Literature Review

https://doi.org/10.31288/oftalmolzh202515459

Current optical methods for controlling progressive myopia control in children: a review

Tsybulska T.Ye., Titkova O.Yu.

Zaporizhzhia State Medical and Pharmaceutical University
Zaporizhzhia (Ukraine)

Key words:
myopia, spectacles, soft contact lenses, orthokeratology lenses, axial length

The prevalence of myopia has been steadily increasing worldwide. The role of optical methods for controlling progressive myopia control in children is still important. Therefore, the purpose of this study was to review current optical methods for controlling progressive myopia control in children. It is well established that myopic children wearing full optical correction are less prone to the progression of the disease. It has been reported that the undercorrected group of myopic school children showed a 1.3 times greater rate of progression over 24 months as compared to the fully corrected group. Correction of myopia with spectacles is common in children. Many clinicians share the opinion that myopic peripheral defocus has a positive effect on axial elongation, and peripheral defocus spectacles have been increasingly used for this purpose. Optical correction with spectacles, however, may have some disadvantages. Some children wearing spectacles may feel psychological discomfort due to negative peer comments and/or have problems with compliance. Soft contact lenses with myopic defocus and othokeratology (OK) lenses are of special value for myopia progression control. It has been reported that myopia progression was controlled by 38.6% and 66.6% in children wearing Multistage + 1.50D and Proclear +3.00D multifocal contact lenses, respectively, in comparison to children wearing single-vision control lenses over an 18-month period. Refractive therapy with orthokeratology lenses has become an increasingly popular technique for controlling the progression of myopia. It has been reported that orthokeratology lenses are more effective than spectacles or soft contact lenses at reducing myopia progression. The review provides evidence that myopia control devices utilizing the myopic defocus principle are the first-line means for optical correction in children with progressive myopia.

Myopia is one of the most common eye conditions and still a major public health issue worldwide [1, 2]. The prevalence of mild and moderate myopia among school children and students in Ukraine has been estimated to range from 30% to 68% [3, 4]. Progressive myopia not only is characterized by vision loss and axial elongation, but also is associated with complications like retinal detachment, macular and peripheral retinal degeneration, choroidal thinning and neovascularization, macular hemorrhage and retinal tear [5-8]. This justifies efforts by ophthalmologists to continue a search for methods of stabilization of the course of myopic eye growth [4, 9].

In recent decades, the interest in research on the mechanisms affecting the course of myopia has increased due to the use of orthokeratology lenses. Attention is also drawn to studies on the use of soft contact lenses and specially designed glasses not only as means for correcting visual acuity, but also means for therapeutic impact on the course of myopic progression in children [10, 11]. This called for regular reviewing of some issues of the management of progressive myopia in children and active attention from ophthalmologists.

The purpose of this study was to review current optical methods for controlling progressive myopia control in children.

Spectacle correction is a traditional and still the most widely used form of optical correction in children. Data from prospective clinical trials suggest that undercorrection of myopia increases myopia progression [11-13]. Full optical correction of myopia allows more precise image focusing on the retina, eases the visual load on the eye, and, consequently, may slow further axial elongation. In a study by Chung and colleagues [12], myopic school children were randomly allocated to an undercorrected group or a fully corrected control group to assess the effect of myopic defocus on myopia progression. The undercorrected group showed a 1.3 times greater rate of progression over 24 months as compared to the fully corrected group [12].

Consequently, full correction of myopia is the current standard of care, as offered by contemporary optometric clinicians [11].

Currently, prescribing spectacles in myopic children aims not only to correct for a myopic refractive error and enable a clear image on the retina, but also to slow down the progression of myopia. Peripheral defocus spectacles have been increasingly used for this purpose [13]. Myopic peripheral defocus has a special role in the regulation of refractive eye growth and development of myopia. It has been established that it is the image focusing on the peripheral retina that impacts eye growth and, consequently, the course and progression of myopia. Currently, many clinicians share the opinion that myopic peripheral defocus has a positive effect on axial elongation whereas hyperopic defocus may stimulate eye growth and contribute to the progression of myopia [12, 14]. Among progressive spectacle optic lenses, MyCon lens (Rodenstock GmbH, Munich, Germany) has been given special attention. The Rodenstock MyCon lens has a central vision zone that corrects the child's ametropia with asymmetrical nasal (+2.00D) and temporal (+2.50D) progressions, which reflect the more hyperopic nasal hemifield. Therefore, light in the periphery is refracted to hit in front of the retina, slowing eye elongation [15, 16].

