Evisceration with Prosthetic Restoration of the Human Eye

ABSTRACT: *The loss of vision or removal of an eye is a difficult decision for both the patient and the ophthalmologist. The process must consider the significant emotional impact on the patient and family; it further requires the ophthalmic surgeon to select an approach and surgical technique. In this article, the authors discuss in detail the surgical procedure of evisceration, its indications in respect to alternatives, and the prosthetic restoration. A patient case report documents the entire series from start to finish.*

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INTRODUCTION

The surgical removal of any eye, even a diseased, blind, or disfigured eye, involves a difficult decision for all involved: the medical team, the patient, and the patient's loved ones. While the ocularist is rarely consulted before this treatment, all those concerned need to become aware before the surgery of what may aid restoration after the surgery. This information should include surgeons' awareness of an optimal outcome before treatment decisions are imminent.

In an ophthalmology practice where the goal is "to do everything to enhance vision," the last resort, eye removal, may seem imbued with a subtext of professional failure, an unspoken feeling that, "We could have done something." Unseen, this feeling is heartfelt by many clinicians and is viewed as the end of a struggle. In fact, treatment continues, usually with a healthier patient.

Amid psychological and medical reasonings, the strengths of, and advances in, evisceration technique in the past two decades have increased its use in surgical removals. Even when each patient receives a "clear explana-tion" of alternatives with their loved ones, some may refuse to sign consent to the "complete removal of [my] eye." In these instances, "removal of the diseased part of the eye, while keeping the covering," may be accepted or imagined more easily. Once secured, evisceration technique still has options. In the following sections we discuss evisceration and present the case of one recent patient.

GENERAL CONSIDERATIONS: ENUCLEATION VS. EVISCERATION

Evisceration is the surgical procedure in which the entire intraocular contents are removed, leaving the sclera and orbit intact (with or, more often, without the cornea). Enucleation removes the entire globe (without opening it) by severing all muscles, nerves, and blood vessels attached to it from the orbit. Several variables must be considered before selecting the appropriate technique.

Eye Removal Surgeries Animation

Advantages and Disadvantages

In evisceration, most of the sclera is retained and the extraocular muscles' attachments are preserved. This procedure generally produces better cosmetic results and implant/prosthetic motility than most enucleation surgeries. There is also less chance of orbital volume changes, evidenced as a retracted supratarsal sulcus or generalized atrophy of the orbital soft tissues.

These two procedures, evisceration and enucleation, must be compared relative to the management of intraocular tumors, the surgical treatment of uncontrollable endophthalmitis, the prevention of sympathetic ophthalmia, and the maintenance of maximal anatomic integrity of the orbit. The relative simplicity of an evisceration permits its use for even the most debilitated patient, as anesthesia and blood loss are minimized.

These procedures produce markedly different effects on the position and appearance of the orbital contents. In the occasional surgeon's hands, enucleation might be thought of as the total removal of a well-suspended, properly located globe, and replacing it with a poorly supported implant without an established rotational center or a reason to stay put. In this context, especially from the ocularist's perspective, enucleation is decidedly inferior to evisceration. Evisceration has the distinct cosmetic and functional advantage of leaving the orbital anatomy virtually undisturbed with intact suspensory ligaments and pulley system. Motility of the socket and eyelids may be retained indefinitely, and ptosis of the muscle cone and socket may never occur.

Enucleation, sometimes adopted alone for its conceptual simplicity, is actually a complex orbital operation fraught with pitfalls. The orbital anatomy can be severely disrupted in enucleation, leading to unpredictable, diminished motility of the socket, as well as other early/late postoperative cosmetic defects, subsequent enophthalmos, erosion of the ocular implant, or a ptosis of the muscle cone or the entire orbital contents. Lacrimal sequelae produce dry eye or tearing much more often in .

Indications

The indications for enucleation or evisceration may seem clear. More often, however, the election of procedure is difficult and must be based on case-by-case evaluation, the individual preferences of the ophthalmologist, the experience of the ophthalmic surgeon, and the consent of a fully-informed patient.

