Primary Intraocular Lens Implantation in Pediatric Uveitis

A Comparison of 2 Populations

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Objective: To evaluate the visual outcome and postoperative complications of cataract surgery with posterior chamber intraocular lens implantation in children with uveitis.

Design: A multicenter, retrospective, interventional case series. The setting included 3 medical centers in Israel. The interventions were cataract surgery and intraocular lens implantation. Aggressive preoperative and postoperative systemic and topical anti-inflammatory treatment was instituted. The main outcome measures included postoperative inflammation, complications, and visual outcome.

Results: Children with juvenile rheumatoid arthritis (JRA)–associated uveitis were seen and underwent cataract surgery at an earlier age, and had a lower preoperative visual acuity and more severe uveitic complications when first seen, than those with non–JRA-associated uveitis. Visual acuity improved by 2 or more lines in all patients, and in 13 eyes the final visual acuity was 20/40 or better. Postoperative complications included elevated intraocular pressure, posterior and anterior capsular opacities, and macular dysfunction.

Conclusions: Compared with those with non–JRA-associated uveitis, children with JRA-associated uveitis tend to have more severe manifestations of disease when first seen and after surgery, but there is no significant difference in postoperative course or complications. Intraocular lens implantation, including small-incision, foldable, intraocular lenses, is well tolerated, when combined with aggressive medical treatment, for controlling inflammation. We believe that intraocular lens implantation is not contraindicated in those with pediatric uveitis, including uveitis associated with JRA.

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in recent years. This change in attitude, and the increasing rates of successful surgery, can be attributed to improved medical control of inflammation, new surgical techniques, and better-designed and more biocompatible IOL materials.

In this study, we examined the outcome of IOL implantation in children with uveitis at 3 medical centers in Israel.

## METHODS

### PATIENTS

A search of the medical records for all pediatric patients with uveitis who had undergone cataract surgery with lens implantation between March 1, 1987, and August 31, 2004, was undertaken at 3 referral centers in Israel: Meir Medical Center, Goldschleger Eye Institute, and Rabin Medical Center. Institutional review board and ethics committee approval were not required for this study. All of the children underwent a diagnostic workup for uveitis, including a detailed questionnaire and laboratory tests.

Data from the patients' charts were collected. Variables recorded for the study were age when first seen and at surgery, VA, results of ophthalmic examinations, associated ocular complications, and any systemic disease. Retinal detachment was excluded in all patients by examination of the dilated fundus or B-scan ultrasonography. The intraocular pressure (IOP) was measured by applanation tonometry. Complications related to uveitis were noted. Surgical details were recorded, including the period of remission of inflammation before surgery, additional procedures performed during surgery, and postoperative complications.

### PERIOPERATIVE TREATMENT

All patients were treated preoperatively to achieve full control of inflammation, lasting for at least 3 consecutive months before surgery. Ten days before surgery, they were asked to instill 0.1% dexamethasone phosphate 4 times daily and continue doing so until surgery. Similarly, they received systemic corticosteroids, 1 mg/kg per day, for 3 days before surgery and following surgery, according to the inflammation and the surgeon's judgment. Typically, we aim at a rapid tapering schedule.

### SURGICAL PROCEDURE

The surgical technique showed some variation, according to the preference of the surgeon and the policy at each medical center. Most of the operations were done as follows.

Surgery was performed with the patient under general anesthesia, except for 3 patients (4 eyes) 18 years or older, in whom the operation was performed using peribulbar local anesthesia. We regarded those 3 patients as “pediatric uveitis cases” because the ocular inflammation was a childhood disease. Even though the cataracts developed during childhood, the referring ophthalmologists opted to delay surgery until the patients were 18 years or older. Band keratopathy was removed by application of a 10% solution of EDTA to loosen corneal deposits. The deposits were then removed by mechanical scraping.

The anterior chamber was irrigated with balanced salt solution (Alcon Laboratories, Fort Worth, Tex). A round anterior capsulotomy, 5.0 to 5.5 mm in diameter, was performed using a cystitome or capsular forceps under a viscoelastic substance, and the lens contents were then aspirated from the capsular bag. When a posterior capsulotomy was required, it was combined with core anterior vitrectomy.

A polymethylmethacrylate lens was implanted through a limbal incision, or a foldable hydrophilic or hydrophobic acrylic IOL was inserted through a corneal incision made with a 3.2-mm symmetry knife (Surgistar, Knoxville, Tenn.).

Betamethasone acetate and betamethasone sodium phosphate (Celestone Chronodose; Schering-Plough, Kenilworth, NJ) and gentamicin (Gentamicin-IKA; Teva Pharmaceutical Industries, Netanya, Israel) were injected subconjunctivally at the end of the surgical procedure.

