A COMPARISON OF IMPLANT EXTRUSION RATES AND POSTOPERATIVE PAIN AFTER EVISCERATION WITH IMMEDIATE OR DELAYED IMPLANTS AND AFTER ENUCLEATION WITH IMPLANTS

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ABSTRACT

Purpose: To examine implant extrusion rates after evisceration with immediate or delayed implants in patients with culture-proven endophthalmitis. To compare postevisceration and postenucleation pain.

Methods: This prospective, nonrandomized interventional case series included four groups of patients: group 1, 25 endophthalmitis patients undergoing evisceration with immediate implants; group 2, 15 endophthalmitis patients undergoing evisceration with delayed implants; group 3, 31 patients without endophthalmitis undergoing evisceration with immediate implants; and group 4, eight patients undergoing enucleations with implants. Standardized techniques and follow-up schedules were used. Postoperative pain was assessed by weighted frequency of pain medications used during two 48-hour periods. Statistical analysis was performed. Retrospective review of two series of patients undergoing evisceration was performed.

Results: No cases of implant extrusion occurred during an average follow-up of 37.9 months. Average implant size was 19.0 mm. Conjunctival dehiscence occurred in one patient. Average total pain scores were 20.8 in endophthalmitis patients with immediate implants; 22.1 in endophthalmitis patients with delayed implants; 20.3 in patients without endophthalmitis and with immediate implants; and 23.1 in patients with enucleations and immediate implant insertions. Retrospective review suggested possible causes of implant extrusion.

Conclusion: Both immediate and delayed implant techniques appear safe in patients with endophthalmitis, with the former being simpler, more cost-effective, and perhaps less painful. Prolonged antibiotic therapy and smaller implants may render a false sense of security against implant extrusion; good surgical technique and meticulous postoperative wound care are essential. Postenucleation pain appears more severe than postevisceration pain.

INTRODUCTION

Much is still unknown about the factors that increase the risk of implant extrusion after evisceration for endophthalmitis, even though implants have been used in this setting for more than 100 years.[1-4] Controversy persists regarding the wisdom and timing of implant insertion. Because of the long-held surgical principle that an implant placed in an infected site is likely to extrude,[5-8] many investigators believe that when the eye is infected, an implant must not be inserted at the time of evisceration. Instead, they advocate packing the scleral shell with antibiotic-saturated gauze and allowing it to granulate in. They believe insertion of an implant should be performed only as a secondary procedure, if at all.[9-14] Variations in this approach, based on the same principle, include eradicating the infection before evisceration and implant insertion are performed.[15-17]

Alternatively, other investigators believe the likelihood of implant extrusion in an infected eye is not great enough to warrant postponement of implant insertion. Rather, they believe it is better to take the small risk of implant extrusion than not place an implant or subject the patient to a secondary implant procedure. Several surgeons in recent years have reported their results with immediate implant insertion after evisceration for endophthalmitis.[18-20]

As a third alternative, a few investigators advocate an intermediate approach, between no implant or secondary implant and an immediate implant. With the intermediate approach, primary wound closure is delayed following evisceration and the scleral shell is packed with antibiotic-saturated gauze for a few days. Several days after evisceration, a second procedure is performed to insert the implant and then close the wound.[21-23]

To date, no well-controlled, prospective, comparative studies have been performed to prove conclusively that one approach is preferred over another in patients with endophthalmitis. Specifically, it is not known if the implant extrusion rate is increased with immediate insertion. Nor is it known whether the degree of postoperative pain differs with immediate versus delayed implant and with evisceration versus enucleation.[24-29] Whereas many investigators believe that postevisceration pain is more intense than postenucleation pain,[3,4,27-30] others disagree.[24-26] Only two studies have recently been performed to examine this issue.[28-30]

The current prospective study was conducted to determine the early implant extrusion rates in patients with endophthalmitis undergoing evisceration and immediate or delayed implant insertion and in patients without endophthalmitis undergoing evisceration and immediate implant insertion. The study also included a prospective assessment of the degree of postevisceration pain with immediate and delayed implants and of postenucleation pain with immediate implants. Given the paucity of data on factors that might play a role in implant extrusion, the current study also includes a retrospective review of two large series of patients who underwent

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evisceration with implant insertion for endophthalmitis. The first is the author's own series performed elsewhere. The second is a series of patients treated by other surgeons at the same eye center where the prospective study was completed.

METHODS

STUDY DESIGN

This prospective nonrandomized study was approved by the Research Council and by the Human Investigation Committee of the King Khalid Eye Specialist Hospital, Riyadh, Saudi Arabia. The consent form was carefully explained to adult patients and to the parents of all pediatric patients.

The study was designed to compare implant extrusion rates and postoperative pain in a consecutive series of patients with or without endophthalmitis who underwent evisceration with immediate implants, evisceration with delayed implants, or enucleation with immediate implants. Positive intraoperative smears and cultures were required for a diagnosis of endophthalmitis.

During the first 13 months of the study, from June 1998 through June 1999, patients who had intraoperative culture-proven endophthalmitis were assigned to undergo evisceration with immediate implants (group 1). During the subsequent 18 months of the study, from July 1999 through December 2000, patients with culture-proven endophthalmitis were assigned to undergo evisceration with delayed implants (group 2). During the entire 31-month period, patients with conditions other than endophthalmitis and those with negative intraoperative cultures who underwent evisceration with immediate implant were assigned to a third group (group 3). Similarly, during the entire study period, patients who required enucleation for various reasons were assigned to a fourth group and underwent immediate implant insertion (group 4).

The same medical regimen, evisceration and enucleation techniques, intraoperative cultures and smears, suture materials, postoperative wound care regimen, and follow-up schedule were used in all patients. Polymethylmethacrylate (PMMA) spherical implants were used in nearly all patients. A few patients without endophthalmitis (group 3) received a hydroxyapatite motility implant because they specifically requested it. Follow-up visits during the first postoperative year were scheduled at 1, 3, 6, and 12 months and then yearly thereafter. Any complications, such as wound dehiscence, postoperative infection, and implant migration, exposure, or extrusion were recorded. Pain scores were obtained in all patients.

Endophthalmitis in this study was defined as positive intraoperative culture and smear results, in addition to a typical clinical course. Ocular symptoms of endophthalmitis were characterized by decreased vision, pain, injection, and discharge, along with a history of intraocular surgery or ocular trauma. Evidence of globe involvement was often visualized on ultrasound or computed tomography. Vision in the affected eye eventually decreased to no light perception despite medical or surgical therapies or both. Patients with endophthalmitis received systemic antibiotics for various durations.

PATIENT SELECTION

All patients with a clinical diagnosis of endophthalmitis who were candidates for evisceration with insertion of a spherical PMMA implant (Storz Instrument Co, St Louis, Missouri) were offered an opportunity to participate in the study. Patients were included regardless of age, race, and sex. Patients with an existing or suspected ocular, orbital, lid, paranasal sinus, or cranial malignancy were excluded from the study, as were those with concurrent facio-orbital fractures or immunosuppression. A total of 79 patients ranging in age from 7 to 83 years were included in the nonrandomized study. The four groups of patients were as follows:

Group 1 initially included 31 patients, aged 11 to 83 years, who had clinical endophthalmitis and underwent evisceration with immediate implant insertion. Five of these patients were subsequently transferred to the nonendophthalmitis group (group 3) because of negative intraoperative smears and cultures. A sixth patient, a 22-year-old severely malnourished female, was excluded because she had received immunosuppressive agents. Thus, the final number of patients in group 1 was 25.

Group 2 initially included 17 patients, aged 46 to 73 years, who had clinical endophthalmitis and underwent evisceration with delayed (3 to 5 days later) implant insertion. Two of these patients who had already been treated with intensive systemic and intravitreal antibiotics had negative intraoperative smears and subsequent negative cultures. They had the immediate implants instead and were transferred to the nonendophthalmitis group (group 3). Thus, group 2 included 15 patients.

Group 3 consisted of 31 patients, aged 7 to 83 years, without endophthalmitis who underwent evisceration with immediate implant. Patients in this group required evisceration because of a blind painful eye secondary to end-stage glaucoma or corneal ulcer, or because of phthisis bulbi secondary to trauma or multiple intraocular procedures. In some of these patients, ultrasound study or computed tomography (or both) was used to rule out occult intraocular malignancy. Among this group were seven patients (five from group 1 and two from group 2) who had a clinical diagnosis of endophthalmitis but negative intraoperative intraocular cultures and smears.

Group 4 included eight patients, aged 39 to 70 years, who underwent enucleation with immediate implants during the entire 31-month study period. Inclusion of this group allowed a comparison of postevisceration pain and postenucleation pain. Each patient received a PMMA implant. A standardized enucleation technique described by Nunery and Chen[31] and modified by the author was used. The same suture material and suturing technique, postoperative wound care regimen, and follow-up schedule were used in these patients.

PREOPERATIVE EVALUATION

At the time of preoperative evaluation, patients had been diagnosed as having clinical endophthalmitis and no light perception vision in the affected eye and were prepared to have evisceration. Nearly all of them had previously received topical, oral, or intravenous

antibiotics as ordered by the referring physician or dictated by culture and sensitivity studies. Some patients received intravitreal injection of antibiotics. If no contraindication or reasons to do otherwise existed, patients were given fortified topical gentamicin and intravenous gentamicin (or vancomycin) and cefazolin in an appropriate dose. Some patients also received ofloxacin or trimethoprim sulfate and polymyxin B eye drops. The intravenous antibiotic regimen was continued for 2 to 4 days postoperatively before changing to appropriate oral antibiotics, which were given for another 5 to 7 days. Topical antibiotic eye drops were continued throughout this period.

SURGICAL TECHNIQUE

Evisceration was performed within 24 to 72 hours of admission. The procedure was performed with patients under general anesthesia except for three patients. In these three patients local anesthesia with intravenous sedation was used because general anesthesia was contraindicated for various medical reasons. All of the patients, including those undergoing enucleations, received a 3-mL retrobulbar bolus injection of a 50-50 mixture of 2% lidocaine and 0.75% bupivacaine with epinephrine 1:100,000 to augment hemostasis and, possibly, to reduce postoperative pain.