In cases of a suspected malignant intraocular tumor, the procedure of choice is an enucleation.[1] Here, thorough histologic examination of an intact specimen and total removal of the tumor are absolute necessities. Examination of the globe for any extrascleral extension or optic nerve involvement of the tumor can only be performed during or following enucleation. In comparison, evisceration provides a disrupted pathologic specimen that may risk leaving tumor cells behind. As the methods and results of treatments for tumors of all types are evolving, however, absolute indications for an *en bloc* removal of an eye for a malignancy must be reviewed with current studies and alternatives.

The choice between the two procedures is significant in a case of active enophthalmitis. As evisceration avoids invading the orbit, it thus minimizes possible orbital contamination by intraocular contents and complications of orbital cellulitis. Enucleation, however, involves severing the optic nerve within the orbit, which necessarily enters the subarachnoid space surrounding it (containing the fluid that communicates directly with the intradural brain cavity). While mitigated by the use of systemic antibiotics, this exposure still increases the risk of an enucleation spreading any ocular infection into meningitis.

Sympathetic ophthalmia (SO) is an auto-immune reaction in the other eye, once thought to be caused by the mere exposure of uveal pigment to the blood system. It must be considered in all cases involving uveal prolapse. While some now consider SO to be rare (and possibly separate from pigment), the removal of an eye following lacerating trauma complicates the choice of operation. The two procedures differ in its avoidance: enucleation minimizes this concern by removing all pigment entirely within the globe; evisceration, on the other hand, is felt to be safe if performed soon after the injury. If the patient opts for maximum safety, of

FIGURE 1 Family photographs show the young boy's appearance within one year of the eye injury. The subsequent images show the same patient at various ages. Note the progressive worsening of the affected eye; the appearance has become a distraction even to the casual observer. The photo at the far right shows the patient at age twenty-four, by which time he was never without dark glasses to cover the unsightly (OD) eye.

course, specify enucleation.

Evisceration relieves pain as well as enucleation.[2,3] Total post-operative pain (as compared to pre-operative pain or immediate post-op pain) with evisceration has been shown to be both lower in intensity and with a shorter life.[4]

CASE REPORT

In 1987, a four-year-old boy (Figure1) was struck with a broken glass bottle in the right orbital area. Emergency examination revealed multiple, very ragged lacerations of the globe with significant exudation of intraocular contents. Immediate surgical exploration discovered posterior extensions of these lacerations with fragmented wound edges, disrupted lens material, and uveal/vitreous prolapse. Visualizing the entire extent of damage required the detachment of two rectus muscles. The integrity of the globe was secured, but the patient was discharged for observation with only light-perception acuity. Subsequent photographs relate his growth and affect during puberty and teen years.

This patient next presented as a 33-year-old with a blind, scarred, light-sensitive right eye (Figure 2). He was motivated to seek treatment of his 24-year-old injury because of increasing discomfort. He also noted an increased distraction from his appearance by others and renewed health concerns. After evaluation and his informed consent, evisceration was elected.

Below we describe his entire treatment from childhood photos to presentation to surgery to follow-up procedures, including his eventual prosthetic restoration. While there are several techniques of evisceration, we concentrate here on his treatment alone.

