Review Article

Lower Eyelid Blepharoplasty: A Comprehensive Revisit of the History, Technique, Clinical Management and Further Directions

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ABSTRACT

Background: Lower eyelid blepharoplasty has evolved from a simple tissue excision to a sophisticated procedure that must balance aesthetic enhancement with functional restoration. Surgeons today face the complex challenge of integrating historical techniques, modern minimally invasive options, and emerging technologies to achieve optimal, natural-looking results while minimizing complications.

Methods: This comprehensive review synthesizes current evidence and clinical practices by conducting a broad analysis of the literature. It examines the historical evolution of surgical techniques, details both traditional (transcutaneous, transconjunctival) and minimally invasive approaches, and evaluates core clinical principles such as preoperative assessment, volume preservation, and lid-cheek junction optimization.

Results: Successful contemporary blepharoplasty relies on meticulous preoperative planning and adherence to volume-preserving principles, moving beyond simple fat removal to fat repositioning. It details the management of common challenges like lower eyelid retraction and highlights pertinent ethical considerations. Furthermore, the review identified promising future directions involving artificial intelligence for surgical planning and advanced biomaterials for structural support.

Conclusion: This review consolidates key evidence and clinical insights, providing surgeons with a practical, evidence-based framework for navigating lower eyelid rejuvenation. By integrating established principles with an understanding of evolving trends, surgeons can implement safer and more effective treatment strategies to improve patient outcomes.

KEYWORDS
Lower eyelid blepharoplasty; Periorbital rejuvenation; Transconjunctival approach; Fat repositioning; Postoperative complications

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INTRODUCTION

Anatomy and Physiology of the Lower Eyelid

The lower eyelid is a delicate and intricate anatomical structure composed of various anatomic components, all functioning in concert to promote health and proper function of the eye. Recognition of its

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anatomy and physiology is important to accomplish successful lower eyelid blepharoplasty.

The lower eyelid is composed of skin, subcutaneous tissues, orbicularis oculi muscle, orbital septum, tarsus and conjunctiva. The skin of the lower eyelid is thin and tender, and it can move smoothly and expressively. Under the skin, the fat pads of the subcutaneous tissue can constitute a shape contour of the lower eyelid. Orbicularis oculi muscle closes the eyelid and participates in facial expression. The orbital septum divides the eye lid from orbital contents and assists in holding in place the orbital fat pads. The tarsus or tarsal plates are two relatively thick, elongated plates of dense connective tissue, measuring approximately 5 mm in length on the lower eyelid. The conjunctiva covers the inside of the eye lid providing a smooth surface for eye movement[1].

Lacrimal drainage system is integral portion of the anatomy of lower eyelid and it is comprised of lacrimal punctum, canaliculi, lacrimal sac and nasolacrimal duct. Lacrimal punctum is a small opening in the medial part of the eyelid through which the tears are collected. Canaliculi are small tubes that carry the tears from punctum to lacrimal sac. The lacrimal sac is dilated portion of the drainage system that stores the tears for a time. The lacrimal sac's tears are transported by nasolacrimal duct to nasal cavity.

The anatomy of the lower eyelid consists of the coordinated movements of its constituent parts. Blinking is a mechanism to spread the tears across the surface of the eye and maintain the ocular surface moist and clean. Contraction of the orbicularis oculi muscle during blinking causes closing of the eyelid and the forcible pushing of tears towards the punctum. The tear producing lacrimal gland is superiorly located at the outside corner of the eye; tears flow down on to the eye, and enter the lacrimal drainage system.

Apart from their function of tear drainage and blinking, the lower eyelid can also help improve the esthetic appearance of face. A youthful lower eyelid displays a smooth contour, small fat prolapses, and tight skin. When people age advances, the lower eyelid may become changed, for example with skin laxity, fat herniation and tear trough deformities, which can both impair the function and the lower eyelid appearance resulting in tiredness or aged-looking aspects[2].

It is critical that surgeons who perform blepharoplasty must understand and comprehend the anatomy and physiology of the lower eyelid so as to be able to make appropriate clinical decisions regarding the technique they use to address the patient's particular issue. These might be (but are not limited to) fat repositioning, skin excision, placement of implants in order to return to a youthful form of the lower eyelid while maintaining its function[3].

