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OCULOPLASTICS AND ORBIT

Normative anthropometric analysis and aesthetic indication of the ocular region for young Chinese adults

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Abstract
Purpose The ocular region is of prime importance for the facial aesthetic outlook. Various anthropometric analyses for the periocular region have developed to ensure a pleasing postoperative appearance. However, little information exists for Chinese young adults. In this study, authors not only analyzed the periocular anthropometric characteristics, but, more importantly, searched out the most meaningful aesthetic indicators of the population.
Methods The cross-sectional study was executed using two-dimensional photogrammetry acquired from 162 Chinese young adults (79 males, 83 females) between 20-30 years old. Anthropometric parameters including palpebral fissure length and height, intercanthal and outercanthal width, crease height, angle of endocanthion and exocanthion, axis of palpebral fissure, palpebral fissure index, canthal index, and angular index were acquired from standardized photographs. Then, 134 volunteers (20-30 years old) gave each photograph a score within 1-5 points to evaluate their ocular aesthetic attractiveness. The correlation between anthropometric parameters and aesthetic assessment was analyzed.
Results A statistical difference between genders was found for palpebral fissure length and height, outercanthal width, angle of exocanthion, palpebral fissure index and canthal index ($p<0.05$), with no statistical difference found for crease height between genders. Moreover, the palpebral fissure index, canthal index, crease height, and angle of exocanthion were significantly associated with aesthetic assessment.
Conclusions The normative anthropometric parameters are fundamental to interpret the morphology of eyes and to design plastic surgery for young Chinese adults. The parameters of palpebral fissure index, canthal index, crease height, and angle of exocanthion are strong indicators of aesthetic assessment.

Keywords Periocular features · Aesthetics · Young Chinese adults

Introduction

The concept of facial proportions hearkens back to the Renaissance and has served as a reference standard for scholars and artists for centuries [1]. The derivatives of this neoclassical canon-for example, the formulation of "facial thirds" and "the rule of fifth" [2, 3]-are regarded as valid aesthetic criteria during plastic surgery. Thus, it would be prudent to provide precise anthropometric parameters and search out the objective indicators of quantitative aesthetic assessment based on ethnicity and gender specific anthropometric norms.

For the past few years, with the introduction of anthropometry into clinical application [4, 5], normative data on the anthropometric parameters are indispensable in accurate interpretation of facial deformity and in determining reference points for plastic surgery. Over three methods for capturing and quantifying craniofacial morphology have been described to date [6, 7]. Traditionally, Farkas et al. employed manual

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anthropometry using calipers to obtain the data [4]. Other methods, such as two-dimensional photogrammetry, have been used to assist conventional anthropometric measurements for over 40 years [8]. Three-dimensional laser scanning [9] and digital three-dimensional photogrammetry [10, 11] have been frequently used in recent years. Nonetheless, none is preferable to the other in terms of measurement accuracy and repeatability [12, 13]. The selection of measurements is completely on the basis of the common resources and cost [14].

The facial morphology shows tremendous variations between differential racial types, especially within the upper one-third of the face [15]. Thus far, there are many published anthropometric studies of the ocular region of Caucasians [14, 16–19], but fewer credible sources of information for the Chinese are provided. The scanty studies contained small samples, limited anthropometric parameters, and had not put forward the most correlative anthropometric parameters of aesthetic assessment [20–22].

The objective of the current study was to analyze the periocular anthropometric characteristics and providing a normative data for Chinese young adults. In addition, we secondarily investigated the correlations between aesthetic assessment and general periocular anthropometric parameters so as to determine the most meaningful aesthetic indicators of the population.

Subjects and methods

Two-dimensional photogrammetry

The cross-sectional study was executed using two-dimensional (2D) photogrammetry acquired from 162 Chinese young adults (79 males and 83 females) between 20-30 years of age. The mean age of the subjects was 25 years old. The subjects who had any conditions that could affect the measurements, such as congenital craniofacial abnormalities, any orbital or eyelid diseases or tumors, and history of periocular or ocular surgery and/or trauma were excluded. The study was approved by the Medical Ethics Committee of Zhongshan Ophthalmic Center. Informed consent was obtained from all individual participants included in the study. The study adhered to the tenets of the Declaration of Helsinki.

