

REVIEW ARTICLE

# Periocular Plastic Surgery

Christoph Hintschich

## SUMMARY

**Background:** Good vision depends on the normal anatomy and function of the eyelids and orbital structures.

The goals of periocular ophthalmic plastic surgery are the anatomical and functional preservation and restoration of the lids, orbits, and periorbital structures when they are affected by congenital or acquired malpositions, defects and mass lesions. In this region, functional and esthetic considerations are closely linked.

**Method:** This review is based on selected articles retrieved by a PubMed search, the guidelines of the German Ophthalmologists' Association (Bundesverband der Augenärzte, BVA) and German Ophthalmological Society (Deutsche Ophthalmologische Gesellschaft, DOG), and the authors' own clinical and scientific experience.

**Results:** The surgical correction of eyelid malpositions is based on the restoration of normal anatomy with attention to function. Eyelids are reconstructed with a combination of local flaps and free grafts, preferably from the periorbital structures. Orbital procedures are usually performed in specialized centers, by multidisciplinary surgical teams if necessary. The surgical approaches are becoming ever smaller and cosmetically less noticeable. For patients with acquired anophthalmos, the use of orbital implants is essential for optimal fitting of the prosthesis.

**Conclusion:** Modern periocular plastic surgery exploits an extensive range of specialized surgical techniques to treat a wide variety of abnormalities and diseases in this region. The success of such procedures depends on thorough knowledge of the complex anatomy and physiology of these structures as well as on the surgeon's expertise in microsurgical techniques.

Periocular plastic surgery, as performed by ophthalmologists, encompasses operations on the eyelids, the periorbital area of the face, the orbits, and the lacrimal system. This subspecialty within ophthalmology is characterized by a wide range of surgical procedures in a narrow anatomical region that contains many small, delicate structures in proximity to one another. Any periocular plastic and/or esthetic procedure can have an impact on, and may adversely affect, the integrity of the eyelids, orbits, and periorbital region that is necessary for normal visual function. Severe visual loss, or even blindness, is a possible complication. Although a distinction is commonly drawn between functional and esthetic procedures, these two aspects are closely intertwined in the field of periocular plastic surgery.

In this article, the authors set forth the principles of plastic and reconstructive surgery of the eyelids and orbits, on the basis of a selective review of the literature (a PubMed search for articles that appeared from 1978 to 2008 and contained the terms "entropion," "ectropion," "ptosis," "surgery," "BCC," or "orbital decompression"), the 1998 guidelines of the German Professional Association of Ophthalmologists (Bundesverband der Augenärzte, BVA) and the German Society of Ophthalmology (Deutsche Ophthalmologische Gesellschaft, DOG) regarding eyelid malpositions and tumors (No. 9) and orbital diseases and exophthalmos (No. 28) (see [www.augeninfo.de/leit/leitvo.htm](http://www.augeninfo.de/leit/leitvo.htm) [in German]), and their own longstanding experience. Hardly any randomized trials have been published in this field, and thus clinical decision-making must be based on the results of case series and observational studies. It should become clear to the reader that the range of procedures in this field extends far beyond that of purely esthetic plastic surgery.

## Anatomy and physiology

The eye, the external eye muscles, the lacrimal gland, and bundles of blood vessels and nerves all lie protected within the bony enclosure of the eye socket (orbit), embedded in the orbital fat. The anterior limit of the orbit is formed by the orbital septum, which constitutes a functional barrier in case of hemorrhage or infection, and the lid apparatus. The eyelids keep foreign bodies off the ocular surface, protect it from light and ultraviolet radiation, distribute the tear film through blinking, and prevent the cornea from drying. Their proper position and function are a necessary precondition for normal vision. The upper and lower lids are constructed in essentially identical fashion,

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Augenklinik der Universität München: Prof. Dr. med. Hintschich, FEBO



**Figure 1:** a) This 3-year-old girl had severe, bilateral congenital ptosis, right esotropia, and amblyopia. She was able to look out from under her drooping eyelids only by holding her head in the abnormal position seen in the picture. b) The patient's appearance after correction of the ptosis with a bilateral frontalis suspension employing alloplastic material (threads). Autologous fascia lata was not used, because her legs were still very short

with an anterior layer (lamella) consisting of skin and muscle and a posterior lamella consisting of the tarsal plate and conjunctiva. The posterior lamella provides the smooth back surface that the lids need to be able to close smoothly; the tarsus, which is anchored to the periosteum medially and temporally by the palpebral ligaments, gives the necessary stability. Lid opening is mediated by the levator palpebrae muscle, whose connective tissue aponeurosis fans out into the upper lid, while lid closure is mediated by the orbicularis oculi muscle, which forms a ring around the eye and is innervated by branches of the facial nerve.