### POSTOPERATIVE TREATMENT

Postoperative topical treatment included corticosteroid eye-drops (Teva or Pred Forte; Allergan, Irvine, Calif) 8 times daily, antibiotic eyedrops (chloramphenicol; Taro Pharmaceutical Industries Ltd, Haifa, Israel) 5 times daily, and 1% atropine sulfate twice daily for 1 week. Thereafter, the number of daily instillations was gradually decreased according to the intensity of the intraocular reaction. Depending on the preoperative regimen and the response to postoperative topical treatment, systemic treatment with corticosteroids was prescribed for some patients after surgery.

A comparison between categorical variables of the JRA and non-JRA groups was analyzed using χ² tests, and t tests were used for age variables.

### RESULTS

A total of 19 eyes of 18 patients (9 girls and 9 boys) met the inclusion criteria and were included in this study. After they were initially seen, all patients were followed up until their VA was reduced to 20/70 or less, after which they underwent lens aspiration and IOL implantation. In all but 1 patient, the operation was unilateral. Age when first seen ranged from 11 months to 17 years (mean±SD age, 9.0±2.6 years), and age at surgery ranged from 4 to 24 years (mean±SD age, 14.3±3.9 years). In 13 patients, VA at surgery was 20/200 or worse. Preoperative procedures are described in Table 1 and Table 2.

Follow-up ranged from 4 months to 14 years (mean±SD, 3.9±3.9 years). During the follow-up, 17 of the 19 eyes were treated with systemic corticosteroids; 9 were treated with methotrexate, cyclosporine, or both.

The best-corrected VA (BCVA) before surgery varied from 20/70 to light perception. The postoperative BCVA ranged from 20/20 to 20/200. All eyes demonstrated an improvement in VA of at least 2 lines. The final BCVA was 20/40 or better in 13 eyes and worse than 20/40 in 6 eyes, 4 of them from the JRA group. Preoperative and postoperative BCVA, reasons for any reductions in BCVA results, and complications and additional procedures are described in Table 1 and Table 2.

There were 8 girls and 2 boys in the JRA group and 1 girl and 7 boys in the non-JRA group. Age when first seen was 0.9 to 14.0 years in the JRA group and 4.6 to 17.0 years in the non-JRA group. Cause in the JRA group was anterior uveitis (7 patients) and intermediate uveitis, posterior uveitis, and panuveitis (1 patient each). In the non-JRA group, there were 6 patients with pars planitis and 1 patient with anterior uveitis, 1 with posterior uveitis, and 1 with chronic posterior postirradiation uveitis.
During cataract surgery, 9 eyes in the JRA group required synechiolysis, 4 needed anterior vitrectomy, and 2 underwent removal of band keratopathy, compared with synechiolysis in 1 eye, anterior vitrectomy in 2 eyes, and band keratopathy removal in 1 eye in the non-JRA group. Posterior capsulectomy and anterior vitrectomy were done to remove vitreous opacities and eliminate posterior capsular opacification that often occur in this age group. The comparisons between patients in the JRA and non-JRA groups are given in Table 3.

The mean follow-up was 3.4 and 4.6 years for the patients in the JRA and non-JRA groups, respectively. During follow-up, at least 1 subtenon corticosteroid injection was needed by all of the patients in the non-JRA group; this injection was needed by only 2 of the patients in the JRA group.

Intraocular inflammation persisted in 7 eyes after surgery, 3 of them from the JRA group. In all other eyes, the ocular reaction was mild or completely resolved during follow-up.

The most common complication was posterior capsular opacification (11 eyes). Cystoid macular edema, epiretinal membrane, or changes in retinal pigmentation were seen in 9 eyes, and postoperative elevation in
IOP and anterior capsular opacification were each seen in 6 eyes. Three patients needed repositioning of the IOL. In 2 of 4 patients with preoperative glaucoma, the IOP was normal after the operation, whereas 4 patients developed a high IOP after the operation. All of them were treated topically with pressure-lowering eyedrops; 2 required laser iridotomy, and 1 of them was treated with Nd:YAG laser iridoplasty as well. Two of them (patients 15 and 18) with a temporary elevation and 1 (patient 10) with a permanent elevation developed chronic secondary glaucoma, and eventually underwent filtering surgery followed by diode laser cyclophotocoagulation.

