Evaluation of Efficacy and Complications

Primary Pediatric Orbital Implants After Enucleation

Nancy J. Christmas, MD; Kurt Van Quill; Timothy G. Murray, MD; Craig D. Gordon; Scott Garonzik; David Tse, MD; Thomas Johnson, MD; Joyce Schiffman, MS; Joan M. O’Brien, MD

Background: Orbital implants are used routinely in pediatric patients at the time of enucleation. Complications, such as exposure, ptosis, and infection, may occur after implantation. Controversy continues regarding the rate of complications with newer implants in the pediatric population.

Objective: To examine the effects of orbital implants on children whose eyes have been enucleated.

Methods: Records of orbital implantation after enucleation performed by 5 surgeons on 120 pediatric patients (123 eyes) over a 10.5-year period were reviewed retrospectively. Demographic data, ocular diagnosis, prior ophthalmic surgery, implant characteristics, and postoperative complications were described using a standardized format for all patients, with a minimum of 6 months of follow-up (mean, 3 years).

Results: Complications were observed in 7 eyes (5.7%). Implant exposure (1 [0.8%]), implant extrusion (0 [0%]), and implant migration (3 [2.4%]) were rare. One hundred eighteen eyes (96%) had good cosmesis and 120 (98%) had good motility.

Conclusions: Orbital implantation after enucleation is successful in the pediatric population. Complications are minimal. Hydroxyapatite implants were not associated with unacceptable complications in this pediatric population.


The use of orbital implants after enucleation was first described by Frost in 1886. Since then, many shapes, sizes, and materials have been used in the development of the orbital implant. The ideal orbital implant offers excellent cosmesis and motility and few complications.

Porous spherical implants, such as those made from porous polyethylene and hydroxyapatite (HA), are most widely used today. Many studies have demonstrated good appearance and motility from surgical implantation. Associated complications have been reported in large series and in case reports, which are typically focused on the adult patient population.

Many children in the past did not undergo orbital implantation at the time of enucleation. As most children undergo enucleation for tumors, such as retinoblastoma, many surgeons have been concerned about placing an implant in an orbit that is at risk for tumor recurrence.

Enucleation in a child may result in retarded orbital growth. Orbital implants can provide good cosmesis, good motility, and adequate orbital volume as well as stimulate orbital growth in the pediatric patient. We report 123 cases of orbital implants in pediatric patients and their complications at the Bascom Palmer Eye Institute, Miami, Fla (54 eyes of 54 patients), and the Department of Ophthalmology, University of California, San Francisco (69 eyes of 66 patients), over a 10.5-year period.

RESULTS

The most common indication for enucleation was retinoblastoma (106 [86%] of 123). All children with complications had a final histopathologic diagnosis of retinoblastoma. The types of implants presented in Table 2 demonstrate that eyes with acrylic spheres had a higher complication rate than those with other types of implants (4 [44%] of 9 vs 3 [2.6%] of 114, respectively) (<.001 by χ² test). This result was also significant (<.001 by log-rank test) when survival analysis, which adjusts for length of follow-up, was used. Thirteen eyes received radiation preoperatively; 11 received external-beam radiotherapy and 2 received plaque radiotherapy. In this study, none of these eyes with a history of previous radiation therapy developed a complication.

One hundred twenty eyes (97.6%) demonstrated good prosthetic motility; 2 (1.6%), fair motility; and 1 (0.8%), poor motility. Cosmesis was noted to be good in 118 eyes (95.9%), fair in 4 (3.3%), and poor in 1 (0.8%).
PATIENTS AND METHODS

Institutional review board approval was obtained from the University of Miami and the University of California, San Francisco, prior to medical record review. A retrospective medical record review was performed for all patients undergoing primary enucleation with orbital implant placement at the Bascom Palmer Eye Institute from January 1, 1987, to June 30, 1997, and at the University of California, San Francisco, Department of Ophthalmology from December 31, 1987, to May 5, 1998. Data are reported on 120 patients 15 years or younger with at least 6 months of follow-up. Mean patient age was 2.6 years (median, 1.0 years; range, 2 months to 15 years) at the time of surgery. Mean follow-up was 154 weeks (median, 126 weeks; range, 27-520 weeks). Sixty-two patients (52%) were boys, and 58 (48%) were girls. This cohort included 45 whites (50%), 520 weeks). Sixty-two patients (52%) were boys, and 58 (48%) were girls. This cohort included 45 whites (50%), 18 African Americans (20%), 24 Hispanics (26%), and 4 Asians (4%); 29 patients were of unknown racial background.

