Evaluation of Efficacy and Complications

Primary Pediatric Orbital Implants After Enucleation

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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 1886.1 Since then, many shapes, sizes, and materials have been used in the development of the orbital implant.2-17 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.2,8,10,12-17 Associated complications have been reported in large series and in case reports, which are typically focused on the adult patient population.5,13-27

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.28

Enucleation in a child may result in retarded orbital growth.29,30 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) (P<.001 by chi-square test). This result was also significant (P<.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 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%), 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 bulb, phthisis bulb, medulloepithelioma, 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), Ioway (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.31 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 isolated on a muscle hook and cleaned of surrounding Tenon attachments, secured on a double-armed 5-0 Vicryl suture with locking bites at each end, and then disinserted from the globe. The superior and inferior oblique muscles were 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 χ² 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>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%) Complications</td>
<td>No. (%) Complications</td>
<td></td>
</tr>
<tr>
<td>Retinoblastoma</td>
<td>38 (71)</td>
<td>68 (99)</td>
<td>106 (86.2)</td>
</tr>
<tr>
<td>Blind painful eye</td>
<td>10 (19)</td>
<td>0</td>
<td>10 (8.1)</td>
</tr>
<tr>
<td>Ruptured globe</td>
<td>4 (7)</td>
<td>0</td>
<td>4 (3.3)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (4)</td>
<td>1 (1)</td>
<td>3 (2.4)</td>
</tr>
<tr>
<td>Total, No. (%)</td>
<td>54 (101)*</td>
<td>69 (100)</td>
<td>123 (100.0)</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.

Table 2. Types of Implants

<table>
<thead>
<tr>
<th>Type</th>
<th>Eyes Reviewed, No. (%)</th>
<th>Eyes With Complications, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solid</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acrylic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sphere*</td>
<td>9 (7.3)</td>
<td>4 (44.4)</td>
</tr>
<tr>
<td>Allen</td>
<td>1 (0.8)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Iowa</td>
<td>3 (2.4)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Universal</td>
<td>1 (0.8)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Silicone</td>
<td>5 (4.1)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Microporous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydroxyapatite</td>
<td>103 (83.7)</td>
<td>3 (2.9)</td>
</tr>
<tr>
<td>Porous polyethylene</td>
<td>1 (0.8)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Total</td>
<td>123 (99.9)‡</td>
<td>7 (5.7)</td>
</tr>
</tbody>
</table>

*Acrylic spheres had a significantly higher rate of complications than other implants (P < .001 by χ² and log-rank test).†Percentages do not add to 100 because of rounding.

Many studies have demonstrated the use of different implant types and associated complications, including exposure, migration, ptosis, infection, and pain.3,5,15-27,34 Most of these series did not focus on the pediatric population. Karcıoğlu and colleagues35 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. Karcıoğlu et al35 described a boy with extrusion of the porous polyethylene orbital implant from recurrent retinoblastoma.

Shields et al28 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 colleagues32 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 vauluting 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 Trawnik36 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 colleagues.37 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.

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Table 3. Clinical Data of 7 Patients With Complications of Orbital Implants*  

<table>
<thead>
<tr>
<th>Case</th>
<th>Implant Type</th>
<th>Implant Size, mm</th>
<th>Wrapping</th>
<th>Complication</th>
<th>Time After Implantation, wk</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1†</td>
<td>HA</td>
<td>20</td>
<td>Sclera</td>
<td>Ptosis ≥2 mm</td>
<td>3</td>
<td>Surgical repair</td>
</tr>
<tr>
<td>2‡</td>
<td>HA</td>
<td>18</td>
<td>Sclera</td>
<td>Implant migration and ptosis</td>
<td>416</td>
<td>Observation</td>
</tr>
<tr>
<td>3‡</td>
<td>HA</td>
<td>18</td>
<td>Sclera</td>
<td>Epithelial breakdown</td>
<td>13</td>
<td>Erythromycin ointment</td>
</tr>
<tr>
<td>4‡</td>
<td>AS</td>
<td>18</td>
<td>Sclera</td>
<td>Implant migration</td>
<td>56</td>
<td>Implant removal and dermis-fat graft placement</td>
</tr>
<tr>
<td>5‡</td>
<td>AS</td>
<td>18</td>
<td>None</td>
<td>Implant migration and ptosis</td>
<td>30</td>
<td>Implant removal and dermis-fat graft placement</td>
</tr>
<tr>
<td>6‡</td>
<td>AS</td>
<td>20</td>
<td>None</td>
<td>Ptosis and superior sulcus syndrome</td>
<td>13</td>
<td>Fasanella procedure and full-thickness ressection</td>
</tr>
<tr>
<td>7‡</td>
<td>AS</td>
<td>18</td>
<td>Sclera</td>
<td>Ptosis of 2 mm</td>
<td>161</td>
<td>Upper eyelid ressection (&gt;2)</td>
</tr>
</tbody>
</table>

* HA indicates hydroxyapatite; AS, acrylic sphere.  
† Procedure was performed at the University of California, San Francisco.  
‡ Procedure was performed at the Bascom Palmer Eye Institute, Miami, Fla.

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REFERENCES