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Evisceration Versus Enucleation in Ocular Globe Injury

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A B S T R A C T

Evisceration and enucleation have been acceptable therapeutic modalities to treat not only severe ocular trauma but also various ocular conditions, such as intraocular tumors, endophthalmitis, and blind-painful-cosmetically disfiguring eyes, over the last two centuries. Clinical indications and choices of procedure, whether enucleation or evisceration, vary among institutions, surgeon experience, and severity of structure loss. In the past, enucleation has been preferred by most surgeons for various reasons, including the fear of sympathetic ophthalmia (SO) after evisceration. Despite the possibility of causing SO, anophthalmic socket also has complications, including superior sulcus defect, conjunctival surface changes, implant exposure, fornix/socket contraction, and eyelid malposition. This literature review will discuss indication, technique, and decision with regard to enucleation or evisceration after ocular trauma.

1. Introduction

Ocular trauma is a significant source of morbidity in North America and worldwide, with over 2 million eye injury cases estimated by the American Society of Ocular Trauma. The incidence of ocular trauma sustained in combat has also steadily increased over the past 150 years, with military surgeons now expecting around 10% of battlefield casualties to present with eye injuries. Although most cases of eye injury result in significant recovery, severe penetrating and perforating open globe injuries (OGIs) are often devastating and may lead to complete visual loss in the traumatized eye, loss of ocular architecture, and can be a subsequent compromise of the fellow eye. When eye salvage has failed, enucleation and evisceration are two commonly utilized options for removal of the eye.[1, 2, 3]

Evisceration involves the removal of the contents of the globe, leaving the sclera, extraocular muscles, and optic nerve intact. Evisceration should be considered if the presence of an intraocular malignancy has been ruled out. Enucleation involves first releasing the extraocular muscles from the sclera, then removing the globe. Evisceration and enucleation have been acceptable therapeutic modalities to treat not only severe ocular trauma but also various ocular conditions, such as; intraocular tumors (enucleation only), endophthalmitis, and blind-painful-cosmetically disfiguring eyes, over the last two centuries.[4,5,6]

Clinical indications and choices of procedure whether enucleation or evisceration vary among institutions, surgeon experience, and severity of structure loss. In the past, enucleation has been preferred by most surgeons for various reasons, including the fear of sympathetic ophthalmia (SO) after evisceration. However, after recent studies demonstrating the high safety of evisceration and low risk of SO, interest in evisceration has increased because of its purported advantages.[2,7]

If the ruptured globe is beyond repair, primary eye removal (either enucleation or evisceration) may be the only choice. The decision to perform evisceration rather than enucleation has given rise to controversy over the years. As antigenic uveal tissue may theoretically remain the following evisceration, SO is a potential sequela. Historically, enucleation was considered within the first 10 to 14 days following severe globe trauma with extensive prolapse of uveal tissue because of concerns that the risks of sympathetic ophthalmia and harm to the remaining eye were thought to be greater than the likelihood of recovering useful vision in the traumatized eye.[7,8] Despite to the possibility of causing SO, anophthalmic socket also has complications include superior sulcus defect, conjunctival surface changes, implant exposure, fornix/socket contraction, and eyelid malposition.[4,5]

This literature reviews will discuss indication, technique, and decision with regard to enucleation or evisceration after ocular trauma.

Evisceration and enucleation: indication and technique

Once the decision is has been made regarding the futility of globe preservation, a detailed discussion with the patient and the family regarding the clear indications for the globe removal, post-operative rehabilitation, and alternatives should be held and documented with a valid informed consent.[7,9]

Surgical indication

In most cases, when globe removal is required, either surgery is adequate, and the surgeon may choose their personal preference. However, there are circumstances where one is preferable or, in some cases, contraindicated. Table 1 compares and contrasts the benefits of evisceration and enucleation for individual indications.[10,11,12]

Table 1. Indication versus contraindication for evisceration and enucleation.[10]

Indication	**Evisceration**	**Enucleation**
Neoplasm	-	++
Penetrating trauma	±	+
Blind, painful eye	+	+
Endophthalmitis	+	±
+ = indicated, ++ = absolute, indicated, ± = controversially indicated, - = not indicated		

Neoplasm

Malignancy is an absolute contraindication to evisceration. An enucleation should be performed whenever managing an eye suspected or known to harbor an intraocular malignancy. The ocular tumors most commonly requiring enucleation are retinoblastoma and choroidal melanoma. When enucleation is performed on an eye with an intraocular tumor, the surgeon must take care to avoid penetrating the globe during surgery and to handle the globe gently to minimize the theoretical risk of disseminating tumor cells.[4,10,11,12]

Penetrating trauma

One of the most common indications for evisceration is penetrating ocular trauma despite the possible association with sympathetic ophthalmia. Removal of the eye (or its contents) before sensitization is considered preventive. Classic teaching is to perform surgery within 14 days of injury. The origin of this teaching is unclear, although it may stem from a study indicating that visual outcome improves significantly if surgery is performed within two weeks of injury, given that sympathetic ophthalmia has not developed.[10,11,12]

Although traditionally, enucleation has been recommended in the setting of penetrating trauma, evisceration is also routinely performed for the purpose of protecting against sympathetic ophthalmia. In cases with extensive disruption of the globe, removal of all uveal tissue may be difficult via an evisceration; therefore, enucleation may better safeguard against retained uveal tissue, a risk factor for sympathetic ophthalmia. However, in cases where the sclera is largely intact, and the intraocular contents are contained and identifiable, an evisceration may be a reasonable alternative. The selection is usually based on the surgeon's judgment or preference.[10,11,12]

