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The facial plastic surgeon must appreciate the contribution of the brow position and its role in periorbital aging and the contribution to upper eyelid skin redundancy. The brow should be repositioned before any intervention is undertaken to address the upper eyelid. After proper repositioning of the brow, the upper eyelid redundancy may be remedied entirely or the amount of upper eyelid skin required for removal may be reduced.

Anatomy

- Subunits: The forehead represents the upper third of the face and may be divided into subunits based on the vertical fifths of the face: the central forehead, lateral forehead, and brows. The anatomic boundaries include the trichion or anterior hairline superiorly, the supraorbital rim and nasion inferiorly, and the temporal line laterally.
- Vascularity: Branches of the external and internal carotid provide vascularity to the forehead. Namely, the superficial temporal artery and subsequent zygomaticotemporal branches provide blood supply to the lateral forehead. Centrally, the internal carotid via the ophthalmic artery provides the supratrochlear and supraorbital branches, located approximately 1.7 cm and 2.7 cm from the midline, respectively.
- Innervation:
 - Sensory: All branches of the trigeminal nerve provide sensation to the forehead. Central forehead sensation is supplied by the ophthalmic (V1) division of the trigeminal nerve via the supraorbital and supratrochlear nerves. Laterally, the lacrimal branch of V1, the zygomaticofacial branch of V2, and the auriculotemporal branch of V3 provide sensation.
 - Motor: The temporal branch of the facial nerve provides all motor innervation. The temporal branch exits the parotid and courses superiorly from a point 1.5 cm below the external auditory canal, crossing the zygoma approximately 2.5 cm anterior to the auditory canal and traverses superomedially toward to the frontalis muscle, approximately 2 cm lateral to the lateral orbital rim. The temporal or frontal branch of the facial nerve traverses within the temporoparietal fascia, prior to innervating the frontalis muscle from below. Endoscopically, the zygomaticotemporal vein, otherwise known as the

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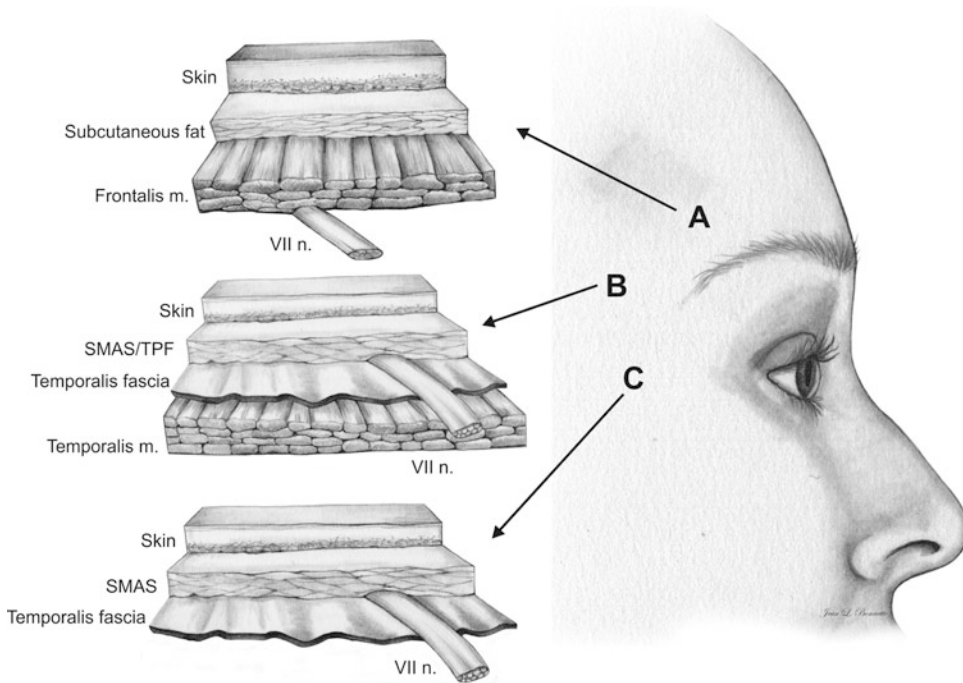


Fig. 19.1 Pathway of the frontal branch of the facial nerve. Note the frontal branch of the facial nerve traverses beneath the frontalis muscle in the forehead (*area a*); yet in the temple, the nerve is intimately associated with the

temporoparietal fascial layer (*area b*) and within close proximity to the overlying skin while traversing over the zygomatic arch (*area c*)

“sentinel” vein, may serve as a landmark of the temporal branch of the facial nerve; the nerve typically runs immediately superficial to this vessel and must be protected if cautery is required.

