Options in Repositioning the Asymmetric Brow from Paralysis and Trauma

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Abstract

Brow asymmetry is a relatively common occurrence, especially in the facial plastic surgeon’s office. In this article, the authors review causes of brow asymmetry, pertinent anatomy, and a litany of treatment options including nonsurgical and surgical approaches. They offer an algorithm that summarizes the various techniques for management with the goal of tailoring treatment tactics to the individual patient’s needs.

Keywords
► brow ptosis
► brow lift
► brow asymmetry
► facial nerve paralysis

Brow asymmetry is a relatively common occurrence. MacDonald et al reported that in 100 patients being evaluated for upper blepharoplasty, 93% had asymmetric brow positioning of greater than 1 mm, 75% with greater than 2 mm of asymmetry, and 37% with asymmetry greater than 3 mm.1 Brow asymmetry can lead to asymmetric upper eyelid appearance, visual field deficits especially in the superolateral gaze, and significant depressed quality of life when associated with facial nerve paralysis.2

Subtle differences in eyebrow position are readily detected. Hohman et al found that 23% of those surveyed could detect eyebrow asymmetry as low as 1 mm with an increase up to 97% at 6 mm of asymmetry.3 Asymmetric faces tend to be misinterpreted by observers. In a study comparing pictures of patients with normal facial movement to patients with paralyzed faces, observers were significantly more likely to associate pictures of paralyzed faces with negative affect, even when the paralyzed patient is smiling.4 In another study, involving 88 patients with facial paralysis, 42% screened positive for depression and were significantly more likely to have lower self-reported attractiveness, mood, and quality of life scores.2 These studies highlight the psychological challenges these patients encounter when interacting with others and the importance of treating brow asymmetry to improve quality of life.

Brow asymmetry can be due to a variety of etiologies. Hyperkinesis of unilateral frontalis muscle may cause asymmetric brow elevation. Similarly, hyperactive depressor supercili muscle or orbicularis oculi muscle may lead to brow depression. Because brow asymmetry is common in patients undergoing assessment for upper blepharoplasty, it is important to recognize this phenomenon preoperatively as performing only upper blepharoplasty in these patients will further exacerbate existing brow asymmetry.1

Another cause of brow asymmetry is from injury to the temporal branch of the facial nerve.5 If the facial nerve trunk itself is injured, all the distal ipsilateral branches will be affected, and the asymmetric brow may be just a part of unilateral facial paralysis. Diagnosis and management of facial nerve dysfunction are outside the scope of this article. However, one must always rule out neurovascular injuries, such as a stroke as well as gross cancer involvement of the facial nerve in the parotid or the temporal bone, as the underlying causes of paralysis.

Anatomy

To treat an asymmetric brow, one must understand basic brow anatomy and aesthetics. The brow position is affected by the brow depressor muscles (corrugator supercili,
depressor supercili, orbicularis oculi, and procerus) and the brow elevator muscle (frontalis). In females, the ideal brow lies just above the supraorbital rim while in males the ideal brow sits directly at the rim. The preferred arch of the female brow is ever-evolving and has varied between peaking at the lateral limbus to as lateral as the lateral canthus (Fig. 1). In contrast, the male brow has little to no arch (Fig. 2). The ideal distance from the upper edge of the eyebrow to the anterior hairline is 5 to 6 cm.

Branches of the facial nerve supply motor innervation to the brow elevator and depressor muscles. The temporal branch innervates the frontalis, the superior orbicularis oculi, the transverse head of the corrugator supercilii, and the superior part of the procerus. The zygomatic branch innervates the inferior and medial orbicularis oculi, the inferior part of the procerus, the depressor supercili, and the oblique head of the corrugator supercilii. When a patient has unilateral facial paralysis, the intact frontalis muscle on the opposite side can become hyperactive, exaggerating brow asymmetry. This is thought to occur from brow ptosis on one side leading the intact side to compensate with the continuous recruitment of the intact frontalis muscle. This can be targeted with neurectomy, myotomy, or a neuromodulating agent to counteract compensatory hyperactivity. Correcting the brow ptosis on the paralyzed side also diminishes frontalis hyperactivity on the nerve intact side, highlighting the importance of treating both sides of the face when addressing brow asymmetry in select patients.

