Chapter 31

Complications in Esthetic Surgery

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Additional information is available at the end of the chapter

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Abstract

Facial plastic and reconstructive surgery is a remarkably diverse specialty, ranging from maxillofacial trauma and reconstruction to facial rejuvenation, rhinoplasty, cleft surgery, microvascular surgery, facial cosmetic procedures, and pain control. It is unique among surgical specialties due to changing trends, racial, and regional ethnic preferences that influence what is considered an esthetic result.

A growing trend of popularity is seen for facial cosmetic surgery recently. One reason is the consumer's increased accessibility to information through television, the Internet, and other media sources. Also, the development of safe and effective surgical techniques, with reduced "downtime" and long-lasting, natural–appearing results, has popularized this field. Although some patients seek to rejuvenate their appearance to "turn back" the clock, others are interested in altering their appearance to a more desirable social norm.

As a result of this huge interest for cosmetic procedures, variable complications may also arise. Complications are important, and they play a critical role in developing practice guidelines, identifying gaps in knowledge, defining surgical quality metrics, and allocating resources. This chapter reviews both early, often transient, complications as well as delayed, often prolonged or permanent, complications with special attention to prevention and management.

Keywords: complication, aesthetic, management, plastic surgery, facial surgery

1. Introduction

In this chapter, we address;

- Complications in the periorbital area and midface
  - **Table 1**: periorbital and midface complication
- Complications in cosmetic rhinoplasty
  - **Table 2**: summary of complications
  - **Table 3**: comparative incidence of complications with grafts implants
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2. Periorbital area and midface

2.1. Periorbital area

The eyes play a central role in what we consider beautiful face. The goal of periorbital rejuvenation surgery is to restore youthful proportions and focus attention on the eyes. This

is the reason made blepharoplasty as the third most common cosmetic procedure performed today, and for the foreseeable future. [1, 2, 3].

Patients with systemic diseases such as Sjogren syndrome, rheumatoid arthritis, Grave's disease, or neuromuscular diseases should be evaluated appropriately and counseled regarding the increased risks (**Table 1**).

Keratoconjunctivitis sicca or dry eye syndrome (DES) is a common condition that has a wide range of etiologies. Symptoms of dry eyes (redness, soreness, mucoid discharge changes) must be asked from patients, because blepharoplasty can cause DES, or worsen the condition if present preoperatively [4].

Preoperative DES, transcutaneous approaches, preoperative skin laxity, simultaneous upper and lower blepharoplasty, hormone therapy, and male sex can also increase the incidence of both DES and chemosis. To reduce the risk of this complication, adjunctive lid-tightening procedures should be done in potential risky patients.

During the preoperative evaluation, it is important to identity patients with Grave's disease. This condition is owing to autoimmune activity against thyroid-stimulating hormone receptors and is associated with orbital disease in 40% of patients [5]. It is characterized by glycosaminoglycan deposition, fibrosis of extraocular muscles, and adipogenesis in the orbit [6]. Although blepharoplasty is often required in the surgical management of this disease, there are often multiple stages and varying techniques to address the proptosis and lid retraction that are associated with this condition [5, 7].

Critical to maximizing outcomes after upper blepharoplasty is proper preoperative evaluation of the brow. Excessive contraction of the frontalis muscle occurs to compensate for significant upper lid dermatochalasia. If blepharoplasty is performed alone, relaxation of the brow will occur after surgery, which reduces the effectiveness of the operation [8]. Relaxed gaze is preferred to identify brow ptosis. Another method is to manually fixate the brow while assessing for excess skin.

Unusually high creases can be a sign of levator dehiscence that, if present, should be addressed at the time of surgery. Prolapse of lacrimal gland can be mistaken for excess fat, and injury to this structure can lead to postoperative complications such as DES (**Figure 1**). Proper evaluation of the lower lid helps to prevent complications from lower blepharoplasty such as ectropion/entropion, lid malposition, DES, and chemosis [9].

Excessive lid laxity should be addressed by either lid tightening or shortening techniques. Malposition of the lower lid should also be assessed by placing upward traction on the lower lid. A normal lid should elevate to at least the mid-pupillary level (**Table 1**).

Anterior lamellar shortening can be prevented by preoperative evaluation of excess skin in the lower eyelid. This is evaluated by having the patient open the mouth widely while pinching the lower eyelid skin. If there is no excess in this position, removal of skin will put the patient as risk for lower lid malposition and ectropion. A negative vector eyelid is described as a prominent globe with a recessed orbital rim/maxilla [10]. Blepharoplasty in these patients is associated with higher complication rates, particularly lid malposition [11].

For patients with significant exophthalmos, operative intervention should be modified by performing minimal fat excision or using spacer grafts to reduce the incidence of lid malposition. In addition, canthal-tightening procedures can exacerbate the malposition, as increased tension along the prominent globe will force the lid to retract further [13].

Periorbital complications	Cause	Prevention	Management
Dry eye syndrome	Missed preoperative, exposure, irritation	Preoperative history/ examination, eye protection	Lubrication, lacrimal puncta ducts
Chemosis	Conjunctival irritation, disruption of lymphatics	Temporary tarsorrhaphy	Topical dexamethasone, topical phefrylephrine, lubricants, severe cases
Ptosis	Missed preoperative, mechanical factors, levator injury	Limited deep cautery in lateral fat pad, muscle preservation	If persistent after 3 months, surgical ptosis repair
Diplopia/ strabismus	Scar tissue, muscle injury	Preoperative history/ examination	Local steroid injections, corrective strabismus surgery
Lower lid retraction/ lagophthalmos	Missed brow ptosis, under resection	Preoperative history/ examination, Chantal tightening procedures	Canthopexy/plasty, spacer graft, skin brow lift
Corneal abrasion	Muscle injury, preoperative lid laxity, overzealous skin excision	Corneal protector	Lubrication, topical antibiotics
Hemorrhage	Corneal exposure during surgery	Meticulous homeostasis	Surgical exploration, lateral canthotomy lubrication
Lacrimal gland injury	Anticoagulant use, vascular injury	Proper identification intraoperatively	Lubrication
Infection.	Improper diagnosis, missed preoperative	Preoperative antibiotics	Oral antibiotics, surgical decompression for abscess formation
Overcorrection	Surgical wound contamination, unsterile technique	Thorough preoperative assessment, conservative fat removal	Postoperative fat grafting, fillers
Under correction	Inappropriate preoperative assessment	Thorough preoperative assessment, marking	Revision surgery

Periorbital complications	Cause	Prevention	Management
Midface complications			
Sensory nerve damage	Surgical error	Subperiosteal dissection	Expectant management
Facial nerve damage	Cautery, wrong plane of dissection	Subperiosteal dissection	Expectant management
Infection	Oral contamination	Copious irrigation, possibly avoiding	Antibiotics, surgical drainage as indication
Asymmetry	Suture fixation		Revision surgery
Implant malposition	Improper placement, shiftin	Tight subperiosteal pocket, implant fixation	Revision surgery.

Table 1. Periorbital and midface complications.

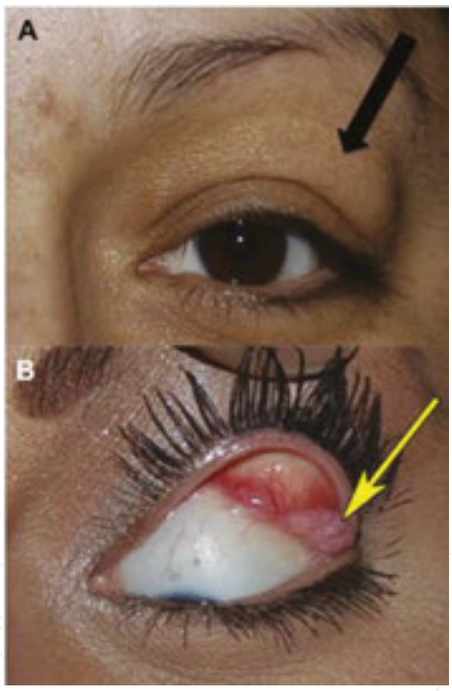

Figure 1. (A) Prolapsed lacrimal gland causing temporal fullness in the left upper eyelid (black arrow). (B) On eversion of the upper eyelid, the prolapsed gland can be seen beneath the conjunctiva (yellow arrow) [12].

2.1.1. Intraoperative complications

Corneal abrasions are a potential perioperative complication. Oculotoxic sterilization chemicals, surgical instruments, gauze, or desiccation of the ocular surface predispose to inadvertent injury to corneal epithelium. By using corneal shields, which can be placed after applying tetracaine drops to the eye and a generous amount of oil-based lubricant, it is completely

preventable. When corneal abrasions occur, patients often complain of pain, foreign body sensation, burning, tearing, and blurry vision. Evaluation with a fluorescein stain and a slit lamp seems to be necessary. Most can be managed with 48 h use of topical erythromycin or bacitracin [14]. The surface can also be protected with application of contact lens [15].

Thermal injuries have been reported after cosmetic blepharoplasty, and complications have resulted in postoperative astigmatism [16].

Topical antimicrobials followed by topical steroids to reduce scar tissue formation are mentioned for treatment. **Hemorrhage** is a potentially devastating complication with high risk of the potential blindness. Retrobulbar hematoma presents symptoms like rock hard proptosis, chemosis, severe pain, and visual changes. Ophthalmic consultation is requested early on in the course of therapy. Intraocular pressure is also elevated; however, surgical management is more dependent on the presence of visual changes. For patients with intact vision, conservative measures of cold compresses, intravenous osmotic agents, topicalb-blocker drops, and acetazolamide are initiated. For patients with visual loss, aggressive management is required beginning with a lateral canthotomy. Persistent visual should be evaluated with an orbital CT. If a posterior hematoma is present, bony decompression is warranted [17].

2.1.1.1. Postoperative complications

Postoperative DES is a common complication after blepharoplasty, as mentioned. Postoperative lagophthalmos, orbicularis injury, and lacrimal gland injury can have increasing effect on the risk of developing DES. Irritation, blurry vision, or foreign body sensation are some of the patient's common complains. Diagnosis is confirmed with a positive Schirmer test [18].

The management generally entails usage of ocular lubricants such as artificial tears and a petroleum-based ointment. If symptoms persist, blockage of the lacrimal outflow via a punctal plug can be useful. Chemosis often accompanies DES after blepharoplasty and is defined as swelling of the conjunctiva. It can be incited by inflammatory factors such as allergy or infection, as well as traumatic causes. After blepharoplasty, chemosis has been attributed to disruption of the lymphatic channels [19] or canthal disruption [20].

Temporary tarsorrhaphy should be performed if significant chemosis is encountered intraoperatively, to limit propagation of the chemosis and protect the conjunctiva. Conservative measures include topical phenylephrine, dexamethasone, and lubrication. Severe cases are managed with a conjunctivotomy and patching to apply pressure to the eye. There are several causes for ptosis after upper blepharoplasty. The most common is likely failure to properly identify ptosis before surgery. Injection of anesthetic agents causes a temporary ptosis if the levator superioris innervation is affected. Ptosis in the immediate postoperative period is usually dependent on mechanical forces and increased weight of the lid from edema. This edema resolves by 1 week after surgery as it is resorbed.