### Malpositions of the eyelids

Entropion (inward turning of the eyelid) and ectropion (outward turning of the eyelid) are among the more common eyelid malpositions. Either one can compromise the surface of the eye. Both of these malpositions can be found congenitally, but they are more commonly acquired through the involutional processes of old age, or else as a result of infection, trauma, or prior lid surgery (1).

Surgery is the only way to correct eyelid malpositions permanently. The proper surgical procedure is chosen after meticulous clinical ophthalmological examination and analysis of the type of pathology that is present.

An involutional entropion of the lower lid, with slackening of the lid, can be corrected with horizontal lid tightening—preferably using a lateral canthopexy—combined with tightening of the lower lid retractors (2, 3). The reported recurrence rate of this procedure is under 4% (4). On the other hand, a cicatricial entropion of the upper lid caused by shortening of the posterior layer of the lid can be corrected by repositioning the anterior lamella with respect to the posterior lamella (5) or, if it is very severe, by replacing the connective tissue with a free palatal or oral mucosal graft.

Horizontal lid tightening is also an effective treatment for ectropion of involutional origin. Often, the ectropion affects the nasal portion of the lid and causes eversion of the lacrimal punctum, so that the patient complains of tears overflowing onto the face (epiphora) even though the tear duct is open and can be freely irrigated. In this situation, an additional punctoplasty with inverting sutures can be additionally helpful. The treatment of cicatricial ectropion is different: All of the scar tissue must be excised, and the missing skin must be replaced with skin flaps or free skin grafts.

### Ptosis and lid retraction

Ptosis is a type of lid malposition in which the entire upper lid hangs down. It can be either congenital or acquired; involutional changes in old age or after many years of wearing contact lenses are far more common causes than myogenic or neurogenic ptosis. Simple involutional ptosis is the most likely diagnosis when the patient presents with the typical picture of a high palpebral fissure in the presence of good levator function. If severe, ptosis can produce a functional visual field defect, leading to a forced repositioning of the head (*Figure 1a*). Infants and small children whose visual axis is affected by ptosis can develop amblyopia, i.e., irreversible visual loss (6).

Ptosis is generally treated surgically; when the ptosis is severe, surgical treatment restores the patient's vision. The timing of surgery is elective, although severe congenital ptosis in infants and small children must be treated early because of the risk of amblyopia.

The surgical procedure is chosen according to the type and severity of ptosis. The particular method to be used, and its chances of success, depend on the degree of levator function that is present. The procedure can be either direct (e.g., levator resection) or indirect (e.g., frontalis suspension) (7). If levator function is adequate, a direct procedure is chosen. Because of the wider surgical exposure and the opportunity to combine the procedure with a skin resection, the operation is then usually performed transcutaneously (1). Local, rather than general, anesthesia is usually given, in order to afford optimal intraoperative adjustment. Procedures involving resection of the tarsus should be avoided.

In severe ptosis with poor levator function and absence of Bell's phenomenon, e.g., neurogenic ptosis, frontalis suspension can be used. This operation involves the creation of a mechanical connection between the frontalis muscle and the upper lid. Either alloplastic material or autologous fascia lata can be used for this purpose (*Figure 1b*).

The reported success rate of surgery for involutional ptosis is excellent (over 80%); for congenital ptosis, the reported success rates are mostly somewhat lower (7). Typical complications of ptosis surgery include over- or undercorrection, asymmetry, contour irregularities, and insufficient lid closure.

