over 5D) is onset by six to seven years of age, independent of ethnicity.[58] Commencing a myopia control strategy at a younger age will yield the best results – myopic children wearing single vision spectacles at seven years of age progress by at least 1D per year whereas children aged 11–12 progress at around half of this rate.[11] While Asian ethnicity has been linked to faster myopic progression,[11,59] more recent Australian data indicates that progression in Asian and Caucasian children may be similar.[1]

Effective clinical communication starts with the practitioner ensuring their own comfort with the evidence base for myopia control, and then communicating the benefits of both contact lens wear and myopia control to parents of progressing children. Initially parents find the concept of slower changes in prescription appealing, but once they understand the long term picture of their child's lifetime eye health, they will be committed to myopia management strategy. Effectiveness of health relevant messages depend on framing both the gains and losses, and the perceived hazard of a particular health behaviour.[60] Health affirming choices include consent to a myopia management correction such as atropine, MFSCLs or OK, and making active plans to increase time spent outdoors. Conversely, continued prescription of single vision corrections for the progressing myope, along with minimal change to the child's habitual visual environment, should be framed in discussions as leading towards lifelong increased ocular health risk. Just as a dose-dependent relationship between sugar availability and population incidence of diabetes has been proven,[61] every part-millimetre increase in axial length brings an increased risk of ocular pathology. Degree of myopia is the dominant risk factor for development of myopic maculopathy and retinal detachment, and it is second only to age in risk for cataract and glaucoma.[7]

Children cannot be expected to take such a far-sighted outlook on myopia as their parents, so in overcoming immediate barriers, will benefit from the chance to touch and look at a contact lens to remove fear of the unknown, along with understanding the immediate benefits of exchanging spectacle wear for contact lenses. If a parent maintains that their child is too young for contact lens wear, or if they are unsuitable for other reasons, it is still beneficial to explain all options for myopia control to form a basis for future discussions.

There is a wealth of scientific information available on myopia causes, consequences and treatments – in translating this into practice, a free downloadable clinical communication tool is available from www.myopiaprofile.com. Explanation of successful cases, expectations for contact lens wear and reinforcement of the evidence base for myopia control will reassure the parent and child in taking a proactive approach to progressing myopia, and their present and future eye health.

Kate Gifford BAppSc(Optom)Hons, GCOT, FBCLA, FIACLE, FCCLSA, FAAO operates an independent practice in Brisbane with special interests in contact lenses, binocular vision and myopia control. Graduating from Queensland University of Technology (QUT) in 2003 with First Class Honours and a University Medal, Kate is now undertaking a part-time PhD by clinical research. She is a fellow of the BCLA, IACLE, CCLSA and AAO and is the current National President of Optometry Australia. Kate is an award-winning clinical supervisor and visiting lecturer at QUT, has contributed to 28 peer reviewed and professional publications, and has presented over 60 lectures at conferences in Australia and internationally.

Optometry Board of Australia 2 Click here to open the assessment questions New Zealand CPD TBA

References

1. French AN, Morgan IG, Burlutsky G, Mitchell P, Rose KA. Prevalence and 5- to 6-year incidence and progression of myopia and hyperopia in Australian schoolchildren. Ophthalmol. 2013;120:1482-91.

2. Rose KA, Morgan IG, Ip J, Kifley A, Huynh S, Smith W, Mitchell P. Outdoor Activity Reduces the Prevalence of Myopia in Children. Ophthalmol. 2008;115:1279-85.

3. Lin LLK, Shih YF, Hsiao CK, Chen CJ. Prevalence of myopia in Taiwanese schoolchildren: 1983 to 2000. Annals Acad Med. 2004;33:27-33.

4. Jung SK, Lee JH, Kakizaki H, Jee D. Prevalence of myopia and its association with body stature and educational level in 19-year-old male conscripts in seoul, South Korea. Invest Ophthalmol Vis Sci. 2012;53:5579-83.