The levator is more susceptible to injury at the inferior aspect of the lid where it attaches to the orbital septum and muscle to form the upper eyelid crease. To avoid injury, access to the orbital fat pads should be performed at the superior aspect of the lid through the orbital septum. The medial fat pad serves as an important landmark because it rests on top of the levator aponeu-

rosis, preventing its injury. Correction of ptosis requires operative exploration of the wound through an anterior approach. If a tear in the aponeurosis is identified, direct repair is performed. If the aponeurosis is disarticulated from the tarsal plate, it must be reattached using interrupted sutures [21].

Lagophthalmos can occur owing to anterior lamellar deficiency (aggressive skin excision), incorporation of septal fibers into the skin during closure, or significant injury to the orbicularis muscle. Anterior lamellar shortening can often be treated with full-thickness skin grafts. Septal adhesions should be explored early and lysed. A new technique that is gaining popularity is the application of fillers to correct lagophthalmos [22, 23]. The technique mentioned has been used for patients with paralytic lagophthalmos [23] and for patients with superior sulcus syndrome [22] with excellent results.

Infections after blepharoplasty are extremely rare. Infections typically occur 5–7 days after surgery and present with increasing edema, erythema, and pain.

Orbital cellulitis involves the orbit and is associated with proptosis, restricted extraocular muscle movement, and visual changes. Organisms involved in periorbital infections include beta-hemolytic streptococcus and staphylococcus aureus and require more aggressive treatment [24].

Necrotizing fasciitis has been reported after blepharoplasty [25, 26].

Diplopia is thought to relate to direct trauma to the extraocular muscles during the procedure [25] or scar tissue formation, which limits extraocular muscle movement [27].

Strabismus in which superior oblique injury or inferior rectus injury is diagnosed can be treated successfully with systemic steroids and triamcinolone injections.

Diplopia has also been reported directly owing to lower lid fat repositioning [28].

Canthal webbing can occur both medially and laterally after blepharoplasty. The usual error is incision placement too medial or lateral, or too close to the lid margin. It can also occur from excessive anterior lamellar shortening. Managements ranging from gentle massage, steroid injections up to surgical correction with V–Y advancement, or multiple Z-plasties are performed.

Poor scarring is a potential complication anytime the skin is incised. Joshi and colleagues [29] looked at various closure techniques and found that a running 6-0 plain gut with several interrupted prolenes resulting in the lowest rates of standing cone deformities and milia formation. Running locking 6-0 prolene was associated with the highest rate of complications. For patients with track formation, subcuticular closure reduces the risk of recurrence. Fat repositioning can be performed in the subperiosteal or preperiosteal plane [30].

If hollowing does occur in the lower lid, this can be corrected with autologous fat grafting or placement of fillers. Owing to the delicate quality of the lower lid, softer hyaluronic acid fillers are preferred to prevent palpable or visible abnormalities. Hollowing in the upper lid is also a potential complication not only does it result in a cosmetic deformity, severe cases can result

in lagophthalmos [22]. Recent techniques such as limited removal of the central fat pad and repositioning of the nasal fat into the orbitoglabeller groove are developed [30].

Lower eyelid retraction can be caused by inadequate vertical laxity from lamellar shortening in 1 or a combination of the 3 lamella. To diagnose which of the 3 has the deficiency, cheek skin is pushed up to artificially recreate the anterior lamella. If the deformity is corrected, then the issue is from anterior lamellar shortening. If the retraction persists, middle or posterior lamellar shortening is more likely. Vertical inadequacy results in ectropion with anterior lamellar shortening, entropion with posterior lamellar shortening, and lower lid retraction with middle lamellar shortening.

Ectropion most commonly occurs from excessive skin excision. A transcutaneous approach alone, without skin excisions leads to 2–3 mm of anterior lamellar shortening [31].

Correction of anterior lamellar shortening is usually done with full thickness skin grafts. The ideal skin donor is the upper eyelid skin owing to the thinness and color match. If patients have had recent upper eyelid surgery and this skin is not available, supraclavicular skin or postaurical skin is an option. Another option to correct lower lid malposition from anterior lamellar shortening is the midface lift. Repositioning of the suborbicularis oculi fat pad supports the lower lid, recruits skin and muscle, and rejuvenates the midface. Multiple approaches have been described, including a transconjunctival, temporal approach, and subcilliary with subperiosteal or preperiosteal dissections. Marshak et al. [40] described a lateral canthal incision that allows for release of scar tissue and adequate access to the subperiosteal plane of the midface. Middle and posterior lamellar shortening is managed with scar lysis and placement of spacer grafts. Various autogenous and allogenic materials have been used with varied results. Common autogenous grafts include palate grafts, conchal cartilage, septal cartilage, temporalis fascia, and fascia lata [32].

Allogenic grafts, such as acellular dermis, palate grafts [33] dermis fat grafting [34], have also been used with variable results. Another significant factor in lower eyelid malposition is horizontal lid laxity, which is assessed preoperatively with snap and distraction tests. If this laxity is present preoperatively, a prophylactic canthal tightening procedure can prevent lid malposition. Multiple techniques can be used to resuspend the canthus, including canthoplasty, tarsal strip removal, and canthal suspension.

2.2. Midface

Midface rejuvenation can be performed using a multitude of different techniques. Preventable complications include improper implant choice, migration, and improper placement. The proper size is one that is slightly smaller than the desired projection, because soft tissue over the implant increases the fullness [35].

Implant migration is a preventable complication. Creating a limited subperiosteal pocket to reduce mobility, placement of a temporary stay suture, or screw fixation of the implant can prevent this complication. There have been several reports of severe orbital complications from implant migration, including conjunctival extrusion, scleral erosion [36], and intraorbital erosion [37].

Nerve injury can occur, and the most common is the infraorbital nerve which occurred during malar augmentation with implants, owing to its close proximity of the dissection. These injuries are commonly transient [38] and resolve without intervention. **Infection** is also potential complication, as with any other surgical implants. These complications were reported in proplast implants and often occurred as a late sequela owing to maxillary sinus erosion [39].

The transtemporal approach has been shown to be an effective technique to rejuvenate the midface. Because the lateral canthus and other orbital structures are not manipulated in this approach, lower lid malposition is not encountered [40].

The incision in the temporal tuft of hair carries a risk of **Alopecia**, which can be limited by beveling the incisions to limit disruption of hair follicles. **Bleeding** and **infection** are not common complications. Abscess formation has been reported, which led to malar wasting requiring malar implants for correction [41].

3. Rhinoplasty

Rhinoplasty is one of the most difficult cosmetic operative procedures performed today. Surgeons must develop skills for a three-dimensional manipulation of various tissues, often performed with limited access. Like all other surgeries, occurrence of complications is inevitable but must be managed properly. Early complications in rhinoplasty can be avoided through very careful and precise techniques during or at the end of the operative procedure. Late complications may occur due to failure to understand the consequences of surgical manipulation of the underling tissues, or from the idiosyncrasies of the various anatomic tissues healing (**Table 2**).

Complication	Cause	Avoidance	Correction
Asymmetry of the bony vault	Asymmetric osteotomies	Meticulous attention to osteotomies	Percutaneous osteotomies
Asymmetry of the middle vault	Unmasked dorsal septal deviation after dorsal reduction	Recognition of septal deviation	Crushed cartilage camouflage grafts
Tip asymmetry	Asymmetric tip sutures unmasked caudal septal deviation	Meticulous attention to suture technique Meticulous inspection	Revision Possible placement of septal extension graft Possible repositioning of caudal septum with swinging door, secure to nasal spine with suture
Over resection of nasal bones	Overaggressive resection	Judicious bony dorsal reduction	Placement of dorsal onlay graft

Complication	Cause	Avoidance	Correction
Open roof deformity	Bony dorsal reduction	Judicious bony dorsal reduction when no osteotomies are planned, but unavoidable when narrowing of the bony base is planned	Lateral osteotomies to close open roof
Rocker deformity	Continuation of osteotomies into frontal bone	Meticulous planning of o steotomies and continuous palpation/inspection	Percutaneous osteotomies
Stair step deformity	Improper placement of lateral osteotomy anterior to the ascending process of the maxilla	Meticulous planning of dorsal reduction, both bony and cartilaginous dorsum	Percutaneous osteotomies
Polly beak deformity	Over resection of nasal bones under resection of dorsal septum (anterior septal angle) Postoperative soft tissue scar formation	Meticulous planning of reduction both bony and cartilaginous dorsum Avoid overaggressive dossal reduction in\ thick-skinned patients	Dorsal onlay camouflage graft Appropriately match cartilaginous dorsal reduction to that of bony dorsal reduction May require revision Kenalog injections postoperatively
Inverted V deformity	Upper lateral cartilages drop inferior and posterior, causing show of the nasal bones and dorsal septum This results from failure to repair the upper laterals to the dorsal septum after dorsal reduction	Repair upper lateral cartilages to dorsal septum after dorsal reduction use of spreader grafts or auto spreader grafts	Revision with use of spreader grafts (if upper lateral cartilage present), possible onlay crushed cartilage camouflage grafts, consider osteotomies to narrow the bony base if this is a contributing factor
Saddle nose deformity (**Figure 2**)	Overaggressive dorsal reduction with septoplasty, resulting in a dorsal strut that is inadequate to support cartilaginous dorsum	Maintain 1.5-cm dorsal strut	Revision with dorsal onlay camouflage graft (minor cosmetic deformity) and rib cartilage graft reconstruction (severe cases)
Bossae	Overaggressive cephalic trim of lateral	Note predisposing factors for bossae formation (see below),	Revision with structural grafting of lateral crura (strut grafts). crushed

Complication	Cause	Avoidance	Correction
	crura	avoid over aggressive resection	cartilage, and/or temporal is fascia camouflage grafts
Visible grafts (**Figure 3**)	Thin skin	Note thin skin preoperatively and place temporalis fascia overlay grafts to camouflage	Revision with possible graft removal and/or placement of temporal is fascia for contour smoothing and camouflage
Pinched tip (**Figure 4**)	Over resection of lateral crura during cephalic trim malpositioning of lateral crura Contracture from wound healing	Spare 6- to 7-mm rim strip Ensure appropriate orientation and patient about this risk and document having done so	Lateral crural strut grafts, possible crushed cartilage grafts for camouflage Removal/revision of any offending tip sutures, possible lateral crural strut grafting, possible repositioning of lateral crura Revision surgery with one or more of the above maneuvers
Poorly defined tip	Overaggressive tip deprojection in thick- skinned patient	Avoid overaggressive deprojection	Judicious superficial nasalis aponeurotic system (SNAS) excision intra operatively, ken log injections postoperatively
Nostril asymmetry	Altered caudal septum, medial, intermediate, and lateral crura dynamics from intra-operative sture technique or alteration	Meticulous attention to symmetric placement of sutures, such as tip and tongue in groove sutures	Revision, with correction of underlying offending cause
Alar retraction	Overly tight closure of marginal incision Over resection of lateral crura during cephalic trim Malpositioning of the lateral crura Overly tight lateral crural spanning sutures Contracture from wound healing		Remove/revise offending sutures Lateral crural strut grafts, possible alar rim grafts (minor cases), auricular composite grafts (severe cases) Repositioning of the lateral crura, lateral crural strut grafts, possible alar rime Grafts (minor cases),