INDICATIONS FOR SURGERY

Indications for primary surgery included diagnoses of retinoblastoma, ruptured globe, blind painful eye, persistent hyperplastic primary vitreous, and iris mass (Table 1). Thirty-one eyes (25%) had undergone earlier ocular treatment before enucleation: 2 eyes received plaque radiotherapy, 11 were treated with external-beam radiation, 2 had ruptured globe repair, and 16 received a spectrum of other ophthalmic surgical procedures. Final histopathologic diagnoses included retinoblastoma, history of ruptured globe, atrophy of a bulb, phthisis of a bulb, multilocular glioma, congenital glaucoma, buphthalmos, and persistent hyperplastic primary vitreous.

IMPLANT TYPES

Implant types in this series included HA (n = 103), acrylic sphere (n = 9), silicone (n = 5), Iova (n = 3), Allen (n = 1), Universal (n = 1), and porous polyethylene (n = 1) (Table 2). In 109 patients (89%), the implant was wrapped in donor scleral shell. The mean implant size was 18 mm (range, 14-20 mm). A prosthesis was fitted approximately 6 to 8 weeks after intraorbital implant placement in all 123 eyes (120 patients). Drilling for peg placement was performed on 2 HA implants.

SURGICAL TECHNIQUE

This technique has been reported previously. Briefly, enucleation was performed by incising the conjunctiva and Tenon capsule for 360° around the corneal limbus with Wescott scissors. Hemostasis was achieved with wet-field cautery. The 4 interrectus muscle quadrants were opened using Stevens scissors. Each of the 4 rectus muscles was dissected from the globe. The optic nerve was cut deep within the orbit with the snare or with long Metzenbaum scissors. The globe was removed from the socket and sent to the pathology department for evaluation in all cases. If the implant was covered in donor sclera, windows were made. The implant was placed into the orbit. The 4 rectus muscles were sutured securely into the scleral windows. The Tenon capsule was closed in a double-layered fashion using interrupted 5-0 Vicryl suture. The conjunctiva was closed with running 7-0 Vicryl suture. An antibiotic ophthalmic ointment was applied to the wound and a conformer was inserted. A pressure patch was applied.

The socket and prosthesis were evaluated at each postoperative visit. Prosthetic motility was subjectively determined by assessing the patient’s ocular motility in cardinal positions of gaze and graded as good, fair, or poor. The cosmetic appearance was subjectively determined by the physician, using evaluation of eyelid contour and symmetry with the fellow eye. Complications throughout the postoperative course were recorded. We used \( \chi^2 \) analysis to compare complication rates between different groups of patients. Survival analysis was also used to adjust for varying lengths of follow-up.

### Table 1. Indications for Enucleation

<table>
<thead>
<tr>
<th>Indication</th>
<th>Bascom Palmer Eye Institute, Miami, Fla</th>
<th>University of California, San Francisco</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%) Complications</td>
<td>No. (%) Complications</td>
</tr>
<tr>
<td>Retinoblastoma</td>
<td>38 (71) 1 68 (99) 6</td>
<td>106 (86.2) 7</td>
</tr>
<tr>
<td>Blind painful eye</td>
<td>10 (19) 0 0 (0) 0</td>
<td>10 (8.1) 0</td>
</tr>
<tr>
<td>Ruptured globe</td>
<td>4 (7) 0 0 (0) 0</td>
<td>4 (3.3) 0</td>
</tr>
<tr>
<td>Other</td>
<td>2 (4) 0 1 (1) 0</td>
<td>3 (2.4) 0</td>
</tr>
<tr>
<td>Total, No. (%)</td>
<td>54 (101)* 1 (2) 69 (100) 6 (9)</td>
<td>123 (100.0) 7 (5.7)</td>
</tr>
</tbody>
</table>

*Percentages do not add to 100% because of rounding.

Ten complications occurred in 7 eyes (5.7%) (Table 3). At 1 year, the mean (SE) complication rate was 3.3% (0.02); at 2 years, 5.5% (0.02) (Kaplan-Meier survival analysis). These complications were noted 21 days to 8 years after placement of the intraorbital implant. There were 3 boys and 4 girls, with a mean age of 1.3 years (range, 2 months to 4 years). No eye that developed complications had received external-beam radiation, plaque radiotherapy, or surgery prior to enucleation. None of the patients with a complication had undergone drilling or peg placement during this time.
Three cases of implant migration were noted, all more than 6 months postoperatively. In 2 of these cases, an acrylic implant had been used without integration of residual rectus muscles. In the third case, the HA implant had migrated superonasally, which caused moderate ptosis and limited motility. In 2 cases, the implant was removed and replaced by a dermis-fat graft with good results.

Five instances of significant ptosis were observed. In 2 cases, this was associated with implant migration as described above. Another patient had an associated superior sulcus deformity. He was treated with a Fasanella procedure followed by a full-thickness resection with a good outcome. Two of the other patients with 2 mm or less of ptosis underwent surgical repair.

Epithelial breakdown without extrusion was noted in 1 patient 3 months postoperatively. The area healed after treatment with antibiotic ointment.