The opposite of ptosis is upper lid retraction, i.e., a relatively high-standing upper lid. The most common cause of this is fibrosis of the levator complex as a



**Figure 2:** a) After two surgical procedures for the histologically guided excision of a tumor, this patient had an extensive tissue defect involving all layers of the left upper lid; b) View of the operative field showing the free tarsomarginal graft from the contralateral upper lid; c) After tarsomarginal grafting and the creation of a plastic myocutaneous flap, the reconstructed upper lid has a smooth edge and a normal configuration

component of endocrine orbitopathy in Graves' disease. Lid retraction results not just in esthetic impairment, but in functional impairment as well (drying out of the cornea, epiphora, exposure keratopathy). A plastic surgical procedure can achieve permanent correction provided that the underlying disease has been adequately treated and (for a good esthetic result) that there is no significant degree of exophthalmos. Many different surgical methods can be used; blepharotomy, a simple technique with reproducibly good results and a low complication rate, is now increasingly being used as the standard form of treatment. This operation involves the stepwise division of all layers of the lid, including the conjunctiva, through a transcutaneous approach. It is performed under local anesthesia and does not require the implantation of any foreign material. The upper lid lies at the desired level postoperatively in 88% of cases, the height of the palpebral fissure is preserved in 73% of cases, and the rate of complications (overcorrection, wound dehiscence) is below 5% (8).

### Dermatochalasis

Slackening of the skin of the upper and lower eyelids becomes more prominent with age and is not uncommonly a familial phenomenon. For many affected individuals, the resulting "hooded" eyelids are an undesired and bothersome change in their personal appearance. The characteristic finding is the presence of an excessive amount of loose lid tissue covering the palpebral fissure and sometimes completely overlying the edge of the eyelid and the eyelashes. Prolapsed orbital fat, particularly in the nasal portion of the upper lid, is a further cause of swelling. An apparent excess of lid tissue is often worsened by sinking of the eyebrows (eyebrow ptosis).

Aside from the esthetic impairment, which usually mainly disturbs the patient's perception of his or her own appearance, dermatochalasis can also disturb function by limiting the visual field or by giving rise to intertriginous skin changes. Criteria for the presence of a functional impairment can be found on the website [www.dog.org/dog-oprc/RichtlinienBlepharoplastik.pdf](http://www.dog.org/dog-oprc/RichtlinienBlepharoplastik.pdf) (in German).

Blepharoplasty—i.e., the surgical correction of dermatochalasis—is by no means a trivial procedure. The indispensable prerequisites for such operations

are a thorough ophthalmological examination and proper information and counseling of the patient. A wide range of complications can arise, including hemorrhage and infection leading to visual loss (in rare cases, blindness) as well as more common problems such as overcorrection with insufficient lid closure, ectropion and retraction leading to keratopathy, wrinkle formation, asymmetry, problems affecting the palpebral fissure, undercorrection, and poor wound healing with scarring (9). A good functional and esthetic result depends both on a proper judgment of the indication for surgery and on a well-placed incision, with removal of the correct amount of tissue. If the eyebrows are very low, a procedure to raise them should be considered. This can be done directly (with a skin incision in the eyebrow area itself), internally (through a blepharoplasty incision in the palpebral fissure), endoscopically (through small, scarcely visible incisions at the hairline), or by a coronal approach in combination with face-lifting (10).

