Anthropometry of Eyelid and Orbit in Four Southern Thailand Ethnic Groups

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Objective: *To study the basic eyelid and orbital measurement in the four main ethnic groups of southern Thailand.*
Material and Method: *The basic eyelid and orbital surface anatomy of 101 normal subjects aged 20-40 years old were measured in the four ethnic groups of which the majority of people in southern Thailand belong to: Thai, Chinese, Thai-Malay, and Thai-Chinese.*
Results: *Of the 101 subjects, 51 were male and 50 were female. Each ethnic group had at least 12 normal subjects. Male-female data were analyzed separately and compared between groups. The palpebral fissure heights in Thai, Chinese, Thai-Malay, and Thai-Chinese males were 9.5, 9.0, 10.2 and 9.6 mm respectively, which demonstrated statistically significant differences between Thai-Malay versus Thai, and Thai-Malay versus Chinese. The palpebral fissure lengths were 30.4, 29.8, 30.5 and 30.5 mm, but without statistically significant differences. The marginal reflex distances were 3.2, 2.8, 3.7 and 3.1 mm respectively with a statistically significant difference only between Thai-Malay versus Chinese. The levator functions were 15.2, 15.2, 15.3 and 15.2 mm. The upper lid creases were 7.1, 4.0, 6.6, and 4.4 mm, statistically significantly different in Thai versus Chinese, Thai versus Thai-Chinese and Chinese versus Thai-Malay. The Hertel exophthalmometer measurements were 15.4, 16.3, 16.6 and 15.9 mm without statistically significant differences. The female measurements were overall similar to the male measurements, with some parallel differences between the groups. The eyebrow position in this age group was mostly at and above the orbital rim in both genders and all ethnic groups. An absence of upper lid crease and an epicanthal fold were found in significantly greater numbers in the Chinese group compared to the others, while parallel lid crease was significantly found in greater numbers in the Thai-Malay group than in the others.*
Conclusion: *Different eyelid characteristics in different ethnic groups are an important feature to note when planning for eyelid surgery. As there is a wide range of ethnic groups in Asia, with many differences in eyelid characteristics, it is important for the ophthalmologist to be aware of and understanding these anatomical variations in clinical assessment and treatment in Asians.*

Keywords: *Anthropometry, Surface anatomy, Palpebral fissure, Marginal reflex distance, Levator function, Exophthalmometric measurement*

J Med Assoc Thai 2011; 94 (2): 193-9
Full text. e-Journal: *http://www.mat.or.th/journal*

The differences between the oriental and the occidental eyelid and orbit have been well-documented[1-5]. The occidental eye is set horizontally in the orbit with a deep eyelid crease, wide palpebral fissure and long lashes. The oriental eye is set slightly obliquely with a narrower palpebral aperture and fullness in the upper lids and frequently has an epicanthal fold. The relationship between the globe and orbit position is also important to understand when examining patients who have experienced head trauma or may have possible autoimmune, neoplastic, or congenital diseases, or certain infections[2]. The differences of protrusion of the globe from the bony orbit between black, white, and Asian populations are again well documented[2,6]. Asian populations include a wide variety of ethnic groups such as Arabian, Indian, Chinese, Thai, Vietnamese and Japanese. However, no studies describing differences in eyelids and orbits related to the different ethnicities have been done yet.

In the present study, the differences of eyelids and orbits were examined in the four major ethnic groups of southern Thailand, Thai, Chinese, Thai-Chinese, and Thai-Malay. Awareness of the anatomical differences in the eyelids and orbits of the different ethnic groups is vital to effective clinical assessment and treatment of patients.

