The Septal Pulley in Frontalis Suspension

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- We present a modification of the frontalis suspension for blepharoptosis, first described in 1937, that eliminates many of the drawbacks of traditional brow suspension techniques. Functional and cosmetic problems with standard suspension procedures are related to the superficial location of the sling in the eyelid, which leads to unsatisfactory geometric tenting of the pretarsal and pre-septal skin, obliteration of the lid crease, and a pulling away of the upper lid from the globe with brow elevation. Eyelid height is also limited by the upper lid being pulled away from the globe. By anchoring the suspensory material behind the superior orbital septum near the arcus marginalis, more physiologic vectors of elevation are transmitted to the upper eyelid. This modification has yielded good cosmetic and functional results in 96 cases of frontalis suspension using both autogenous and alloplastic materials, and it deserves to be more widely used.

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Due to increased knowledge of eyelid anatomy, particularly regarding the levator aponeurosis and Whitnall's ligament, aponeurotic ptosis surgery has become the most common procedure for blepharoptosis. Even some congenital ptosis cases with poor levator function can be adequately corrected with maximal aponeurosis resection ("Whitnall's sling" procedure) or maximum levator resection. Thus, frontalis suspension procedures are progressively more reserved for severe ptosis cases with minimal levator function or synkinetic ptosis.

Frontalis suspension procedures often result in suboptimal cosmetic appearance and eyelid function. The geometric outlines of the suspensory material beneath the thin upper-eyelid skin are unacceptable in some patients and obliterate, rather than help form, a lid crease. With maximum brow elevation, the upper eyelids may be pulled away from the globe because of the abnormal vector of elevating force on the lid.

Hildreth first reported this frontalis suspension technique, and later Hildreth and Silver reported a modification whereby the sling was positioned posteriorly to the entire orbital septum. M. Quickert, MD, also advocated this principle, but he modified the technique by anchoring the suspensory material superiorly near the arcus marginalis where the septum fuses with the periosteum (oral communication, 1974). Unfortunately, these concepts have not been widely accepted, and the technique involved with the operation has not been adequately described. We have used a modification of Hildreth's technique in 96 patients, with follow-up ranging from six months to ten years (mean follow-up, 3.5 years), with good results. The aforementioned problems of frontalis suspension have been minimized with this technique.

REPORT OF CASES

Case 1.—A boy had severe bilateral congenital blepharoptosis corrected by frontalis suspension at age 4 years. The frontalis suspension was performed in a standard fashion using autogenous fascia lata. The patient had adequate postoperative lid heights and no evidence of amblyopia.

The patient was referred to us at age 13 years for evaluation of further correction. He was most bothered by the "popping out" of his left upper eyelid when raising his eyebrow, as shown in Fig 1. His palpebral fissures measured 5 mm vertically, and there was 2 mm of levator function bilaterally. Although he could widen his fissures to 7 mm with moderate brow elevation, the patient was reluctant to use his brows due to the annoying sound and popping-out sensation of his left upper eyelid. This abnormal lid position in elevation was also a source of embarrassment to him. This patient is presented as an example of severely abnormal eyelid elevation that can occur with standard frontalis suspension techniques. The parents did not desire a resuspension procedure, so a modification of his existing sling was performed.

Case 2.—A 3-year-old girl with blepharophimosis had severe bilateral congenital blepharoptosis with 3 mm of levator function. Her palpebral fissures measured 2 mm vertically and 16 mm horizontally, as shown in Fig 2. Her eyelid reconstructions were performed in two stages. First, she had bilateral medial canthoplasties for correction of epicanthus inversus. Five months later, a septal-pulley autogenous fascia-lata frontalis suspension was performed bilaterally. She is shown two months postoperatively in Fig 3.

SURGICAL TECHNIQUE

Autogenous fascia lata is our material of choice, when available, for frontalis suspension. When alloplastic materials are used (usually in newborns and infants to prevent amblyopia), a simple pentagon configuration is utilized, but the same...
principles of fixation behind the orbital septum are applied.

Autogenous fascia lata is harvested in a standard fashion using a fascia stripper. The fascia lata strip, cleaned of its fatty attachments, is divided longitudinally into four equal strips, measuring approximately 2 mm in width, and stored in saline-soaked gauze. Gentian violet is used to mark the incision sites in a modified double-triangle Crawford technique, as shown in Fig 4. A 4-0 silk lid-traction suture may be placed to put the eyelid and septum stretch. The lid-margin incisions are approximately 2.0 mm in length and located 2.0 to 3.0 mm above the cilia. Three such incisions, each equally spaced and situated, are made in the medial three fourths of the lid. The most lateral incision is placed just outside the temporal limbus. The incisions are placed more medially than usually described, resulting in a more natural eyelid contour with the highest point of the eyelid just nasal to the pupil. Two brow incisions are made immediately above the brow cilia medially and laterally to the lid incisions. A third brow incision is made 5 mm above and centered between the first two brow incisions. The stab lid incisions are made down to the anterior tarsal surface and the brow incisions down to the frontal bone periosteum.

A Wright needle is passed through the medial brow incision down to the periosteum. The needle is then passed in the submuscular plane anteriorly to the periosteum and inferiorly to the orbital rim. After palpating the tip and confirming a location well superior to the globe, the needle is rotated vertically and carefully directed posteriorly immediately inferior to the supraorbital rim. After rotating the needle vertically, it is very important to direct the needle tip in a posterosuperior direction, rather than in a posteroinferior direction, to avoid the possibility of penetrating the globe should the needle tip penetrate too deeply.