Historical Evolution of Blepharoplasty Techniques

Over time, blepharoplasty has become a powerful tool in the cosmetic surgeon's quiver due to the continual innovations in the field to enhance its results as well to adapt itself to the many different requests of their patients.

Initial strategies aimed at blepharoplasty were mainly devoted to excision of redundant skin and fat aiming to improve aesthetical aspects that characterize aged eyelids. Such primitive surgeries were minimally challenging, not only generating poor aesthetics, a "operated" look, and risk.

With further knowledge of anatomy and physiology of the eye lid and development of surgical techniques, cutaneous or transcutaneous approach became prevalent by 1950s in which incision was made at the sub-epidermal area, just below the lash line, to expose the underlying layers, and was used for more detailed exposure of fat pads and the skin; thus, further improvement for fat removal or re-location could be achieved. But it was also exposed to a risk of scarring and damage to the orbicularis oculi muscle which may cause lower eyelid malposition or other complications[4].

To overcome these difficulties the transconjunctival method was proposed. The latter entails an incision inside the lower eyelid, within the conjunctiva, and it does not leave any external scar, with a decreased risk of orbicularis oculi muscle injury. Transconjunctival approach is an optimal procedure when fat prolapse is present in absence of marked skin excess. Despite this, it is not quite as successful at correcting patients with surplus skin or those for whom more liberal rejuvenation of the lower eyelid – cheek junction is required[5].

Surgeons have also been aware over the years of the need to treat the second phase – structural changes related to aging: orbital septum weakness, mid-facial descent and lift, and canthal re-support to

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achieve a more holistic and natural look. In another case, extension of transconjunctival lower eyelid blepharoplasty with release of tear trough ligament and redistribution of fat led to correcting tear trough deformity and better aesthetic appearance of the lower eyelid-cheek junction[6].

Over the past few years, minimally invasive approaches in blepharoplasty are being appreciated. Minimally invasive approaches like laser, radiofrequency or fillers are beneficial, as they present potentially better patient recovery, lesser scarring and result that may appear to be natural in aesthetic field. All these approaches require a more scrupulous patient selection; however, they are not indicated in all patients or at all types of eyelid conditions.

Throughout blepharoplasty history, we see surgeons' works trying to enhance safety, efficacy and outcomes of the surgery. Staying abreast of advances and finding the best solutions to patients' varying needs can help improve patients' satisfaction.

Basic Principles of Aesthetic Surgery in Lower Eyelid Blepharoplasty

Aesthetic surgery of the lower eyelids seeks to improve the appearance of the eyes while preserving their function. There are general principles that dictate surgical behavior in the performance of this task.

Preoperative Assessment

It should be rigorous for the skin quality of each patient, the quantity of fat prolapses, the tear trough deformity and the laxity of the lower eyelid in order to choose an ideal operation for every patient. For instance, transcutaneous approach might be required for removal of excess skin in patients with severe skin laxity, while in patients with little skin laxity but prominent fat pads transconjunctival approach might be appropriate[7].

Another principle is preservation of volume. Historically, in traditional blepharoplasty techniques, excess fat was removed but now it is acknowledged that retaining or restoring the volume in the lower eyelid region can have a good contribution for achieving a youthful and natural result. This can be addressed using fat repositioning wherein the herniated fat pads are repositioned to fill the tear trough deformities or using fillers, autologous fat grafting etc., to augment the volume of lower eyelid – cheek junction[8].

The lid - cheek junction plays also an important role in aesthetic lower eyelid surgery. For a natural - looking outcome a smooth and harmonious transition from lower eyelid to the cheek is desirable. Surgeons also apply specific techniques like the release of the orbicularis retaining ligament and a repositioning of the fat pads for better contouring of the lid - cheek junction. Furthermore, fractional fat injection application in lower blepharoplasty procedure has been suggested for a better blending of lid - cheek junction and a more esthetic result[9].