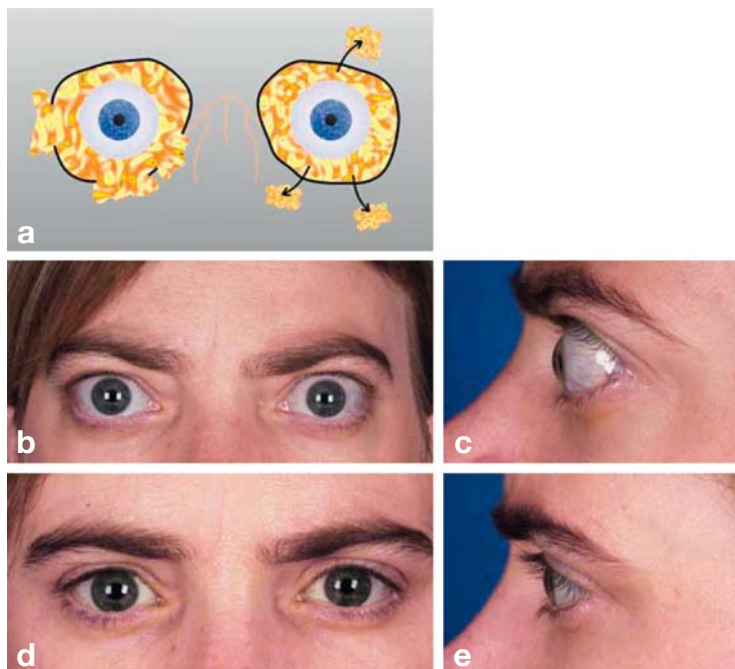
If the lower lids are affected by an excess of skin, wrinkling, and prolapse of orbital fat, a lower lid blepharoplasty may be indicated. This procedure is performed either transcutaneously or transconjunctivally. Excessive tissue resection should be avoided at all costs, as overcorrection may well result in cicatricial ectropion and lid retraction. The most important factor is the adequacy of horizontal lid tension. Redistribution, rather than simple resection, of fatty tissue should be aimed at, because of the more natural-appearing result (11). In some cases, these plastic surgical procedures on the eyelids are combined with a superficial skin treatment with laser light ("skin resurfacing") or with botulinum toxin injection, to influence the function of the muscles of facial expression and to smooth out wrinkles. The complications of superficial skin treatment include persistent erythema and scarring due to overtreatment (12).

### Lid defects

#### Lid reconstruction

The purposes of lid reconstruction are to restore lid function, relieve symptoms, and improve the patient's appearance. Lid defects can be either congenital or acquired; usually, they arise after the resection of tumors affecting the eyelids.





**Figure 3:** a) The principles of orbital decompression (schematic diagram): enlargement of the bony orbit by bone resection (left), reduction of the soft-tissue content of the orbit by resection of fatty tissue (right); b, c) This woman with Graves' orbitopathy had severe exophthalmos and lid retraction, without any impairment of optic nerve function or ocular motility; d, e) The patient's appearance after bilateral three-wall bony decompression of the orbit through a swinging-eyelid approach and upper lid lengthening with anterior blepharotomy

Tumor surgery is an important component of periocular plastic surgery. Many different kinds of tumor can arise on the eyelids and in the periocular area, and up to 25% of them are malignant. Basal-cell carcinoma is the most common malignant tumor of the eyelids, accounting for about 90% of such tumors (13). Squamous cell carcinoma, Meibom's sebaceous cell carcinoma, and melanoma are rarer, but still important, types of malignant lesion; these are tumors with aggressive biological behavior and the potential to metastasize. The most important question in the differential diagnosis of lid tumors is their degree of malignancy (grading), and this question can only be answered by the histopathological examination of excised tissue. Clinical findings suggesting the presence of a malignant process include a poorly demarcated lesion, loss of eyelashes, a pathological vascular pattern, and a tendency to bleed spontaneously. Although there are many nonsurgical methods of treatment in oncology, histologically controlled surgical excision remains the treatment of choice for eyelid tumors (14).

The lid defects that arise after tumor surgery can affect the anterior or the posterior lamella of the lid, or both. A full-thickness defect can affect the edge of the lid as well. Extensive defects can involve the canthus, the septum, the retractors, or the orbital fatty tissue.

The techniques used in the reconstruction of lid defects include direct wound closure, flaps, grafts, and combinations of these. The particular method to be

used depends on the age of the patient, the consistency of the tissue, and the quality of the patient's vision. It is best to cover the defect with tissue from its immediate vicinity, in accordance with the principle that lid tissue is the best lid replacement. Skin defects are closed primarily and without vertical tension whenever possible, to prevent lid retraction and lagophthalmos. Large defects are reconstructed with rotational or translational flaps if possible, or else with free skin grafts from the upper lid or the pre- or retroauricular area. Defects of the posterior layer of the lid are correspondingly treated with connective tissue suturing, conjunctival flaps, or free mucosal grafts (1).