An independent clinical study examining the progression of myopia in European children aged 7 to 14 over a 5-year period has shown that myopia control lenses based on Rodenstock MyCon™ principles can reduce myopia progression by up to 40%. In addition, the axial length (AL) of the eye could be reduced by up to 56% after 2 years and by up to 35% after 4 to 5 years [16].

Radhakrishnan and colleagues [17] and Atchison and colleagues [18] also believe that progressive lens spectacles offer an effective approach for reducing hyperopic defocusing and, consequently, slowing myopia progression. Special design of progressive spectacle lenses facilitates reductions in the load on the accommodation system of the eye, asthenopic symptoms and negative effects of near work on futher development of myopia in children [18].

The patented Cylindrical Annular Refractive Elements (C.A.R.E.) Technology incorporates alternating defocus and correction zones expanding towards the periphery of the lens. The signal originating in these microstructures causes slower axial elongation. In addition, ZEISS MyoCare features a ClearFocus design – a unique free-form optimised back surface aimed to minimize the hyperopic defocus, while maintaining myopic defocus for all gaze angles [19].

Ohlendorf and colleagues [19] evaluated the performance of spectacle lenses (SPL) with CARE (ZEISS MyoCare and MyoCare S) after 1-year of SPL wear with metrics based on age-related physiological eye growth. The former lens design (with CARE mean surface power of +4.6 D and a central clear zone of 7 mm) is recommended for children younger than 10 years and the latter lens design (with CARE mean surface power +3.8 D and 9 mm central clear zone), for children 10 years and older. In myopic eyes, AL growth decreased from 0.60 ± 0.25 mm/yr at 7 years to 0.30 ± 0.15 mm/yr at 12 years, whereas in emmetropes, AL growth was lower at 0.18 ± 0.13mm/yr at 7 years and 0.07 ± 0.10/yr mm at 12 years. For all ages, 1-year AL growth with MyoCare and MyoCare S was lower than in myopes and closer to emmetropes. It was concluded that MyoCare and MyoCare S reduced myopic AL growth by an average of 70% and 68% compared to emmetropic eye growth. Seven of ten eyes wearing MyoCare or MyoCare S had eye growth similar to or equivalent to emmetropic eyes [19].

Therefore, optical corrections with spectacles of this and similar designs seem promising for slowing down myopia progression [20]. Optical correction with spectacles, however, may have some disadvantages. Some children wearing spectacles may feel psychological discomfort due to negative peer comments and/or have problems with compliance, which contributes to the risk of myopia progression [21].

Contact lenses are another means of optically correcting myopia in children. Soft contact lenses incorporating myopic defocus and orthokeratology lenses may slow down myopic progression. These modalities are not only helpful in correcting vision, but also enable managing myopic progression and slowing down AL growth [22, 23]. Soft contact lenses incorporating myopic defocus are helpful in reducing visual load on the central retina and thus slow down AL growth.

Of note, concentric bifocal lenses, extended depth of focus lenses and multifocal lenses are the three major types of soft contact lenses (SCL) that have been found to be effective in managing pyopia progression. The first two types have been acknowledged in Europe as reliable modalities for slowing down myopia progression [22, 24, 25]. Although studies have confirmed the efficacy of multifocal lenses, these lenses may be inappropriate in junior school children due to possible instability of vision in this age. The impact of wearing SCL in young children is not yet fully understood [22, 25].