In severely traumatized eyes, early enucleation may be considered if the risk of sympathetic ophthalmia and harm to the remaining eye is judged to be greater than the likelihood of recovering useful vision in the traumatized eye. Sympathetic ophthalmia is thought to be a delayed hypersensitivity immune response to the uveal antigens. Enucleation with complete removal of the uveal pigment may be beneficial in preventing this subsequent immune response. The yearly incidence of sympathetic ophthalmia is estimated to be 0.03 per 100,000. The condition has been reported to occur from 9 days to 50 years after corneoscleral perforation. The infrequency of sympathetic ophthalmia, coupled with improved medical therapy for uveitis, has made early enucleation strictly for prophylaxis a debatable practice.[4,11,12]

Blind eyes

Blind eyes are commonly removed for both pain control and improvement of cosmesis. Both enucleation and evisceration are effective in these settings. Again, the choice of procedure usually depends on the surgeon's personal experience and preference.[10-12] Painful eyes without useful vision can be managed with enucleation or evisceration. Patients with end-stage neovascular glaucoma, chronic uveitis, or previously traumatized blind eyes can obtain dramatic relief from discomfort and improved cosmesis with either procedure.[4,11,12] For nonpainful, disfigured eyes, and it is generally advisable to consider a trial of a cosmetic scleral shell prior to removal of the eye. If tolerated, scleral shells can provide excellent cosmesis and motility.[4,11,12]

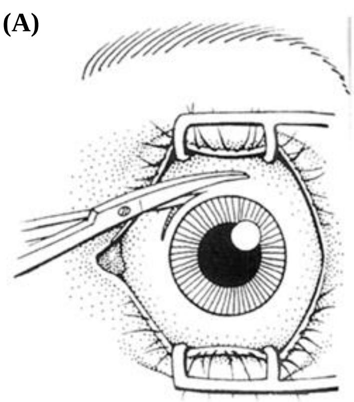
Endophthalmitis

Endophthalmitis is the common reason for evisceration and enucleation in some developing countries. Before the advent of antibiotics, surgeons fairly uniformly advocated evisceration over enucleation. Evisceration leaves the optic nerve intact and thus avoids the spread of intraocular microbials into the subarachnoid space.[10,11,12]

Evisceration surgical technique

Evisceration may be performed under local or general anesthesia. After preparation and drape in the standard fashion using povidone-iodine for the skin and conjunctiva, place the eyelid speculum between the eyelids. Using Westcott scissors or dissection scissors, perform a 360° limbal peritomy trying to leave on the limbus and dissect posteriorly back. (Figure 1A). Incise full thickness of the cornea at the limbus with a blade and do a complete 360° keratectomy (Figure 1B).[5,13,14]

(A)



(B)

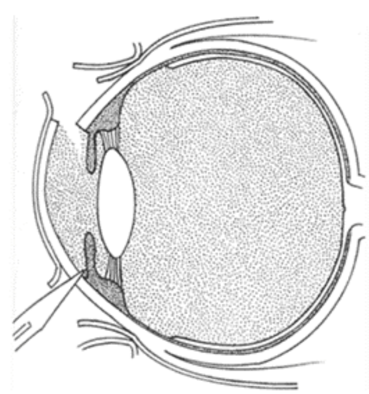


Figure 1. (A) Peritomy. (B) Entering the anterior chamber [5]

Use an evisceration spoon to dissect the sclera from the choroid (Figure 2). It is common to find active bleeding from the central retinal artery and other perforant arteries that branch from long anterior ciliary arteries. After this dissection is completed, the entire content of the globe is scooped out.[5,13,14]

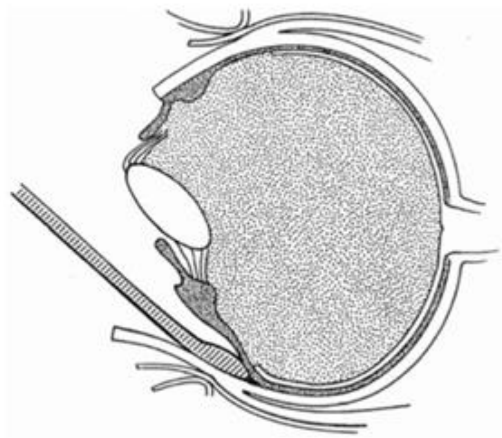


Figure 2. Evisceration spoon into suprachoroidal space.[5]

Gauze can be used to abrade the scleral shell, and hydrogen peroxide soaked pledgets can be inserted and then washed with saline to control capillary bleeding. This process has a hemostatic effect and loosens uveal tissue from the scleral pouch and destroys any residual uveal pigments with a cotton-tipped applicator or a peanut dissector (Figure 3A). The wound is irrigated with an antibiotic solution. The scleral shell is packed snugly with a long folded piece of povidone-iodine gauze (Figure 3B).[5,13,14]