- **Layers:** The forehead layers are extensions of the scalp. The mnemonic SCALP reminds us of the surgical layers of the scalp from superficial to deep, namely skin, subcutaneous tissue, aponeurosis of the galea and frontalis muscle, loose connective tissue, and the pericranium. Laterally, the galeal layer is continuous with the temporoparietal fascial layer, which is continuous with the superficial musculoaponeurotic system (SMAS) inferiorly.
- **Muscles:** The predominant muscle of the forehead is the anterior belly of the occipitofrontalis muscle. The vertical orientation of the frontalis muscle creates the transversely oriented relaxed skin tension lines (RSTL) of the forehead. The primary brow elevator is the

frontalis muscle. Brow depressors include the paired corrugator supercilii, procerus, and orbicularis oculi muscles. The corrugator supercilii muscles form the glabellar vertical rhytids and the procerus muscle forms the transverse glabellar rhytids. Lateral rhytids at the lateral canthus, otherwise known as crow’s feet, appear secondary to orbicularis oculi contraction (Fig. 19.1).

Aesthetics of the Orbital Complex and Brow Positioning

The ideal brow shape and position vary depending on gender, age, culture, and current aesthetic trends (Fig. 19.2).

- **Women:**
 - The medial brow begins at a vertical line drawn through the medial canthus extending to the alar-facial junction.

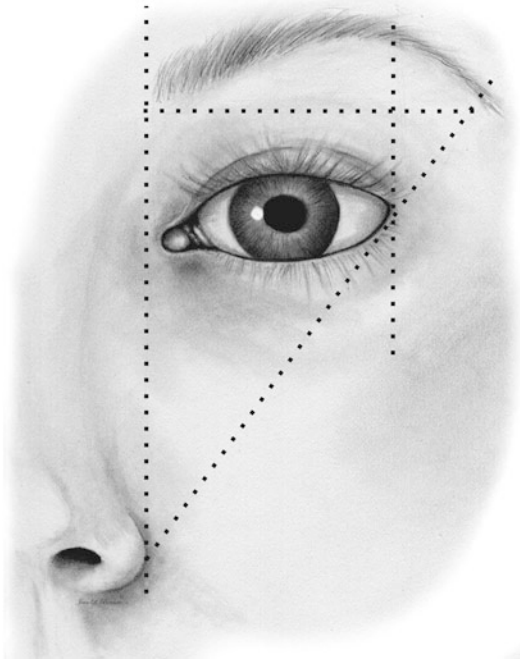


Fig. 19.2 The ideal female brow. Note the apex of the brow is tangent to the lateral canthus

- The brow is club shaped medially and gradually tapers while resting above the supraorbital rim.
- The apex of the brow typically arches above the lateral limbus; yet recent trends have supported a more laterally based apex tangent to the lateral canthus.
- The lateral brow ends along an oblique line drawn through the alar-facial junction and lateral canthus while resting on the same horizontal plan as the medial brow.
- The average height of the female brow from eyebrow to hairline is typically between 5 and 6 cm. Forehead heights greater than 7 cm may be aesthetically improved with forehead shortening maneuvers.
- Men:
 - The male brow shape should assume a more transverse orientation and rest along the orbital rim.
 - The male brow is thicker and flatter than the female brow and should taper slightly while traversing from medial to lateral.
- An isolated elevation of the medial brow creates an unnatural, surprised look while an arched shape to the brow creates a “feminized” appearance.

Preoperative Analysis: Anatomic Considerations

Individuals with ptotic eyebrows often involuntarily attempt to elevate the brow via contraction of the frontalis muscle. The surgeon must encourage patients to close their eyes and allow the forehead to relax. Only then may the surgeon accurately assess the actual position of the brow and the degree of upper eyelid dermatochalasis. Overaggressive resection of brow or upper eyelid skin may result in further brow ptosis, short upper eyelid syndrome, and lagophthalmos.