The use of bifocal SCL is an alternative modality for optical correction of myopia. A centre-distance design has the central portion of the optical zone for distance vision, which is surrounded by an area containing the near power. The lens that features commonly is a centre-distance, concentric design, simultaneous vision bifocal with an add power of +1.50 D to +2.00 D [26, 27]. This strategy for the use of bifocal SCL has been applied in the Bifocal Lenses In Nearsighted Kids (BLINK) study which reported on the reduction in the rate of myopia progression [24, 26]. This opinion has been supported by a 6-year multicenter clinical trial on the long-term effect of dual-focus contact lenses (DFCL) on myopia progression in children. The trial concluded that dual-focus soft contact lenses continue to slow the progression of myopia in children over a 6-year period revealing an accumulation of treatment effect. Eye growth of the initial control cohort with DFCL was slowed by 71% over the subsequent 3-year treatment period [28].

There have been reports evaluating the efficacy of multifocal soft contact lenses (MFSCL) in slowing the progression of myopia in children. It is believed that administration of these lenses slows down the progression of myopia. A study by Raffa and colleagues aimed to establish the outcome of MFSCL (Multistage + 1.50D and Proclear + 3.00D) on myopia progression and AL elongation in myopic children aged 13-15 years over an 18-month period. Myopia progression was controlled by 38.6% and 66.6% in children wearing Multistage + 1.50D and Proclear +3.00D MFSCL, respectively, in comparison to children wearing single vision contact lenses (SVCL) over an 18-month period. In terms of axial elongation, the study found a 31.1% and 63.2% control in axial elongation over 18 months of treatment in comparison to the SVCL group [29].

Refractive therapy with orthokeratology (OK) lenses has become an increasingly popular technique for controlling the progression of myopia [13, 30-32]. Orthokeratology may be defined as the planned, temporary reduction in myopia by the wearing of flat-fitting rigid contact lenses. This is achieved by flattening the central corneal and steepening the peripheral cornea [33-35].

There are several potential mechanisms of myopia control with OK such as a myopic shift in peripheral refractive error that results in peripheral myopic defocus after OK [14,35].

Other researchers hypothesize that OK lenses slow down myopia progression by impacting accommodative response and aberration which become spherically positive due to an increase in peripheral refraction. Song and colleagues [36] concluded that, after switching from spectacles to OK lenses, myopic children showed improvements in accommodative function, stereopsis, and ocular motility; and a decrease in the binocular horizontal vergence range. In a study by Ding and colleagues [37], myopic children were divided into an OK group and a single-vision spectacles (SVS) group to investigate the effect of OK on accommodative function and aberrations. They concluded that increased high-order aberrations and improved accommodative accuracy were observed during OK treatment, but began to regress after the cessation of OK. A significant positive correlation between improved accommodative accuracy and slowed axial elongation was only observed during the first 6 months of treatment. Therefore, further research is required to elucidate the association between changes in accommodation and slowing down myopia progression with refractive therapy.

The hypothesis of the involvement of choroidal thickening in myopic eyes has been suggested with regard to the impact of OK lenses on myopia progression. Researchers advocating this hypothesis view choroidal and retinal changes as a compensatory mechanism preventing excessive axial elongation in myopic eyes treated with OKL [38, 39].

Orthokeratology efficacy issues have been debated over years. It has been reported that orthokeratology efficacy may depend on the patient's baseline characteristics like age, corneal asphericity, and pupil diameter, and well as refraction of the lens [40]. Wang and colleagues [41], however, found no significant associations between gender, mean corneal power, corneal toricity, central corneal thickness, white-to-white corneal diameter and pupil size with AL elongation after OK lens wear.

Others compared myopia progression among children wearing different types of orthokeratology lenses and children wearing SVS. Nakamura and colleagues [23] evaluated factors related to myopia progression in children wearing either three types of OK lenses or SVS for 2 years. Regardless of OK lens design, myopia progression in school-aged children was suppressed. The myopia control effect by OK lenses was found to be 0.85 D over the 2-year period. These findings have demonstrated that, regardless of OK lens design and type, orthokeratology has an advantage over SVS in the impact on myopia progression.