The eye and the periorbital area were prepared and draped in a sterile fashion. A 360° peritomy was performed with Westcott scissors. Handling of tissues with toothed forceps was kept at a minimum. An incision was made at the superior limbus with a sharp blade, and the cornea was removed with Stevens scissors. A dialysis spatula was used to dissect the uveal tissues from the sclera.

Intraoperative cultures were obtained from intraocular contents before removal of the contents of the eye. Specimens were plated on two sets of blood agar, chocolate agar, Sabouraud agar, thioglycolate broth, and brain-heart infusion broth. At least one set of the agars plus a broth had to be positive to render a diagnosis of endophthalmitis. Gram and Giemsa stains of the intraocular content smears were performed and were read immediately. These served as a crude and immediate confirmation of infection.[32-45] Any patient with a negative intraoperative smear result was considered a nonendophthalmitis case.

The inside of the scleral shell was scraped with a flat evisceration spoon, and bleeding vessels were controlled with bipolar cautery. Three to 5 mL of absolute alcohol was used for several minutes to denature any remaining uveal tissues, followed by vigorous cleansing and copious irrigation. All of the dirty instruments and towels were removed from the surgical field. The surgeons and nurses also regloved before the operation continued.

Immediate Implant Procedure

A No. 69 Beaver blade was used to make radial relaxation incisions in the oblique quadrants. These incisions began a few millimeters anterior to the equator and extended posteriorly to within a few millimeters of the optic disc. The incision was enlarged by spreading the blades of Stevens scissors in the wound. Gentamicin eye drops were then instilled in the opened scleral shell and periodically sprinkled into the surgical field during the procedure.

The implant size was estimated with a sizer. After the appropriate sized implant was inserted, the scleral shell was closed with eight to 10 interrupted 5-0 Vicryl sutures, tied in 2-2-1 fashion (ie, two throws followed by two throws in reverse direction and then followed by a single throw in the original direction). Tenon closure was achieved with several interrupted 5-0 Vicryl sutures, tied in 2-2-1 fashion. Conjunctiva was closed with running 6-0 chromic sutures. A conformer of the appropriate size was inserted, and gentamicin ointment was instilled. Tincture of benzoin was applied to the cheek and forehead. Elastic bandage was used to keep a fluffy pressure dressing over the socket.

Delayed Implant Procedure

After evisceration was completed, the scleral shell was packed with iodine-impregnated gauze that was saturated with gentamicin ointment. A fluffy pressure dressing was placed over the operated socket. Anesthesia was reversed, and the patient was returned to the recovery room.

The pressure dressing and scleral packing were removed after 24 hours. Generally, the patient was given either two tablets of acetaminophen with codeine (300 mg acetaminophen and 30 mg codeine) by mouth or 25 mg to 50 mg of intramuscular meperidine approximately 30 minutes before the dressing change. The dressing and packing were removed, and the scleral shell was inspected. The scleral shell was cleansed with cotton applicators and povidone-iodine solution, followed by irrigation with normal saline. It was repacked with fresh iodine-impregnated gauze saturated with gentamicin ointment. A light patch was placed over the socket. Cleansing and repacking were repeated every 24 to 26 hours over the next 3 to 5 days, until the patient was taken to the operating room for implant insertion. Slight variations in this time interval were due to the unavailability of an operating room and scheduling logistics.

The patch and packing were removed in the operating room. Cultures and smears were taken from the inside of the scleral shell before preparing the area for implant insertion. The scleral shell was cleansed with povidone-iodine solution, followed by irrigation with saline and suction. The conjunctival wound and scleral edges were freshened and granulation tissues were removed. Hereafter, the procedure proceeded exactly in the manner as that described for the immediate implant technique.

POSTOPERATIVE WOUND CARE

The pressure dressing was kept in place for 4 to 6 days in patients who received immediate implants. With delayed implants, the pressure dressing remained in place for the first 24 hours postevisceration, until the dressing-packing change. When the pressure dressing was changed, it was always inspected first and removed by the author. The periorbital area was cleansed with adhesive remover, and the socket was irrigated with saline. Antibiotic ointment was applied, and a light patch was placed over the socket following the dressing change. After 3 to 5 days, the implant was inserted. After this operation, a pressure patch was placed over the

area and left undisturbed for 4 to 6 days, like the procedure in patients who received immediate implants. Patients were instructed to avoid manipulation of the conformer and the operated socket and to use gentamicin ointment twice daily for the next 7 to 10 days. Patients were scheduled to see an ocularist 6 to 8 weeks later.

POSTOPERATIVE PAIN MANAGEMENT AND ASSESSMENT

Acetaminophen with codeine (ie, 30 mg or 60 mg of codeine) was part of the standard postoperative orders. Patients were informed of the availability of intramuscular meperidine for stronger pain relief, but they had to specifically request it. The author, residents, fellows, and nursing staff stayed neutral, neither encouraging nor discouraging patients to request pain medications. No questions were asked of the patient when and after he or she requested an injection. A record was kept of the frequency and type of all pain medications used. To measure the degree of postoperative pain, each dose of the oral pain medication was given a weight of 1 and each dose of intramuscular meperidine was given a weight of 2. The pain score for each patient was derived from the sum of the weighted frequency of all pain medications administered.

Pain scores were recorded for two periods: the first 48 hours and the second 48 hours postoperatively. In groups 1, 3, and 4, the two 48-hour periods were derived from the first 96 hours after surgery. Because patients who received delayed implants (group 2) underwent two separate procedures, their first 48-hour pain scores were derived from the first 48 hours following evisceration, and their second 48-hour pain scores were derived from the first 48 hours following insertion of the implant. A total pain score was determined for each patient by adding the scores from each measurement period (ie, 96-hour pain score).

Packing-dressing changes in patients with delayed implants were always scheduled 24 to 26 hours after the period of pain measurement to avoid introducing artifacts in pain scores. Thus, the oral or injected pain medication that these patients received prior to packing-dressing change was not counted in their pain score. In addition, a 6-hour grace period following the packing-dressing change was observed so that the pain score during the next 24 hours in these patients would be minimally affected by medication given before the packing-dressing change. This meant a packing-dressing change occurred 30 to 32 hours after the previous one.

RETROSPECTIVE REVIEW OF TWO LARGE SERIES OF EVISCERATION

A retrospective review was conducted on an uncontrolled series of 53 cases of evisceration performed by the author at two different teaching institutions from 1981 to 1997. To further examine factors that might affect implant extrusion rates, a retrospective review was also conducted on a series of 192 cases performed by other surgeons, from 1984 to 1998, at the same eye hospital where the current prospective study was conducted. Particular attention was paid to the definition of eye infection, duration of antibiotic administration, surgical technique, suture materials, implant material and size, extrusion rate, and postoperative wound care regimen.

STATISTICAL ANALYSIS

Statistical analysis was performed by Dr Richard Madsen of the University of Missouri, using SAS technique (SAS Institute Inc, Cary, North Carolina). Chi-square tests for homogeneity of proportions were used to compare groups relative to nominal variables such as sex and eye. Because the pain scores are ordinal, the Kruskal-Wallis test was used to compare the mean responses across groups. The significance level was set at 0.05 for these tests. When significant differences were found, pairwise comparisons of the groups were made using Dunn's method. Because there are six pairwise comparisons for each response variable, differences were considered significant if the *P* value was less than .01. In an effort to account for the effect of other variables, such as gender or size of implant, Cochran-Mantel-Haenszel methodology was used to stratify these covariates. The same methodology was used to examine the relationship between implant size and pain when stratifying on group membership. Comparisons of the two groups of implant type (PMMA or hydroxyapatite) were done using the Wilcoxon rank sum test.

RESULTS

IMPLANT EXTRUSION, IMPLANT SIZE, AND FOLLOW-UP

Implant extrusion did not occur in any of the patients in each of the four groups. The only complication in the entire series was conjunctival dehiscence in one patient in group 1. Tables 1 through 4 summarize the demographics, diagnoses, pathogens, implant size, and duration of follow-up for patients in each group.

Follow-up of the 25 patients (20 males, five females) who underwent evisceration and immediate implant (11 right eyes, 14 left eyes) ranged from 40 to 51 months (average, 43.7 months; median, 43.0 months). Conjunctival dehiscence (2 × 2 mm) occurred in an elderly patient at 3 months postoperatively. This patient did not present with other signs of infection, implant exposure, or implant extrusion. He lived in the desert under conditions of poor environmental and personal hygiene. He lost his conformer and developed an upper lid entropion, with lashes constantly rubbing against the conjunctiva and evidence of mechanical injury of the tissue. The patient responded well to topical antibiotic treatment and a scleral patch graft repair. No other complications occurred. Implant size in this group ranged from 14 mm to 20 mm (average, 18.3 mm). Patients in this group received systemic antibiotics for 12 to 14 days (average, 13.1 days).

Follow-up of the 15 patients (seven males, eight females) who underwent evisceration and delayed implant (seven right eyes, eight left eyes) ranged from 22 to 39 months (average, 27.0 months; median, 25.0 months). Implant size ranged from 16 mm to 20 mm (average, 18.0 mm). Patients received systemic antibiotics for 13 to 16 days (average, 14.5 days).

Follow-up of the 31 patients (18 males, 13 females) who underwent evisceration for ocular conditions other than endophthalmitis (15 right eyes, 16 left eyes) ranged from 22 to 52 months (average, 38.0 months; median, 42.0 months). Seven of the patients in this group completed a full course of systemic antibiotics, which had been started on the day of admission. Antibiotic therapy ranged from

12 to 14 days (average, 12.7 days). Culture and sensitivity studies were performed in selected patients with suspected (and later excluded) endophthalmitis and in patients with corneal ulcer. Implant size in this group ranged from 16 mm to 22 mm (average, 19.2 mm).

Follow-up of the eight patients (six males, two females) who underwent enucleation with a PMMA implant (four right eyes, four left eyes) ranged from 30 to 52 months (average, 41.8 months; median, 41.5 months). No systemic antibiotics were used in any of these patients. Implant size in this group ranged from 20 mm to 22 mm (average, 20.5 mm).