Aesthetic Functional aspect

Lower eyelid surgery is a functional surgery and the functionality of the lower eyelid may be the most important. The aesthetic functional should be guaranteed by surgeons to the lower eyelid function, include blinking, tear drainage and eyeball protection etc. It must be done with a thorough knowledge of the lower eyelid anatomy and skilled surgical techniques. As another example, where there may be pre - existing lower eyelid laxity, proper action may be required either as lateral canthopexy or canthoplasty to stabilize the lower lid in order to avoid postoperative problems like ectropion or scleral show[10].

In summary, fundamental concepts in aesthetic surgery of the lower eyelid blepharoplasty include comprehensive preoperative evaluation, Volume preservation, enhancement of the lid - cheek junction, and maintenance of lower lid function. Based on the above-mentioned concepts, beautiful results that improve the patient's look can be delivered by preserving normal lower eyelid function.

Prevalence of Lower Eyelid Disorders Requiring Blepharoplasty

Lower eyelid disorders that can lead to blepharoplasty are frequent. Their frequency is dependent on several variables (age, sex, race).

An audit of 656 eyelid surgeries done by oculoplastic and reconstructive surgery at a tertiary hospital in South Korea revealed that blepharoplasty was the most frequent procedure of the eyelid surgery with

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its contributing percentage to all the eyelid surgeries to be 24.2%[11]. This information reflects the fact that a considerable number of oculoplastic patients needing surgical procedures actually have lower eyelid issues treatable with blepharoplasty.

Age plays a critical role in lower eyelid diseases. With age, decrease in the skin elasticity and laxity of supporting structures of lower eyelid become a cause of many diseases like dermatochalasis (excess skin), fat herniation and tear trough deformities. In one study of patients presenting for blepharoplasty consultation, a certain amount of brow ptosis, as a syndrome possibly related to lower eyelid changes, was observed in 83% of patients, with most of those patients being >40 years old[12].

Gender might also be a factor. Some reports indicate women may be more inclined to undergo blepharoplasty for esthetic concerns, as they might be more anxious about lower eyelid appearance. Nevertheless, the distribution of some lower eyelid diseases like involutional entropion and ectropion might be more prevalent in men, probably because of gender-based hormonal factors or differences in eyelid anatomy[13].

Ethnicity may also impact the prevalence of lower eyelid disorders. Asian patients, for instance, may display different eyelid anatomy, with a thicker subcutaneous fat layer and a different orbital septum, configuration that would impact on lower eyelid disorders presentation and culturally speaking may impact on the potential motivation to search for treatment.

In order for surgeons to be able to counsel their patients, plan surgeries and assign resources, the distribution of lower eyelid pathologies that necessitate blepharoplasty need to be understood. With a better comprehension of pathologies which incite lower eyelid problems surgeons can better prepare for their patients in order to offer them appropriate treatment options.

Pathophysiological Mechanisms in Lower Eyelid Aging

Lower eyelid ageing is a multifactorial phenomenon resulted from a combination of pathophysiological processes, which can cause multiple aesthetic and functional alterations.

The main mechanism is the skin elasticity loss. Collagen and elastin fibers of the skin would gradually degrade in individuals aged. The loss of firmness and increase of laxity could cause surplus skin in the lower eyelid, which is termed as dermatochalasis. One research of lower lid ageing showed that skin of lower eyelid becomes thinner and loose over time, resulting in its droopy aspect[14].

Another critical process is weakening of the orbital septum. The orbital septum is a fibrous partition that separates the contents of the orbit from that of the eyelid. The orbital septum weakens with age and allows fat pads of the orbit to herniate into the front of the orbital septum resulting in the “bags” underneath the eyes. The herniated fat also allows for contribution to deepening of the tear trough deformity which is a linear groove from the inner corner of the eye to the cheeks. Research on the anatomical basis of lower eyelid aging reported the orbital septum become weaker, which was the main cause of the appearance of fat herniation and tear trough deformities[15].

The mid-face descent is highly related to the age of lower eyelids. As the mid-face soft tissues including the malar fat pad migrate inferiorly over the years, it could result in additional separation of the lower eyelid from the cheek that contributes to intensify the tear trough and also increasing the sense of aging. The mid-face structures’ loss of support can also explain the lower eyelid inferior displacement due to fat prolapse, which might also result in functional problems such as the lower eyelid malposition.

