The Tear Trough and Lid/Cheek Junction: Anatomy and Implications for Surgical Correction

Nicholas T. Haddock, M.D.
Pierre B. Saadeh, M.D.
Sean Boutros, M.D.
Charles H. Thorne, M.D.

New York, N.Y.; and Houston, Texas

Background: The tear trough and the lid/cheek junction become more visible with age. These landmarks are adjacent, forming in some patients a continuous indentation or groove below the infraorbital rim. Numerous, often conflicting procedures have been described to improve the appearance of the region. The purpose of this study was to evaluate the anatomy underlying the tear trough and the lid/cheek junction and to evaluate the procedures designed to correct them.

Methods: Twelve fresh cadaver lower lid and midface dissections were performed (six heads). The orbital regions were dissected in layers, and medical photography was performed.

Results: In the subcutaneous plane, the tear trough and lid/cheek junction overlie the junction of the palpebral and orbital portions of the orbicularis oculi muscle and the cephalic border of the malar fat pad. In the submuscular plane, these landmarks differ. Along the tear trough, the orbicularis muscle is attached directly to the bone. Along the lid/cheek junction, the attachment is ligamentous by means of the orbicularis retaining ligament.

Conclusions: The tear trough and lid/cheek junction are primarily explained by superficial (subcutaneous) anatomical features. Atrophy of skin and fat is the most likely explanation for age-related visibility of these landmarks. “Descent” of this region with age is unlikely (the structures are fixed to bone). Bulging orbital fat accentuates these landmarks. Interventions must extend significantly below the infraorbital rim. Fat or synthetic filler may be best placed in the intraorbicularis plane (tear trough) and in the suborbicularis plane (lid/cheek junction). (Plast. Reconstr. Surg. 123: 1332, 2009.)

The terms “tear trough” and “lid/cheek junction” are ubiquitous at plastic surgery meetings and in the literature. There is general agreement that these landmarks become more visible with age. Disagreement exists, however, regarding the anatomical explanation for these landmarks and which procedure is best to disguise, improve, or correct them.

The tear trough,¹ also known as the nasojugal groove,² is the natural depression extending inferolaterally from the medial canthus (Fig. 1). When this external landmark is deep enough to be unsightly in the eyes of the patient or the surgeon (usually because of the aging process), it is known as the “tear trough deformity.” The tear trough is short (no more than 3 cm in length) and terminates approximately in the midpupillary line. Extending laterally from this point, below and approximately parallel to the infraorbital rim, is another indentation that becomes more obvious with age. This groove has been variably referred to as the palpebromalar groove³ or, by some, the lid/cheek junction (Fig. 1). A tear trough deformity and a well-demarcated lid/cheek junction, along with visible bulging of orbital fat, may stimulate a patient to seek periorbital aesthetic surgery.⁴

Various anatomical explanations for the tear trough deformity have been provided in the

Disclosure: None of the authors has a conflict of interest.

From the Institute of Reconstructive Plastic Surgery, New York University School of Medicine, and Houston Plastic and Craniofacial Surgery.

Received for publication April 4, 2008; accepted September 16, 2008.


Copyright ©2012 by the American Society of Plastic Surgeons

DOI: 10.1097/PRS.0b013e318269c70f

www.PRSJournal.com
literature.1,2,5–7 These include (1) an attachment of the orbital septum to the arcus marginalis at the orbital rim, (2) the gap between the levator labii superioris alaeque nasi muscle and the orbicularis oculi muscle, and (3) loss of facial fat in the trough or herniation of fat superior to the trough.

Despite numerous descriptions of the periorbital and midface fascial system, contradictory anatomical explanations also exist for the deepening of the lid/cheek junction.3,8–13 Some have suggested that the lid/cheek junction descends with age.14–17 Studies by Lambros18 using photographs of the same patients over time, however, demonstrate that the lid/cheek junction does not actually descend with age.

How can there be such a lack of consensus regarding the anatomical cause, and behavior over time, of such important landmarks? Palpation of the tear trough and lid/cheek junction in the upright patient makes one thing clear: the explanation for their existence has nothing to do with the orbital rim or the arcus marginalis. The tear trough and lid/cheek junction extend well below the orbital rim.

Given the diversity of anatomical explanations, it is not surprising that numerous and often conflicting surgical and injectable procedures have been described as treatments for the tear trough deformity and the lid/cheek junction. Treatments for the tear trough include alloplastic implants, release of the orbicularis oculi muscle origin, transposition of pedicled orbital fat, grafting of fat by injection, and injection of other materials such as hyaluronic acid fillers.1,2,7,17,19–25 Proposed treatments for the deepening lid/cheek junction are even more diverse and include midface lifting, redraping, and cephalic traction on the orbicularis muscle; transposition of pedicled orbital fat; and injection of either fat or other materials.14–17,19,23–29 In addition, traditional treatment for orbital fat herniation, namely, orbital fat excision, may disguise the tear trough deformity and the lid/cheek junction interface to some extent.