The temporal branch of the facial nerve plays a significant role in brow positioning; its course should be recognized to avoid iatrogenic injury. After the facial nerve trunk exits the stylomastoid foramen, its upper and lower branches form the pes anserinus, with the upper branch transversing superficially to the distal portion of the parotid gland. At the level of the zygoma, it is located halfway between the lateral canthus and the tragus and continues superiorly toward the lateral border of the frontalis muscle innervating the muscle deep to it. In the temporal region, the nerve travels immediately deep to the temporoparietal fascia (TPF). Beneath the TPF lies the loose areolar plane. Deep to the areolar plane, the deep temporalis fascia (DTF) covers the underlying temporalis muscle and splits into a deep and a superficial layer. Superiorly, these two layers join with the frontoparietal periosteum to form the temporal line (Fig. 3). This temporal line is released in an endoscopic brow lift to allow full mobilization of the brow and forehead. To avoid injury to the temporal nerve, it is critical to stay immediately superficial to the DTF when dissecting anterior to the tragus in the temple region. Another useful landmark that runs near the temporal nerve is the sentinel vein, located along the lateral margin of the forehead.

Along the supraorbital rim, the supraorbital and supratrochlear neurovascular bundles exit from the skull in the subperiosteal plane. These should be protected to preserve brow and scalp sensation. The arcus marginalis is a periosteal attachment around the periorbital region. For proper brow repositioning, the arcus marginalis should be incised or fully released to allow for full mobility and elevation.

**Treatment Approaches**

A surgeon should document before and after repair photographs with the patient’s brow in various positions, including at rest with eyes closed and eyes open, while frowning, and while raising bilateral brows. Often, patients may be unaware of one’s brow asymmetry, especially with unilateral hyperkinesis. As such, it is best to demonstrate the dynamic nature of the patient’s brow by comparing when the patient’s frontalis muscle is relaxed and activated. Having the patient close their eyes before reopening with the brow descended will help reveal the full extent of brow ptosis and asymmetry.
It is important to set realistic patient expectations, including the potential need for additional procedures to optimize cosmesis and function.

When evaluating a patient with asymmetric brow, several factors should be considered. First and foremost, one should ensure that the asymmetric brow is not the result of urgent conditions, such as stroke or malignancy that require immediate evaluation. Once such conditions have been ruled out, next is to assess the urgency of treatment intervention.

When there is dysfunction of other facial nerve branches, especially the upper branches that control periorcular muscles, one must be mindful of periorbital complications associated with the asymmetric brow. Preventing exposure keratopathy with proper eye protection, artificial tears, and optimizing eyelid closure takes precedence in management over brow asymmetry. Although outside the scope of this article, when there is clinically significant lagophthalmos, aggressive treatment with artificial tears and early placement of a gold or platinum weight is recommended even in temporary paralysis since the weight implant can be removed easily once the facial nerve function returns. Brow correction can be delayed or staged while a clinically significant lagophthalmos should be addressed immediately to prevent vision compromise. Tarsorrhaphy suture placement is another effective option for protecting the cornea by closing the eyelids shut but has the disadvantages of obscuring vision and unsightly cosmesis. To avoid tarsorrhaphy, Ellis and Daniell described a technique of injecting five units of botulinum toxin to the levator palpebrae superioris muscle to cause intentional ptosis of the eyelid with successful avoidance of tarsorrhaphy.\(^9\) There were reports of some patients with temporary diplopia. If there is a concurrent upper lid retraction, this should be addressed before lid loading by using graduated mullerotomy, levator recession, or myotomy with or without a spacer. These procedures are more permanent and may not be ideal for patients with temporary facial nerve paralysis.\(^9\) Lower eyelid laxity can result from orbicularis oculi paralysis and cause ectropion and epiphora as the lower lid can no longer contain overflowing tears. Several authors have reported successful outcomes with concurrent brow lift and periorbital reconstructive procedures.\(^10\)–\(^12\) We thus advocate for performing adjunctive periorbital procedures at the time of brow correction to minimize the number of surgeries a patient must undergo.

In patients with normal facial nerve function bilaterally, one may consider targeting the hyperkinetic eyebrow muscles either through botulinum toxin injection, selective neurectomy, or conventional surgical methods to elevate brows with consideration of concurrent selective myectomy or myolysis procedures.