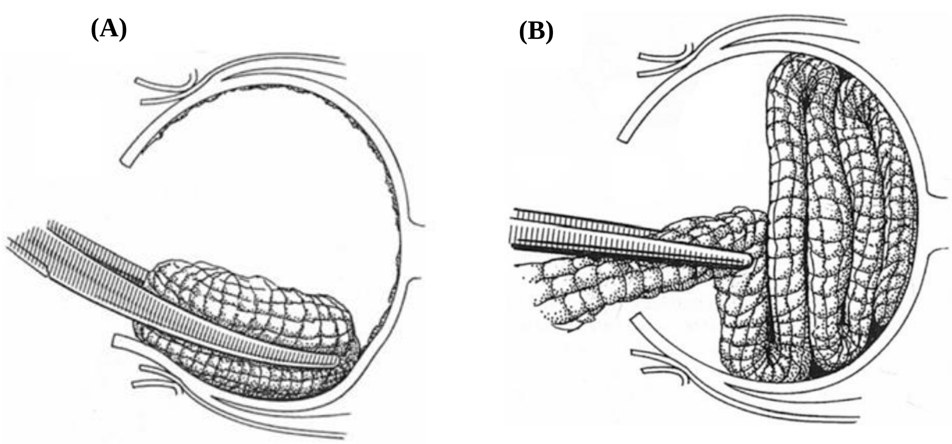


Figure 3. (A) Uvea removed with peanut dissector. (B) Scleral shell packed with iodoform gauze.[5]

Make radial scleral incisions in the four oblique quadrants, avoiding the insertions of the rectus muscles (the four-petal technique) (Figures 4 A-B).[5,13,14]

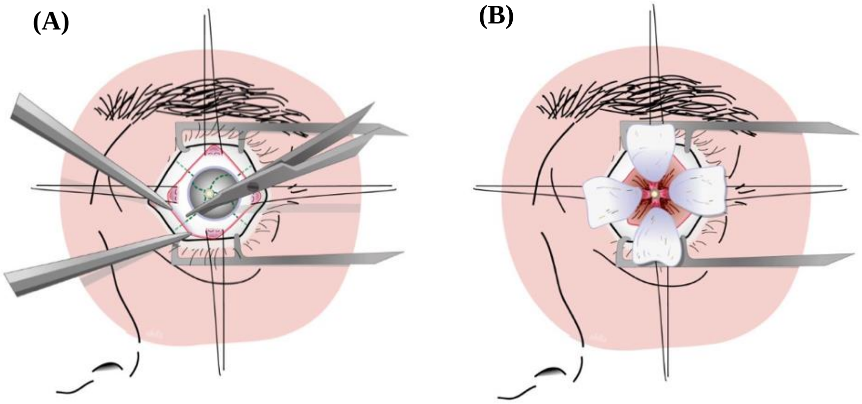
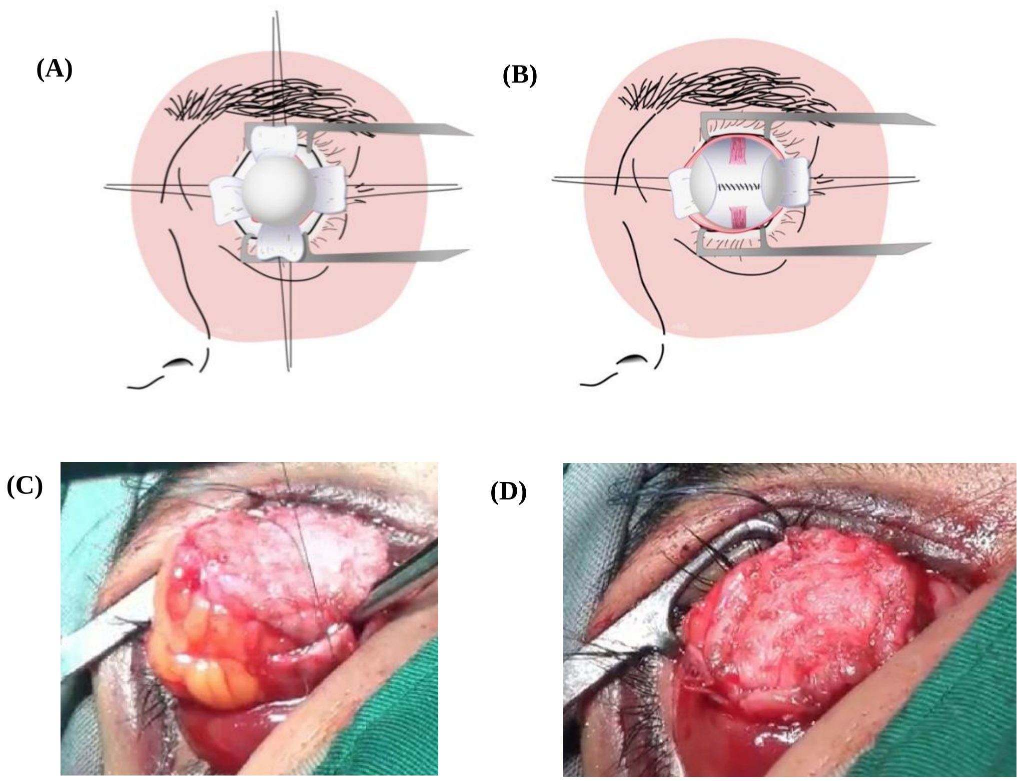


Figure 4. (A) Four sclerotomies were performed with scissors. (B) Four petals stretched wide apart.[13]