The anatomical study reported in this article was designed to answer the following question: What exactly are the tear trough and lid/cheek junction, from an anatomical point of view? After answering this primary question, it was hoped that the following questions might be addressed secondarily: Why do these external landmarks become more obvious with age? In which anatomical plane is surgical intervention most likely to succeed? Which of the procedures heretofore described to correct the tear trough and deepening lid/cheek junction make the most anatomical sense?

**METHODS**

Twelve fresh cadaver lower lid and midface dissections were performed (six heads; three male, three female cadavers). The ages of the cadavers were noted, the anatomical components of the region were examined, and photographs were taken. A representative cadaver is shown in Figure 2.

Dissection was performed carefully, layer by layer, to evaluate whether there were multiple anatomical contributions to the overlying surface...
anatomy. Attention was directed to the thickness of the skin, the amount of subcutaneous fat, the origin and configuration of the orbicularis oculi muscle, and the attachments between the orbicularis oculi muscle and the underlying bone.

RESULTS

All cadavers were older than 50 years. There was no distinction between the anatomy of the tear trough and the adjacent lid/cheek junction in the subcutaneous plane. Rather, they were continuous and correlated in every case with the junction between the palpebral (or preseptal) and orbital portions of the orbicularis oculi muscle.

Additional features contributed to the visibility of these landmarks. The skin overlying the palpebral orbicularis (eyelid skin) was thin, with no subcutaneous fat. The skin over the orbital orbicularis (cheek skin), in contrast, was thicker and was separated from the underlying orbicularis muscle by the malar fat pad. The cephalic border of the malar fat pad was located, in every case, precisely at the junction of the palpebral and orbital portions of the orbicularis oculi muscle (Fig. 3).

The tear trough, and the underlying anatomical features that explain it, begin at the medial canthus and extend inferolaterally away from the orbital rim, terminating 4 to 6 mm caudal to the arcus marginalis at the orbital rim. The gap between the orbital portion of the orbicularis and the levator labii superioris alaeque nasi muscle, thought by some to explain the tear trough, was always inferomedial to the tear trough and did not contribute to the overlying surface anatomy (Figs. 4 and 5).

Although the anatomy of the tear trough and its lateral continuation, the lid/cheek junction, were identical in the subcutaneous plane, this was not the case deep to the orbicularis muscle. Along the tear trough, there was no dissectible anatomical plane deep to the orbicularis. Rather, the pal-

![Fig. 3. Subcutaneous anatomy of the tear trough and lid/cheek junction. The cephalic border of the malar fat pad corresponds precisely with the tear trough medially (black arrow) and the lid/cheek groove laterally (double white arrow). The palpebral portion of the orbicularis (single white arrow) lacked overlying fat and the reflected eyelid skin was thin (far left).](image-url)

![Fig. 4. Subcutaneous anatomy with malar fat reflected. The malar fat pad (single white arrow) has been reflected laterally, exposing the junction of the palpebral and orbital components of the orbicularis oculi muscle, which precisely corresponded to the tear trough deformity (black arrow) and the lid/cheek groove (double white arrow).](image-url)

![Fig. 5. Relationship between the orbicularis oculi muscle and the levator labii superioris alaeque nasi muscle. In no case did the tear trough deformity (white arrow) correlate with the junction between the orbicularis oculi and the levator labii superioris alaeque nasi (black arrow).](image-url)
The palpebral portion of the orbicularis was rigidly attached to the maxilla where it takes origin (Fig. 6). Laterally, however, along the lid/cheek junction, the attachment between the orbicularis muscle and the underlying bone was ligamentous (the orbicularis retaining ligament). In this region, there was a dissectible plane deep to the orbicularis muscle.

The orbicularis retaining ligament was attached to the underlying zygoma caudal to the arcus marginalis at the orbital rim (Fig. 7). The orbicularis retaining ligament was furthest from the rim in the midpupillary line (4 to 6 mm) and terminated closer to the rim near the lateral canthus (2 to 4 mm). To repeat, the orbicularis retaining ligament did not arise from the infraorbital rim but, like the cutaneous landmark overlying it, was several millimeters caudal to the rim.

Finally, attenuation of the orbital septum accompanied by orbital fat herniation was transmitted through the relatively lax palpebral orbicularis, further accentuating the tear trough. This was especially evident medially, where the strong orbital orbicularis attachments originate. Table 1 summarizes the findings, comparing the tear trough anatomy to the lid/cheek junction anatomy. Figures 8 through 11 illustrate these findings.