Complication	Cause	Avoidance	Correction
			auricular composite grafts (severe cases) Removal/ revision of any offending tip sutures Revision surgery with one or more of the above maneuvers
Columellar retraction	Over resection of the caudal septum Excessive setback of the medial crura during tongue-in-groove	Avoid over resection Avoid excessive setback	Caudal septal extension graft, columellar strut graft, columellar plumping graft Revise tongue-in-groove, consider columellar plumping graft Septocolumellar suture can be used to help prevent contracture during wound healing
Columellar and alar base scar formation	Wound healing	Meticulous wound closure	Kenalog injections with revision reserved for severe cases
Nasal obstruction	External nasal valve collapse Internal nasal valve collapse Septal deviation intranasal synechia Recurvature of the lateral crura	Maintain integrity and appropriate position of lateral crura, avoid overaggressive narrowing of the alar base Avoid overaggressive narrowing of the bony base, use spreader grafts or auto spreader grafts to maintain patency Appropriately address any septal deviation careful soft tissue handling and fastidious wound closure Recognize contribution to the patency of the nasal airway	Lateral crural strut grafts, possible alar rim grafts Spreader or autospreader grafts Septoplasty Lysis of synechia Lateral crural strut grafts
Septal perforation	Opposing mucoperichondrial	Meticulous elevation of mucoperichondrial	Place fascia or crushed cartilage

Complication	Cause	Avoidance	Correction
	lacerations Septal hematoma	flaps to prevent opposing lacerations Placement of septal whip sutures and use of removable soft silastic intranasal splints, prophylactic mucoperichondrial flap incision to allow drainage of any accumulated blood	graft interposed between lacerations Incision and drainage
Costal cartilage (autograft and homograft) warping	Intrinsic property of cartilage	Concentric carving	Revision
Pneumothorax after costal cartilage harvest	Injury to the pleura	Harvest cartilage in subperichondrial plane	Close wound under water with positive pressure ventilation

Table 2. Summary of complications [42].

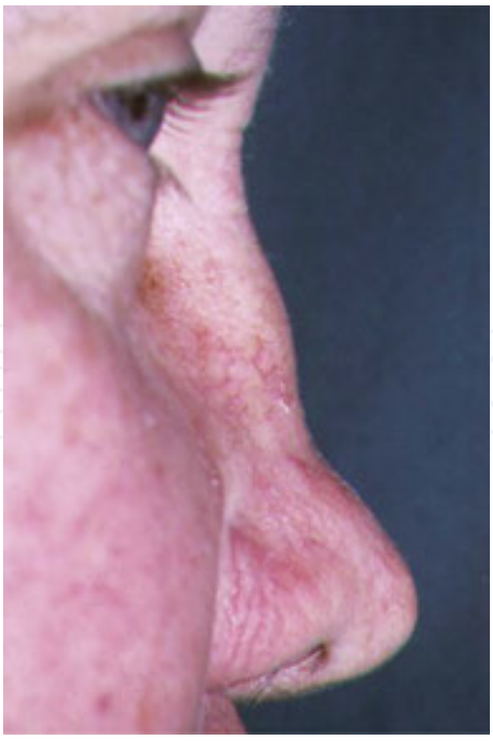

Figure 2. A saddle deformity caused by excessive loss of the bony and cartilaginous dorsum [1].

Figure 3. Erosion of a dorsal Gore-Tex implant through the skin of the nasal dorsum [2].

Figure 4. A pinched tip due to over-resection of the tip cartilages and insufficient tip framework [43].

The focus of rhinoplasty is to achieve nasal balance and maintain harmony with the face while keeping the nasal airway functional. Understanding the use of autologous, homologous, and alloplast materials for grafting and implantation purposes has become a necessity (**Table 3**; **Figures 5** and **6**).

	Resorption	Warping	Infection	Extrusion	Skin changes	Support
Cartilages	+	+	Low	–	–	Good
Bone	++	+	Low	–	–	Rigid
Homograft	+++	+	+++	–	–	Good
Alloderm	++++	NA	Low	Low	–	None
Silicone	–	–	+	+++	+	Rigid
Medpor	–	–	Low	–	–	Rigid
Gore-Tex	–	–	++	Low	+	Mesh
Mersilene	–	–	++	–	–	Mesh
Prolene	–	–	Low	–	–	Mesh

Table 3. Comparative incidence of complications with grafts and implants [44].

Figure 5. Extruding silastic implant 14 years postoperatively [45].

Figure 6. (A) Patient at surgery to remove an infected alloplastic dorsal graft that had been in place for 5 years. The patient was a heavy smoker. (B) No incision was made, as the graft had begun extruding through the columella. The material appeared to be porous, high-density polyethylene [46].

4. Midface lifting and blepharoplasty

4.1. Complications of midface lifting and the related surgical technique

Various complications may be encountered in the transeyelid approach, including temporary complaints of dry eyes, and lateral periorbital skin excess may occur in the early postoperative period, but these typically resolve with time. In the subciliary approach, a visible scar may remain. In the transconjunctival approach, conjunctival edema (chemosis) may be seen in up to 20% of patients [47].

In addition, there is a potential for middle lamellar scarring, leading to vertical shortening of the eyelid, which could present as a cicatricial ectropion or entropion or even permanent

changes in the shape of the eyes. There could also be zygomatic branch injury, leading to forms of lagophthalmos (**Figure 7**).

Figure 7. Patient referred with bilateral lagophthalmos resulting from overzealous skin excision during prior blepharoplasty [12].

4.2. Endoscopic temporal approach

Several complications may be encountered in this approach. Injury to the frontal branch of the facial nerve may occur. Injury may occur when approaching the zygomaticotemporal nerve and vein [48].

Injury to the vascular structures without adequate hemostasis results in hematoma formation. Aggressive medial dissection through the temporal incision may lead to lateral canthal distortion [41]. When beginning this temporal approach, if the plane is dissected too superficially, injury to hair follicles can lead to permanent hair loss. The use of the sublabial incision carries risks, given the potential exposure to oral flora. These patients may be at greater risk for developing malar subperiosteal abscesses [41]. Therefore, it is of the utmost importance for patients to receive postoperative antibiotics to cover oral flora for 7–10 days [48].

4.3. Preauricular deep plane approach

Complications include parotid duct fistulas if the parotid duct is invaded [49]. These complications are addressed by recannulizing the duct after locating the stensen duct intra-orally. If not a full cut, this complication could be addressed with warm compresses and aspiration. Another complication is earlobe deformity, including pixie ears. There could also be complications of the buccal branch or marginal branch nerve injury. There is also the risk for hematomas, leading to possible necrosis of the skin flap.

4.4. Complications of lower eyelid blepharoplasty and the related surgical technique

Lower eyelid blepharoplasty is generally performed through a transconjunctival or transcutaneous route. Both approaches can be complicated by lower eyelid retraction, DES, retrobulbar hemorrhage, diplopia, and volume depletion.

4.4.1. Lower eyelid retraction

The transconjunctival approach has a lower incidence of retraction, because it avoids the orbital septum [50].

Patients can present with an inferior scleral show chemosis, rounded lateral canthus, tearing, and a postsurgical look. A forced upward traction test can show tethering to the orbital rim or an overall tight feel. During the first 3 months, it is customary to encourage lower eyelid pushups and, if needed, injections of fluorouracil 50 mg/mL directly into the cicatrical region once per month. If, after 3 months, lower eyelid retraction remains, a surgical approach is planned. Depending on the severity of the lower eyelid retraction, a plan is formulated accordingly.

- First, it must be established whether the problem is anterior or middle lamella. If there is vertical inadequacy of the anterior lamella, a full-thickness skin graft is generally the treatment of choice.
    - More commonly, a middle lamellar problem is encountered. In this case, because of cicatrical contraction of the middle lamella, a spacer graft is the treatment of choice.
        - A cantholysis is performed, a transconjunctival incision is made with tenotomy scissors, and the tether is released.
        - If needed, a SOOF lift can be performed, and the orbitomalar ligament disinserted at this point.
            - A spacer graft, whether hard palate graft or acellular human or animal product, is secured, essentially extending the lower eyelid retractors to the conjunctiva.
            - The canthus is closed with a standard tarsal strip procedure, and the lower eyelid is placed up on a frost lower eyelid suspension suture for 5–7 days.

4.4.2. Diplopia

If the medial and central fat pads are injured during a lower eyelid blepharoplasty, torsional diplopia can result. If injury results from scarring to the inferior rectus or its attachments, hypotropia can result.

4.4.3. Dry eye syndrome

Most eyelid surgery can result in temporary dry eye symptoms or can be subclinical, which is evident only in the tear film breakup time or consistency of the tear film itself. Artificial tears can be prescribed, and, if more significant symptoms present, punctual plugs can be used.

4.4.4. Volume depletion

Excessive fat removal during a lower eyelid blepharoplasty will present the patient with complaints of a sunken appearance or darkened lower eyelids from a shadow effect and looking more tired than before surgery. The orbital rim can be seen with increased definition,

especially in patients with a less prominent orbicularis or thinner skin. A more prominent tear trough deformity can also be seen. This complication can be corrected with fat grafting to the newly hollowed area or a transeyelid midface lift. The best option is to avoid this complication by conservative fat reduction or performing a fat transposition.

5. Rhytidectomy (face lift)

A thorough preoperative evaluation will result in fewer complications after surgery. Patients are instructed to avoid the use of aspirin and nonsteroidal anti-inflammatory drugs for at least 2 weeks before surgery. Smoking must be stopped for at least 1 month before surgery. All other medications should also be avoided for 2 weeks prior to surgery because of the risk of postoperative bleeding and intraoperative anesthetic complications, including arrhythmias [51].

Chemotherapeutic agents and oral steroid use can alter the wound. Facial nerve paresis or paralysis must be documented preoperatively. Complete documentations for possible submalar hollowing, microgenia, facial asymmetry, submandibular gland ptosis, low-riding hyoid, and platysmal bands need to be done and discussed with the patient. Patients must be aware that perioral rhytids, deep neck rhytids, and nasolabial folds are unaffected by this surgery so alternative treatment plans must be discussed. It is important to evaluate the patient's position of the frontal and temporal hairline and look for evidence of alopecia. The present position of the temporal and mastoid hairlines needs to be respected in the design of any rhytidectomy incision. The temporal hairline must not be elevated or narrowed as the result of a poorly designed incision. The upper end of the rhytidectomy incision should be placed along and parallel to the lower end of the temporal hairline and should not extend above the upper edge of the pinna. If it does, the temporal hairline is raised and narrowed, compromising the final aesthetic result and making reconstruction of this valuable landmark difficult. Hairline incisions in the mastoid and post-auricular area should be avoided because they often result in hypopigmented and quite obvious scars that prevent the patient from wearing her hair up, which might expose them. If it is necessary to extend the incision behind the ear, then it is prudent to continue it into the hair-bearing scalp.

