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Effects of axial length and corneal curvature on corneal biomechanics in elderly population

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老年人群眼轴和角膜曲率对角膜生物力学的影响

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摘要

目的:本研究旨在应用可视化角膜生物力学分析仪(Corneal Visualization Scheimpflug Technology,Corvis ST)研究不同眼轴长度(Axial Length,AL)和角膜曲率的老年人角膜生物力学特点。

方法:横断面研究。收集拟接受白内障手术的患者 220 例(426 眼),将其中 AL 在 22-24 mm 之间、K 值在 42-44 D 范围之间的研究对象按性别进行分组,男性 44 眼,女性 49 眼。进而对 K 值在 42-44 D 之间的研究对象按 AL 值的不同进行分组:22-24 mm,共 99 眼;24-26 mm,共 22 眼;大于 26 mm,共 12 眼。对 AL 在 22-24 mm 之间的研究对象按 K 值的不同分组:42-44 D,共 88 眼;大于 44 D,共 102 眼。应用可视化角膜生物力学分析仪(Corvis ST)测量角膜生物力学参数,并对不同性别、不同眼轴、不同角膜曲率患者的角膜生物力学参数进行比较性分析,采用单因素方差分析、独立样本 t 检验等对数据进行统计并分析各组生物力学参数间的相关性。

结果:男女之间角膜生物力学参数差异无统计学意义(P>0.05),不同角膜曲率间平均第一压平长度、平均第二压平长度,差异具有统计学意义(P<0.05)。不同眼轴长间:AL 为 22-24 mm 和 AL 为 24-26 mm 两组间只有第二压平长度、角膜中央厚度差异具有统计学意义(P<0.05),AL 为 22-24 mm 和 AL 大于 26 mm 两组间第二压平长度、最大形变幅度、中央角膜厚度、第一压平时间、眼压、矫正眼压差异均具有统计学意义(P<0.05),而 AL 为 24-26 mm 和 AL 大于 26 mm 两组间各参数比较,差异均无统计学意义(P>0.05)。患者眼轴长度与最大形变幅度、眼压、矫正眼压值均呈线性正相关(r=0.263,P=0.002;r=0.463,P=0.000;r=0.449,P=0.000),与角膜厚度、第二压平长度均呈线性负相关(r=-0.240,P=0.006;r=-0.344,P=0.000)。

结论:角膜曲率和眼轴长度可能是影响角膜生物力学特性的一个因素,眼轴长度越长,角膜厚度越薄,角膜越容易发生形变,而且随着眼轴长度的增加眼压也升高。在探讨白内障手术切口的选择是否受到患者自身因素的影响,应该考虑其角膜曲率和眼轴长度的不同。

关键词:角膜;生物力学;可视化角膜生物力学分析仪;眼轴;角膜曲率

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Abstract

• AIM: To explore the corneal biomechanical properties of the elderly with different axial length (AL) and corneal curvature by Corneal Visualization Scheimpflug Technology (Corvis ST).

• METHODS: A cross-sectional study. A total of 220 patients (426 eyes) undergoing phacoemulsification were collected in this study. One of them whose the AL was 22-24 mm and the corneal curvature was 42-44 D were divided into male and female groups (44 eyes and 49 eyes, respectively). One of them whose the corneal curvature was 42-44 D were divided into 22-24 mm, 24-26 mm, and more than 26 mm groups according to AL (99 eyes, 22 eyes and 12 eyes, respectively). One of them whose the AL was 22-24 mm were divided into 42-44 D, and more than 44 D according to corneal curvature (88 eyes, 102 eyes, respectively). Corvis ST was used to measure the biomechanical parameters of the cornea. The differences in the parameters between different groups were analyzed using the independent-samples t-test or one-way analysis of variance and correlation analyses were performed using Pearson correlation analysis.

