53 Orbital Exenteration

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Introduction

Orbital exenteration is defined as the surgical excision of the ocular globe, orbital soft tissues, and ocular adnexa. Total exenteration entails removing the orbital contents in their entirety, whereas a subtotal exenteration spares some portion of the posterior orbital soft tissues. In extended exenteration, removal of bone and/or adjacent structures is also performed. Because the operation results in permanent vision loss and significant facial deformity, it is usually reserved for the treatment of life-threatening or progressively destructive disease processes, such as high-grade or advanced malignancies or invasive infections. In cases where exenteration is contemplated, consideration should be given to management alternatives, including medical therapy and chemotherapy, radiation therapy, or observation.

Georg Bartisch, the father of German ophthalmology, is credited with performing the first exenteration procedure and described it in his 1583 textbook. In that operation, much of the contents of the orbit were removed, and the eyelids were preserved. The lack of anesthesia, blood replacement, antibiotics, and sterile surgical techniques made the operation and follow-up, at best, a significant risk and challenge for patient and surgeon. Present-day surgical techniques and preoperative and postoperative management make the operation one with a more acceptable rate of morbidity and mortality.

As a result of modern advances in the diagnosis and treatment of orbital disease, the need for exenteration has become less frequent. Computed tomography (CT) and magnetic resonance imaging (MRI) have become invaluable tools in the diagnosis and surveillance of orbital tumors and disease processes, and positron emission tomography (PET) [1] is also becoming more widely utilized. Alternative treatment strategies have also emerged for many tumors and disease processes which historically would have led to exenteration [2]. For example, exenteration was once considered standard treatment for orbital rhabdomyosarcoma, but tremendous advances in chemotherapy and radiation therapy over the past several decades have greatly reduced the need to resect this malignancy in such an aggressive manner [3]. Uveal melanoma with extrascleral extension was, at one time, a frequent cause for exenteration, but alternative treatments such as brachytherapy and modified enucleation have become more commonly favored [4]. Orbital mucormycosis and aspergillosis have also, in the past, been thought to necessitate exenteration but are now often treated with globe-sparing approaches such as surgical debridement with frozen section control, systemic and intraorbital antifungal therapy, hyperbaric oxygen therapy, and treatments aimed at boosting the patient's immune system [5–9]. Nonetheless, despite these advances, the occasion still arises for which exenteration is the most effective means of controlling orbital disease, extending patient survival, or improving quality of life.

Indications for Orbital Exenteration

The indications for orbital exenteration include the following:

1. Malignant primary orbital tumors
2. Malignant eyelid or ocular adnexal tumors with orbital invasion
3. Malignant secondary orbital tumors invading from the paranasal sinuses or cranium
4. Malignant intraocular tumors with extrascleral extension
5. Life-threatening invasive orbital infections
6. Severe trauma or orbital contracture

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7. Massive or debilitating benign tumors of the orbit
8. Congenital deformities of the eye and orbit

This list, while not all-inclusive, accounts for the vast majority of conditions for which exenteration is performed.

Malignant tumors are the most common indication for orbital exenteration [10–16]. Examples include basal cell carcinoma, squamous cell carcinoma, melanoma (eyelid, conjunctival, and uveal), sebaceous cell carcinoma, adenoid cystic carcinoma, sarcoma, and retinoblastoma. In general, indolent tumors such as basal cell carcinoma only require exenteration if they have grown to such a size or invaded orbital tissues to such an extent that complete resection with clear margins cannot be accomplished without sacrificing the globe or its supporting structures [17]. However, the long-term prognosis after exenteration with clear margins is generally good. By contrast, high-grade malignancies such as adenoid cystic carcinoma often prompt exenteration even when the tumor size is relatively small, in an effort to decrease the risk of metastasis and improve patient survival [18]. Unfortunately, tumor recurrence or metastasis can still occur after exenteration in far too many cases, even with the use of adjunctive radiation and chemotherapy [19]. Consequently, the decision to treat any orbital malignancy must take into account its histologic type and natural history, tumor size and stage, the current status of the globe and visual function, overall patient health along with any comorbidities, and the expectations of the patient and family. Exenteration will not improve survival for orbital malignancies with known metastasis but, in selected cases, may provide palliation and improved quality of life. The importance of definitive histopathologic diagnosis from permanent sections before committing to exenteration cannot be overemphasized. This operation should never be performed on the basis of clinical impression or pathologic frozen sections.

Benign orbital tumors are rarely the cause for exenteration. Even in the case of massive congenital teratomas, it is sometimes possible to perform a globe-sparing resection and achieve a satisfactory aesthetic outcome [20]. However, the operative risks incurred by such a strategy must be taken into account, particularly when a neurosurgical approach is considered. Disfigurement, intractable pain, or intracranial extension are other potential factors which might lead one to consider exenteration for a benign tumor or inflammatory process [21–23].

Significant controversy and practice variation exist regarding exenteration for invasive orbital fungal infections. Because of the potential mortality from intracranial spread of organisms such as *Mucorales* and *Aspergillus*, aggressive surgical debridement of all infected tissue is widely accepted as an important component of treatment [24]. However, subtotal or total exenteration has not been definitively shown to improve the chance of survival in these patients, and no practical guidelines or predictive features have been identified to indicate which patients might benefit from exenteration [25]. Extensive counseling of the patient and family members is required, taking into account all clinical, emotional, and psychosocial factors during the decision-making process.

Periocular necrotizing fasciitis is a rare but potentially fatal infection which is usually caused by group A β-hemolytic *Streptococcus*. Systemic antibiotic therapy and subcutaneous debridement of involved tissue can sometimes spare the patient's globe and life, but exenteration may be necessary if orbital invasion is present [26].

