The Study of Ocular Parameters in Low to Moderate Myopic Chinese Children Age Between Eight to Eighteen-Year-Old

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Research Article

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Abstract

Purpose: The primary aim of this study was to analyze the distribution of ocular parameters of children aged from eight to eighteen-year-old with low to moderate myopia as well as offer useful information for the design and clinical fitting of ortho-k lens in China.

Methods: In this retrospective study, we collected data of 300 subjects (600 eyes) age between eight to eighteen-year-old from the myopic control outpatient clinic at Beijing Tongren Hospital, Beijing, China. The spherical equivalent (SE), axial length (AL), central corneal thickness (CCT), anterior chamber depth (ACD), corneal endothelial cell density (CECD), corneal diameter (CD), simulated K (Sim K) were collected from all the subjects and analyzed.

Results: The mean of SE for all subjects was $-3.12 \pm 1.21\text{D}$, the median was -3.16D . The mean of AL for all subjects was $24.72 \pm 0.83\text{ mm}$, the median was 24.72 mm . The mean of CCT for all subjects was $537.8 \pm 29.82\text{ }\mu\text{m}$, the median was $538.17\text{ }\mu\text{m}$. The mean of CECD for all subjects was $3340.3 \pm 352.6\text{ cells/mm}^2$, the median was $3357.77\text{ cells/mm}^2$. The mean of ACD for all subjects was $3.71 \pm 0.21\text{ mm}$, the median was 3.69 mm . The mean of CD for all subjects was $12.15 \pm 1.67\text{ mm}$, the median was 12.05 mm . The mean of flat K was 42.80 ± 1.29 , the median was 42.81 . The mean of steep K was 43.76 ± 1.37 , the median was 43.76 .

Conclusions: This study provided the distribution of ocular parameters to offer useful information for diagnosis of many eye conditions. Meanwhile, the distribution of ocular parameters of children aged from eight to eighteen-year-old with low to moderate myopia is beneficial to make the application of overnight orthokeratology lens more appropriate and effective.

Background

Together with the sclera, the cornea forms the outermost layer. Cornea, as one of the most essential links, must ensure its transparency, so there is no blood vessel in the cornea tissue.[1, 2] Blood vessels end at the limbus of the cornea to form a vascular network, and nutrients expand into the cornea from of the eyeball-fibrous tunic. Cornea with aqueous humor, lens, vitreous body constitutes the indispensable way for light to enter the inner eyes. The five layers of the cornea are: epithelium, lamina elastica anterior, stroma, lamina elastica posterior and endothelium.[3–5] The ocular parameters are of great significance for diagnosis of keratoconus, glaucoma, diabetes and other systemic diseases manifests in eyes. [6]

Myopia is the most universal ocular refractive disorder all over the world, especially in China. It was reported that myopia prevalence was 80–90% in young adults, and 10–20% young adults developed into high myopia.[7–9] National prevalence of myopia increased from primary to high school continued the same trend.[10–13] Overnight orthokeratology (ortho-k) lens has been regarded as a safe and effective method to control the myopia progression. Therefore, understanding the distribution of ocular parameters in low to moderate myopic Chinese adolescents is important in ortho-k lens design and fitting. Ocular parameters has been studied in adults in different population, such as in Caucasians, Nigerians and

Chinese.[14–16] Chan and colleagues studied the corneal parameters in Chinese children aged between six and twelve years old in Hongkong where is southern part of China in 2012, and this study mainly focused on the corneal anterior parameters, also this study was performed almost ten years ago, many ocular parameters in population may have changed .[17] To provide more detailed ocular information, we collected the ocular parameters of children aged from eight to eighteen-year-old with low to moderate myopia from Beijing Tongren Hospital myopic control clinic, Beijing, China, and we analyzed the ocular parameters distribution in these subjects. The distribution of ocular parameters will provide useful information for the design and application of the ortho-k lens in China.

Methods

Subjects' data were collected from the children who came to the myopic control clinic at Beijing Tongren Hospital between January 2018 and July 2019. The inclusion criteria were children age between eight to eighteen-year-old, with no history of contact lens worn, and free of history of intraocular surgery or ocular trauma, with myopia no more than - 6.00 D and astigmatism (negative cylinder) lower than - 3.50 D. Best corrected vision was 20/20 or better. The study adheres to the Declaration of Helsinki and was approved by Beijing Tongren Hospital Review Board and Ethics Committee.

IOL-Master (Carl Zeiss, Germany) was used in axial length measurement and corneal diameter, corneal topography (Medmont E300 topography, Medmont Pty Ltd, Vermont, VIC, Australia) was used to collect the cornea topography data. Corneal endothelium density was measured by a noncontact specular microscope Topcon Robo SP-9000 (Konan, Hyogo, Japan). Statistical analysis was performed using SPSS 19.0 (SPSS, Inc, Chicago, IL, USA). All data were presented in the shape of the mean $\pm$ Std Dev. All distributions were shown in the form of a box graph.

Results

Three hundred subjects' data were collected in our study. Figure 1 shows the distribution of spherical equivalent (SE), axial length (AL), central corneal thickness (CCT), corneal endothelial cell density (CECD), anterior chamber depth (ACD), corneal diameter (CD) and simulated K (Sim K).