5.1. Intraoperative complications

5.1.1. Positioning and preparation

Careful patient positioning following anesthesia and before surgery improves patient visibility and outcome and reduces complications. Surgical lights should shone on the outer surface of the skin flaps and not directly into the surgical field for transillumination and to achieve the so-called peau d'orange effect in order to make necessary adjustments to avoid perforation of the SMAS and possibility of parotid fistula.

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5.1.2. Parotid duct injury

It may occur along the anterior border of the masseter on a line from the external auditory canal to the upper lip. If it is injured, the distal end of the duct is cannulated with a small catheter and passed retrograde into the field and then passed into the proximal severed end. It is left in place for about 2 weeks.

5.1.3. Facial nerve branch injury

Too deep dissection might result in injury to branches of the facial nerve. If recognized during the surgery, the nerve must be repaired. The temporal branch is most vulnerable anterior to the temporal hairline so dissection here must be superficial with observation of the overlying hair follicles in the skin flap. Marginal mandibular and cervical branch injuries are possible if the dissection below the mandibular border extends beneath the platysma.

5.1.4. Auricular nerve and jugular vein injury

The posterior neck flap dissection must be done superficially but without buttonholing the skin flap. Care is taken to avoid exposing the fascia overlying the sternocleidomastoid muscle and risking injury to the great auricular nerve and accompanying external jugular vein. If injured, direct repair of nerve and suture ligature of vein should be undertaken.

5.1.5. Spinal accessory nerve injury

More posteriorly, injury to the spinal accessory nerve can occur if the dissection becomes too deep. A good superficial landmark to keep in mind is Erb's point (**Figure 8**).

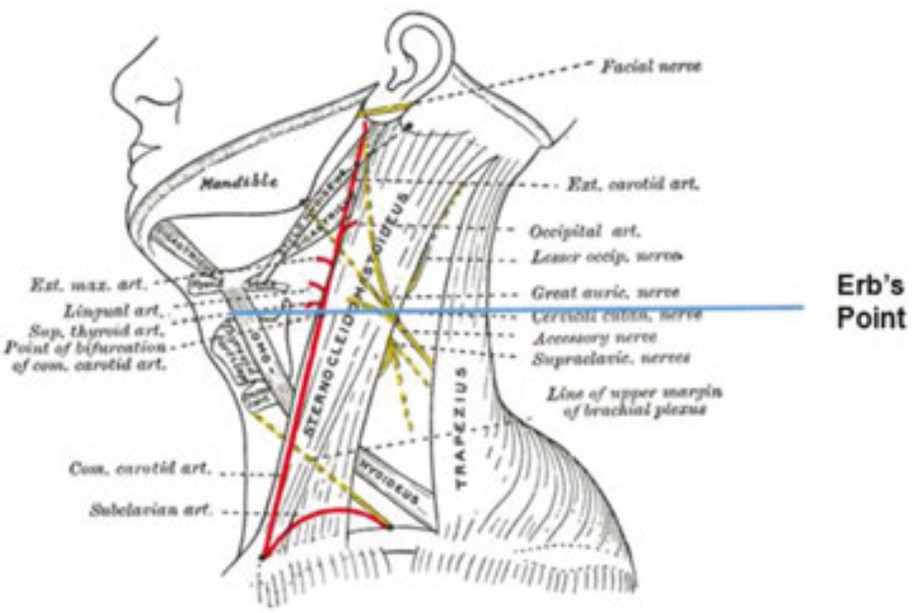

Figure 8. Erb's point [51].

5.2. Postoperative complications

5.2.1. Hematoma

Hematoma formation the most common postoperative complication typically occurs within the first 24 h following surgery, ranging from 3 to 8% of cases according to multiple studies [52–56]. Before discharge, the dressings are inspected and flaps viewed with a flashlight while lifting up the Kerlix wrap from each cheek. In the presence of significant pain or asymmetric swelling, flaps inspection is done. If a hematoma is discovered, the patient is returned to the operating room to prevent further complication to an already compromised flap. The incision is opened, clots evacuated, bleeding controlled, and the incisions closed over an active drain.

5.2.2. Infection

Infection is unusual following rhytidectomy but may occur as the result of a stitch abscess or, more rarely, a suture passed through the tragal cartilage. The offending suture(s) should be removed, and local wound care with an antimicrobial ointment often clears the problem. Significant erythema and tenderness to the auricular cartilage warrants oral antibiotics to cover *Staphylococcus, Streptococcus*, and *Pseudomonas* to prevent permanent cartilage damage.

5.2.3. Nerve injury

If noted during surgery, primary repair results in the best outcome. Mild facial paresis is usually temporary but may persist for 12 h after surgery, caused by the prolonged duration of local anesthetic agents or edema of the nerve. The great auricular nerve is the most frequently injured sensory nerve and results in numbness. If the nerve is repaired during surgery, return of sensation is common but may be delayed for 12–18 months and result in localized areas of persistent anesthesia. The temporal branch is the most frequently injured motor nerve and may resolve within 18–24 months of onset, but the resultant asymmetric brow can be improved with careful use of paralytic agents like Botox or Dysport on the nonparalyzed side. If the forehead paralysis is permanent, treatment is dictated by the extent of the subsequent deformity and disability. Mild asymmetry is best managed by the paralytic agents mentioned earlier, whereas significant brow ptosis may require a brow lift on the affected side.

Other nerve injuries may include marginal mandibular, zygomatic, buccal, or cervical branches of the facial nerve, and permanent damage was <1% in a large study [57].

5.2.4. Systemic complications

Major systemic complications are unusual in patients undergoing facelift surgery and may include deep vein thrombosis (DVT), pulmonary embolism, stroke, blood transfusions, major anesthetic complications, and death [58].

5.2.5. Skin slough

Skin slough is a rare occurrence following rhytidectomy (**Figure 9**). Vascular compromise is usually noted in the periauricular region and may appear as a distinct area of ecchymosis. Local application of nitropaste or DMSO 2–3 times daily may be beneficial to reduce the chance of full-thickness skin loss. Nevertheless, the area of concern is allowed to demarcate fully into an eschar before conservative debridement is done in the office. Excision of scars and closure are delayed until full maturation of the wound and scars has occurred to prevent further compromise of the flaps and ultimate aesthetic result.

Figure 9. Preauricular skin slough. The preauricular and postauricular regions represent the most distal segments of the facelift skin flap. These sites are prone to skin loss in smokers and in other instances where flap vascularity is compromised [59].

5.2.6. Scarring

Hypertrophic scars are injected with a dilute concentration of Kenalog 2–5% every 6 weeks once noted, along with the use of silicone sheeting or gels. Persistent scars may respond to pulsed dye laser therapy if resistant to the aforementioned measures and usually require multiple treatments. Hypopigmented scars are most common along the posterior hairline when incisions have been placed along the hairline instead of behind it.

5.2.7. Alopecia

Alopecia occurs following damage to the hair follicles from electrocautery, excess traction of tension on the skin flaps, and inadvertent elevation or elimination of the temporal hair tuft and temporal hairline. Temporary loss may be shortened with the use of topical minoxidil. Permanent alopecia requires the insertion of single-hair follicular units into the areas of alopecia or the replacement or lowering of the temporal hairline.

5.2.8. Contour deformities

Contour deformities are common immediately after rhytidectomy. Most of these are temporary and related to postoperative edema and ecchymosis and occur in the preauricular and submental regions (**Figure 10**). As the swelling subsides, most of these resolve, and resolution may be hastened with gentle local digital massage. Persistent contour deformities may be seen for several months and require no further treatment. If localized areas of depression persist after 6–12 months, they can be improved by injections of dermal fillers or fat.

Figure 10. Submental banding following overaggressive liposuction. Excessive fat removal or aggressive liposuction with scarification of the dermis may result in banding and an unnatural contour. This deformity is difficult to correct. Early in the postoperative period, massage and the judicious use of triamcinolone injections may help to minimize such irregularities. In the long run, the juxtaposition of soft tissue or fat grafting may diminish the appearance of banding. Avoidance of overaggressive lipocontouring is an important tenet [59].

Another problem with facelift skin adjustment is an unnatural-appearing earlobe. Although this seems like a straightforward part of the lift, failure to address the earlobe properly can lead to the most telltale sign of a poor technique, which is a "pixie" earlobe (**Figure 11**). The pixie or "elfin" earlobe is a result of lack of attention to the skin cutback to deliver the earlobe from under the excess pulled skin.

Figure 11. The pixie ear lobe deformity can occur with improper technique in facelift surgery [60].

6. Hair restoration surgery

6.1. Donor site

6.1.1. Complications

- Poor wound healing/scarring (atrophic, widened, hypertrophic, hypopigmented)
- Necrosis (**Figure 12**)
- Chronic pain

Cause: Improper donor harvesting (too wide a scar, too much tension, poor location, transection of hair follicles, transection of blood and nerve supply, improper undermining).

Avoidance: Surgical complications can be avoided by paying attention to the depth and angle of one's harvest (staying within the subcutaneous plane and above the galea), avoiding transection of the underlying blood supply, nerves, galea, and surrounding hairs. It should be ascertained that there is sufficient laxity (preoperative scalp relaxation exercises in a tense scalp), sufficient time between operative harvesting cases so that the scalp has had time to relax, and only 1 cm or less in width should be harvested when removing a donor strip. Use of tumescent solution to help straighten follicles and to limit injury to the underlying nerve and blood supply is critical. A careful two-layered closure is helpful to minimize scarring. Use of platelet-rich plasma (PRP) can help with good wound healing. If a wound is under tension, the wound should be closed in a delayed fashion rather than undermined or forcefully drawn close, both of which can lead to necrosis, unpredictable hair loss in the donor area, and additional scarring.

Correction: Albeit tempting, surgical excision of a scar tends to lead to the reappearance of the same scar over time. Placing grafts into the scar can be helpful but sometimes the blood

Figure 12. Donor-site necrosis resulting from a high-tension suture closure. Eschar is identified over the necrotic site in this 2-week postoperative photo. Early postoperative effluvium surrounds the devitalized incision site [61].

supply is poor and may not be entirely beneficial. Use of micropigmentation (tattooing) can also help cover the previous scarring. Chronic nerve pain (or conversely permanent anesthesia) that can arise from inadvertent transection of occipital nerves can be addressed with targeted botulinum-toxin injections into the specific area of discomfort. After 1–2 sessions of neurotoxin (2–5 units), the patient can be afforded lasting relief.

6.2. Recipient site

6.2.1. Complications

- **Pitting** (**Figure 13**)

  Cause: The graft was placed too deep relative to the surrounding tissue.

  Avoidance: The graft should fit the site correctly, and test grafts should always be undertaken first to ensure that the graft-to-site fit is appropriate before major graft dissection is undertaken. The graft should fit so that it rests approximately 1 mm above the surrounding skin because when the edema resolves, the graft settles to be flush with the surrounding skin. If placed flush or lower than the surrounding skin, the site has a greater likelihood of eventual pitting.

  Correction: It is very hard to correct pitting. In sensitive areas like the hairline, if the hairline is at the appropriate position or too low, then the grafts can be removed through punch excision. Otherwise, additional grafts can be placed around the bad grafts to camouflage them in an approach known as "de-emphasis grafting."

- **Cobblestoning** (**Figure 13**)

Figure 13. Graft height error. Careless graft placement resulted in a combination of cobblestoning (too high) and pitting (too low) [61].