Eye Gaze Animation

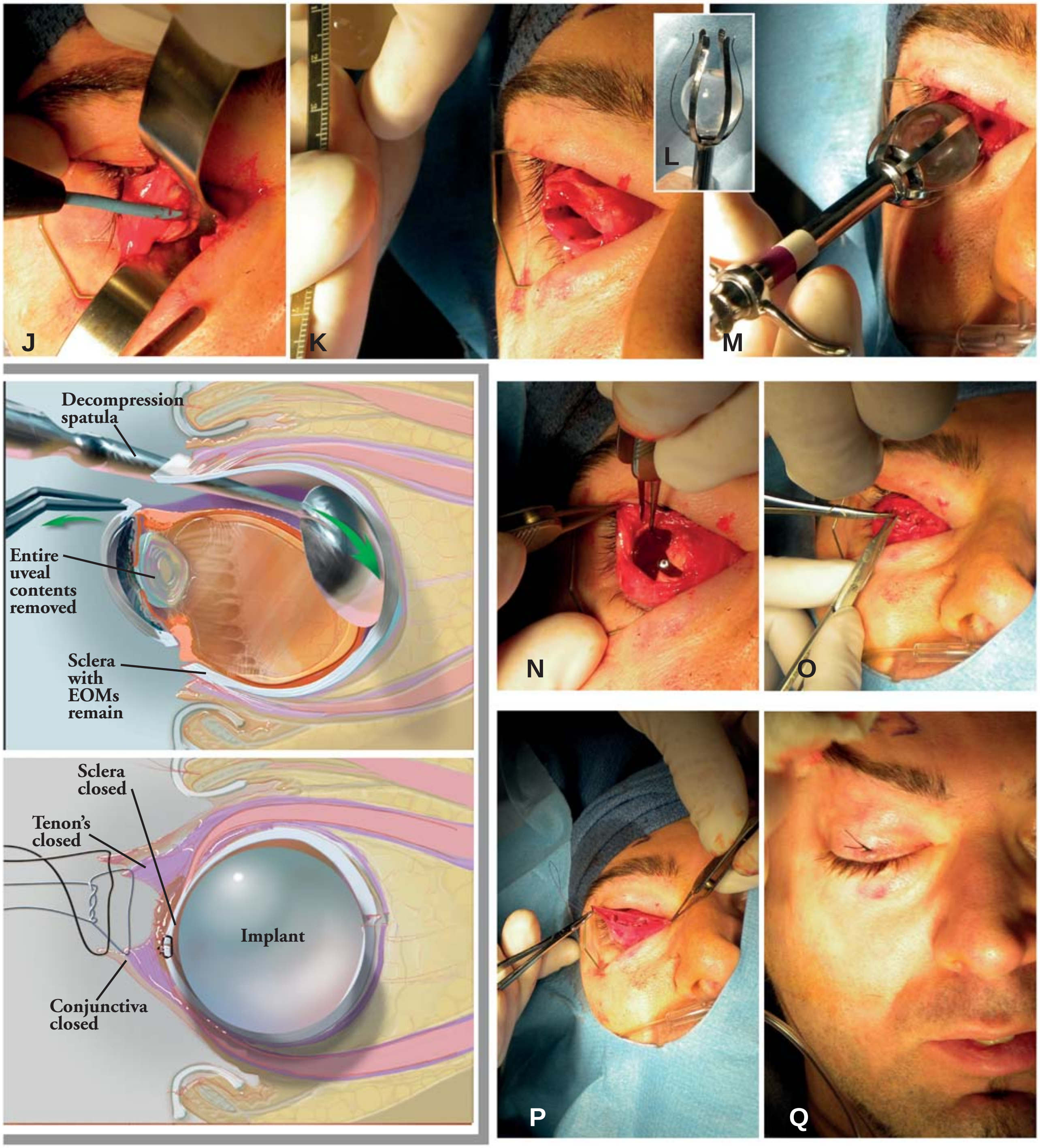
SURGICAL TECHNIQUE

After administration of intravenous (iv) preoperative antibiotic and steroid, the affected eye was confirmed. Tetracaine and mydfrin drops were placed in the inferior cul-de-sac, IV sedation was administered, and 10 cc of an equal mixture of 1% xylocaine with epinephrine and 0.5 % marcaine were infiltrat-

FIGURE 2 This image shows how distracting and debilitating the unsightly (OD) eye has become shortly before the elective (evisceration) surgery.

FIGURE 3 (A1) The patient at arrival. (A2) Placed on the operating table. (B) The affected side is identified and confirmed, the patient is sedated. (C) Dressing is prepared around the (OD) eye. (D) The eye to be eviscerated is prepped/draped. (E) After local anesthesia is administered, retractors are placed and a 360 periotomy releases the conjunctiva and anterior Tenon's capsule. (F) The anterior chamber is decompressed by a needle incision at the limbus, and curved corneal scissors mobilize the anterior sclera behind the scleral spur, cleaving the uveal tissue (including the iris and ciliary body) from the sclera, which will remain. (G) The entire intraocular contents are shelled-out of the scleral bed using evisceration spatulas and removed from the sclera. Posterior to the scleral spur in the drainage angle, the primary regions of adhesion include the vortex at the equator, the long and short ciliary nerves and arteries at the posterior pole, and the optic nerve. (H,I) The surgical specimen containing

