The Asian Upper Eyelid

An Anatomical Study With Comparison to the Caucasian Eyelid

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Objective: To evaluate the differences between Asian and Caucasian upper eyelid anatomy through cadaver dissection, histopathological study, and magnetic resonance imaging.

Materials and Methods: Upper eyelids of 9 Korean and 5 Caucasian cadavers were dissected, and then were studied microscopically with hematoxylin-eosin, Masson trichrome, and elastin stains. Four healthy young Korean men were studied by dynamic high-resolution magnetic resonance imaging with regard to demonstration of upper eyelid structure.

Results: More subcutaneous and suborbicularis fat, with a pretarsal fat component, is present in Asian eyelids. The Asian double eyelids showed an amount of fat intermediate between Asian single eyelids and Caucasian eyelids. Asian single eyelids showed fusion of the orbital septum to the levator aponeurosis below the superior tarsal border, while fusion is above the superior tarsal border in Caucasians. The preaponeurotic fat pad descends anteriorly to the tarsal plate in the Asian single eyelid, but not in the Caucasian eyelid. A pretarsal fat pad is identified in the Asian single eyelids.

Conclusions: The causes of absent or lower crease in the Asian upper eyelid are as follows: (1) the orbital septum fuses to the levator aponeurosis at variable distances below the superior tarsal border; (2) preaponeurotic fat pad protusion and a thick subcutaneous fat layer prevent levator fibers from extending toward the skin near the superior tarsal border; and (3) the primary insertion of the levator aponeurosis into the orbicularis muscle and into the upper eyelid skin occurs closer to the eyelid margin in Asians. Structural differences relating to increased fat in the Asian upper eyelid include the presence of a pretarsal fat pad and a moderate fat increase in the double Asian eyelid.


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THE UNITED STATES is a melting pot with people of different races living together. Presently there are approximately 7.5 million Asian American people in the United States, including 0.8 million Korean Americans. Increasingly, the North American surgeon encounters an Asian patient requesting eyelid surgery and thus encounters problems of anatomical and cultural differences. There has been a lack of information concerning the terminology and the anatomical characteristics of the Asian eyelid.

A clinically known anatomical racial difference in the upper eyelid between Asians and Caucasians is apparent in the upper eyelid crease. Most Westerners regard the Asian upper eyelid as a single eyelid (without visible lid crease). However, there are 3 morphologic types of Asian upper eyelids: single eyelid: no lid crease with puffiness; low eyelid crease: low-seated, nasally tapered, inside-fold type of crease; and double eyelid: lid crease parallel to the lid margin.

We have studied the Asian eyelid in the cadaver to demonstrate any anatomical differences between Asians and Caucasians. Noninvasive techniques for studying the eye structures were used to obtain additional anatomical information and dynamic images of structure. Recent advances in magnetic resonance imaging (MRI) techniques have made it possible for us to study noninvasively the Asian upper eyelid’s dynamical anatomical images. We additionally report dynamic high-resolution MRI study findings in Asian single, low, and double upper eyelids in staged movement.

RESULTS

CADAVER GROSS DISSECTION

Dissection of the Caucasian cadaver upper eyelid revealed a well-demarcated upper eyelid crease area at the preseptal/pretarsal orbicularis muscle junction at the superior tarsal border. Asian cadavers with a single eyelid crease showed diffuse fat...
deposits on the anterior and posterior surfaces of the preseptal/pretarsal orbicularis muscle with no identifiable trace of a lid crease as seen in the Caucasian cadaver eyelid (Figure 1). With dissection of the orbicularis muscle posterior surface from the eyelid margin to the orbital rim, firm connections were observed between the levator aponeurosis and the orbicularis muscle at the lid crease area in Caucasians. In contrast, a loose fibroadipose layer was interposed between the orbicularis muscle and the orbital septum with fat deposits on the anterior surface of the tarsal plate in the Asian single eyelid (Figure 2).