Swarbrick and colleagues [42] concluded that overnight OK inhibits AL growth and myopia progression compared with conventional rigid gas-permeable (GP) lenses. In a 12-month randomized, contralateral eye crossover study, AL elongation and myopia progression with OK were compared with conventional daytime rigid contact lens wear. Subjects were fitted with overnight OK in 1 eye, chosen at random, and conventional rigid gas-permeable (GP) lenses for daytime wear in the contralateral eye. Lenses were worn for 6 months. After a 2-week recovery period without lens wear, lens-eye combinations were reversed and lens wear was continued for further 6 months, followed by another 2-week recovery period without lens wear. After 6 months of lens wear, AL had increased in the GP eye but showed no change in the OK eye. During the second 6-month phase of lens wear, in the OK eye there was no change from baseline in AL at 12 months. However, in the GP eye, the 12-month increase in AL was significant. AL change in the GP lens-wearing eye during phase 2 was approximately double the change found during phase 1, and this difference reached statistical significance. The GP lens-wearing eye showed progressive AL growth throughout the study. The study provided further confirmation that orthokeratology is an effective treatment modality for progressive myopia in children [42].

The impact of orthokeratology lens wear on progressive myopia in chilfren has been investigated by Ukrainian researchers, too. Bushueva and Maliieva contributed significantly to the research on the efficacy of OK lens wear on myopic refraction in children. They conducted a 3-year study to assess the impact of orthokeratology lens wear on myopic refraction in children with mild to moderate myopia. Increases in myopic refraction to 0.50D and 0.75D to 1.75D were noted in 28.57% and 7.14% of children, respectively. In addition, myopic refraction stabilized in 64.29% of children [43]. Malieva developed the criteria for diagnostic assessment of axial, refractive, mixed and combinatory myopias on the basis of studies on the morphometrical, biometrical and functional characteristics of the eye. The rate of myopia stabilization was found to be 1.8 times higher in patients with refractive myopia than in patients with axial myopia. In the late period of the study, the positive effect of orthokeratology lens wear on the course of myopic eye growth was preserved in 77% of subjects [44].

Bezditko and Parkhomets [40] assessed the efficacy of OK lens wear depending on the pupil diameter and optical zone of the lens. They concluded that while examining a child with progressive myopia, attention should be given to the diameter of the pupil under photopic conditions because it is a potential predictor of myopia progression, and recommend using an individualized approach for selecting the optical correction. A negative correlation between the pupil diameter and gradient of myopia progression was found for a group of myopic children wearing OK lenses but no correlation for a group of of myopic children wearing full correction spectacles. Bezditko and Parkhomets found that refractive therapy with OK lenses enabled the most efficient myopia control in progressive myopia and a baseline pupil diameter smaller than 4.52 mm [40].

Parkhomenko, Mogilevsky and Prisiazhna [45] reported on a pediatric high-myopia case where OK correction combined with soft contact lens correction, but not spectacle correction alone resulted not only in the stabilization of myopic progression, but also in the disappearance of amblyopia.

Kovalev [46] put forward an interesting opinion on the impact of OK lenses on spherical aberrations and accommodation reserves in myopic eyes. He concluded that OK correction for myopia induces negative spherical aberrations, resulting in a reduction in the depth of focus and contributing to the development of accommodative reserves, which is a component of the mechanism underlying the stabilization of myopia. Kovalev [46] reviewed the medical records of patients of myopic patients wearing OK lenses and demonstrated the advantages of OK correction compared with full optical correction with spectacles in the impact on the visual system.

Of the myopic children wearing OK lenses over two years, 57% showed a 1.4-times reduction in the rate of myopia increase and the rate of axial elongation [47].

As research and development in the OK lens industry continue to evolve alongside improved understanding of the myopia control mechanism of OK lenses, there is likely to be improved efficacy and better consistency with designing more customized lenses based on the patients' age, level of myopia, corneal shape, pupil size, and angle κ, among other factors [48]. Customized OK lenses (Paragon CRT (Corneal Reshaping Technology) or Paragon CRT Dual Axis (DA) lenses) are Food and Drug Administration approved for overnight wear without age restrictions for the temporary reduction of myopia may be helpful for patients with refractive problems, especially in those with astigmatism of 1.5-1.75D and/or unusual corneal shape, by inducing the required peripheral myopic defocus and providing the optimal optic zone size for a particular patient.