Severe trauma resulting in loss of a significant portion of the orbital bone and/or soft tissues may necessitate some form of exenteration when orbital reconstruction is impossible. However, trauma of such severity is uncommon and often nonsurvivable, and every attempt should be made to salvage any remaining periocular and orbital tissues, however severely traumatized, before resorting to exenteration. If severe orbital contracture results from trauma or prior surgery, exenteration may be indicated to rehabilitate the orbit [27]. The suboptimal aesthetic results of this procedure must be kept in mind when considering treatment options for these patients. The effectiveness of exenteration for the treatment of chronic pain in anophthalmic sockets has not been clearly demonstrated.

Preoperative Evaluation and Planning

It goes without saying that a complete ocular examination is essential in the preoperative evaluation of the exenteration patient. The effects of the orbital process on the patient's vision, ocular motility, globe position, and eyelids and ocular adnexa should be clearly documented. Other possible pertinent findings include facial abnormalities, lymphadenopathy, signs of lacrimal outflow obstruction, or sensory deficit in the distributions of the ophthalmic (V1) or maxillary (V2) divisions of the trigeminal nerve. Malignancies with the potential for metastatic spread must undergo a complete metastatic workup. In certain cases, such as with periocular melanoma or sebaceous cell carcinoma, sentinel lymph node biopsy may provide useful information in guiding the patient's management [28, 29]. In most cases, CT or MRI images of the orbit have already been obtained during the initial evaluation of the orbital process in question, and these studies can provide information which is invaluable both preoperatively and intraoperatively. In particular, evidence of extraorbital extension of tumor or disease should be noted, as this may necessitate additional resection of bone and adjacent structures. In cases where resection of tissue adjacent to or invading the sinuses or cranial vault is anticipated, collaboration with other specialists such as otolaryngologists or neurosurgeons is useful, and even essential. This is especially important when considering an extraorbital surgical route, such as transnasal or transcranial. An example of a tumor commonly requiring transcranial exenteration is adenoid cystic carcinoma of the lacrimal gland with involvement of the orbital roof [18]. In order to safely remove the involved portion of frontal bone, a frontal craniotomy performed by neurosurgery will provide optimal surgical exposure and protect the dura and brain during resection.

Reconstruction of the exenterated orbit must also be considered during preoperative planning. As will be discussed later in this chapter, skin grafts, bone grafts, transfer flaps, or microvascular free flaps can all be utilized to reconstruct various orbital defects, and consultation with a facial plastic surgery specialist may be very useful in some of these cases.

Finally, the importance of postoperative follow-up, the options for rehabilitation, and, in many cases, the need for adjunctive therapy should be discussed carefully with patients and their families. Preoperative consultation with an orbital prosthetic specialist (anaplastologist) can often be quite reassuring and may go a long way toward preparing the patient emotionally for the operation and its aftermath. In cases of malignant orbital tumors in which adjunctive chemotherapy or radiation is indicated, a team-oriented approach is necessary, and good communication with hematology/oncology and radiation oncology is essential.

Exenteration Techniques

From a technical standpoint, orbital exenteration can be thought of as several different techniques or as one basic technique with several variations. The latter approach will be presented here, describing first the total exenteration and then proceeding to the various modifications with their potential indications.

Total Exenteration

Exenterations should be performed under general anesthesia whenever possible. Local infiltration anesthesia is helpful for hemostasis in the eyelid, but intraorbital or retrobulbar injections are not generally useful and should be particularly avoided in the presence of an orbital malignancy. At the beginning of the case, sutures (e.g., 3-0 silk) can be placed around the rectus muscles or through the upper and lower tarsi to provide traction on the orbital contents. An elliptical incision is made with a scalpel blade or electrocautery through the skin overlying the orbital rim (Fig. 53.1). Dissection is then carried to the orbital rim, and the periosteum just outside the arcus marginalis is incised. Periosteal elevators are used to dissect the periorbita from the bony orbit, beginning at the orbital rim and continuing all the way back to the orbital apex. Most of the periorbita is loosely adherent to the bone, but it is more tightly adherent at several anatomic locations, including the anterior and posterior lacrimal crests, lateral orbital tubercle, trochlea, inferior oblique origin, and superior and inferior orbital fissures (Fig. 53.2). If disease involvement of the lacrimal sac is not suspected, the sac can be spared by dissecting lateral to it and dividing the common canaliculus and orbicularis attachments. Subperiosteal dissection can then proceed from the posterior lacrimal crest and beyond. If the lacrimal sac is to be