5. Logan NS, Shah P, Rudnicka AR, Gilmartin B, Owen CG. Childhood ethnic differences in ametropia and ocular biometry: the Aston Eye Study. Ophthal Physiol Opt. 2011;31:550-8.

6. Vitale S, Sperduto RD, Ferris FL, 3rd. Increased prevalence of myopia in the United States between 1971-1972 and 1999-2004. Arch Ophthalmol. 2009;127:1632-9.

7. Flitcroft DI. The complex interactions of retinal, optical and environmental factors in myopia aetiology. Prog Retin Eye Res. 2012;31:622-60.

8. Holden BA, Jong M, Davis S, Wilson D, Fricke T, Resnikoff S. Nearly 1 billion myopes at risk of myopia-related sight-threatening conditions by 2050 - time to act now. Clin Exp Optom. 2015;98:491-3.

9. Wu L, Sun X, Zhou X, Weng C. Causes and 3-year-incidence of blindness in Jing-An District, Shanghai, China 2001-2009. BMC Ophthalmol. 2011;11:10.

10. Wolffsohn JS. Review of current myopia management practice across the globe: the BCLA survey. Cont Lens Anterior Eye 2015:conference presentation.

11. Donovan L, Sankaridurg P, Ho A, Naduvilath T, Smith ELI, Holden BA. Myopia progression rates in urban children wearing single-vision spectacles. Optom Vis Sci. 2012;89:27-32.

12. Brennan NA. Predicted reduction in high myopia for various degrees of myopia control. Cont Lens Anterior Eye. 2012;35 S1:e14-e5.

13. Sun Y, Xu F, Zhang T, Liu M, Wang D, Chen Y, Liu Q. Orthokeratology to control myopia progression: a meta-analysis. PLoS One. 2015;10:e0124535.