The subjects were requested to sit in a well-illuminated room. Colored frontal view photographs with brows fixation, first with eyes open in a primary gaze were captured with a digital camera (SONY CORP DSC-H70, Japan). Then another photograph was taken with the subject's eyes look slightly upward to eliminate the disturbance of eyelashes when confirming the exact point of exocanthion, measuring the palpebral fissure length and outercanthal width. The last photograph was obtained when the subjects kept their eyes gently closed. All photographs were taken by the same photographer. The photographs were standardized by aligning the camera with the axial plane of the eyes. A scale bar (20 mm) was included in each photograph for calibration to avoid measuring mistakes because of the actual different focal distance and allow accurate comparison between images. The standardized photographs were then analyzed using an image processing program (Adobe Photoshop CS 8.0.1.0, America).

Definitions

Anthropometric landmarks defined by Farkas et al. were firstly identified on each image (Fig. 1) according to standard definitions (Table 1) [5, 23, 24]: palpebral superius (Ps)-the highest point of the free margin of upper eyelid, palpebral inferius (Pi)-the lowest point of the free margin of lower eyelid, endocanthion (En)- the soft tissue point at the inner commissure of the eye fissure, located slightly lateral to bony endocanthion, exocanthion (Ex)- the soft tissue point at the outer commissure of the eye fissure, located slightly medial to bony landmark, and upper lid crease superius (Us)-the highest point of upper lid crease.

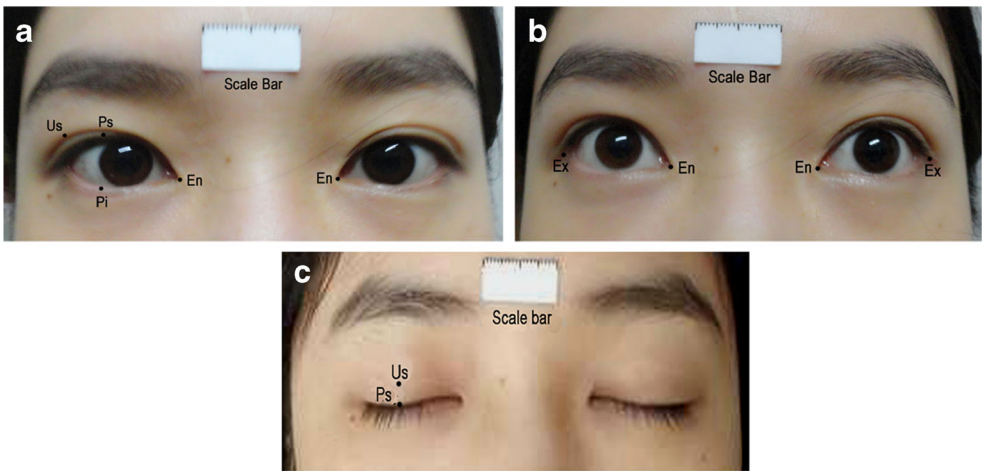

Fig. 1 Anthropometric landmarks used in this study. **a**: The subject looked straight forward with her brows fixation. **b**: The subject looked slightly upward to eliminate the disturbance of eyelashes when measuring the palpebral fissure length and outercanthal width. **c**: The subject kept her eyes gently closed. En: Endocanthion, Ex: Exocanthion, Ps: Palpebral Superius, Pi: Palpebral Inferius, Us: Upper Lid Crease Superius

Table 1 Definition of anthropometric landmarks used in this study

Landmarks	Abbreviation	Illustration
Palpebral Superius	Ps	The highest point of the free margin of upper eyelid
Palpebral Inferius	Pi	The lowest point of the free margin of lower eyelid
Endocanthion	En	The soft tissue point at the inner commissure of the eye fissure, located slightly lateral to bony endocanthion
Exocanthion	Ex	The soft tissue point at the outer commissure of the eye fissure, located slightly medial to bony landmark
Upper Lid Crease Superius	Us	The highest point of double lid crease

The locations of palpebral superius and inferius were divided into three groups according to the contact point of the palpebra to the limbus cornea (Tables 2 and 3). The double lid crease was classified into four types according to its morphological characteristics (Table 4).