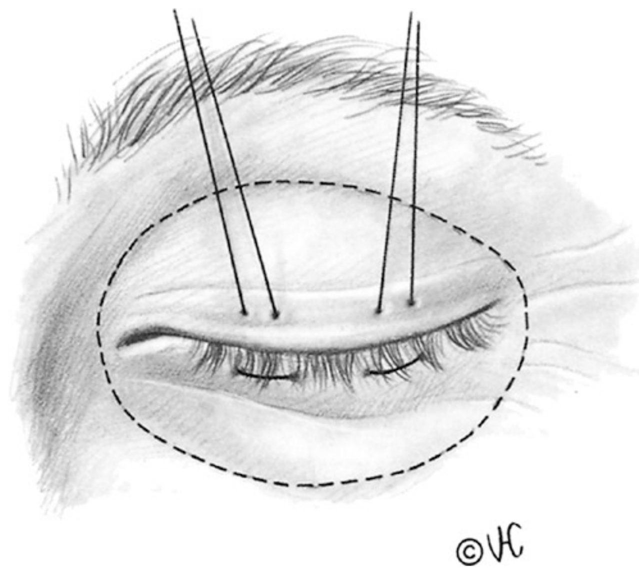

Fig. 53.1 Initial incision for total orbital exenteration

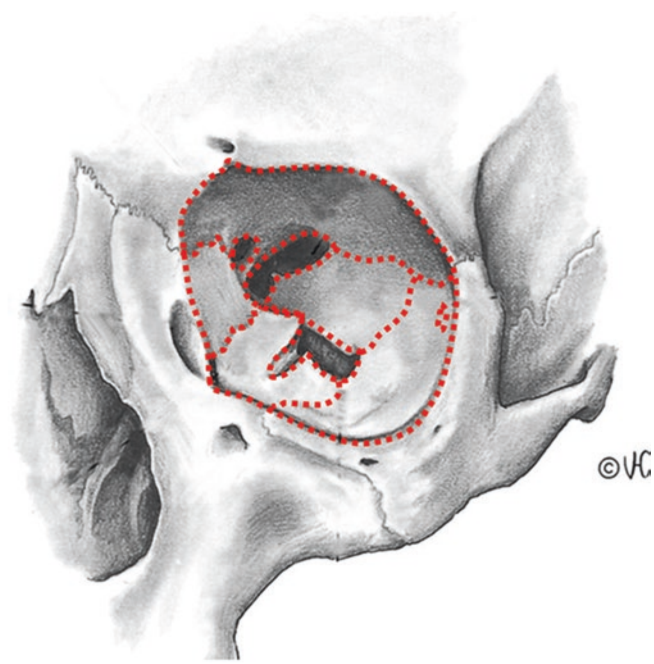

Fig. 53.2 Bony anatomy of the orbit showing points of increased periosteal adherence

removed, it is dissected from the lacrimal sac fossa and divided from the nasolacrimal duct with electrocautery. The exposed nasolacrimal duct can be obliterated with fat, muscle, or soft tissue to decrease the risk of postoperative fistula formation.

Throughout the course of the subperiosteal dissection, the supraorbital, supratrochlear, anterior and posterior ethmoidal, zygomaticofacial, and zygomaticotemporal neurovascular bundles are identified, cauterized or ligated, and divided. Dissection should be performed carefully along the orbital floor and medial wall, so as to not fracture the thin bone and create a communication with the ethmoid or maxillary sinuses. In the inferotemporal orbit, the inferior orbital fissure is encountered and penetrating vessels divided with electrocautery. The infraorbital nerve should be preserved unless it must be sacrificed to achieve the intended result. Once the periorbita has been dissected to the apex, gently curved scissors are introduced into the posterior orbit and the optic nerve, and superior orbital fissure contents and posterior orbital tissues are cut (Fig. 53.3). If desired, a clamp may be placed across the apical tissues prior to cutting in order to aid in hemostasis. If the ophthalmic artery is identified, it can be cauterized, suture-ligated, or clipped. Additional hemostasis may be obtained with ice-cold wet gauze, pressure, and cautery. As discussed in detail later in this chapter, the orbit may be left to granulate or covered with a skin graft or tissue flap. The orbit is then packed with petrolatum gauze and a pressure patch placed.

In cases of tumor resection, clearance of surgical margins using either frozen or permanent sections is often advisable. The location of these specimens is, of course, dependent on the location and characteristics of the original tumor, and intraoperative findings such as bony erosion or apparent periocular soft tissue invasion may prompt the biopsy of additional anatomic locations as deemed appropriate.

Fig. 53.3 Intraoperative photograph during total exenteration. Following complete subperiosteal dissection to the orbital apex, curved scissors are used to cut the posterior orbital tissues

Eyelid-Sparing Exenteration

In cases where the orbital disease process does not involve the eyelids, a lid-sparing technique, as popularized by Coston and Small [30], can be utilized. The total exenteration technique described above is modified by placing the initial skin incisions just outside the upper and lower lid lash lines and joining them at the medial and lateral commissures (Fig. 53.4). Dissection is then carried in the preorbicularis or preseptal plane to the orbital rim (Fig. 53.5), after which point the exenteration technique remains unchanged. Dissecting in the preorbicularis plane decreases

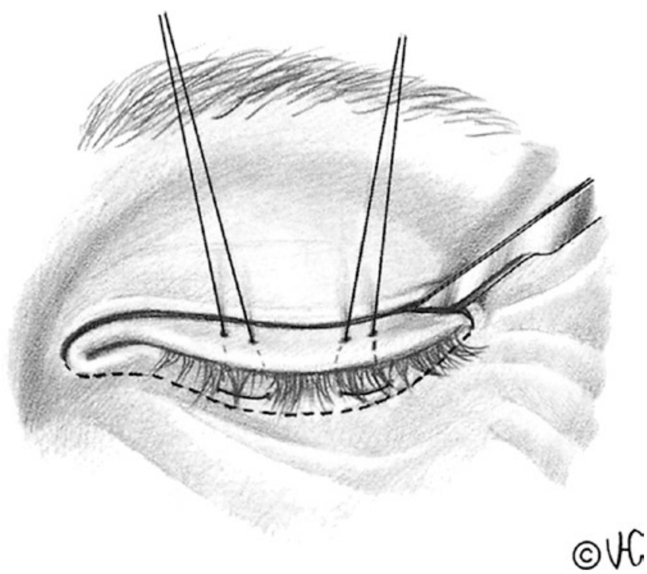

Fig. 53.4 Initial incision for eyelid-sparing exenteration

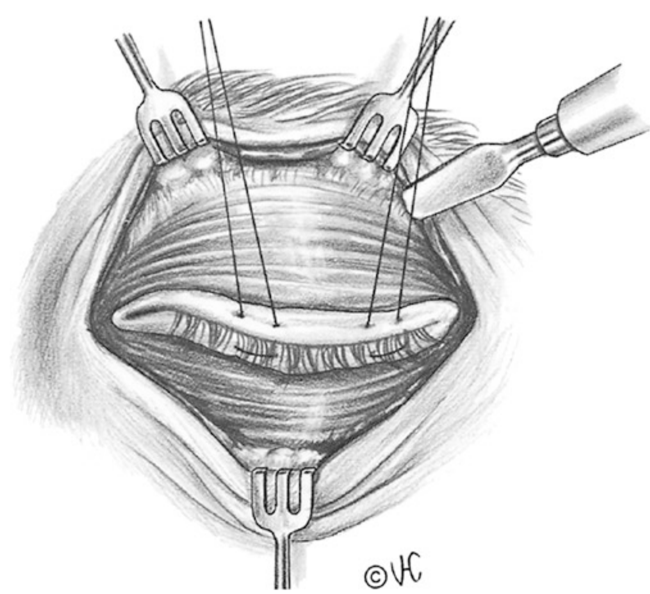

Fig. 53.5 The lid skin is dissected in the preorbicularis plane to the orbital rim