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Material and Method

After the institutional review board permission according to the "Declarations of Helsinki", we measured the basic eyelid and orbital surface anatomy of the subjects from eye department in Songklanagarind and Pattani hospitals who met the inclusion criteria. The inclusion criteria were age between 20-40 years, no history of ocular or orbital trauma, no pathological myopia, soft tissue disease, congenital eyelid, orbit anomaly or endocrinological disease such as hyperthyroidism, or with a history of ocular, eyelid, or orbital surgery. We divided the subjects into four groups, Thai, Chinese, Thai-Malay, and Thai-Chinese, based on their ethnic background by taking a history that included determining their grandparents' ethnicities, the language they normally spoke in their families and their origins. The physical examination included measuring the palpebral fissure height, palpebral fissure length, marginal reflex distance one (MRD1), levator function, lid crease height, anterior lamellar (the distance between lower cilia of the eyebrow to the upper eyelid margin with the subject looking down), intercanthal distance, outer canthal distance, pupillary distance, and protruding of the globe by Hertel exophthalmometer. The eyebrow position, eyebrow characteristics, eyelid crease characteristics, and presence/absence of epicanthal fold were recorded. A sample size based on differences in eyelid and orbit measurements (data as above mentioned) of 1 mm was done The analysis concluded that 12 male and 12 female subjects were required from each ethnic group.

The examinations and analysis of males and females were performed independently and compared between ethnic groups. The eyelid and orbit measurement was analyzed by one way Anova and eyelid characteristic was analyzed by Fisher's exact test. A p-value of less than 0.5 was considered statistically significant.

Results

One hundred one subjects, 51 male and 50 female were included in this study. Each gender-ethnic specific group had at least 12 normal subjects. The eyelid and orbit measurements are shown in Table 1. In the male group, the palpebral fissure heights were statistically significantly different between Thai-Malay versus Chinese ($p = 0.001$) and Thai-Malay versus Thai, ($p = 0.035$) while the palpebral fissure heights in females showed no statistically significant differences among the ethnic groups. Conversely, the palpebral fissure lengths were not statistically different between the male ethnicities but were significantly different in the females. The marginal reflex distances also showed significant differences between Thai-Malay and Chinese ($p = 0.007$) in males, but no statistically significant differences in the females. This indicated that among males the height of the eyelid tends to be different in each ethnicity, while in females the length of the eyelid will be different among the groups.

The male groups had statistically significant differences in upper lid creases in Thai versus Chinese ($p = 0.001$), Thai versus Thai-Chinese ($p = 0.003$), Chinese versus Thai-Malay ($p = 0.005$) and Thai-Malay versus Thai-Chinese. In females, statistically significant differences were found in upper eyelid creases between Thai-Malay versus Chinese ($p = 0.001$). The intercanthal distances also showed statistically significant differences in male but not in female. In the male group statistically significant differences were found between Thai versus Chinese ($p = 0.00$), Thai versus Thai-Chinese ($p = 0.019$) and Chinese versus Thai-Malay ($p = 0.001$). This finding corresponded with the presence of an epicanthal fold, which was more pronounced in the Chinese ethnic groups than in the others (Tables 2), making the intercanthal distance wider in the Chinese-related groups than in the other groups. The anterior lamellar in males showed no statistically significant differences while females showed a statistically significant difference in Chinese versus Thai-Malay ($p = 0.001$).

In males, the outer canthal distance was statistically significantly different in Thai versus Chinese ($p = 0.025$), and Chinese versus Thai-Malay ($p = 0.18$), but there were no significant differences in females. Pupillary distance was statistically significantly different in Thai versus Chinese ($p = 0.011$), and Thai versus Thai-Chinese ($p = 0.042$). Neither levator function or proptosis measurement had any statistically significant differences between any combination of sexes or ethnic groups.