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Cause: Cobblestoning is the opposite problem of pitting. When grafts are placed too high to the surrounding scalp, they can create a cobblestoned appearance (i.e., raised vis-a`-vis the surrounding scalp).

Avoidance: Grafts must be placed that fit the site correctly. If the grafts are too large, they may not settle into the site correctly and thereby leave a cobblestoned appearance after wound healing.

Correction: Cobblestoning is very hard to correct. The cobblestoned area can be transected flush to the scalp, or more grafts can be used to be placed around the existing bad grafts through "de-emphasis grafting."

- **Compression**

  Cause: Grafts with numerous hairs and that are too large for a particular site can be squeezed together to appear as a central tuft of hair, almost like a plug of yesteryear.

  Avoidance: Ensure that grafts fit the site appropriately.

  Correction: Similar to the correction stated above in "pitting."

- **Kinky hair**

  Cause: The hair shaft is overly manipulated or crushed during insertion by the grasping forceps leading to a wiry hair growth.

  Avoidance: The graft should be held only by the surrounding fat cuff and never on the hair shaft itself.

  Correction: Correction is similar to the correction stated above in "pitting."

- **Poor growth**

  Avoidance: Patients must understand that sometimes, despite a surgeon's best efforts, growth can be underwhelming based on a patient's growth characteristics. However, certain factors can predispose toward poor growth including not using recipient tumescent solution (0.01% lidocaine with 1:500,000 epinephrine) to protect the underlying neurovasculature, implanting grafts into too dense a distribution, and poor handling and manipulation of grafts (as mentioned above in pitting and kinky hair). Use of PRP during a procedure can improve a patient's chance of success with hair growth in the author's experience.

  Correction: A second hair transplant may need to be performed with better technique.

- **Unnatural hairline**

  Cause: An unnatural hairline can arise from a host of problems that involve a badly positioned hairline (too low, too high, improper slope, too wide, too narrow, and does not match a natural Norwood pattern of hair loss), too straight or harsh [use of grafts that are too large in the frontal hairline, not angling the grafts correctly (see **Figure 4**), not creating a natural micro-undulating hairline, not putting "sentinel" one-hair grafts to soften the hairline], or having any of the problems like pitting, kinky hair, and so on, mentioned above.

Avoidance: The macro-hairline (the line drawn on the head) should be undertaken only after a surgeon understands the natural Norwood patterns and can construct a hairline based on accepted principles that mimic nature. The micro-hairline (the actual recipient sites and grafts placed) must be constructed with utmost care so that the angles are low and straightforward and appear to look like a cragged coastline (i.e., without appearing too straight and harsh). The assistants who place grafts must adhere to careful attention to avoid previously enumerated problems, including pitting, kinky hair, placement of inappropriate graft sizes for a particular location, poor growth, and similar problems.

Correction: If the hairline is too high, the hairline can be redrawn lower and a better designed and constructed hairline can be placed in front of the bad grafts to camouflage them ("de-emphasis grafting"). If the hairline is too low to be acceptable or natural in appearance, then grafts can be punched out that reside in front of the proposed new hairline (**Figure 13**). Alternatively, a strip of grafts can be excised from the hairline to raise the hairline upward, after which time when the wound is well healed, a new hairline can be constructed according to the meticulous principles of good hairline design and execution.

- **Necrosis/poor scalp healing. Poor scalp healing can manifest as a hypopigmented scalp, a chronically discolored scalp, or frank necrosis**.

  Cause: Besides a patient's predisposing factors, such as smoking, chronic sun damage, and diabetes, a surgeon can inflict this outcome when the underlying vasculature is carelessly transected during recipient-site creation.

  Avoidance: Use of proper recipient-tumescent fluid is important to increase the distance between the recipient-site creating instrument (e.g., needle, blade) and the underlying neurovasculature. Also, avoiding overdense packing (>50 sites per cm^2) may help to minimize this problem. For signs of venous congestion or incipient necrosis, using nitropaste can be an immeasurably important rescue tactic. As mentioned earlier, use of PRP injected into the scalp an hour or so before site creation can help improve wound-healing capacity and minimize this risk. In patients who are very bald and have signs of poor vascularization, use of topical minoxidil for several months may anecdotally improve blood supply to the target recipient area but no conclusive studies have been undertaken to demonstrate that benefit.

  Correction: If the scalp looks discolored or hypopigmented in some way, additional grafts (placed in a more careful manner explained above and only undertaken a year or more later to allow for wound healing) may camouflage the scalp appearance. However, clearly the concern is compromising the blood supply further from additional transplantation. Use of minoxidil postoperatively may also help revitalize the scalp. In cases of frank necrosis, the eschar should be left in place (not debrided for fear that the tenuous blood supply is further compromised) and kept moistened with an antibiotic solution. When the eschar sloughs, the surgeon can consider excision of the necrosis or grafting into the area preferably many months to a year later. As an alternative, micropigmentation of the scalp can be performed to camouflage the area of baldness.

7. Otoplastic surgery

	Complication	Importance	Cause	Treatment	Note
Early complications	*Hematoma*	Can lead to infectious chondritis and necrosis Lead to cauliflower ear deformity	Improper plane of dissection Inadequate hemostasis before closure Poor auricle protection with dressing Postoperative trauma	Release sutures and milk out clotted blood Passive closure over a passive Penrose drain Apply fresh dressing Prescribe broad-spectrum antibiotics	Pay attention to extreme or asymmetric pain Bent ear and pressure necrosis can cause unilateral pain
	Infection	Chonritis	Non aseptic operative technique Ischemia Pressure necrosis Untreated hematoma	Irrigate with antibiotics before closure Incision and drainage Wound irrigation with clindamycin or gentamycin Postoperative antistaphylococcus and antipseudomonas antibiotics	Uncommon Associated with pain and focal erythema Purulence may be seen
	Skin and cartilage necrosis	Cartilage necrosis	Technical error Violation of subdermal plexus during dissection Excessive cautery use An overly compressive dressing causing compartment syndrome, and placement over a bent ear	Similar to that of infection Possible skin grafting or flap advancement to cover exposed cartilage	Rare Necrotic tissue must be debrided before coverage
Late complications	*Patient dissatisfaction*	Most common	Technical error Unrealistic expectation of patient and family	Revision	Preoperative discussion with the patient and family must establish realistic expectations Slight overcorrection

	Complication	Importance	Cause	Treatment	Note
					is likely to be more accepted than slight undercorrection
	Suture complications	Surface irregularities Erosion of the sutures through the skin Contour irregularities of the ear Narrowing of the external Auditory meatus Bowstringing Granuloma formation	Monofilament nonabsorbable sutures, such as nylon or polypropylene, can erode through the thin postauricular skin causing suture fistulae or granuloma formation Polyfilament nonabsorbable sutures, such as silk or polyester, may cause less erosion through the skin, but tend to have a higher infection risk placing sutures under tension across a gap spanning an area with little to no subcutaneous tissue	No treatment Suture removal using 4–0 mersilene suture for the mustarde technique Postauricular skin incision is closed with 4–0 plain gut suture	Sutures can safely be removed after 6 months without fear of relapse
	Loss of correction		Elastic recoil of the auricular cartilage Technical error such as improper suture location or placement Too few sutures, resulting in excess tension and subsequent pull-through of the sutures Inadequate weakening of the cartilage with adjunctive techniques	Proper placement of the suture through the anterior perichondrium	Slight overcorrection is advisable to account for the expected loss of correction
	Pathologic scarring	Patients at risk are younger or darkly pigmented or	Pathologic scarring occurs almost exclusively in Asians, Africans,	Particularly following postauricular incision Careful surveillance for infection	Particularly following postauricular incision

	Complication	Importance	Cause	Treatment	Note
		those with either a personal or family history	and Scandinavians		
	Hypesthesia		Technical error	Resolves spontaneously over several months During the winter months patients must cover their ears when outside for prolonged periods to help avoid frostbite	Quite rare Patients may be at increased risk of frostbite following otoplasty because of disruption in blood supply and/or transient sensory changes
Esthetic complications	*Telephone ear deformity*	Protruding superior and inferior poles	Overcorrection in the mid-third, such as overzealous conchal setback or excessive skin removal in the mid-portion of the auricle under correction of the superior and inferior poles	Careful preoperative planning and proper intraoperative technique Positioning the patient during surgery to be able to evaluate the ear from the frontal view	
	Reverse telephone ear deformity	Protruding middle pole	Prominence in the mid-third persists, and the superior and inferior poles are relatively overcorrected under correction of the middle third occur in the absence of conchal setback sutures when indicated overutilization of Mustarde-type sutures	Careful preoperative planning and proper intraoperative technique Positioning the patient during surgery to be able to evaluate the ear from the frontal view	
	Vertical post-deformity	Shows exaggerated vertical scaphal folding	Mustarde-type sutures placed in a vertical, rather than oblique, fashion	Placement of sutures along the natural arc of the antihelix	

Complication	Importance	Cause	Treatment	Note
Overcorrection and hidden helix deformity	"stuck down" appearance of the auricle	Excessive reduction of cartilage in the concha bowl is performed excess flattening if overcorrection of the antihelix is applied Helix that sits medial to (and hidden by) the antihelix on frontal view	Can be circumvented by initial placement of conchal setback sutures to avoid over tightening the antihelical sutures	
Antihelix creasing and puckering		Mustarde sutures that are too closely placed will cause notches or creases to form within the antihelix, rather than the desired gentle curvature overly large bites of more than 6 mm may cause puckering within the scapha	Careful preoperative planning and proper intraoperative technique	
Tragal prominence		When a considerable degree of conchal setback is attempted without adequate excision of postauricular soft tissue	Careful preoperative planning and proper intraoperative technique	
Auricular ridges		Cartilage-cutting techniques tend to destabilize the auricular cartilage	Cutting techniques should be confined to finely feathered abrasions or scoring of the anterior antihelical surface	
Interaural asymmetry		Technical error	Precise replication of both the sites for suture placement Frequent reevaluation and comparisons of both ears throughout the procedure	When prominauris is present only unilaterally, the patient should be advised of the possibility of achieving greater

Complication	Importance	Cause	Treatment	Note
				balance if both ears are operated on despite the relative normalcy of the uninvolved side

Table 4. Complications in otoplastic surgery [62].

8. Forehead and brow lift

Although the nonendoscopic approaches (coronal or trichophytic) have been the standard, there has been a trend toward, and wider acceptance of, the endoscopic brow lift as a preferred method for surgical rejuvenation of the brow.

8.1. Trichophytic forehead and brow lift

8.1.1. Bleeding

Bleeding complications may occur with any approach. Avoidance of injury to the superficial temporal or zygomaticotemporal arteries, supraorbital or supratrochlear vascular bundles, and sentinel vein improves outcomes.

8.1.2. Nerve injury

The supratrochlear and supraorbital neurovascular bundles should be identified and preserved to minimize additional forehead hypoesthesia medially up to the vertex. Direct injury is uncommon; however, traction neuropraxia may occur secondary to suspension [63].

Temporally, dissection in a plane superficial to the superficial layer of the deep temporal fascia minimizes injury to the zygomaticotemporal and auriculotemporal branches of the second division of the trigeminal nerve and avoids temporal and lateral frontal paresthesias [64].

