Techniques in
Cosmetic Surgery

Upper Blepharoplasty with Bony Anatomical Landmarks to Avoid Injury to Trochlea and Superior Oblique Muscle Tendon with Fat Resection

Bradon J. Wilhelmi, M.D., Arian Mowlavi, M.D., and Michael W. Neumeister, M.D.

Springfield, Ill.

The trochlea and superior oblique muscle tendon separate the medial and central fat compartments in the upper lid. The purpose of this study was to determine anatomical landmarks to predict the location of and avoid injuring the trochlea and superior oblique muscle tendon with orbital fat resection during upper blepharoplasty. The trochlea and superior oblique muscle tendon were identified in 14 cadaver heads. Bony anatomical landmarks were identified to predict the oblique vector along which the trochlea and superior oblique tendon lie. The trochlea was measured in millimeters from the palpable superior orbital foramen. The oblique course of the superior oblique muscle tendon was measured from its medial location in the lateral direction in millimeters from the frontozygomatic suture. These measurements were obtained with 4.0-power loupe magnification. The trochlea was identified 10.0 ± 0.9 mm inferior to the palpable superior orbital foramen. The superior oblique muscle tendon coursed laterally along an oblique vector to within 1 mm of the frontozygomatic suture for all 14 dissections. The vertical vector of the superior orbital foramen was measured 15.9 ± 1.1 mm lateral to the medial canthus. The width of the bony orbit measured 42.2 ± 1.6 mm. In two dissections, the superior orbital foramen could not be palpated, and the latter measurements were used to predict the superior orbital foramen. This anatomical study showed that when performing orbital fat resection with upper blepharoplasty, the trochlea and superior oblique muscle tendon can be identified and avoided with the above-described bony landmarks. (*Plast. Reconstr. Surg.* 108: 2137, 2001.)

"The eyes are the windows of the soul" and are probably the most viewed structure of the face when interacting with others, so the appearance of the eyelids can be very influential in conveying our emotions, overall health, and age. Since the description of upper-lid skin excision by Ambroise Paré in 1678, which stressed the importance of avoiding overresection, the upper eyelid has received much attention in the literature.[1] Sichel,[2] in 1844, was the first to describe herniated orbital fat, and Merkel[3] (1874) recognized that bulging of periorbital fat occurred because of orbital septal atrophy. The term blepharoplasty was first coined by Von Graiefe[4] in 1815, but it was not until 1908 when a book devoted to cosmetic surgery was published, and it even contained illustrations on the excision of wrinkled eyelid skin.[5]

The upper blepharoplasty procedure has become a popular and generally safe means of facial rejuvenation. Often, resection of excess fat is required as a component of the procedure of upper blepharoplasty. The two fat compartments deep to the orbital septum in the upper eyelid, the medial and central, are separated by the trochlea and superior oblique muscle tendon.[6,7] Two techniques are used to perform fat resection with upper blepharoplasty. One approach involves incising across the entire orbital septum to access the two fat compartments. The second technique involves making two separate smaller incisions in the

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orbital septum over each isolated compartment. This demands sound knowledge of upper-lid and orbital anatomy in predicting where to make these incisions in the opaque orbital septum to approach the two fat compartments without injuring the trochlea or superior oblique muscle tendon. Injury to the trochlea and superior oblique tendon may result in diplopia, pain, head tilt, and asymmetry. Accurate knowledge of bony landmarks to predict the course of the trochlea and superior oblique muscle tendon could facilitate the approach to the upper-lid fat compartments.

Methods

The trochlea and superior oblique muscle tendon were identified in 14 cadaver heads. Bony anatomical landmarks were identified to predict the location of the trochlea and superior oblique muscle tendon. The trochlea was measured in millimeters from the palpable superior orbital foramen (Fig. 1, *above*). The oblique course of the superior oblique muscle tendon was measured from its medial location at the level of the medial orbit in the lateral direction in millimeters from the frontozygomatic suture (Fig. 1, *below*). These measurements were obtained with 4.0-power loupe magnification.

Results

The trochlea was identified 10.0 ± 0.9 mm inferior to the palpable superior orbital foramen (Fig. 2, *above*). The superior oblique muscle tendon coursed laterally along an oblique vector to the frontozygomatic suture within 1 mm for all 14 dissections. The vertical vector of the superior orbital foramen was measured 15.9 ± 1.1 mm lateral to the medial canthus (Fig. 2, *below*). The width of the bony orbit measured 42.2 ± 1.6 mm. In two dissections the superior orbital foramen could not be palpated, and the latter measurements were used to predict the location of the superior orbital foramen.

