

**TITLE: Management of the Aging Upper Face**  
**SOURCE: Grand Rounds Presentation, UTMB, Dept. of Otolaryngology**  
**DATE: December 5, 2001**  
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## **Introduction**

The upper one third of the face encompasses the brow, eyelids, and orbit traditionally. More recently the rejuvenation of this portion of the face has been extended to include the area of the midface inferior to the lower lid which when adversely affected is referred to as the tear trough deformity or nasal jugal line. When looking at this region and the changes afforded through the acts of time and gravity it is useful to address the entire area, but also subdivide the regions into the management of the brow and upper eyelid, and the lower eyelid and midface. While surgical techniques for the upper eyelid have remained relatively unchanged new techniques have recently been developed for the management of the brow. Additionally, aging changes of the lower eyelids has been completely reevaluated in the last 10 years leading to new concepts in both surgical management of the lower eyelid as well as the midfacial fatty tissue. The anatomic considerations for the different areas of the upper face will first be discussed followed by aesthetic considerations and then techniques of rejuvenation.

## **Brow Anatomy**

The brow, which is defined as the region from the frontal hairline to the glabella, is in intimate relation to the upper eyelid. These two anatomically separate but interrelated regions must be considered together when analyzing the aging face. The brow anatomically may be divided into three compartments a central compartment and two temporal compartments. The layers of the forehead and scalp region are skin, subcutaneous tissues, aponeurosis, loose areolar tissue, and periosteum, easily remembered by the acronym SCALP. The aponeurosis or galea aponeurosis is the connecting band between the bellies of the frontalis and occipital muscles. With contraction of

these muscles the scalp slides back and forth on the loose areolar plane. Laterally the galea thins and becomes incorporated into the superficial temporal fascia (STF) a.k.a. temporal parietal fascia.<sup>1</sup> This is probably the anatomic equivalent of the superficial musculoaponeurotic system (SMAS) of the lower 2/3 of the face although anatomic studies recently have found no connection between the STF and the SMAS across the level of the zygomatic arch.<sup>2</sup>

The lateral compartment fascial layers have importance with regard to the level of the frontal branch of the facial nerve. In the supra-zygomatic area the temporal fascia consists of three layers, the superficial temporal fascia (STF) (a.k.a. temporal-parietal fascia, or SMAS), and the deep temporal fascia (DTF) which separates into superficial and deep layers as it progresses inferiorly at about the level of the superior helix. Between the superficial and deep layers of the DTF lies the superficial temporal fat pad, and deep to the deep fascial layer lies the temporalis muscle. The superficial layer of the DTF inserts onto the lateral aspect of the zygoma and the deep layer onto the medial aspect of the zygoma. Inferior to the zygoma the zygomatic branch of the facial nerve is deep to the SMAS and as it courses anteriorly it courses deep to the orbicularis oculi. The frontal branch is present at the same level inferior to the zygoma, as it progresses superiorly it comes in close approximation to the zygomatic arch. If approached at this level the lateral periosteum of the arch, which is the superficial layer of the DTF, must be elevated to protect the nerve. It continues in this plane between the STF and the superficial layer of the DTF until it passes into the central forehead compartment deep to the frontalis muscle. Elevating the superficial layer of the DTF superior to the zygoma protects the nerve, which is elevated with the fascia.<sup>3,4</sup> The superficial temporal fat pad need not and be elevated to protect the nerve and if performed may lead to temporal wasting.

The central compartment contains the muscles of facial expression to be addressed by the brow lift including the frontalis, occipital, corrugator supercillus, and procerus. The frontalis muscle is the only elevator of the brow and is responsible for the horizontal furrows of the forehead. The corrugator, procerus, and orbicularis all depress the brow; the corrugator causes the vertical glabellar lines, the procerus the horizontal glabellar lines, and the orbicularis the lateral orbital “crows feet”. The main neurovascular supply to the forehead courses within this compartment. The supratrochlear and supraorbital nerve branches of V<sub>1</sub> and the accompanying vasculature emerge from within the orbit in a sub-periosteal plane and pierce the periosteum at the level of the orbital rim. They then course over and through the corrugator and procerus and deep to the orbicularis to eventually lie in a plane just superficial to the frontalis muscle

