

The effect of age and gender on the anatomic structure of Caucasian healthy eyelids

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ABSTRACT

Objectives: To determine the normal values of the eyelid parameters in Caucasians and to describe the effects of age and gender on eyelid and eyebrow anatomy.

Methods: We evaluated the effects of age and gender on eyelid structures in 100 Caucasian volunteers in the Ophthalmology and Anatomy Departments, University of Gaziantep Medical School, Turkey between 2003 and 2004. Forty-five females with mean age of 36 years (5-80 years) and 55 males with mean age of 39 years (3-68 years) participated in the study. We divided subjects into 6 groups according to decades. We measured the palpebral fissure length (PFL), the distance between the pupil center and the upper eyelid (PC-UE) and lower eyelid margin (PC-LE), the eyebrow height (EH), the eye crease height (ECH) and the distance from the reference line to the pupil center (RL-PC), using a reference line

through the medial canthus and vertical line through the pupil center of the frontal slides.

Results: The measurements of PFL were between 23.5 mm and 29 mm in females, 24.8 mm and 29.1 mm in males and showed a gradual decrease with age. The PC-UE, PC-LE, ECH and RL-PC remained stable throughout life and were identical for both gender. However, EH ranging from 10.7 - 12 mm in females and 6.5 - 11 mm in males appeared to have a significant association with gender, which was higher in females than males, but was not effected with age.

Conclusion: These results demonstrate the importance of providing a normal anatomic relationship that relates to the patient's age and gender.

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The position of the eyebrow, eyelid, and eyelid crease are distinctive factors in facial landmarks and are significant factors of aesthetic conformation of the facial appearance. In cosmetic, corrective and restorative surgical procedures maintaining the anatomic relationship of these landmarks ensures a normal postoperative appearance.¹ Aging changes may effect the position of the eyelids, eyeball and eyebrow. Aging may also cause laxity of eyelid tissues and atrophy of the orbital fat.^{2,3} Information regarding normal eyelid position in different age groups might be helpful in understanding of age related eyelid pathology. The purpose of this study

was to describe the eyelids measurements of Caucasian subjects and the effects of age and gender on eyelid and eyebrow anatomy.

Methods. The present descriptive study was planned and managed in the Ophthalmology and Anatomy Departments, University of Gaziantep, Turkey between 2003 and 2004. All chosen cases from routine eye examination had neither squint nor eyelid pathology. They had only refractive errors approximately ± 2.00 diopters of myopia, hyperopia or regular astigmatism. The cases being likely to

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Figure 1 - Picture showing both eyes of one case with a ruler held on the forehead.

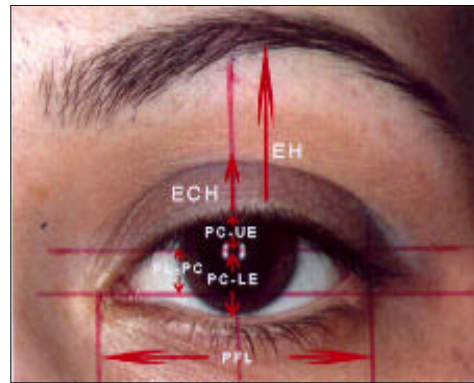


Figure 2 - The measurement points of the eyes.

affect the measurements were excluded such as congenital craniofacial anomalies, anophthalmos, phthisis, Grave's orbitopathy, trauma, orbital pseudotumor and history of previous ocular or eyelid surgery. The age of the subjects ranged between 3 and 80 years of age. In order to obtain its connection with age, we recruited 100 subjects and divided them into 6 age groups: group 1 - younger than 10 years old, group 2 - between 10 and 20, group 3 - between 21 and 40, group 4 - between 41 and 50, group 5 - between 51 and 60 and group 6 - older than 60 years old. Forty-five participants were females and 55 were males. The mean age of females was 36.09 ± 16.79 years (range 5-80 years) and the mean age of males was 38.56 ± 18.89 (range 3 - 68 years). For both gender, median age was 34. Each slide of subjects was evaluated with a camera mounted with a 135 mm macro lens and a flash unit. The photo slides in a frontal plane were performed while the subjects were looking at a 6 m distanced point. A ruler was held horizontally on the forehead and both eyes were pictured on the same slide (Figure 1). Measurements were taken on these slides projected with 3-fold magnification. The ruler was used for calibration. On frontal slides a reference line was drawn from the inner most nasal point of both medial canthal angles and a vertical line was drawn across the pupil center. The measurement points were as follows and were shown in Figure 2.