TABLE 1. DATA ON PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMMEDIATE IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	CAUSE OF ENDOPHT-ALMITIS	SYSTEMIC CONDITIONS	INTRAOPERATIVE CULTURE RESULTS	IMPLANT SIZE (mm)*	DURATION OF ANTIBIOTIC THERAPY (days)†	FOLLOW-UP (mo)‡
1	76	M	L	PKP	—	*Propionibacterium acnes*	18	12	42
2§	74	F	L	Cat IOL, PKP	HD, obesity	*Staphylococcus aureus*	20	14	40
3	80	M	R	Cat IOL	—	*S aureus, Streptococcus salivarius*	20	12	47
4	73	M	L	RD	DM	*S aureus, Streptococcus pneumoniae, P acnes*	18	13	51
5	60	M	R	Cat IOL, PKP	Trichiasis	*P acnes*	20	14	44
6#	75	M	L	Glaucoma, MMC procedure	—	MRSE, *P acnes*	18	14	46
7**	83	M	R	Glaucoma, MMC procedure	TB	*Haemophilus influenzae*	20	14	45
8	71	M	R	Glaucoma, MMC procedure	—	*Streptococcus viridans*	18	13	45
9	65	M	L	RD	—	*Staphylococcus capitis*	20	14	47
10	75	M	L	Glaucoma, MMC procedure	DM	*S capitis*	16	14	40
11	64	M	L	RD (panophthal-mitis)	DM	*Bacillus cereus*	20	14	46
12	68	M	L	PKP (panophthal-mitis)	—	*Staphylococcus epidermidis*	18	14	40
13	52	M	R	Glaucoma, MMC procedure	DM, HTN	*P acnes*	20	14	43
14	62	F	R	Cat IOL	DM, asthma	MRSE	16	14	47
15	11	F	R	Chemical burn	—	MRSA type I, II, *S viridans*	16	14	43
16	65	M	L	Penetrating ocular trauma	DM	No fungal growth, MRSA	18	14	48

TABLE 1 (CONTINUED). DATA ON PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMMEDIATE IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	CAUSE OF ENDOPHT-ALMITIS	SYSTEMIC CONDITIONS	INTRAOPERATIVE CULTURE RESULTS	IMPLANT SIZE (mm)*	DURATION OF ANTIBIOTIC THERAPY (days)†	FOLLOW-UP (mo)‡
17	64	M	L	PKP (panophthal-mitis)	—	*S aureus*	18	13	45
18	35	M	R	Acid burn	—	*S aureus*, coagulase negative	14	12	44
19	66	M	L	Ruptured globe (panophthal-mitis)	—	*Proteus mirabilis*	20	14	43
20	23	F	R	PKP, panophthal-mitis	—	*S aureus*	20	15	43
21	77	M	L	PKP	—	*S aureus, Bacteroides ovatus*	16	14	41
22	65	M	R	Cat IOL	DM, HTN	*P acnes*	20	14	41
23	55	M	L	Chemical burn	—	MRSA	16	14	40
24	60	M	L	PKP (panophthal-mitis)	—	*S aureus*	18	14	41
25	16	F	R	Cat IOL	DM	*Pseudomonas aeruginosa*	20	14	40

Cat IOL = cataract extraction with intraocular lens implant; DM = diabetes mellitus; HD = heart disease; HTN = hypertension; L = left eye; MMC = mitomycin C; MRSA = methicillin-resistant *Staphylococcus aureus*; MRSE = methicillin-resistant *Streptococcus epidermidis*; PKP = penetrating keratoplasty; R = right eye; RD = retinal detachment; TB = active tuberculosis.
*Average implant size was 18.3 mm.
†Average duration of antibiotic therapy was 13.1 days.
‡Average duration of follow-up was 43.7 months.
§Patient had local anesthesia instead of general anesthesia.
#Patient developed entropion, trichiasis, rubbed eye; patch graft was performed.
**Patient received antituberculosis medication.

TABLE 2. DATA ON PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH DELAYED IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	CAUSE OF ENDOPH-THALMITIS	SYSTEMIC CONDITIONS	INTRAOPERATIVE CULTURE RESULTS	IMPLANT SIZE (mm)*	DURATION OF ANTIBIOTIC THERAPY (days)†	FOLLOW-UP (mo)‡
1	46	F	L	Corneal ulcer, perforation	—	*Propionibacterium acnes*	18	15	27
2§	64	M	L	Cat IOL	Obesity	*Haemophilus influenzae, Moraxella*	18	14	26
3	73	M	R	Cat IOL	DM	*Staphylococcus aureus*	20	14	37

TABLE 2 (CONTINUED). DATA ON PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH DELAYED IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	CAUSE OF ENDOPH-THALMITIS	SYSTEMIC CONDITIONS	INTRAOPERATIVE CULTURE RESULTS	IMPLANT SIZE (mm)*	DURATION OF ANTIBIOTIC THERAPY (days)†	FOLLOW-UP (mo)‡
4	67	M	L	PKP	—	*Streptococcus pneumoniae*	18	13	33
5	58	M	R	PKP	—	*Pseudomonas*	16	14	39
6	64	F	L	Cat IOL	—	*S aureus*	16	15	22
7	54	F	R	Glaucoma, MMC	—	*P acnes*	18	14	24
8	65	M	R	Cat IOL	DM	*Pseudomonas*	18	15	37
9	63	F	R	Cat IOL	DM	*Streptococcus epidermidis*	18	14	25
10	60	F	L	Cat IOL	DM	*P acnes*	18	15	25
11	50	F	L	Cat IOL, PKP	—	*Escherichia coli*	18	14	22
12	60	M	L	Glaucoma, MMC procedure	—	*S epidermidis*	18	14	25
13	52	F	R	RD	—	*Proteus*	18	15	22
14	61	M	L	PKP, corneal ulcer, perforation	Facial palsy	*P acnes*	18	16	23
15	68	F	R	PKP, corneal ulcer, perforation	DM	*S aureus*	20	15	31

Cat IOL = cataract extraction with intraocular lens implant; DM = diabetes mellitus; L = left eye; MMC = mitomycin C; PKP = penetrating keratoplasty; R = right eye; RD = retinal detachment.
*Average implant size was 18.0 mm.
†Average duration of antibiotic therapy was 14.5 days.
‡Average duration of follow-up was 27.0 months.
§Patient had local anesthesia instead of general anesthesia.

POSTOPERATIVE PAIN ASSESSMENT

Tables 5 through 8 delineate the pain scores for all individual patients in each group. Table 9 summarizes the average pain scores of all the groups and statistically significantly differences. The first 48-hour pain scores ranged from 10 to 16 (average, 13.4) in patients undergoing evisceration with immediate implant (group 1); from 9 to 14 (average, 12.1) in patients undergoing evisceration with delayed implant (group 2); from 9 to 16 (average, 12.2) in nonendophthalmitis patients undergoing evisceration with immediate implant (group 3); and from 12 to 16 (average, 14.1) in patients undergoing enucleation with immediate implant (group 4).

During the first 48-hour period, the Kruskal-Wallis test shows that the difference in the groups is statistically significant (P = .008). Multiple comparison procedures show no statistically significant difference between all the groups. The difference, however, approaches statistical significance when the pain score of group 4 is compared with that of group 2 (group 4 being higher than group 2, P = .014) and when the pain score of group 4 is compared with that of group 3 (group 4 being higher than group 3, P = .013).

Pain scores during the second 48-hour period ranged from 6 to 8 (average, 7.4) in patients undergoing evisceration with immediate implant (group 1); from 8 to 12 (average, 9.9) in patients with delayed implant (group 2); from 6 to 11 (average, 8.1) in nonendophthalmitis patients (group 3); and from 8 to 11 (average, 9.0) in patients undergoing enucleation (group 4). The Kruskal-Wallis test shows a statistically significant difference in the groups (P = .000). Multiple comparison procedures show a significant difference for various pairs. The score of group 2 is higher than the score of group 1 (P = .000), group 4 is higher than group 1 (P = .002), and group 2 is higher than group 3 (P = .000).

The average total pain scores during the entire 96-hour period were 20.8 in the immediate implant group with endophthalmitis

(group 1), 22.1 in the delayed implant group with endophthalmitis (group 2), 20.3 in the nonendophthalmitis group (group 3), and 23.1 in the enucleation group (group 4). The Kruskal-Wallis test shows a statistically significant difference in the groups ($P = .006$). Multiple comparison procedures show a significant difference between group 2 and group 3 and between group 4 and group 3 (group 2 > group 3, $P = .009$; group 4 > group 3, $P = .005$).

Additional analysis using Cochran-Mantel-Haenszel statistics and/or Wilcoxon rank sums method was performed to determine the possible role of age, sex, and implant size on pain scores. Comparison was also made between patients with PMMA implants and patients with hydroxyapatite implants in the nonendophthalmitis group. No significant relationship was found between pain score and any of these factors.