Small full-thickness lid defects involving up to one-third of the edge of the lid—or even more, in case the upper lid is affected—can be closed by primary adaptation of the edge of the lid, after a lateral canthotomy if necessary. Larger defects of the edge of the lid are reconstructed through a sandwich technique, in which the anterior (skin/muscle) and posterior (tarsus/connective tissue) layers are replaced in such a way that at least one layer retains its vascular supply (15–17). Cutaneous and skin-muscle flaps can be combined with free tarsal and tarsomarginal grafts or with the transplantation of oral mucosa or hard palate, while conjunctival or tarsoconjunctival translational flaps can be combined with free skin grafts (Figure 2). Alloplastic implants are generally unsuitable for use in the thin and delicate structures of the eyelids because of their high complication rates.

### Orbital diseases

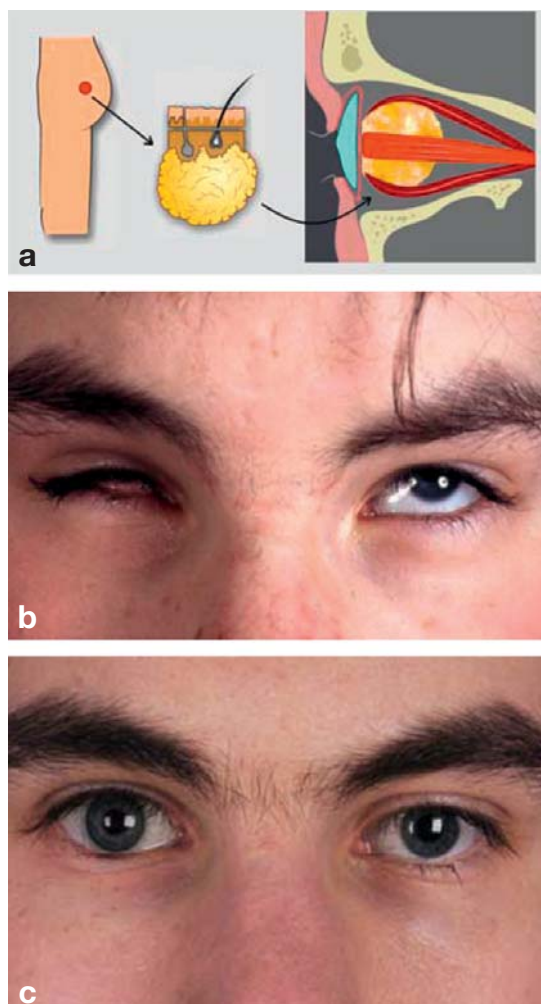
Plastic and reconstructive procedures are carried out less commonly on the orbits than on the eyelids, yet they have a special significance because the underlying disease often has wide-ranging implications. These procedures tend to be performed in specialized centers. Depending on the location and extent of the lesion, an interdisciplinary collaboration with surgical specialists from other areas may be needed, e.g., otorhinolaryngology, neurosurgery, or oral and maxillofacial surgery.

Exophthalmos is the most important clinical sign of an orbital disease. Its most common cause is Graves' orbitopathy, followed by mass effect from neoplastic lesions and vascular malformations (18). If an orbital tumor is present, an incisional biopsy can be performed to obtain tissue for histopathological study, or the tumor can be "debulked"; for non-infiltrative lesions, gross total excision is the objective whenever possible. A number of different surgical approaches can be used. The more common approaches in current use are the anterior approach through an incision in the palpebral fissure, the transconjunctival approach, and the so-called swinging-eyelid approach, in which a small skin incision in the lateral canthus is combined with a lower fornix conjunctival incision. Classic lateral orbitotomy (the Kröhnlein approach), in which the zygomatic bone is temporarily removed, is now only performed for rare indications, e.g., for the resection of a pleomorphic adenoma of the lacrimal gland.