The following linear and angular parameters between the landmarks were measured and shown in Fig. 2: palpebral fissure length (En-Ex)-the horizontal distance between the endocanthion and exocanthion, palpebral fissure height (Ps-Pi)-the vertical distance between the lowest point of lower eyelid and the highest point of upper eyelid, intercanthal width (En-En)-the horizontal distance between the endocanthion of binoculus, outercanthal width (Ex-Ex)-the horizontal distance between the exocanthion of binoculus, angle of endocanthion (Aen)- the angle between medial upper and lower eyelid, endocanthion acting as the apex, angle of exocanthion (Aex)- the angle between lateral upper and lower eyelid, exocanthion acting as the apex, axis of palpebral fissure (Apf)-the inclination of the horizontal axis of the eye between endocanthion and exocanthion, and crease height (Us-Ps)-the vertical distance between the highest point of upper lid crease and the highest point of upper eyelid. One thing to be noted was the crease height had to be measured twice, first with eyes kept in primary gaze and second with the subjects keeping their eyes gently closed.

Table 2 Three groups for the location of the palpebral superius

Palpebral superius	Definition
GroupI	The contact point of palpebra to limbus cornea located at the medial 1/3 of upper palpebral
Group II	The contact point of palpebra to limbus cornea located at the middle of upper palpebral
Group III	The contact point of palpebra to limbus cornea located at the lateral 1/3 of upper palpebral

Table 3 Three groups for the location of the palpebral inferius

Palpebral inferius	Definition
GroupI	The contact point of lower palpebra to limbus cornea located at the endocanthion
Group II	The contact point of palpebra to limbus cornea located at middle of lower palpebra
Group III	The contact point of palpebra to limbus cornea located at the lateral 1/3 of lower palpebra

The following index parameters were subsequently calculated : palpebral fissure index (Ps-Pi/En-Ex)-the palpebral fissure height, as a percentage of the palpebral fissure width, canthal index (En-En/Ex-Ex)-the intercanthal width, as a percentage of the binocular width, and angular index (Aen/Aex)-the angle of endocanthion, as a percentage of the angle of exocanthion.

The anthropometric parameters used in this study are shown in Table 5.

Aesthetic assessment

Overall, 134 volunteers (67 males, 67 females) were invited to participate in the aesthetic assessment. Sociodemographic information, including age, sex, and education were collected. The mean age of the volunteers was 26 years. The photographs of the 162 young Chinese adults recruited in 2D photogrammetry were displayed by sexual category. The volunteers only graded photographs of the opposite sex. A grade of 1 to 5 was defined for each of the photographs. The volunteers were requested to give each photograph a score within this range. The five grades were defined as follows. A 5 denoted the most attractive eyes and 1 indicated the least attractive eyes in the set. In this way, higher scores would correlate with higher perceived ocular attractiveness. To prevent injustice during the grading process, the volunteers who happened to have met the subjects in the pictures were

Table 4 Four types of double lid crease

Double lid crease	Definition
TypeI	No eyelid crease
Type II	The upper eyelid sulcus stretches parallel with upper eyelid margin, the double lid crease height of medial, intermediate and lateral region are roughly equal
Type III	The upper eyelid sulcus generally stretches away from the medial part of upper eyelid margin. The double lid crease presents as fan-shaped
Type IV	The highest point of upper eyelid sulcus locates at the intermediate margin and the double lid crease presents as a crescent