14. Walline JJ, Greiner KL, McVey ME, Jones-Jordan LA. Multifocal contact lens myopia control. Optom Vis Sci. 2013;90:1207-14.
15. Aller TA, Liu M, Wildsoet CF. Myopia Control with Bifocal Contact Lenses: A Randomized Clinical Trial. Optom Vis Sci. 2016;93:344-52.
16. Katz J, Schein OD, Levy B, Cruiscullo T, Saw S-M, Rajan U, Chan T-K, Yew Khoo C, Chew S-J. A randomized trial of rigid gas permeable contact lenses to reduce progression of children's myopia. Am J Ophthalmol. 2003;136:82-90.
17. Walline JJ, Jones LA, Sinnott L, Manny RE, Gaume A, Rah MJ, Chitkara M, Lyons S, on behalf of the ACHIEVE Study Group. A Randomized Trial of the Effect of Soft Contact Lenses on Myopia Progression in Children. Invest Ophthalmol Vis Sci. 2008;49:4702-6.
18. Hoogerheide J, Rempt F, Hoogenboom WP. Acquired myopia in young pilots. Ophthalmologica. 1971;163:209-15.
19. Mutti DO, Sholtz RI, Friedman NE, Zadnik K. Peripheral Refraction and Ocular Shape in Children. Invest Ophthalmol Vis Sci. 2000;41(5):1022-30.
20. Mutti DO, Hayes JR, Mitchell GL, Jones LA, Moeschberger ML, Cotter SA, Kleinstein RN, Manny RE, Twelker JD, Zadnik K. Refractive error, axial length, and relative peripheral refractive error before and after the onset of myopia. Invest Ophthalmol Vis Sci. 2007;48:2510-9.
21. Smith ELI. Prentice Award Lecture 2010: A Case for Peripheral Optical Treatment Strategies for Myopia. Optom Vis Sci. 2011;88:1029-44.
22. Sankaridurg P, Holden B, Smith E, 3rd, Naduvilath T, Chen X, de la Jara PL, Martinez A, Kwan J, Ho A, Frick K, Ge J. Decrease in rate of myopia progression with a contact lens designed to reduce relative peripheral hyperopia: one-year results. Invest Ophthalmol Vis Sci 2011;52:9362-7.
23. Anstice NS, Phillips JR. Effect of Dual-Focus Soft Contact Lens Wear on Axial Myopia Progression in Children. Ophthalmol. 2011;118:1152-61.
24. Charman WN, Mountford J, Atchison DA, Markwell EL. Peripheral refraction in orthokeratology patients. Optom Vis Sci. 2006;83:641-8.
25. Kang P, Swarbrick H. Peripheral Refraction in Myopic Children Wearing Orthokeratology and Gas-Permeable Lenses. Optom Vis Sci 2011;88:476-82.
26. Queirós A, González-Méijome JM, Jorge J, Villa-Collar C, Gutiérrez AR. Peripheral refraction in myopic patients after orthokeratology. Optom Vis Sci. 2010;87:323-9.
27. Ticak A, Walline JJ. Peripheral Optics with Bifocal Soft and Corneal Reshaping Contact Lenses. Optom Vis Sci. 2013;90:3-8.
28. Kang P, Fan Y, Oh K, Trac K, Zhang F, Swarbrick HA. The effect of multifocal soft contact lenses on peripheral refraction. Optom Vis Sci. 2013;90:658-66.
29. Tarrant J, Severson H, Wildsoet CF. Accommodation in emmetropic and myopic young adults wearing bifocal soft contact lenses. Ophthalmic Physiol Opt. 2008;28:62-72.
30. Tarrant J, Liu Y, Wildsoet CF. Orthokeratology Can Decrease the Accommodative Lag in Myopes. Invest Ophthalmol Vis Sci. 2009;50:4294.
31. Drobe B, de Saint-André R. The pre-myopic syndrome. Ophthal Physiol Opt. 1995;15:375-8.
32. Gwiazda J, Bauer J, Thorn F, Held R. A dynamic relationship between myopia and blur-driven accommodation in school-aged children. Vision Res. 1995;35:1299-304.
33. Gwiazda J, Thorn F, Held R. Accommodation, accommodative convergence, and response AC/A ratios before and at the onset of myopia in children. Optom Vis Sci. 2005;82:273-8.
34. Mutti DO, Jones LA, Moeschberger ML, Zadnik K. AC/A Ratio, Age, and Refractive Error in Children. Invest Ophthalmol Vis Sci. 2000;41:2469-78.
35. Charman WN. Near vision, lags of accommodation and myopia. Ophthalmic and Physiological Optics. 1999;19(2):126-33.
36. Gwiazda J, Hyman L, Hussein M, Everett D, Norton TT, Kurtz D, Leske MC, Manny R, Marsh-Tootle W, Scheiman M. A randomized clinical trial of progressive addition lenses versus single vision lenses on the progression of myopia in children. Invest Ophthalmol Vis Sci. 2003;44:1492-500.
37. Zhu MJ, Feng HY, He XG, Zou HD, Zhu JF. The control effect of orthokeratology on axial length