In patients with abnormal facial nerve function, initial compensatory hyperactivity of the frontalis muscle can diminish once the paralyzed brow is in an improved position. Traditionally, only the paralyzed brow was treated. However, some authors now recommend treating both brows especially if there is ptosis already present on the nerve intact side as in the elderly population to reestablish bilateral brows into ideal position and shape.\(^12\) In young patients with optimized brow position on the nerve intact side, the goal is to reposition the depressed brow to match the intact side.

In patients with facial nerve injury, the timing of surgery and treatment methods should be individualized according to the underlying cause of paralysis, duration of paralysis, and temporary versus permanent nature of paralysis. Addressing brow asymmetry in patients with temporary facial nerve dysfunction should involve temporary options, such as botulinum toxin injections to hyperkinetic muscles. In cases of idiopathic Bell’s palsy, patients may benefit from antiviral and/or steroid therapy.\(^13\)–\(^14\) In patients with traumatic facial nerve injury, an attempt can be made to perform direct nerve repair or cable nerve grafting to optimize nerve recovery. In cases of complete nerve transection, the best functional outcome that can be expected is a House–Brackmann score of 3. Deferring definitive correction of brow asymmetry for 6 to 12 months after injury is reasonable to assess for final brow position while awaiting any nerve recovery. Patients with permanent facial nerve paralysis from onologic resections of parotid or skull base tumors should have earlier reconstructive procedures (3–6 months postradiation therapy if there is no malignancy recurrence). These patients may still benefit from early gold weight placement before the radiation therapy, which can be performed even at the time of initial cancer resection.
Treatment Methods

There is a variety of options for repair of the asymmetric brow. One must consider factors, such as whether other facial reconstructive procedures are planned, the degree of asymmetry, the patient’s hairline, how to fixate the brow (Fig. 4 and 5), and whether to treat one or both sides. In general, if the patient’s nonparalyzed brow also has ptosis, we recommend treating both sides. Minimal asymmetry (<2 mm) can be corrected with botulinum injection or a transblepharoplasty approach brow lift if the patient would also benefit from concurrent upper blepharoplasty (Fig. 4). For a more significant lift, a wide range of brow lift procedures are available and should be tailored to the individual based on consideration of forehead skin redundancy, presence/absence of forehead creases, anterior hairline position, and presence/absence of male pattern baldness (Fig. 6). No one technique is universally ideal. Thus, a surgeon should be well versed in a breadth of procedures.

Botulinum Toxin

If the degree of asymmetry is minimal, one may consider botulinum toxin injection. Botulinum toxin is a neuromuscular junction blocking agent with extensive use in cosmetic and medical conditions. It offers a nonsurgical treatment modality for ptotic brows and hyperactive brows. It can be used in conjunction with surgical procedures to maximize lift and has few side effects. Its effects are temporary, so it is ideal for patients with unknown facial nerve prognosis. Results are achieved around 2 weeks after injection and last about 3 months. Repeat injections may be required.

The targeted muscles vary as per the patient’s condition. One can target either the brow depressors on the affected side, the hyperactive frontalis on the unaffected side, or both (Fig. 7). This must be balanced with the loss of facial expression and occasional upper lid ptosis with subsequent visual field obstruction that can be seen with excessive frontalis targeting.

An isolated injury to the temporal branch of the facial nerve, which results in paralysis of frontalis muscle with intact innervation to the orbicularis oculi and depressor supercili, will lead to unopposed eyebrow depression. In this situation, treatment of the brow depressors on the affected side will elevate the brow. Ahn et al report their technique of injecting the superolateral portion of the orbicularis oculi in the lateral third of the brow. Care is taken to inject outside the orbital rim and not too deep to avoid diffusion into the orbit, lateral rectus (which can cause diplopia), or levator palpebrae superioris (which can cause lid ptosis). In their update in 2002, they increased their dosage to 16 to 20 units to achieve improved elevation. The authors noted an average of 1.0-mm lift in the mid-pupillary region and an average of 4.8-mm lift in the lateral canthus region.

Olson reported his technique of injecting botulinum toxin bilaterally but asymmetrically to achieve a more symmetric eyebrow appearance. In patients with abnormal regeneration of the facial nerve with resulting asymmetric eyebrow elevation, the frontalis muscle was targeted on the side with the elevated brow, and the depressor supercili or orbicularis oculi muscles were targeted on the depressed side. For patients undergoing brow lift surgery, Olson also suggested preoperative botulinum injection to relax the antagonist brow depressor that will allow the tissue to heal at a higher position postoperatively.