the likelihood of violating the orbital septum, which is undesirable if tumor is present in the anterior orbit. Alternatively, dissecting in the preseptal plane spares the orbicularis muscle, which provides an excellent vascular supply to the skin flap. It should be noted that the term “lid-sparing” is somewhat of a misnomer since only the anterior lamella is spared, while the lashes, tarsus, septum, levator, and conjunctiva are all resected.

The advantage of sparing the lid skin is that it provides some coverage for the bone of the anterior orbit [31]. For total exenterations, this amount of skin will typically provide only partial coverage, and the remainder of the socket will need to be grafted or left to granulate. However, in cases of subtotal exenteration (as discussed below), the eyelid skin may be enough to provide complete coverage of the socket.

Subtotal Exenteration

For diseases that involve only the anterior orbit or conjunctiva, subtotal exenteration may be considered [32]. Conjunctival melanoma or sebaceous cell carcinoma without evidence of deep orbital invasion can potentially be treated in this manner. The advantage of subtotal exenteration is that soft tissue is left in the posterior orbit which can be covered with eyelid skin (if spared) or a skin graft. However, secure fixation of an orbital prosthesis may be more difficult postoperatively since the socket is left shallow (Fig. 53.6). There is also a theoretically increased risk of recurrence if residual tumor or disease is inadvertently left in the posterior orbital tissues.

The technique for subtotal exenteration proceeds as with total exenteration, except that subperiosteal dissection is only carried as far posteriorly as deemed necessary. The orbital tissues are clamped and cut at the level chosen by the surgeon, ensuring that the optic nerve is cut posterior to the globe. The orbit can then be lined with a skin flap or split-thickness skin graft if desired.

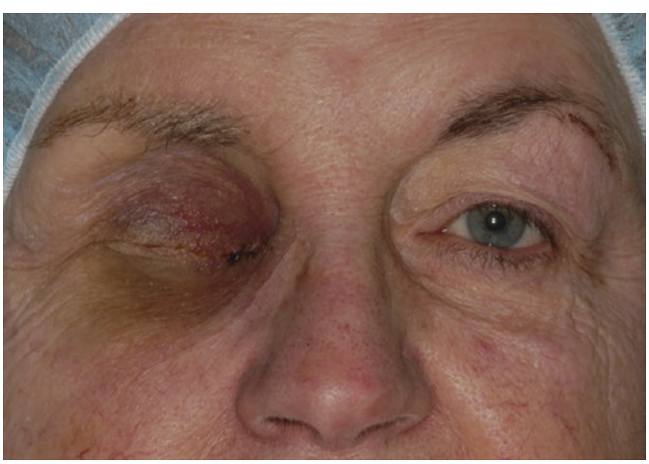

Fig. 53.6 Early postoperative photograph following eyelid-sparing subtotal exenteration. Because the posterior orbital tissues were preserved, the lid skin was sufficient to completely cover the orbital defect

Extended Exenteration with Bone Removal and/or Additional Resection

For particularly high-grade malignancies or destructive osteolytic processes, total exenteration with removal of a portion of the bony orbit may be indicated. The location and extent of bony resection is dictated by the primary tumor location, gross or microscopic evidence of bony invasion, perineural tumor spread, and/or involvement of the orbital fissures and foramina. When resection involves the orbital roof or other portions of the skull base, a transcranial approach in collaboration with neurosurgery should be utilized [33–35]. For tumors arising from or involving the paranasal sinuses, an otolaryngologist can provide invaluable assistance in navigating the complex anatomy of this region and resecting tumor-involved portions of the midface using open or endoscopic surgical techniques [36].

Primary Reconstruction of the Exenterated Orbit

A plethora of surgical options are available for reconstructing the exenterated socket [37–39]. The decision on which method is used primarily depends upon whether an “open” or “closed” cavity is planned [40]. Open cavities are generally preferred in patients who desire rehabilitation with an orbital prosthesis, and spontaneous epithelialization, skin grafts, or thin local flaps can all achieve this goal (Fig. 53.7a, b). Closed cavities in which the orbit is filled with soft tissue (microvascular free flap or muscle flap) up to the level of the orbital rim may be preferred when prosthesis use is not planned or may be helpful after extended exenteration resulting in communication with the cranial fossa or paranasal sinuses (Fig. 53.8). Modern imaging technologies allow for detection of tumor recurrence even posterior to a vascular flap, and this subject should be discussed with the patient and among the medical team members.