**DISCUSSION**

The anatomical features that explain the external landmarks known as the tear trough and lid/cheek junction exist in three different planes: at the skin level, at the subcutaneous plane, and at the suborbicularis plane. In the subcutaneous plane, the tear trough and lid/cheek junction correlate with the junction of the palpebral and orbital portions of the orbicularis muscle. Along the tear trough, there tends to be a particularly obvious cleft between the two portions of the orbicularis muscle. In addition, there is virtually no fat between the skin and the muscular junction, accounting for its visibility as a cutaneous landmark. Further contributing to external visibility is the fact that the eyelid skin above the landmark and the cheek skin below the landmark have distinctly different textures and thicknesses. In addition, the malar fat pad begins precisely at the same muscular junction, providing further definition.

In the suborbicularis plane, the tear trough and the lid/cheek junction differ. Along the tear trough, the palpebral portion of the orbicularis oculi muscle is rigidly attached to the bone, with no dissectible anatomical plane deep to the muscle. It was not technically possible to dissect above the periosteum and below the muscular attachment. Along the lid/cheek junction, however, the orbicularis muscle has a ligamentous attachment to the bone by means of the orbicularis retaining ligament. Unlike the tear trough region, there is a plane deep to the muscle into which material can be injected or surgical dissection performed. Although there appeared to be one main orbicularis retaining ligament, there were several weaker ligamentous attachments between the orbital rim and the attachment of the main orbicularis retaining ligament.
Flowers described a set of factors contributing to the formation of the tear trough deformity, including (1) descent of the cheek with the junction of cheek skin and eyelid skin occurring at a lower point than usual; (2) a muscular defect between the orbicularis muscle and angular head of the quadratus labii superioris muscle; (3) underdevelopment of the suborbital malar complex (hemioexophthalmos); and (4) a progressive loss of facial fat with age. Flowers focused his efforts on developing alloplastic implants designed to fill varying degrees of tissue inadequacy.1 In a related observation, Freeman noticed that the formation of the nasojugal deformity was associated with the inferior migration of the sub–orbicularis oculi fat pad.21,22

Loeb described three theoretical malformations that cause what he termed the nasojugal groove. These include (1) fixation of the orbital septum at the level of the inferomedial portion of the arcus marginalis; (2) the existence of a triangular gap limited by the lateral portion of the angular muscle on one side and the medial portion of the orbicularis oculi muscle on the other;
and (3) the absence of fat tissue from the central and medial fat pads subjacent to the orbicularis oculi muscle in the area below the groove. Loeb also noted that this natural sulcus may be inconspicuous until neighboring fat pads grow and exaggerate the defect. To manage these spatial derangements, Loeb described a number of treatment options, including (1) transplant of free fat grafts; (2) sliding fat from the medial and central hypertrophic fat pads; and (3) liposuction of excess fat on the cheek region.

According to Codner and Ford, the tear trough deformity overlies the muscular triangle formed by the orbicularis oculi, the levator labii superioris, and the levator alaque nasi muscles. They also point out that, with age, there is postseptal fat herniation and prezygomatic fat ptosis that accentuates the defect. Barton et al. referred to the tear trough triad: (1) herniation of orbital fat, (2) tight attachment of the orbicularis along the arcus marginalis, and (3) malar retraction.

Regarding the issue of apparent descent of the lid/cheek junction, Lambros has pointed out that the lid/cheek junction is in fact stable over time and the perception of descent is related to age related tissue contrasts and not actual movement. Much of the apparent descent is attributable to herniation of the orbital fat following orbital septal and preseptal orbicularis oculi muscle attenuation. These shadows exaggerate the tear trough deformity and palpebromalar groove. Furthermore, skin atrophy leads to darkening of the preseptal skin, causing an increase in contrast and therefore an accentuated lid/cheek junction. Our study suggests that the tear trough deformity is not related to facial “descent,” the arcus marginalis, the orbital rim, or the junction of the levator labii superioris alaeque nasi muscle and the orbicularis oculi muscle.

In patients with a deep tear trough combined with a deep lid/cheek junction, the two landmarks form a near continuous indentation several millimeters below the infraorbital rim. Muzaffar et al. described the anatomy of the lateral lower eyelid, specifically focusing on the orbicularis retaining ligament. Our findings were consistent with these observations with the exception that the orbicu-
The traditional treatment for the bulging eyelid fat is fat resection. In recent years, some authors have recommended limiting or avoiding eyelid fat removal, but controversy remains over the benefits of fat mobilization and repositioning. Various methods of fat restoration have been proposed.