While good results can be achieved with botulinum toxin injections, most agree that it is limited by its temporary effects as well as unpredictability in results. It is frequently

![Fig. 4](https://example.com/fig4.png)  
Fig. 4  Treatment algorithm for patients with mild asymmetry (1–2 mm difference).
offered as a temporizing measure before definitive surgical repair or as an adjunct to surgical repair to either improve lift and/or target synkinesis. Botulinum toxin is a useful tool in treating patients with mild brow asymmetry due to hyperkinesis. However, if the patient has paralysis of all brow muscles as seen in patients with extensive facial nerve injuries, injecting these muscles will not be of much benefit as hyperkinesis is not the underlying cause of brow asymmetry.

**Surgical Treatment Options**

**Selective Neurectomy**

Selective neurectomy of a hyperkinetic frontalis may provide a more permanent solution compared with botulinum injection. One to two distal branches of the temporal branch of the facial nerve that innervate the frontalis muscle are identified with a percutaneous nerve stimulator. A regional nerve block can be performed with a local anesthetic to assess the efficacy of these distal branches. Once the surgeon determines that these branches are adequate for neurectomy, a percutaneous incision overlying the nerve can be used to transect the nerve. One drawback of this approach is that...
the transected nerve may unpredictably reinnervate resulting in frontalis reactivation. The surest method to prevent this is to resect the lateral edge of the frontalis muscle, although this essentially denervates the entire ipsilateral frontalis muscle. We feel that by correcting bilateral ptotic brows, hyperactivation of the frontalis to correct brow ptosis will lessen. With botulinum injections as an adjunct for any residual hyperkinesis, the neurectomy procedure may not be necessary.

Direct Brow Lift
The direct brow lift involves excising skin along the superior margin of the brow. This procedure can be performed under local anesthesia. The desired brow position and planned excision area should be marked preoperatively with the patient in upright position. A slight overcorrection of 1 to 2 mm is recommended to account for some descent in brow positioning over time. Lidocaine (1%) with 1:100,000 epinephrine can be injected into the region after marking. The inferior incision is designed just superior to the brow hairs (Fig. 8). The surgeon excises the desired amount of skin while remaining no deeper than the subcutaneous fat to preserve motor and sensory nerves. Subcutaneous dissection is performed along the inferior incision to allow for adequate brow release. No dissection is performed along the superior incision to act as an anchoring point. The inferior skin flap is then secured to the periosteum of the superior incision margin with sutures. The deep dermis and skin layers are closed in a layered fashion.

The direct brow lift is ideal for patients with sufficient brow hairs to hide the incision line as this technique’s main disadvantage is a visible scar along the upper margin of the brow. Advantages include precise repositioning of the brow and no alteration of the hairline, thus making it an ideal approach in patients with bald or high receding hairlines. Paresthesia and numbness in the perioperative region are a common complication (27.5–60% reported), but patients typically are not bothered by it.

Midforehead Brow Lift
The midforehead indirect brow lift is performed through an incision based off an existing deep rhytid. The patient is marked preoperatively in an upright position. The planned incision is marked around a deep rhytid with the removal of excess skin to elevate the brow to the desired position. Lidocaine (1%) with 1:100,000 epinephrine is injected. Once the incision is made down to the subcutaneous plane, dissection remains superficial to the frontalis and periorbital muscles and proceeds inferiorly to the level of the supraorbital rim. One should be mindful of the supraorbital and supratrochlear nerves, which can be avoided by remaining within the subcutaneous plane. The inferior skin flap is then suspended to the periosteum of the superior incision margin to lift the brow. The incision is then closed in layers.
This approach has the advantage of an unchanged hairline and hiding the incision in preexisting rhytids, thus providing a more cosmetically discreet scar. However, its scar may heal unpredictably and is not recommended in patients who do not already have deep forehead creases, such as younger patients. Forehead paresthesia is a complication of this approach.

**Transblepharoplasty Approach for Brow Lift**

The advantages of this approach include a nearly imperceptible scar hidden in the traditional blepharoplasty incision. It is ideal for patients who have a balding or thinning hairline as it does not affect the hairline and in those who would benefit from concurrent upper blepharoplasty. Forehead paresthesia can occur from supraorbital and supratrochlear nerve dissection. The main disadvantage is that since no excess skin is removed, the degree of brow elevation is relatively minor (2–3 mm) compared with that of other techniques.