Conclusion

Our review of the recent literature on current optical treatment modalities for control of myopic progression in children demonstrated a variety of opportunities offered for solving the issue. The selection of an appropriate optical treatment modality requires a comprehensive approach, with consideration of baseline refractive, axial length and accommodative facility measures, psychological commitment of child and parents, and the course of myopic progression. The review provides evidence that myopia control devices utilizing the myopic defocus principle are the first-line means for optical corr

References

1. Flitcroft DI, He M, Jonas JB, Jong M, Naidoo K, Ohno-Matsui K, et al. IMI - Defining and Classifying Myopia: A Proposed Set of Standards for Clinical and Epidemiologic Studies. Invest Ophthalmol Vis Sci. 2019 Feb 28;60(3):M20-M30. doi: https://doi.org/10.1167/iovs.18-25957.
2. Tsai TH, Liu YL, Ma IH, Su CC, Lin CW, Lin LL, et al. Evolution of the Prevalence of Myopia among Taiwanese Schoolchildren: A Review of Survey Data from 1983 through 2017. Ophthalmology. 2021 Feb;128(2):290-301. doi: https://doi.org/10.1016/j.ophtha.2020.07.017
3. Moiseenko RO, Holubchykov MV, Mykhalchuk VM, Rykov SO. [Ophthalmological care in Ukraine for 2014-2017: analytical and statistical reference book]. Kropyvnytskyi: POLIUM; 2018. 314 p. Ukrainian.
4. Bezditko PA, Parhomets RA. [Analysis of the Influence of Corneal Parameters on the Pattern of Myopia Progression when Using Orthokeratology Lenses in Children]. Ophthalmology. 2021 Jun;2(13):56-63. doi: https://doi.org/10.30702/Ophthalmology30062021-13.2.39-46/17.7-05. Ukrainian.
5. Maliyeva EV, Bushueva NN. [Comparative analysis of morphometric parameters of the macular region of the retina in patients with different types of myopia]. Materials of the Scientific and Practical Conference with International Participation "Filatov Readings - 2016," May 19-20, 2016, Odessa, Ukraine; 194-195. Ukrainian.
6. Horbatyuk TL, Boichuk IM. [Morphostructural features of the optic nerve and peripapillary fibers in children with myopia]. Ophthalmological Journal. 2011;(1):41-44. Ukrainian.
7. Ulyanova NA. High axial myopia: pathogenesis, diagnostics, prevention, and treatment (clinical and experimental study). [Author's abstract of the dissertation for the degree of Doctor of Medical Sciences in the specialty 14.01.18 "Ophthalmology"]. Odesa, 2015. 32 p. Ukrainian.
8. Ulyanova NA, Burdeinyi SI. [Morphometric features of the choroid in patients with progressive myopia according to the SS-optical coherent tomography-angiography]. Ukrainian Archives of Ophthalmology. 2018;(1)10:52-56. doi:https://doi.org/10.22141/2309-8147.6.1.2018.172270.Ukrainian.
9. Grzybowski A, Kanclerz P, Tsubota K, Lanca C, Saw SM. A review on the epidemiology of myopia in school children worldwide. BMC Ophthalmol. 2020 Jan 14;20(1):27. doi: https://doi.org/10.1186/s12886-019-1220-0
10. Lawrenson JG, Shah R, Huntjens B, Downie LE, Virgili G, Dhakal R, et al. Interventions for myopia control in children: a living systematic review and network meta-analysis. Cochrane Database Syst Rev. 2023 Feb 16;2(2):CD014758. doi: https://doi.org/10.1002/14651858.cd014758.pub2
11. Yazdani N, Sadeghi R, Ehsaei A, Taghipour A, Hasanzadeh S, Zarifmahmoudi L, et al. Under-correction or full correction of

myopia? A meta-analysis. J Optom. 2021 Jan-Mar;14(1):11-19. doi: https://doi.org/10.1016/j.optom.2020.04.003