## **Eyelid Anatomy**

The orbicularis oculi forms the transition from the brow into the upper eyelid and circumscribes the eye. It is divided into the orbital, the portion overlying the bony orbit, and the palpebral portions, that overlying the globe. The palpebral portion is further divided into the pretarsal and preseptal portions. Deep to the palpebral orbicularis lies the tarsal plate and the orbital septum respectively. The orbital septum divides the lid into anterior and posterior lamella.<sup>5</sup> The anterior lamella consists of skin and orbicularis muscle and the posterior lamella of conjunctiva and upper or lower lid retractors respectively. Some consider the orbital septum and tarsus to be the middle lamella.<sup>4</sup> The septum originates at the bony orbital rims as a confluence of the periosteum of the orbital rims and the periorbita called the arcus marginalis. In the upper lid the septum does not

extend over the upper surface of the tarsus, but is readily found as a thin membrane 10 mm or more above the lid margin inserting on the upper lid retractors. In the lower lid, the septum is attached to the inferior edge of the tarsus. In the upper lid the tarsus is 8-10 mm in height and in the lower lid is only 4-5 mm in height.

Deep to the septum is the preaponeurotic fat, which is an excellent landmark for both the depressors and elevators of the lids. The upper lid has two fat pads: nasal (medial) and middle (central) with the temporal (lateral) compartment being occupied by the lacrimal gland. The middle is the largest. The lower lid has three fat pads, medial (nasal), central, and lateral (temporal). The inferior oblique muscle separates the medial and central compartments. The medial compartment in both the upper and lower lids contains a denser, whiter fat. The amount of fat is genetic and is not altered by body habitus. The deepest layer of the lid is the conjunctiva. The lower lid retractors are densely adherent to the conjunctiva and are routinely transected in lower lid transconjunctival approaches. In the upper lid the levator must not be injured or ptosis will result.<sup>6</sup>

## **Mid-face/Sub-Orbicularis Oculi Fat Pad (SOOF) Anatomy**

The midface extends from the lower eyelid to a horizontal line through the oral commissure. Mimetic musculature important to midfacial position and contour are the orbicularis oculi (OO), levator labii superioris alaque nasi (LLSAN), levator labii superioris (LLS), zygomaticus major (Zma) and minor (Zmi), and levator anguli oris (LAO). These muscles originate from periosteal insertions over the maxilla or zygoma. The suborbicularis oculi fat (SOOF) begins at the lower border immediately deep to the OO and surrounds and engulfs the bodies of the LLSAN, LLS, ZMa, and ZMi. At the level of the nasolabial crease, the LLS, ZMa, and ZMi pierce the SOOF to insert into the dermis. The SOOF and its surrounding fascia is in continuity with the SMAS.

## **Analysis of Brow and Upper Eyelid Aesthetic Unit**

Patients may present with a variety of concerns regarding the brow and upper eyelid. The major indications for intervention include decreased visual acuity from sagging eyelid skin documented by improvement with brow elevation, visual field deficit, asthenopsia which is the feeling of heaviness and fatigue caused by the eyelid skin resting on the upper eyelashes, eyelid reconstruction using upper eyelid skin as a donor site, or cosmesis.<sup>7</sup> The evaluation should include a thorough history and physical examination including testing of visual acuity, evaluation for Bell's phenomenon, testing for lagophthalmos, seventh nerve function, corneal sensitivity, extraocular muscle function, lid ptosis, and lacrimal gland function.<sup>8</sup> Photodocumentation is a must.

The ideal aesthetic position of the eyebrow is classically described as follows:

- 1) The brow begins medially at a vertical line drawn perpendicular through the alar base.
- 2) The brow terminates laterally at an oblique line drawn through the lateral canthus of the eye and the alar base
- 3) The medial and lateral ends of the eyebrow lie at approximately the same horizontal level.
- 4) The medial end of the eyebrow is club shaped, and this gradually tapers down laterally.
- 5) The apex of the brow lies on a vertical line drawn directly through the lateral limbus of the eye.