Moreover, the orbicularis oculi muscle can also change during ageing. It can weaken or its tone can alter causing a disruption of the natural blinking and interfering in the overall appearance of the lower eyelid. Muscle change can contribute to loss of a regular contour of the lower eyelid and enhancement of the fine lines and wrinkles[16, 17].

The comprehension of these pathophysiological mechanisms is imperative for surgeons in planning a lower eyelid blepharoplasty: identifying these, surgeons could make appropriate surgical techniques that directly act on one of them, in order to respond to aging process and to obtain better aesthetic and functional outcome.

Risk Factors Associated with Lower Eyelid Deformities

Several risk factors might contribute in affecting the lower eyelid deformity; they must be recognized by

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the surgeon at the preoperative evaluation.

Age is one of the primary risk factors. The skin, muscle, and lower eyelid supporting structures undergo a variety of changes that occur as a consequence of the natural aging process. The loss of skin elasticity, orbital septum laxity and the mid-face descent occurring due to the natural aging process is predisposing factor for having deformity including dermatochalasis, fat herniation and lower eyelid malposition. In patients who had undergone treatment for involutional lower eyelid entropion, age was found to be an important risk factor and patients with elder age were more frequent[18].

Yet another risk factor is previous eyelid surgery. Patients who underwent previous blepharoplasty, or other eyelid procedure, have a risk of lower eyelid deformities that may result from, among other reasons, scarring and disruption of the normal tissue handling during the previous surgery or anatomical changes of the eyelid. For instance, one study on secondary upper lid blepharoplasty, revealed that having prior blepharoplasty is one of the factors that predispose to the common symptomatic complications including asymmetry, lid ptosis, and scarring, with potential effects to the lower eyelid[19].

Finally, systemic conditions, although less frequently, such as thyroid related conditions can involve changes in orbit soft tissues, which result in eyelid retraction or other deformities. Graves' orbitopathy represents a situation in which lower eyelid retraction, possibly with association to proptosis and other orbit changes, is at a relative risk[20].

Trauma or external causes can also be responsible for lower eyelid deformities. Trauma to the face and eyelid can cause injury to the supporting structures leading to either immediate or delayed deformities. For instance, a fracture of orbital floor may displace lower eyelid and cause malposition or some other deformity[21].

Certain medications may also be a risk factor. Prolonged use of prostaglandin analogs for glaucoma treatment has been associated with changes in the lower eyelid, including horizontal eyelid shortening, increased eyelid margin tension, and lower eyelid retraction[22].

This identification of risk factors is essential for surgeons to employ suitable treatment plans. In certain cases, treating the underlying risk factor, e.g. controlling thyroid disease might be required before lower eyelid surgery can be considered in order to achieve optimal outcome and mitigate the risk for complication.

Clinical Assessment Methods for Lower Eyelid Conditions

Clinical examination is the basis for diagnosing lower eyelid disease before blepharoplasty. It is a comprehensive examination of any features of lower eyelid to decide the most suitable method of treatment.

The first stage of the clinical evaluation involves visual inspection. The lower eyelid is examined for evidence of skin laxity, fat prolapse as well as tear trough deformities. The lower eyelid margin position relative to the globe is then considered. If either the lower eyelid margin is too high or low, this may signify an underlying pathology. For instance, lower eyelid retraction (eyelid pulled away from the globe) appears to be visible when using the scleral show for assessing an increased amount of exposed scleral area. In a study of patients with lower eyelid malpositions, visual inspection was used for identifying presence and severity of ectropion and entropion[23].

Palpation is also an important examination. Gently palpating the lower eyelid can be helpful to evaluate whether the fat pads underneath the lid appear normal, in terms of their soft consistency. Thickening/firmness of fat pads may suggest fat herniation. Palpation can help to identify any nodules/mass (potential tumor/lesion) that exists.

Functional tests, as well, are an important component of the clinical examination. The snap-back test is applied for evaluating the lower eyelid's laxity. For this test, the lower eyelid is pulled downward with a gentle force, then it is let go, and the normal eyelid is supposed to snap back to its original position quickly. If it snaps back slower or does not fully snap back, there should be quite severe laxity present, which would probably need some improvement via surgery. An additional functional test, the so-called distraction test, can serve as well. This measures the outward displacement of the lower eyelid upon gentle traction. Excessive displacement means a need for procedures tightening the lower eyelid such as lateral canthopexy and canthoplasty[10].