12. Chung K, Mohidin N, O'Leary DJ. Undercorrection of myopia enhances rather than inhibits myopia progression. Vision Res. 2002 Oct;42(22):2555-9. doi: 10.1016/s0042-6989(02)00258-4.
13. Walline JJ, Lindsley KB, Vedula SS, Cotter SA, Mutti DO, Ng SM, et al. Interventions to slow progression of myopia in children. Cochrane Database Syst Rev. 2020 Jan 13;1(1):CD004916. doi: https://doi.org/10.1002/14651858.cd004916.pub4
14. Kang P, Swarbrick H. Peripheral refraction in myopic children wearing orthokeratology and gas-permeable lenses. Optom Vis Sci. 2011 Apr;88(4):476-82. doi: 10.1097/OPX.0b013e31820f16fb
15. Rodenstock. Children's lenses from Rodenstock [Internet]. Germany: Rodenstock; 2024 Apr 19 [cited 2024 Dec 2]. Available from: https://www.rodenstock.com/lenses/childrens-lenses
16. Rodenstock. MyCon lenses from Rodenstock for myopia control in children [Internet]. Ukraine: Lens; [cited 2024 Dec 28]. Available from: https://lens.com.ua/ua/goods_for_know/linzi-mycon-vid-rodenstock-rozrobleni-dlya-kontrolyu-korotkozorosti/
17. Radhakrishnan H, Lam CSY, Charman WN. Multiple segment spectacle lenses for myopia control. Part 2: Impact on myopia progression. Ophthalmic Physiol Opt. 2023 Sep;43(5):1137-1144. doi: https://doi.org/10.1111/opo.13194
18. Atchison DA, Charman WN. Optics of spectacle lenses intended to treat myopia progression. Optom Vis Sci. 2024 May 1;101(5):238-249. doi: https://doi.org/10.1097/opx.0000000000002140
19. Ohlendorf A, Rifai K, Boeck-Maier C, Ungewiss J, Lappe C, Li L, et al. Myopia control efficacy through Emmetropic Progression Ratio: 1-year of spectacle wear with cylindrical annular refractive elements (CARE). Invest Ophthalmol Vis Sci. 2024;65(7):127.
20. Kaphle D, Atchison DA, Schmid KL. Multifocal spectacles in childhood myopia: Are treatment effects maintained? A systematic review and meta-analysis. Surv Ophthalmol. 2020 Mar-Apr;65(2):239-249. doi: https://doi.org/10.1016/j.survophthal.2019.10.001
21. Kearney S, Coverdale S, Saunders C, Day M, Rountree L, Webber K, et al. Perceptions and barriers to accessing myopia management in the UK. Children. 2024 Dec;11:1490. doi: https://doi.org/10.3390/children11121490
22. Cooper J, O'Connor B, Watanabe R, Fuerst R, Berger S, Eisenberg N, et al. Case Series Analysis of Myopic Progression Control With a Unique Extended Depth of Focus Multifocal Contact Lens. Eye Contact Lens. 2018 Sep;44(5):e16-e24. doi: https://doi.org/10.1097/icl.0000000000000440
23. Nakamura Y, Hieda O, Yokota I, Teramukai S, Sotozono C, Kinoshita S. Comparison of myopia progression between children wearing three types of orthokeratology lenses and children wearing single-vision spectacles. Jpn J Ophthalmol. 2021 Sep;65(5):632-643. doi: https://doi.org/10.1007/s10384-021-00854-4
24. Ruiz-Pomeda A, Pérez-Sánchez B, Valls I, Prieto-Garrido FL, Gutiérrez-Ortega R, Villa-Collar C. MiSight Assessment Study Spain (MASS). A 2-year randomized clinical trial. Graefes Arch Clin Exp Ophthalmol. 2018 May;256(5):1011-1021. doi: https://doi.org/10.1007/s00417-018-3906-z
25. Hieda O, Nakamura Y, Hiraoka T, Kojima M, Oshika T, Sotozono C. Clinical study on the effect of multifocal contact lenses on myopia progression in myopia school children : Multifocal contact lens study for suppression of myopia progression. Trials. 2021 Mar 31;22(1):239. doi: https://doi.org/10.1186/s13063-021-05197-6