TABLE 3. DATA ON PATIENTS WITHOUT ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMMEDIATE IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	CAUSE OF ENDOPH-THALMITIS	SYSTEMIC CONDITIONS	IMPLANT SIZE (mm)*	DURATION OF ANTIBIOTIC THERAPY (days)	FOLLOW-UP (mo)†
1	62	F	R	RD	HTN	20 HA	0	29
2‡	57	M	L	Trauma	—	20	14	48
3	24	M	L	Phthisis bulbi	—	18 HA	0	22
4	50	F	L	End-stage glaucoma	—	20 HA	0	43
5	49	M	R	Phthisis bulbi	—	16 HA	0	48
6‡	53	F	L	Corneal ulcer, perforation	HTN	14	13	45
7§	78	F	L	Trauma	DM	20	14	24
8	7	M	R	End-stage glaucoma	—	16 HA	0	51
9#	75	M	R	End-stage glaucoma	HTN	18	0	45
10	73	M	R	End-stage glaucoma	HTN	20	0	50
11	64	F	L	End-stage glaucoma	—	18	0	23
12	44	M	L	Trauma	DM	16	0	39
13	49	M	L	End-stage glaucoma	—	20	0	52
14	45	M	L	End-stage glaucoma	Obesity	18	0	28
15	75	M	L	End-stage glaucoma	HTN	22	0	49
16	63	F	L	End-stage glaucoma	—	22	0	34
17‡	47	M	L	RD	—	22	14	52
18‡	53	M	R	Corneal ulcer, perforation	Obesity	20	12	51
19	67	F	L	End-stage glaucoma	HTN	18	0	49
20	54	F	R	End-stage glaucoma	HTN, obesity	20	0	52
21	29	F	L	Trauma	—	16 HA	0	50
22	22	F	L	End-stage glaucoma	—	20 HA	0	35
23	19	M	R	End-stage glaucoma	HTN	18 HA	0	44
24	52	F	R	Phthisis bulbi	—	18	0	25
25	27	M	R	Corneal ectasia	—	20 HA	0	24
26	83	M	R	Anterior staphyloma	HTN	20	0	37
27	10	M	R	Trauma	—	16 HA	12	42

TABLE 3 (CONTINUED). DATA ON PATIENTS WITHOUT ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMMEDIATE IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	CAUSE OF ENDOPH-THALMITIS	SYSTEMIC CONDITIONS	IMPLANT SIZE (mm)*	DURATION OF ANTIBIOTIC THERAPY (days)	FOLLOW-UP (mo)†
28‡	24	M	R	Phthisis bulbi	—	16 HA	0	28
29	52	F	R	End-stage glaucoma	DM	18	0	22
30	38	F	R	End-stage glaucoma	—	20	0	25
31§	57	M	L	Corneal ulcer, perforation	—	20	14	27

DM = diabetes mellitus; HA = hydroxyapatite; HTN = hypertension; L = left eye; R = right eye; RD = retinal detachment.
*Average implant size was 19.2 mm.
†Average duration of follow-up was 38.0 months.
‡Excluded from the immediate arm.
§Excluded from the delayed arm.
#Patient received local anesthesia.

TABLE 4. DATA ON PATIENTS WITHOUT ENDOPHTHALMITIS WHO UNDERWENT ENUCLEATION WITH IMMEDIATE IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	REASON FOR ENUCLEATION	SYSTEMIC CONDITIONS	IMPLANT SIZE (mm)*	FOLLOW-UP| (mo)†
1	67	M	R	Trauma	—	20	42
2	62	M	L	Trauma	—	20	50
3	44	M	R	Tumor	—	22	41
4	62	F	R	Trauma	DM	20	52
5	39	M	L	Trauma	—	20	39
6	70	F	R	Trauma	HTN	20	34
7	49	M	L	Trauma	—	20	46
8	52	M	L	Trauma	—	22	30

DM = diabetes mellitus; HTN = hypertension; L = left eye; R = right eye.
*Average implant size was 20.5 mm.
†Average duration of follow-up was 41.8 months.

TABLE 5. PAIN SCORES IN PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMMEDIATE IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	PAIN SCORES BASED ON NUMBER OF WEIGHTED DOSES (ONE PO DOSE = 1, ONE IM DOSE = 2)						
				FIRST 48 HOURS, 1	FIRST 48 HOURS, 2	SCORE FOR FIRST 48 HOURS*	SECOND 48 HOURS, 1	SECOND 48 HOURS, 2	SCORE FOR SECOND 48 HOURS†	TOTAL SCORE (96 HOURS)‡
1	76	M	L	8	3	14	6	0	6	20
2	74	F	L	7	4	15	6	1	8	23

TABLE 5 (CONTINUED). PAIN SCORES IN PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMMEDIATE IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	PAIN SCORES BASED ON NUMBER OF WEIGHTED DOSES (ONE PO DOSE = 1, ONE IM DOSE = 2)						
				FIRST 48 HOURS, 1	FIRST 48 HOURS, 2	SCORE FOR FIRST 48 HOURS*	SECOND 48 HOURS, 1	SECOND 48 HOURS, 2	SCORE FOR SECOND 48 HOURS†	TOTAL SCORE (96 HOURS)‡
3	80	M	R	10	1	12	7	0	7	19
4	73	M	L	9	2	13	6	0	6	19
5	60	M	R	8	3	14	7	0	7	21
6	75	M	L	9	2	13	7	0	7	20
7	83	M	R	7	3	13	6	1	8	21
8	71	M	R	9	1	11	7	0	7	18
9	65	M	L	9	2	13	7	0	7	20
10	75	M	L	8	4	16	8	0	8	24
11	64	M	L	6	3	12	8	0	8	20
12	68	M	L	8	4	16	6	1	8	24
13	52	M	R	10	1	12	7	0	7	19
14	62	F	R	9	2	13	8	0	8	21
15	11	F	R	7	2	11	7	0	7	18
16	65	M	L	9	3	15	8	0	8	23
17	64	M	L	10	0	10	7	0	7	17
18	35	M	R	10	2	14	8	0	8	22
19	66	M	L	8	4	16	8	0	8	24
20	23	F	R	10	2	14	8	0	8	22
21	77	M	L	8	3	14	8	0	8	22
22	65	M	R	8	3	14	6	0	6	20
23	55	M	L	9	2	13	7	0	7	20
24	60	M	L	8	2	12	8	0	8	12
25	16	F	R	9	3	15	7	0	7	22

IM = intramuscular injection; L = left eye; PO = oral dose; R = right eye.
*Average pain score for the first 48 hours was 13.4.
†Average pain score for the second 48 hours was 7.4
‡Average 96-hour pain score, or total score, was 20.8.

RETROSPECTIVE REVIEW

The Author's Series

The author's series of 53 cases of evisceration included 11 patients with a clinical diagnosis of endophthalmitis and 42 patients without endophthalmitis. The duration of systemic antibiotic therapy in the 11 patients with clinical endophthalmitis ranged from 11 to 14 days (average, 13.6 days). The secondary implant technique was used in seven of the 11 patients with endophthalmitis. Surgery was performed from several days to many weeks after the infection had cleared. Different types of sutures and implants were used in these seven patients. The other four patients with clinical endophthalmitis underwent evisceration and immediate implant insertion within 72 hours of presentation. Only two of these four patients had positive intraoperative cultures that confirmed the diagnosis of endophthalmitis. Each of the 11 patients received a hollow acrylic sphere implant. The 42 nonendophthalmitis patients underwent evisceration with immediate implants. Forty-two of the 53 patients received a hollow acrylic sphere; four, a PMMA sphere; four, a silicone sphere; and three, a hydroxyapatite implant.

The surgical technique used in this series of 53 patients was the same as that used in the prospective study. All patients were followed for 6 years or more. Implant size ranged from 16 to 22 mm (average, 18.8 mm). There was no implant extrusion or other complication.

TABLE 6. PAIN SCORES IN PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH DELAYED IMPLANTS

PT NO.	AGE (YR)	SEX	EYE	PAIN SCORES BASED ON NUMBER OF WEIGHTED DOSES (ONE PO DOSE = 1, ONE IM DOSE = 2)						
				FIRST 48 HOURS, 1	FIRST 48 HOURS, 2	SCORE FOR FIRST 48 HOURS*	SECOND 48 HOURS, 1	SECOND 48 HOURS, 2	SCORE FOR SECOND 48 HOURS†	TOTAL SCORE (96 HOURS)‡
1	46	F	L	9	2	13	7	1	9	22
2	64	M	L	8	2	12	8	2	12	24
3	73	M	R	7	3	13	9	0	9	22
4	67	M	L	9	1	11	8	1	10	21
5	58	M	R	8	3	14	8	1	10	24
6	64	F	L	9	0	9	8	0	8	17
7	54	F	R	9	2	13	8	2	12	25
8	65	M	R	6	2	10	9	1	11	21
9	63	F	R	10	1	12	8	1	10	22
10	60	F	L	9	2	13	8	1	10	23
11	50	F	L	8	2	12	7	1	9	21
12	60	M	L	9	1	11	9	1	11	22
13	52	F	R	6	4	14	7	1	9	23
14	61	M	L	8	2	12	9	0	9	21
15	68	F	R	9	2	13	8	1	10	23

IM = intramuscular injection; L = left eye; PO = oral dose; R = right eye.
*Average pain score for the first 48 hours was 12.1.
†Average pain score for the second 48 hours was 9.9
‡Average 96-hour pain score, or total score, was 22.1.

TABLE 7. PAIN SCORES IN PATIENTS WITHOUT ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMMEDIATE IMPLANTS

PT NO.	AGE (yr)	SEX	EYE	PAIN SCORES BASED ON NUMBER OF WEIGHTED DOSES (ONE PO DOSE = 1, ONE IM DOSE = 2)						
				FIRST 48 HOURS, 1	FIRST 48 HOURS, 2	SCORE FOR FIRST 48 HOURS*	SECOND 48 HOURS, 1	SECOND 48 HOURS, 2	SCORE FOR SECOND 48 HOURS†	TOTAL SCORE (96 HOURS)‡
1	62	F	R	9	2	13	7	0	7	20
2	57	M	L	9	2	13	8	0	8	21
3	24	M	L	8	3	14	7	2	11	25
4	50	F	L	9	1	11	8	0	8	19
5	49	M	R	8	4	16	8	1	10	26
6	53	F	L	7	2	11	6	0	6	17
7	78	F	L	10	2	14	8	0	8	22

TABLE 7 (CONTINUED). PAIN SCORES IN PATIENTS WITHOUT ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMMEDIATE IMPLANTS

				PAIN SCORES BASED ON NUMBER OF WEIGHTED DOSES (ONE PO DOSE = 1, ONE IM DOSE = 2)						
PT NO.	AGE (yr)	SEX	EYE	FIRST 48 HOURS, 1	FIRST 48 HOURS, 2	SCORE FOR FIRST 48 HOURS*	SECOND 48 HOURS, 1	SECOND 48 HOURS, 2	SCORE FOR SECOND 48 HOURS†	TOTAL SCORE (96 HOURS)‡
8	7	M	R	9	1	11	8	0	8	19
9	75	M	R	8	2	12	7	0	7	19
10	73	M	R	7	1	9	8	0	8	17
11	64	F	L	9	2	13	9	0	9	22
12	44	M	L	6	4	14	7	1	9	23
13	49	M	L	8	1	10	8	0	8	18
14	45	M	L	8	1	10	7	0	7	17
15	75	M	L	9	0	9	7	0	7	16
16	63	F	L	9	1	11	7	1	9	20
17	47	M	L	10	1	12	8	0	8	20
18	53	M	R	8	2	12	7	0	7	19
19	67	F	L	10	0	10	8	0	8	18
20	54	F	R	8	2	12	7	0	7	19
21	29	F	L	8	3	14	8	1	10	24
22	22	F	L	8	2	12	7	0	7	19
23	19	M	R	9	2	13	8	0	8	21
24	52	F	R	8	3	14	8	0	8	22
25	27	M	R	8	3	14	6	2	10	24
26	83	M	R	10	0	10	8	0	8	18
27	10	M	R	9	2	13	7	0	7	20
28	24	M	R	8	3	14	7	1	9	23
29	52	F	R	9	1	11	8	0	8	19
30	38	F	R	8	3	14	8	0	8	22
31	57	M	L	9	2	13	8	0	8	21

IM = intramuscular injection; L = left eye; PO = oral dose; R = right eye.
*Average pain score for the first 48 hours was 12.2.
†Average pain score for the second 48 hours was 8.1.
‡Average 96-hour pain score, or total score, was 20.3.

