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Study and Analysis of The Long-Term Changes of The Axial Length of The Adult Patients with Pathological Myopia

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Abstract

Objective: The undertaken research intends to explore the long-term variations within the axial length of grownup diseased persons having pathological myopia.

Methods: The research reflects an open-label, incessant and reflective case study. The medical histories of 101 grownup diseased persons (184 eyes) having pathological myopia (myopia ≥ -6 diopters or axial length > 26.5 mm) had been scrutinized. The axial length had been assessed by A-mode ultrasound for governing the variations within axial length while follow-up. The impact of age, axial length, and posterior scleral staphyloma on axial length elongation had been resolute while the original checkup.

Results: The normal follow-up period was 8.2 years. The median axial length enlarged meaningfully from 28.6 mm at the preliminary check to 29.4 mm at the concluding scrutiny. The axial length of 69% of the pretentious eyes endured steady (difference ≤ 1 mm), and the axial length of 31% of the affected eyes increased by more than 1 mm. For these 31% of the affected eyes, the median axial length amplified by 1.55 mm. The yearly axial length growth of aging diseased persons had been sufficiently advanced as compared to the young affected persons; the yearly axial distance growth of the artificial eyes regarding attendant posterior scleral staphyloma had been meaningly advanced t as compared to those of the artificial eyes having no concomitant posterior scleral staphyloma. The outcomes of manifold linear reversion examination exposes that the growth rate of the axial distance had been meaningfully definitely connected with the age of diseased persons at the preliminary inspection.

Conclusion: In mature diseased persons having pathological myopia, the axial length will last to rise. The axial length of the diseased persons having advanced age and concomitant posterior scleral staphyloma amplified more suggestively. The growth of posterior scleral staphyloma and the growth of age are the crucial features for the incessant growth of axial length within mature diseased persons having pathological myopia.

[Key words] Pathological myopia; Axial length; Posterior scleral staphyloma

Introduction

A major cause of permanent vision reduction is pathological myopia, which is particularly prevalent in Asian populations. Studies have shown that another mutual reason of reduced idea and sightlessness among individuals over the age of 40 in China is pathological myopia [1]. An abnormal growth within the axial distance of affected eyes is characterized by pathological myopia. While a clinical study involving 1,852 affected eyes at ± 5.00 diopters (D) found that the length of the axis reached the length of the adult at age 13[2], it was not known if the length of the axis in adult patients with pathological myopia would continue to develop. Fledelius and Goldschmidt [3] tested 9,243 subjects and reported 39 pathological myopia patients with 6 D. These 39 patients were further analyzed and found that the unkind axial distance rose from 26.7±1.3 mm at age 26 to 27.5±2.1 mm at age 54, regarding growth of 0.8 mm on average. Mere 39 diseased persons with an average axial length of 26.7 mm were studied, however.

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Furthermore, the age limit for subjects to be studied was between the ages of 26 and 54 years, so there was no data on elderly patients. This research aims to study the long-term axial length changes in China in adult patients with pathological myopia.

1. Study Objects and Methods

1.1. Study objects

This study analyzed the medical history of 1,355 patients (2710 eyes) with pathological myopia from 2006 to 2015 in the Hospital's Outpatient Department of Ophthalmology. Both patients underwent minimum 5 years of follow-up. Addition criteria: (1) Myopia refractive error (spherical equivalent) ≥6.0 D, or axial duration ≥26.5 mm; (2) Age at the time of initial review ≥18 years; (3) Time of follow-up ≥5 years; (4) During each continuation examination, the axial distance had been assessed by A-mode ultrasound. Exclusion criteria: (1) History of vitreoretinal surgery, history of cataract surgery or history of refractive surgery; (2) Mild or extreme cataract (Emery-Little≥ Level 3 [4]) affecting accurate axial length measurement; (3) Pathological changes in retina affecting accurate axial length measurement; (4) Lively choroidal neovascularization found while original scrutiny or follation. 101 adult patients participated in the study (184 eyes). Of the 101 patients, 41 were men and 60 were women, with a mean age of 46.0 years (18-73 years old). The average refractive error is -12.0 D (-6.5 to -24.0 D) and the axial distance median is 28.5 mm (25.1 to 33.3 mm). There was clear concomitant posterior scleral staphyloma in 106 eyes (57.6 percent). The average follow-up duration of 7.0 years was (5 to 14 years).

