Comparative effect analysis of multi zone forward optical defocus glasses and orthokeratology lens

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【**Abstract**】**Objective** To compare the effects of multi zone forward optical defocus lens (DIMS) and orthokeratology lens (OK lens) on myopia control in children and adolescents. **Methods** Retrospective study. Twenty nine patients (53 eyes) with myopia diagnosed in the optometry center of Daming aiyan eye hospital from January 2022 to October 2023 were collected and divided into DIMS group (10 cases, 19 eyes) and OK lens group (19 cases, 34 eyes) according to myopia correction methods. The equivalent spherical lens and ocular axis data of patients before and after wearing glasses for 18 months were collected and analyzed. **Results** after wearing glasses for 18 months, the equivalent spherical lens and axial growth of DIMS group were (-0.43 ± 0.35) D and (0.41 ± 0.22) mm, respectively; In the OK group, the equivalent sphericity and axial growth were (-0.32 ± 0.34) D and (0.37 ± 0.32) mm, respectively; The equivalent spherical lens and ocular axis of the two groups were increased compared with those before wearing glasses ($p<0.01$). The equivalent spherical lens and axial growth in the OK mirror group were lower than those in the DIMS group, but the difference between the two groups was not statistically significant ($p>0.05$). **Conclusion** there is no significant difference in axial control between multi zone forward optical defocus glasses and orthokeratology lens.

【**Key words**】Myopia prevention and control; Orthokeratology lens; Multi zone forward defocus lens; Children and adolescents; Equivalent sphericity; Ocular axis

In recent years, the problem of myopia in children and adolescents in China has become increasingly serious, and the incidence of myopia tends to be younger and higher. According to the national student health examination data, the myopia incidence rates of primary school students, middle school students and high school students were 22.78%, 55.22% and 70.34%, respectively. In order to deal with this problem, it is not only necessary to pay attention to and improve students' learning and living habits, but also to explore effective myopia prevention and control measures. Optical correction methods have been widely welcomed for their convenience and effectiveness. Among them, ortho-k (OK lens), as a specially designed oxygen permeable rigid corneal contact lens, has been proved to be one of the effective means to control the development of myopia. However, there are other types of myopia prevention and control lens in the market, such as defocus incorporated multiple segments (DIMS) [1]. This study compared myopic children and adolescents wearing DIMS lens and OK lens, and evaluated the effect difference of these two lens in controlling myopia progression, so as to provide basis for clinical practice and myopia prevention and control strategies.

1. Data and methods

1.1 General information

Retrospective case-control study. Methods the clinical data of 29 children and adolescents who were diagnosed with myopia and selected DIMS or orthokeratology lens for optical correction treatment in the optometry center of Daming eye hospital from January 2022 to October 2023 were selected. Among them, 10 cases (19 eyes) wore DIMS lens; 19 cases (34 eyes) were fitted with orthokeratology lens. Inclusion criteria: ① age 8-16 years. ② Cycloplegic optometry hind foot correction lens: equivalent spherical lens -0.50 ~ -5.00d, best corrected visual acuity ≥ 1.0. Exclusion criteria: ① unable to cooperate with ophthalmic examination. ② Combined with history of ocular trauma or surgery. ③ Other interventions during wearing glasses, such as drug treatment (such as 0.01% atropine eye drops), visual function training and traditional Chinese medicine physiotherapy Combined with ocular or systemic diseases affecting visual development, such as keratoconus, oblique amblyopia, etc. ⑤ Those with incomplete diagnosis and treatment data.

1.2 method

1.2.1 DIMS group: wear frame glasses with Heuer xinleshi lens; For optometry under cycloplegia, compound tropicamide eye drops were used, one drop at a time interval of 5 min, four times in total. After waiting for 20 min for the last time, the full-automatic computer optometer (Nidek Co., Ltd., Japan) was used for objective optometry, and then the professional optometrist carried out retinoscopy optometry and subjective fine adjustment. The degree after fine adjustment was inserted for trial wearing. The trial wearing time was 5-10min. After adaptation, personalized adjustment was carried out. Glasses matching principle: except for some people who can't adapt, they are all given myopia correction. Wearing requirements: it is required to wear glasses for at least 12 hours every day. After the initial fitting of glasses, conduct a routine review every 3 months, ask about the clarity and comfort of wearing glasses, and check the condition of lens frame and lens. The lens must be replaced in the following cases: ① degree change ≥ 0.50D; ② The lens is severely worn, affecting the clarity ③ The frame is damaged or deformed seriously and cannot be repaired. The reexamination results of wearing glasses for 1 year and 1.5 years (before and after 1 week) were included in the analysis.

1.2.2 OK lens group: wear dream David AP corneal plastic lens. According to the patient's equivalent spherical lens, corneal curvature value and corneal eccentricity, select the appropriate trial lens for trial wearing, use sodium fluorescein staining, and use Cobalt blue light under slit lamp microscope for fitting evaluation. The lens center positioning is ideal, the lens movement is 1 ~ 2mm after blinking, and the arc segment boundaries are uniform and clear for fitting. Try and wear the orthokeratology lens with corresponding parameters customized by the ideal person. All patients wore it for 8-10h at night.