When determining which brow-lifting procedure to perform, one must consider specific factors of the patient:

- Location of frontal and temporal hairline
- Quality of hair—alopecia, thinning, or abundant.
- Forehead height relative to facial proportions.
- Eyebrow aesthetics—shape, symmetry, quality, position, and mobility
- Degree of dermatochalasis of the upper eyelids, lateral canthal hooding, medial fat pseudoherniation
- Presence of eyelid ptosis or eyelid lagophthalmos
- History of dry eyes, prior eye surgery or blepharoplasty, thyroid disorders

Static and dynamic rhytids must be assessed preoperatively. Older patients typically have more subcutaneous atrophy and hence rhytids appear more pronounced due to actions of the muscle being transmitted directly to the skin.

Fair and thin-skinned patients usually heal with more favorable scars than individuals with darker or sebaceous skin. Older patients often demonstrate thinner scars secondary to decreased skin elasticity.

Nearly all patients have some aspect of facial asymmetry. Passive and active asymmetries of the brow must be noted preoperatively. Dynamic eyebrow asymmetries should not be addressed. Surgeons must take caution if attempting to correct a static brow asymmetry, as these subtle changes may alter the patient's unique facial characteristics.

Forehead bony contour should be noted. Women with frontal bossing or prominent supra-orbital rims may appear masculinized. Bone reduction or alloplastic augmentation techniques may be considered.

In general, the brow elevation procedure is performed first before an upper lid blepharoplasty, if indicated. Often, after correction of the brow position, the amount of upper lid eyelid redundancy is significantly reduced, allowing the surgeon to accurately assess the need for blepharoplasty, thereby limiting the risk of lagophthalmos.

Similar to other facial plastic surgery procedures, accurate preoperative and postoperative measurements and photographic

documentation are essential for introspective critique and medicolegal security. Typical views include the frontal full face, lateral, oblique, and frontal views with brows at rest, raised, and frowning.

Selection of Browplasty Techniques

A variety of procedures and incisions exist designed to improve the brow position from which the facial plastic surgeon must select based on individual anatomic and aesthetic considerations.

- A chemical brow lift is a nonsurgical therapeutic option used to elevate the temporal brow by using Botox (Allergan, Irvine, CA) to selectively denervate the temporal brow depressors, the lateral orbicularis muscle. Unopposed elevation by the frontalis muscle leads to brow elevation, typically providing 3–4 mm in vertical height ((Fig. 19.3).

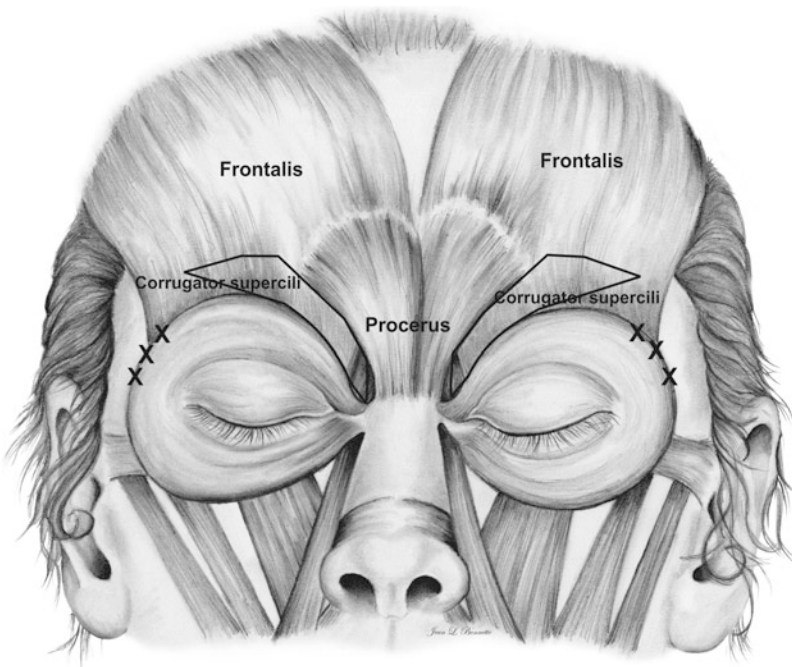


Fig. 19.3 Muscular anatomy of the brow and forehead. X indicates the lateral orbicularis oculi muscle and site for injection of Botox to elevate the temporal brow

