Histopathologic Findings of the Orbicularis Oculi in Upper Eyelid Aging

Total or Minimal Excision of Orbicularis Oculi in Upper Blepharoplasty

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Objective: It is well known that gradual loss of elastic fibers and skin relaxation cause the aging process, but whether changes in the orbicularis oculi muscle may contribute to the aging of the upper eyelid is not known. The aim of the present study was to use histopathologic examination to investigate whether the orbicularis oculi contributes to upper eyelid aging.

Methods: Full-thickness upper eyelids, which were removed during blepharoplasty using en bloc resection, were stained with hematoxylin-eosin and examined. Eleven patients with oriental eyelid, 14 patients with bilateral dermatochalasia, and 2 patients with facial nerve palsy and contralateral dermatochalasia were included in this study.

Results: Patients ranged in age from 21 to 73 years (median age, 55.8 years). Histologic results revealed that changes in the aging upper eyelid were mainly in the skin and subcutaneous layers with large masses of deranged elastic fibers in the papillary dermis, which was characterized as solar elastosis.

Conclusions: Our study revealed that the entire orbicularis oculi muscle layer remained morphologically intact with aging. Moreover, our findings suggest that a minimally invasive surgical approach with muscle sparing in upper blepharoplasty in selected patients could yield good results in terms of cosmetic outcomes and upper eyelid function while minimizing postoperative complications.


Previous concepts of facial aging emphasized the increases in redundant skin and fatty tissues that occur with aging. The upper and lower eyelids were thought to appear increasingly heavy with time as gravity stretched the eyelid skin and caused the orbital fat to bulge forward. More recently, increased tissue laxity, soft-tissue descent, and bony- and soft-tissue deflation were all thought to be contributing factors to facial aging.1 It is well known that gradual loss of elastic fibers and relaxation of skin cause the aging process.2-4 However, it is not known whether changes in the orbicularis oculi muscle may contribute to aging of the upper eyelid.

The orbicularis oculi is a broad, flat, oval subcutaneous muscle that lies underneath the skin of the eyelids and the surrounding facial areas, including the forehead, temples, and cheeks.5 This muscle is divided into 2 main anatomic portions: the palpebral and the orbital. The high-speed closure mechanisms involved in winking are controlled by the palpebral portion of the muscle that overlies the tarsus and the orbital septum. Forcible closure of the eyelids is a coordinated effort between the orbital portion of the muscle and other muscles of the brow region.

Upper blepharoplasty is a surgical procedure that is performed for cosmetic reasons or to relieve visual symptoms caused by skin laxity and orbital fat bulge. Most patients expect a more youthful appearance after surgery. The standard technique of upper blepharoplasty includes an en bloc excision. This technique involves the resection of anterior lamellar tissue of the upper eyelid, including skin, subcutaneous tissue, and the orbicularis muscle and is a reliable debulking method.6 Removing this tissue from the upper eyelids makes it possible to identify aging changes in the skin, subcutaneous layer, and orbicularis oculi muscle layer. The aim of this study was to use histopathologic examination to investigate whether the orbicularis oculi contributes to aging of the upper eyelids.
In this prospective study conducted at the Korea University Hospital Department of Ophthalmology between August 2006 and July 2007, 1 oculoplastic surgeon (S.H.B.) performed incisional blepharoplasty on 22 eyelids in 11 patients younger than 40 years with oriental eyelids and 32 eyelids of 16 patients with dermatochalasia. Among the patients with dermatochalasia, 2 patients had right facial nerve palsy and left dermatochalasia, and 14 patients had bilateral dermatochalasia. Demographic data such as age and sex were reviewed. Informed consent was obtained from all patients.

Surgery was performed under local anesthesia. After preparation and draping of the eyelids, an incision line was marked approximately 5 to 6 mm from the lash line in men and 7 to 8 mm above in women. With the patient’s eyes gently closed, forceps were used to access and mark the redundant anterior lamellar tissue above the initial incision line. The upper eyelid was infiltrated with a mixture of lidocaine, 2%, and 1:200 000 epinephrine, and a scalpel blade was used to make a scratch incision along the marked lines. One snip with a curved sharp-tipped scissors, directed toward the lateral orbital rim, was used to incise subcutaneous tissue and orbicularis muscle. An incision perpendicular to the skin surface was used to enter the suborbicularis space. Scissors were advanced across the lid from the lateral to the nasal extent of the redundant tissue to complete the en bloc resection.