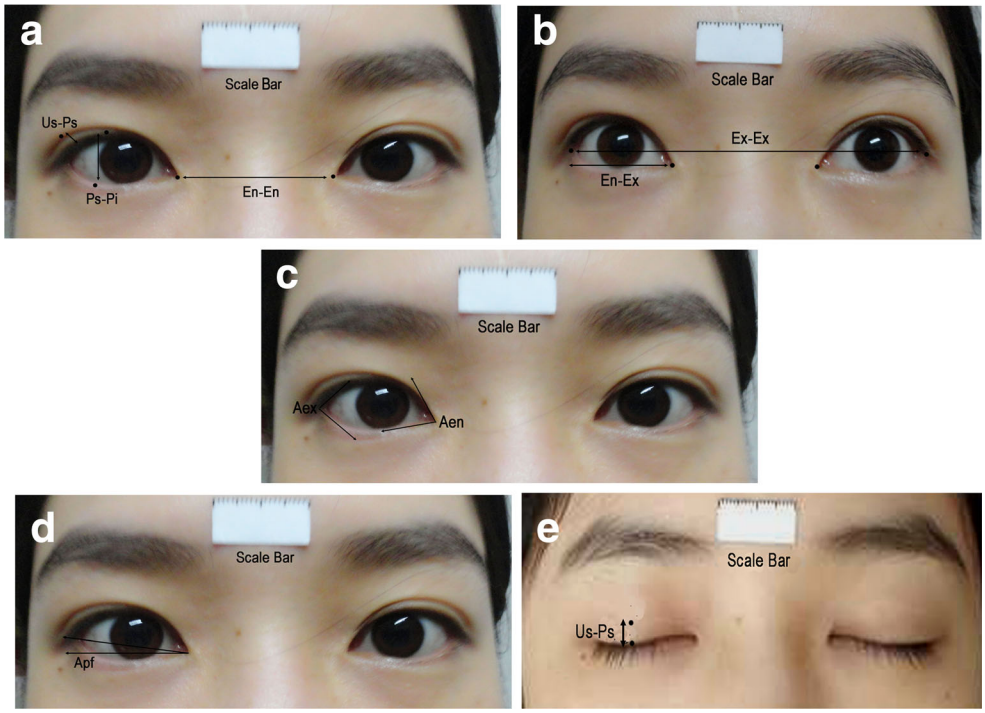

Fig. 2 Anthropometric parameters measured in this study. **a**, **c** and **d**: The subject looked straight forward with her brows fixation. **b**: The subject looked slightly upward to eliminate the disturbance of eyelashes when measuring the palpebral fissure length and outercanthal width. **e**: The subject kept her eyes gently closed. Ps-Pi: The vertical distance between lowest point of lower eyelid and highest point of upper eyelid. Us-Ps: The height of upper lid crease. En-En: The horizontal distance between endocanthion of binoculus. Ex-Ex: The horizontal distance between exocanthion of binoculus. Aen: The angle of endocanthion. Aex: The angle of exocanthion. Apf: The inclination of the horizontal axis of the eye between endocanthion and exocanthion

excluded. Moreover, to facilitate the grading efficiency and to insure the grading fairness, assessment was executed according to the protocols . Each of the pictures was shown in succession, so as to give the volunteers a brief impression. They randomly selected the picture and asked the volunteers to grade it. In view of each volunteer, they had to evaluate and grade over 70 photographs in the process, which easily resulted in aesthetic fatigue. The volunteers were permitted to reconsider the pictures.

Statistical analysis

The statistical analysis was performed using statistical software (SPSS, version 17.0; SPSS, America). The significance of difference of anthropometric parameters for sex category was analyzed using the t test and χ^2 test. Multiple linear regression analysis was used to investigate the associations of aesthetic assessment and general periocular anthropometric