After complete orbicularis oculi muscle extirpation in the Caucasian specimens, the orbital septum was noted to fuse above the supratarsal border with the levator aponeurosis. The orbital septum of the Asian single eyelid fuses with the levator aponeurosis below the supratarsal border, sometimes close to the eyelid margin (Figure 1). The levator aponeurosis is noted to attach to the tarsal plate 3 to 4 mm above the upper eyelid margin in Caucasians and 2 to 4 mm above the upper eyelid margin in Asians.

In cases of Asian double eyelid specimens, the anatomical dissection findings were similar to Caucasian eyelid, except more subcutaneous and suborbicularis muscle fat was found. The fusion level of the orbital septum with the levator aponeurosis in the Asian double eyelid is higher than in the Asian single eyelid.

SUBJECTS, MATERIALS, AND METHODS

Two groups of anatomical specimens were studied and compared. Special attention was given to differences in the structure and its relation to the upper eyelid crease. Five formalin-preserved Caucasian cadavers (supplied by the Department of Anatomy, University of Wisconsin Medical School, Madison) and 9 formalin-preserved (6 single and 3 double eyelid) Korean cadavers (supplied by the Department of Anatomy, Chonnam National University Medical School, Kwangju, Korea) were studied.

One orbit of each cadaver was used for anatomical dissection while the contralateral orbit was sectioned for histological analysis. Eyelid crease structure was bilaterally symmetric in all specimens. Dissection findings were recorded photographically. The upper eyelid specimens were cut into lateral and medial portions to study the central portion. The specimens were fixed in 10% formalin, decalcified, and then processed for routine paraffin embedding. Multiple 5-µm sections were then prepared and stained with hematoxylin-eosin, Masson trichrome, and elastin stains.

Four healthy young (25- to 30-year-old) Asian men were studied by MRI following proper informed consent procedures. The subjects were scanned after 0.5% tetracaine ophthalmic solution instillation with the eyelids open, half-closed, and closed with instruction to stare at a point. All MRI experiments were performed with a 1.5-T scanner (General Electric, Milwaukee, Wis). Five series of sagittal images of the upper eyelid were obtained with a 7.6-cm (3-in) surface coil by means of conventional T₁-weighted spin echo images and spoiled gradient echo images. Closed eyelid images of T₁-weighted spin echo image were done by an echo time of 20 milliseconds and a repetition time of 450 milliseconds. Opened eyelid images were performed with an echo time of 14 milliseconds and a repetition time of 400 milliseconds. Opened, half-opened, and closed eyelid spoiled gradient echo were done by 4.2-millisecond echo time, 68-millisecond repetition time, and 30° flip angle.
HISTOPATHOLOGIC STUDY

The fusion of the orbital septum with the levator aponeurosis above the supratarsal border in the Caucasian and the Asian double eyelid specimens prevents the preaponeurotic fat pad from extending toward the lid crease area; the levator aponeurosis is inserted into the subdermal eyelid tissue. In contrast, the preaponeurotic fat pad in the Asian single eyelid specimens extends closer to the eyelid margin, inferiorly limited by the low fusion between the orbital septum and the levator aponeurosis. Additionally, subcutaneous and suborbicularis muscle fat layers with pretarsal fat are noted in Asian specimens that inhibit the levator insertion into the subdermal skin of the Asian single eyelid (Figure 3 and Figure 4).

MRI IMAGING STUDY

Comparison of Asian single, low, and double upper eyelid anatomical structural differences were evaluated by dynamic high-resolution MRI study. The Asian single eyelid showed a remarkable amount of subcutaneous fat. The fusion of the orbital septum to the levator aponeurosis below the superior tarsal border with interposed preaponeurotic fat was noted during eyelid closure: when open, the orbital septum folded and the preaponeurotic fat pad retracted posteriorly (Figure 5). The Asian low eyelid showed a lesser amount of subcutaneous fat than the single eyelid, with a similar low orbital septum fusion with the levator aponeurosis below the superior tarsal border (Figure 6). The Asian double eyelid demonstrated a moderate subcutaneous fat layer, orbital septum fusion to the levator aponeurosis above the superior tarsal border, and absent downward prolapse of the preaponeurotic fat pad (Figure 6).