1.2.3 follow up in the case of full refractive correction, the equivalent spherical lens and ocular axis were followed up for 18 months and recorded. In the last follow-up of the OK lens group, the equivalent spherical lens and ocular axis length need to be

detected after 1 month of stopping wearing, so as to compare the differences between the two groups of experimental results.

1.3 statistical methods

SPSS 26.0 was used, and the counting data were expressed in%, and the comparison between groups was performed using X^2 Inspection. The measurement data are expressed as the mean ± standard deviation. The paired sample Wilcoxon test is used to compare the data within the group before and after wearing glasses, and the independent sample Mann Whitney U test is used to compare the data between groups. The test level is: $\alpha < 0.05$.

2 Results

2.1 comparison of general information

A total of 29 patients (53 eyes) were included. A total of 19 patients (34 eyes) were included in the OK mirror group. Ten patients (19 eyes) were included in the DIMS group. The baseline data of the two groups were comparable. See Table 1 for details.

Table 1. comparison of baseline data between the two groups

Group	number of cases (eyes)	Gender (male / female)	age （year）	Equivalent spherical lens （d）	Ocular axis （mm）
OK group	19（34）	8/11	10.53±2.12	-3.35±1.49	24.75±1.00
DIMS group	10（19）	3/7	11.90±2.13	-2.68±1.00	24.46±0.76
X^2/t		0.408	1.657	-1.754	1.111
P		0.523	0.109	0.085	0.272

2.2 comparison of equivalent spherical lens and ocular axis between the two groups after wearing glasses for 18 months

After wearing glasses for 18 months, the equivalent spherical diopter and ocular axis of the OK lens group were (-3.67 ± 1.45) D and (25.12 ± 0.99) mm, respectively, which were significantly different from those before wearing glasses ($p<0.01$). The equivalent spherical lens and ocular axis in the DIMS group were (-3.11 ± 1.01) D and (24.91 ± 0.80) mm, respectively, which were significantly different from those before wearing glasses ($p<0.01$). The equivalent spherical lens and axial growth in the OK mirror group were lower than those in the DIMS group, but the difference between the two groups was not statistically significant, see Table 2.

Table 2. changes of equivalent spherical lens and ocular axis in the two groups after wearing glasses for 18 months

Group	number of eyes	Equivalent spherical lens growth （d）	axial growth （mm）
OK group	34	-0.32±0.34	0.37±0.32
DIMS group	19	-0.43±0.35	0.41±0.22
F		1.235	0.932
P		0.272	0.339

3. Discussion

The number of myopia in the world is about 2.6 billion, and 312million people under the age of 18 have myopia, of which 67% are Chinese adolescents [2]. Chinese children and adolescents have a large number of needs for close eye use in daily activities. The myopia degree is growing rapidly and irresistibly. Children's higher and higher degrees have become the most worrying and intractable problem for parents. At present, the etiology of myopia is not yet clear, and there are also many development methods to delay the equivalent spherical lens of myopia, such as frame glasses, orthokeratology lens, drugs, surgery and other measures' advantages and possible limitations. We should comprehensively consider and apply the existing myopia prevention and control measures, formulate scientific and effective intervention strategies, and strengthen the scientific prevention and control of myopia in children and adolescents in China [3].

The DIMS (multi area forward defocus) technology used in this study has achieved a new breakthrough in the field of myopia prevention and control. The hexagonal area 9mm in the center of the lens has no dot structure, which is used by the wearer to see far, that is, the prescription light intensity; 9mm away from the center of the lens, 396 dot like microlens are distributed into a hexagonal area with a diameter of about 33mm, which is used to form a myopic defocus area, called a multipoint defocus area; The lens outside the multi-point defocus area no longer has a dot like microlens, but this part still has the prescribed luminosity. When the wearer's glasses turn to different areas on the lens, the microlens in this area will play a role, which allows the lens to continuously provide myopia and defocus for the wearer without the influence of eye rotation. This is the basic structure that xinleshi lens can help delay the deepening of myopia and slow down the growth of ocular axis. Some studies have reported that after wearing the multi zone forward defocus design lens, the deepening of myopia slowed down by 59%, and the growth rate of ocular axis slowed down by 60% [4]. Orthokeratology lens is a specially designed rigid breathable contact lens, which is divided into four areas: base arc area, reverse arc area, positioning area and peripheral arc area. The central cornea is flattened by the compression of the base arc area of the lens, so as to achieve the effect of vision correction [5]. At the same time, as for the mechanism of orthokeratology lens to improve vision, some scholars believe that wearing orthokeratology lens at night can make the central epithelial intercellular fluid move to the periphery through the pressure of eyelid and lens, so that the peripheral epithelial cells proliferate and cause the patient's cornea to form a concave lens shape with thick edge and thin middle to improve the patient's vision, but this theory is still a conjecture and needs to be confirmed by experimental research [6].

This study shows that both DIMS and OK lens can effectively control the development of myopia in children and adolescents. OK lens is slightly better than DIMS in controlling diopter and axial growth, but DIMS is faster in wearing. In clinical treatment, traditional Chinese medicine students need to combine the patient's own situation and choose a more suitable method to delay the development of myopia.

The number of cases selected in this paper is small, and other factors that may affect the progression of myopia are not considered. Therefore, future research needs to further explore the long-term effect and safety of the two correction methods on myopia control, so as to provide more accurate guidance for clinical practice.

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