Table 5 Illustration of anthropometric parameters used in this study

Anthropometric Parameters	Abbreviation	Illustration
Palpebral Fissure Length	En-Ex	The horizontal distance between endocanthion and exocanthion
Palpebral Fissure Height	Ps-Pi	The vertical distance between the lowest point of lower eyelid and the highest point of the upper eyelid
Intercanthal Width	En-En	The horizontal distance between endocanthion of binoculus
Outercanthal Width	Ex-Ex	The horizontal distance between exocanthion of binoculus
Crease Height	Us-Ps	The vertical distance between the highest point of upper lid crease and the highest point of upper eyelid
Angle of Endocanthion	Aen	The angle between medial upper and lower eyelid, endocanthion acting as the apex
Angle of Exocanthion	Aex	The angle between lateral upper and lower eyelid, exocanthion acting as the apex
Axis of Palpebral Fissure	Apf	The inclination of the horizontal axis of the eye between endocanthion and exocanthion
Palpebral Fissure Index	Ps-Pi/En-Ex	The palpebral fissure height, as a percentage of the palpebral fissure width
Canthal Index	En-En/Ex-Ex	The intercanthal width, as a percentage of the binocular width
Angular Index	Aen/Aex	The angle of endocanthion, as a percentage of the angle of exocanthion

parameters. The multiple linear regression models were established on the basis of independent linear, angular, and index variables. The dependent variable was the median of aesthetic scores of each subject. The multiple regression model significance was assessed by the p-value. The adjusted β-value was computed to approximate the variability in dependent variables that was accounted for by the independent variables. Values of $p \leq 0.05$ were considered significant.

Results

The present study provided normative anthropometric parameters of the periocular region for young Chinese adults. The means (± standard deviations) for each of the parameters are presented in Table 6. The differences of each parameter between genders was described by a p-value and a χ^2-value, the results were shown in Tables 6, 7, 8, and 9. Among male subjects, the mean palpebral fissure length, palpebral fissure height, intercanthal width, and outercanthal width were 28.61 ±2.77 mm, 9.71±1.50 mm, 33.40±2.69 and mm, 88.26± 7.17 mm, respectively. The crease height obtained the in primary position the of eye was 1.65±1.63 mm and 6.29± 1.26 mm when the eyes were gently closed. However, we noted that the linear measurements mentioned above tended to be smaller (27.65±2.72 mm, 33.17±2.58, 85.63±6.03 mm for palpebral fissure length, intercanthal, and outercanthal width, respectively) in the female group, with the exception of palpebral fissure height (10.21±1.45 mm). The crease heights measured in opened or closed eyes were 1.95± 1.55 mm and 6.43±1.27 mm, respectively. Obviously, females had a slightly larger double lid crease height, which showed a very slight trend toward significance ($p = 0.257$, $p = 0.203$).

Across all angular measurements, females had a larger (59.98±9.62° and 84.68±15.31°) angle of endocanthion and exocanthion compared with males (56.64±11.28° and 74.69± 12.64°). Likewise, females had a more acclivitous palpebral fissure (9.78±2.99°) in comparison with males (9.62±2.46°), but there was no difference between the two groups ($p = 0.654$).

The palpebral fissure index (×100) and canthal index (×100) in the study were significantly smaller in the male group (34±6 vs 37±9, 38±3 vs 39±6, $p<0.05$). But the angular index (×100)