Spontaneous Granulation

An open socket with exposed bone may be allowed to spontaneously granulate and epithelialize postoperatively [41]. Although this approach entails the least operative time and no additional surgical sites, it does require intensive cooperation and perseverance on the part of the patient. Regular dressing changes with petrolatum gauze, typically three

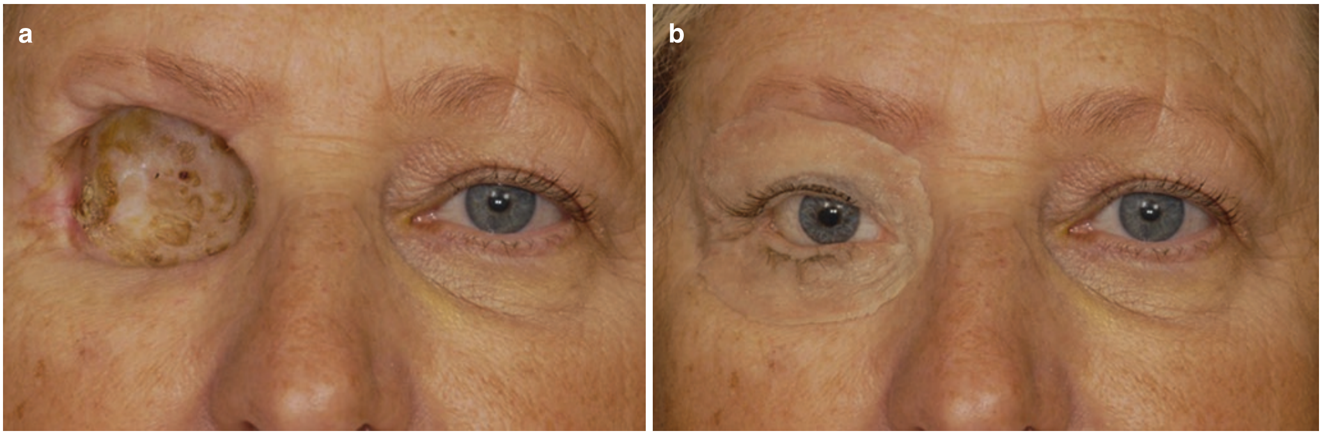

Fig. 53.7 (**a**) Open cavity following total orbital exenteration with split-thickness skin graft. (**b**) Same patient with an orbital prosthesis

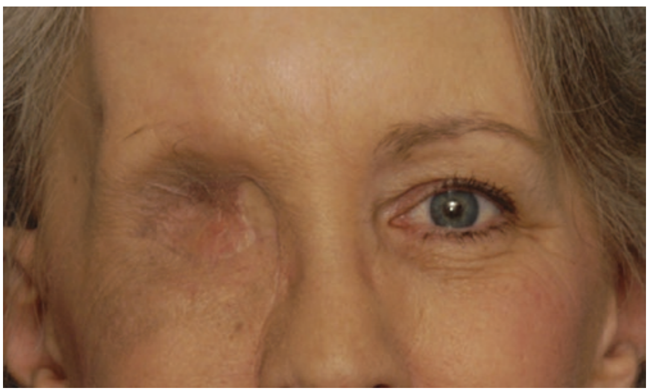

Fig. 53.8 Closed cavity following extended transcranial exenteration with maxillectomy and primary reconstruction with scapular free flap

times a week, should be performed by a home health nurse or other trained caregiver. Granulation tissue begins to appear within a week postoperatively, and epithelialization progresses over a period of 3–6 months. Orbital radiation can significantly delay the healing process. The opposite is also true – a slowly healing, granulating socket may delay initiation of needed radiation. If desired, the patient may be fit with an orbital prosthesis once complete epithelialization has occurred.

Skin Grafting

Although the harvesting of a skin graft necessitates an additional operative site, the placement of such facilitates much more rapid healing of the socket and earlier rehabilitation compared to spontaneous granulation. While full-thickness skin grafts are acceptable, split-thickness grafts are more commonly used in this setting due to the need for relatively large grafts to cover the surface area inside the orbit [42]. Split-thickness grafts are also more likely than full-thickness grafts to successfully take onto the bare bone surface of the orbit.

Split-thickness skin grafts can be harvested from the thigh or other suitable location with an automated dermatome (Fig. 53.9). The graft may be meshed if desired, or alternatively, several slits can be made with a scalpel or scissors to allow for fluid drainage and increased stretching of the graft. For optimal cosmesis, any meshed graft should be limited to the confines of the socket and avoid any areas that will not eventually be covered by a prosthesis or patch. After the graft is trimmed to an appropriate size and shape, it is placed in the socket and the edges secured with absorbable sutures (Fig. 53.10). The socket is packed with petrolatum gauze and a pressure dressing placed. The first dressing change is performed approximately 1 week postoperatively, followed by dressing changes every other day for up to another week. If desired, a cotton-tipped applicator soaked in hydrogen peroxide may be used to carefully clean the socket during this period. Once good graft take is observed, the orbit can simply be covered with an eye patch until a prosthesis is made, and the patient should be instructed to clean the socket periodically with soap and water. The skin graft donor site can be covered with a single layer of fine mesh gauze and allowed to dry. The dressing will spontaneously separate once the wound has healed in about 3 weeks.

The dermis-fat graft has also been described as an alternative method of covering the exenterated socket, both with and without a temporalis muscle transfer flap [16, 43]. This provides a substrate for epithelialization and partially replaces the lost orbital soft tissue while still potentially leaving room for a prosthesis.

Soft Tissue Reconstruction

In lieu of rehabilitation with an orbital prosthesis, some surgeons advocate primary reconstruction of exenterated sockets by replacing the lost orbital soft tissue volume and periocular skin with pedicled or microvascular free flaps.