Gently pull the four petals out of the socket so the implant can be placed as deep as possible. Because the petals are independent of each other and form the optic nerve, the sclera can cover any size of the implant without tension. The vertical petals are sutured to each other in front of the implant using a 6/0 absorbable suture. The horizontal petals are sutured in the same way as the vertical petals. Make sure that sutures are tied with no tension. If using dermis fat graft (DFG), put the DFG into the scleral pocket. Suture the edge of the dermis to the sclera using 6/0 vicryl (Figures 5 A-D).[5,13,14]



Figures 5. (A) Implant placed between petals pressed deep inside the orbit. (B) Implant wrapped with sclera from the upper and lower petals with muscles attached. (C) Place the DFG into the scleral pocket and suture the edge of the dermis to the sclera. (D) The DFG is secured to the sclera at four poles.[13,14]

The final step is closure. All techniques include the closure of multiple layers, including the sclera, Tenon's membrane, and, lastly, conjunctiva. Meticulous closure is felt to be essential in preventing implant extrusion (Figure 6).[5,13,14]

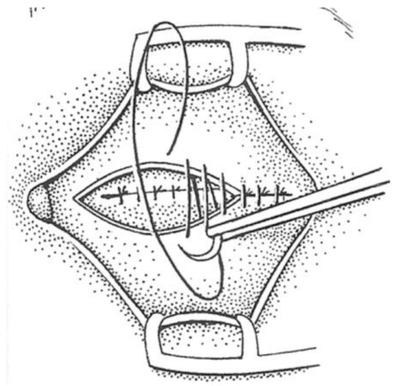


Figure 6. Closure of sclera and conjunctiva.[5]

Enucleation surgical technique

Once in the operating room, the patient is prepped and draped in the usual sterile fashion for ophthalmic surgery. An eyelid speculum or sutures may be used to retract the eyelids away from the globe. To maintain adequate fornix depth and conserve as much conjunctiva as possible, a peritomy is made 360 degrees at the limbus. The globe is bluntly dissected from Tenon's capsule. Despite being separated from the globe, Tenon's capsule's attachments to the rectus muscles are not disturbed. Using a muscle hook, the rectus muscles are isolated one at a time. A double-armed Vicryl suture is then placed through the muscle in a locking fashion 2 mm posterior to muscle insertion into the globe.[15,13,16]

Using scissors, the isolated muscle is disinserted anterior to the suture, and the double-armed suture is gently pulled to retract the detached rectus muscle away from the globe while still maintaining its appropriate orientation (Figure 7).[15,13,16]

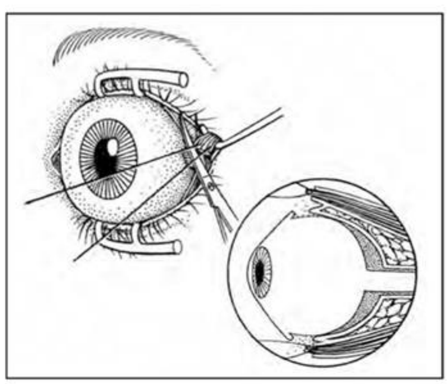


Figure 7. Isolation and disinsertion of rectus muscle.[16]

Two 4-0 silk sutures are then passed through the stumps of the medial and lateral rectus muscles to provide traction anteriorly at the time of globe removal. After detaching all extraocular muscles from the globe, a muscle hook can be used to bluntly separate the sclera anteriorly and posteriorly to ensure that all Tenon’s capsule attachments to the globe have been broken.[15,13,16]

To isolate the optic nerve, a curved or right-angled hemostat is extended posterior to the globe, and the optic nerve is identified by touching its superior and inferior borders with the tip of the hemostat. While placing anterior traction on the 4-0 silk traction sutures, the clamp is advanced along the medial or lateral orbital wall and closed over the nerve and its vessels roughly 3–10 mm posterior to the globe. In performing the lateral approach, it is important to proceed with caution to avoid penetrating the very thin medial orbital wall with the tip of the clamp. The clamp is left closed over the nerve for 5 min. Moving the hemostat while it is clamped around the optic nerve and watching the globe move in the appropriate direction (Figure 8a, b) will assure the surgeon of its proper placement.[15,13,16]

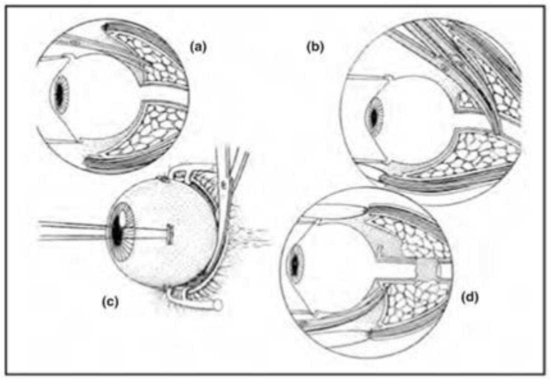


Figure 8. (a) Anterior traction of the globe. (b) Clamping the optic nerve. (c) Cutting the optic nerve. (d) Removal of the enucleated globe.[16]

After 5 min, the clamp is removed, and curved enucleation scissors are then placed such that they will cut the optic nerve and its associated vessels slightly anterior to the previously crushed area (Figure 10c, d). Anterior traction is applied to the globe before cutting the nerve by softly pulling on the pre-placed traction sutures of the horizontal muscle stumps. The nerve is then cut, and the globe is removed. Any remaining globe attachments that were not previously removed can be detached at this time.[15, 13, 16]