Surgical Techniques

In general, the techniques for surgical rejuvenation of the upper face may be considered within three categories: the coronal lift and modifications, the direct brow lift and modifications, and the endoscopic brow lift. The indications, advantages, and disadvantages are listed in the chart along with details of the surgical techniques described below (Table 19.1).

Coronal forehead lift:

- The coronal lift remains a reliable method to address a forehead with short vertical height with significant brow ptosis and forehead rhytids. Exposure of the forehead musculature allows for precise myoplasty, if desired.
- Patients must be counseled on visible scarring and possible alopecia, scalp hypesthesia, and posterior displacement of the hairline.
 - **Technique:** The surgical curvilinear incision is placed approximately 4–6 cm posterior to the hairline and designed in a beveled fashion to minimize follicle injury.
- A subgaleal dissection is performed until 1–2 cm above the supraorbital rim. Laterally, blunt dissection proceeds above the superficial layer of the deep temporal fascia. The flap is dissected over the supraorbital rim to release the arcus marginalis in a subperiosteal plane.
- Myoplasty of the corrugator and procerus muscles may be performed bluntly with care to avoid the supratrochlear artery and nerve traversing around and through the corrugator. The frontalis muscle is identified in the flap and unipolar cautery may be used to incise the muscle and galea immediately deep to the horizontal forehead crease, with care to remain medial to the midpupillary line to avoid injury to the temporal branch of the facial nerve. Lastly, excision of frontalis or procerus muscle is commonly avoided to prevent contour irregularities.
- The flap is advanced superiorly and posteriorly with an appropriate amount of redundant skin excision parallel to the hair follicles. The incision is closed in layers and a suction drain may be used for 24 h.

Table 19.1 Surgical indications and considerations for brow lifting

Procedure	Indications	Advantages	Considerations and disadvantages
Browpexy	Mild brow ptosis	Performed via upper lid blepharoplasty	Possible brow asymmetry, possible, prolonged eyelid edema
Direct brow lift	Correct brow asymmetry, unilateral brow ptosis, pale-nosebaceous skin	Most accurate brow elevation, preserves forehead sensation, favorable scar camouflage in patience with nonsebaceous skin	Visible scare, sharply defined supabrow, only treats the brow with limited glabella exposure
Midforehead lift	Correct brow asymmetry, patients with thick horizontal forehead rhytids and androgenic baldness	Precise brow elevation, useful in patients with horizontal forehead creases, preserves the hairline	Visible scar, avoid in oily, thick skin
Endoscopic brow lift	Less invasive brow and forehead lift	Excellent scar camouflage, preserves hairline	Less precise manipulation of brow position, possible soft tissue irregularities due to brow fixation techniques
Trichophytic forehead lift	High forehead	Reduces vertical height of high forehead, preserves hairline	Visible scar, prolonged hypesthesia of scalp hairline alopecia
Coronal forehead lift	Forehead and brow lift, low forehead	No visible scars, increases vertical height of low forehead	Elevates the hairline, vertically lengthens the upper third of the face, visible scar, less precise manipulation of brow position

- Disadvantages of this technique include the elevation of the anterior hairline, temporary or permanent hypesthesia or paresthesia posterior to the incision and the risk for hematoma formation.
- Due to the distance between the incision and the brow, the coronal lift and its modifications are not routinely used to correct precise brow asymmetries.