Moreover, tear film integrity is worthy of note. Dry eye can be a preexisting condition and may be

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accentuated by blepharoplasty. Tear production test (Schirmer test) and tear break-up time test (assessing tear film stability) can be conducted to detect patients who have risk of dry eye, which may necessitate other prep preoperative treatment or surgical plan adjustments to reduce risk postoperatively[24].

In summary, with a comprehensive clinical evaluation using these techniques, surgeons are able to correctly determine lower eyelid pathology and make the best surgical decision toward an optimal aesthetic and functional final result.

Traditional Surgical Approaches in Lower Eyelid Blepharoplasty

Traditional surgical approaches in lower eyelid blepharoplasty have been the mainstay of treatment for many years, with well - established techniques that address various aspects of lower eyelid aging and deformities.

The transcutaneous method is a commonly used traditional technique. In this technique, the incision is done directly beneath the lash line in the subciliary crease, giving direct access to the subcutaneous tissues such as skin, orbicularis oculi, fat pads etc. The transcutaneous technique is especially helpful in patients that have substantial skin laxity, since the surgeon is able to excise the excess skin and relocate the fat pads in order to provide a more youthful appearance. One study on lower eyelid blepharoplasty utilizing the transcutaneous route described good long - term results regarding skin tightening and fat reduction with a relatively low complication rate[25].

Another classical technique is the transconjunctival approach where the incision is made in the lower eye lid on the inside, through conjunctiva. This method is preferred as it does not give any scar in the visible area of the skin and it reduces the risk of injuring the orbicularis oculi muscle. This is typically the case when the patient has little skin laxity but bigger fat pads. The transconjunctival technique permits evacuating the fat pad or displacing it so to correct the "bags" below the eyes.Yet, it is likely to be suboptimal to treat skin laxity or to cases where more comprehensive rejuvenation of the lower eyelid -cheek junction is needed[26, 27].

In certain circumstances, both the transcutaneous and transconjunctival approaches are used. It may prove useful when patients exhibit a mixture of severe skin laxity and fat herniation. The transconjunctival approach is utilized to treat the fat pads, and the transcutaneous approach to remove the excess skin while conducting other procedures including lateral canthopexy, or canthoplasty to support the lower eyelid[28].

Traditional surgical methods also had some fat management techniques. The resection of the herniated fat pad has been widely used in the past years where the herniated fat pads were removed to minimize the visibility of "bags". Nowadays, fat repositioning becomes more popular, by moving the fat pads to fill the tear trough deformities with a more natural, youthful contour. For instance, during the augmented transconjunctival lower eyelid blepharoplasty, the fat is displaced inferiorly under the released tear trough ligament in tear trough deformity correction[29].

In spite of the recent technics for eyelid surgery, classic incisions of lower eyelid blepharoplasty are widely practiced because they offer all the correct tools for the diagnosis and treatment of multiple lower eyelid diseases. But surgeons should pay attention to individual needs of the patient and the anatomical characteristics to obtain best outcomes.

Minimally Invasive Techniques and Their Efficacy

Minimally invasive methods of lower eyelid blepharoplasty were proposed as an alternative to the usual surgical method of blepharoplasty for various potential advantages.

One approach is the injection of fillers. Fillers, including hyaluronic acid-based products, may be utilized to treat tear trough deformities and for the improvement of the contour of the lower eyelid. Fillers are used to introduce volume into the region, minimizing the appearance of the depression. A study published exploring fillers in the lower eyelid region noted they could offer a relatively rapid, minimally invasive alternative with immediate results and little to no downtime. Yet, the treatment by fillers is mostly reversible and multiple sessions are needed over time[30].

Laser - assisted interventions have also gained traction. Lasers can resurface the lower eyelid skin, improving the overall texture and minimizing the signs of fine wrinkling. The most promising in terms of treating the low eyelid thin skin is fractional laser resurfacing, which involves microscopic columns

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of thermal damage within the skin, which induce the collagen production and skin rejuvenation. In a laser treatment for periocular skin conditions, a good outcome of improvement was shown, while adverse effects were few[31].