A “pop” is usually felt when the needle punctures the orbital septum near the arcus marginalis. The needle tip is then directed inferoanteriorly toward the medial eyelid incision, exiting the septum at approximately its junction with the levator aponeurosis. This exit is at the level of a natural lid crease and helps form the crease (rather than obliterate it when the fascia is placed more anteriorly). It is again mandatory to palpate the tip of the needle during this maneuver.

Staying posterior to the orbicularis muscle and immediately anterior to tarsal plate, the needle is brought out through the medial lid-margin incision. The fascia lata strip is placed in the eye of the needle, and both are pulled out through the medial brow incision. The needle is introduced into the middle lid incision, passed over the anterior tarsal surface, and exited through the medial lid-margin incision. The fascia is placed into the needle eye; the needle and fascia are then withdrawn from the middle incision.

The Wright needle is then passed from the same brow incision in a like manner,
only exiting at the middle lid incision. The fascia is placed into the eye and the needle is again withdrawn, thus completing a base-down triangle of fascia in the medial eyelid. A similar lateral triangle of fascia lata is placed using the lateral brow incision and lateral and middle eyelid incisions. Again, care must be taken in engaging the orbital septum at the arcus marginalis during the vertical passages. The strips of fascia lata are usually tied under considerable tension with a square knot reinforced with a surrounding 5-0 polyglaclin 910 suture. The inner arm of each fascial knot is left long, and the Wright needle is used to pull each long inner arm of the fascial knot submuscularly to exit through the superior central brow incision, creating a third fascial triangle with its apex centrally located above the brow. These two fascial strips are again tied and secured by a surrounding 5-0 polyglaclin 910 suture. The fascial tails of each knot are cut into 5-mm lengths; each tail is then deposited under the frontalis muscle in a horizontal fashion to prevent unraveling and to further utilize frontalis muscle function. The brow incisions are closed with 6-0 nylon or mild chromic, interrupted, vertical mattress sutures. The lid incisions seldom require closure. This triple triangular configuration maximally uses frontalis action and allows three places to adjust eyelid height and contour.

COMMENT

Standard frontalis suspension procedures have an inherent nonphysiologic design that can lead to predictable functional and cosmetic deformities. Normally, the elevating-force vector of the levator muscle on the upper eyelid is superior-posterior. This is due to the pulley effect of Whitnall’s ligament, which diverts the anteroposterior contractile force of the levator muscle to a more superior-posterior direction, as shown in Fig 5.

The physiologic eyelid elevating-force vector is altered in a standard frontalis suspension in which the sling is passed relatively superficially from the brow into the anterior eyelid layers. Here the brow transmits a superior and, frequently, an anteroposterior elevating force to the upper eyelid (Fig 6, left). The force vector from the brow to the anterior eyelid can occasionally cause the upper lid to be pulled away from the globe, as demonstrated in case 1. This pulling presents an even greater problem in patients (especially male patients) with prominent brows or deep-set eyes. In attempting to avoid this pulling away of the upper eyelid by using standard frontalis suspension procedures, many surgeons just tighten the sling until the lid begins to pull away.

Fig 4.—Geometric configuration of subcutaneous suspensory material. Bases of both triangles are displaced medially to create more natural lid contour. Arrows indicate where sling is posterior to orbital septum.

Fig 5.—Physiologic superior-posterior elevating-force vector (arrow) of levator muscle on upper eyelid. Whitnall’s ligament acts as pulley, changing direction of levator action to more posterosuperior direction.
from the globe. This technique not only results in undercorrection of the patient’s ptosis, but it still may not rectify the pulling away problem that can occur with brow elevation.

By passing the sling posterior to the orbital septum near the arcus marginalis, the resulting pulley effect causes the lid to follow a more natural backward arc when the brow is elevated (Fig 6, right). In addition, the sling is tethered more posteriorly, thus avoiding the vertical tension lines in the thin upper-eyelid skin and obliteration of the lid crease.

Hildreth first conceived placing the suspensory material behind the septum to direct the elevating force more posteriorly, thus avoiding the lifting of the eyelid away from the globe “as a hat is raised.” This technique was revitalized by Hildreth and Silver in 1970, but it was not widely utilized due to concerns that the suspensory material might adhere to the septum and leave the upper eyelid at a “frozen” level. While these concerns might be valid theoretically, in practice neither we nor other surgeons using this technique have observed this problem. The upper eyelid’s vertical and range of motions have not been decreased from the standard technique without septal engagement. In fact, the upper eyelid can be placed at a higher level because the lid is not pulled away from the globe. The amount of lagophthalmos and incidence of exposure keratopathy have not increased using the septal pulley technique and, in fact, the eyelid better apposes the globe than when “hung from the brow.” We have not directed more closely postoperative cases to see if there are septal tears or tracts that allow for the lack of restriction.

Aside from the aforementioned potential late complications, possible intraoperative complications include globe penetration, orbital hemorrhage, or injury to the superior oblique muscle. With proper precautions and technique, these problems can be avoided, and thus far none have occurred in our experience. Late infections of nonautogenous suspensory materials could conceivably occur in the orbital space with a septal pulley technique. However, in those cases where alloplastic slings have become infected and extruded, there was no evidence of orbital cellulitis.

In summary, the septal pulley in frontalis suspension offers the following advantages over traditional brow suspension techniques: (1) it minimizes skin tension lines; (2) it eliminates the pulling away of the upper eyelid from the globe with brow elevation; and (3) it facilitates, rather than obliterates, lid crease formation. Thus, this technique deserves better exposure and utilization.

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References