Eye Removal Surgeries Animation



the corneal, all uveal tissue, and the vitreous is delivered to Pathology; its appearance here makes clear the source of the word "uvea." (J) The central retinal vessels are cauterized and the scleral is opened posteriorly using a Colorado electrocautery needle through the posterior Tenon's space (K) A clear acrylic sphere is selected as a volume-conserving implant (here, 20-mm) and (L,M) inserted inside the sclera. (N) The sclera is trimmed with scissors to be closed over the implant using interrupted sutures. (O) The anterior Tenon's capsule is closed. (P) The conjunctiva is mobilized and closed in a layered fashion. (Q) A clear acrylic confirmer is placed inside the new socket. A temporary Frost suture maintains eyelid closure. The eye is packed and bandaged with a stiff protective shield at the end of the procedure. The four illustrations in the center are used to represent the complicated medical and surgical concepts involved in evisceration of the human eye.

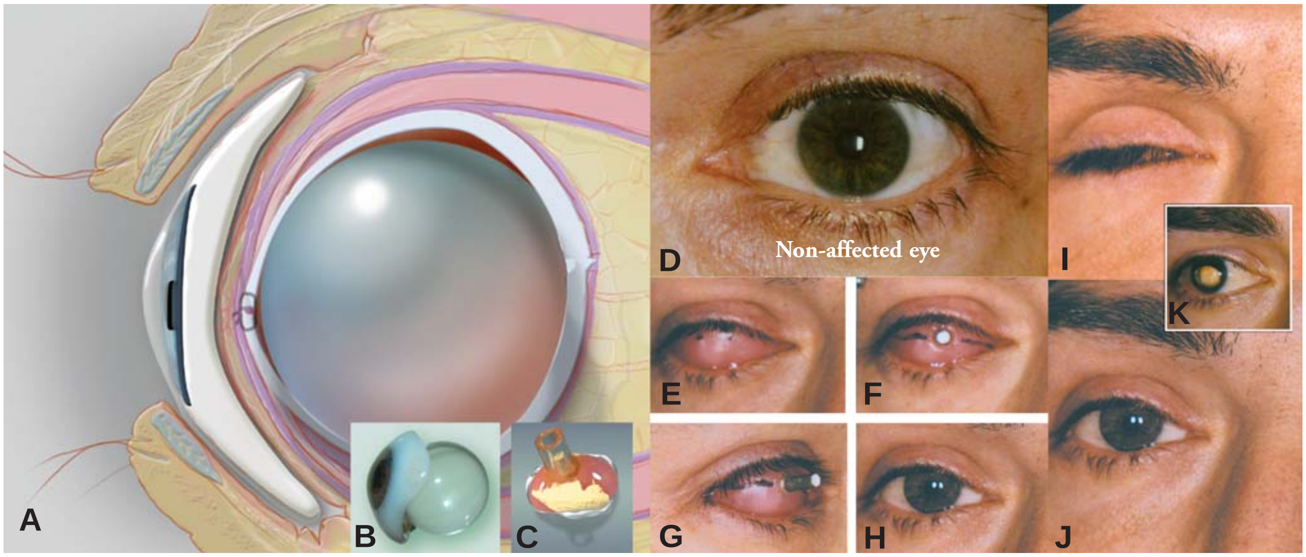


FIGURE 4 These images show a few steps in the fitting of the custom ocular prosthesis, including a sectional illustration (A) and a photo representing the implant/prosthesis ratio (B). An alginate impression is taken using a custom, modified tray (C). The wax intermediate pattern (E) is used to establish fit, and the gaze of the iris/pupil is evaluated using a post (F,G). After casting the impression-wax pattern into acrylic and hand painting all anterior anatomy, the inserted custom ocular prosthesis is seemingly realistic (H) when compared with the non-affected eye (D). The inset photograph (K) is a reminder of the preop eye.

ed in a retrobulbar and peribulbar fashion. The periorbital skin and eye were prepped and draped in customary fashion for surgery. The eyelids were retracted with a speculum without compression on the globe. A 360-degree periotomy incision was performed at the limbus, then undermining the conjunctiva and anterior Tenon's capsule to the equator. Blunt dissection with scissors was performed in all four quadrants between the recti muscles (Figure 3).