TABLE 8. PAIN SCORES IN PATIENTS WITHOUT ENDOPHTHALMITIS WHO UNDERWENT ENUCLEATION WITH IMMEDIATE IMPLANTS

				PAIN SCORES BASED ON NUMBER OF WEIGHTED DOSES (ONE PO DOSE = 1, ONE IM DOSE = 2)						
PT NO.	AGE (yr)	SEX	EYE	FIRST 48 HOURS, 1	FIRST 48 HOURS, 2	SCORE FOR FIRST 48 HOURS*	SECOND 48 HOURS, 1	SECOND 48 HOURS, 2	SCORE FOR SECOND 48 HOURS†	TOTAL SCORE (96 HOURS)‡
1	67	M	R	8	2	12	8	1	10	22
2	62	M	L	4	6	16	7	2	11	27

PT NO.	AGE (yr)	SEX	EYE	FIRST 48 HOURS, 1	FIRST 48 HOURS, 2	SCORE FOR FIRST 48 HOURS*	SECOND 48 HOURS, 1	SECOND 48 HOURS, 2	SCORE FOR SECOND 48 HOURS†	TOTAL SCORE (96 HOURS)‡
				PAIN SCORES BASED ON NUMBER OF WEIGHTED DOSES (ONE PO DOSE = 1, ONE IM DOSE = 2)						
3	44	M	R	8	2	12	8	0	8	20
4	62	F	R	10	2	14	8	0	8	22
5	39	M	L	9	3	15	9	0	9	24
6	70	F	R	9	2	13	8	0	8	21
7	49	M	L	9	3	15	8	1	10	25
8	52	M	L	8	4	16	8	0	8	24

IM = intramuscular injection; L = left eye; PO = oral dose; R = right eye.
*Average pain score for the first 48 hours was 14.1.
†Average pain score for the second 48 hours was 9.0.
‡Average 96-hour pain score, or total score, was 23.1.

TABLE 9. SUMMARY OF AVERAGE PAIN SCORES IN THE FOUR GROUPS

POSTOPERATIVE PERIOD	GROUP 1	GROUP 2	GROUP 3	GROUP 4
First 48-hour period*	13.4	12.1	12.2	14.1
Second 48-hour period†	7.4	9.9	8.1	9.0
Total pain score ‡	20.8	22.1	20.3	23.1

*During the first 48-hour period *P* values are insignificant for all pairwise comparison.
†During the second 48-hour period, group 1 < 2 *P* = .000, group 3 < 2 *P* = .000, and group 1 < 4 *P* = .002.
‡For the entire 96-hour period, group 3 < 4 *P* = .005, and group 3 < 2 *P* = .009.

The Other Surgeons' Series

From 1984 to 1997, a total of 192 patients underwent evisceration with PMMA implants at the same eye center where the current study was conducted. A review of this large series provided a unique opportunity to examine factors that might influence the implant extrusion rate. Each of these patients had an infected eye, and operations were performed by several different surgeons. Because of difficulties in coding and changes in computerization of the medical record, an infected eye did not necessarily mean either clinical or culture-proven endophthalmitis. Nonetheless, because of some type of eye infection, all of these patients had received various preoperative, intraoperative, and postoperative intravenous and topical antibiotics.

Endophthalmitis was diagnosed by preevisceration anterior chamber or vitreous tap culture in 151 (78.6%) of the 192 patients. However, intraocular cultures at the time of evisceration, 2 to 17 days after the initial diagnosis, revealed only four positive results (10%) in 37 patients. Many of the 192 patients apparently had a blind, painful eye due to corneal ulcer, bacterial keratitis, or hypopion from unspecified causes. With vigorous intravenous and topical antibiotic therapy, the scleral cavity of most of these patients likely had become sterile by the time an implant was inserted 2 to 17 days later, as demonstrated by only four of 37 positive intraoperative cultures. All of the patients in this series had a follow-up of 3 years or longer. Data on these 37 patients are summarized in Table 10.

Each of the surgeons at the eye center used essentially the same surgical technique and postoperative wound care regimen. Surgeons, however, used different suture materials: 5-0 or 6-0 Vicryl, 4-0 or 5-0 chromic, and 4-0 or 5-0 silk. Although an implant was inserted at the time of evisceration, the procedure was not performed until 2 to 17 days after admission. No surgeon made posterior sclerotomies or administered gentamicin intraoperatively. There was no documentation in the operative notes of clearing the "dirty" instruments from the field or of changing gloves. Cleansing of the scleral shell with absolute alcohol was documented in only one of 37 cases. All of the 37 patients received systemic antibiotics for 28 to 46 days (average, 34.2 days). The size of the implant ranged 10 mm to 16 mm (average, 13.7 mm).

Postoperatively only a light patch was placed over the eye. Ice-cold compresses were not used. All 37 patients were examined by

an in-house ocularist on the first postoperative day, with another appointment scheduled 1 to 4 weeks later. Follow-up examination with the surgeon was usually scheduled 4 to 6 weeks postoperatively. In the meantime, patients received systemic antibiotics. They also continued to apply topical antibiotic ointment to the socket four to six times daily for 4 to 8 weeks. Once a patient had a prosthetic eye made, he or she would not have an appointment with the ophthalmologist unless a medical problem such as socket infection, implant exposure, or implant extrusion developed.

Implants extruded in 54 (28.1%) of the 192 patients. In 49 (90.7%) of the 54 instances, implant extrusion occurred within the first 6 months. Implant extrusion was likely due to infection, edema, hemorrhage, or faulty surgical technique. The extrusion rate of 28.1% is consistent with a previously unpublished rate of 21.6% in "infected" eyes at the same eye center from 1984 to 1990, using the same definition of infection. During that same period, implant extrusion occurred in 18 (11.4%) of 158 uninfected eyes. In that unpublished review, it was concluded that suture materials did not affect the extrusion rate.

In the subgroup of 37 patients in whom intraoperative cultures were obtained, the extrusion rate was three of four (or 75%) in patients with culture-proven endophthalmitis and seven of 33 (21.2%) in patients with sterile intraocular contents. All instances of implant extrusion occurred at 1 week to 5 months postoperatively.

Statistically significant differences were found in the implant size, duration of antibiotic administration, and the implant extrusion rates between the author's series and the current study and the other series ($P = .000$). Major differences existed in intraoperative techniques and postoperative wound care regimen.

PT NO.	AGE (yr)	SEX	INTRAOPERATIVE CULTURE RESULTS*	TYPE OF SUTURES	IMPLANT SIZE (mm)	EXTRUSION	DURATION OF ANTIBIOTICS (days)
			TABLE 10. RETROSPECTIVE REVIEW CASES: DATA ON THE 37 PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMPLANT INSERTION				
1	42	M	*Staphylococcus aureus*	V, C	12	Yes	38
2	26	M	*Propionibacterium acnes*	V, C	10	Yes	36
3	44	F	*Staphylococcus epidermidis*	C	12	Yes	42
4	59	F	*S epidermidis*	V, C	14	—	33
5	74	M	—	V, C	14	—	34
6	75	F	—	C, S	12	—	29
7	64	F	—	V, C	16	—	32
8	53	M	(Alcohol used to cleanse scleral shell)	C	14	—	37
9	37	F	—	S, C	14	Yes	44
10	27	M	—	V, C	12	—	41
11	64	M	—	C	14	—	32
12	37	M	—	S, C	16	—	31
13	82	F	—	V, C	14	Yes	32
14	66	M	—	V, C	14	Yes	28
15	47	M	—	S	12	—	28
16	70	M	—	V, C	14	—	28
17	58	F	—	V, C	14	—	35
18	31	F	—	V	10	Yes	46
19	64	F	—	S, C	12	—	36
20	69	M	—	V, C	12	—	31
21	57	F	—	V	16	—	34
22	55	M	—	S, C	14	—	28
23	36	F	—	V, C	14	Yes	32
24	37	F	—	V, C	14	—	28
25	74	M	—	S, C	14	—	28

PT NO.	AGE (yr)	SEX	INTRAOPERATIVE CULTURE RESULTS*	TYPE OF SUTURES	IMPLANT SIZE (mm)	EXTRUSION	DURATION OF ANTIBIOTICS (days)
26	77	M	—	V, C	12	—	36
27	46	F	—	S,C	14	Yes	39
28	74	M	—	V	16	—	41
29	73	M	—	V, C	12	—	44
30	68	F	—	S	14	—	33
31	44	F	—	V, C	14	—	31
32	30	F	—	S, C	14	—	40
33	75	M	—	V, C	14	—	28
34	65	M	—	V, C	12	—	29
35	35	M	—	V, C	14	—	34
36	54	F	—	S	14	Yes	36
37	65	M	—	V, C	14	—	33

TABLE 10 (CONTINUED). RETROSPECTIVE REVIEW CASES: DATA ON THE 37 PATIENTS WITH ENDOPHTHALMITIS WHO UNDERWENT EVISCERATION WITH IMPLANT INSERTION

C = chromic; S = silk; V = Vicryl.
*Intraoperative cultures were not obtained in patients 5 through 37.

