Clinical efficacy of high aspherical microlenses in correcting myopia in children and adolescents of different age groups

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Abstract

Objective To observe the control effect of wearing high aspherical microlens (HAL) lenses on children and adolescents with myopia in different age groups.

Method A retrospective analysis was conducted on 18 adolescent myopia patients (36 eyes) who underwent HAL optometry at the Hanshan Outpatient Department of Aiyan Group from August 2022 to October 2023. They were divided into two groups based on age: Group A, aged 6-9 years old, with 11 cases (22 eyes); Group B, aged 10-13 years, consisted of 7 cases (14 eyes). Statistical analysis was conducted on the changes in equivalent spherical mirror power and eye axis of two groups of patients after wearing it for 1 month, 3 months, and 6 months.

Results The axial length and refractive index of both groups of patients increased compared to before wearing glasses at 1 month, 3 months, and 6 months. There was no statistically significant difference in the equivalent spherical lens growth between the two groups of patients after 1 month, 3 months, and 6 months of glasses fitting. The axial growth of Group B was higher than that of Group A patients after 1 month, 3 months, and 6 months of glasses fitting, but the difference was not statistically significant.

Conclusion There is no significant difference in the short-term control effect of HAL lenses on myopia in children of different age groups.

Keywords： Prevention and control of myopia; High aspherical microlens; Children and adolescents

Myopia has become a global public health issue. As of 2012, 1.95 billion people worldwide had myopia[1-2]. It is estimated that by 2050, approximately 4.76 billion people worldwide will have myopia, of which approximately 938 million are at risk of developing high myopia. High myopia increases the risk of visual loss, which may lead to blind retinal disease and glaucoma, causing significant economic and social losses [3-4]. The occurrence and development of myopia are closely related to the growth and development of children[5]. Therefore, myopia control measures are mostly used during the peak growth and development period of children and adolescents, and research hotspots focus on outdoor activities, low concentration atropine, corneal reshaping lenses, and peripheral defocusing techniques. Research has shown that micro lens multi point myopic defocus glasses in frame glasses can control the development of myopia, but there is no consensus on the control effect of high aspherical lenses (HAL) on adolescents and children of different ages. This article analyzes its myopia prevention and control effect on children and adolescents of different ages.

1 Data and methods

1.1 Retrospective analysis of clinical data

From August 2022 to October 2023, 18 adolescent myopia patients (36 eyes) were treated with high aspherical lenses (HAL) in the outpatient department of Aiyan Group's Hanshan Clinic. Group A consisted of 11 patients (22 eyes) aged 6-9 years old; Group B, aged 10-13 years, consisted of 7 cases (14 eyes). Inclusion criteria: ① Age: 6-13 years old; ② Equivalent spherical mirror: -1.005~-6.00D; ③ The degree of myopia should be corrected with glasses, and the corrected visual acuity should be ≥ 1.0; ④ Willing to wear the designated frame glasses for this trial and be able to follow the doctor's advice for regular follow-up. Exclusion criteria: ① Other eye diseases that affect vision, such as keratoconus, amblyopia, strabismus, keratitis, etc.; ② Previous history of eye surgery and trauma; ③ Patients with missing follow-up data; ④ Previously received other myopia control treatments, including corneal reshaping lenses, multifocal soft lenses, medication therapy (such as low concentration atropine), and feeding devices.

1.2 Material HAL

Application Stellust, ESSILOR. This product uses 11 circles of 1021 invisible concentric ring arranged aspherical microlenses to form a non focused beam of light, creating a signal area in front of the retina that slows down the growth of the eye axis, thereby playing a role in slowing down the progression of myopia [6].

1.3 Inspection methods

Optometry: Under the condition of ciliary muscle paralysis, all patients first undergo ciliary muscle paralysis with compound tobicamide, and then use a computer refractometer (TOPCON, Japan) to obtain initial refractive power. Then, a comprehensive refractometer (fully automatic subjective subjective refractometer (NIDEK, Japan) is used for optometry (Suzhou Liuliu Technology Co., Ltd.) to determine the degree of refractive error. The judgment is made by adding or subtracting lenses and asking the patient's subjective clarity, Obtain the best visual acuity with the highest orthogonality.

Optician: Follow the principle of maximum corrected visual acuity for foot correction, and ensure that the best corrected visual acuity for one eye is ≥ 1.0. After fine tuning, perform at least 10 minutes of trial wear adaptation and make personalized adjustments. Mirror principle: Except for individual individuals who cannot adapt, full correction of myopia degree will be given. HAL frame mirror needs to be customized, with a customization cycle of about 1 week. Wearing glasses requirement: It is required to wear glasses for no less than 12 hours every day. After the initial glasses fitting, inquire about the clarity and comfort of wearing glasses at regular intervals of 1 month, 3 months, and 6 months, and check the condition of the frame and lenses. In case of the following situations during re examination, the lens must be replaced: (1) a change in degree of 0.50 D or more; (2) Lens wear is severe, affecting clarity; (3) The frame is severely damaged or deformed and cannot be repaired. Include the follow-up results of wearing glasses for 6 months (within 1 week before and after) in the analysis.