Another minimally invasive modality is the radiofrequency (RF) technology. RF devices can directly transfer energy into lower eyelid tissue, inducing collagen remodeling and lower eyelid skin tightening, which may be helpful in treating mild to moderate skin laxity. RF treatment is well-tolerated by patients and doesn't require any downtime. Nonetheless, results might not be as impressive as obtained with conventional surgical methods, and multiple treatments might be required for satisfactory outcomes[32].

Other minimally invasive methods involve small-incision procedures. For instance, some surgeons choose to approach the fat pads with a small-incision, avoiding a larger transcutaneous/transconjunctival incision, which allows for lower risk for scarring, minimizing the damage to underlying tissues. A minimally invasive technique for lower lid blepharoplasty study presented satisfactory aesthetic results and a very low complication rate[33].

The success of those minimal access procedures relies on multiple parameters, such as the degree of the lower eyelid changes, the individual patient's condition and the surgeon's skill. Although these are not suitable treatments for all the lower lids and are less indicated for patients with higher degree of skin laxity or with anatomical changes, they present for such patients the option of minimal access or damage treatment for a faster recovery with less visible changes in the patient's lower eyelids.

Postoperative Care and Management in Lower Eyelid Surgery

Postoperative and management are elements integral of lower eyelid surgery that can have a significant role in the result and experience of the patient during recovery.

Soon after surgery, patients are generally recommended to make a cold compress on a lower eyelid area. Cold compress is useful for the reduction of swelling and bruising because cold compress causes the contraction of the blood vessels. A study using cold compress in blepharoplasty reported they were found helpful for the reduction of early postoperative swelling[34].

Patients are also typically prescribed an antibiotic to prevent infection. While the likelihood of infection following lower eyelid surgery remains minor, this can still be crucial. Antibiotics can be administered orally or topically, determined by the surgeon's preference, and patients' condition. Furthermore, patients are informed to keep the surgical site clean and dry to minimize the probability of infection.

Post-operative pain management is common in most procedures. In most cases, over the counter anti-inflammatory pain medications are sufficient, while in some individuals' prescription medications are required. Surgeries involving the lower eyelid often include pain management recommended by the surgeon, such as using arnica, yet a RCT did not demonstrate benefits of treatment with arnica ointment following upper blepharoplasty[35].

The postoperative period should be monitored for complications. Bleeding, infection and lower eyelid malposition are complications that can develop. Routine follow-ups at fixed intervals have to be scheduled where the healing progress and appearance of any complications can be monitored early. Most complications were discovered during the first 6 weeks of the upper lid ptosis surgery[36].

For long-term management, it is recommended for patients to have a healthy lifestyle. Good life habit should be accompanied by a balanced diet and regular exercise training to assist the comprehensive healing of the wound and contribute to a more favorable outcome; meanwhile, patient should be forbidden to do some pressure-bearing movements on their lower eyelids (e.g., rubbing eyes) or should avoid wearing tight-fitting glasses for a while after an operation.

In all, good postoperative management and care are key to a successful outcome of lower eyelid surgery. Patient compliance and attendance at clinical visits helps avert most complications, enabling the attainment of ideal aesthetic and functional results.

Debates on Aesthetic vs. Functional Outcomes

Whether the pursuit of a strictly aesthetic outcome versus a functional result for lower eyelid blepharoplasty is the end goal of cosmetic surgeons remains, under discussion.

Patients generally desire lower eyelid blepharoplasty solely for aesthetic reasons; they

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want a more youthful, fresher, renewed-looking appearance with reduction of "bags" below their eyes, smoothing of fine creases, and more regular contour of the lower eyelid – cheek interface. Surgeons try to accomplish these aesthetic effects by means of different surgical maneuvers including fat re-positioning, skin excision and canthal support. For instance, in a study of patients undergoing the lower eyelid blepharoplasty, high satisfaction scores were recorded with the aesthetic outcome when the procedure adequately addressed the aesthetic complaint that patients had regarding the appearance of their lower eyelids[10].