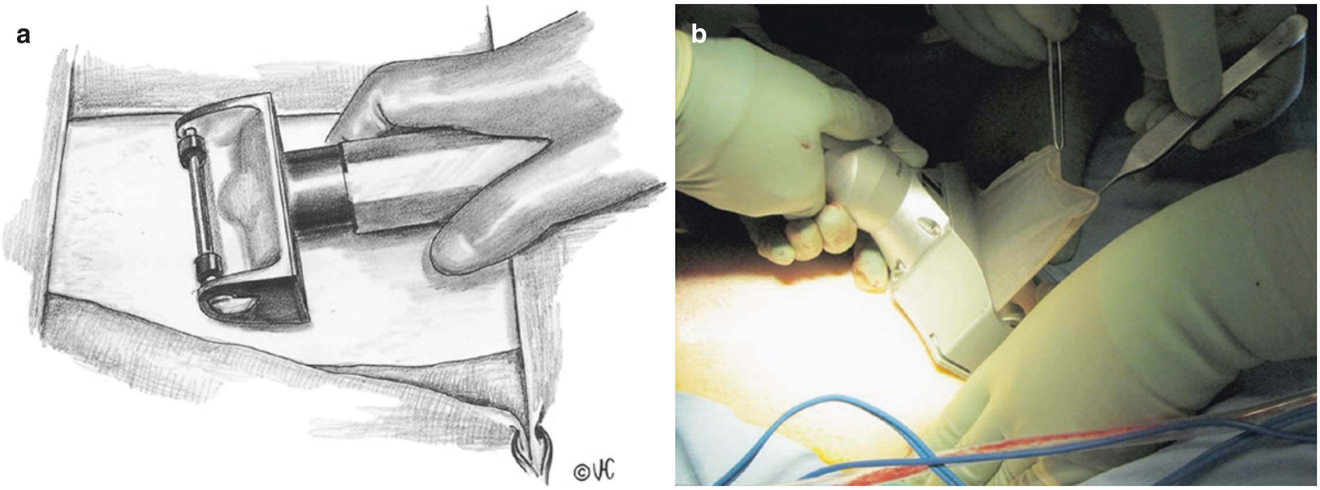

Fig. 53.9 Split-thickness skin graft is harvested from the thigh with an automated dermatome. (**a**) Line drawing. (**b**) Intraoperative photograph showing a split-thickness graft harvested from the thigh

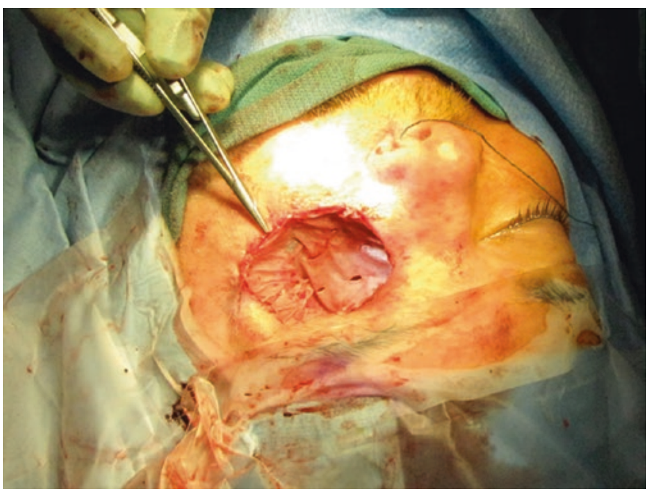

Fig. 53.10 Intraoperative photograph showing exenterated orbit lined with split-thickness skin graft. The graft was meshed with a #15 scalpel blade prior to being placed, and the edges are secured with 6-0 chromic sutures

Because these techniques do not attempt to recreate the appearance of the eyelids and globe, their aesthetic outcome is admittedly unnatural. Potential donor site morbidity is another disadvantage. However, postoperative orbital healing takes place quite rapidly, and the problems associated with orbital prostheses are eliminated. Vascularized flaps are also advantageous for covering any grafts or alloplastic implants that may be utilized for bony reconstruction, as discussed below.

Many local flaps have been described for orbital reconstruction, such as temporoparietal fascia, temporalis muscle, frontalis muscle, and myocutaneous flaps from the forehead, scalp, and cervicofacial region [38, 39, 43–46]. In some cases of lid-sparing exenteration, mucous membrane grafts have been placed over vascularized flaps to create a cavity suitable for wear of an ocular prosthesis [38].

Microvascular free flaps which have been utilized for reconstruction of the exenterated socket include radial forearm, latissimus dorsi, rectus abdominus, lateral arm, and anterolateral thigh flaps [47–50]. An additional advantage of free flaps is the potential for bony reconstruction with vascularized osseocutaneous flaps such as radial forearm, scapular, or fibular free flaps [49, 51, 52]. Free flap reconstructions are typically performed by facial or general plastic surgeons trained in microvascular surgery, and postoperative hospitalization is required.

It should be noted that these methods of soft tissue reconstruction can potentially affect postoperative tumor surveillance [37]. Their size and bulk will mask the direct clinical observation of recurrent tumor, necessitating the use of periodic imaging studies in these patients, in contrast with orbits covered with skin alone, where tumor recurrence can more readily be detected on clinical exam. MRI would typically be the imaging modality of choice for surveillance of soft tissues.

Bony Reconstruction

When orbital bone is either destroyed by the primary disease process or resected during exenteration, reconstruction of the bony orbit may be necessary to achieve an optimal outcome. Whenever possible, defects of the orbital rim should be reconstructed to maintain the continuity and bony contour of the upper and midface (Fig. 53.11). Defects of the orbital roof may not require reconstruction unless more than half of the roof is involved. Likewise, lateral orbital wall defects do not typically require reconstruction, with the possible excep-

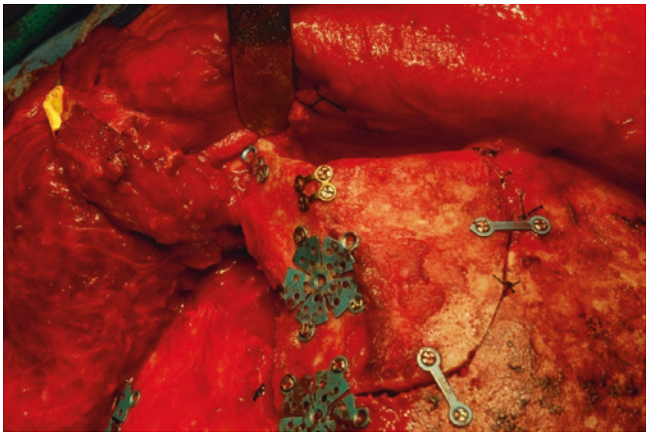

Fig. 53.11 Bony reconstruction of the superotemporal orbital rim with autogenous calvarial bone graft, following extended transcranial exenteration with removal of the orbital roof and lateral wall

tion of cases in which the entire greater sphenoid wing is removed. Reconstruction of the orbital floor and medial wall can be problematic due to the paucity of bony support and vascularized tissue within the ethmoid and maxillary sinuses. The necessity and type of such reconstruction largely depend on the chosen method of soft tissue coverage. Spontaneous epithelialization will not take place within an exposed sinus, and skin grafts are likely to fail if placed either over the defect, within the sinus, or over a reconstructed orbital wall. In these cases, microvascular free flaps are typically used to reconstruct or obliterate the open sinus.