While the patient is sitting up, lift the affected depressed brow into the desired position. Mark along the brow where the fixation suture will be placed intraoperatively. Then mark the upper blepharoplasty incision and the desired upper eyelid excision. Standard upper blepharoplasty is performed. Suborbicularis dissection is then performed along the lateral eyelid toward the supraorbital rim superficial to the periorium. Subgaleal dissection is performed along the medial and lateral brow. If desired, dissection can continue superiorly to the hairline, posterolaterally to the temporal line, and medially to the midforehead. The periostium is kept intact to act as an anchoring point. Once the suborbicularis dissection is complete, if there is lateral eyebrow descent, the lateral orbicularis oculi muscle is divided. Similarly, the corrugator muscle, procerus muscle, and depressor supercili can be accessed and divided if there is a notable medial brow depression. Langsden et al advocate for the muscle division (myolysis) instead of muscle resection (myectomy) as it may leave undesirable skin dimpling and contour deformities.

Next, the skin–orbicularis flap is secured with sutures to the periostium in the desired fixation point above the supraorbital rim, usually 1 to 2 cm superior to the supraorbital rim. It is important to avoid placing the fixation sutures too close to the skin to avoid undesirable skin dimpling. The upper blepharoplasty incision is then closed in standard fashion.

Several variations of this technique have been described. Pascali et al and Cohen et al describe using an Endotine device (Coapt Systems, Inc.) that can be drilled superior to the supraorbital rim at the midbrow point that suspends the periostium and soft tissue flaps. The authors advocate using the Endotine to avoid issues that can arise from the use of fixation sutures. Paul describes another variant that involves subperiostial dissection above the supraorbital rim by incising through the periostium up to the level of the hairline. A separate scalp incision is made behind the hairline, and the subperiostial dissection plane is connected inferiorly to the transblepharoplasty incision. This technique allows full mobilization of the forehead, scalp, and the brow.

**Bicoronal Brow Lift**

The bicoronal brow lift is the classic "gold standard technique" for open brow lift procedures. It provides excellent exposure and hides the incision in the hairline when performed on the appropriate patient. Because of the wide exposure, myotomy or myectomy to the corrugator, procerus, depressor supercili, and frontalis muscle can be performed concurrently to address forehead furrows. However, there are several disadvantages to this approach, including elevation of the anterior hairline. Thus, the bicoronal brow lift should be avoided in patients with a high hairline or balding hair pattern. In this technique, scalp paresthesia is common. Also, alopecia can occur along the incision line.

A curvilinear incision is designed from ear to ear posterior to the hairline near the vertex. Lidocaine (1%) with 1:100,000 epinephrine is injected along the incision to optimize hemostasis. The surgeon uses a scalpel down to the subgaleal or subperiosteal plane while beveling the knife to parallel the hair follicles to minimize the risk of alopecia. The decision to remain subgaleal or subperiosteal is surgeon dependent. In the temporal region, the temporal branch of the facial nerve should be protected by remaining immediately superficial to the DTF by dissecting deep to the loose areolar tissue located deep to the TPF. Some will advocate incising through the superficial layer of the DTF to remain one fascial layer deeper to DTF; however, dissecting in this plane can lead to undesirable temporal hollowing associated with temporal fat pad atrophy.

Bilateral temporal dissection planes should be connected to the central scalp dissection by releasing attachments along the superior temporal line. If the central scalp pocket was raised in the subperiosteal plane, the bilateral temporal scalp flaps are connected to the central scalp flap in the subperiosteal plane where dissection continues to the supraorbital rim. Supraorbital and supratrochlear neurovascular bundles can be seen when dissecting in the subperiosteal plane. If the central scalp flap was raised in the subgaleal plane, bilateral temporal flaps are similarly connected along the superior temporal line. The subgaleal dissection along the forehead is deep to the frontalis muscle. About 1 cm above the supraorbital rim, the periostium is incised to enter the subperiosteal layer. Here the supraorbital and supratrochlear neurovascular bundles are identified. The arcus marginalis from one lateral orbital rim to the opposite side is released to allow full mobilization of the brow.