• RESULTS: When comparing the corneal biomechanical parameters, no statistically significant differences were found between male and female groups (P>0.05). The first applanation length and second applanation length among different corneal curvatures were statistically significant (P<0.05). There was statistically significant only for the difference of the second applanation length and central cornea thickness between two groups of 22-24 mm and 24-26 mm (P<0.05). There was statistically significant for the difference of the second applanation length, deformation amplitude, central cornea thickness, the first applanation time, intraocular pressure and corrected intraocular pressure between the two groups of 22-24 mm and more than 26 mm (P<0.05). But there was no statistically significant differences of the parameters between groups of 24-26 mm and more than 26 mm (P>0.05). The patient's AL was positively correlated with deformation amplitude, intraocular pressure and corrected intraocular pressure (r=0.263, P=0.002; r=0.463, P=0.000; r=0.449, P=0.000), and there is negative correlation between the patient's AL and central cornea thickness, the second applanation length (r=-0.240, P=0.006; r=-0.344, P=0.000).

• CONCLUSION: The corneal curvature and ocular AL may be the factor affecting the corneal biomechanical properties. The longer AL, the thinner corneal thickness, the more easily the corneal is deformed, and with the increase of the AL, intraocular pressure also increases. When discussing whether the preparation of the cataract incision is affected by the patient's own factors, the different corneal curvatures and AL shall be considered.

• KEYWORDS: cornea; biomechanic; cornea visualization Scheimpflug technology; axial length; corneal curvature
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INTRODUCTION

The cornea is biological soft tissue materials with certain thickness and surface tension. It is viscoelastic and thus not easy to distort greatly. The biomechanical properties of the cornea is quite complex and unfixed. In Clinical Department of Ophthalmology, when the micro structure of the cornea changes, the corneal biomechanical properties will also change, and decreases with aging[1]. Under pathological state, such as glaucoma, keratoconus, corneal degeneration and so on, the biomechanical properties of the cornea will change[2-4]. Corneal mechanical properties play an important guiding role in the etiology and diagnosis of cornea disease such as keratoconus, corneal inflammation and degeneration, effect evaluation before and after operation of corneal collagen cross-linking, research and development of artificial cornea, corneal refractive surgery and improvement of eyes' total refractive power. Therefore, it has become a hot spot to evaluate the surgery, diagnose related diseases and develop effective diagnosis and treatment by measuring the relevant parameters of corneal biomechanics.

Recently, corneal visualization Scheimpflug technology (Corvis ST; Wetzlar, Germany), a new instrument for detecting biomechanical properties of the cornea *in vivo*, has been developed. The device displays the whole process of corneal deformation in real time and records the deformation parameters and analyzes corneal biomechanics. However, the device has just been applied in clinical, and lacks reliable data of a large number of trials and clinical applications, and relevant researches mainly analyze the repeatability and consistency of the equipment measuring parameters[5-6]. In the recent studies, researchers have applied Corvis-ST to the measurement of intraocular pressure[6], diagnosis and identification the keratoconus[7], and evaluation of the changes of corneal biomechanics after corneal crosslinking and refractive surgery[8-9].

The cataract surgery gradually develops to micro-incision phacoemulsification surgery. The size of operation incision is not only related to the healing of the eyeball, the incidence of infection, the surgical induced astigmatism and postoperative visual acuity recovery, but also related to the destruction of the integrity of the eyeball, and the changes in the overall biomechanical. The preparation of surgical incision is affected by the patient's own factors such as corneal thickness, corneal curvature and so on. In the past, many researches focused on the study of different refractive surgery and corneal diseases and there are few reports on the study of the biomechanical properties of the cornea in the elderly. This study takes the elderly people at the age of 60-80 as research object, measures the biomechanical properties of the cornea of the aged with Corvis-ST, observes the biomechanical characteristics of the elderly with different axial lengths and corneal curvatures, and attempts to analyze whether different corneal curvatures and different lengths of the axis of the cornea will affect the biomechanical properties of the cornea, so as to explore the best choice of surgical incision.

SUBJECTS AND METHODS

Research Objects A total of 220 patients (426 eyes) undergoing phacoemulsification in the Cataract Department of the Tianjin Eye Hospital between November 2014 and September 2015 were selected for this study. The average age was 69.97±5.81y (60-80y). The exclusion criteria were as follows: patients had other special eye diseases, such as keratoconus, corneal nebula, corneal scar, corneal degeneration, glaucoma and active ocular disease, and excludes ocular trauma, surgical history, and other systemic diseases that affect the eye. The research objects included 89 males (173 eyes), accounted for 40.61%, 131 women (253 eyes), accounted for 59.39%. This study followed the Declaration of Helsinki and was approved by the Ethics Committee of the aforementioned hospital. All the participants signed the informed consent.