In an attempt to soften the orbital rim, Hamra described an extension of Loeb’s technique, in which the arcus marginalis is released and the herniated fat is draped over the entire length of the orbital rim and secured to the periosteum. Barton et al. and Eder reproduced this technique. Goldberg suggested a benefit of repositioning the fat in the subperiosteal location with a decreased chance of a visible demarcation. Kawamoto and Bradley found that dissection through the subperiosteal suborbicularis plane was possible and noticed that in comparison to the subperiosteal plane there was better filling of the nasojugal groove. Our study does suggest that any fat transposition procedures would have to include release of the orbicularis retaining ligament and medial orbicularis muscle and placement of the fat at least as far below the rim as those attachments.

Hester et al. introduced the concept of transpalpebral midface lifting to treat “descent” of the lid/cheek junction. They originally used a subciliary incision but modified the technique in favor of a lateral endoscopic approach because of lower eyelid complications. Alternative less invasive approaches to ablate the tear trough deformity have been developed. Coleman applied a lipostructure fat transplantation technique to fill the defect and others have attempted similar techniques of tissue injection and combined traditional blepharoplasty with fat grafting. Kane injected hyaluronic acid (Restylane; Q-Med, Uppsala, Sweden) superficially to elevate the surface from the orbitomalar ligament and add volume to the trough, whereas Lambros describes injection in the orbicularis oculi muscle or at the periosteum to correct the tear trough deformity.

It is appealing to design surgical procedures that are physiologic (i.e., that seem to reverse the process that created the deformities they are correcting). For example, transposition of fat over the orbital rim often improves the tear trough, but it is not physiologic. The procedure is not returning fat to the place it originated. The ideal and most physiologic treatment for these landmarks would appear to be in the superficial plane between the skin and the underlying muscle. The problem is that the skin is extremely thin and interventions in this plane may leave contour irregularities. Midface lifting may improve the appearance of the lower orbit in some patients, but it is not physiologic either; that is, the lid/cheek junction does not descend so lifting it is less appealing. As aesthetic surgeons, however, our interventions need not be physiologic, provided they work. Injection of fat grafts or synthetic fillers may be more safely placed in a deeper plane, although it is less physiologic and has only an indirect effect on the external landmarks. Along the lid/cheek junction, the material (fat or filler) can be injected deep to the orbicularis muscle. Along the tear trough, however, it is important to appreciate that there is no plane deep to the muscle. Any attempts to place fat or filler deep to the muscle along the tear trough are probably, in actuality, placing the material within the muscular origin of the orbicularis.

CONCLUSIONS

Our study suggests that the tear trough deformity is not related to facial descent, the arcus marginalis, the orbital rim, or the junction of the levator labii superioris alaeque nasi muscle and the orbicularis oculi muscle. The tear trough and lid/cheek junction extend significantly below the orbital rim and are explained primarily by anatomical features in the subcutaneous plane. Specifically, these landmarks overlie the junction between the palpebral and orbital portions of the orbicularis oculi muscle and are made more obvious by the absence of subcutaneous fat, a difference in skin quality, and the presence of the malar fat pad whose cephalic border is immediately caudal to the lid/cheek junction and the tear trough. The two landmarks differ in their attachment to the bone. Along the tear trough, the muscle is...
rigidly attached to the bone. Along the lid/cheek junction, the orbicularis retaining ligament attaches the muscle to the bone. The anatomical findings in this study have led to the following secondary conclusions/impressions:

1. Atrophy of the skin and underlying subcutaneous fat is the most likely explanation for the increasing visibility of the tear trough and lid/cheek junction with age.
2. It is unlikely that there is age-related descent of these structures because they are fixed to the bone.
3. Because descent is not an etiologic factor, midface lifting (a significant procedure with complications) may not be the best solution.
4. Any surgical intervention aimed at correction of the tear trough and lid/cheek junction must extend significantly below the infraorbital rim because these deformities extend at least 4 mm below the arcus marginalis at the rim.
5. Although the cause is atrophy, especially of fat, injection of material above the muscle is fraught with hazard. Injected fat frequently does not resorb and is difficult to remove without creating a greater deformity. There may be a role for the injection of filler in this superficial plane, but we have no experience with that procedure. It seems likely that the filler would also be visible or cause discoloration.
6. Treatment may be best directed to the suborbicularis plane in the case of the lid/cheek junction and intraorbicularis plane in the case of the tear trough, not because it is a physiologic correction but because the treatment is less likely to result in a visible deformity. The term “intraorbicularis” plane is used to emphasize that there is no plane deep to the muscle in the tear trough into which to inject anything.

Charles H. Thorne, M.D.
Institute of Reconstructive Plastic Surgery
New York University Medical Center
TH 169, 550 First Avenue
New York, N.Y. 10016

REFERENCES