1.2. Inspection methods

All patients underwent full ophthalmological evaluation, including refractive error (spherical equivalent), axial distance, and astigmatism screening at least once a year. A-mode ultrasound was used to measure the axial length (Ultrascan, Alcon, USA). The specifics are as follows: conduct topical anesthesia on the affected eye of the patients, drop tetracaine eye drops at 1% concentration in the affected eyes, guide the patients to lie flat on the examination bed, keep the eyes of the patients straight ahead of the level, place the ultrasonic probe gently in the center of the affected eyes of the cornea, and at this time the instrument will be carried on the affected eyes.

1.3. Grouping

In this study, patients were divided in 2 classes by age at the time of preliminary scrutiny, when the original scrutiny was conducted having concomitant posterior scleral granuloma, and by axial length at the time of initial examination, to analyze whether these factors influenced the growth within axial distance. The frequency of posterior scleral staphyloma had been advanced and the follow-up period was shorter for diseased persons aged 45 years or older. See Table 1. Age and refractive error and longer axial length were greater within diseased persons having associated posterior scleral staphyloma, Table 2. Shows the examination at the time of original examination, the incidence of posterior scleral staphyloma was higher in patients with axial length ≥ 28.5 mm, refractive error was greater and axial length had been longer, see Tab. 3.

Table 1. **Evaluation of Medical Structures within diseased persons ≥ 45 Years Old and diseased persons ＜45 Years Old at the Time of Original Checkup**

	＜45 years old [34 cases (66 eyes)]	≥ 45 years old [59 cases (103 eyes)]	p value
Median age at preliminary checkup [range (years old)]	28（18-40）	57（45-75）	
Median refractive error (D)	-11.0	-12.8	n.s.
Median axial distance [range (mm)]	28.2（25.5-31.6）	28.6（26.1-32.6）	n.s.
Posterior scleral staphyloma	28 （42.4%）	74 （71.8%）	＜0.001
Median follow-up time [range (year)]	10（5-13）	6（5-14）	＜0.01

Table 2. **Assessment of Medical Structures within diseased persons having and not having Concomitant Posterior Scleral Staphyloma at Preliminary Checkup**

	Un-concomitant [41 cases (78 eyes)]	Concomitant [53 cases (106 eyes)]	p value
Median age at preliminary checkup [range (years old)]	38（18-68）	51（23-75）	＜ 0.0001
Median refractive error (D)	-10.5	-13.0	＜0.01
Median axial distance [range (mm)]	27.8（25.1-31.6）	29.1（25.8-32.6）	0.002
Median follow-up time [range (year)]	8（5-14）	7（5-14）	n.s.

Table 3. **Assessment of Medical Structures of diseased persons Whose Axial Span Is Above and Below Average throughout Preliminary Checkup**

	＜28.5 mm [58 cases (95 eyes)]	≥ 28.5 mm [55 cases (89 eyes)]	p value
Median age at preliminary checkup [range (years old)]	46（18-73）	46（18-75）	n.s.
Median refractive error (D)	-10.3	-15.0	＜0.01
Median axial distance [range (mm)]	27.4（25.1-28.56）	29.9（28.6-33.3）	0.002
Posterior scleral staphyloma	43 （45.3%）	63 （70.8%）	＜ 0.001
Median follow-up time [range (year)]	8（5-14）	6（5-14）	n.s.

1.4. Statistical analysis

For numerical investigation, SPSS 17.0 statistical software (SPSS, USA) had been utilized in this research. The patients were classified between 2 categories by age at the time of preliminary checkup, whether at the time of preliminary checkup they had concomitant posterior scleral staphyloma, and by axial distance at the time of initial examination. A paired t-test compared the differences within axial distance, lens thickness, corneal curvature and vitreous cavity depth between the two classes. The X2 procedure was used in 2 groups to compare the frequency of posterior scleral staphyloma. To evaluate the relative factors of the axial length increase, multiple linear regression was used. Statistically important is $p < 0.05$.

2. Consequences

2.1. The growth within the axial distance in all diseased persons

The median axial length of 184 eyes increased substantially during the follow-up period, from 28.5 mm at the time of preliminary checkup to 29.2 mm at the time of final examination ($p < 0.0001$). The median axial distance was raised by 0.7 mm as a result. The axial length remained unchanged (about 1 mm) for 127 eyes (69.0 percent), the axial distance increased more than 1 mm for 57 eyes (31.0 percent), and the median axial distance enlarged by 1.42 mm.

The thickness of the median lens and the width of the median vitreous cavity were substantially greater in the final analysis for different parts of the axial length than in the initial examination, rising from 4.05 mm to 4.17 mm ($p < 0.0001$) and from 21.0 mm to 22.3 mm ($p < 0.0001$). The increase in median lens thickness was 0.27 mm and the increase in median vitreous cavity depth was 1.33 mm for 57 eyes, the axial length of which increased by more than 1 mm. No major disparity had been observed within median corneal curvature between original checkup and concluding examination (7.75 vs 7.74 mm).