The research objects were divided into different groups according to the sex, axial lengths and corneal curvatures (Tables 1, 2). One of them whose the axial length was 22-24 mm and the corneal curvature was 42-44 D were divided into male and female groups (44 eyes and 49 eyes, respectively). One of them whose the corneal curvature was 42-44 D were divided into 22-24 mm, 24-26 mm, and more than 26 mm groups according to axial length (99 eyes, 22 eyes and 12 eyes, respectively). One of them whose the axial

Table 1　The group of different corneal curvatures (AL:22-24mm)

K (D)	Means	s	n
42-44	43.4	0.38	88
More than 44	45.55	1.01	102

Table 2　The group of different lengths of the eye (k:42-44D)

AL (mm)	Means	s	n
22-24	23.36	0.4	99
24-26	24.52	0.46	22
More than 26	29.54	2.04	12

length was 22-24 mm were divided into 42-44 D, and more than 44 D according to corneal curvature (88 eyes, 102 eyes, respectively).

Research Methods

Routine preoperative testing　All participants undergo a routine ophthalmic examination, including naked eye and corrected visual acuity, computer optometry, slit - lamp microscopy, fundus examination, corneal curvature and axial length (IOL master), corneal biomechanical parameters and intraocular pressure (Corvis ST). Three effective results are obtained from all measurements and the average is utilized.

Introduction of basic information of Corvis ST measurement　Corvis ST (Wetzlar, Germany) uses high-speed Scheimpflug technique (with a highest colleting speed of 4 330 frames/s, anterior chamber up to 8.5 mm in diameter with a resolution of 640×480 pixels[10]) to record the deformation with full corneal cross-sections, which are then displayed in slow motion on a control panel after being analyzed by professional system software. During the deformation response, a precisely metered air pulse causes the cornea to move inward or flatten to reach the first applanation. When the cornea continues to move inward until reaching the highest concavity, because of the nature of the effect of gas flow decreased and intraocular pressure and corneal viscoelastic, the cornea move outward to reach the second applanation during the return to the initial state. Corvis ST recorded the relevant deformation parameters of reflecting the corneal biomechanical properties in the whole deformation process of the cornea (Table 3). These parameters have good repeatability and consistency[5-6], one of them, deformation amplitude, is the most talked about in clinical practice research[11].

Examination Method　Automatic mode aiming and focusing of Corvis ST, and automatic firing air pulse pressure corneal deformation, during the 30ms of acquisition time, 140 images of the corneal deformation process are recorded, and the parameters of the biomechanical properties of the cornea are analyzed and obtained.

Statistical Analysis　A cross-sectional study. Statistical analyses were performed using SPSS 18.0 software (SPSS, IL, USA). The data were expressed as mean ± standard deviation. Firstly, the Kolmogorov-Smirnov normality test was used to assess the data in each group. The independent-samples t-test was adopted to analyzed the different genders and different corneal curvatures, and the different axial lengths were analyzed using one-way analysis of variance, while multiple comparisons between different groups were performed using the SNK test. Pearson correlation analysis was used to evaluate the relatedness of axial length to corneal biomechanical parameters. The difference of P less than 0.05 was considered statistically significant.

RESULTS

Corneal biomechanical parameters between different genders are shown in Table 4. There were no significant differences in the 13 parameters of corneal biomechanics measured by Corvis ST (P>0.05) in different genders.

Corneal biomechanical parameters in different corneal curvature groups were compared with the results shown in Table 5. Comparing with the results, we considered that there was no difference in the corneal biomechanical parameters in the gender, so one of them whose the axial length was 22-24 mm were divided into 42-44 D, and more than 44 D according to corneal curvature, and the parameters of corneal biomechanical between two groups were compared and analyzed. Thirteen parameters of corneal biomechanical measured by Corvis ST, The first applanation length between different corneal curvature were respectively 1.78±0.07 mm and 1.74±0.12 mm. There was a statistically significant differences between different corneal curvatures (P<0.05). The second applanation length was 1.83±0.21 mm and 1.73±0.25 mm. There was a significant differences between different corneal curvatures (P<0.05). And the other parameters were not statistically significant between different corneal curvatures.