If desired, myotomy or myectomy of procerus, corrugator, and depressor supercili can be performed to correct glabelar crease or medial brow descent. If the central flap was raised in the subgaleal plane, these muscles should be readily accessible at the paramedian region. However, if the central flap was raised in the subperiosteal plane, these muscles can be accessed once the periostium has been incised with care to avoid the supraorbital and supratrochlear nerves. Within the subgaleal plane, the frontalis muscle medial to the midpupillary line can be safely targeted to diminish forehead creases while protecting temporal branch innervation located laterally.
Next, the skin flap is draped posteriorly until the brow is at the desired location. Excess skin is excised along the incision line. Approximately 1.5 to 2.5 cm of tissue is excised depending on the degree of tissue laxity and skin redundancy present preoperatively. Drains are placed bilaterally to minimize hematoma formation. The scalp incision is closed in layers, and the skin can be closed with sutures or staples.

**Pretrichial or Trichial Brow Lift**

The pretrichial or trichial brow lift places the incision either immediately anterior to or at the anterior hairline, respectively. This lift is ideal for patients with normal to high hairlines (greater than 6 cm from the brow) since it can lower the frontal hairline as the brow is elevated, shortening the forehead. The major disadvantages of this approach are the potentially prominent scar in the anterior hairline and incision alopecia. Patients can experience posterior scalp flap paresthesia depending on the plane of dissection, although this is relatively well tolerated. This approach is contraindicated in patients with an anterior thinning hairline or balding hair pattern. Ideal candidates are female patients who wear their hair downwards to best camouflage the scar.

Some feel that the pretrichial incision made immediately anterior to the hairline may leave a more notable scar as there is no hair growth in the anterior scalp flap. Therefore, by using a trichial incision approximately 1 to 2 mm into the hairline, hair can grow through the anterior scalp flap for better scar concealment. It is important to bevel the scalp to cut across the hair shafts so that the hair will grow through the anterior skin flap (Fig. 9). In the temporal region, the incision can follow the temporal hairline or be placed 1 to 2 cm behind the hairline. The incision does not need to be carried down to the ear as done in the coronal brow lift. The temporal hairline incision is usually not necessary unless significant lateral brow lift is desired. Some surgeons will try to keep the incision limited to the frontal hairline as the temporal incisions may be harder to conceal.

Another option for dissection is to remain superficial to the frontalis muscle in the subcutaneous plane. Frontalis muscle myolysis can be performed. However, in this dissection plane, one cannot release the arcus marginalis. If desired, a second dissection plane can be performed deep to the frontalis muscle in the subgaleal or subperiosteal plane to allow for arcus marginalis release as well as myolysis of the corrugator, procerus, and depressor supercilii if indicated.

The forehead skin flap is then draped back over the incision line lifting the brow to the desired position. Multiple fixation sutures are placed along the incision line. If subgaleal dissection was performed, additional fixation sutures could be secured to the periosteum. Excess skin is excised. Drains are not typically necessary.

**Temporal Brow Lift**

The temporal brow lift is performed if there is lateral brow ptosis with minimal midline brow ptosis (Fig. 10). Similar
to the pretrichial brow lift, it is best suited for aging patients where lateral brow ptosis is commonly seen, female patients who wear their hair down to cover the scar incision or male patients without signs of baldness. Similar to pretrichial/trichial lift, the hairline is not raised and can be lowered if desired. Disadvantages of this approach include a potentially, visible scar along the hairline and limited access to the midforehead region, making myolysis of frontalis muscle to address deep central forehead rhytids difficult.

The desired incision is marked out. One can consider either pretrichial or trichial incision as discussed previously. Along the frontal hairline, the scalp should be beveled to incise through hair follicle to allow for hair growth through the anterior skin flap. Along the temporal hairline, the incision should parallel the direction of the hair follicle to minimize alopecia. While hiding the temporal incision behind the hairline optimizes scar concealment, this will raise the temporal hairline more superolateral.