elongation in Chinese children with myopia. BMC Ophthalmol. 2014;14:141.
38. Evans BJW. Esophoric conditions. Pickwell's Binocular Vision Anomalies (Fifth Edition). Edinburgh: Butterworth-Heinemann; 2007:109-16.
39. Atchison DA, Collins MJ, Wildsoet CF, Christensen J, Waterworth MD. Measurement of monochromatic ocular aberrations of human eyes as a function of accommodation by the howland aberroscope technique. Vision Res. 1995;35:313-23.
40. Joslin CE, Wu SM, McMahon TT, Shahidi M. Higher-Order Wavefront Aberrations in Corneal Refractive Therapy. Optom Vis Sci. 2003;80:805-11.
41. Stillitano I, Schor P, Lipener C, Hofling-Lima AL. Long-term follow-up of orthokeratology corneal reshaping using wavefront aberrometry and contrast sensitivity. Eye Cont Lens. 2008;34:140-5.
42. Gifford P, Li M, Lu H, Miu J, Panjaya M, Swarbrick HA. Corneal versus ocular aberrations after overnight orthokeratology. Optom Vis Sci. 2013;90:439-47.
43. Cheng X, Xu J, Chehab K, Exford J, Brennan N. Soft Contact Lenses with Positive Spherical Aberration for Myopia Control. Optom Vis Sci. 2016;93:353-66.
44. Hiraoka T, Kakita T, Okamoto F, Takahashi H, Oshika T. Long-term effect of overnight orthokeratology on axial length elongation in childhood myopia: a 5-year follow-up study. Invest Ophthalmol Vis Sci. 2012;53:3913-9.
45. Chua WH, Balakrishnan V, Chan YH, Tong L, Ling Y, Quah BL, Tan D. Atropine for the treatment of childhood myopia. Ophthalmology. 2006;113:2285-91.
46. Chia A, Lu QS, Tan D. Five-Year Clinical Trial on Atropine for the Treatment of Myopia 2: Myopia Control with Atropine 0.01% Eyedrops. Ophthalmology. 2016;123:391-9.
47. Yang Z, Lan W, Ge J, Liu W, Chen X, Chen L, Yu M. The effectiveness of progressive addition lenses on the progression of myopia in Chinese children. Ophthal Physiol Opt. 2009;29:41-8.
48. Cheng D, Schmid KL, Woo GC, Drobe B. Randomized Trial of Effect of Bifocal and Prismatic Bifocal Spectacles on Myopic Progression: Two-Year Results. Arch Ophthalmol. 2010;128:12-9.
49. Aller TA. Clinical management of progressive myopia. Eye. 2014;28:147-53.
50. Gifford P, Gifford KL. The Future of Myopia Control Contact Lenses. Optom Vis Sci. 2016(93):336-43.
51. Stapleton F, Keay L, Edwards K, Naduvilath T, Dart JKG, Brian G, Holden BA. The Incidence of Contact Lens Related Microbial Keratitis in Australia. Ophthalmol. 2008;115:1655-62.
52. Bullimore MA, Sinnott LT, Jones-Jordan LA. The risk of microbial keratitis with overnight corneal reshaping lenses. Optom Vis Sci. 2013;90:937-44.
53. Sulley A. Fitting children with contact lenses: Part one. Optician. 2009;237:26-30.
54. Wu Y, Carnt N, Stapleton F. Contact lens user profile, attitudes and level of compliance to lens care. Cont Lens Ant Eye. 2010;33:183-8.
55. Walline JJ, Jones LA, Rah MJ, Manny RE, Berntsen DA, Chitkara M, Gaume A, Kim A, Quinn N. Contact Lenses in Pediatrics (CLIP) Study: chair time and ocular health. Optom Vis Sci. 2007;84:896-902.
56. Walline JJ, Lorenz KO, Nichols JJ. Long-term contact lens wear of children and teens. Eye Contact Lens. 2013;39:283-9.
57. Walline JJ, Jones LA, Sinnott L, Chitkara M, Coffey B, Jackson JM, Manny RE, Rah MJ, Prinstein MJ. Randomized trial of the effect of contact lens wear on self-perception in children. Optom Vis Sci. 2009;86:222-32.
58. Gwiazda J, Hyman L, Dong LM, Everett D, Norton T, Kurtz D, Manny R, Marsh-Tootle W, Scheiman M, Comet G. Factors associated with high myopia after 7 years of follow-up in the Correction of Myopia Evaluation Trial (COMET) Cohort. Ophthalmic Epidemiol. 2007;14:230-7.
59. Hyman L, Gwiazda J, Hussein M, Norton TT, Wang Y, Marsh-Tootle W, Everett D. Relationship of age, sex, and ethnicity with myopia progression and axial elongation in the correction of myopia evaluation trial. Arch Ophthalmol. 2005;123(7):977-87.
60. Rothman AJ, Salovey P. Shaping perceptions to motivate healthy behavior: the role of message framing. Psychol Bull. 1997;121:3-19.

61. Basu S, Yoffe P, Hills N, Lustig RH. The relationship of sugar to population-level diabetes prevalence: an econometric analysis of repeated cross-sectional data. PLoS One. 2013;8:e57873.