26. Walline JJ, Walker MK, Mutti DO, Jones-Jordan LA, Sinnott LT, Giannoni AG, et al. BLINK Study Group. Effect of High Add Power, Medium Add Power, or Single-Vision Contact Lenses on Myopia Progression in Children: The BLINK Randomized Clinical Trial. JAMA. 2020 Aug 11;324(6):571-580. doi: https://doi.org/10.1001/jama.2020.10834
27. Bressler NM. Reducing the Progression of Myopia. JAMA. 2020 Aug 11;324(6):558-559. doi: https://doi.org/10.1001/jama.2020.10953
28. Chamberlain P, Bradley A, Arumugam B, Hammond D, McNally J, Logan NS, et al. Long-term Effect of Dual-focus Contact Lenses on Myopia Progression in Children: A 6-year Multicenter Clinical Trial. Optom Vis Sci. 2022 Mar 1;99(3):204-212. doi: https://doi.org/10.1097/opx.0000000000001873
29. Raffa LH, Allinjawi K, Sharanjeet-Kaur, Akhir SM, Mutalib HA. Myopia control with soft multifocal contact lenses: 18-month follow-up. Saudi J Ophthalmol. 2022 Jun 13;35(4):325-331. doi: https://doi.org/10.4103/1319-4534.347305
30. Lau JK, Vincent SJ, Cheung SW, Cho P. Higher-Order Aberrations and Axial Elongation in Myopic Children Treated With Orthokeratology. Invest Ophthalmol Vis Sci. 2020 Feb 7;61(2):22. doi: https://doi.org/10.1167/iovs.61.2.22
31. Brennan NA, Toubouti YM, Cheng X, Bullimore MA. Efficacy in myopia control. Prog Retin Eye Res. 2021 Jul;83:100923. doi: https://doi.org/10.1016/j.preteyeres.2020.100923
32. Lipson MJ, Boland B, McAlinden C. Vision-related quality of life with myopia management: A review. Cont Lens Anterior Eye. 2022 Jun;45(3):101538. doi: https://doi.org/10.1016/j.clae.2021.101538
33. Sun L, Li ZX, Chen Y, He ZQ, Song HX. The effect of orthokeratology treatment zone decentration on myopia progression. BMC Ophthalmol. 2022 Feb 15;22(1):76. doi: https://doi.org/10.1186/s12886-022-02310-4
34. Guo B, Cheung SW, Kojima R, Cho P. One-year results of the Variation of Orthokeratology Lens Treatment Zone (VOLTZ) Study: a prospective randomised clinical trial. Ophthalmic Physiol Opt. 2021 Jul;41(4):702-714. doi: https://doi.org/10.1111/opo.12834
35. Bullimore MA, Johnson LA. Overnight orthokeratology. Cont Lens Anterior Eye. 2020 Aug;43(4):322-332. doi: https://doi.org/10.1016/j.clae.2020.03.018
36. Song Y, Zhu S, Yang B, Wang X, Ma W, Dong G, Liu L. Accommodation and binocular vision changes after wearing orthokeratology lens in 8- to 14-year-old myopic children. Graefes Arch Clin Exp Ophthalmol. 2021 Jul;259(7):2035-2045. doi: https://doi.org/10.1007/s00417-021-05106-2
37. Ding C, Chen Y, Li X, Huang Y, Chen H, Bao J. The associations of accommodation and aberrations in myopia control with orthokeratology. Ophthalmic Physiol Opt. 2022 Mar;42(2):327-334. doi: https://doi.org/10.1111/opo.12930
38. Xiao J, Pan X, Hou C, Wang Q. Changes in Subfoveal Choroidal Thickness after Orthokeratology in Myopic Children: A Systematic Review and Meta-Analysis. Curr Eye Res. 2024 Jul;49(7):683-690. doi: https://doi.org/10.1080/02713683.2024.2310618
39. Meng QY, Miao ZQ, Liang ST, Wu X, Wang LJ, Zhao MW, et al. Choroidal thickness, myopia, and myopia control interventions in children: a Meta-analysis and systemic review. Int J Ophthalmol. 2023 Mar 18;16(3):453-464. doi: https://doi.org/10.18240/ijo.2023.03.17
40. Bezditko PA, Parkhomets RO. [The effect of pupil diameter on the axial length of the eye in children with myopia using orthokeratology lenses]. Archive of Ukrainian Ophthalm. 2021; 9(1): 6-9. doi: https://doi.org/10.22141/2309-8147.9.1.2021.229517. Ukrainian.
41. Wang B, Naidu RK, Qu X. Factors related to axial length elongation and myopia progression in orthokeratology practice. PLoS One. 2017 Apr 18;12(4):e0175913. doi: https://doi.org/10.1371/journal.pone.0175913