Surgically removed upper eyelid tissue from the level below the eyebrow to the eyelashes included all the layers of the upper eyelids. Excised tissue materials were fixed by immersion in 10% buffered formalin for 20 hours. Following dehydration in alcohol, the tissue was embedded in paraffin blocks, and sections were cut from the blocks using a sliding microtome. Tissues were subsequently stained with hematoxylin-eosin. Photographs of the histologic slides at low- and high-power fields were taken. Two independent teams of investigators (1 pathologist and 1 ophthalmologist) unaware of the specimen-identifying information independently reviewed all of the sections to identify any changes in the epidermis, dermis, and orbicularis oculi muscle. Discrepancies in estimations were reconciled by a concurrent review using a multiple-headed microscope.

A total of 54 eyelids (27 patients) were included in this study. Patients ranged in age from 21 to 73 years (median age, 55.8 years). The mean age of patients with oriental eyelid was 32.3 years, and that of the patients with dermatochalasia was 65.5 years. There were 9 male and 18 female patients. Eleven patients were diagnosed as having oriental eyelid, and 14 patients were diagnosed as having bilateral dermatochalasia. Two patients had right facial nerve palsy and left dermatochalasia. Surgery was performed on both eyelids in all patients.

Light microscopic evaluation of the anterior lamella of the upper eyelid obtained from patients with oriental eyelid and dermatochalasia revealed that the whole orbicularis oculi muscle layer remained morphologically intact, retaining the characteristics of striated muscle fibers, including multinucleated cylindrical cells with nuclei located at the periphery under the sarcolemmal membrane with the same bulk of fibers throughout the aging process (hematoxylin-eosin, original magnification ×40 for all panels).
with aging in upper eyelids were found primarily in the skin and subcutaneous tissue. In 4 samples with dermatochalasia, there were large masses of deranged elastic fibers visualized as nodular aggregations of fibrous and amorphous material in the papillary dermis, which is characterized as solar elastosis. The patients with these changes ranged in age from 63 to 73 years. There was minimal elastic tissue loss in young patients with oriental eyelids (Figure 2B).

In 1 patient with facial nerve palsy, the orbicularis oculi muscle showed moderately severe atrophy due to denervation (Figure 3A). There was distinct population of small or large atrophic fibers compared with the morphologically intact orbicularis muscle fibers in the opposing eyelid (Figure 3B).

**COMMENT**

The authors of a histochemical study of the orbicularis oculi in ectropion and entropion concluded that there was no significant difference between orbicularis muscle fibers to account for the development of eyelid malpositions. To our knowledge, our study is the first report comparing the orbicularis oculi muscle and skin changes in patients of different ages without lid malposition or other abnormalities. Our study showed that the orbicularis oculi muscle remains morphologically intact with the same bulk of fibers throughout the aging process. The loss of elastic fibers and skin laxity were identified with advanced age.

In a frequently cited study, Tan et al reported that forearm skin thickness increases until around age 20 years then decreases linearly with time. Although this finding likely applies to thicker facial skin, eyelid skin might not

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**Figure 2.** Photodamaged facial skin (A) and minimal elastic tissue loss (B) (hematoxylin-eosin, original magnification ×100). A, Large masses of deranged elastic fibers are characteristic of solar elastosis. There is a nodular aggregation of fibrous to amorphous material in the papillary dermis (arrow). B, There was minimal elastic tissue loss in young patients with oriental eyelids.

**Figure 3.** Two specimens from the same patient with facial nerve palsy (hematoxylin-eosin, original magnification ×400). A, The orbicularis oculi muscle showed moderately severe atrophy due to denervation. There was a distinct population of small or large atrophic fibers. B, In the left upper eyelid, the whole orbicularis oculi muscle layer remained morphologically intact.
undergo these changes. Hwang et al., for instance, did not find an age-related decrease in upper eyelid skin thickness in blepharoplasty skin samples. Skin elasticity also decreases with age. Facial skin undergoes both intrinsic aging as well as photoaging, resulting in a greater decrease in elasticity than in sun-protected areas.