Trichophytic forehead lift:

- The pretrichial forehead lift can offer a means of shortening the vertical height of the forehead in patients with a high hairline. The procedure offers the benefit of reducing the redundant forehead skin without raising the anterior hairline (Fig. 19.4).
 - Technique: The incision is designed in an irregular fashion approximately two or three hair follicles behind the anterior

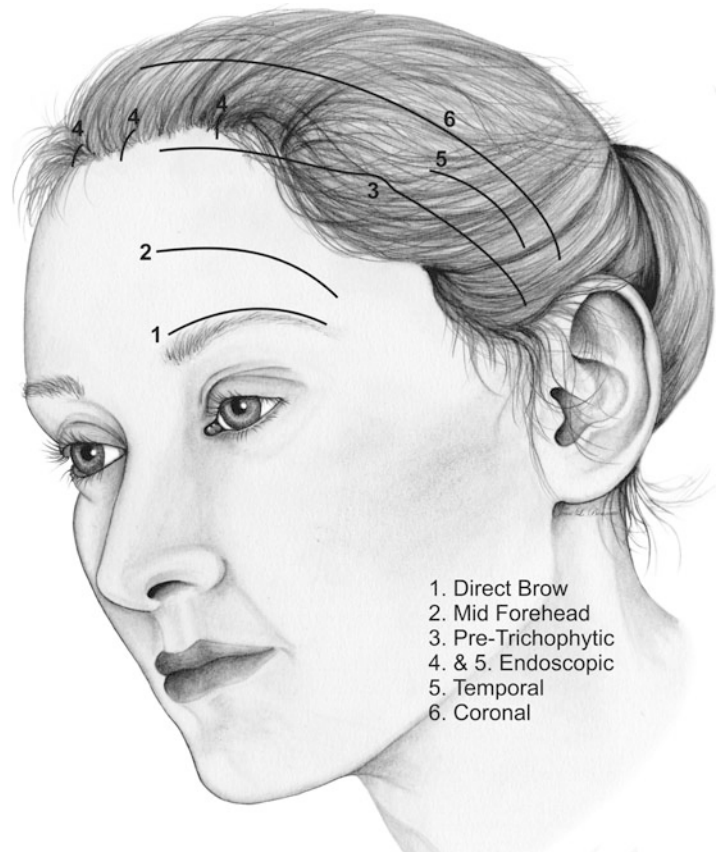
hairline. The incision is beveled parallel to hair follicle shaft to allow ingrowth of hair and designed at the junction of the cephalad forehead and anterior hairline to optimize scar camouflage. The pretrichial incision is extended laterally in the temporal region posterior to the hairline.

- The flap is elevated in a similar fashion to the coronal lift with similar options to perform myoplasty, if desired.
- Disadvantages include the visible scar despite meticulous closure and the broader area of anesthesia posterior to the incision.

Temporal lift:

- This lift is designed to address the lateral one-third of the brow and indicated primarily for female patients with appropriate medial brow position and isolated lateral brow ptosis. This procedure offers excellent results, yet

Fig. 19.4 Proposed incision placement for brow lift procedures in oblique view: 1. Direct brow. 2. Midforehead. 3. Pre-trichophytic. 4,5. Endoscopic port sites and temporal incision. 5. Temporal lift. 6. Coronal



requires complete release of the temporal line, lysis of all brow ligaments, and release of the periosteal ligaments along the orbital rim.

- **Technique:** The incision is typically 2 cm posterior to the temporal hairline and dissection proceeds along the superficial layer of the deep temporal fascia. The dissection extends inferiorly to identify the lateral orbital rim with release of the arcus marginalis, conjoint tendon, and temporal line to enable lateral brow mobility. Use of the endoscope is commonly practiced to improve visualization of the zygomatico-temporal (sentinel) vein and adequate release of the arcus marginalis. Finally, lateral suspension is directed superiorly and posteriorly and secured with suture secured from the deep temporal fascia to the temporoparietal fascia. The scalp is closed in layers.

Midforehead brow lift:

- The midforehead brow lift may be considered in males with deep horizontal rhytids and a receding anterior hairline.
 - **Technique:** An elliptical incision is designed around the rhytid with two-thirds of the ellipse above the incision and one-third below. Two different horizontal rhytids are selected to stagger the incisions; however, some surgeons prefer one continuous incision across the brow, often requiring an intentional irregularization to improve scar camouflage.
 - The overlying skin and subcutaneous tissue is excised until the frontalis muscle is exposed. Dissection proceeds in the subcutaneous plane until the orbicularis oculi muscle or supraorbital rim is exposed.
 - Horizontal mattress sutures are placed inferiorly through the orbicularis oculi muscle and attached superiorly to the periosteum. A layered skin closure then follows.