For analyses, the results from the randomized one eye were used as the representative measurement. The data were divided into females and males groups. Connections with age and gender of these eyelid and eyebrow measurements were evaluated using one-way ANOVA. The SPSS version 10 was used in the statistical evaluation of the measurement results. For controlling gender independent samples T-test was used for the palpebral fissure length (PFL), the distance between the pupil center and the

upper eyelid (PC-UE) and lower eyelid margin (PC-LE), the eyebrow height (EH), the eye crease height (ECH) and the distance from the reference line to the pupil center (RL-PC) values.

Results. The measurements, means and standard deviations and statistical outcome of the study were shown in Table 1. The average size of PFL was changing between maximum 29 ± 2.2 mm to minimum 23.5 ± 1 mm in females and from 29.1 ± 1.7 mm to 24.8 ± 1.6 mm in males and denoted a gradual decrease with age ($p=0.0001$) but insignificant with gender effects after controlling for age. This shortening was similar for the 2 genders. The mean of PC-UE ranged 5.1 ± 1.2 mm to 3.7 ± 2 mm in females and from 5.3 ± 0.9 mm to 4.1 ± 0.6 mm in males. The mean PC-UE size showed a small but statistically insignificant decrease with age both in males and females. The average of PC-LE ranged was 4.5 ± 1.1 mm to 3 ± 0.8 mm in females and from 5.1 ± 1.3 mm to 3 ± 0.8 mm in males. The PC-LE values manifested no change with age and gender ($p>0.05$). The mean measurement of EH varied on average from 6.5 to 12 mm across for all ages and they were consistently greater in females ($p=0.0001$). The mean values of EH were between 6.5 ± 3.1 mm and 11 ± 2.5 mm in males and 10.7 ± 3.1 mm and 12 ± 3.3 mm in females. The effect of age was not significant after controlling for gender effect ($p>0.05$). The mean of ECH varied from 1.5 ± 1.9 mm to 3.9 ± 1.3 mm in females and from 2 ± 1.2 mm to 4 ± 1.4 mm in males. The mean RL-PC value was achieved between 2 ± 1.4 mm and 3.8 ± 0.9 mm in females and between 2.2 ± 0.9 mm and 3.5 ± 1 mm in males. Both of ECH and RL-PC values pointed at no significant difference between males and females as well as age effect on their size ($p>0.05$).

Table 1 - The mean values of the anatomic structures.

Age	Female			Male		
	n	Mean	SD	n	Mean	SD
Palpebral fissure length (PFL) - (Analyses of variance results of PFL: Gender, controlling for age; $p>0.05$ age, controlling for gender, $p=0.0001$).						
<10	8	29	2.2	8	29.1	1.7
11-20	5	28.5	3	13	28	2.8
21-40	11	28.8	1.4	10	27.8	1.8
41-50	10	28.7	2.9	9	28	0.8
51-60	6	27.8	1.6	8	26.4	2
>60	5	23.5	1	7	24.8	1.6
The distance between the pupil center and the upper eyelid margin (PC-UE) - (Analyses of variance results of PC-UE: Gender, controlling for age; $p>0.05$ age, controlling for gender, $p>0.05$).						
<10	8	5.1	1.2	8	5.3	0.9
11-20	6	5	0.95	14	4.5	1.2
21-40	12	5	1.5	8	4.7	0.7
41-50	10	4.7	1.3	4	4.7	0.9
51-60	5	4.4	1.8	7	4.1	0.6
>60	4	3.7	2	7	4.7	0.9
The distance between the pupil center and the lower eyelid margin (PC-LE) - (Analyses of variance result of PC-LE: Gender, controlling for age; $p>0.05$ age, controlling for gender, $p>0.05$).						
<10	8	4.3	1.7	8	5.1	1.3
11-20	5	4.5	1.1	13	3.5	1.5
21-40	11	4	1.2	10	3.8	1.1
41-50	10	4.5	1.7	9	3	0.8
51-60	6	3.6	1.6	8	3.5	1.5
>60	5	3.2	1.2	7	3.2	1.8
The eyebrow height (EH). - (Analyses of variance results of EH: Gender, controlling for age; $p=0.0001$ age, controlling for gender, $p>0.05$).						
<10	8	11.6	2.5	8	8.5	2.07
11-20	5	11.6	2.6	13	8.6	2.06
21-40	11	12	3.3	10	9	2.7
41-50	10	10.7	3.1	9	11	2.5
51-60	6	11	2.2	8	6.5	3.1
>60	5	10.7	4.6	7	9.2	4.1
The eyelid crease height (ECH) - (Analyses of variance results of ECH: Gender, controlling for age; $p>0.05$ age, controlling for gender, $p>0.05$).						
<10	8	2.8	1.1	8	3.3	1.6
11-20	5	3.9	1.3	13	3.5	1.7
21-40	11	3.6	1.03	10	2.8	1.8
41-50	10	3.1	1.5	9	4	1.4
51-60	6	2.8	1.6	8	2	1.2
>60	5	1.5	1.9	7	3.7	1.1
The distance between the reference line and the pupil center (RL-PC) - (Analyses of variance results of RL-PC: Gender, controlling for age; $p>0.05$ age, controlling for gender, $p>0.05$).						
<10	8	3.8	0.9	8	3.5	1
11-20	5	3.3	0.7	13	3	0.8
21-40	11	3.5	1	10	3.3	0.7
41-50	10	3.4	0.8	9	2.2	0.9
51-60	6	2.4	1.1	8	3.1	0.6
>60	5	2	1.4	7	2.7	0.9