A variety of materials can be utilized for reconstruction of the bony orbit. Autogenous bone grafts, such as split calvarium or iliac crest, are ideal for this purpose due to their biocompatibility and longevity. A microvascular free flap with a bony component is also an excellent choice. Irradiated cadaver bone is suitable but less optimal due to its propensity for absorption. Alloplastic implants, while readily available, are more prone to exposure and infection and require adequate coverage with well-vascularized tissue. Standard titanium plates and screws can be used to fixate grafts or implants during bony reconstruction.

Special Clinical Considerations

The orbital diseases which require treatment by exenteration are typically severe and complex. Many of the malignant tumors, by virtue of their size, invasiveness, or propensity for metastasis, will require adjunctive treatment with chemotherapy or radiation. In an orbit that has undergone radiation prior to exenteration, the surgeon must keep in mind the fibrosing and devascularizing effects of radiation on orbital tissues and their potentially detrimental effects on postoperative healing. By the same token, when the administration of postoperative radiation is anticipated, consideration may be given to the use of thicker or more vascularized reconstructive soft tissue flaps, as radiation-induced necrosis is more likely with skin grafts or thinner flaps [53]. Coordination should also take place with the radiation oncologist to determine the ideal time frame to initiate radiation treatment once adequate healing has occurred.

Recent research by Tse et al. [54]. in the use of preoperative intra-arterial cytoreductive chemotherapy for lacrimal gland adenoid cystic carcinoma deserves specific mention. Under this protocol, chemotherapeutic agents are administered via the external carotid artery directly to the orbital tissues. Following completion of this therapy, the orbit is exenterated with or without bone removal, and postoperative radiation is administered as indicated. Early data suggests that this treatment strategy may increase survival for patients with this highly malignant tumor. (Please see “Lacrimal Gland” chapter in this book for additional reading.)

Exenteration of the post-traumatic orbit can be particularly challenging. Extensive scarring, distortion of anatomic landmarks, and bony loss with paranasal sinus communication are commonly encountered. In addition, if the orbital roof has been violated, the potential exists for intraoperative or postoperative neurosurgical complications. The surgeon must be prepared to deal with these potential issues, along with the detrimental effects of trauma on vascular supply and postoperative wound healing.

Complications of Exenteration

As with all surgical procedures, bleeding, infection, damage to surrounding structures, and an unsatisfactory aesthetic outcome are potential complications of exenteration. Hemostasis can be particularly difficult following division of the major vessels of the orbit, the ophthalmic artery in particular. Violation of the ethmoid or maxillary sinuses can also increase the risk of microbial contamination and infection. The usefulness of prophylactic antibiotics for exenteration has not been demonstrated, but they may be prescribed at the surgeon’s discretion.

An unavoidable side effect of exenteration is postoperative numbness in the distribution of the ophthalmic division of the trigeminal nerve (V1) due to resection of the supraorbital, supratrochlear, infratrochlear, and ethmoidal nerves. Preoperative counseling is important to ensure that this unpleasant effect is fully expected by the patient. Return of sensation is unpredictable but may take place over many months. Numbness in the V2 distribution is also common due to division of the zygomatic nerves but is usually much less noticeable and shorter-lived. Infraorbital nerve injury is unusual unless the orbital floor is inadvertently violated along the course of the infraorbital canal.

Fistular communication with the paranasal sinuses can result from violation of the orbital floor or medial wall, either as a result of the orbital disease or from intraoperative trauma [55]. The nasolacrimal duct is also a potential cause of fistulas, and intraoperative obliteration of the proximal nasolacrimal duct with fat or muscle may decrease the risk of this complication. While smaller bony defects may spontaneously epithelialize with proper socket care, larger defects more commonly result in fistulas causing discharge, crusting, and possible difficulty maintaining an orbital prosthesis. Orbital radiation also increases the risk of sino-orbital fistulas. Skin grafts or vascularized flaps can be used primarily to prevent fistulas or secondarily to treat persistent, symptomatic fistulas [56]. The use of an extraocular muscle and orbital fat graft has also been described to primarily fill orbital wall defects during exenteration [57].

Cerebrospinal fluid (CSF) leaks can potentially complicate exenteration due to violation of the orbital roof, cribriform plate, or greater sphenoid wing [58, 59]. In many cases, CSF leaks that are recognized intraoperatively can be controlled with bone wax if the bony defect is small. However, consultation with a neurosurgeon is advisable if the leak persists despite attempted repair by the orbital surgeon. Intracranial infection can also complicate orbital exenteration with bone removal, with or without a CSF leak. This risk can be decreased by primary obliteration of the socket with soft tissue grafts or flaps [60].

Tumor recurrence can follow exenteration for malignant or benign lesions. This risk increases when residual gross or microscopic tumor is left and can be minimized through careful operative planning and surgical margin control. However, clear surgical margins do not preclude the possibility of tumor recurrence or metastasis, and the occurrence of such does not necessarily imply any failure on the part of the surgeon, particularly with high-grade malignancies such as adenoid cystic carcinoma or melanoma. As mentioned above, periodic postoperative imaging is essential for tumor surveillance after reconstruction with thick vascularized tissue flaps.