Direct brow lift:

- The direct brow is commonly indicated to modify an asymmetric or ptotic brow.

Technically, this method requires minimal undermining with relative low risk of damage to the supratrochlear and supraorbital neurovascular bundles. The control of the brow positioning is direct, yet requires precise placement of permanent suspension sutures to the superior periosteum. Due to the proximity of the incision to the brow, this technique allows precise changes in the brow position and may be useful in cases of unilateral facial paralysis to correct the ptotic brow.

- **Technique:** An ellipse of skin is resected from the suprabrow area to elevate the brow approximately 4–8 mm above the opposite eyebrow. The inferior border of the skin ellipse is incised along the superior margin of the eyebrow parallel to the axis of the hair shafts, with great care to avoid injury to the hair follicles of the brow. The incision is beveled to maximize scar eversion. Horizontal suspension sutures are placed between the sub-brow dermis and the forehead periosteum approximately 1 cm above the desired point of eyebrow elevation. The skin incision is closed in a layered fashion.
- Alternatively, the ellipse of skin incision may be designed in a prominent midforehead rhytid in an attempt to camouflage the incision, utilizing the same surgical technique as described above.

Browpexy:

- This procedure is typically indicated in women with mild-to-moderate brow ptosis.
 - **Technique:** A standard blepharoplasty excision of skin and orbicularis muscle is performed followed by dissection superiorly toward the brow in a submuscular orbicularis plane or in a subperiosteal plane, extending above the superior orbital rim. Permanent suture is then passed transcutaneously at the level of the infrow hairs into the sub-brow space and then passed through the periosteum above the supraorbital rim. It is then secured through the sub-eyebrow tissue at

the level of the original transcutaneous sutures. With tightening of the suture, the eyebrow will be elevated. Precise placement and tension of each suture may allow modification of the eyebrow position based on the degree of elevation desired. The blepharoplasty procedure is then completed.

- Risk of this procedure involves potential injury to the supraorbital neurovascular bundle resulting in bleeding or forehead anesthesia. Additionally, due to the meticulous suspension suture placement, dimpling of the thinner eyelid skin, overcorrection with lagophthalmos, and inadequate correction of brow ptosis have been described.

Endoscopic brow lift:

- The indications for the endoscopic brow lift are similar to the coronal lift with the advantage of direct endoscopic visualization, magnification, and perhaps improved identification of the supraorbital and supratrochlear neurovascular bundles. Advantages include the use of smaller incisions made possible with the use of the endoscope, decreased incidence of sensory neuropathy and alopecia, and less bleeding compared to the coronal lift. Key principles of endoscopic brow lift include subperiosteal dissection and adequate and complete release of the arcus marginalis.
 - Technique: Typical incision placement includes a midline sagittal, and bilateral paramedian incisions tangent to the midbrow (or at the location of the desired brow apex between the lateral canthus and lateral limbus) that are typically 2 cm in length and located 1–2 cm posterior to the anterior hairline. Additionally, two temporal incisions are marked in an elliptical fashion obliquely oriented from the alar-facial junction, through the lateral canthus, and parallel to and approximately 1–1.5 cm posterior to the hairline. These locations may vary depending on surgeon preference.

Dissection: The central scalp and paramedian incisions are elevated anteriorly and posteriorly in a subperiosteal plane, typically in a blunt fashion, and dissections proceed to a level 1–2 cm above the supraorbital rim, as the neurovascular bundle and/or branches can emanate from a true foramen above the supraorbital rim in approximately 10 % of cases. The endoscope is then introduced to allow improved visualization of the supratrochlear and supraorbital neurovascular bundles while releasing the arcus marginalis over the orbital rim and onto the nasion. Laterally, the temporal incisions are dissected similarly to the lateral brow lift as described above. Of note, the sentinel vein lies in close proximity to the temporal branch of the facial nerve. If bleeding arises from this vessel, cautery should be applied with great care at the deep aspect of the vessel to avoid overlying nerve injury. The temporal line is divided from lateral to medial to connect the two planes. Transverse releasing incisions are made through the periosteum along the supraorbital margin to allow appropriate brow mobility and release.