Additionally, in the temporal region, great care must be taken to avoid injury to the temporal branch of the facial nerve because this results in paralysis and asymmetry of the forehead.

8.1.3. Scarring and alopecia

This complication may be minimized in open approaches by making an irregular incision with an extreme bevel 4–5 mm posterior to the hairline in an area of consistent follicular density to avoid dermal appendages and allow for postoperative hair follicle growth through and around the forming scar [65].

8.1.4. Asymmetry

Brow asymmetry and over/under elevation: Postoperative brow asymmetries may cause poor patient satisfaction. Asymmetries must be documented preoperatively and discussed with patients. Postoperative asymmetry may be caused by unrecognized preoperative asymmetries or blepharoptosis with failure [66].

Overelevation or underelevation of the brow may occur with any approach to forehead rejuvenation [66].

Overresection of skin in any variation of the coronal lift or excessive suspension with any technique may result in overelevation of brow with possible lagophthalmos. This may resolve with time or uncommonly may be permanent and difficult to manage. Concomitant upper blepharoplasty can increase the risk. The forehead lift should always be done before eyelid surgery and overexcision of eyelid skin must be avoided. Lagophthalmos with symptoms of dryness or irritation should be treated with lubricating eye drops and ointments. Limiting postoperative lagophthalmos to <2 mm is advised to decrease the risk of DES [4].

8.2. Endoscopic brow lift

Despite noticeable advantages over coronal approach, like short incisions which limit scarring, direct endoscopic visualization, that enables a safer and more complete dissection in endoscopic brow lifting, there remain complications inherent to endoscopic brow lifting such as asymmetry, irregular facial expressions, lagaophthalmos, visible scars, alopecia, infection/abscess, bleeding and hematoma, temporary hypesthesia of forehead, permanent anesthesia of forehead, brow paresis, wound dehiscence, skin sloughs or perforations, eyelid ptosis, corneal abrasions, DES, relapse and contour irregularities.

When bleeding occurs, the superficial temporal and/or zygomaticotemporal vessels are often the source. A head wrap with Kerlix, placed for the first 24 h, helps eliminate dead space within the optical pockets. The risk of bleeding or infection is similar for all techniques (endoscopic, trichophytic or coronal approach).

Lagophthalmos must be considered a risk of brow lifting. Once complete release of the arcus marginalis has been achieved, considerable elevation of the upper eyelid will occur with brow elevation. Patients who have undergone a previous upper blepharoplasty are most at risk. The authors attempt to limit this risk by performing the brow lift procedure before performing the upper blepharoplasty.

The risk of alopecia is significantly less with the endoscopic technique than in the coronal approach brow lifting. However, hair follicle damage can occur at any of the 5 incision sites, resulting in transient or permanent alopecia. The risk of alopecia with trichophytic technique is extremely lower in comparison with other techniques.

There is inherent risk of temporary hypesthesia or even permanent anesthesia of the forehead. The authors think that the temporary hypesthesia commonly seen after an endoscopic brow lift is secondary to a traction neuropraxia of the supratrochlear and supraorbital neurovascular bundles that occurs during elevation and release of the arcus marginalis. Lastly, injury to the

temporal branch should not occur during endoscopic brow lifting to avoid brow paresis. If paresis is noted in the immediate postoperative period, one must consider the possible temporary effect of local anesthetic. Sensation typically returns over the course of months, with improvements in sensation starting near the brow and extending toward the vertex, typically with full return of sensation by 12 months. Rarely, but occasionally, a patient may have some dysesthesia along the incision line or in the caudad scalp after sensation returns. It can be successfully treated with complete resolution through injection of the incision or with the use of supraorbital nerve blocks consisting of 0.5% marcaine with 1:200,000 epinephrines.

Postoperative brow asymmetry can result from failure to elevate either brow adequately by inadequate release of the orbital rim tissues.

We routinely place our patients in a standard facelift dressing for the first 2 postoperative days. The forehead component places pressure on the operative field, whereas the portion going around the head prevents displacement of the forehead dressing. The patient is instructed to keep the incision sites dry until sutures are removed on postoperative day 7.

9. Complications in skin resurfacing

Complication	Risk factors	Prevention and management
Erythema	Sensitive and thin skin Excessive sun damage	Icing, rigorous sun precautions Masking with makeup Treat with topical biafine (Valeant, Montreal, QC) and 590-nm LED photomodulation Consider a mild topical corticosteroid if condition persists
Blistering and burns	High-energy/penetration lasers Improper pulse stacking or high-density passes Insufficient cooling of the dermis Loss of pain feedback with heavy sedation or general anesthesia	Implement standard device safety and review of laser settings Allow the dermis to cool between passes and after treatment Burn care for severe thermal injuries
Infection (**Figure 14**) *and herpetic eruption*	Closed facial dressing left >48 h Insufficient facial hygiene/care History of herpetic rash	Adherent to posttreatment facial care with topical disinfectant with hypochlorous acid 0.01% (NeutroPhase, NovaBay, Emeryville, CA) or acetic acid 0.25–0.0125% (vinegar solution) Prophylactic antibiotic (cephalosporin), and a 1–2 weeks anti viral course (valacyclovir) started 24–48 h before treatment
Acne and milia	Closed facial dressings Oil-based creams	Daily facial rinses and noncomedogenic moisturizer Course of oral tetracycline for persistent acne Milia can benefit from topical tretinoin, gentle epidermabrasion, or extraction

Complication	Risk factors	Prevention and management
Postinflammatory hyperpigmentation	Fitzpatrick skin type III–VI Recent sun exposure/tanning History of hyperpigmented healing	Careful skin type selection with appropriate laser type setting Sun precaution 2–4 weeks before treatment and continued for 2–4 months Prophylactic or therapeutic 2–4% hydroquinone, 2–4% kojic acid or Kligman formula (5% hydroquinone, 0.1% tretinoin, and 0.1% dexamethasone). This should be started 2–4 weeks before treatment and continued for 2–4 months
Scarring and hypertrophic healing	Secondary to infections or burns Poor healing capacity History of keloid formation The periorbital region, the neck, and off-face areas	Scar-prone areas require lower fluence and density Apply silicon gel dressing to healing scars and hypertrophic bands Intralesion corticosteroid or 5-fluorouracil

Table 5. Summary of common laser complications and their management [67].

Resurfacing modality	Complications
Phenol based peels	Cardiac arrhythmias Laryngeal edema and stridor
Baker-Gordon solution	Prolonged erythema Permanent hypopigmentation Cardiac arrhythmias Laryngeal edema and stridor
Medium-depth peels	Scarring and permanent hypopigmentation (rare)
CO_2lasers	Scarring, permanent hypopigmentation (higher incidence in older lasers)
Infrared lasers	Dermal blisters, heals with depressed scars
Microdermabrasion	Streaks of hyperpigmentation
Visible light lasers and broadband light sources	Epidermal blisters; may heal with scarring and permanent hypopigmentation
Monopolar capacitive radiofrequency	Skin blisters Permanent fat atrophy when delivered in very high energy
Plasma skin regeneration	Burns, scarring
Fractional resurfacing	Scarring Recalcitrant hyperpigmentation
Photodynamic therapy	Intra- and postoperative pain, burning sensation, edema

Table 6. Resurfacing modality and complications.

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Figure 14. The crusting of a bacterial infection that developed after resurfacing [68].

10. Facial suction lipectomy and fat transfer

	Complication	How occurs	How avoid	How treat	Note
Other complications	*Embolization: blindness, stroke and skin/ tissue necrosis*	Permanent blindness usually results by tiny amount of the filler slipping into the retinal artery which can precipitate a central retinal artery blockage It is also possible to force the column back into the internal carotid a rtery and embolize into any area supplied by the internal carotid area, and this may result in a stroke	-Do not use sharpneedles. Additionally, one should limit bolus size, limit syringe size (only 1 mL syringe to the face), and avoid using ratcheting guns -The volume placed with each pass of the cannula should also be limited. Infiltration of less than 0.1 mL with each pass of the cannula is		Use only 1 ml Luer-Lok syringes for subcutaneous infiltration into the face

	Complication	How occurs	How avoid	How treat	Note
			recommended in the face		
	Fat necrosis: calcifications and oil cysts	Dead adipocytes become oil droplets and are first surrounded by infiltrated M1-type (inflammatory) macrophages for phagocytosis At a later stage, stratified layers of M2-type (anti-inflammatory) macrophages surround the M1 macrophages and form a fibrous cyst wall	-Fat particles with a more than 2–3 mm diameter cannot been grafted at 100%. - Use smaller injection syringes such as 1 mL syringe for the face and 3 mL syringe for the body	not easy totreat without surgical resection. Another option is to partially cut the cystic wall with an 14–18G needle and squeeze it, leading to leakage and phagocytosis of oil or necrotic tissue	Ultrasound assessment at 1 month after lipoinjection is particularly valuable
	Infection	As the grafted fat is not vascularized, it can be a focus of infection once severely contaminated by bacteria	Sterile technique should be observedat all times. Intraoperative antibiotics are recommended to use, but perioperative use of antibioticsis not recommended unless there is a specific indication	In cases of delayed infection, a high index of suspicion should be maintained for mycobacterialor other unusual infections	
	Damage to underlying structures	Even a blunt cannula, when inserted for removal and placement of fat, can damage underlying structures			Permanent injuries are extremely rare
	Pneumonia	Induced by damaging the pleura with an injection cannula/needle	Great care should be taken to avoid when introducing fat into the bottom layer close to the rib	It can be treated by a conservative treatment such as waiting with careful monitor of X-ray and symptoms	

Complication	How occurs	How avoid	How treat	Note
Aesthetic problems and complications	The presence of irregularities, which can be caused by the intrinsic nature of the patient's body, from the technique used for placement, and from migration after placement, is also noted	Irregularities after fat grafting diminish significantly as the surgeon gains experience with the technique		
Swelling and downtime	The placement of fatty tissue may create remarkable swelling in the recipient tissues	Elevation, cold therapy, and external pressure with elastic tape or Tegaderm (3 M, Maplewood, MN, USA) help prevent swelling. Certain medications (Arnica montana and bromelain) may also speed recovery. The patient is asked to avoid heavy pressure on the grafted areas for 7–10 days to avoid migration of the grafted fat		A slight staining of the skin, possibly hemosiderin deposits or other pigment changes, can remain for months in some patients after minimal fat grafting to the lower eyelid
Donor site problems	Some patients simply do not have adequate donor sites, especially if they have previously undergone liposuction	Complications of the donor sites are rare, but irregularity of the surface could occur, particularly when an excessive volume liposuction is performed in verythin patients		

Table 7. Complications of fat grafting.