Lidocaine (1%) with 1:100,000 epinephrine is injected for hemostasis and hydrodissection. After incision, there are three levels of dissection available. Subcutaneous dissection superficial to the frontalis muscle can be performed down to the level of the brow. Subgaleal dissection deep to the frontalis muscle can be performed to approximately 1 cm above the supraorbital rim where one converts to subperiosteal dissection to release the peristomal attachment along the arcus marginalis. The last dissection plane is subperiosteally from skin incision down to the brow. One major challenge with subgaleal and subperiosteal dissection is limited exposure, which can be overcome with the use of an angled endoscope for improved visualization. Once sufficient dissection has been performed, the brow is elevated to the desired location and suspended as described in previous sections with care to avoid the temporal branch of the facial nerve entering the lateral border of the frontalis muscle. Excess skin can be draped over the incision line and excised. Meticulously layered closure of the incision line is then performed.

**Endoscopic Brow Lift**

The endoscopic brow lift allows elevation of the brow through relatively small scalp incisions that can be placed posterior to the hairline. It is ideal in patients with male pattern baldness due to the small scars. There is no skin excision; rather, this technique relies on the peristomeum of the forehead/scalp flap healing to the cranium in the desired elevated position. Because one has to rethread the forehead and scalp, addressing bilateral brows at the time of surgery is recommended with this technique. A disadvantage of this approach is raising the anterior hairline; it is best suited for patients with low anterior hairline or a short forehead. Furthermore, as excess skin is not excised, the degree of brow lift (~10 mm) may not be as significant as the skin excision procedures described previously. Nonetheless, the outcomes of endoscopic brow lift are comparable to the classic coronal brow lift.

There are numerous variations to the endoscopic brow lift, including the plane of dissection (subgaleal or subperiosteal), the types of incisions, and the technique for brow fixation. There has not been a systemic, randomized comparison between variations; overall, different techniques have comparable results. As such, there is no one proven method that is superior to others.

Classically, five incisions behind the hairline are made for a bilateral brow lift. One sagittal incision is placed midline for instrumentation or endoscopic visualization while two additional parasagittal incisions are made near the midpupillary lines. Two additional obliquely oriented incisions that run parallel to the temporal hairline are made along the temporal scalp to allow for a lateral brow lift. The senior author (Y.D.) prefers to use six incisions consisting of four paramedian incisions near the midpupillary line and the lateral limbus and two temporal scalp incisions for a bilateral brow lift. For unilateral brow lift, three incisions are used. We feel that the midline scalp incision is often not necessary as the parasagittal incisions can be used for instrumentation and endoscope visualization as well.

The senior author’s (Y.D.) technique is described here. Preoperatively, while the patient is sitting up, using a caliper, the desired amount of brow lift is measured on both sides at slightly medial to the midpupillary line and a point between the lateral limbus and the lateral canthus. In the operating room, an imaginary line is drawn from the lateral alar base to the midpupillary line. About 5 to 8 mm medial and lateral to this line is chosen for two 1.5 cm parasagittal incisions (Fig. 11). This will roughly correspond to a point medial to the midpupillary line along the brow and a point slightly lateral to the lateral limbus along the brow. The next incision is made in the temporal scalp oriented obliquely approximately 1.5 cm posterior to the temporal hairline, approximately 2 to 3 cm in length, by drawing an imaginary line extending from the lateral alar base to the lateral canthus. The middle of the temporal incision should bisect the imaginary line (Fig. 11). The parasagittal incision is sharply incised with a scalpel down to subperiosteal layer. At the anterior most margin of the parasagittal incisions, a monocortical hole using a 4 to 5 mm stop drill is made to act as a reference point for the preoperative scalp/brow position. A 4 to 5 mm stop drill is essential to avoid bicortical or intracranial placement. Subperiosteal dissection is performed along the forehead down to approximately 1 cm above the supraorbital rim. Subperiosteal dissection is also performed along the posterior scalp toward the occiput. The temporal incision is sharply incised down to the DTF. As long as this incision is placed behind the midway point between the lateral canthus and tragus and within the temporal hairline, the temporal branch of the facial nerve should be well anterior to this incision. The DTF is identified as a shiny, white fascial layer immediately over the temporalis muscle. When in doubt, one can make a small incision within the DTF to ensure there is muscle immediately below. Once the correct plane immediately superficial to DTF has been identified, dissection proceeds toward the superior temporal line to connect the temporal scalp flap to the subperiosteal central scalp flap. Typically, posterior dissection is performed toward the central scalp flap to minimize injuring
the temporal branch of facial nerve. Once the temporal and central scalp flaps are connected, subperiosteal dissection is continued toward the supraorbital rim via endoscopic visualization. The sentinel vein may be visualized, marking the vicinity of the temporal branch of the facial nerve. Along the medial supraorbital rim, the supraorbital and supratrochlear neurovascular bundles are identified and preserved. The dissection is extended laterally to the lateral orbital rim to mobilize the lateral brow fully. Medially, subperiosteal dissection is carried over the nasal root down to the upper portion of the nasal bones. Next, the periosteal attachment along the arcus marginalis is released from lateral supraorbital rim to the opposite lateral supraorbital rim while preserving the neurovascular bundles. The brow flap should now be fully mobilized. If indicated, myolysis of procerus, corrugator, and depressor supercilii muscles is performed. Similarly, the central frontalis muscle can be divided at this time, remaining medial to the midpupillary line to minimize the risk of temporal branch nerve injury.