Eyebrow characteristics and positions again had no statistically significant differences between either sexes or ethnic groups. However, compared to males, the females showed more of a tendency to an arched brow rather than a straight brow. There were statistically significant differences in the appearance of an upper lid crease between the Chinese ethnics compared to other ethnics, in both sexes. A tapered upper eyelid crease was commonly found in Thai, Chinese, and Thai-Chinese but not in Thai-Malays, who usually had a parallel lid crease. This finding was

Table 1. Eyelid and orbit measurements of males and females in mm-average (range)

Ethnics	Male									
	Palpebral fissure height	Palpebral fissure length	Marginal reflex distance 1	Levator function	Upper lid crease	Anterior lamellar#	Intercanthal distance	Outercanthal distance	Pupillary distance	Hertel exophthalmometer
Thai (T)	9.5 (8-10)	30.4 (28-32)	3.2 (2-5)	15.2 (13-17)	7.1 (5-10)	19.5 (18-22)	30.9 (27-34)	88.1 (84-93)	61.3 (58-64)	15.4 (12.5-18)
Chinese (C)	9.0 (7-10)	29.8 (28-32)	2.8 (2-3.5)	15.2 (12-18)	4.0 (1-8)	20.0 (17-23)	35.8 (32-42)	91.2 (85-96)	64.4 (60-70)	16.3 (13-20)
Thai-Malay (TM	10.2 (9-11)	30.5 (28-32)	3.7 (2-6)	15.3 (12-18)	6.6 (4-13)	20.2 (17-24)	31.5 (27-42)	87.9 (82-98)	62.9 (58-75)	16.6 (12-21)
Thai-Chinese (TC)	9.6 (8.5-12)	30.5 (28-32)	3.1 (2-4)	15.2 (13-20)	4.4 (1-10)	20.3 (18-22)	33.8 (30-38)	90.4 (85-93)	63.8 (60-66)	15.9 (12-19.5)
p-value*	TM and T = 0.035 TM and C = 0.001	NS**	TM and C = 0.007	NS	T and C = 0.001 T and TC = 0.003 TM and C = 0.005	NS	T and C = 0.000 T and TC = 0.019 C and TM = 0.001	T and C = 0.025 C and TM = 0.018	T and C = 0.011 C and TC = 0.042	NS
Ethnics	Female									
	Palpebral fissure height	Palpebral fissure length	Marginal reflex distance 1	Levator function	Upper lid crease	Anterior lamellar#	Intercanthal distance	Outercanthal distance	Pupillary distance	Hertel exophthalmometer
Thai (T)	9.5 (8-11)	27.3 (26-29)	3.2 (2-4)	14.9 (13-17)	6.2 (4-9)	20.4 (18-23)	32.6 (31-35)	85.8 (82-96)	59.5 (57-63.5)	14.8 (12.5-18)
Chinese (C)	9.2 (8-10)	27.6 (25-30)	3.3 (2.5-4)	14.6 (12-17)	5.3 (2-8)	20.2 (18-23)	33.6 (28-39)	85.2 (82-89)	59.7 (57-64)	14.8 (13-17)
Thai-Malay (TM)	9.5 (8-11)	29.0 (27-33)	3.6 (2-5.5)	15.6 (13-18)	7.4 (6-10)	21.8 (20-26)	30.9 (25-38)	85.7 (76-92)	60.7 (57-67)	15.2 (11-21.5)
Thai-Chinese (TC)	9.8 (8-11)	28.2 (26-30)	3.6 (2.5-4)	14.6 (13-17)	5.8 (4-8)	20.4 (15-22)	33.3 (28-38)	87.2 (82-93)	60.0 (55-64)	15.1 (13-17)
p-value*	NS	T and TM = 0.006 C and TM = 0.02	NS	NS	TM and C = 0.001 TM and TC = 0.004	C and TM = 0.011	NS	NS	NS	NS