Place the implant within the socket. Orbital fat should be seen through the posterior opening in Tenon's capsule. The implant is then placed through this opening and into the orbital fat (Figure 9a). Using a running 5-0 Vicryl suture, the posterior layer of Tenon's capsule from around the optic nerve is sutured over the implant (Figure 9b).[15,13,16]

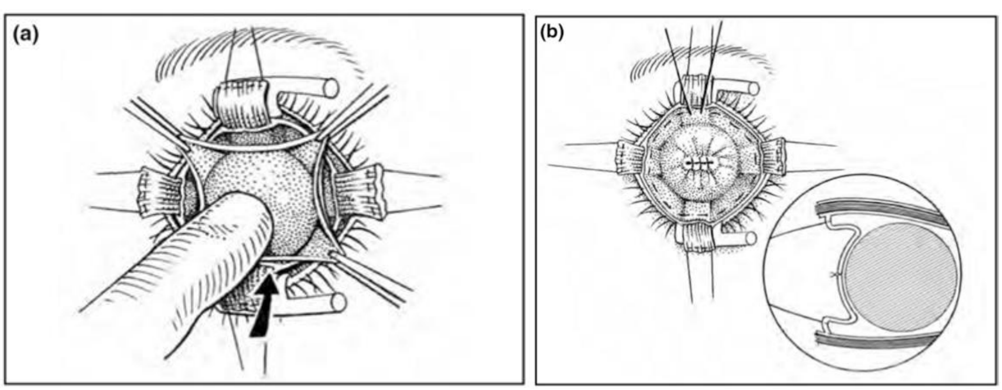


Figure 9. (a) Inserting implant behind posterior Tenon's capsule. (b) Closing posterior Tenon's capsule over the implant.[16]

Using the previously placed 5-0 Vicryl suture, the superior rectus muscle is then tied to the inferior rectus muscle in front of the sphere, and the lateral rectus muscle is advanced and attached to the medial rectus muscle. Since horizontal movement is more important to the patient for postop cosmesis, the horizontal muscles are placed anterior to the vertical rectus muscles, which puts them in closer contact with the conjunctiva. If the superior rectus is advanced too far inferiorly, ptosis may occur (Figure 10).[15,13,16]

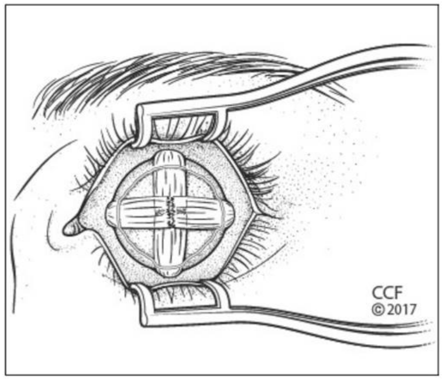


Figure 10. Tying vertical and horizontal muscles over posterior Tenon's capsule closure.[16]

The anterior aspect of Tenon's capsule is closed with a running 5-0 Vicryl suture in 1 or 2 layers, and the conjunctiva is closed with a running 6-0 plain gut or chromic suture (Figure 11), preferably in a parallel line to the Tenon's closure.[15,13,16]

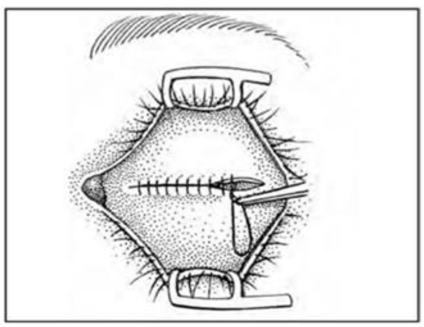


Figure 11. Closing anterior Tenon's capsule and conjunctiva over rectus muscles.[16]

Once the conjunctiva is closed, an ophthalmic antibiotic ointment is administered into the socket, and an appropriate size conformer is placed into the fornices. The conformer should be transparent and can have holes (optional) at least 2 mm in size to allow for the egress of fluid. In the post-operative period, the surgeon can then examine the socket without removing the conformer.[15,13,16]

Orbital implant

The average volume of the adult human orbit is 30 mL, approximately 6.5–7.0 mL being occupied by the globe. To avoid enophthalmos or distortion of the superior sulcus, most recent oculoplastic literature has focused on replacing optimal orbital volume after enucleation or evisceration. Research by Kaltreider et al. suggested the use of A-scan ultrasonography of the fellow healthy eye to provide a tool for correct orbital implant size to replace 80% of the volume removed at enucleation.[17,18]

Custer et al. have focused on the volumetric determination of enucleation implant size. Accordingly, the volume of implant used should be equal to the volume of the enucleated eye minus the volume of the prosthesis. For example, if the prosthesis size is 2.5 mL (with a spherical diameter of 21 mm) and the volume of an eye is 7.2 mL (with an axial length of 24 mm), then the implant volume should be 4.7 mL. A scleral wrap adds approximately 1.5 mm to the diameter of the implant. Based on this formula, Table 2 demonstrates calculated orbital implant sizes for different globe volumes and axial lengths.[19,16]

Table 2. Calculating implant size.[16]