For the comparison among biomechanical parameters of differentthe axial lengths, based on the comparing result of genders and curvatures, we considered that there was no difference in the corneal biomechanical parameters between men and women, and there were differences among different groups of corneal curvatures. So one of them whose the corneal curvature was 42-44 D were divided into 22-24 mm, 24-26 mm, and more than 26 mm groups according to axial length, and the parameters of corneal biomechanical between different the axial length groups were compared and analyzed. The corneal biomechanical parameters measured by Corvis ST were analyzed using one-way analysis of variance. There was a statistically significant difference between different ocular axial lengths in the second applanation length, deformation amplitude, central cornea thickness, applanation-1 time, intraocular pressure and corrected intraocular pressure (P<0.05). The other seven parameters were not statistically significant (P>0.05). As shown in Table 6, while multiple comparisons between different groups were performed using the SNK test, there was a statistically significant difference between 22-24 mm and more than 26 mm, only the second applanation length and central cornea thickness had

Table 3 The meaning of corneal deformation parameters measured by Corvis ST

Parameters	Meaning
Length1 (mm)	The length of the flattened cornea at the first applanation
Length2 (mm)	The length of the flattened cornea at the second applanation
V1 (m/s)	The corneal velocity during the first applanation moments
V2 (m/s)	The corneal velocity during the second applanation moments
Peak distance (mm)	Distance of the two surrounding "knees" at the highest concavity as seen in cross-section
Radius (mm)	Central curvature radius at the highest concavity
Deformation amplitude (mm)	Maximum deformation amplitude at the corneal apex, it is considered that most of the corneal mechanical parameters should be paid attention to in clinical research[11].
CCT (μm)	Central corneal thickness
Time1 (ms)	The time from the initiation of the air puff until the first applanation
Time2 (ms)	The time from the initiation of the air puff until the second applanation
Thc (ms)	Time from the start until the highest concavity of the cornea is reached, this parameter is related to age[24].
IOP nct (mmHg)	Gains intraocular pressure recording standard tonometry
IOPpachy (mmHg)	Correction of intraocular pressure based on corneal thickness.

Table 4 Comparison of biomechanical parameters between different genders $\bar{x}\pm s$

Parameters	Male	Female	t	P
Length1 (mm)	1.79±0.06	1.78±0.08	0.54	0.591
Length2 (mm)	1.85±0.20	1.82±0.20	0.78	0.44
$V1$ (m/s)	0.14±0.02	0.15±0.01	-1.87	0.06
$V2$ (m/s)	-0.32±0.11	-0.30±0.11	-0.49	0.62
Peak distance (mm)	4.09±1.16	4.54±0.97	-1.96	0.06
Radius (mm)	7.54±0.77	7.20±1.15	1.62	0.11
Deformation amplitude (mm)	1.11±0.12	1.14±0.12	-1.18	0.24
CCT (μm)	546.93±34.12	544.74±37.56	0.29	0.78
Time1 (ms)	7.35±0.39	7.27±0.31	0.98	0.33
Time2 (ms)	21.59±0.79	21.37±3.20	0.44	0.66
Thc (ms)	17.32±0.96	17.25±0.84	0.41	0.69
IOP nct (mmHg)	13.45±4.13	12.81±3.40	0.81	0.42
IOPpachy (mmHg)	13.0.7±3.97	12.52±3.34	0.71	0.48

Table 5 Comparison of biomechanical parameters between different corneal curvatures $\bar{x}\pm s$

Parameters	42-44D	More than 44D	t	P
Length1 (mm)	1.78±0.07	1.74±0.12	2.478	0.014[a]
Length2 (mm)	1.83±0.21	1.73±0.25	3.035	0.003[a]
$V1$ (m/s)	0.14±0.02	0.14±0.04	-0.299	0.765
$V2$ (m/s)	-0.33±0.09	+0.34±0.09	0.274	0.785
Peak distance (mm)	4.26±1.11	4.22±1.16	0.229	0.819
Radius (mm)	7.34±1.00	7.10±1.31	1.410	0.160
Deformation amplitude (mm)	1.13±0.12	1.15±0.14	-1.444	0.150
CCT (μm)	546.20±35.54	538.20±32.79	1.615	0.108
Time1 (ms)	7.31±0.34	7.31±0.45	-0.010	0.992
Time2 (ms)	21.70±0.62	22.35±0.46	-1.423	0.158
Thc (ms)	17.33±0.82	17.04±1.83	1.397	0.164
IOP nct (mmHg)	13.19±3.70	13.26±4.65	-0.108	0.914
IOPpachy (mmHg)	12.85±3.58	13.03±4.58	-0.288	0.744