**COMMENT**

Cataract is the most common complication in children with uveitis, especially in those in whom the ocular disease is associated with JRA.1-3 Undesirable sequelae of IOL implantation that might occur in these patients are excessive intraocular inflammation, thick retrolental membranes, lens capture, fibrosis, and cystoid macular edema, all of which are more common in children with JRA-associated uveitis than in those with non–JRA-associated uveitis.5,14

The implantation of an IOL during cataract surgery in these children with uveitis has some potential advantages. Studies have shown that children left with unilateral aphakia, the alternative choice to IOL implantation, do not tolerate contact lenses for an extended period, for reasons that include corneal involvement and band keratopathy. The result is deep amblyopia in younger children with JRA and the development of strabismus in all children with unilateral aphakia.14 Secondary IOL implantation later in life to correct the high anisometropia carries the risk of much more complicated surgery with numerous potential complications. Intraocular lens implantation at lens removal, on the other hand, allows for immediate correction of the aphakic refractive error and better ocular alignment.14

In an earlier report,15 the documented prevalence of ocular complications related to uveitis ranged from 21% to 50% in those with JRA. Recent studies16,17 record a much lower prevalence of uveitis-related complications, between 9% and 13%, probably because of improved medical therapy, which largely prevents the development of ocular inflammation with its sequelae, such as cataract formation.17 The increasing success rates of cataract operation might likewise be attributed to better and more aggressive prophylactic and postoperative medical management, new surgical techniques, and improvements in the design of IOLs and in the biocompatibility of their component materials.12

**Table 3. Comparison Between Patients With JRA-Associated Uveitis and Those With Non–JRA-Associated Uveitis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Those With JRA-Associated Uveitis</th>
<th>Those With Non–JRA-Associated Uveitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of eyes</td>
<td>10</td>
<td>9 (8 Patients)</td>
</tr>
<tr>
<td>Girl-boy ratio†</td>
<td>8:2</td>
<td>1:7</td>
</tr>
<tr>
<td>Present age, y‡</td>
<td>6.1 ± 3.7 (0.9-14.0)</td>
<td>12.2 ± 4.3 (4.6-17.0)</td>
</tr>
<tr>
<td>Those with a preoperative VA ≥20/200</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Age at operation, y‡</td>
<td>11.8 ± 4.6 (4.0-17.0)</td>
<td>17.1 ± 4.5 (11.5-24.0)</td>
</tr>
<tr>
<td>Anterior uveitis†</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Intermediate uveitis†</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Posterior uveitis</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Panuveitis</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ANA positive†</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Posterior synechiea†</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Band keratopathy†</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Elevated IOP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperatively†</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Postoperatively</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCO-YAG laser capsulotomy ratio</td>
<td>5:3§</td>
<td>6:3</td>
</tr>
<tr>
<td>Persistent inflammation</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Subtenon betamethasone acetate and betamethasone sodium phosphate injection during follow-up†</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Additional surgery</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Abbreviations: ANA, antinuclear antigen; IOP, intraocular pressure; JRA, juvenile rheumatoid arthritis; PCO, posterior capsular opacification; VA, visual acuity.

*Data are given as number of eyes affected unless otherwise indicated.

†P < .01.

‡Data are given as mean ± SD (range).

§Of the 10 patients with JRA-associated uveitis, 5 patients had PCO and 3 of them had Nd:YAG laser capsulotomy as a treatment. The rest of the 5 patients did not develop PCO.


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In recent years, new therapeutic modalities have been developed for use after pediatric cataract surgery. Intracameral injection of recombinant tissue plasminogen activator has been suggested for fibrinolysis after cataract surgery in children. A biodegradable drug delivery system that allows sustained and controlled release of dexamethasone into the anterior chamber (Surodex; Oculex Pharmaceuticals, Sunnyvale, Calif) is a safe and effective adjunctive anti-inflammatory agent.

Because the postoperative inflammatory reaction can now be more effectively controlled, it seems reasonable to revisit the controversy over IOL implantation in those with pediatric uveitis, including uveitis associated with JRA. Some reports published in the 1990s warned against IOL implantation in children with JRA-associated uveitis and cataract. Foster and associates reported good postoperative results in children with uveitis who were left aphakic after lens aspiration and pars plana vitrectomy. Paikos et al concluded that IOL implantation in patients with JRA, nevertheless recommended its use only for selected adults and did not support its use in children.

More recently, BenEzra and Cohen reported that, in young children with uveitis, IOL implantation seems preferable to correction with contact lenses in those needing unilateral cataract surgery.

Lundvall and Zetterstrom suggested that implantation of a heparin surface-modified polymethylmethacrylate IOL is also an alternative to correct aphakia in children with uveitis, including JRA-associated uveitis. Subsequently, Lam et al reported favorable surgical outcomes in a small series of children with JRA-associated uveitis after cataract surgery with posterior chamber IOLs, even when combined with trabeculectomy. A summary of the most recent clinical series of cataract surgery in children with uveitis is given in Table 4.