Nonetheless, attention should equally be paid to preservation/improvement of functional eyelid. The lower eyelid serves a vital function on preserving the eye from potential damage, distributing tears and maintaining the ocular surface integrity. Surgeries should not impair any of these functions. For example, excessive skin excision or loss of fat, especially improperly excised lower eyelid can result in loss of lower eyelid's position, otherwise known as lower eyelid retraction can result in dry eye, exposure keratitis and other functional complications. In studies on complications of lower eyelid surgery, lower eyelid retraction was one of the major complications that could have adverse impact on patient's quality of life[37, 38].

Another element of the debate is "what" should be seen as an "optimal" result. For one patient what could be aesthetically desirable could be not the same for another, as aesthetic preferences are very much a matter of, for example, culture, age and individual expectations. Surgeons must have extensive discussions with patients about their goals and expectations and they should strive to meet such expectations in an acceptable manner. They must also guarantee that the implementation of the surgical treatment does not affect the proper lower eyelid function.

In some cases, achieving both aesthetic and functional goals can be challenging. For example, in patients with significant lower eyelid laxity, tightening the eyelid to improve the aesthetic appearance may require procedures that carry a risk of affecting the normal function of the eyelid. Surgeons must carefully weigh the potential benefits and risks of each procedure and choose the approach that best balances the patient's aesthetic desires with the need to maintain or improve eyelid function[39].

Complications and Their Management in Lower Eyelid Surgery

As with any surgical intervention, lower eyelid surgery carries certain potential complication that must be considered by the surgeon and how to treat them should become familiar knowledge to all the surgeons.

Lower eyelid retraction is one of the most common complications. Lower eyelid retraction happens when the skin of the eyelid is retracted from the globe. Consequently, it causes the increase of the scleral show. Lower eyelid retraction may be triggered by the over-aggressive skin excision, the damage to the supporting structures during the surgery and the preexisting proptosis. The surgeons can also employ methods such as placing spacer grafts to support the lower eyelid and restore it to its natural position to control lower eyelid retraction. A study concerning the prevention of lower eyelid retraction using primary eyelid spacer grafts during cosmetic lower lid blepharoplasty suggested that primary lower eyelid spacer grafts could be a viable option for the prevention of lower eyelid retraction in patients of lower eyelid retraction with high risk factors[37].

Bleeding is also a common complication that may occur during or after the surgery. With minor bleeding, physicians may control them with local pressure, but the severe bleeding may need surgeons to operate for finding the bleeding source to be closed. To avoid post-operative bleeding, surgeons should pay attention to control the blood vessels during the surgery for example using electrocautery to coagulate the blood. An investigation on the estimation of postoperative bleeding after blowout fracture repair showed that the application of a negative-pressure drainage system may serve as a tool to prevent retrobulbar hematoma, which is a life-threatening bleeding complication in the region periorbital[40].

Infection is also a concern. To minimize the risk of infection, surgeons typically prescribe antibiotics before and after surgery. Patients are also instructed to keep the surgical area clean. If an infection does occur, it is usually treated with appropriate antibiotics, and in some cases, surgical drainage may be required.

Ectropion and entropion are other complications that can occur. Ectropion is the outward turning

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of the lower eyelid, while entropion is the inward turning. These can be caused by factors such as improper suturing, scarring, or damage to the eyelid muscles. Treatment for ectropion and entropion may involve surgical correction, such as tightening the lateral canthal tendon or repositioning the eyelid tissues[41, 42]. A study on the comparison of lower eyelid complications after subciliary versus transconjunctival approaches to orbital floor fractures found that the subciliary approach was associated with a higher rate of ectropion, while the transconjunctival approach was associated with a higher rate of entropion[43].

In summary, surgeons should take heed in lower eyelid surgery complications and ready to manage them if encountered. The use of the reasonable preoperative preparation, meticulous surgical technique and proper postoperative care can minimize the risk of complications and improve the patient outcomes.

Ethical Considerations in Cosmetic Lower Eyelid Procedures

Ethical issues can be considered critical aspect of cosmetic lower eyelid surgery, considering not only the patient's physical status, but also the emotional and social side.