[a]$P<0.05$.

a statistically significant differences between 22-24 mm and 24-26 mm ($P<0.05$). But corneal biomechanical parameters between 24-26 mm and more than 26 mm had no significant differences($P>0.05$).

Correlation analysis between axial length and biomechanical parameters The Pearson correlation analysis shows significantly positive correlation between axial length and deformation amplitude, intraocular pressure and corrected intraocular pressure ($r=0.263$, $P=0.002$; $r=0.463$, $P=0.000$; $r=0.449$, $P=0.000$). But between axial length and cornea thickness, the second applanation length showed significantly negative correlation ($r=-0.240$, $P=0.006$; $r=-0.344$, $P=0.000$) (Figure 1).

DISCUSSION

There are many methods to measure the biomechanical properties of the cornea, mainly *in vitro* and *in vivo* measurement. The former includes the axial tension method of cornea, corneal expansion method, and the method of measuring the total eyeball expansion *in vitro* and so on, because there is no real reflection of the biomechanical properties of the cornea *in vivo*, there are a lot of limitations. The latter includes laser confocal microscope, ultrasonic microscope, ocular response analyzer (ORA), visualization of corneal biomechanics analyzer (Corvis ST) and so on. At present, the method used to measure the biomechanical properties of the cornea *in vivo* is mainly ORA. Luce[12] firstly introduced the method of ORA in 2005. It uses a two-way dynamic principle applanation tonometry, and evaluates corneal hysteresis (CH) and corneal resistance factor (CRF) at the same time. There are related researches for the device in healthy people and patients suffering from a variety of eye diseases[13-14], but quantitative relationship among the equipment measurement parameters CRF and CH and the classical biomechanical parameters of corneal materials such as elastic modulus, stress and strain is not yet established, and in some degree effected by the corneal morphology[15]. Therefore, the clinical application in the Department of Ophthalmology has been a certain limit. Recently, a new type of instrument for biomechanical properties of the cornea *in vivo* is Corvis ST. Studies have shown that the deformation parameters measured by Corvis ST are not affected by corneal morphology and are more favorable to describe the corneal biomechanical properties of the study population[16-17].

In this study, we use Corvis ST to observe the characteristics

Table 6　Comparison of biomechanical parameters of different ocular axial lengths $\bar{x}\pm s$

Parameters	22-24 mm	24-26 mm	More than 26 mm	F	P
Length1 (mm)	1.78±0.07	1.75±0.009	1.77±0.06	1.92	0.15
Length2 (mm)	1.82±0.2	1.75±0.34	1.6±0.42	4.54	0.01[ab]
V1 (m/s)	0.14±0.02	0.15±0.02	0.14±0.02	2.86	0.06
V2 (m/s)	-0.31±0.24	-0.37±0.06	-0.44±0.12	2.56	0.08
Peak distance (mm)	4.3±1.09	4.85±1.04	4.79±1.49	2.77	0.07
Radius (mm)	7.35±0.96	7.25±1.07	7.32±1.04	0.08	0.92
Deformation amplitude (mm)	1.13±0.12	1.18±0.11	1.24±0.24	4.97	<0.01[a]
CCT (μm)	544.69±34.79	544.82±25.96	518.42±28.44	3.46	0.03[ab]
Time1 (ms)	7.31±0.35	7.11±0.15	7.38±0.6	3.27	0.04[a]
Time2 (ms)	21.72±0.61	21.97±0.32	21.66±0.92	0.34	0.72
Thc (ms)	17.25±0.88	17.13±0.83	17.12±0.64	0.22	0.8
IOP nct (mmHg)	13.16±3.75	11.13±1.92	14.04±6.37	3.11	0.04[a]
IOPpachy (mmHg)	12.86±3.68	10.84±1.82	14.06±6.17	3.58	0.03[a]

[a]There was a statistically significant differences between 22-24 mm and more than 26 mm; [b]There was a statistically significant differences between 22-24 mm and 24-26 mm.