- 6) Although the brow arches above the supraorbital rim in women, it lies approximately at the level of the rim in men.<sup>9</sup>

Additional considerations regarding the brow must be given to the presence of hyperkinetic or dynamic facial lines which are present with mimetic action, but absent at rest, unlike wrinkles which are caused by age related laxity of the skin. Hyperdynamic facial lines may be addressed with the use of botulinum toxin whereas wrinkles must be addressed surgically or with skin resurfacing techniques. Chronic hyperfunction of the corrugator muscle however can lead to hypertrophy and persistent glabellar furrows which while not oriented gravitationally, will not be wholly responsive to botulinum and may require surgical correction. Brow position and eyelid excess should be evaluated with the brow in the relaxed position. Some individuals chronically elevate the brow involuntarily and must be relaxed by gentle downward pressure. Additionally, position of the hairline and any anticipation of baldness should be considered and will affect operative decisions to be discussed later.

When evaluating the upper lid the cause of the aesthetic problem may be related to excess skin, muscle, pseudoherniation of fat, or ptotic lacrimal gland. Upper lid skin and muscle redundancy is termed blepharochalasis. Several sources define the different terms blepharochalasis and dermatochalasis, but there is no agreement, and in fact the sources are contradictory.<sup>5,7,8</sup> I believe that most practitioners use these terms interchangeably. The point to be made is that redundant lid may contain excess skin or muscle, but usually both. Note should also be made as to the presence of herniated orbital fat and its location, especially of the medial fat pad that can be accentuated by downward gaze and gentle pressure on the globe. The skin texture, pigmentation, location of the palpebral fissures in relation to the cornea, and any skin lesions should also be noted. Additionally, the lacrimal gland should be palpated and its size, location, and any amount of ptosis noted.<sup>8</sup>

## **Operative Decisions and Techniques**

Operative decisions for the brow and upper eyelid must be interdependent to afford the best results. While many surgeons will quote that upper blepharoplasty without addressing the brow will lead to worsening brow ptosis, this statement was addressed and found to be incorrect.<sup>9</sup> Regardless, to achieve the best cosmetic result both the brow and the lid should be addressed. The general technique of upper lid blepharoplasty is relatively consistent only varying in the amount of skin or muscle removed, whether or not fat is removed, and variability in the need to address a ptotic lacrimal gland or other patient specific factors. Many different approaches are available to elevate the brow however. The following will relate to bilateral functional or aesthetic brow elevation and will not discuss unilateral procedures such as in facial nerve rehabilitation.

The possible approaches to brow elevation include the internal browpexy, direct browpexy, mid-forehead, pretrichial, coronal, or endoscopic. The internal browpexy is performed through the upper blepharoplasty incision in which the dissection is extended superiorly over the superior orbital rim for correction of laxity in the lateral third of the brow only. The direct incision technique involves skin excision in the forehead crease just above the eyebrow. The lower incision must be performed parallel to and just at the superior border of the brow hair follicles to prevent damage and brow alopecia with resultant reduced scar camouflage. This technique may be useful in elderly

patients with deep furrows over the brows or for functional elevation. The advantages are that it allows precise brow elevation, with minimal edema or ecchymosis. Disadvantages are that the incision is difficult to camouflage, the depressor muscles are not addressed and so the brow may descend with time and it can distort existing forehead furrows. The mid-brow incision is placed in an existing horizontal furrow. Dissection is subcutaneous so as to not damage the sensory neurovascular bundle and suspension is made from the upper orbicularis to the periosteum of the upper incision. Patients to be considered for the technique are mainly older men with deep horizontal furrows and male pattern baldness.

The advantages are selective skin excision with precise brow elevation; disadvantage is that the incision may leave an obvious scar in an area not easily camouflaged. The two most popular of the open techniques for aesthetic brow elevation are the pretrichial and coronal incisions. The pretrichial is made in the soft hairs at the anterior hairline beveled from a posterior to anterior direction to avoid the hair follicles. The dissection is carried out in a subgaleal plane and the corrugator and procerus muscles may be transected. The brow is then elevated, the anterior skin is excised, and the wound closed. This incision is good for females with thick hair especially if worn over the frontal hairline. It is not a good choice in males due to the high chance of a receding frontal hairline. The advantages of the incision are of good scar camouflage, direct access to forehead muscles and that it does not raise the frontal hairline and may even lower it. The disadvantages are scalp anesthesia behind the incision, noticeable scar if not performed correctly and technically more challenging.