COMMENT

Until recently, for several reasons little has been written in the American literature regarding the Asian upper eyelid anatomical characteristics, especially with regard to lid
crease and the aesthetic features. First, most studies on the subject are written in Asian-language journals. Unfortunately, English-language surgeons have little access to this knowledge. Second, until the number of emigrated Asian people reached higher proportions in North America, there had been less interest here in Asian anatomical studies. Third, religious and cultural inhibitions to cadaver donation in Asian countries considerably limit materials available for anatomical study.

By the eighth century BC, Mongoloid tribes living in the forested areas of North Asia had moved to the Kamchatka peninsula along the eastern side of Asia. Mongoloid groups, including Korean, Mongolian, Turk, Japanese, Chinese, and Indo-Chinese, have similarities in their physical stature and language. For our purposes of comparison and discussion, Korean eyelid anatomical characteristics have been grouped with those of the Japanese and Chinese because of cultural, religious, and geographic similarity. To our knowledge, this is the first report of Korean eyelid cadaver anatomy study in the English-language literature.

Many Americans misunderstand the importance of upper eyelid crease variations in Asian people. Asian people who want to have an eyelid crease think of an upper eyelid crease not as a westernization but as a form of beauty. Eyelid crease formation surgery was performed in Asia before the occurrence of notable western influence. Some Asian individuals with a single eyelid perceive their eyes as puffy, small, and drowsy, and then want blepharoplasty to create the appearance of a bigger eye.

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**Figure 4.** Illustration of Korean (A) and Caucasian (B) single eyelid anatomical characteristics.

**Figure 5.** A, Korean single eyelid (25-year-old man) showing extension of the orbital septum (arrow) during eyelid closure. B, Open eyelid with folding of the orbital septum (arrow) and retraction of the preaponeurotic fat pad (F) posteriorly. The levator aponeurosis fuses with the orbital septum below the superior tarsal border (open arrow).

**Figure 6.** A, Korean low eyelid (27-year-old man) showing a lesser amount of fat than the single eyelid. The orbital septum fuses (white arrow) with the levator aponeurosis below the supratarsal border (open arrow). Note the inferiorly prolapsed preaponeurotic fat pad (F). B, Korean double eyelid (30-year-old man) exhibiting a moderate subcutaneous fat layer (S). Orbital septum (black arrow) fusion to the levator aponeurosis (white arrow) above the supratarsal border (open arrow) prevents the downward prolapse of the preaponeurotic fat pad (F).
Several previous studies have identified differences of anatomical characteristics between Caucasian and Asian people.\textsuperscript{10-15} Doxanas and Anderson\textsuperscript{11} identified the orbital septum variations in the Asian eyelid. They noted that the levator aponeurosis fuses with the orbital septum below the level of the superior tarsal border. Preaponeurotic fat anterior to the tarsus prevents the insertion of the levator aponeurosis from extending to the subcutaneous tissue and thus prevents the normal eyelid crease formation. Asian authors have found the location of the orbital septum fusion site with levator aponeurosis to be a main factor in eyelid crease formation.\textsuperscript{2-5} In our Caucasian and Asian double eyelid specimens, these structures were found to fuse above the superior tarsal border, but below the superior tarsal border in the Asian single and low eyelid types.

We found more prominent subcutaneous, suborbicularis, and preaponeurotic fat tissue in the Asian upper eyelid specimens. This is in agreement with Uchida’s\textsuperscript{16} study, wherein he first described the presence of 4 areas of fat pads in Asian eyelids: the subcutaneous, the preaponeurotic, submuscular or preseptal, and the preaponeurotic fat pads. He identified preaponeurotic fat as an entity different from a herniated preaponeurotic fat pad. In our study, we confirmed the presence of preaponeurotic fat in Asian single and low eyelid specimens. We consider the more prominent subcutaneous and preseptal fat tissue in Asians as spacers that act to prevent the levator aponeurosis from extending to the subdermal tissue.