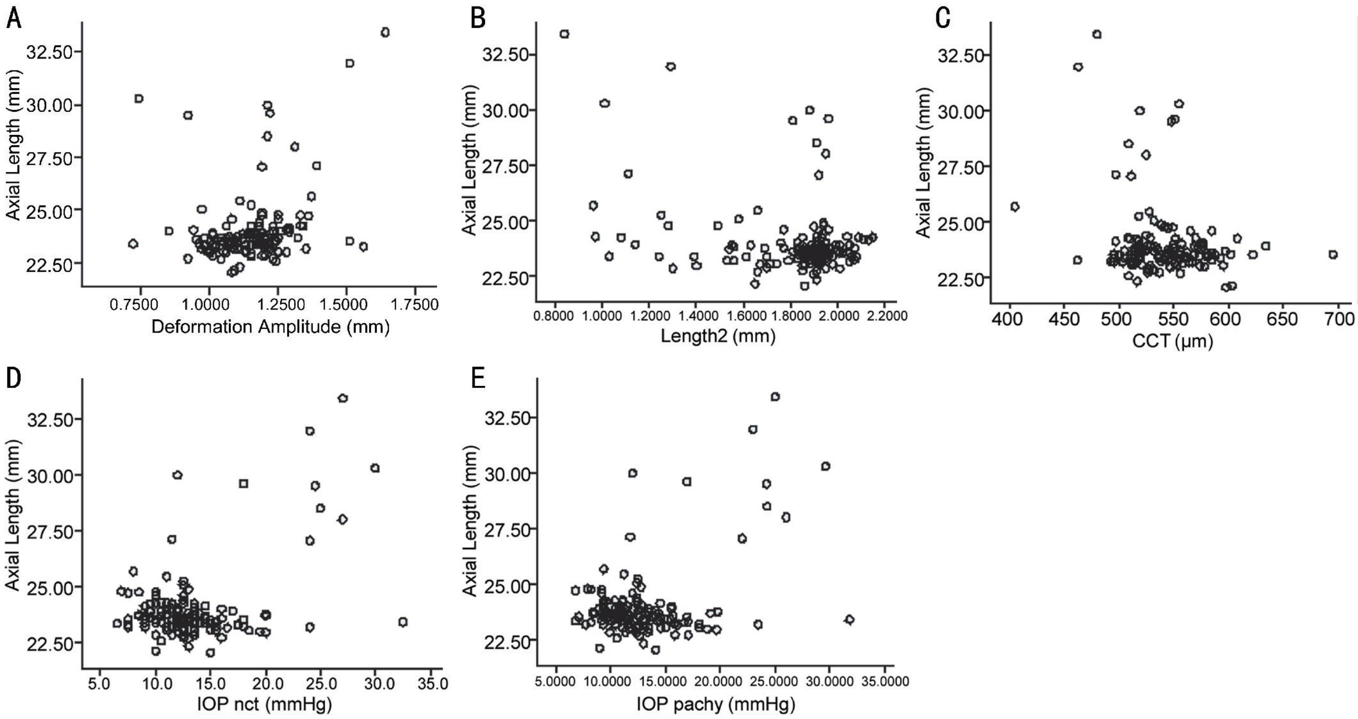

Figure1　Scatter plots axial length versus deformation amplitude (A), Length2 (B), CCT (C), IOP nct (D), IOPpachy (E).

of corneal biomechanics in aged people with different genders, different axial lengths and corneal curvatures. The results show that there is no significant difference in the corneal biomechanical parameters between the different sexes. In further study, according to different axial length and corneal curvature of the group to compare, the results show that there are significant statistical difference between different corneal curvature at the first applanation length and the second applanation length ($P<0.05$). The first applanation length is the length of the flattened cornea at the first applanation under the action of the air pressure pulse. The corneal curvature is bigger, the cornea steeper, needing greater strength to flatten. At the same pressure pulse, the length of the flattened cornea at the first applanation is smaller. The second applanation length is the length of the flattened cornea at the second applanation. The force in this process include corneal viscoelastic, intraocular pressure, and gradually diminish the effect of gas flow. The greater of the cornea curvature may lead to reduce corneal viscoelastic itself. The return elasticity of the cornea when it returns to the original state becomes smaller, resulting in the second applanation length shorter. This indicates that corneal curvature may be a factor affecting the biomechanical properties of the cornea. But some researchers report that there is a better correlation between central corneal thickness and corneal biomechanical parameters than the corneal curvature and corneal biomechanical parameters[18-20]. There is no significant difference in the corneal thickness between different groups, so the difference of biomechanical parameters between different groups of corneal curvature is caused by different corneal curvatures. Therefore, in the future research should consider the factors of corneal curvature.