The corneo-scleral junction was incised 2 mm outside the limbus into the anterior chamber. The corneal button was excised with scissors. A uveal spatula was used to establish a posterior dissection plane in the suprachoroidal space (between the sclera and uvea), which was continued to the optic nerve.

The entire intraocular contents were then removed. The optic nerve head and retinal artery were cauterized. Venous bleeding was addressed by direct digital pressure and/or tamponade with a test-tube and neurosurgical pads placed intrasclerally. Any visible areas of residual uveal tissue were removed by scraping with a spatula or curette. The entire internal sclera was swabbed with absolute alcohol to denature any residual proteins. A sclerotomy was made posteriorly around the optic nerve with a microsurgical needle so as to expand the posterior wall of the globe and allow for larger implant placement.

The spherical acrylic implant was introduced into the sclera shell with an inserter, the tips of which retract the sclerotomy edges, allowing a trial fit to be repeated, if necessary. Given a normal average adult interior diameter of ~21-24 mm,[5,6] a 20-mm implant will usually allow scleral closure without wound edge tension and volume restoration. However, the largest implant that can be accommodated should be selected. Once the implant is placed, the sclera is closed with simple-interrupted or horizontal mattress 5.0 vicryl sutures. The anterior Tenon's capsule is closed in a layered fashion with 5.0 vicryl sutures. Finally, the conjunctiva was closed with a running 6.0 plain gut suture. A conformer was placed over the orbital tissues behind the lids to retain the conjunctival fornices without compromising vascular supply during post-op swelling. Often the lids are temporarily closed with a 4.0 silk suture to prevent the edematous conjunctiva from prolapsing out of the socket. An antibiotic steroid ointment was placed in the socket followed by a light pressure dressing to absorb any bloody discharge. The patient was discharged to his home with

FIGURE 5 Patient photographs showing custom ocular prosthesis (OD). Images with and without protective glasses display a pleasing all-around result.

anti-nausea, opiate analgesics, and a short oral steroid course.

PROSTHETIC RESTORATION

Evisceration has several advantages for motility in the prosthesis. As it is gaining in popularity, you may see more patients in your ocularistry practice asking about evisceration. The ocularist is expected to evaluate the patient for adequate healing by careful observation and by making sure that the patient is ready for the manipulations required when fitting the prosthesis. Generally at four weeks to six weeks following surgery, a quieting socket (with sutures resorbed or fallen-out) is ready for an initial fitting of a custom ocular prosthesis (Figure 4). Note that many socket irregularities are discovered only upon obtaining an accurate impression.[7]

The surgical implant size selected has a great impact on the motility and axial attitude of the prosthesis.[1,2,8] The effective implant must reasonably reproduce the volume, position, and motility of the natural eye, so proper sizing of the intrascleral implant in evisceration is critical. Too small an implant may contribute to low-volume enophthalmos or a superior sulcus defect, which can only result in a larger prosthesis and lid laxity. Too large an implant may increase pressure to the front of the implant, thus increasing a risk of implant erosion, wound dehiscence, implant exposure, and infection.

A good target ratio for the implant/sclera:prosthesis total is 65%-70% of the volume of the affected eye to 30%-35% supplied by the ocular prosthesis.[7] The ocularist can then choose whatever build is required, as the fornices of a eviscerated socket are usually well-formed and require few extremes. The prosthesis can often be shallower, thinner, and, thus, lighter, approaching a scleral shell.

Ocular Implant and Prosthesis Animation

SUMMARY

If a tumor can be ruled out, the authors prefer evisceration. If an intraocular tumor is suspected (or cannot be ruled out by imaging scans), an enucleation is performed. The patient should be advised of the cosmetic benefits of evisceration as well as the long-term cosmetic challenges in enucleation. The prosthesis in an eviscerated socket can gain motility with less lag than in other surgical approaches (Figure 5).

CONCLUSION

While there are several surgical techniques to remove an eye, evisceration remains a vital option that is finding new traction in the ophthalmic world. With careful prosthetic restoration, this approach serves the ultimate goal of all concerned, that is, to enhance the patient's long-term appearance after removing disease and discomfort.

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