DISCUSSION

EXTRUSION RATES AND TIMING OF IMPLANT INSERTION

Improved cosmesis was recognized as a benefit of implant insertion since the procedure was first described.[1-4,26] Implant extrusion, however, continued to be a frequent complication.[3,4,18,46-51] Subsequently, the surgical technique underwent modifications,[52-59] and different materials were investigated for making implants of various designs.[60-74] Implant extrusion rates from early reports are difficult to assess. Most are reported as comments made in passing and not based on a systematic review or a prospective study. Different surgical techniques and implants were used, and patient selection criteria and the duration of follow-up were not specified. Most of the time, no effort was made to separate cases of endophthalmitis and nonendophthalmitis.

Implant extrusion following evisceration was first examined in 1939, when Burch reported a 25% extrusion rate and quoted Moretti as having the same rate.[24] Burch, too, did not specify whether endophthalmitis was present or not.[24] As antibiotics became available and surgical techniques were refined, extrusion rates became lower and ranged from 2% to 22% in reports from the 1960s to the 1990s.[26,46-51,75-78] These rates, however, represent best estimates, as none of them was derived from a prospective study or a systematic review.

In the early days of evisceration for endophthalmitis, implant insertion was performed at the completion of evisceration, as described by Mule.[1] Clinical experiences with evisceration seemed to support the principle that an implant inserted in an infected field would likely extrude.[1-4,24-27,79,80] As a consequence, many advocated no primary implant in cases of endophthalmitis and would insert an implant only as a secondary procedure, usually months or years after evisceration.[9-14] Other surgeons preferred not to perform evisceration until the ocular infection had been completely eradicated. This usually took place weeks later.[15,16] They believed that the implant extrusion rate in patients who undergo implant insertion after elimination of infection would not differ from that of patients without endophthalmitis to begin with. For a number of years, many surgeons used this approach, and implant extrusion rates ranged from zero to 2% in patients without endophthalmitis.[9,11,16,24,26,47,50,52,81]

The need to eliminate infection before implant insertion also led to the concept of a delayed primary wound closure in patients with an infected wound.[82-88] In the case of evisceration for endophthalmitis, delayed primary wound closure means implant placement 3 to 5 days following evisceration. The scleral shell is left unsutured and packed with antibiotic-saturated gauze until the implant is inserted.

Among the first to report success with an immediate implant technique were Sisler and coworkers,[89] who described the use of a drain in the socket in two patients. These two patients had positive intraoperative cultures, but no other details, including the duration of follow-up, were provided. In 1987, Baylis and colleagues[18] described their successful experience with the immediate implant approach in a book chapter, but they did not provide details on patient selection and exclusion criteria, follow-up length, and implant extrusion rates. In 1989, Holds and Anderson[20] stated, in a letter to the editor, that implant extrusion occurred after immediate implant in five of 21 patients in their series. No other details were described.

More recently, in 2000, Dresner and Karesh[19] reported favorable results with the immediate implant technique in 11 patients who

were operated on by two different surgeons using different techniques and different types of implants. Temporalis fascia graft was used in three patients, scleral button transposition in one patient, and corneal transposition in another patient. Of the 11 patients, two received methylmethacrylate spheres (16 mm and 18 mm), two received 18-mm porous polyethylene spheres, and seven received 20-mm porous polyethylene conical implants. Although cultures were obtained, it was not clear if these were preoperative external cultures or anterior chamber-vitreous tap, or intraoperative cultures of the intraocular contents. In fact, four of the 11 patients had negative cultures. With no selection-exclusion criteria and no uniformity in surgical technique, data from this small series offered few new insights.

In the late 1980s, Shore and colleagues[21] emerged among the proponents for the delayed primary wound closure technique.[82-88] Prior to that time and thereafter, no other report of this technique existed in the ophthalmic literature. These investigators reported on only four patients operated on by, perhaps, three different surgeons. They used silicone implants that ranged in size from 12 mm to 14 mm. Despite a detailed description of each patient's clinical presentation, there was no mention of intraoperative cultures of intraocular contents. In fact, one patient in their series did not have endophthalmitis. Another patient had endophthalmitis due to trauma several weeks previously. A 16-mm silicone sphere was initially inserted in this patient by the referring physician, and wound dehiscence was noted by the tenth postoperative day. By the time the investigators intervened with their delayed implant technique 7 weeks later, the patient had already received various antibiotics, and cultures of the sclera and conjunctiva were negative.

In response to concerns of patient comfort, inconvenience, and cost associated with the delayed implant technique, Shore and colleagues[90] countered that because endophthalmitis presents in many different forms, ranging from indolent to virulent with constitutional signs and symptoms, it is therefore "natural to assume that primary implant extrusion is more likely to occur in patients with more severe infections" and "placing an implant at the time of surgery in [this] clinical setting makes no sense."

In short, there is no prospective, well-controlled study to date. The published retrospective reports have a small number of patients and short follow-up period, and there is no uniformity in patient selection criteria or surgical technique. More important, the definition of endophthalmitis is unclear, with only very few cases proven by intraoperative culture.

Are Extrusion Rates Different With Immediate and Delayed Implants?

Endophthalmitis was defined in the current study as positive intraoperative intraocular cultures and smears. The results of this prospective comparative study show that the rate of implant extrusion does not differ with immediate implant, delayed primary implant, and secondary implant techniques. No instance of extrusion occurred in any patient. Extrapolation of the data on extrusion rates to the general population provides an estimate of the expected extrusion rate.

With a 0% extrusion rate in the 25 evisceration patients who underwent immediate implant for endophthalmitis, a 95% exact confidence interval (CI) estimate for the overall population rate is 0% to 13.7%. Consequently, whereas the overall rate might not be zero, it would be no more than 13.7%. With a 0% rate of implant extrusion in the 15 patients with delayed implants, a 95% exact CI estimate for the overall population rate is 0% to 21.8%. In other words, the extrusion rate in the overall population would be expected to be no more than 21.8%. On the basis of this study, it seems reasonable to conclude that fear of implant extrusion because of endophthalmitis is not warranted.

With no implant extrusion in the 31 patients without endophthalmitis, a 95% CI estimate for the general population is 0% to 11.2%. Because evisceration with secondary implant techniques was performed when no active ocular infection was present, theoretically the result in these 31 patients without endophthalmitis could be extrapolated to imply that the secondary implant extrusion rate in the overall population would be expected to be no more than 11.2%.

Given the evidence, the immediate implant procedure has many advantages over the delayed and secondary implant procedures, including convenience, comfort, and cost-effectiveness. Indeed, five patients evaluated during the delayed implant period decided to not enter the study because they wanted to receive an immediate implant. Two of these patients could not afford the prolonged hospital stay required by the delayed implant procedure. A young girl and two other adults wanted to undergo the immediate implant procedure because of concern over pain and over the inconvenience of having the procedure in two stages. Most of the 15 patients who underwent daily dressing-packing changes complained of pain and discomfort despite administration of oral or injected analgesics prior to dressing change.

Compared with the delayed implant technique, the immediate implant technique produced a better orbital volume replacement, which generally implies better cosmesis.[46-49,75,76,81,91-93] The average implant size was 18.3 mm (range, 16 to 20 mm) in the immediate implant group and 18.0 mm (range, 16 to 20 mm) in the delayed implant group. Although this difference is not statistically significant, in an individual patient this could mean an implant of 18 mm instead of 16 mm. (The average implant size was reduced in the immediate implant group by three patients with chemical burns who required implants of 14 mm or 16 mm.) Tissue contracture over the 3 to 5 days and wound debridement during preparation for delayed implant insertion likely account for the difference in implant size.

Follow-up averaged 37.9 months, a duration more than adequate for evaluating early implant extrusion rates, as "early" generally means the first 6 months postoperatively.[46-47,49-51,75,76,81,94] Whether or not postoperative infection is secondary to endophthalmitis or to intraoperative or postoperative contamination, implant extrusion caused by infection usually occurs within 6 months. Other causes of early implant extrusion include orbital hemorrhage or edema, faulty wound closure, and excessive implant size.[48-53,75-77,93,95]

Although one patient in the immediate implant group had a small (2 × 2 mm) conjunctival dehiscence at his 3-month postoperative visit, he did not present with other signs of infection, implant exposure, or implant extrusion. His poor hygiene and upper lid entropion, without a conformer, resulted in mechanical injury of the tissue. He responded well to topical antibiotic therapy and a

scleral patch graft repair.[96-99] If endophthalmitis or infection were the cause of conjunctival dehiscence, it would likely have resulted in implant exposure and, perhaps, eventual extrusion despite rigorous treatment.[46-47,49,78,91,97-99]

To achieve an optimal cosmetic result, it is generally recommended that the largest implant possible be used, without creating undue tension in the wound closure.[46-50,91,93] Implant sizes were not provided by Baylis and colleagues,[18] nor by Holds and Anderson.[20] Implant size ranged from 12 mm to 14 mm in the study by Shore and colleagues[21] and from 16 mm to 20 mm in the study by Dresner and Karesh.[19] Clinical experience has shown that an implant larger than 16 mm is difficult to insert without sclerotomies.[26,47,52-55] The current study, as well as previous work, shows that implants of 18 mm to 22 mm in size can be accommodated by performing posterior sclerotomies,[53-55] even in cases of phthisis bulbi.

Although volume deficit following evisceration with corneal button removal can be calculated accurately, the volume deficit with sclerotomies or relaxation incisions is more difficult to estimate. Posterior sclerotomies not only accommodate a larger implant but also allow intraoperative topical gentamicin to penetrate the deep orbit. Posterior sclerotomies perhaps contributed to the good outcomes with the surgical technique used in this study, as the series included several patients with well-documented panophthalmitis or orbital cellulitis or with intraocular cultures that grew virulent organisms.