A major ethical issue is the selection of patients. This means that the surgeons must be sure that the patient had made an informed choice of whether to undergo the procedure. This must mean that the patient has received details of the likely consequences of undergoing or not undergoing the surgery including alternative treatments for the condition. For example, in a research paper that discussed the ethical considerations of cosmetic Asian facial surgeries, they stated that candidates needed to fully aware the possible results or the complications the blepharoplasty could cause, before decided the surgery[44].

The second ethical question is body image and risk of unrealistic expectations. A cosmetic lower eyelid surgery is generally pursued by patients who are discontent with their look. For this reason, surgeons should prevent from leading or even enabling patients with unrealistic expectations. Sometimes patients could have underlying body dysmorphic disorder and it could not be a surgical indication[45]. Such conditions should be screened by surgeons for every patient and proper counseling or referral should be offered as applicable.

Another ethical problem is the use of images and the patient's privacy. If the surgeon uses the images, before and after surgery, for educational or promotion, it needs patient informed consent before usage of images, as also it should protect the patient's identity. In a study on the moral dilemmas associated with the use of images from donated cadavers in the anatomical sciences the importance of informed consent for the use of images was highlighted and this applies equally to the use of patient images in cosmetic surgery[46].

Cosmetic lower eyelid surgery is associated with also ethical issues connected with money issues. The charges should be legitimate and patients should be avoided of being cheated. There should not be any false claims about lower eyelid surgery.

The cultural aspects might also have an impact as for instance in some cultural contexts, differing views of aesthetics and acceptability of cosmetic surgery exists. The surgeons have to be considerate regarding these cultural aspects and are required to respect the patient's cultural history during treatment.

In summation, ethical issues for cosmetic lower eyelid surgery are well to be aware of in which it is up to the surgeon to be able to simultaneously be responsive to a patient's cosmetic request alongside our responsibility to place the well-being of the patient to the utmost, physically and mentally. Ethical practice permits surgeons to offer optimum care to the patients in the process of building patient's confidence.

Emerging Technologies and Future Directions

Lower eyelid blepharoplasty approaches using emerging technologies hold the potential to revolutionize the field, with opportunity for enhanced outcomes and satisfaction.

One such emerging tool is the use of artificial intelligence (AI) and machine learning. AI may be used for preoperative image and patient-data analysis to make predictions of surgical outcomes, for surgical planning, and, potentially, even during the execution of the operation itself. An example may be an AI algorithm which, based on facial anatomy, skin properties and desired cosmetic outcome, recommends what specific form of surgery may be most suitable. This might allow for more individualized and accurate surgical planning, while decreasing potential complications and increasing

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patient satisfaction. Researchers have reported their findings that AI in plastic surgery could aid in enhancing patient education and training but that ethical integration needs to be properly addressed[47]. Another potential technology involves new biomaterials. New types of biomaterials might have multiple applications in lower eyelid surgery, ranging from providing support to the lower eyelid structures to increasing the healing process. For example, bioabsorbable implants might be used to replace, or reinforce, a weakened orbital septum, giving prolonged support without the subsequent procedure for its removal[48].Such materials may also support tissue healing resulting in better long term outcome[49].

Finally, we expect developments in imaging technologies will also play a role. High -resolution, 3D imaging with real-time feedback could allow the surgeon to get more information concerning the patient's anatomy during the surgical procedure. This could facilitate more precise dissection, fat relocation and overall surgical execution[50].For example, intraoperative MRI or CT imaging can possibly guide surgeons to make any necessary modifications based on the real time view of the tissues, optimizing the surgery precision[51, 52].

Minimally invasive procedures will presumably evolve further. Next generation minimally invasive surgical techniques may require even smaller incisions, less tissue trauma and shorter recovery. In particular, advances in laser or radiofrequency devices may provide new treatment strategies for skin tightening/fat removal of the lower eyelid with fewer complications[53, 54].

CONCLUSION

The potential influence of these new technologies is considerable. These techniques may help to enhance safety and outcomes regarding both efficacy and aesthetic results in lower eyelid blepharoplasty. But, as any emerging technology, evaluation and validation prior use to guarantee efficacy and safety are relevant before generalization.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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