Axial measurement: Both groups of patients used the Zeiss IOL Master500 optical biometric instrument to measure the distance from the tear film surface in the axial direction to the optical path of the retinal pigment epithelium layer before wearing the glasses and during each follow-up. Measure 5 times per eye and take the average value.

1.3 Statistics

SPSS 26.0 is used for statistics, and quantitative data is represented as mean ± standard deviation. Two sets of baseline data were compared using non parametric tests. Single factor analysis of variance was used to measure the changes in equivalent spherical mirror power and eye axis at different follow-up times between groups. For data that do not meet homogeneity of variance, Welch's test of variance was used, with a test level of 0.05.

2 Results

2.1 Characteristics of baseline data

The naked eye visual acuity (LogMAR) of Group A patients was (0.75 ± 0.35), while that of Group B patients was (0.97 ± 0.38). The naked eye visual acuity, equivalent spherical mirror power, and axial data of the two groups of patients were comparable (P>0.05), as shown in Table 1.

Table 1 Baseline data of two groups of patients

	Number of cases (eyes)	LogMAR	equivalent spherical diopter（D）	Axial length（mm）
Group A	11（22）	0.75±0.35	-2.66±1.27	24.56±1.13
Group B	7（14）	0.97±0.38	-3.14±0.90	24.69±0.93
P		0.08	0.225	0.506

2.2 Comparison of changes in equivalent spherical mirror power and axial changes between two groups

The axial length and refractive index of both groups of patients increased compared to before wearing glasses at 1 month, 3 months, and 6 months. The axial growth of patients in Group B (10-13 years old) after 1 month, 3 months, and 6 months of glasses placement was higher than that of patients in Group A (6-9 years old), but the difference was not statistically significant, as shown in Table 2. There was no statistically significant difference in the increase in equivalent spherical endoscopy between the two groups of patients in January, March, and June, as shown in Table 3.

3 Discussion

The prevalence and younger age of myopia in children and adolescents have become a global focus of attention. The prevalence of myopia among young adults in Southeast Asian countries is as high as 80%~90%, of which the incidence rate of high myopia is as high as 10%~20% [7]. More than 300000 people in China have become blind due to high myopia or pathological myopia. In 2012, the World Health Organization pointed out that the blindness caused by myopia can be avoided if it is given sufficient attention [8]. However, the mechanism of myopia occurrence and development is complex, and there is currently no etiological prevention and treatment method. It is possible to actively prevent and find methods to control the progression of myopia, reduce its complications and blindness rate.

Table 2 Comparison of axial length changes between two groups of patients (mm, mean ± standard deviation)

	Number of cases (eyes)	1 month	3 months	6 months
Group A	11（22）	-0.010±0.077	-0.036±0.120	0.109±0.126
Group B	7（14）	0.106±0.256	0.136±0.300	0.186±0.342
F		3.949	1.971	0.949
P		0.055	0.169	0.337

Table 3 Comparison of changes in equivalent spherical mirror power between two groups of patients (mm)

	Number of cases (eyes)	1 month	3 months	6 months
Group A	11（22）	-0.318±0.329	-0.329±0.466	0.272±0.369
Group B	7（14）	-0.214±0.237	-0.178±0.359	-0.125±0.235
F		2.675	1.133	0.067
P		0.123	0.295	0.427

At present, the commonly used methods for intervening in the progression of myopia in clinical practice include atropine, corneal reshaping lenses, defocused soft corneal contact lenses, and peripheral myopia defocusing frame lenses without defocusing. High quality concentration (0.1~l g · L^{-1}) of atropine can control the development of myopia [9]. However, high-level atropine has side effects such as photophobia, blurred vision, and may cause an increase in myopic resilience after discontinuation[10]. The side effects of low-quality concentrations (0.01-0.1 g · L^{-1}) of atropine are relatively small[11], but the preventive and therapeutic effects of long-term use are not yet clear. Therefore, it is currently unclear which concentration of atropine is most effective in controlling myopia and has the least side effects. The scope of use of corneal contact lenses is relatively limited due to limitations such as age, refractive power, and corneal curvature, as well as relatively high prices and high requirements for hygiene, nursing compliance, and other factors [12-13]. So the design of defocus frames has a wider range of clinical application value. Experiments on animals such as river monkeys, chicks, and mice have shown that forming a myopic defocus state on the peripheral retina can delay axial growth and even reverse it, thereby controlling the development of myopia [14-15].