Table 6 Mean values of measured anthropometric parameters

Anthropometric parameters	Gender	N	Mean	SD	Range	*P*-value
Palpebral Fissure Length (En-Ex)	Male	79	28.61	2.77	13.92-33.62	0.001*
	Female	83	27.65	2.72	21.32-34.57	
Palpebral Fissure Height (Ps-Pi)	Male	79	9.71	1.50	5.77-13.78	0.043*
	Female	83	10.21	1.45	6.96-14.12	
Intercanthal Width (En-En)	Male	79	33.40	2.69	27.09-39.70	0.546
	Female	83	33.17	2.58	26.32-39.75	
Outercanthal Width (Ex-Ex)	Male	79	88.26	7.17	74.50-110.2	0.007*
	Female	83	85.63	6.03	68.1-100.3	
Crease Height[1] (Us-Ps)	Male	79	1.65	1.63	0-7.17	0.257
	Female	83	1.95	1.55	0-5.3	
Crease Height[2] (Us-Ps)	Male	79	6.29	1.26	0-8.4	0.203
	Female	83	6.43	1.27	0-8.9	
Angle of Endocanthion (Aen)	Male	79	56.64	11.28	33.1-96.3	0.058
	Female	83	59.98	9.62	35.8-84.5	
Angle of Exocanthion (Aex)	Male	79	74.69	12.64	49.9-113.3	<0.001*
	Female	83	84.68	15.31	37.5-121.5	
Axis of Palpebral Fissure (Apf)	Male	79	9.62	2.46	4.2-16.6	0.654
	Female	83	9.78	2.99	2.7-17.4	
Palpebral Fissure Index (Ps-Pi/En-Ex×100)	Male	79	34	6	0.2-0.48	<0.001*
	Female	83	37	9	0.26-0.51	
Canthal Index (En-En/Ex-Ex×100)	Male	79	38	3	0.29-0.46	0.049*
	Female	83	39	6	0.31-0.48	
Angular Index (Aen/Aex×100)	Male	79	76	17	0.47-1.19	0.146
	Female	83	73	15	0.42-1.23	

Parameters in terms of palpebral fissure length and height, intercanthal width, outercanthal width, and crease height are shown in millimeters; parameters in terms of angle of endocanthion and exocanthion, and axis of palpebral are shown in degrees. Crease Height[1] represented the crease height and was measured when the subjects kept their eyes in primary gaze. Crease Height[2] represented the crease height and was measured when the eyes were gently closed

*Statistical significance ($p<0.05$)

Table 7 Distribution for the location of the palpebral superius

	Palpebral superius(n/%)			χ^2	*P*
	GroupI	Group II	GroupIII		
Male	22(28.0)	53(67.0)	4(5.0)	0.16	0.963
Female	21(21.7)	57(56.7)	5(4.6)		

Table 9 Distributions of four types of double lid crease

	Double lid crease (n/%)				χ^2	*P*
	TypeI	Type II	Type III	Type IV		
Male	34(43.6)	13(16.7)	27(34.6)	4(5.1)	18.612	0.034*
Female	27(32.5)	29(34.9)	20(24.1)	7(8.4)		

*Statistical significance($p<0.05$)

between male and female groups showed as approaching formal significance, although the parameters for males was a little larger than that of females (76±17 vs 73±15, $p=0.146$).

In addition, the classification of the double lid crease in the different sexual groups was statistically significant ($p=0.034$). Figure 3 displays the most representative photographs of double lid crease in each type. Meanwhile, the distribution of palpebral inferius in two groups also showed a significant sexual difference tendency ($p=0.001$). However, the classification of palpebral superius was found to have no gender difference.

The medians of aesthetic scores of each subject are presented in Supplemental Table, and the results of regression analysis are presented in Table 10. The multiple linear regression analysis revealed a positive association between aesthetic assessment and the palpebral fissure index (*Adj* $\beta=0.276$, $p<0.001$). The double lid crease height had a positive contribution to aesthetic assessment as well (*Adj* $\beta=0.37$, $p=0.004$). Specifically, an increased palpebral fissure index and double lid crease height were correlated with a higher degree of aesthetic identity.

The multiple linear regression analysis also revealed the intercanthal index and angle of exocanthion significantly affected the aesthetic assessment ($p<0.001$ and $p=0.003$, respectively). Collectively, these results suggested aesthetic identity would be improved with a decrease in the intercanthal index and the angle of exocanthion (*Adj* β=-0.466 and *Adj* β=-0.178, respectively).