One conclusion already alluded to is that the implant extrusion rate would be in the range of 0% to 11.2% with the secondary implant technique because there was no implant extrusion in any of the 31 nonendophthalmitis patients. Since no extrusion occurred with either PMMA or hydroxyapatite implants in this group of patients, another conclusion may be made. Namely, the type of implant material likely has no bearing on extrusion risk**.**

The findings from this study indicate that the timing of implant insertion is not a factor in implant extrusion. All three techniques—immediate, delayed, and secondary implants—are safe and effective in patients with endophthalmitis. Fear of implant extrusion because of endophthalmitis is not warranted. The immediate implant technique has the advantage of being simpler, more cost-effective, and more convenient for patients.

A weakness in the comparison of implant extrusion rates with immediate and delayed techniques is that the culture-proven endophthalmitis patients were not randomized to receive immediate or delayed implants. Because of this nonrandomized, noncontemporaneous design, the statistical comparisons may not be valid and the conclusions in this part of the study should be taken with caution.

The nonrandomized design was due to time limitation to conduct the study and an unknown number of suitable patients. Such a design assured a minimal number of 25 patients in the immediate implant arm, sufficient to produce some valid data and conclusions about this technique. The comparison with nonendophthalmitis patients undergoing evisceration or enucleation is contemporaneous.

Possible Factors That Might Affect Implant Extrusion Rates

The implant extrusion rate was much lower in the author's series of 53 patients and in the current prospective study as compared with the extrusion rate in the 192 patients operated on by other surgeons. That the prospective study was completed at the same center where the series of 192 patients were treated gave a unique opportunity to examine outcomes with different surgical techniques. Careful analysis of surgical techniques, duration of antibiotic administration, and postoperative wound care regimen strongly suggests that these factors influence the outcome.

There was a statistically significant difference ($P = .000$) between the duration of antibiotic therapy used by the author (10 to 18 days) and by the other surgeons (28 to 46 days) at the same hospital. Systemic antibiotic therapy for more than 10 to 14 days is deemed unnecessary, as injudicious use of antibiotics encourages the emergence of resistant bacterial strains.[5-8,34,38,40,44,100-102] Removal of contaminated instruments from the surgical field and changing gloves, as routinely practiced by the author, seem to be an obvious, logical approach to reduce the risk of infection.[6-8,86-88] This practice, however, apparently was not carried out or documented by other surgeons at the same hospital.

Implant size also differed significantly in these two series. The author was able to accommodate larger implants by consistently using posterior sclerotomies.[53-55] All of the other surgeons at the same hospital never used posterior sclerotomies. They believed that the smaller the implant, the lower the risk of extrusion.

The role of intraoperative use of absolute alcohol is unclear; no controlled studies of this aspect have been performed. Whereas proponents of alcohol use believe it aids in destroying any remaining uveal tissues and microorganisms, opponents believe it irritates the tissues and causes prolonged inflammation, which might encourage early implant extrusion.

Many investigators advocate removal of the uveal tissues with various instruments or gauze. Berens and Breakey[62] appear to have been the first to use metaphen to cleanse the scleral shell. Other investigators have used absolute or 70% alcohol.[22,46,55,64,81,91] Use of alcohol during the procedure was not a randomized, controlled aspect of the current study. Therefore, whether cleansing the scleral shell with alcohol contributes to implant retention is not known.

Postoperative wound care is an integral part of total patient care but is often overlooked. Moderate to severe orbital and periorbital edema lasting several days is expected following evisceration with implant insertion. To prevent or subdue the edema, some surgeons prefer the application of ice-cold compresses[9,24,26] or a temporary tarsorrhaphy,[22,23,51] whereas others apply a pressure dressing over the operated socket for several days.[46,49,91] Unfortunately, too often a surgeon leaves the operating room and delegates the task of wound dressing to a resident or nurse, not knowing if the orders were carried out properly. I made a point of personally placing the pressure dressing and inspecting it before removal on the fourth to sixth postoperative day. In my years of experience, only minimal residual edema occurs after evisceration or enucleation in patients wearing a properly placed pressure dressing for several days.

The wound care regimen I use for evisceration involves no tissue manipulation by an ocularist for at least 6 weeks postoperatively. The other surgeons initiate evaluation and tissue manipulation by an ocularist on the first postoperative day and reevaluation 1 to 4

weeks later, which accomplishes very little except irritating the already edematous tissues.[46,49,55,68,75] In contrast, I wait 6 to 8 weeks after surgery before referring patients to an ocularist. Similarly, it seems superfluous and a potential irritant to apply ointment to the operated socket four to six times daily for many weeks, in addition to continued and prolonged systemic antibiotic administration.

Studies have shown that more experienced surgeons tend to have lower implant extrusion rates, suggesting that surgical technique and experience make a difference in the outcome.[78] Zolli[78] showed in 1988 that the overall implant extrusion rate was 6% for evisceration and 1.8% for enucleation for the staff at the Wills Eye Hospital. However, these rates increased to 22% and 6%, respectively, if all "others" were included. No details were provided regarding surgical techniques and postoperative wound care. Of note, nearly half of the procedures in the current study were performed by a resident or fellow under the author's supervision, demonstrating that the technique used in this study is reliable and the results are reproducible.

There are statistically significant differences in surgical technique, implant size, duration of antibiotic therapy, and postoperative wound care regimen between the two series. The retrospective review of these two separate case series suggests that a smaller implant does not necessarily signify a lower risk of extrusion. Therefore, use of a smaller implant at the expense of good orbital volume replacement and possibly good cosmesis should be avoided. Posterior sclerotomies aid in the accommodation of larger implants. The reviews also suggest that prolonged administration of antibiotics does not help prevent implant extrusion in patients with endophthalmitis. Antibiotics should be judiciously administered. Surgical technique should include intraoperative use of antibiotic drops and removal of dirty instruments. Suture and implant materials do not appear to affect implant extrusion rates. Good postoperative wound care is essential in the total care of the patient.

Measurement of Pain

Since the early days of evisceration, postevisceration pain has been considered by many to be more intense and/or recovery more prolonged than postenucleation pain.[3,4,14,28-30] Intact sensory nerve supply to the scleral shell is offered as the explanation.[9,14,28] Such statements, although based only on clinical impression, are often assumed to be scientific conclusions and are often quoted in the literature. In fact, some investigators believe the opposite is true.[24-27]

Only recently have comparative studies of pain control after evisceration and enucleation been performed. In 1999 Calenda and coworkers[29,30] prospectively assessed the efficacy of pain control with peribulbar anesthesia in 17 enucleation patients and 14 evisceration patients. Nine of the 31 patients were subsequently excluded because they required general anesthesia. These investigators found peribulbar anesthesia to be very effective in controlling perioperative pain in the 22 patients. They included all 31 patients in their postoperative pain assessment and found a statistically significant higher pain score (as measured by the frequency of requests for pain medication) in patients undergoing evisceration. In this study pain was assessed for only the first 24 postoperative hours and the frequency of analgesic administration was unweighted.

In 2002 Giligson and associates[28] conducted a prospective, comparative study of the efficacy of intraoperative retrobulbar ethanol as compared with bupivacaine in controlling postevisceration pain and nausea. Eleven patients were in the study. Pain was quantified by a patient self-reporting survey technique and a 10-point pain scale. In addition to intrinsic problems with the self-reporting technique,[103-107] the small number of participants and variations in pain tolerance are among the shortcomings of the study.

The current study compared postevisceration and postenucleation pain by deriving a pain score based on a weighted frequency of pain medication used by each patient. The patient population at the eye center where the current study was conducted came from a multicultural, multilingual, diverse ethnic background. For this reason, the author modified a technique introduced in 1961 by Parkhouse and coauthors,[108] who were the first to use the frequency of pain medication requests as a measure of postoperative pain. Their study included nearly 1,000 patients undergoing various general surgical procedures. Marked differences in pain scores were noted among patients in different wards and with different operative sites. Less dramatic differences were found between sexes and among age groups. However, the design of their study is not without flaws. These investigators did not elaborate on patient selection criteria or clarify the health care provider's position (ie, encouraging, discouraging, or neutral). Nor was the frequency of doses of various medications weighted. Last but not least, all of the patients did not enter the study with the same baseline pain.[103-105,109] For example, a patient undergoing an appendectomy for acute appendicitis did not have the same baseline pain as a patient undergoing the same operation for a different reason or as a patient undergoing a different operation, such as cholecystectomy.

The current study avoided such design flaws. All patients underwent similar operations—evisceration or enucleation—with specific criteria and standardized surgical techniques. The neutral position of all care providers was specified and honored. A weight of 1 was assigned to each dose of oral pain medications and 2 to each intramuscular injection, which took into account the relative potency of different dosages and frequencies of administration. The current study also established an equal baseline pain level.[103-105,109] Most of the patients had a blind, painful eye and had been taking pain medication prior to admission. Pain medications were available to all of the patients following admission, and evisceration was not performed until 24 to 72 hours later. All of the patients, including those undergoing enucleation, received a bolus retrobulbar injection of a 50-50 mixture of lidocaine and bupivacaine following induction of general anesthesia. A similar retrobulbar injection was given during the delayed implant insertion procedure. Presumably, a retrobulbar injection might decrease postoperative pain in these patients, but such a clinical impression is not supported by controlled studies. Various controlled studies have shown that the preemptive use of analgesics has largely been negative in terms of providing pain relief.[110-118]

Two separate sets of 48-hour pain scores were obtained in all patients. Pain scores in patients with immediate implant insertion were obtained during the two consecutive 48-hour periods after surgery. To compensate for two separate procedures 3 to 5 days apart in the delayed implant group, the first 48-hour pain score in this group was derived from the first 48 hours after evisceration and the second 48-hour pain score from the first 48 hours after implant insertion. The length of hospital stay varied among study patients, but

all of them stayed for a minimum of 4 days. A total pain score, representing the entire 96 hours, was also determined.

It is surmised that the pain intensity experienced by all patients was about the same during the initial 48-hour period, because there was no statistically significant difference between all the groups. There was, however, a weak suggestion that postenucleation pain might be more intense than postevisceration pain in patients undergoing delayed implants and in nonendophthalmitis patients.