Next, the brow is lifted by pulling the scalp flap posteriorly. Through the parasagittal incisions, a single monocortical screw is placed into the cranium. Using a caliper, a new monocortical hole is drilled located posterior to the previously drilled reference hole. The exact location of the second hole would depend on the amount of brow lift desired as determined when the patient was sitting upright.

A 4 to 5 mm stop drill bit is once again used. Next, a 12 to 14 mm long self-tapping screw (length dependent on scalp flap thickness) is placed into the hole. About 2 to 3 mm of the screw should be seen above the scalp to allow for the scalp to be secured behind the screw. Once the screws are in place, the brow and scalp flap is pulled posteriorly by the desired amount as determined with a caliper preoperatively, while staples are placed behind the screw to secure the scalp and close the incisions (►Fig. 12). The patient is placed upright to ensure proper brow symmetry and elevation.

The temporal scalp is also pulled back superolaterally as the lateral brow is elevated to the desired location. If necessary, the incision can be lengthened to avoid a standing cone deformity. Excess skin is excised. The temporal scalp flap is secured to the superoposterior aspect of the DTF with multiple 3–0 absorbable sutures. The incision is closed with buried subdermal sutures and skin staples. The screws and staples are removed in clinic 14 days later. Botulinum toxin can be injected at least 2 weeks before surgery as a surgical adjunct. If not done preoperatively, botulinum toxin can also be injected approximately 6 weeks postoperatively once forehead edema has decreased.

Because the endoscopic technique relies on the forehead/scalp complex to heal to the cranium in the elevated position, it is imperative to ensure that the tissue remains in the desired location while the healing process occurs over approximately 2 weeks. There are four common methods of scalp fixation. The screw fixation method is described above. A second technique is with the Endotine device whereby the device is secured to the temporal scalp flap. The brow/scalp flap is pulled posteriorly and then stapled behind the screw to anchor and allow the brow to heal in the elevated position.
the skull with a monocortical screw, and the scalp/forehead flap is draped back and impaled on top of the device, suspending the scalp like a coat hanger (►Fig. 13). A third method is through the use of a monocortical bone tunnel. Typically, the tunnel is created with a drill at 30 to 40 degrees of angulation from the skull surface. A suture is passed through the tunnel, attached to the anterior scalp flap, and secured (►Fig. 14). Finally, the use of a specialized tissue glue such as BioGlue surgical adhesive (CryoLife, Inc.) has been reported by Sidle et al as an effective adhesive in 80 patients undergoing endoscopic brow lift.\(^2\) It is a fast and reliable technique that provided brow elevation at 12-month follow-up.

**Conclusion**

The asymmetric brow is a relatively common issue that may be present in both cosmetic and reconstructive patients. Brow ptosis can have profound psychological and functional issues in patients. In cosmetic patients, it is important to note forehead/brow asymmetry, especially before upper blepharoplasty. Not addressing brow ptosis at the time of upper blepharoplasty may lead to worsening of brow asymmetry and suboptimal outcomes. In patients with facial nerve injury brow ptosis, clinicians must make treatment decisions on the temporary or permanent nature of facial nerve dysfunction. Surgeons should be adept in a range of brow lift procedures and select techniques tailored to the individual patient, as there is no one technique superior to others.

**References**

8. Ellis MF, Daniell M. An evaluation of the safety and efficacy of botulinum toxin type A (BOTOX) when used to produce a protective ptosis. Clin Experiment Ophthalmol 2001;29(06):394–399