Discussion

The ocular region is of prime importance to facial aesthetic outlook and expression [25]. Even small changes of this region can induce a changed facial expression [26] and have major impact on patients' physiognomy and psychological well-being. Clearly, the development of reliable quantitative anthropometric parameters of ocular attractiveness would be desirable. The existing principles of aesthetic evaluation remained vague and most were derived from the fields of art (e.g., vertical thirds and horizontal fifth [2, 3], ideal proportions [27], symmetry [28] and averageness [29]). Nevertheless, cosmetic surgery requires a perfect combination of art and science. In the past three decades, many scholars made attempts to define aesthetic standards, but their like and dislikes lack imperative scientific support [30]. The present study not only created a database of normative periocular anthropometric values, but firstly combined 2D photogrammetry and aesthetic assessment together. Moreover, we restricted our study to the 20-30 year age range of Chinese subjects, since the ocular region exhibits obvious variations in different ethnic [5], age, and gender groups [31].

In this study, we found that males expressed larger dimensions with respect to palpebral fissure length, intercanthal width, and outercanthal width. The results were in agreement with those of Yasas et al. [20] and Wu et al. [22]. However, the palpebral fissure height measured in our study presented as being subtly larger compared to those of a previous study. We considered this difference resulted from the discrepancy of the definitions of Ps and Pi. Wu et al. have defined Ps and Pi as "the midpoint of palpebral margin, which was of the equal distance to En, also as to Ex". In contrast, we insisted that not all eyelid peaks and bottoms were located at the median aspect of the eyelids. In our study, although the palpebral superius was located at the middle of the upper eyelid (group II) and accounted for 67.0 % among male subjects, there were another 28 % of the subjects attached to group I and 5 % of the subjects belonged to group III (Table 7). Compared to males, the percentage of group II among females accounted for only 56.7 %. Similarly, as listed in Table 8, the palpebral inferius was located at the middle of the lower eyelid in 46 male subjects (58.0 %). It was not surprising that 69.9 % of females presented with the palpebral inferius located at the same position. Therefore, the value of palpebral fissure height measured in this study was more accurate and reproducible. The absence of gender differences in the means of the palpebral fissure index and canthal index were consistent with the findings of Wu et al. and Yasas et al.

Table 8 Distribution of three groups for the location of the palpebral inferius

	Palpebral inferius(n/%)			χ^2	*P*
	GroupI	Group II	Group III		
Male	0(0.0)	46(58.0)	33(42.0)	13.183	0.001*
Female	7(8.4)	58(69.9)	18(21.7)		

*Statistical significance ($p<0.05$)

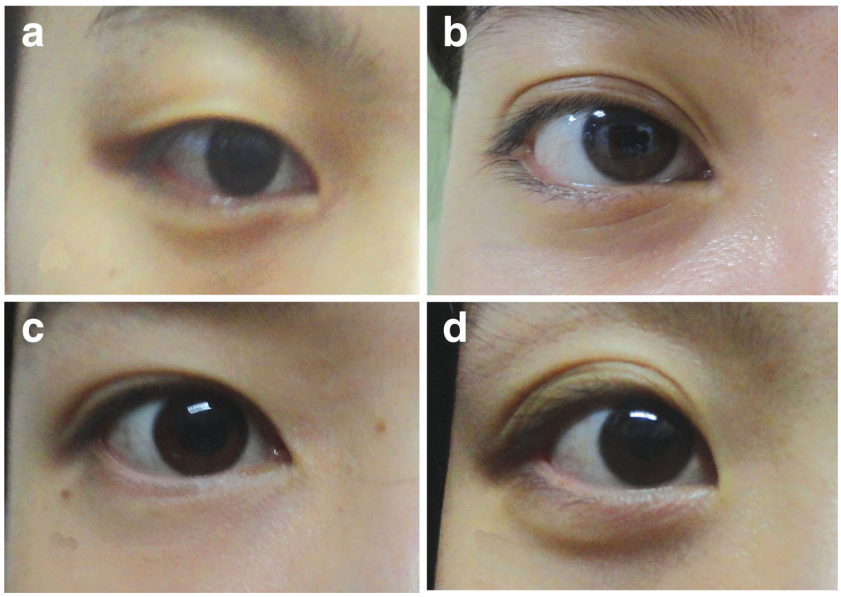

Fig. 3 Representative forms of double lid crease. **a**: No eyelid crease. **b**: The upper eyelid sulcus stretched parallel with the upper eyelid margin, which appeared as the crease height of medial, intermediate and lateral regions that were roughly equal. **c**: The upper eyelid sulcus generally stretched away from the medial part of the upper eyelid margin. The double lid crease presented as fan-shaped. **d**: The highest point of the upper eyelid sulcus located at the intermediate margin and the double lid crease presented as a crescent