This study showed that the axial length and refractive index of both groups of patients increased at different time points, but the increase in group A (younger age) was slightly lower than that in group B, but there was no statistically significant difference. This indicates that age grouping has no significant effect on axial and refractive index growth. However, factors beyond age may affect these results. There was no significant difference in axial and refractive growth between the two groups, which may be due to insufficient sample size or measurement errors. In the future, data from 9 to 12 months will be further observed and new patients will be included to enrich the data.

In summary, there is no significant difference in the short-term control effect of HAL lenses on myopia in children of different age groups, but there is a problem of insufficient sample size in this study. Therefore, it is necessary to further expand the sample size and conduct longer-term studies to comprehensively evaluate the control effect of HAL lenses on myopia in children. At the same time, other possible influencing factors need to be considered, such as the duration of close eye use, outdoor activities, sleep duration, etc., in order to more accurately evaluate the control effect of HAL lenses on myopia in children.

References

[1] MORGAN I G,OHNO-MATSUI K,SAWS M. Myopia[J].Lan-cet,2012,379(9827);1739-1748.

[2] Matsumura S, Kuo AN, Saw SM. An Upadate of Eye Shape and Myopia. Eye Contact Lens. 2019,45(5):279-285.

[3] CORBELLI E, PARRAVANO M, ACCONI R, et al. Prevalence andPhenotypes of Age - Related Macular Degeneration in Eyes With HighMyopia[J]. Invest OphthalmolVis Sci,2019,60(5):1394-1402.

[4] LI Z, YANG Z, LIAO Y, et al. Relative peripheral refractioncharacteristics and their relationship with retinal microvascu-l aturein young adults: Using a novel quantitative approach[J].Photodiagnosis Photodyn Ther, 2022 (38): 102750.

[5] Zhang JY, Wang Q, Lin S, et al. Analysis of the Prevalence of Myopia and Axial Length and Its Related Factors in Children Aged 7-14 Years in the Wenzhou Region [J]. Chinese Journal of Ophthalmology, 2016, 52(7):514 -519.

[6] Bao J , Yang A , Huang Y , et al. One-year myopia control efficacy of spectacle lenses with aspherical lenslets[J]. British Journal of Ophthalmology, 2021:bjophthalmol-2020-318367.

[7] MORGAN I G, FRENCH A N, ASHBY R S, et al. The epidemics of myopia: Aetiology and prevention[J]. Prog Retin Eye Res, 2018(62):134-149.

[8] FRICKE T R, HOLDEN B A, WILSON D A, SCHLENTHERG,NAIDOO K S, RESNIKOFFS,et al. Global cost of correc-ting vision impairment from uncorrectedrefractive error[J]. Bull World Health Organ,2012,90(2012):728-738.

[9] CHEN C W,YAO J Y. Efficacy and Adverse Effects of Atropine for Myopia Control in Children:A Meta -Analysis of Randomised Con-trolled Trials[J].J Ophthalmol,2021,2021:4274572.

[10] BULLIMOR M A,RITCHEY E R,SHAH S,et al.The Risks and Benefits of Myopia Control[J].Ophthalmology,2021, 128(11):1561-1579.

[11] CHIA A,CHUA W,CHEUNGY, et al. Atropine for the treatment of childhood myopia:safety and efficacy of 0. 5% ,0.1% , and 0.01% doses (Atropine for the Treatment of Myopia 2) [J].Ophthalmology ,2012,19(2):347-354.

[12] LAU JASON K, VINCENT STEPHEN J, CHEUNG SIN-WAN,et al. Higher-order aberrations and axial elongation in myopicchildren treated with orthokeratology[J].Invest Ophthalmol VisSci,2020(61): 22.

[13] BENAVENTE-PEREZ A, NOUR A, TROILO D.Shortinterruptions of imposed hyperopic defocus earlier in treatmentare more effective at preventing myopia development[J]. Sci Rep,2019,9(1): 11459.
[14] ZHANG H Y, LAM C S Y, TANG W C, et al. Defocus Incorporated Multiple Segments Spectacle Lenses Changed the Relative Peripheral Refraction:A 2-Year Randomized Clinical Trial[J].Invest Ophthal-mol Vis Sci,2020,61(5):53.
[15] Guo Y, Tian F, Wu M, et al. The impact of peripheral defocusing design of frame glasses on the progression of myopia in school-age children: a four-year retrospective analysis [J]. Chinese Journal of Optometry & Ophthalmology & Visual Science, 2021, 23(4):267-271.