Pain scores during the second 48-hour period suggested that pain with delayed implant was relatively more intense and assumes a more sustained course as compared with pain in patients with and without endophthalmitis undergoing immediate implant. Similarly, postenucleation pain was relatively more intense and more sustained as compared with the pain of patients undergoing evisceration with immediate implant. The differences in these pain patterns seem logical, as patients with delayed implant underwent a second procedure while patients receiving immediate implants continued recovering from the operation.

The pain scores over the entire 96-hour period show that pain intensity decreases following immediate implant. This is not surprising, because postoperative pain tends to decrease with time.[103-105,108,118] The pain scores over the entire 96-hour period also show that pain appears more intense and sustained following delayed implant and enucleation. The possible explanation for the more sustained course with delayed implant has already been alluded to.

From the results of this study, it seems that the more extensive dissection of enucleation causes more edema and more intense and sustained postoperative pain. Enucleation is a more complex procedure than evisceration. Muscles are retracted and disinserted, Tenon's capsule is incised, and fat pads are violated. Nerves are cut and their ends exposed.

On the other hand, an intact sensory nerve supply to the scleral shell following evisceration is used to explain the more intense pain following evisceration.[9,14,28-30] However, compared with the pain signals received by numerous cut and exposed nerve endings following enucleation, the intact nerves to the scleral shell, being fewer in number, do not seem to be exposed to as much pain stimulation. As a group, patients undergoing enucleation had pain scores consistently higher than patients in the evisceration groups. In relative terms, these patients appear to have a fairly uniform response to postoperative pain. There was not a wide interpersonal variation, as seen in other groups of patients. The data must be interpreted with caution, however, because only eight patients were in the enucleation group.

Pain scores during the entire 96 hours also indicate that patients with endophthalmitis undergoing delayed implant experience more sustained pain than those undergoing immediate implant and those without endophthalmitis undergoing immediate implant. The delayed implant procedure consists of two procedures, each alone being less complex and less time-consuming than the total of the immediate implant technique. Technically, the sum of these two procedures is no greater or less than the immediate implant procedure. However, pain experienced by these patients appears to be entirely different, as demonstrated by the pain scores over the first and the subsequent 48 hours and over this entire 96-hour period.

Following evisceration in the delayed implant group, the wound was left open and subjected to multiple dressing changes. Although the medications received prior to each dressing change were not included in this analysis and a 6-hour grace period was incorporated into the study design, these additional procedures and medications could conceivably change the patient's pain experience. These patients might need more pain medication following the procedure because it causes more pain, or these patients might perceive an additional need. Their psychological state certainly would have been different while they anticipated dressing changes and a second procedure.[104,109,118-122]

In terms of total dose and frequency of pain medication used during the entire hospital stay, patients in the delayed implant group used 30% to 80% more pain medication than those in the immediate implant group. This difference, however, does not mean they have more pain, because it is almost impossible to make any comparison following two different procedures. The reason that group 2 patients used more pain medications can be explained by the effects of undergoing two procedures, pain medication prior to packing-dressing changes, and a longer hospital stay. The patient's dependency and attitude could also be a factor.[105,119,123-126] Despite the neutral stand of the health care providers, patients knew that medications were available to them upon request, and many of them likely took advantage of that while in the hospital.

Granulation tissues and wound contracture were noted during implant insertion in patients having delayed implants. Although relaxation incisions in this group were the same as those used in the immediate implant groups, a tighter feeling was encountered during implant insertion in the delayed group. This is indirectly verified by the smaller average implant size of patients who received delayed implants. This tightness might also contribute to postoperative discomfort. Tightness, a smaller implant size, and discomfort seem to be common findings in patients with phthisis bulbi.

Although only average pain scores were included in the analysis, it must be emphasized that large variations existed among the patients and among the groups. For example, at least one patient in each evisceration group never requested an injection for pain during either the first or second 48-hour period. It is not known whether these patients were truly comfortable, were very stoic, or wanted to avoid an injection. Conversely, some patients in each group had pain scores out of proportion with other patients in the same group. Other questions arose. For example, Why did a patient rely heavily on oral medication? Was it truly effective or was the patient trying to avoid a "painful" injection? When a patient requested injections more often than others, was it because of its effectiveness or the patient's dependency? The patient's personality, past pain experience, and relationship with the physician and staff probably all play a role in pain perception and requests for pain medication.

Caution must be exercised when interpreting pain score results in this study. Although the method used was refined compared to the method used by Parkhouse and colleagues,[108] it has shortcomings. The quality of pain was purposely not studied, as it would have greatly complicated the quantification of pain.[103,104] To avoid subjective influence, the patient's past experience of pain, coping mechanism, and emotional, behavioral, educational, and cultural background were not factored into the pain assessment.[103,104,127,128]

Measurement of pain was performed at 48 and 96 hours but not longer. Giving a weight of 1 for each dose of oral medications and 2 for each intramuscular injection is meant to reflect their relative potency, but this method is an imprecise way to take potency into account. The pain scores are not objective, and their validity has not been scientifically tested.

Another shortcoming is that the three patients (one patient each in groups 1, 2, and 3) who received local anesthetic and intravenous sedation were not treated differently from those who underwent general anesthesia. Finally, it is presumed that the timing and duration of the procedure do not influence postoperative pain.

Whether surgical intervention early versus late in the disease course might influence the pain experience is not known. Nor is it known whether the duration of the operation influences the degree of pain. The duration of the immediate implant procedure ranged from 40 to 60 minutes, with more time required in endophthalmitis patients than in nonendophthalmitis patients. The duration of evisceration with scleral packing was 15 to 25 minutes in the delayed implant arm. The insertion of the delayed implant typically took 20 to 30 minutes. Enucleation typically took 50 to 65 minutes. No marked differences occurred in the average duration of these various procedures, but the data were not subjected to statistical analysis.

The nature of postenucleation and postevisceration pain eludes description. No description of postenucleation or postevisceration pain was found in the literature. Perhaps shortly after the procedure, the pain resembles phantom limb pain because a part of the body has been removed. No study of phantom limb pain has included enucleation or evisceration pain.[129-134] Additional studies with more sophisticated methods of measuring and analyzing postoperative pain are required to answer the many questions about pain associated with evisceration and enucleation. These shortcomings notwithstanding, the delayed implant technique appears to result in more postoperative pain than the immediate implant technique in the present study. The findings also suggest that postenucleation pain is more intense and prolonged than postevisceration pain in this collection of patients.

Scientific data cannot, however, begin to touch our understanding of the human dimensions of evisceration with implant insertion, from both the patient's and the physician's perspective. Ophthalmologists are trained to save vision and enthusiastically exert great effort in improving or preserving vision. Such enthusiasm is usually replaced with hesitation and frustration when ophthalmologists are faced with the decision of removing an eye, even when it is blind. Certainly, the degree of satisfaction from performing enucleation or evisceration pales in comparison to the satisfaction derived from performing vision-saving, vision-improving procedures.

To many ophthalmologists, evisceration, like enucleation, is an old, mutilating procedure performed in patients who are predisposed to remain unhappy about the surgical results. Referral to a specialist is the easy way out. Indeed, the author was able to conduct the current study because many colleagues were relieved that they did not have to perform this "boring procedure" or deal with these unhappy patients. In many teaching institutions, evisceration and enucleation are often relegated to junior residents and postoperative care is deferred to ocularists.[12,18,49,77] Yet it is a misconception to believe that nothing more can be learned about evisceration or enucleation, that nothing can go wrong with removing a diseased eye, and that once it is removed, the surgeon's job is done.[12,18,49] Nothing can be further from truth. As Baylis and coworkers[18] stated, "this operation [enucleation], frequently disdained for its simplicity, is in fact very involved and fraught with difficulties."

From the patient's perspective, the possibility of blindness is frightening and removal of an eye, blind or not, a devastating experience. The need for understanding, support, and reassurance is the greatest during the time the patient struggles to cope with the psychological effects and progresses through the grief process. Surgical removal of a diseased eye is but the beginning of a long relationship between the ophthalmologist and patient.

The patient's eventual acceptance and successful rehabilitation depend not only on the technical success of the procedure but also on the fit of the prosthesis and the continued, caring, compassionate support from the ophthalmologist.[135-141] The attitudes of health care providers, family members, and coworkers often influence the speed of psychological recovery.[135,138,140,141] The patient's self-image and eventual rehabilitation are hampered, for example, when family members are unable or unwilling to change the eye patch or instill ointment in the socket, or when acquaintances and coworkers hesitate to make eye contact. The psychological effects of the operation can be so great that some patients have suicidal ideation or commit suicide.[135,138,140,141]

SUMMARY

The current prospective study demonstrates that the immediate implant technique in patients with endophthalmitis is not associated with unacceptably high implant extrusion rates. It is simple, effective, more cost-effective, and perhaps causes less pain than the delayed implant technique. Postevisceration pain appears to be less intense and less prolonged than postenucleation pain. The study also shows that orbital volume replacement can be achieved with implants of 18 to 22 mm, aided by posterior sclerotomies. The retrospective review shows that smaller implants and prolonged antibiotic administration do not necessarily help prevent implant extrusion and that meticulous surgical technique and proper postoperative wound care are essential.

Needless to say, enucleation and evisceration should be taken seriously and carry risks of complications. Yet few large studies have been performed to determine whether a particular evisceration surgical technique is preferred over others. Similarly, our understanding of postevisceration and postenucleation pain is extremely poor. Clinically, we may believe administration of pain medication serves to address the problem of pain, but in reality very little is known about the nature, intensity, and duration of postenucleation and postevisceration pain. Moreover, the psychology, behavior, and coping mechanisms of patients experiencing loss of an eye have not been studied, nor has the effectiveness of various medications, therapeutics, and rehabilitation programs.

We really know very little about the total care of these patients. As old and as basic as evisceration and enucleation with implant insertion may be, achieving the best outcome remains a challenge for all ophthalmologists. Further prospective, randomized studies

with a multidisciplinary approach are warranted to identify ways of improving outcomes, both physically and psychologically, in patients who must reckon with the loss of an eye.

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