The threat of visual loss or massive exophthalmos due to Graves' orbitopathy may necessitate orbital decompression. The purpose of this procedure is to decompress the optic nerve while restoring normal ocular function and appearance, i.e., to achieve the surgical rehabilitation of the patient (Figure 3). In principle, this can be done in either of two ways: by enlarging the orbital volume through bone resection, or by reducing the orbital contents through the resection of orbital fat. Bone resection, involving the removal of parts of the medial and lateral orbital wall as well as the floor of the orbit, is more effective than fat resection. The surgical approach can be transcutaneous, transconjunctival, endonasal, or transantral, though the rate of postoperative diplopia is higher after the latter two approaches (up to 50% or more) (19). The overall risk-benefit ratio of orbital decompression is favorable: exophthalmos is reduced by an average of 3.5 to 6 mm (depending on the preoperative findings and the surgical technique employed), vision is improved in 76% to 100% of patients who undergo surgery, and the rate of blindness is very low (0.1%) (Tarantini A, Hintschich C: Surgical decompression in thyroid eye disease: does the approach matter? 26th annual meeting of the ESOPRS, Lucerne, Switzerland, 2008). The contemporary technique of double or triple orbital wall decompression through a swinging-eyelid approach reduces proptosis by an average of 5 mm and is associated with a postoperative diplopia rate below 10% (20). Other operative treatments that these patients might also need, such as surgery on the extraocular muscles, lid lengthening, or blepharoplasty, are performed only after orbital decompression.

### Surgical treatment for anophthalmos

Anophthalmos, i.e., the absence of an eye, is rarely found congenitally (3 per 100 000 population) and is usually acquired through the loss of an eye (in Germany, there are about 2000 such cases per year [21]). Enucleation, i.e., the surgical removal of an eye, is still indicated today as the final step in the treatment of large, malignant intraocular tumors (e.g., uveal melanoma) or of pain or esthetic problems arising in a blind eye. This procedure can lead to post-enucleation syndrome from volume loss, which is characterized by endophthalmos of the prosthesis, a retracted upper lid sulcus, slackening of the lower lid, and malpositions of the upper lid. The development of these undesired changes can be prevented by the insertion of an orbital implant. Alloplastic materials of various designs can be used: The more common types today are spherical implants made of silicone or hydroxyapatite (22). Alternatively, dermis-fat grafts can be used. These autologous transplants combine the advantages of long-term safety with excellent cosmetic results (24) (Figure 4). The typical complications of alloplastic orbital implants include infection and implant migration/exposure/extrusion, while the typical complications of dermis-fat grafts include necrosis and atrophy. Problems of these types can lead to volume deficiency



**Figure 4:**  
a) Dermis and fat grafting (schematic diagram): Deepithelialized dermis from the gluteal region, with fatty tissue attached, is transplanted into the orbit, and the straight extraocular muscles are fixed to the edge of the dermis and to the connective tissue on its surface;  
b) This young man suffered from painful phthisis bulbi as a sequela of neonatal retinopathy;  
c) The patient's appearance ten years after enucleation and primary dermis and fat grafting. He has been fitted with an ocular prosthesis made out of glass

or a so-called contracted socket (23). To restore the ability to wear an ocular prosthesis, a stepwise treatment plan can be applied, involving secondary grafting of dermofat, and oral mucosa as well as surgical procedures on the lids. When treating a patient with anophthalmos, the surgeon must cooperate closely with the ocularist who fashions the prosthesis out of glass or another synthetic material and is responsible for fitting it.

The author's personal experience suggests that periocular plastic surgery should be performed by ophthalmologists, who have unrivaled knowledge of the complicated anatomy and physiology of this region as well as extensive practice in microsurgical technique. There have not been any controlled studies on this particular subject, however. Ophthalmologists who perform periocular plastic surgery belong to the Section for Oculoplastic and Reconstructive Surgery (SORC) of the German Society of Ophthalmology (Deutsche Ophthalmologische Gesellschaft, DOG) and, at the European level, to the European Society of Ophthalmic Plastic and Reconstructive Surgery (ESOPRS). Ophthalmologists can obtain advanced training in this subspecialty through many organized courses, symposia, and wet

labs, as well as by educational visits to recognized centers in which these procedures are performed.

#### Conflict of Interest Statement

The author declares that he has no conflict of interest as defined by the guidelines of the International Committee of Medical Journal Editors.

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#### Corresponding authors

Prof. Dr. med. Christoph Hintschich, FEBO  
Augenklinik der Universität München  
Mathildenstr. 8  
80336 München, Germany  
christoph.hintschich@med.uni-muenchen.de