Natural eye diameter (mm)	Natural eye volume (mL)	Prosthetic eye volume (mL)	Implant volume required (mL)	Implant diameter required (mm) unwrapped
20.0	4.19	2.5	1.69	15.0
20.5	4.51	2.5	2.01	15.5
21.0	4.85	2.5	2.35	16.5
21.5	5.21	2.5	2.71	17.5
22.0	5.58	2.5	3.08	18.0
22.5	5.97	2.5	3.47	19.0
23.0	6.37	2.5	3.87	19.5
23.5	6.80	2.5	4.30	20.0
24.0	7.24	2.5	4.74	21.0
24.5	7.70	2.5	5.20	21.5
25.0	8.18	2.5	5.68	22.0
25.5	8.69	2.5	6.19	23.0

The various materials that may be used to replace lost globe volume may be either autologous or alloplastic. Autologous DFG has the great advantage of not only providing volume but a socket surface (dermis) which may be epithelized by native conjunctival epithelium, making it an ideal material for contracted sockets, provided there is some vascularity of the socket structures.[9,20]

Alloplastic implants are the materials of choice in most anophthalmic socket reconstruction. Factors to be considered while placing alloplastic implants include the material, shape, size, and cost-benefit ratio. Alloplastic implants may be broadly classified into non-porous and porous implants. Non-porous implants include glass, silicone, and acrylic (PMMA) spheres. Porous implants include porous polyethylene spheres, hydroxyapatite, and bioceramics (Figure 12).[9,20]

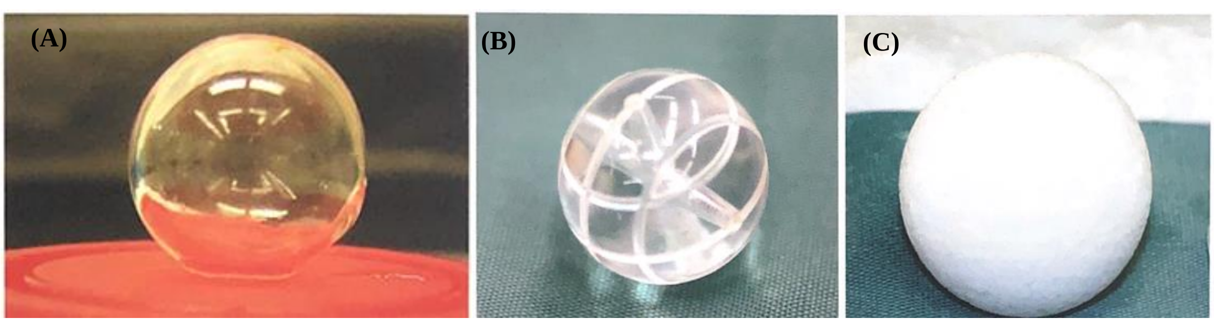


Figure 12. Alloplastic orbital implant (A) Glass Sphere, (B) Acrylic sphere, (C) Porous polypropylene sphere.[20]

Severe ocular trauma: evisceration or enucleation

Open globe injuries are one of the main reasons for the removal of an eye in order to avoid SO. Sympathetic ophthalmia (SO) is a rare, bilateral, diffuse, granulomatous, nonnecrotizing panuveitis that may develop after either surgical or accidental trauma to 1 eye (called the exciting eye), followed by a latent period and the appearance of uveitis in the uninjured fellow eye (the sympathizing eye).[21]

The prevalence of SO after eye injury is estimated to be between 0.1% and 0.3%. A meta-analysis of 24 population-based studies of SO following open globe injuries (with a median study duration of 9.5 years) found an overall incidence of 0.19% of the study populations, but the specific period of time was not defined. Due to its very low incidence, it is controversial whether or not SO can be prevented by removing the eye after trauma. Even if it occurs, there may be a good prognosis with early diagnosis and the use of modern immunotherapies. There is no scientific consensus on the technique and timing of prophylactic surgery.[22,23]

In military conflicts, SO reported has decreased significantly throughout the last century despite an increase in incidents of ocular trauma. In the US military, every attempt is made to close open globe ruptures primarily rather than to perform a primary enucleation. Timely evacuation to medical facilities, improved toilets of perforating wounds, and advances in surgical techniques to repair and preserve the globe are thought to be responsible for the near disappearance of SO from military injury.[24,2]

Despite its long history, the etiology and pathophysiology of the disease are still not clearly understood but are largely thought to be autoimmune. The most convincing theory to date points to the role of autoimmunity with a T cell-mediated response to antigens from the retinal photoreceptor layer of the injured eye that is normally hidden or sequestered. With penetrating trauma, the introduction of these antigens from conjunctival lymphatics to local lymph nodes results in sensitization followed by a cell-mediated response. While the particularly responsible antigen is yet to be determined, possible antigens include retinal soluble antigen (S-antigen), rhodopsin, interphotoreceptor retinoid-binding protein, and recoverin.[21,25 26]

SO cannot simply occur because of exposure of normally sequestered intraocular antigens to the immune system. It has been suggested that some patients may be genetically predisposed to the condition with a particular focus on human leukocyte antigens (HLA, e.g., HLA-A11, HLA-DRB1*04, DQA1*03, DQB1*04). In addition, the concurrent presence of an infectious agent with an antigen may be necessary to incite an immune response or to serve as an adjuvant to sensitization. Attention has also recently been drawn to suggestive cytokine and chemokine involvement in SO pathogenesis and the potential role of photoreceptor oxidative stress. The only presumed prevention for SO has been timely prophylactic enucleation, and to prevent the disease, it must be performed before the development of the autoimmune response. The antigen exposure at the time of injury is thought to be limited by timely globe closure or removal of the uveal tract, that is, enucleation.[21,25,26]