The median axial distance rise was 0.08 mm/year within all diseased persons (-0.16 to 0.43 mm/year). The median axial length was increased by 0.20±0.08 mm/year for 57 eyes whose axial length was increased by more than 1 mm. A common case of an increase in the axial distance of more than 1 mm is shown in Figure 1, as shown in Figure 1.

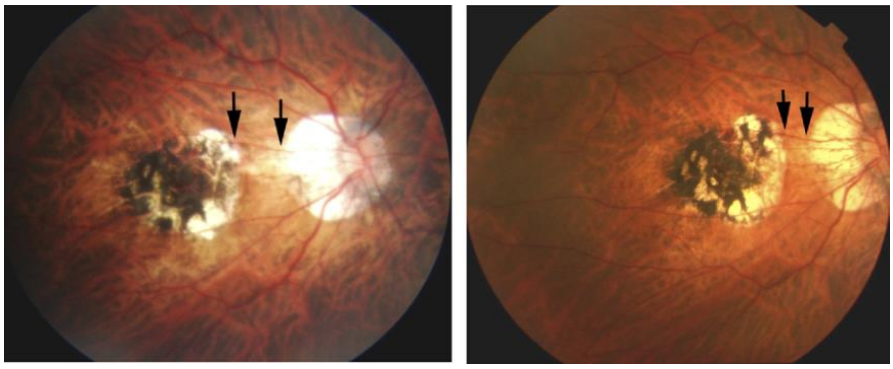

Figure 1. **Figure 1 A 56-year-old diseased persons with pathological right eye myopia (diopter -11.0 D, axial length 27.0 mm) with a substantial increase in axial length was seen by Fundus photography. (Left figure) The macula at the bottom of the left eye atrophied at the initial examination with posterior scleral staphyloma; (right figure)12 years later, the atrophy of the macula was expanded and the gap (arrow) between the atrophy of the macula and the cone was shorter than that at the initial examination. The axial length had been enlarged to 30.0 mm.**

2.2. The increase in the axial length in patients ≥ 45 years old and＜ 45 years old at the time of the initial examination

The axial length increment / year and vitreous cavity complexity increment / year of affected persons ≥ 45 years old at the time of original checkup had been observed meaningly developed in diseased persons ＜ 45 years old when preliminary test was conducted (p = 0.01 and p < 0.001). This fact is reflected through Table 4.

Table 4. **Assessment of the Rise in the Axial Distance within diseased persons ≥ 45 Years Old and＜ 45 Years Old at the Time of the Preliminary Checkup**

	＜45 years old [34 cases (66 eyes)]	≥ 45 years old [59 cases (103 eyes)]	p value
Median eye axial length increment / year [range (mm)]	0.06（-0.02-0.30）	0.12（-0.06-0.43）	0.01
Median corneal curvature increment / year [range (mm)]	0（-0.02-0.05）	0.01（-0.01-1.38）	n.s.
Median lens thickness increment / year [range (mm)]	0.03（-0.04-0.11）	0.02（-0.08-0.07）	n.s.
Median vitreous cavity depth increment / year [range (mm)]	0.05（-0.03-0.27）	0.12（-0.08-1.12）	＜ 0.001

2.3. Increased axial length during preliminary checkup within diseased persons patients with and without concomitant posterior scleral staphyloma

The axial distance increment / year and vitreous cavity depth increment / year within diseased persons patients regarding associated subsequent scleral staphyloma during preliminary checkup and recorded growth sufficiently as compared to those having no concomitant posterior scleral staphyloma at the time of preliminary checkup (all p < 0.001). Table 5 shows this fact.

Table 5. **Comparison of Improved Axial Length throughout Original Checkup within diseased persons having and having not Concomitant Posterior Scleral Staphyloma**

	Un-concomitant [41 cases (78 eyes)]	Concomitant [53 cases (106 eyes)]	p value
Median eye axial length increment / year [range (mm)]	0.06（-0.09-0.33）	0.11（-0.33-1.12）	＜ 0.001
Median corneal curvature increment / year [range (mm)]	0.002（-0.01-0.03）	0.002（-0.02-1.38）	n.s.
Median lens thickness increment / year [range (mm)]	0.02（-0.04-0.11）	0.03（-0.02-0.18）	n.s.
Median vitreous cavity depth increment / year [range (mm)]	0.05（-0.04-0.11）	0.12（-0.02-0.18）	＜ 0.001

2.4. The increase in the axial length within diseased persons whose axial length is above and below the average during the preliminary checkup

The vitreous hollow profundity increase / year within diseased persons regarding axial length ≥ 28.5 mm had been sufficiently advanced as compared to those diseased persons having axial length ＜ 28.5 mm while original inspection (p < 0.001). Table 6. Reflects this.