The last open technique is the coronal in which the incision parallels the frontal hairline 5-7 cm back. The dissection is the same as for the pretrichial incision. This is arguably the “gold standard” of the open approaches for females except in those with high frontal hairlines, although that is controversial and many accomplished surgeons use the pretrichial incision in females almost exclusively with excellent results. It once again is not ideal for males due to male pattern baldness. The advantages are that the incision is hidden in the hairline and there is good exposure to the forehead muscles. The disadvantages are that the frontal hairline is elevated and there is anesthesia posterior to the incision.<sup>10</sup>

Over the last 8-10 years the endoscopic technique to brow elevation has been introduced and has gained in popularity. The main controversy in endoscopic techniques revolves around fixation techniques and longevity of the procedure. The technique is performed through 3-4 incisions placed in the hair immediately posterior to the frontal hairline. The dissection may be subgaleal, but more popularly subperiosteally. The entire scalp must be elevated from the insertion of the occipital muscle posteriorly to and over the superior brow. This must be done because this procedure involves no excision of skin, but is rather a repositioning of the entire scalp in order to elevate the brow. Both the lateral and medial compartments are elevated taking care to elevate the frontal branch of the facial nerve.

At the superior orbital rim the periosteum is incised and released, a myectomy is performed of the corrugator and if desired procerus muscle taking care to identify the supraorbital and supratrochlear neurovascular bundles and preserve them. Once the dissection is complete the scalp is fixed in the new position. Controversy exists as to the method of fixation such as titanium or absorbable screws, suture, or bone tunnels. Rabbit studies of periosteal refixation after elevation

have shown that it requires 8 to 12 weeks for complete adherence to occur.<sup>11</sup> Additionally, reports of recurrent ptosis following removal of fixation at 2 weeks have led to longer fixation methods being used.

Whichever method of fixation is chosen, stability for at least 8 weeks to 12 weeks may be needed, however, human study confirmation of this is not present. The advantages of the endoscopic technique are mainly related to scar camouflage. It is the procedure of choice for men, and more and more surgeons are expanding and using the technique more frequently. The disadvantages include the need for special instrumentation and technical challenge. Additionally, the longevity of the procedure has been questioned. However, early one and two year outcomes are favorable and longer outcome studies are pending.

### **Analysis of Lower Eyelid and Midface Aesthetic Unit**

Traditionally lower eyelid aging was thought to be only due to weakening of the orbital septum with orbital fat pseudoherniation. In the 1990's, the aesthetic changes of the lower lid and midface began to be evaluated as an aesthetic unit as with the brow and upper eyelid. While many surgeons still routinely perform transcutaneous, or more commonly, transconjunctival lower lid blepharoplasty and orbital fat removal with good results, the long term effects of this procedure and the hollowing bony appearance of the lower orbit have come under scrutiny. This has led to the creation of procedures designed to address the midface area. With aging, the anatomic changes of the lower eyelid and malar area show a skeletonization or orbitalization as the patient enters the fourth decade that continues progressively. In youth, the appearance of the orbits shows no signs of underlying bony landmarks. The youthful contour of the eyelid-cheek complex is a single convex line running from the tarsus inferiorly over the young cheek.

Normally, there is no obvious underlying bony landmark such as the infraorbital rim. The youthful composition of the skin, orbicularis oculi muscle, and orbital fat appears almost as one unit. With progressive aging, the underlying anatomic landmarks become more separate and obvious. The patient who never had evidence of extra subseptal orbital fat will progressively demonstrate a contour deformity, since the aging septum orbitale allows the fat to bulge above the fixed orbital rim, giving the contour of the aging midface a double convexity. The small initial convexity of the orbital fat joins the fixed infraorbital rim, followed by a larger convexity over the aging ptotic cheek tissues, transforming the youthful single convexity to an aging double-convex pattern.<sup>12</sup> This second convexity is termed the nasojugal deformity or tear trough deformity. In conventional blepharoplasty with orbital fat removal the superior convexity is softened, but nothing is done to correct the gravitational changes on the orbicularis muscle or the malar fat pad. Over time this leads to a hollowing and skeletonized appearance of the lower lid that is dissatisfying to both surgeon and patient.