Discussion

Upper-lid blepharoplasty usually involves the resection of excess or herniated fat. The two fat compartments can be accessed by an incision across the width of the orbital septum or by small separate orbital incisions directly over the two fat compartments. Of the two fat compartments, which are separated by the trochlea and superior oblique tendon, the medial compartment contains fat that is lighter in color and has larger and more abundant vessels.[8] The central fat is a darker yellow and is less vascular. When approaching the upper-lid fat with either technique, using the above-described bony landmarks can help avoid injury to the trochlea and superior oblique muscle tendon. To avoid injury to the trochlea and superior oblique tendon, the small, separate orbital septal incisions should be placed on either aspect of the oblique vector extending from 10 mm inferior to the superior orbital foramen to the frontozygomatic suture (Fig. 2, *above*). When the superior orbital foramen is not palpable, it can be predicted by the dis-

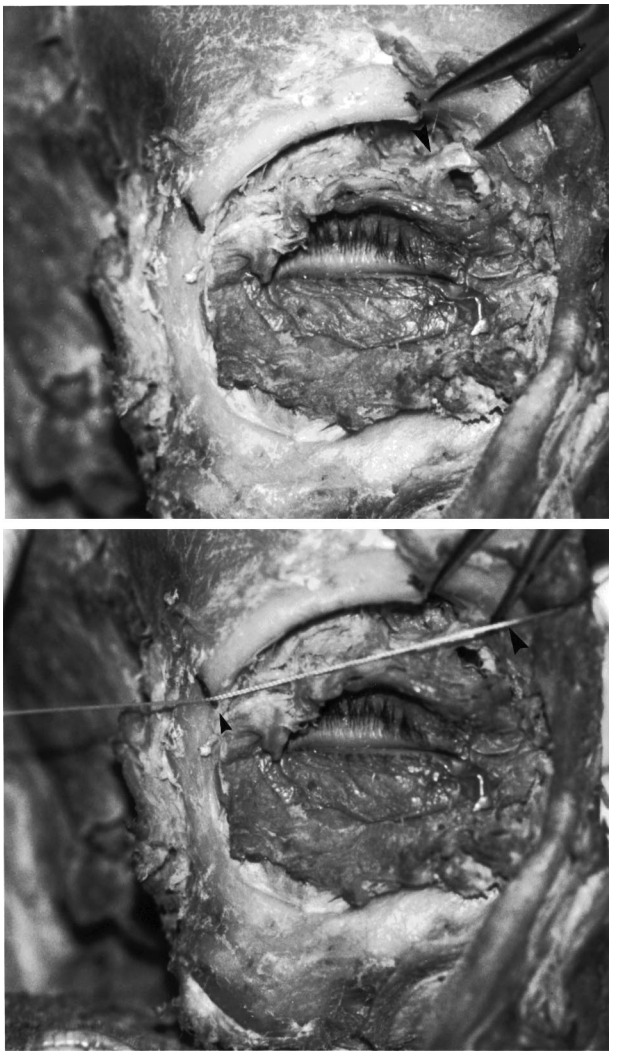

Fig. 1. (*Above*) The right orbit demonstrates the trochlea (*arrowhead*), measured approximately 10 mm (or 1 cm) from the palpable superior orbital foramen. (*Below*) The oblique course of the superior oblique muscle tendon was measured from its medial location (*large arrowhead*) at the level of the medial orbit in the lateral direction in millimeters from the frontozygomatic suture (*small arrowhead*).

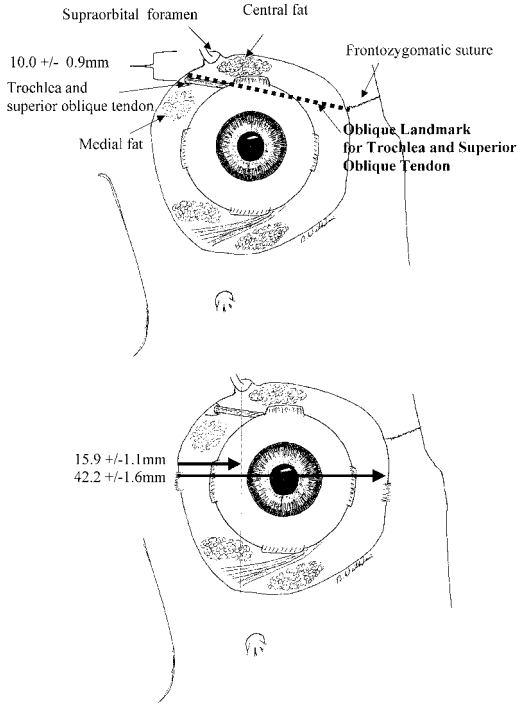

FIG. 2. (*Above*) The trochlea was identified 10.0 ± 0.9 mm inferior to the palpable superior orbital foramen (approximately 1 cm). The superior oblique muscle tendon coursed laterally along an oblique vector to the frontozygomatic suture within 1 mm for all 14 dissections. The vertical vector of the superior orbital foramen was measured 15.9 ± 1.1 mm lateral to the medial canthus. (*Below*) The vertical vector of the superior orbital foramen was measured 15.9 ± 1.1 mm lateral to the medial canthus. The width of the bony orbit measured 42.2 ± 1.6 mm. If the superior orbital foramen is not palpable, the trochlea can be located by measuring 15.9 mm lateral to the medial canthus and marking a point on the superior orbital foramen; 10 mm inferior to this point predicts the approximate location of the trochlea.

tance of 15.9 mm from the medial edge of the orbit. Then the trochlea can be identified 10 mm inferior to this point (Fig. 2, *below*).