* Show only has statistically significant differences $p < 0.05$

Measure from lower brow cilia to upper lid margin when looking down

** NS = no statistically significant differences between groups

Table 2. Eyelid characteristics of males and females

Ethnics	Male										
	Eyebrow characteristic		Eyebrow position			Upper lid crease		Upper lid crease characteristic		Epicanthal fold	
	Straight brow No. (%)	Arch brown No. (%)	At rim No. (%)	Below rim No. (%)	Above rim No. (%)	Yes No. (%)	No No. (%)	Taper No. (%)	Parallel No. (%)	Yes No. (%)	No No. (%)
Thai (T)	11 (78.6)	3 (21.4)	9 (64.3)	1 (7.1)	4 (28.6)	14 (100)	-	13 (92.9)	1 (7.1)	5 (35.7)	9 (64.3)
Chinese (C)	11 (91.7)	1 (8.3)	8 (66.7)	-	4 (33.3)	8 (66.7)	4 (33.3)	8 (100)	-	11 (91.7)	1 (8.3)
Thai-Malay (TM)	10 (76.9)	3 (21.3)	9 (69.2)	1 (7.7)	3 (23.0)	13 (100)	-	6 (46.2)	7 (53.8)	2 (15.4)	11 (84.6)
Thai-Chinese (TC)	10 (83.3)	2 (16.7)	4 (33.3)	-	8 (66.7)	7 (58.3)	5 (41.7)	7 (100)	-	8 (66.7)	4 (33.3)
p-value	NS			NS		T and C = 0.033 T and TC = 0.012 C and TM = 0.039 TM and TC = 0.015		T and C = 0.005 C and TM = 0.018 TM and TC = 0.044		T and C = 0.005 C and TM = 0.000 TM and TC = 0.015	
Ethnics	Female										
	Eyebrow characteristic		Eyebrow position			Upper lid crease		Upper lid crease characteristic		Epicanthal fold	
	Straight brow No. (%)	Arch brown No. (%)	At rim No. (%)	Below rim No. (%)	Above rim No. (%)	Yes No. (%)	No No. (%)	Taper No. (%)	Parallel No. (%)	Yes No. (%)	No No. (%)
Thai (T)	5 (41.7)	7 (58.3)	8 (66.7)	2 (16.7)	2 (16.7)	12 (100)	-	12 (100)	-	5 (41.7)	7 (58.3)
Chinese (C)	2 (16.7)	10 (83.3)	3 (25)	2 (16.7)	7 (33.3)	8 (66.7)	4 (33.3)	8 (100)	-	11 (91.7)	1 (8.3)
Thai-Malay (TM)	1 (7.1)	13 (92.9)	7 (50)	-	7 (50)	14 (100)	-	11 (78.6)	3 (21.4)	5 (35.7)	9 (64.3)
Thai-Chinese (TC)	4 (33.3)	8 (66.7)	4 (33.3)	3 (25)	5 (41.7)	12 (100)	-	11 (91.7)	1 (8.3)	7 (58.3)	5 (41.7)
p-value	NS			NS		C and TM = 0.033		NS		T and C = 0.027 C and TM = 0.005	

** NS = no statistically significant differences between groups

statistically significant in males but not in females. The Chinese groups showed statistically significant differences in the presence of an epicanthal fold over the other groups, and in both sexes (Table 2).

Discussion

Understanding these differences in facial morphology distinguishing various races/ethnic groups[7,8] is very important for the ophthalmologic surgeon in achieving the best outcomes for his or her patients[1]. The overlying soft tissue anatomy should be the focus of consideration, as these structures have been well-documented in terms of the differences between Caucasians and Asians[3,8]. To date, there is but scarce information about the differences in eyelids and orbits among the many Asian races and ethnic groups.