	Complication	Cause	Treatment	Caution
Complications involving contour problems	*Lumps* (**Figure 15**)	-May arise if too large a bolus of fat is placed in a sensitive region like the lower eyelid. -The fat may have been placed too superficially so that it becomes visible as a contour deformity	Steroid injections may be a reasonable first step, these lumps may need to be excised to achieve complete resolution	If excision is required in the lower lid region, the most discreet placement for an incision is in the tear trough at the junction of the thin lower lid skin and thicker sebaceous cheek skin
	Bulges	-Arise from imprecise placement of fat along the inferior orbital rim, usually from a lateral entry point. -Arise in the lateral aspect of the malar region and may be caused by overcorrection. -May develop when the patient gains excessive weight	-Readily responds to injectable agents that can reduce the element of scarring, such as 5-fluoruouracil and dilute triamcinalone acetonide. -Focused microliposuction to reduce the bulk of fat	A bulge may develop when the patient gains excessive weight. The best way to mitigate this problem is through weight loss
	Persistent malar mound edema (**Figure 16**)	Generally occurs only in patients who have a visibly defined malar mound preoperatively, especially if they have a history of cyclical malar mound edema	The condition may resolve independently over time, if it persists, dilute steroid (kenalog) injections repeated every 4–6 weeks as necessary may hasten this process	The most important step in avoiding this complication is to identify the presence of a malar mound preoperatively and determine whether the patient has a history of cyclical swelling
	Overcorrection		Waiting a minimum of 6 months before	Overcorrection is best avoided through

Complication	Cause	Treatment	Caution
		intervention is advisable to allow for resolution of edema or resorption of fat over time. If this fails, then microliposuction of the overcorrected area may be required	a conservative fat transfer. "Hitting doubles" should underscore every fat-grafting endeavor
Undercorrection		Pre-operative counsel and description on the likely chance that a second fat transfer procedure will be needed to obtain the ideal result	The need for secondary fat transfer is seen more frequently in patients requiring large volume augmentation, those who smoke, and those who are extreme exercisers

Table 8. Complications involving contour problems.

Figure 15. (A) Patient before fat transfer to the inferior orbital rim and cheek. (B) At 6 months postoperatively, patient had a lump in the central inferior orbital rim and was also unhappy with the residual lateral fat pad. (C) Intraoperative photograph showing removal of the lump of transplanted fat that was causing the contour irregularity. This incision, at the junction of the lower lid and cheek skin, allowed for removal of redundant lower-lid skin. At the same setting, the lateral fat pad was reduced through a transconjunctival approach. (D) Postoperative photograph, after correction of the contour irregularity [69].

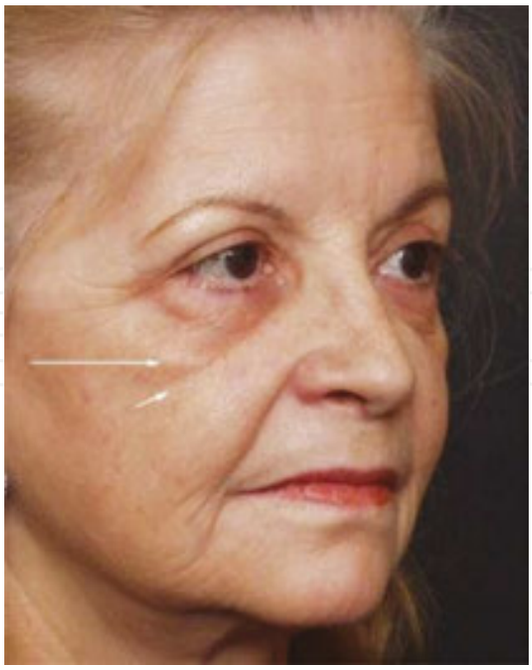

Figure 16. The malar mound is a triangular-shaped elevation (large arrow), anatomically delineated by the orbital septal–periosteal adhesion superiorly and the malar septum inferiorly (small arrow) [70].

11. Filler injections

Although HA fillers have been touted to be safer and thus more widespread than the other filler types, all have been associated with adverse outcomes. These complications range from localized bruising, erythema, edema, migration, allergic response, the formation of small bumps underneath the skin, to more serious sequelae, such as permanent visual loss and nerve paralysis (**Tables 5**–**8**).

The importance of hyaluronidase is due to its value in treating a variety of the complications of facial fillers. Hyaluronidase has the ability to dissolve HA. Approximately 30 U of hyaluronidase are needed to dissolve 0.1 mL of HA. Restylane may resolve the fastest and Belotero the slowest relative to more cross-linking in the latter [71].

Chronic prolonged edema can also be related to a type 4 hypersensitivity reaction. If it is unresponsive to antihistamines, it may need to be dissolved with hyaluronidase (**Figure 17**). Angioedema is an immediate allergic response that can last for several weeks. It may respond to antihistamines or prednisone [72].

Bruising is a complication of any procedure that involves the use of a needle or cannula. There is debate as to whether or not one should stop anticoagulants for patients receiving fillers [74].

For patients at low risk for cardiac disease or cerebrovascular disease, discontinuation of aspirin, nonsteroidal anti-inflammatory drugs, or herbal supplements, such as vitamin E, fish oil, ginseng, and ginkgo, is generally suggested. If a patient is at risk of thrombotic disease,

the anticoagulants may be continued and the patient must be made aware of the increased risk of bruising [72]. Some physicians believe that cannulas are safer and have less chance of causing bruising than needles [75].

Figure 17. This patient was injected with hyaluronic acid filler for tear trough correction and the filler was injected too superficially (top image). The same patient is shown 24 h later (lower image) after injecting 70 units of hyaluronidase (diluted with local anesthetic) in each lower lid in the area of the filler excess [73].

Arnica montanais a herbal supplement that inhibits transcription factor nuclear factor-kB2 has been promoted for its ability to minimize bruising. Some dermatologists fear contact dermatitis from the topical form. Oral Arnica demonstrated no improvement with blepharoplasty and hand surgery [76, 77]; however, it did improve postoperative bruising associated with facelift procedures [78].

Patients can also suffer from vasovagal responses or seizures because of the stress of the injection procedure. Close supervision of the patient at all times is recommended. Asymmetry is always a consideration in filler injections (**Figure 18**).

Figure 18. This patient exhibited asymmetry from under treatment of her left side. The marked area indicates where the touch up filler was needed [73].

11.1. Infection: biofilms

Proper topical preparation of the skin is inherently critical for prevention of infection. Topical alcohol 70% is inexpensive, readily available, and has quick onset. Topical chlorhexidine, available by swab or surgical scrub, is gaining popularity because it demonstrates a longer frame of action and tends to be nonirritating [79].

Immediate bacterial infections are thought to be caused by introduction of bacteria from the surface of the skin though the injection portal sites. Such infections can often be treated with broad-spectrum oral antibiotics, such as clarithromycin, because of its activity against atypical mycobacteria [80].

Makeup application should be delayed until 4 h after injection. Reactivation of a herpetic infection is also possible and can be treated with oral valcyclovir, 2–3 g/day.

Delayed infections caused by biofilms can be more difficult to treat. An inflamed nodule with a delayed presentation of 2 or more weeks can be caused by a biofilm.

They can contain bacteria, protozoa, or fungi in a low-grade infection that chronically seeds the local area and can even trigger a systemic infection [81]. Biofilms can be associated with foreign body granulomas (discussed in next section). Antibiotics should be started before any attempts to remove the granuloma with hyaluronidase (for HA); steroid, 40 mg/mL or fluorouracil (5-FU), 50 mg/mL injections; laser lysis; or surgical excision [72].

11.2. Granulomas

Granulomatous reactions are rare and can present months to years after an injection. Intralesional steroids and 5-FU are the therapeutic mainstay to inhibit fibroblast activity. If the nodules are associated with an abscess, the infectious component is often sterile. Granulomas may occur more commonly with long-lasting or permanent fillers, such as silicone, polyacrylamide, poly-(L)-lactic acid (PLLA), and Poly(methyl methacrylate) (PMMA) [72].

Granuloma can be localized or present as a global systemic response (Box 1). All can be treated with use of hyaluronidase and oral or intravenous steroids.

(Box 1) Presentation and management of common filler complications.

Nodules (early presentation)

- HA: extrusion, hyaluronidase
- Non-HA: intraregional steroids with lidocaine and or 5-FU, micro-focused ultrasound or fractional lasers, surgical excision

Inflammatory nodules

- Biofilm: antibiotics (biaxin, ciprofloxacin, or clarithromycin) for 4–6 weeks.
- 5-FU 50 me/mL, 0.1- to 0.5-mL injections
- Consider biopsy and infectious consultation for atypical mycobacterium of fungus.

Foreign body granulomas

- Localized; hyaluronidase if HA and intraregional steroids and/or 5-FU injections, then excision
- Global: hyaluronidase if HA, test spot on arm, biopsy, intralesional, or intravenous systemic steroids

11.3. Vascular occlusion

It is one of the most devastating complications arising from facial filler injections. Arterial embolization is more commonly direct anterograde with occlusion of an artery causing ischemia distal to the injection point. This direct form of occlusion usually occurs with injections to the glabellar region [82].

Clinically, patients manifest with significant pain and ischemic pallor, eventually leading to necrosis and atrophic changes. Hot compresses, massage, hyaluronidase, aspirin, and possibly oral steroids should be immediately considered. A venous occlusion is also possible during cosmetic injections. Instead of immediate pain and blanching, this presents with venous mottling termed livido. Livido from venous occlusion should be distinguished from bruising. Patient can be treated with heat, massage, hyaluronidase, and prednisone (Box 2).

(Box 2) Vascular occlusive events: presentation, treatment, and prevention.

venous

- Presentation: livido, lack of significant pain
- Treatment: heat, massage, oral prednisone, hyaluronidase if HA
- Prevention: awareness of anatomy danger zones, consider injection with cannulas, aspiration before injection, slow retrograde injections, avoid bolus injections >0.1 mL

Arterial

Anterograde

- Presentation: Pain, blanching distal to site of injection
- Treatment: heat, massage, aspirin, hyaluronidase, dase, oxyent infusion cream, hyperbaric oxygen
- Prevention; awareness of anatomy danger zones, consider injection with cannulas, aspiration before injection, slow retrograde injections, avoid bolus injections >0.1 mL

Retrograde followed by anterograde

- Presentation: dizziness, blindness, cerebrovascular accident, pain
- Treatment: heat, massage, acetylsalicylic acid (aspirin), hyaluronidase, hyperbaric oxygen

- Prevention: awareness of anatomy danger zones, consider injection with cannulas, aspiration before injection, slow retrograde injections, avoid bolus injections >0.1 mL

The literature has described devastating permanent visual loss from injections of steroids in the head and neck region for various benign lesions (i.e., chalazion, capillary hemangioma) [83, 84].

The substance must be injected against the systemic arterial pressure to fill the entire vessel retrograde past the bifurcation before it flows anterograde into the central retinal artery or its distal tributaries. Egbert and colleagues [85] approximated as little as 0.01 mL as the minimum required volume to cause vascular occlusion in the setting of intralesional corticosteroid injections to eyelid lesions. Numerous case reports describe this retrograde occlusive event clinically arising from filler injections in the nasal dorsum, nasolabial folds, and lips [86–89].

When such a vascular event occurs, patients can immediately experience significant pain, skin blanching, loss of vision, and decreased extraocular motility. Rapid recognition of these symptoms can allow the injector to promptly manage the evolving vaso-occlusion with the following measures: applying pressure to the injection site in an effort to dislodge the embolus, injecting hyaluronidase (if an HA filler was used) to dissolve the filler particles, and applying nitroglycerin paste and topical oxygen therapy to allow for vasodilatation and spontaneous release of the occlusive bolus. Some sources, however, indicate that nitroglycerin paste may worsen the impending ischemia by propagating the filler substance into other portions of the arterial tree [90].