Fixation: Multiple fixation techniques have been described in the literature including no fixation, skin staples and taping, microscrew placement in the paramedian incision and fixation with skin staples posterior to the microscrew, suspension sutures with microscrew fixation, sutures secured through cortical bone tunnels, sutures secured to miniplates, and absorbable screws and cortical anchors (Endotine Coapt system, Palo Alto, CA). Sclafani et al. reported that a minimum of 6 weeks is required for adhesion between the cranium and overlying periosteum. Additionally, Thomas

et al. demonstrated in the rabbit model that in 8 weeks the biomechanical strength of the dissected subperiosteal versus subgaleal flaps were similar to matched, undissected controls.

- The temporal incisions are closed as described in the temporal lift and staples are utilized to close the midline and paramedian anterior scalp incisions.

Complications

Endoscopic	Open
Paresthesia/dysesthesia (6.2 %)	Alopecia (8.5 %)
Asymmetry (3.6 %)	Unacceptable scarring (1.4–3.6 %)
Alopecia (3.0 %)	Paresthesia/dysesthesia (0.3–5.4 %)

- Substantial heterogeneity exists in the reporting of paresthesia in the literature (specifically, nerve distribution, severity, and duration of paresthesia). Paresthesia/dysesthesia most frequently occurs with anterior hairline, midforehead, and endoscopic techniques. Coronal lift in the subperiosteal plane is associated with the highest risk of injury to the frontal branch of the facial nerve (6.4 %) while motor injury is less likely to occur in the subgaleal plane.
- The anterior hairline approach in the subcutaneous plane demonstrated the overall highest probability of alopecia.
- Infection or abscess formation is unlikely to occur in any of the techniques studied (0.2–0.4 % incidence).

Questions

Browplasty Review Questions:

1. Which of the following techniques will shorten the vertical height of the forehead?
 - (a) Midforehead lift

- (b) Direct brow lift
 - (c) Endoscopic brow lift
 - (d) Pretrichial lift
2. While performing a midforehead lift, indicate the proper plane of dissection?
 - (a) Subcutaneous
 - (b) Subfrontalis
 - (c) Subgaleal
 - (d) Subperiosteal
3. A patient is concerned over her “angry” appearance and presents with prominent vertical furrows between her brow. You offer treatment with botulinum toxin A. Where should you inject this product and how many units would you advise?
 - (a) 20 units, bilateral corrugator supercilii muscles
 - (b) 4 units, bilateral lateral orbicularis oculi muscle
 - (c) 10 units, procerus muscle
 - (d) 20 units, frontalis muscle
4. A younger patient presents to your office with mild-to-moderate lateral hooding of her upper eyelids secondary to lateral brow ptosis. She is reluctant to undergo surgical correction of her brows. To improve her condition, you offer her:
 - (a) Reassurance. Gently tell the patient that no intervention is warranted.
 - (b) Botulinum toxin A—to forehead, 20 units
 - (c) Botulinum toxin A—to procerus, corrugator supercilii m, 20 units
 - (d) Botulinum toxin A—to lateral orbicularis oculi m, 10 units
5. A 63-year-old female presents to your office with moderate brow ptosis and a high hairline. Which procedure would change her hairline most significantly?
 - (a) Trichophytic lift
 - (b) Coronal lift
 - (c) Endoscopic temporal lift
 - (d) Direct brow lift
6. While performing a temporal brow lift, indicate the proper plane of dissection?
 - (a) Subcutaneous
 - (b) Temporoparietal fascia

- (c) Superficial layer of the deep temporal fascia
 - (d) Subperiosteal
7. Which of the following techniques will allow the most accurate eyebrow lift with the greatest elevation per millimeter of tissue excised?
- (a) Direct eyebrow lift
 - (b) Midforehead lift
 - (c) Temporal lift
 - (d) Endoscopic lift

Answers: 1. (d), 2. (a), 3. (a), 4. (d), 5. (b), 6. (c), 7. (a)

Additional Resources

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