This study found that the soft tissue contours and measurements such as the palpebral fissure height and length, upper lid crease height, upper lid crease characteristics and presence or absence of epicanthal fold were all different to at least some degree between the four studied ethnic sub-groups in southern Thailand. The most interesting differences were that the Thai-Malay group overall had bigger eyes, and featured a parallel lid crease more often than the 'pure' Thai or Chinese groups (Fig. 1, 2). These differences are likely because Malaysian people have more similar descent of western race. Those of Chinese ancestry had a significantly greater presence of an epicanthal fold, absence of upper lid crease, smaller upper lid crease height, and wider intercanthal and outer canthal distances. This finding similar to Le et al[8]. The normal palpebral fissure height in Caucasians is 10-12 mm[9], while in Asians the range is 8-10 mm[10,11]. The current study found average palpebral fissure heights of 9.6 mm in males and 9.5 mm in females, with the Chinese having smaller average palpebral fissure heights than the other groups. The marginal reflex distances in our study were 3.2 mm in males and 3.4 in females, which are smaller values than were found in the Vangveeravong study[11] of 3.9 mm in males and 3.8 in females. This difference may have occurred due to interobserver variation.

The study found it interesting that the levator function showed no differences among our ethnics, and was in the same range as Caucasians, about 12-17 mm[12-14]. The levator function is the parameter, which represents the function of the levator complex to elevate the eyelid, and may not be different in different races. The protrusion of the globe related to the bony orbit was also pretty similar in all of study groups, at 15-17 mm, but has been found to be different between the black and white races, at 18-22 and 17-20 mm respectively[6,15]. In Asians, the proptosis measurement has been around 14-18 mm[6,15] and in Thais have had an average of 14.38 in males and 14.16 mm in females[16]. While the present study accounted the measurements of 16.0 mm in males and 15.0 mm in females. The differences might result from different study populations, or technical errors between interobservers, as it is generally accepted among ophthalmologists that this measurement has an interobserver variation of 1-2 mm.

The most notable and obvious difference between males and females is the eyebrow. Most females have an arched eyebrow while males usually have a straighter eyebrow. Care must be taken when performing eyebrow surgery on male patients to not create too much eyebrow arch.

In conclusion, the surface measurements of eyelid and orbit provided valuable information to the surgeon both before and after surgery[17]. Knowing the difference of eyelid characteristic in different ethnic groups is important in planning for eyelid surgery to

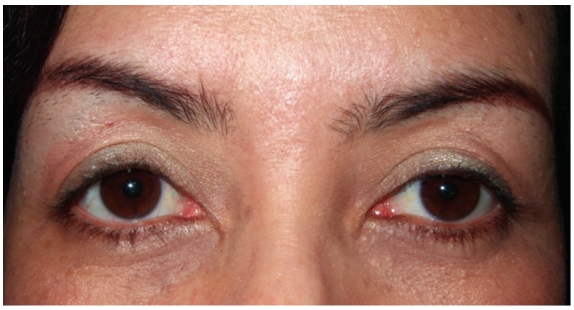

Fig. 1 Parallel lid crease in Thai-Malay

Fig. 2 Epicanthal fold and no lid crease in Chinese

ensure a good surgical result in blending the outcome with the existing facial features.

Potential conflicts of interest

None.

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การวัดเปลือกตาและเบ้าตาทางมานุษยวิทยาในประชากรสี่เชื้อชาติของภาคใต้ประเทศไทย

ภัสสร ปรีชาไว

***วัตถุประสงค์**: เพื่อศึกษาค่าพื้นฐานทางเปลือกตา และเบ้าตาในคนสี่เชื้อชาติของภาคใต้ประเทศไทย*

***วัสดุและวิธีการ**: วัดกายภาพพื้นผิวของเปลือกตาและเบ้าตาแบบพื้นฐานในคนปกติ 101 คน อายุระหว่าง 20-40 ปี ในประชากรหลักสี่เชื้อชาติของภาคใต้ประเทศไทย ได้แก่ ไทย จีน ไทย-มาเลย์ และไทย-จีน ทำการวัดและศึกษาค่าพื้นฐานทางเปลือกตาและเบ้าตาในคนปกติ 101 คน อายุระหว่าง 20-40 ปี ในคน 4 เชื้อชาติ ซึ่งเป็นเชื้อชาติหลักในภาคใต้ของประเทศไทย คือ คนไทยแท้ คนจีนแท้ คนไทยเชื้อสายมาเลย์ และคนไทยเชื้อสายจีน*