42. Swarbrick HA, Alharbi A, Watt K, Lum E, Kang P. Myopia control during orthokeratology lens wear in children using a novel study design. Ophthalmology. 2015 Mar;122(3):620-30. doi: https://doi.org/10.1016/j.ophtha.2014.09.028
43. Bushueva NN, Malieva EV. [Long-term outcomes of orthokeratology ttherapy in patients with myopia]. Ophthalmology Journal. 2015;1:45–49.Ukrainian.
44. Malieva EV. Optimization of diagnostics of different types of myopia based on morphometric and functional indicators of the visual organ. [Author's abstract of the dissertation for the degree of Candidate of Medical Sciences]. Odesa, 2016. 22 p.Ukrainian.
45. Parkhomenko HY, Mohylevskyi SY, Prysiazhna SV, Bilyk IA, Levytska TI. Experience of combined correction of high-degree myopia. (Doctoral dissertation). R45 "One's Childhood Must Be Seen21": 9th Scientific and Practical Conference of Pediatric Ophthalmologists and Optometrists of Ukraine with International Participation, June 10–12, 2021: Collection of Papers / Edited by Professor SO Rykov. Bugaz, Odesa Region. 2021. 157 p.
46. Kovalev AI. The role of higher-order aberrations in the stabilizing effect of orthokeratological correction of myopia in children and adolescents. In: Proceedings of the 7th Scientific-Practical Conference of Ophthalmologists in Chișinău with National and International Participation, "Actualități în Oftalmologie"; 2022 Apr 8–9; Chișinău, Republic of Moldova. Sănătate Publică, Economie şi Management în Medicină. 2022. Available from: https://revistaspemm.md/wp-content/uploads/2022/04/TIPAR_Actuslitati-in-oftalmologie-30-martie-2022.pdf
47. Tsybulska TE. Functional, biometric, and biomechanical changes in eye parameters in children with myopia: features of treatment and optical correction [dissertation abstract]. Kyiv (Ukraine): 2020. Ukrainian.
48. Holmes M, Liu M, Singh S. Retrospective Analysis of Axial Length Changes in Overnight Orthokeratology in an Academic Myopia Control Clinic. Optom Vis Sci. 2023 Sep 1;100(9):597-605. doi: 10.1097/OPX.0000000000002060.
49. Zhang Z, Chen Z, Chen Z, Zhou J, Zeng L, Xue F, et al. Change in Corneal Power Distribution in Orthokeratology: A Predictor for the Change in Axial Length. Transl Vis Sci Technol. 2022 Feb 1;11(2):18. doi: 10.1167/tvst.11.2.18

Disclosures

Received: 05.11.2024

Accepted: 25.01.2025

Corresponding author. *Oleksandra Y. Titkova – titkovaoleksandra7@gmail.com*

Author's contribution. *TT: Conceptualization; Writing – review & editing; OT: Writing - original draft preparation; Formal analysis; Writing – review & editing. All authors analyzed the results and approved the final version of the manuscript.*

Disclosure of relationships and conflict of interest: *The authors declare that they have no conflicts of interest that could influence their opinions on the subject matter or materials described and discussed in this manuscript.*

Funding: *No financial support was received for preparing this review.*

Conflict of interest: *The authors declare no conflict of interest that could influence their views on the subject matter or materials described and discussed in this manuscript..*

Disclaimer. *The opinions expressed in this article are those of the authors and do not reflect the official position of the institution.*

Data Availability Statement: *All the data obtained or analyzed during this study are reported in the article.*