Of importance, 1 patient with a history of bilateral retinoblastoma underwent enucleation with placement of universal implant in the left eye at age 4 months and subsequent enucleation of the right eye with placement of an HA implant at age 4.5 years. Seven months after surgery of the right eye, a right orbital mass (orbital primitive neuroectodermal tumor) was diagnosed.

**COMMENT**

There are several clinical situations that require enucleation in children, with retinoblastoma being the most common at our institutions. Orbital implants are routinely placed in children at the time of initial surgery. As in the adult patient, the ideal orbital implant should offer the child excellent motility and cosmesis in addition to adequate orbital volume. Of course, using an appropriately sized implant (one that allows adequate coverage by conjunctiva without undue tension and fills up the superior sulcus) is important for the success of the orbital implant. The microporous implants, such as the HA implant, have been used with increasing frequency.* Other types of implants made of acrylic and silicone were also used in this series at the time of primary enucleation.

Complications were infrequent, occurring in 7 eyes (5.7%) in this series. Complications seen in this series may be secondary to surgical technique in addition to the implant type itself. The final prosthetic motility was judged by the surgeon to be good in 120 (98%) of the 123 eyes, with cosmetic appearance being good in 118 (96%) of 123. The cases receiving poor or fair grades were also noted to have one of the aforementioned complications, except in 1 case that was graded with fair cosmesis. These observations were based on subjective, nonstandardized grading and therefore may be biased. There was a significant increase in number of complications associated with acrylic sphere implantation. Because of the small number of complications and variety of implant types, it is difficult to determine the best type of implant or to make significant correlations with pre-enucleation diagnosis.

Many studies have demonstrated the use of different implant types and associated complications, including exposure, migration, ptosis, infection, and pain. Several of these series did not focus on the pediatric population. Karcigolu and colleagues described the use of porous polyethylene orbital implants in 34 children with retinoblastoma. They did not wrap the implants but placed them behind the posterior Tenon layer and sutured the rectus muscles directly to the implant. Exposure of the implant occurred in 8 (24%) of 34 patients. Approximately half of these patients had received radiation preoperatively. After exposure, because of poor response to initial treatment, several of the implants required replacement with sclera-wrapped acrylic implants. In addition, these authors observed poor volume replacement in 3 sockets; in 5 cases, shallow fornices precluded proper fitting of a prosthesis. Karcigolu et al described a boy with extrusion of the porous polyethylene orbital implant from recurrent retinoblastoma.

Shields et al have described their enucleation technique for children with retinoblastoma, promoting the use of sclera-wrapped HA implants. They reiterated that the presence of an HA implant in the orbit does not affect the detection of recurrence by imaging studies.

De Potter and colleagues further demonstrated the use of sclera-wrapped HA orbital implants in children younger than 10 years. They reported 2 cases of conjunctival erosion treated with high vaulting of the prosthesis and scleral patch graft and 5 cases of conjunctival thinning among their 60 patients. One patient underwent drilling and peg placement with good results. Mazow and Trawnik emphasized the importance of proper fitting of the prosthesis in children for the development of the orbit.

The use of dermis-fat grafts in 8 pediatric orbits after enucleation has also been described by Heher and coworkers. They concluded that dermis-fat grafts placed in orbits of young children grow, helping to stimulate orbital growth. Children benefit from placement of orbital implants at the time of initial surgery. Our experience suggests that wrapped microporous implants with rectus muscle integration is a well-tolerated procedure with few complications and good cosmesis. An appropriately sized implant is recommended to prevent undue tension on the tis-

---

*References 2, 3, 5, 7, 8, 10, 12, 13, 15-17, 32, 33.
sues. Only 2 children (both older than 15 years) in this series underwent postimplantation integration with pegging, both at least 1 year after enucleation. Neither of these patients had associated complications.

Preoperative radiation therapy has been shown to predispose to socket contracture. Our study had too few eyes (n = 13) with preoperative radiation to evaluate this variable as a risk factor. None of these eyes developed a complication. Excellent cosmesis can still be achieved in these cases with careful prosthetic refitting by an experienced ocularist. Postoperatively, patients with a history of ocular tumors undergo imaging, preferably with magnetic resonance imaging. The imaging schedule is based on clinical factors, such as laterality, presence of germline mutation, and risk for extraocular extension. The risk of undetected recurrence in a patient with retinoblastoma after orbital implant placement is low with careful follow-up.

Orbital implant placement in the pediatric population has significant value. Complications can occur, but not frequently. Ongoing evaluation and investigation of the use of orbital implants in children is indicated.

Accepted for publication April 24, 1999.

Reprints: Timothy G. Murray, MD, Bascom Palmer Eye Institute, University of Miami School of Medicine, PO Box 016880, Miami, FL 33101 (e-mail: tmurray@bpei.miami.edu).

REFERENCES