***ผลการศึกษา**: คนปกติ 101 คน เป็นเพศชาย 51 คน เป็นผู้หญิง 50 คน แต่ละกลุ่มเชื้อชาติมีอย่างน้อย 12 คน เพศชายและหญิงทำการคำนวณและวิเคราะห์แยกกันและทำการเปรียบเทียบระหว่างกลุ่มเชื้อชาติ พบว่าค่าความสูงของเปลือกตาของเพศชาย (palpebral fissure heights) ในคนไทยแท้ คนจีนแท้ คนไทยเชื้อสายมาเลย์ และคนไทยเชื้อสายจีน คือ 9.5, 9.0, 10.2 และ 9.6 มิลลิเมตร ซึ่งพบว่ามีความแตกต่างอย่างมีนัยสำคัญ ทางสถิติระหว่างคนไทยเชื้อสายมาเลย์กับคนไทยแท้ และคนไทยเชื้อสายมาเลย์กับคนจีนแท้ ค่าความยาว ของเปลือกตา คือ 30.4, 29.8, 30.5 และ 30.5 มิลลิเมตร ตามลำดับ แต่ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติ ค่าระยะห่างระหว่างเปลือกตาและแสงตากระทบบนกระจกตา (marginal reflex distances) คือ 3.2, 2.8, 3.7 และ 3.1 มิลลิเมตร พบว่ามีความแตกต่างอย่างมีนัยสำคัญทางสถิติ ระหว่างคนไทยเชื้อสายมาเลย์กับคนจีนแท้ ค่าความสามารถในการเปิดเปลือกตา (levator functions) คือ 15.2, 15.2, 15.3 และ 15.2 มิลลิเมตรตามลำดับ ค่าความสูงของตาสองชั้น (lid creases) 7.1, 4.0, 6.6 และ 4.4 มิลลิเมตร พบว่ามีความแตกต่างอย่างมีนัยสำคัญทางสถิติ ระหว่างคนไทยแท้กับคนจีนแท้ คนไทยแท้กับคนไทยเชื้อสายจีน และคนจีนแท้ กับคนไทยเชื้อสายมาเลย์ ค่าตาโปน คือ 15.4, 16.3, 16.6 และ 15.9 มิลลิเมตร ไม่พบว่ามีความแตกต่างกัน อย่างมีนัยสำคัญทางสถิติ ในกลุ่มเพศหญิง พบค่าโดยรวมมีลักษณะคล้ายคลึงกับในเพศชาย และแตกต่างกันใน แต่ละเชื้อชาติ ตำแหน่งคือ พบว่าส่วนใหญ่อยู่ตรง หรือ สูงกว่ากระดูกเบ้าตาในทั้งสองเพศและทุกเชื้อชาติ คนจีนแท้ พบว่า ไม่มีตาสองชั้น และมีหนังบริเวณหัวตา (epicanthal fold) มากกว่าคนเชื้อชาติอื่นอย่างมีนัยสำคัญทางสถิติ ในขณะที่คนไทยเชื้อสายมาเลย์ มีตาสองชั้นลักษณะขนาน (parallel lid crease) มากกว่าเชื้อชาติอื่น อย่างมีนัยสำคัญทางสถิติ*

***สรุป**: ความแตกต่างของเปลือกตาในแต่ละเชื้อชาติเป็นสิ่งสำคัญในการวางแผนการผ่าตัดเปลือกตา เนื่องจากมีความแตกต่างทางเชื้อชาติมากมายในคนเอเชีย ทำให้ลักษณะเปลือกตามีความแตกต่างกัน ดังนั้นการเข้าใจและคำนึงถึงความแตกต่างทางกายวิภาค นี้มีส่วนสำคัญมากในการประเมิน และการรักษาผู้ป่วยเชื้อสายเอเชีย*