Western authors may think the Japanese, Chinese, and Koreans have the same Asian characteristics of upper eyelid anatomy; however, the configuration of the crease in the upper eyelids of Asians varies greatly. The crease may be absent or exhibit variable shape. There has been a report in young Korean women of the prevalence of upper eyelid crease variations: apparent outer upper eyelid fold (49%), inner or incomplete upper eyelid fold (31%), and no upper eyelid crease (20%).\textsuperscript{2} Liu and Hsu\textsuperscript{12} estimated the prevalence of upper eyelid crease variations in the Chinese: outer upper eyelid fold (67.2%), inner and unilateral upper eyelid crease (9.6%), and no upper eyelid crease (23.2%). About 40% of Japanese have a double eyelid crease.\textsuperscript{17} Comparison between articles is difficult, as there are differences in study groups and in methods. We have not identified an Asian study comparing the Korean with other population groups.

Chen\textsuperscript{13} classified Asian people who have an inner or incomplete upper eyelid crease by their upper eyelid crease shape. One of us (S. J.) collected upper eyelid crease data from young Koreans and found that about 30% of young Korean people have an apparent upper eyelid crease. Most of them want to have an upper eyelid crease inferiorly that tapers medially with a gentle lateral flaring (unpublished data, 1998).

Hisatomi\textsuperscript{7} studied the anatomy of the single eyelid in Japanese cadaver specimens. He found the following typical differences from the Caucasian eyelid. First, white fibrous connective tissue containing fat is located under the orbicularis oculi muscle. Second, distal insertion of the orbital septum is several millimeters above the upper eyelid margin. Third, orbital fat is prolated to the anterior surface of the tarsal plate. Liu and Hsu\textsuperscript{12} described thicker upper eyelid skin in association with the presence of a thicker subcutaneous areolar layer in Asian eyelids. Wang and Bian\textsuperscript{18} dissected Chinese eyelids and found that the fusion level of the orbital septum with the levator aponeurosis in single eyelids is lower than in double eyelids. Our findings agree with these reports. Additionally, our Korean eyelid dissections and findings from histological studies have identified a preaponeurotic fat layer. This preaponeurotic fat layer is not inferior orbital fat prolapse, but a separate entity.

Single eyelid anatomy and the inner upper eyelid crease anatomy have been characterized by a lower primary insertion of the levator aponeurosis just above the upper eyelid margin,\textsuperscript{19} thicker fat and hypertrophic orbicularis oculi muscle and upper eyelid skin,\textsuperscript{20} and a lower primary insertion of the levator aponeurosis through a relatively thin orbicularis oculi and skin at the level of the middle or lower upper tarsal plate.\textsuperscript{6} In our current study, the Asian single or low eyelid crease is affected by 3 factors: lower orbital septum-levator fusion site with preaponeurotic fat prolapse over the tarsal plate; thicker subcutaneous, subdermal, suborbicularis, and preaponeurotic fat layers; and lower primary insertion of the levator aponeurosis toward the upper eyelid skin.

In summary, it is evident that the location of the orbital septum fusion with the levator aponeurosis plays a major role in forming the upper eyelid crease. However, there are more considerations in the formation of the upper eyelid crease. They are the amount of soft tissue (subcutaneous fat, suborbicularis fat, preaponeurotic fat) and the characteristics of the skin and orbicularis oculi muscle of the upper eyelid, especially in the lid crease area. Structural differences relating to increased fat in the Asian upper eyelid include the presence of a preaponeurotic fat pad and a moderate fat increase in the double Asian eyelid. Any facial plastic surgeon requested by Asians to perform eyelid surgery should consider their personal and cultural characteristics. An understanding of the profound anatomical differences is required to achieve the results desired by the patient.

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REFERENCES


Archives Web Quiz

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