The mean of SE for all subjects was -3.12 ± 1.21 D, the median was -3.16 D. The mean of AL for all subjects was 24.72 ± 0.83 mm, the median was 24.72 mm. The mean of CCT for all subjects was 537.8 ± 29.82 μ m, the median was 538.17 μ m. The mean of CECD for all subjects was 3340.3 ± 352.6 cells/mm², the median was 3357.77 cells/mm². The mean of ACD for all subjects was 3.71 ± 0.21 mm, the median was 3.69 mm. The mean of CD for all subjects was 12.15 ± 1.67 mm, the median was 12.05 mm. The mean of flat K for was 42.80 ± 1.29 , the median was 42.81. The mean of steep K for was 43.76 ± 1.37 , the median was 43.76. (Table 1) In the comparison of different genders and ages (Table 2&3), no statistical significance has been found ($P > 0.05$). *Table 1. The results of the ocular parameters of the subjects (see Additional table 1)*

Table 2. The distribution of the ocular parameters in male and female subjects (see Additional table 2)

Table 3. The distribution of the above ocular parameters by decade of age (see Additional table 3)

SE = spherical equivalent, AL = axial length, CCT = central corneal thickness, CECD = corneal endothelial cell density, ACD = anterior chamber depth, CD = corneal diameter, Sim K = simulated K.

Figure 1 The distribution of spherical equivalent(A), axial length(B), central corneal thickness(C), corneal endothelial cell density(D), corneal diameter(E), Flat K(F), Steep K(G) and anterior chamber depth(H) in Chinese juveniles (see Additional Fig. 1)

Discussion

To make the application of overnight orthokeratology lens in China become more appropriate and effective

With the increase of the pace of life and the pressure of the learning, the myopia rate of Chinese children has been presented a sharp rise in the recent years. Reducing and controlling the myopia progression has become a hot topic among researchers all over the world. [18–20] Overnight orthokeratology lens is an effective method in slowing down the progression of myopia. As an external object flatten the central portion of the cornea, the fitting of overnight orthokeratology lens needs the precise data of the ocular parameters of patients, especially for the juveniles who are in the period of growth and development. [21–26]

The main application market of contact lenses was for conveniently refractive correction and cosmetic reason. Therefore, the target customers of contact lens are designed for adults, the research and application of ocular parameters are also based on their data.[17] However, with the prevalence of myopia development, especially the high incidence rate of myopia in East Asia, Overnight orthokeratology lens has gradually become an effective means to control the development of myopia.[9, 27, 28]

In this study, statistical analysis was conducted in groups of different genders (males, 126 subjects with 252 eyes; females, 174 subjects with 348 eyes), simultaneously in age divided younger or equal to ten years old (180 subjects with 360 eyes) and older than ten years old (120 subjects with 240 eyes). No statistical significance was found in the above conditions.

Overnight orthokeratology lens, as a contact lens which were placed against the surface of the cornea, are worn at night and take off during the daytime. The distribution of these ocular parameters is benefit for the first best fitting of overnight orthokeratology lens. The axial elongation is an important factor for evaluating the progression of myopia, while the elongation of the AL does not mean the severity of myopia because there is also a physiological increase in adolescents.[29–32] Studying the distribution of AL in adolescents is helpful to understand the physiological axial growth.

The fitting of ortho-k lens requires accurate measurements of ocular parameters to achieve a proper lens fitting, the variation of ocular parameters was crucial for the practitioner to select the appropriate ortho-k lens. Most of the lenses now offered by manufacturers are based on the corneal profile of Caucasian adults, and repeated adjustments and lens fitting due to the improper lens would cost tremendous money and time.[9, 27, 30] Our study provides the distribution of ocular parameters in low to moderate myopic Chinese adolescents; therefore, it can provide useful information for contact lens design for Asian children.

To compare with previous studies of different race.

Although the distribution of the corneal parameters of Asians, Caucasians, Africans and Arabian have well manifested in the range of adults in the past 20 years (table 4), there was still a shortage of large sample aimed at children. The retrospective study found that Asians have smaller corneal diameter than Caucasians and Africans. The corneal diameter in our study is larger than previous study indicating there may be ocular parameters changes during the past decade. Previous studies demonstrate that Chinese children have thinner central corneal thickness than others, no conspicuous difference with the results of our study. The data of characteristics of the corneal endothelial cell density was similar with previous studies.

Table 4. The comparison of ocular parameters with previous studies of different race (see Additional table 4)

NR = Not reported

Conclusion

In conclusion, our study provides the distribution of ocular parameters in low to moderate myopic Chinese adolescents to offer useful information for the design and clinical fitting of ortho-k lens in China.

Abbreviations

SE: spherical equivalent; **AL:** axial length(B); **CCT:** central corneal thickness; **CECD:** corneal endothelial cell density(D); **CD:** corneal diameter(E); **ACD:** anterior chamber depth(H); **Sim K:** simulated K

Declarations

Ethics approval and consent to participate

The study adheres to the Declaration of Helsinki and was approved by Beijing Tongren Hospital Review Board and Ethics Committee.

Availability of data and materials

The datasets during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interest

No conflicting relationship exists for any author.

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Authors' contribution

Li, Sun and Song were primarily responsible for experimental concept and design. Li and Sun performed data acquisition and analysis, as well as drafting of the manuscript. Li was also involved in data analysis. All authors reviewed and approved the final manuscript.

Consent for publication

Not applicable.

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Figures

Figure 1

The distribution of spherical equivalent(A), axial length(B), central corneal thickness(C), corneal endothelial cell density(D), corneal diameter(E), Flat K(F), Steep K(G) and anterior chamber depth(H) in Chinese juveniles

Supplementary Files

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