Additionally, fat is more likely to cause an embolus, whereas HA filler attracts water, which may prevent further particle migration. The method of injection also contributes to the overall result. Slower injection of smaller volumes generally <0.1 mL in any given location allows for more controlled filling. Injection by blunt cannula may minimize the risk of perforating a vessel and facilitates remodeling of facial ligaments with gentle manipulation of the cannula tip.

12. Botulinum toxin A (Botox) injections

	Complications	Cause	Treatment	Note
Complications of Botox treatment	*Under treatment*	A past subclinical botulinum infection from food poisoning that did not require hospitalization could cause an immunity to botulinum toxin type A. Secondary to that, some patients simply	Use of botulinum toxin type B	It is important for patients to realize that some patients are sensitive to Botox and some are resistant or immune

	Complications	Cause	Treatment	Note
		do not respond to any amount of the toxin		
	Overtreatment	If the frontalis is heavily treated (especially the lateral areas) the main brow elevator is deactivated. When this happens, patients who usually lift their lids no longer can, making the brow and lid feel heavy and, because the brow is not elevated, the excess upper lid skin is more apparent	treat the lateral frontalis conservatively in older patients who have dermatochalasis and protect with informed consent and preinjection consultation	
	True eyelid ptosis	Eyelid opening is controlled by the levator palpebrae superioris muscle, which in turn inserts into the levator aponeurosis of the upper eyelid. If Botox is injected (or more commonly diffuses) into this muscle, the eyelid does not open	This complication can be avoided by keeping all injections at least 1 cm above the bony orbital rim.	It's recommended that inject just beneath the brow. This is acceptable if patients have normal positioned brows, but in patients who have ptotic brows, the injection may be close to the levator muscle
	Asymmetry	Injector placement or patient anatomic variation	This is easily corrected by placing some additional Botox at the active area	One of the most common asymmetries is the Spock eyebrow. This is a demonic curvature of the lateral brow that occurs when the central frontalis is deactivated but the lateral frontalis is active and only lifts the brow tail
	Bruising	This occurs when	Using a 32-gauge	Screening patients

	Complications	Cause	Treatment	Note
		a vessel is disrupted by the injection needle	needle and paying close attention to the superficial vasculature can limit this situation	for aspirin or other drugs that affect platelet aggregation also is important in preventing bruising
	Perioral droop	Can cause or contribute to dysfunctional animation of the perioral region	Lower facial Botox treatment should be reserved for advanced injectors and conservative treatment should be a mantra	A patient who presents to a cosmetic office to look better but is left drooling, lisping, or with the inability to pucker will not be happy
	Unrealistic patient expectations	Although not a complication, an unhappy patient is a problem	Preinjection discussion and informed consent should cover this	

Table 9. Complications of Botox treatment.

13. Facial implants in cosmetic surgery

13.1. Improper selection or placement

Generally speaking, improper placement of the implant is the most common complication followed by improper implant selection. The implant should be slightly smaller than the desired increase in fullness to take the contribution of the soft tissue into account. Appropriate implant selection is also important [38] (**Table 9**).

13.2. Neuropraxia

The malar neuropraxias had a slightly higher ratio of motor nerve injuries than sensory. Neuropraxia can be incurred from impingement by the implant because a size selection that is too large, migration, improper placement, a traction injury, a thermal injury, or a direct traumatic injury from dissection. Most patients regain sensation and function within 3 weeks. Anesthesia postimplant placement probably indicates the implant is resting on the nerve. Dissection for malar implants can also involve instrumentation around the facial nerve branches. Weakness of the zygomaticus, orbicularis oculi, or the frontalis muscles can be induced by the disturbance of the temporofrontal branch of the facial nerve while dissecting posteriorly over the middle third of the zygomatic arch.

During dissection of the chin for genial alloplast placement, it is important to avoid the mental nerve. The marginal mandibular branch of the facial nerve, which supplies muscles of the lower lip and chin, is above the periosteum over the inferior border of the mandible and is difficult to injure unless there is a severe traction injury or perforation of the periosteum.

13.3. Edema and ecchymosis

Typically the majority of postoperative edema and ecchymosis resolves in 2 weeks, but edema can persist for 6 months and even up to a year [91].

Implant fixation is important because excessive continuing movement can cause tissue injury, chronic inflammation, and suboptimal soft tissue acceptance with prolonged edema. This could also be due to a nonspecific immune reaction to the implant material.

13.4. Hematoma and seroma

Smaller hematomas (<5 cc) resolve without treatment in 10–14 days. Large hematomas need to be recognized and evacuated with the implant removed as necessary. Seromas usually present around 2 weeks after surgery. The presence of liquefied hematomas or seromas 2–4 weeks postoperatively may be drained percutaneously. Hematomas and seromas are best prevented with control of blood pressure during the procedure with general anesthesia and adequate local anesthesia, postoperatively with antihypertensive prophylaxis, and gentle handling of the tissues, maintaining a subperiosteal plane, and consideration for a drain in secondary procedures [92].

13.5. Infection

There are many different factors that determine whether an infection will be propagated after an implant is contaminated. Some of these factors include the bacterial load of contamination, host factors such as immune function, the method of contamination and age of the implant, and the perioperative prophylactic interventions by the surgeon to prevent infection. Implants can be contaminated by hematogenous, contiguous spread, or direct inoculation.

Implants decrease the amount of bacterial innoculum required to produce an infection. Foreign bodies have been shown to reduce the number of bacteria required to produce an infection by 10^4–10^6 power [93].

Zimerli found that decreased overall bactericidal activity was seen, including opsonization, bacterial ingestion, and intracellular killing of bacteria in neutrophils exposed to a foreign body [94].

Scalfani and colleagues studied the infection susceptibility of implants with different pore sizes. They found that the PTFE with an average pore size of 22 microns became infected at lower innoculum counts and sooner than polyethylene with a pore size of 150 microns. Most infections in the early postoperative time phase are more likely to occur with porous implants because of increased surface area, irregularity, and surface energy, which facilitates glycolax formation and bacterial adherence. Late infections are less likely to occur with porous implants

because of incorporation of host tissue and improved immune response. Late infection associated with malar implants has been associated with dental injections as reported by Cohen and Kawamoto [23]. In Wilkinson's retrospective review of 35 malar implant found that infections were associated with an old hematoma and subsequently cultured *Staphylococcus aureaus* [95].

Some authors hypothesize that exposure to saliva confers enough risk for development of infection that the intra-oral route should be avoided. In a study by Deva and colleagues, 422 patients had silastic nasal augmentation consisting of primarily columellar struts using an intraoral approach without prophylactic antibiotics and no postoperative infections occurred. Karras and Wolford [96] reported on 18 patients who had hard tissue replacement polymer (HTR) chin implants placed intra-orally with perioperative and postoperative antibiotics and reported no incidence of infection. These studies support the idea that patients with an intact immune system and healthy wound bed do not need additional antibiotics.

If salvage is selected in the setting of a purulent infection, the implant should be removed and scrubbed and/or sterilized to remove the biofilm. In addition, debridement and copious irrigation of the implant pocket, and finally, a prolonged postoperative antibiotic course are advocated. If rapid improvement does not occur and the implant needs to be removed, it should not be replaced for 6–8 weeks to allow for resolution of the infection and inflammation [97].

13.6. Migration and contour changes

There is a hypothesis that this is highly influenced by implant shape and method of fixation. Migration is usually the result of overdissection, selection of the wrong-sized implant, and lack of fixation. Supraperiosteal placement can also predispose the implant to mobility especially without adequate fixation (**Figure 19**).

13.7. Extrusion

Factors which are critical to preventing extrusion include adequate soft tissue bulk with quality tissue for coverage and insertion in the correct plane without tension. Decreased tissue perfusion decreases the potential for successful wound healing. Factors such as prior surgery and history of radiation will decrease the local vascular supply and result in fibrosis and stiffening of the tissues [98].

Excessive tension is usually the result of using too large an implant for too small a dissection. In addition to tensionless closure, subperiosteal placement helps to prevent exposure.

Some biomaterials can be treated symptomatically if exposure occurs without the need for removal. Frodel and Lee report secondary healing over polyethylene implant exposure and believe that if there is adequate vascularity, the implant will do well [98].

Other authors report intra-oral exposure of silastic implants that go on to cover secondarily with local wound care. Typically, however, if extrusion occurs, the implant must be removed and the site allowed to heal for multiple weeks before replacement.

Figure 19. The top figure demonstrations a superiorly displaced chin implant corrected by repositioning and placement of a larger anatomic implant with screw fixation. The lower figure shows on inferiorly displaced chin implant beneath the jaw requiring removal and replacement using screw fixation [99].

13.8. Palpability

Even the most perfect augmentation will be a failure if the patient can feel the implant and does not like it. This can be the result of improper size selection or contour, improper positioning, improperly placed fixation, or capsular contracture. It is important to make sure the implants are intimately adapted before fixation. Patient factors such as a thin amount of overlying tissue also predispose to palpability. In malar augmentation, Whitaker recommends limiting the thickness of the implant to no >4–5 mm and tapering the ends thinly to avoid palpability [100].

13.9. Lip dysfunction

Altered lip function is primarily associated with malar implants. This problem occurs because dissection can interfere with the muscles responsible for smiling mimetics, more so than for mandibular augmentation. Other factors could include edema, interposition of a solid implant which stretches the muscles of the midface, or interference with the facial nerve during dissection over the zygomatic arch. The edema can cause dysfunction in the muscles of the upper lip resembling facial nerve dysfunction. When dysfunction is due to muscle displacement, it usually takes 1–3 months for the muscles to reattach and the capsule to become soft and distensible. In malar augmentation, upper lip weakness can be minimized by a small, vertical mucosal incision, and dissection parallel to and in between the zygomaticus major and minor.

13.10. Bone resorption

Bone erosion under alloplastic implants have occurred to a significant extent with early implants (**Figure 20**) [101].

The bone resorption was often attributed to foreign body giant cell reaction between the implant and the bone or to pressure from the mentalis muscle against the implant. Other factors that were considered were improper implant positioning, pressure due to an oversized implant, subperiosteal placement, and hardness of the implant. Significant resorption poses not only an obvious problem associated with the creation of a bony defect and potential damage to underlying structures like tooth roots, but it also leads to loss of chin projection. Bony erosion probably occurs less with anatomic extended implants because of greater distribution of the pressure forces over a broader anatomic area [102].

Figure 20. Erosion of cheek implant into the maxillary sinus. Fortunately, this is a rare occurrence and most often a result of inadvertent entry during placement over a thin bony sinus wall [99].

13.11. Postoperative asymmetry

Asymmetry has many causes, but it is usually caused by initial malposition or by creation of asymmetric bilaterally dissected spaces. It can also be the result of unrecognized preoperative skeletal or soft tissue deficiencies. Although major asymmetries require a second surgery, minor asymmetries have a natural tendency to adjust and correct themselves over a 6-month postoperative period as healing progresses and the tissue around the implant relaxes and softens.

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