Additional considerations of particular importance to the lower lid are location and quantity of orbital fat. While with newer techniques orbital fat is less often excised it is still important to quantify the fat content, especially the lateral fat compartments. This can be best visualized on upward gaze. The lateral canthal angle should be assessed as well as any rounding of the lids, and scleral show. The degree of horizontal laxity of the lid and skin quality must be assessed to determine whether concomitant horizontal tightening or skin resurfacing should be considered. The

snap test and distraction test are useful in the preoperative identification of patients with lower eyelid laxity. The distraction test is performed by grasping the lower eyelid and pulling it anteriorly away from the globe. If the lower eyelid can be pulled more than 7 mm from the globe, the distraction test is positive, and horizontal laxity exists. The snap test is performed by pulling the lower eyelid inferiorly. If the eyelid does not spontaneously return to its normal anatomic position before the next blink, the snap test is positive, which signifies that the eyelid has diminished tone.<sup>4</sup>

## **Operative Decisions and Techniques**

One major debate over the years has been whether blepharoplasty should be performed via a transcutaneous or transconjunctival incision. The reasoning for transcutaneous dissection was that skin and muscle could be excised with the incision. However, with the transcutaneous approach came an increased risk of ectropion from excess skin and muscle excision or vertical lid deficiency from scarring of the middle lamella to the lower lid retractors. This led to increase popularity of the transconjunctival approach with either a skin pinch technique for removal of excess lower lid skin or concomitant laser/chemical resurfacing. The details of each procedure will not be discussed, but with either minimizing damage to the orbital septum and conservatism will lessen the likelihood of ectropion and vertical contracture. If the lid has shown laxity preoperatively inferior lateral canthal tendon lysis and repositioning or canthal tendon plication should be considered.<sup>4</sup>

Due to the tear trough deformity discussed earlier several new approaches to the lower eyelid have been developed. These new approaches involve two concepts: 1) fat sparing blepharoplasty, and 2) repositioning of the SOOF and orbicularis muscle to its youthful more superior position to camouflage the inferior orbital rim while improving the nasolabial angle and cheek fat pad. Two fat sparing techniques have been developed: 1) fat sparing surgery in which the herniated orbital fat is returned to the orbit and the lax orbital septum is strengthened much like abdominal hernia surgery, and 2) fat-sparing techniques in which the orbital fat is not removed but repositioned to fill periorbital depressions. The later technique is probably the more popular and may be performed via a transconjunctival or subciliary approach. Regardless of the approach an attempt is made to perform the dissection in a preseptal plane. Once the orbital rim is encountered the arcus marginalis is incised broadly to expose all three compartments of orbital fat. The orbital fat and septum are then transposed over the inferior orbital rim and secured.<sup>13,14</sup>

Two basic techniques have been developed to reposition the SOOF: 1) subperiosteal dissection and 2) supraperiosteal dissection. While this is an oversimplification based on the number of techniques described it essentially encompasses the various techniques. The subperiosteal approach introduced by Tessier, continues to gain popularity. The periosteum functions as a platform to elevate the malar soft tissue. As in all subperiosteal face-lifts, the origins of the zygomaticus muscles are included in the subperiosteal flap and are advanced upward. The authors state that a canthotomy and formal canthoplasty are almost always done. Because the origins of the zygomaticus major and minor muscles are repositioned upward on the zygoma, the intermalar distance is necessarily increased in every patient. The second dissection plane used to elevate the orbicularis is the suborbicularis plane.<sup>14</sup> Several minor modifications of this plane have been developed depending on the author. Hamra has described the elevation of the orbicularis as a part of the “composite rhytidectomy” in which he combines a deep plane face-lift with a supraperiosteal dissection. He performs his deep plane dissection in the standard fashion overlying the zygomaticus

major and minor muscles and then overlaps this with the superior suborbicularis dissection without connecting the two planes. The entire cheek, neck, midface complex is then rotated superiorly as a composite flap.<sup>14</sup>

## Summary

Evaluation of the aging face has been ongoing for many years. While the affects of gravity remain constant our understanding of its influences on the appearance of age verses youth are constantly changing. In chorus, the anatomy of the face is constant, but our understanding of the interactions of the soft tissue layer of the face continues to evolve. Addition of advances in instrumentation, chemical, and laser technology adds to the armamentarium of possible interventions to delay the affects of time. However, surgery of the forehead and periorbital area continues to be an anatomical, analytical, and technical challenge that should continue to be so for the foreseeable future.

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