Rehabilitation of the Exenterated Socket

There is no escaping the significant facial deformity that follows orbital exenteration [61]. There are many ways to mitigate the undesirable aesthetic outcome of this procedure, but none of them are ideal. The simplest way to mask the post-exenteration orbit is by patching, which some patients may, for various reasons, find preferable to the other available options [39]. Custom orbital prostheses may arguably produce the most anatomically natural appearance, but the silicone material can never perfectly reproduce the color and texture of the lid and periocular skin, and there is no dynamic movement of the prosthetic eyelids and globe. The social ramifications of an inadvertently dislocated orbital prosthesis in a public setting can also be very disturbing, particularly for schoolchildren. As discussed above, coverage of the socket with vascularized tissue flaps provides natural skin in the periocular region but complete absence of the appearance of ocular structures.

Orbital Prosthetics

The creation of orbital prostheses [62, 63] is a highly specialized field and, in many cases, is performed by an anaplastologist who works with an ocularist, as completely different materials and techniques are utilized by each. Because of the relatively small number of these specialists, it is often necessary for the patient to travel long distances to enlist their services. However, the significant cost and effort involved is far outweighed in many people's minds by the dramatic aesthetic improvement and psychosocial benefits of an orbital prosthesis.

An impression of the orbit is typically made with hydrocolloid, which is then used to create a plaster cast (Fig. 53.12). A custom ocular prosthesis is positioned in the cast, and clay is molded into the "orbit" and around the prosthesis. The clay is then placed into the patient's orbit and sculpted to match the contour and appearance of the contralateral eyelids and periocular region (Fig. 53.13). A plaster mold is made from the sculpted clay and used to create the silicone prosthesis within which the ocular prosthesis is placed (Fig. 53.14). Dental thermal molding material can also be used to line the posterior prosthesis surface to prevent microbial infiltration of the silicone. The prosthesis is trimmed to fit the patient's socket, and eyelashes are added. If desired, the patient may wear spectacles to camouflage the silicone-to-skin interface.

Fig. 53.12 A hydrocolloid impression is made from the orbit for creation of an orbital prosthesis

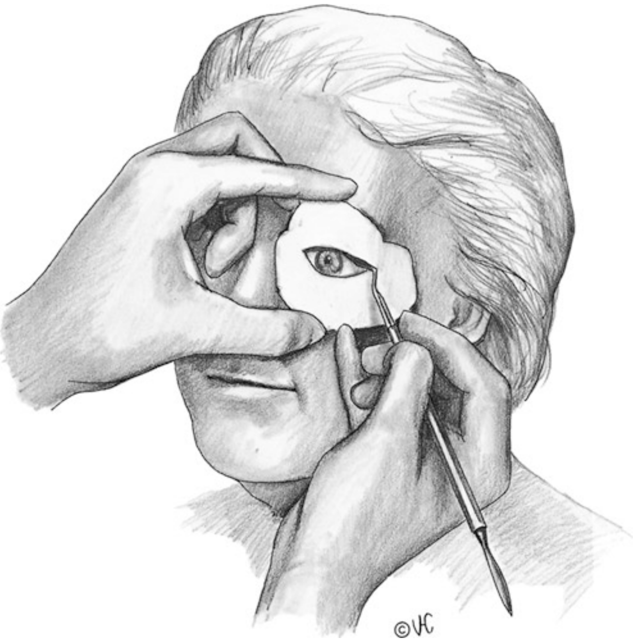

Fig. 53.13 The ocular prosthesis is placed within the clay mold, which is then sculpted to match the fellow eye

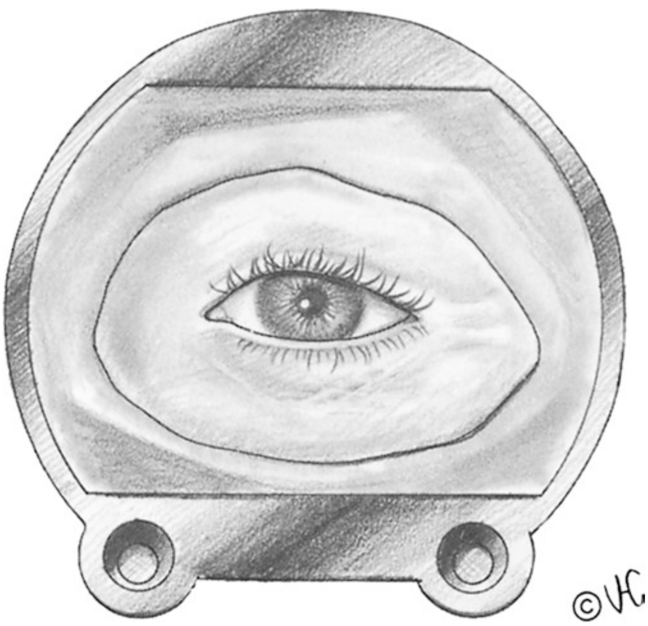

Fig. 53.14 Completed orbital prosthesis within the opened molding flask

Some orbital prostheses may be prone to dislodgement, particularly in shallower orbits. Adhesives or solvents may aid in retention but can also have detrimental effects on the prosthesis or the patient's skin. Support of the prosthesis with spectacles is another option. Magnetic coupling to osseointegrated screws can be very effective but requires additional surgery, typically performed several months post-operatively after epithelialization is complete [64].

As with any other type of prosthesis, care is required by the patient to maintain the prosthesis and keep the orbit clean. Regular follow-up with the prosthetist is important to optimize the comfort, appearance, and longevity of the prosthesis.

Conclusion

Orbital exenteration is an uncommon operation that is thankfully becoming even more rare, thanks to advances in the medical and surgical care of complex orbital disorders. Nevertheless, it has importance in the management of certain conditions and may literally be lifesaving. Modern prosthetic and reconstructive techniques are very helpful in rehabilitation efforts, and a team-oriented approach is recommended for these patients.

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