In the comparison of the corneal biomechanical parameters of different axial lengths, variance is analyzed to get second applanation length, deformation amplitude, central cornea thickness, applanation - 1 time, intraocular pressure and correction of intraocular pressure ($P<0.05$), further by pairwise comparison, there are significant statistical differences at the second applanation length and central cornea thickness between 22-24 mm and 24-26 mm. There were significant statistical differences between 22-24 mm and then 26 mm at all corneal biomechanical parameters. Observation of the corneal biomechanical characteristics of different kinds of corneal curvature ,the greater curvature of the cornea, the smaller the length of the flattened cornea at the second applanation. Some scholars have come to similar conclusions, with the length of the axis of the eye, the cornea becomes steeper, corneal curvature increases[21-22]. From the results of the study, the central corneal thickness of AL more than 26 mm is obviously thinner than that of 22-24 mm. While 22-24 mm is slightly thinner than that of 24-26 mm. And in the correlation analysis, the relationship between the axial length and corneal thickness is linear negative correlation. The results of this study show that when the length of the axial length increases to a certain length, the whole eye expansion and the corneal thickness will become thin. Some scholars have come to similar conclusions that patients with longer ocular axis, the expansion of the eye, the cornea will be thinning[5]. Limei and other research find that there is no difference between the eye axis and corneal thickness. The corneal thickness does not change with the axis of the eye. It is not clear whether the thickness of the cornea is related to the change of the axial length[23]. It needs further research to provide a theoretical basis. Comparison between 22-24 mm and more than 26 mm, deformation amplitude of more than 26 mm is bigger. As the axial length longer , the corneal thickness significantly thinner, the compressive strength of the cornea in the deformation process become small, so that deformation amplitude becomes bigger. And in the correlation analysis, it is found that the relationship between the axial length and deformation amplitude is linear positive correlation. The deformation amplitude is one of the most concerned corneal biomechanical parameters[24]. Therefore, it is speculated that the longer of axial length, the thinner of corneal thickness, the cornea is more prone to deformation. The 22-24 mm for the time from the initiation of the air puff until the first applanation is smaller than more than 26 mm. The reason may be that the longer the axial length, the longer the corneal thickness will be thinner. Resistance to compressive strength has become weak. The time will be longer. The intraocular pressure and correction of intraocular pressure of 22-24 mm is smaller than that of more than 26 mm. Some scholars have come to similar conclusions, with the increase of axial length, the intraocular pressure is gradually increased. When the axial length is greater than 26 mm, the amplitude of the increase of intraocular pressure is the biggest[25]. Comparison of 22-24 mm and more than 26 mm, there are no significant differences in the biomechanical parameters of the cornea. The corneal biomechanical parameters may be similar in a certain axial length range. It can be speculated that the biomechanical properties of the cornea can be changed when the axial length increases to a certain length, and the specific range need to be further studied.

In conclusion, Corvis ST can analyze the biomechanical properties of cornea by recording the parameters of deformation process. This study concludes that the corneal curvature and ocular axial length may be the factors affecting corneal biomechanical characteristics. The longer axial length, the thinner corneal thickness, the more easily corneal is deformed, and with the increase of axial length, the intraocular pressure becomes high. The elderly with different corneal curvatures and different axial lengths have different corneal biomechanics. When discussing whether the preparation of the cataract incision is affected by the patient's own factors, the different corneal curvatures and axial lengths shall be considered. It needs further clinical study to explore whether eyeball integrity of the elderly with different corneal curvatures and axial lengths is destroyed and the overall biomechanical changes after cataract surgery. So as to provide a theoretical basis for the clinical study and the best choice of surgical incision.

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