Table 6. **Comparison of Rise in the Axial Length in Patients Whose Axial Length is above and below the Average during the Original Inspection**

	＜28.5 mm [58 cases (95 eyes)]	≥ 28.5 mm [55 cases (89 eyes)]	p value
Median eye axial length increment / year [range (mm)]	0.07（-0.16-0.31）	0.10（-0.02-0.35）	n.s.
Median corneal curvature increment / year [range (mm)]	0.002（-0.01-0.03）	0.005（-0.01-1.38）	n.s.
Median lens thickness increment / year [range (mm)]	0.02（-0.04-0.15）	0.03（-0.08-0.09）	n.s.
Median vitreous cavity depth increment / year [range (mm)]	0.03（-0.08-0.81）	0.10（-0.06-1.12）	＜0.001

2.5. Multiple linear deterioration study of the growth rate of axial sdistance

The coefficient of determination (R2) adopted was 0.20. At the time of the initial test, the rise in axial length was positively associated with the age of the patients (P < 0.01). During the initial test, there was no important association between axial length or intraocular pressure and the rate of increase in axial distance.

3. Discussion

The coefficient of determination (R2) adopted was 0.20. Previous studies have shown that the axial length exceeds an adult's length at the age of 13[2]. As a result, unlike pathologically myopic patients, the axial length of healthy subjects was less likely to begin to lengthen by the age of 30-50 years. From Gudmundsdottir et al. The coefficient of determination (R2) adopted was 0.20. The rate of increase [5] calculated the axial length of 757 eyes of subjects over 50 years of age and found that the axial length was 23.6±1.1 mm over 50-59 years of age and the axial length was 23.2±1.4 mm over 70 years of age, i.e. the axial length decreased with age. Fotedar et al, respectively. The coefficient of determination (R2) adopted was 0.20. The rate of increase of [5] [6] studied 10-year axial length increases in elderly subjects. The axial length was found to be 23.6 mm for subjects aged 59 to 64, while the axial length was 23.2 mm for those over 85. Patients with pathological myopia were not included in the above two studies. The coefficient of determination (R2) adopted was 0.20. Increase rate [5] [6] The mean axial length of 39 patients with pathological myopia increased from 26.7±1.3 mm at 26 years of age to 27.5±2.1 mm at 54 years of age, according to the findings of the Fledelius and Goldschmidt study [4]. The older diseased persons took part in this conducted research their agewere from 45 to50 and suffered from acute pathological myopia (median refractive error -13.3 D).

The coefficient of determination (R2) adopted was 0.20. Increased rate of follow-up [5] [6] The findings of this study showed that while younger patients (<45 years of age) had a longer follow-up duration, the axial length of older patients (<45 years of age) was significantly higher than that of younger patients. Moreover, in elderly patients (aged 45 years or older), the frequency of posterior scleral staphyloma was substantially higher than in younger patients (<45 years). Pathologica in 39 patients. The increase in axial length was substantially greater in patients with concomitant posterior scleral staphyloma at the time of initial assessment than in patients without concomitant posterior scleral staphyloma when the patients were divided into 2 classes of concomitant posterior scleral staphyloma and unconcomitant posterior scleral staphyloma. Since mm was not used as a unit in this study to measure staphyloma depth, posterior scleral staphyloma was not used as a factor in the multiple linear regression analysis. However, the findings of the multiple linear regression study showed that, at the time of the initial test, the age of the patients was associated positively with the increase in axial length. Previous studies have shown that the incidence and depth of staphyloma with age has increased meaningfully [8]. It can also be concluded that the rise in axial length has been positively associated with age and posterior scleral staphyloma. The exact mechanism of increased axial length is not well known in elderly patients with concomitant posterior scleral staphyloma.

In this research, there are also some deficiencies. In this analysis, to measure axial length, only A-mode ultrasound was used. IOL-Master (Carl-Zeiss, Germany) [9,10] should be the more precise measurement method, however. IOL-Master axial length measurements can be used in the future for long-term and prospective research.

To conclude, the findings of this study showed that in adult patients with pathological myopia, the axial length increased continuously. The axial length increased more dramatically in elderly patients with concomitant posterior scleral staphyloma. Main reasons for the continuous rise in axial length in adult patients with pathologic myopia are the presence of posterior scleral staphyloma and an increase in age.

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