Our results support previous findings indicating that children with JRA-associated uveitis represent a distinct group from those with uveitis not associated with JRA. Compared with the latter group, children with JRA-associated uveitis were seen and were operated on at an earlier age, their VA when first seen was worse, and they had developed substantially more complications, including glaucoma, band keratopathy, and posterior synechiae. After cataract surgery with IOL implantation, however, this group (like the non–JRA-associated group) also showed a marked improvement in VA, and the BCVA of the patients in the JRA group from those with uveitis not associated with JRA. During follow-up, at least 1 subtenon corticosteroid injection was needed by all of the patients in the JRA group. Repositioning of the IOL was needed for sec-

Table 4. Cataract Surgery for Pediatric Uveitis: Results of Studies During the Past 10 Years

<table>
<thead>
<tr>
<th>Source</th>
<th>No. of Cases</th>
<th>Type of IOL</th>
<th>Visual Outcome</th>
<th>Complications</th>
<th>Follow-up, mo</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probst and Holland,19 1996</td>
<td>7 Patients (8 eyes), all with JRA</td>
<td>All 1-piece PMMA</td>
<td>All eyes &gt;20/40</td>
<td>High IOP (n = 4) and PCO (n = 5)</td>
<td>16.6</td>
<td>None</td>
</tr>
<tr>
<td>Lundvall and Zetterstrom,10 2000</td>
<td>7 Patients (10 eyes), all with JRA</td>
<td>All HSM PMMA</td>
<td>8 eyes 20/20-20/50 and 2 eyes &lt;20/50</td>
<td>High IOP (n = 7), PCO (n = 5), and subsequent operation (n = 8)</td>
<td>28.0</td>
<td>None</td>
</tr>
<tr>
<td>BenEzra and Cohen,14 2000</td>
<td>17 Patients (20 eyes), 8 with JRA</td>
<td>All PMMA (3 multifocal diffractive)</td>
<td>JRA, 2 eyes &gt;20/30 and 7 eyes &lt;6/240; non-JRA, 6 eyes &gt;20/40</td>
<td>IOP (n = 4), PS (n = 3), ME (n = 3), distorted pupil (n = 3), corneal decompensation (n = 1), and retinal folds (n = 1)</td>
<td>60.0</td>
<td>Limbal approach plus IOL (n = 10) and pars plana approach plus contact lens (n = 10)</td>
</tr>
<tr>
<td>Paikos et al,12 2001</td>
<td>9 Patients (9 eyes), 7 with JRA</td>
<td>No IOL</td>
<td>All eyes 20/25-20/70</td>
<td>CME plus high IOP (n = 1)</td>
<td>33.0</td>
<td>Limbal approach/no IOL</td>
</tr>
<tr>
<td>Lam et al,23 2003</td>
<td>5 Patients (6 eyes), all with JRA</td>
<td>4 PMMA, 1 HSM PMMA, and 1 acrylic hydrophobic</td>
<td>All eyes &gt;20/40</td>
<td>PCO (n = 6), high IOP (n = 2), and CME (n = 1)</td>
<td>43.5</td>
<td>3 of them combined cataract operation plus trabeculectomy</td>
</tr>
<tr>
<td>Nernet et al (present study)</td>
<td>19 Patients (19 eyes), 10 with JRA</td>
<td>11 Acrylic hydrophobic, 1 acrylic hydrophilic, and 7 PMMA</td>
<td>13 eyes &gt;6/12 and 6 eyes &lt;6/12</td>
<td>PCO (n = 10), high IOP (n = 4), CME (n = 1), and additional operations (n = 11)</td>
<td>45.0</td>
<td>Corneal incision (n = 13) and scleral tunnel (n = 6)</td>
</tr>
</tbody>
</table>

Abbreviations: CME, cystoid macular edema; HSM, heparin surface modified; IOL, intraocular lens; IOP, intraocular pressure; JRA, juvenile rheumatoid arthritis; ME, macular edema; PCO, posterior capsule opacification; PMMA, polymethylmethacrylate; PS, posterior synechiae.
ondary lens subluxation in 3 patients, all in eyes in which the IOL was positioned within the ciliary sulcus. Only 1 eye with documented sulcus fixation did not develop subluxation. We believe that every effort should be made to secure the IOL within the intact capsular bag. In-the-bag implantation seems to be essential in patients with uveitis, not only to prevent uveal irritation and iris chafing, which might result in prolonged disruption in the blood-aqueous barrier and a more severe inflammatory response, but also to ensure a central and stable position.