Initially, owing initially to ignorance of its true pathophysiologic characteristics and subsequently to the lack of appropriate terminology, chronic sun damage was widely mislabeled in the medical literature as aging, premature aging, or accelerated aging. Photoaging usually involves the face, neck, or extensor surfaces of the upper extremities. A prominent feature of photoaged skin is elastosis, a process characterized histologically by tangled masses of degraded elastic fibers that further deteriorate to form an amorphous mass. In addition, the amount of ground substance, largely composed of glycosaminoglycans and proteoglycans, increases in photodamaged skin, whereas the amount of collagen decreases in part because of increased metalloproteinase activity and enhanced cytokine release.

In our study, only 2 patients with dermatochalasia showed solar elastosis. The relative severity of sun-induced cutaneous changes varies considerably among individuals, undoubtedly reflecting inherent differences in vulnerability and repair capacity of the solar insult.

In 1 patient with facial nerve palsy, the orbicularis oculi muscle showed moderately severe atrophy due to denervation. Denervation of the human muscles supplied by the facial nerve results in a reduction in the size of the muscle fibers into a variably smaller diameter, with a relative increase in the number of subsarcolemmal nuclei. Atrophy of the muscle fibers, which is characterized as a reduction in the size or form of the filaments, was observed in the auricularis posterior as early as 6 weeks after facial paralysis. Degeneration and destruction of the muscle fiber started in the auricularis posterior muscle 13 months after facial paralysis. Degenerated muscle fibers were replaced with a coarse granular material. In facial nerve palsy, little attention has been given to the changes occurring in the orbicularis muscle following denervation. Further study on the progression of pathologic changes in muscle fibers according to the duration of denervation of facial nerve with a larger sample size would provide useful information.

Advantages of the en bloc technique include potentially less bleeding than would be expected from separate excision of orbicularis strips and a completely exposed orbital septum. Visualization of the orbital septum facilitates the excision of herniated fat. In cases of involutional ptosis, exposing and advancing the attenuated aponeurosis is more easily accomplished after en bloc resection of the anterior lamellar tissue.

Recently, an interventional randomized double-blind study was conducted in patients with dermatochalasia of the upper eyelid. The preseptal orbicularis muscle was resected from 1 eye of randomly selected patients, and that of the contralateral side was preserved. Upper blepharoplasty with orbicularis muscle resection caused more postoperative symptoms and had worse initial aesthetic outcomes. However, the final aesthetic outcome was the same regardless of preseptal orbicularis oculi muscle preservation. The authors concluded that the orbicularis oculi muscle should be preserved in the upper blepharoplasty for dermatochalasis.

Skin muscle removal in upper blepharoplasty could yield superior cosmetic results with elevation of brow height in patients with full upper eyelids. In addition, some individuals with milder degrees of bilateral upper eyelid ptosis seemed to have improvement and a slightly increased margin reflex distance after upper blepharoplasty only. The explanation for this finding might be related to a reduction in orbicularis tone.

However, excessive removal of the orbicularis oculi in blepharoplasty may cause severe lagophthalmos, which can lead to corneal ulcer or may cause blindness. Moreover, inordinate removal of the orbicularis oculi can also alter the position of the eyebrows, resulting in the long-term complication of eyebrow ptosis because the remaining functioning orbicularis muscle can directly affect eyebrow position during contraction.

In patients who desire a lower-positioned upper eyelid fold and/or rejuvenation, maintenance, or enhancement of the appearance of volume, orbicularis muscle preservation remains a highly advantageous option. The effects of muscle preservation can be similar to results achieved by the injection of soft-tissue fillers such as autologous fat, hyaluronic acid, or other filling agents. The results could vary with each individual because they are dependent on a host of factors, including the amount of skin resection and thickness of the orbicularis muscle. Volume-maintaining methods preserving the orbicularis muscle can also be used in selected patients who desire a higher upper eyelid fold and can also preserve or restore a youthful convexity of the upper eyelid brow junction. Surgeons have the ability to optimally maintain or restore the volumetric appearance of youth, alter the appearance of the upper eyelid to achieve the patient’s desired effects, and treat the most subtle eyelid fissure asymmetry by selective orbicularis muscle removal to maximize the aesthetic outcomes for patients.

In our study, the histologic results showed that the orbicularis oculi does not change significantly with age. Therefore, excessive excision of the orbicularis oculi muscle in upper blepharoplasty may not be appropriate. Moreover, our findings suggests that a minimally invasive surgical approach with muscle sparing in upper blepharoplasty in selected patients could yield good results in terms of cosmetic outcomes and upper lid function while minimizing postoperative complications.

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