The superior oblique muscle originates from the sphenoid lesser wing above and medial to the annulus.[9] From this origin, the superior oblique muscle courses anteriorly and superiorly for 40 mm closely applied to the superomedial orbital wall. Beneath and separating the superior oblique muscle from the medial rectus muscle are the terminal branches of the nasociliary nerve and the ophthalmic artery. The muscle then passes through the trochlea as a tendon and makes a 45-degree angle to continue posteriorly, laterally, and inferiorly to the eye (Fig. 2, *above*). The tendon begins 10 mm behind the globe and narrows to 1 to 2 mm as it passes through the trochlea. Early along this oblique course after passing through the trochlea, the muscle is in its most anterior and vulnerable position. The reflected tendon passes underneath the superior rectus and fans out to insert on the posterior lateral surface of the globe. Generally, this insertion is 10 to 11 mm long along a posterior, lateral convex line. The superior oblique muscle depresses, intorts, and abducts the eye.

The trochlea is situated in a shallow fossa bearing its name on the anteromedial orbital roof. A crescent-shaped cartilage is suspended from the periorbita on either end by fibrous pillars. The central fibers of the reflected tendon exhibit few adhesions to neighboring fibers, whereas those peripheral in the tendon are loosely related to the fibers of the tendon.[10] Located between the cartilage and the tendon is a bursa-like structure, which, presumably, reduces friction. The cartilage is a U-shaped ring with a grooved flange that supports the reflected tendon posteriorly and laterally from the front of the trochlea.[11] The periorbita to which the trochlea is attached can be carefully elevated from the bone by the surgeon and replaced with variable detrimental effect on superior oblique muscle function.

The medial fat pad lies within the confines of the medial canthal tendon inferiorly, the superior oblique tendon superolaterally, the levator aponeurosis laterally, and the frontal bone medially. The central fat pad is bordered by the superior oblique tendon medially, the lacrimal gland laterally, the levator aponeurosis inferiorly, and the frontal bone superiorly.

Ocular motility disturbances due to extraocular muscle injuries have been described following blepharoplasty.[12–27] The extraocular muscles subject to injury include the superior oblique, inferior oblique, superior rectus, and inferior rectus muscles. The superior oblique muscle can be injured because of its relatively superficial position in its anatomical location. During teasing of the upper-lid fat through the two orbital septal incisions, the superior oblique muscle can be inadvertently crushed, attenuated, teased through the septum, and even excised. Resecting only the bulging fat resting anterior to the septum can prevent injury to the superior oblique muscle and the trochlea. The superior oblique muscle never bulges anterior to the orbital septum if there is no pressure on the orbit and no traction on the fat.

The muscle can be injured when the stumps of excised fat are cauterized.[13] Specifically, the

clamp-and-cauterize technique of fat resection is associated with injuries to the superior oblique muscle and trochlea. On clamp removal, inadequately cauterized vessels retract and bleed deep within the fat compartment. Blind cauterization in the attempt to control bleeding is one of the most common causes of superior oblique muscle or trochlea injury.

Entrapment of the superior oblique tendon has also been described with closure of the orbital septum in blepharoplasty.[22] Partial muscle injuries usually heal without residual deformity shortly after the operation. Again, complete resection of the muscle during the course of blepharoplasty is not unknown. This can be suggested by persistent postoperative diplopia, pain, asymmetry, head tilt toward the injured side, chin depression, and a tendency to close one eye to eliminate diplopia.[13]

CONCLUSIONS

The trochlea and superior oblique muscle tendon separate the medial and central fat compartments. The trochlea and superior oblique tendon can be predicted by the oblique vector extending from 1 cm inferior to the supraorbital foramen to the frontozygomatic suture (Fig. 2, *above*). By knowing the exact location of the trochlea and superior oblique tendon, fat resection from the medial and central compartments of the upper lid can be performed easily and safely.

Bradon J. Wilhelmi, M.D.
Southern Illinois University School of Medicine
Division of Plastic Surgery
Plastic Surgery Institute
747 No. Rutledge
P.O. Box 19653
Springfield, Ill. 62794-9653
bwilhelmi@siumed.edu

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