The mechanism of elevated IOP seems to have different origins in patients with and without JRA. In children with JRA, the anterior chamber inflammation tends to be more severe, resulting in pupillary membrane, anterior synechiae and goniosynechiae, and pupillary block. The secondary development of closed-angle glaucoma might, therefore, occur. In the non-JRA group, lower anterior chamber inflammation is associated with lower preoperative elevation of IOP. Of the 4 patients with preoperative glaucoma, glaucoma was resolved in 2 by anti-inflammatory treatment and surgical goniosynechiolysis; the latter is more effective when the synechiae are recent and the process is still reversible. Immunosuppressive therapy should be initiated soon after synechiae are identified because even relatively short periods of untreated inflammation can cause irreversible anterior segment changes and increase the chances of cataract and glaucoma development despite apparently adequate control of subsequent anterior uveitis.

Four new cases of elevated postoperative IOP were seen in the non-JRA group. In 2 patients (“corticosteroid responders”), this was temporary and was attributed to the use of corticosteroids. The other 2 cases might have been related to the prolonged inflammatory reaction seen in the anterior chamber postoperatively. Prophylactic iridotomy at surgery was not done in any of our patients and should probably be considered in some patients, such as those with active persistent anterior uveitis, previous IOP elevation, or sulcus or uncertain IOL position. However, severing the uveal tissue may aggravate the postoperative inflammatory reaction.

It is still an open question whether the posterior capsule in uveitic cataract surgery should be primarily opened or left untouched. Opening it would debulk and remove inflammatory elements from the anterior vitreous and prevent the inevitable opacification of the posterior capsule. On the other hand, leaving the posterior capsule untouched might at least reduce the anterior spread of inflammation.

In our study, the most common postoperative complication was anterior and posterior capsular opacification, which occurred in 11 (85%) of the 13 patients in whom the posterior capsule was left intact after surgery. Six of these children required Nd:YAG laser capsulotomy, and 3 others later needed surgical posterior capsulotomy. Of the 6 patients who underwent anterior vitrectomy and posterior capsule removal at cataract extraction, none required further capsulotomy; in 2 children, however, pupillary membranes developed.

Of the 6 eyes that underwent anterior vitrectomy during cataract surgery, 3 continued to have significant inflammation, compared with 4 of the 13 eyes that did not undergo anterior vitrectomy. This probably reflects a more active disease in the affected patients who required primary capsulectomy and vitrectomy, rather than an adverse effect of the procedure.

Although uveitis is usually a bilateral disease (as in all of our patients, except for 1 with unilateral uveitis secondary to optic nerve irradiation), the severity of inflammation and cataract is often asymmetrical. Only 1 of our patients required bilateral cataract surgery during follow-up.

The present study has certain limitations. Data collection was from 3 different medical centers, and this inevitably led to some differences and inconsistencies in perioperative treatments and surgical procedures. The number of eyes, although limited, was nevertheless enough for assessment of early and late results and complications. Another shortcoming is the age of the 3 patients in the non-JRA group in whom the IOL implantation was performed after the age of 18 years. The amount of inflammation and tissue reactivity is dependent not only on the uveitis status but also on the age of the eye at operation. These 3 patients were followed up at our clinic during their late childhood, and the operation was postponed until a remission of the inflammation was achieved by conservative treatment and subtenon betamethasone acetate and betamethasone sodium phosphate injection given before the cataract operation.

In conclusion, it seems that IOL implantation in children with uveitis, using foldable hydrophobic or hydrophilic acrylic IOLs or polymethylmethacrylate IOLs, is a relatively safe technique that has many advantages, acceptably few complications, and relatively good visual outcome. Despite differences in age, VA level, and ocular complications when first seen for non–JRA-associated uveitis, both groups demonstrated marked improvement in visual function, with no difference in the postoperative sequelae. The use of acrylic lenses, especially hydrophobic ones, allows surgery to be performed through a small corneal incision, and the lenses seem to be well tolerated. Additional procedures are frequently required during follow-up. Because capsular opacity, anterior and posterior, was the most common postoperative complication, anterior vitrectomy and posterior capsulectomy at cataract surgery would seem to be justified. These procedures, however, might be associated with the subsequent spread of inflammation and secondary glaucoma. All patients should be treated topically preoperatively, by corticosteroid pericircular injections, and sometimes systemically to achieve full control of inflammation for at least 3 consecutive months before surgery. The results of the present study suggest that IOL implantation should no longer be considered a contraindication in pediatric uveitis. Further prospective studies are required to substantiate this tentative conclusion.

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