Reports by Shaw (1898), Schirmer (1905), and Randolph (1898) described SO as never coming on less than 2 weeks from the time of injury to the exciting eye and enucleation within 14 days of the penetrating eye trauma (the 14-day rule) was established around this time period. As far as prophylactic enucleation is concerned, there was never any scientific evidence or controlled studies to support the 14-day rule, and it was based solely on limited clinical observation and speculation. With limited medication available at the time to treat SO, prophylactic enucleation of the injured human eye became an established treatment that persists today. Nevertheless, prophylactic enucleation to prevent SO after contralateral eye trauma became controversial as it was clear that enucleation was not always an absolute preventative or guarantee against the later development of SO, even if performed before the development of symptoms in the second eye. Several authors reported cases of suspected SO following enucleation of the exciting eye even when the injured was excised as early as 48h post-injury. Bellan described a case of SO despite having the ruptured globe removed 5 days post-injury and challenged the concept that enucleation within 14 days eliminates the risk of SO. He also made some calculations based on 10,000 theoretical patients with penetrating ocular injury. Assuming an incidence of SO of 0.28%, 9999 prophylactic enucleation procedures would be required within 2 weeks of injury to prevent 1 case of SO with a vision of 20/200 or less. This is quite a high number of unnecessary enucleations, and suggested prophylactic enucleation of an unsalvageable eye following perforating injury should not be mandatory.[27,1]

In a recent study, David and Dutton collected information on the number of evisceration and enucleation worldwide. For enucleations as rough estimates, the worldwide annual occurrence of each procedure is approximately 84,000 eviscerations and

216,000 enucleations. The estimated risk of SO after eye removal is calculated as 0.00006% (1:1,700,000) for enucleation, 0.0001% (1:840,000) for evisceration without predisposing factors (such as penetrating trauma or vitrectomy), and 0.002% (1:55,000) for evisceration with predisposing factors (Table 4).[27] Based on an estimate of 300,000 eye removal cases/year worldwide and 28% eviscerations, the number of cases for each procedure are 216,000 enucleations and 84,000 eviscerations (Table 3).[27]

Table 3. Risk of developing sympathetic ophthalmia after eye removal surgery.

	Enucleation	**Evisceration**
Prevalence of SO from all causes with pre-disposing factors*	0.001%	0.002%
Risk of SO*	1:100,000	1:55,000
Procedure alone	0.00006%	0.0001%
Risk of SO	1:1,700,000	1:840,000

*Predisposing factors include open globe trauma, intraocular foreign body, and vitrectomy surgery.
SO sympathetic ophthalmia.

Although there is no consensus among the United States and United Kingdom authorities concerning the role of enucleation in preventing SO during military conflicts, every attempt is now made to close open globe ruptures primarily rather than to enucleate the eye. Primary eye removal is performed only if the eye is functionally destroyed with no possibility of visual or cosmetic rehabilitation. With explosive and blast injuries associated with improvised explosive devices (IEDs), destruction of the globe can be so severe, there is simply not enough tissue remaining to consider the closure of the ruptured globe, and in some instances, the globe is missing altogether.[24, 2]

If the ruptured globe is beyond repair, primary eye removal (enucleation or evisceration) may be the only choice. Controversy has long existed surrounding evisceration and whether it is an acceptable alternative to enucleation due to a theoretical increased risk of SO from remaining uveal tissue present within scleral emissary channels. As sympathetic ophthalmia that affects the non-traumatized eye is rare and successful uveitis treatment is more common, prophylactic enucleation is now considered a questionable practice. Frequently cited benefits of evisceration include a technically easier alternative to enucleation, faster surgical time, better cosmesis, better motility, improved patient outcomes, and minimization of psychological trauma for the patient as a portion of the eye remains rather than the entire eye being removed.[25,10]

Ultimately, the superior cosmetic outcome depends on volume replacement, socket motility, deep fornices, and normal-appearing and functioning eyelids. Evisceration allows for better preservation of orbital anatomy, improved mobility, and therefore enhanced cosmesis. It has been proposed that evisceration requires less manipulation and consequently less inflammation and scarring of orbital tissues: fornices and suspensory ligaments remain uncompromised. This, in turn, is thought to help maintain the implant. These factors translate to better motility, less risk of superior sulcus deformity, and thus an enhanced cosmetic result for the patients.[4,10]

Table 4 summarizes the more commonly encountered complications. Potential complications common between enucleation and evisceration include infection, hemorrhage, and implant extrusion. Long-term complications include sunken/ deep superior fornix, lower eyelid laxity and ectropion, upper eyelid ptosis, socket contraction, conjunctival cyst formation, implant migration, and late extrusion of the implant. More common and/or serious complications will be addressed in detail.[10,28,29,30]

Table 4. A common complication of evisceration and enucleation.[10]