Furthermore, our findings indicated that females had a slightly larger crease height than males. This result was similar to those in the literature [16, 32]. In particular, we measured the crease height with two different eyelid positions. The double lid crease was more prominent and easier to measure when the subjects kept their eyes gently closed. We considered it would be much closer to the ordinary appearance when measuring this parameter, if, instead, the subjects kept their eyes open in primary gaze.

In addition, we classified the double lid crease into four types (Table 4 and Fig. 3). Indeed, the classification of double lid crease was of great importance for better understanding the morphological characters of double lid crease and designing blepharoplasty.

In addition, we agreed with the opinion of Farkas et al., who reported the anatomical differences existing between the Asian and Caucasian eyes [5]. The intercanthal and outercanthal width were greater in the Chinese than those in Caucasian healthy adults [31]. On the contrary, the rest of the linear measurements were slightly smaller compared with those reports in Turkey [19], Netherlands [33], and America [16].

In contrast to angular parameters, most would agree that a negative canthal tilt [34] created a sad look [35] and an aged appearance [16]. Normally, the lateral canthus laid 10-15° [36] or 2 mm [37] above the medial canthus. We observed that the axis of palpebral fissure was 9.62° and 9.78° for Chinese males and females, respectively. The discrepancies possibly owed to ethnic differences. The age differences among these studies could have implications for comparisons of results as well.

Equally important, we found a strong correlation between some special parameters (the palpebral fissure index, canthal index, double lid crease height, angle of exocanthion) and aesthetic assessment. We believe that these anthropometric parameters are strong indicators of "ocular attractiveness." Interestingly, the linear parameters and axis of palpebral fissure did not correlate with aesthetic assessment. As the face is a tridimensional object, it was likely that errors may occur in defining anthropometric landmarks and getting concrete numbers of distances on photographs. The depth of periocular landmarks may confound some linear parameters, especially for palpebral fissure length, intercanthal width, and outercanthal width [20]. However, the problem could be eliminated by constructing ratios such as palpebral index and canthal index from the primary measurements [38]. Normally, an apparent double eyelid crease was often considered as a significant component in the representation of beautiful eyes. Cosmetic blepharoplasty also continues to be the most popular facial cosmetic procedure in China. Also, this view has been confirmed in our study; the aesthetic score improved with increasing height of double lid crease.

One limitation of this study resulted from the great ethnic differences in China. However, as the subjects

Table 10 The results of multiple linear regression analysis

Anthropometric Parameters	β	Adj β	p-value
Palpebral Fissure Index (Ps-Pi/En-Ex)	4.182	0.276	<0.001*
Canthal Index (En-En/Ex-Ex)	−3.757	−0.466	<0.001*
Crease Height[1] (Us-Ps)	0.108	0.37	0.004*
Angle of Exocanthion (Aex)	−0.005	−0.178	0.013*

The adjusted β-value was computed to approximate the variability in the dependent variable that is accounted for by the independent variables. The p-values described the contribution of each anthropometric parameter to the regression model. Crease Height[1] represented the crease height and was measured when the subjects kept their eyes in primary gaze

*Statistical significance ($p<0.05$)

participated in the study belong to the common "Han" ethnicity, the results of present study can be generalized to the population of the whole ethnic group.

Conclusion

In conclusion, the present study provided normative anthropometric parameters of periocular region for young Chinese adults. Furthermore, we established that the parameters in terms of palpebral fissure index, canthal index, double lid crease height, and angle of exocanthion are strong indicators of aesthetic assessment.

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Conflict of interest statement All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

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