DISCUSSION. Functional and cosmetic surgery involving the eyelids and eyebrows requires knowledge of the anatomic relationships of the landmarks as it is important in the human appearance. The margins of the upper lid and lower lid have been defined anatomically.⁴ The upper lid margin normally rests just below the level of the superior limbus while the lower limb margin is more variable and usually lies less than 1 mm below the inferior limbus. Out of the normal values may result in undesirable effects on facial appearance. There are many studies performed on adult and children measuring their palpebral fissure.⁵⁻¹¹ The PFL in adult has been reported in different dimensions as 25-33 mm in several studies. Baretto and Mathog⁶ reported that PFL^{4,5,12} was 31 mm in females and 32 mm in males in a black population, while the equivalent values were 29 mm in females and 30 mm in males in a Caucasian population. In this study these measurements ranged between 23.5 mm and 29 mm in female and 24.8 mm to 29.1 mm in male. Our results are similar to those of other investigations. Aging primarily affects the size of the PFL. Our PFL findings showed a gradual decrease with age. The data were consistent with that found by Bosch et al,¹³ in which subjects above 50 years of age have smaller size of the PFL compared with younger age group. In contrast, Liu and Stasior¹⁴ reported no difference in size of the lower eyelid between the young and the elders over 50 years of age. The differences among countries may attribute to racial factors. While the lengthening of the PFL in the younger age group probably reflects growth of the facial structures, the shortening of the older age group may be due to progressive laxity of the medial and lateral canthal structures. The positions of the PC-UE and PC-LE were not only affected by age but they also showed no difference between genders. Bosch et al¹³ found that the parameters mentioned above increased with age. These increases may be related to excessive laxity in eyelid disorders such as entropion and ectropion. We could not find any relationship with age. Its cause may be explained by which the present study groups were not included in the cases with eyelid disorder. In some studies the total measurements of PC-UE and PC-LE were evaluated as vertical fissure height or palpebral fissure height.^{6,11,15} When our results were collected, we saw that they were similar to other investigations. In this study, we determined that EH was higher in females than males and this conform to previous studies.^{1,13,16} However the values of EH in women who pluck their natural hairs may affect our measurements. The greater eyebrow height in females provides a space for the placement of eye shadow and is often desirable. It was found that the ECH was identical for both gender and remained stable throughout life. In contrast to previous studies, which reported that aging causes a higher skin crease in both gender.^{1,16} And we consider that this diversity could be a result of the measurement method, the instrument used

and also the racial differences. We also determined that RL-PC was also not affected by age; it also showed no difference between the genders. The RL-PC ranged was from 2 - 3.8 mm across on all ages. The result is consistent with Bosch et al¹³ findings. Fox⁵ concluded that the most rapid growth rate of the eyelid structures occurs during the preschool and school age group.⁵ We observed that the considerable developmental changes in orbital measurements has occurred during the first decade of life and was minimal thereafter. The outcome was similar to Fox's findings. We believe that the effects of age and gender to eyelid anatomy should be considered in all cases due to its importance in oculoplastic surgery and aesthetic correction and should be considered also to produce a cosmetically satisfying outcome. We therefore hope that our data may be use as a guidance of surgical planes and reconstruction procedures for the different aged group of Caucasian patients who lived all over the world.

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