	Complication (%)							
Study	Enophthalmos	Deep superior sulcus	Ptosis	Exposure/ extrusion	Implant migration	Socket edema	Fornix contraction	Pyogenic granuloma
Shoamanesh et al.								
Evisceration (n= 147)	6.8		18.4	4.1	0	8.8	8.8	5.4
Enucleation (n= 180)	9.4		12.2	1.7	0.5	15.0	13.3	4.4
Nakra et al.								
Evisceration (n= 52)		7.7		3.8			12.5	3.8
Enucleation (n= 32)		15.6		12.5			27.5	3.1
Tari et al.								
Evisceration (n= 50)		20.0		4.0				
Enucleation (n= 50)		14.0		2.0				

Nakra et al. is one of the first and most extensive studies involving the systematic comparison of enucleation and evisceration for all causes, and examined 32 enucleated eyes versus 52 eviscerated eyes. They demonstrated statistically significant superior implant motility, but not prosthetic motility, in eviscerated eyes; the latter often holds greater significance for patients. The study also found improved fornix outcomes and sulcus contours in eviscerated eyes, although this again did not necessarily translate to an overall improved aesthetic outcome. A lower complication rate with eviscerations was also noted as compared to enucleations. Based on these findings, evisceration was a safe alternative to enucleation, with the potential for better aesthetic and motility outcomes. The applicability of these findings to trauma should be considered with regard to the study population; only 10% of the enucleated patients and 21% of the eviscerated patients were operated on due to trauma; the majority received surgery due to malignancy, a blind painful eye, or endophthalmitis.[28]

Tari et al. likewise compare 50 eviscerated eyes to 50 enucleated eyes and the outcomes for each; of note, only 5 eyes in this study were operated on for trauma, all of which were enucleated. Consistent with the Nakra et al. study, the primary significant difference between the two groups resided in superior motility in eviscerated eyes, with horizontal movement of 10.25 + 1.99 mm in eviscerated eyes versus 6.90 + 1.74 mm in enucleated eyes, and vertical movement of 8.45 + 1.89 in eviscerated eyes versus 5.69 + 1.63 in enucleated eyes.[29]

Infection and hemorrhage are common in all surgical procedures; evisceration is no exception. Fortunately, hemorrhage is usually self-limited and, even in the most severe cases, can be controlled with a firmly placed pressure patch. Temporary tarsorrhaphy is usually done at the close of the case, which prevents conjunctival prolapse should post-operative bleeding be encountered. Sterile technique with peri- and post-operative systemic antibiotics limits the risk of infection. Delayed placement of the orbital implant reduces the risk of infection in the setting of endophthalmitis. When encountered, removal of the implant with delayed reconstruction is often necessary.[10,31]

Despite the placement of a large implant, patients may still develop a "sunken-in" appearance. Several mechanisms have been proposed for deep superior sulcus and subsequent ptosis. Hypotheses include (1) decreased circulation with cicatrization of orbital tissue and fat atrophy; (2) disturbance in the normal spatial architecture and tissue relationships of the orbit; (3) grossly underestimated orbital volume loss and inadequate volume replacement; (4) contracture of the remaining soft tissues, with an equivalent effect as inadequate volume replacement; (5) orbital expansion following unidentified orbital fractures. Deep superior sulci are managed with orbital volume augmentation. Techniques include implant exchange and autologous fat transfer."[10, 31]

One of the most dreaded and challenging complications is socket contracture. The spectrum of this disorder ranges from posterior lamella shortening to complete obliteration of the fornices. Mild contraction may result in nothing more than an inward rotation of the eyelashes. With further contraction, eyelid mobility is reduced. In the most extreme cases, patients are unable to retain a prosthesis. Management consists of the removal of any inciting irritant. Smoking has been linked with socket contraction. All ophthalmic patients should be counseled regarding smoking cessation. A properly fitted and maintained prosthesis is also essential to a healthy socket. Once contraction has occurred, management usually consists of fornix reconstruction with mucous membrane grafting.10, 31 Implant extrusion usually relates to the placement of an oversized implant, inadequate sclerotomy, or poor closure. Management of an extruding implant is complex, with many varied opinions. Small exposed areas may heal spontaneously and are often just observed. Larger areas may be closed with a variety of flaps, grafts, and even donor or synthetic materials. Most often, exposure is the result of anterior pressure. Even with the most deftly executed anterior reconstruction techniques, recurrences are common. Implant exchange or repositioning may be required.[10, 31]

Evisceration techniques with sclerotomies, allowing for placement of large implants, achieve better results than previously possible. Patients enjoy relatively good socket motility common to all evisceration techniques. With the introduction of the sclerotomy, implant size is no longer a limitation.[4, 10]

2. Conclusion

Enucleation is the removal of the entire globe and a segment of the optic nerve after releasing the extraocular muscles from the sclera. Evisceration is the removal of the ocular contents, leaving the sclera and extraocular muscles intact. Controversy has long existed surrounding evisceration and whether it is an acceptable alternative to enucleation due to a theoretical increased risk of SO from remaining uveal tissue present within scleral emissary channels. As sympathetic ophthalmia that affects the non-traumatized eye is rare and successful uveitis treatment is more common, prophylactic enucleation now should not be mandatory. Although the risk of SO is not zero, evisceration allows for better preservation of orbital anatomy, improved mobility, and therefore enhanced cosmesis. Surgical decision-making in ocular trauma is largely based on surgeon preference and experience, with evidence in the literature to support either enucleation or evisceration.

3. References

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