Intraoperative Miotics and Posterior Capsular Opacification
Following Phacoemulsification with IOL Insertion

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ABSTRACT

**Background and Objective:** Posterior capsular opacification (PCO) is a frequent complication following phacoemulsification with intraocular lens (IOL) implantation. A series of consecutive patients receiving capsular bag-fixated silicone IOL implants were assessed for both incidence of PCO and administration of intraoperative miotic.

**Patients and Methods:** Over a five-year period, 477 consecutive eyes were retrospectively evaluated. Surgeries were grouped according to intraoperative miotic agent: Miostat (0.01% carbachol) or Miochol (1.0% acetylcholine). Patients receiving no miotic drug served as a control group. YAG laser capsulotomy was performed on patients with clinically significant PCO.

**Results:** The percentage of eyes requiring YAG laser posterior capsulotomy was similar for the three groups: Miostat 21.6% (25/91), Miochol 18.4% (14/62), and control 18.6% (53/232). A chi square analysis indicated that the difference among groups was not statistically significant. Groups also had similar average follow-up times between surgery and YAG capsulotomy: Miostat (52.2 weeks), Miochol (47.5 weeks) and control (48.3 weeks).

**Conclusion:** Intraocular miotics do not increase the incidence of PCO.

**KEY WORDS:** Intraocular lens, Nd:YAG laser capsulotomy, Miochol, Miostat, phacoemulsification, posterior capsular opacification.
INTRODUCTION

Reported opacification rates range from 15% to 40% during the first five years following extracapsular cataract extraction (ECCE)\(^1-5\) making it the most common complication following cataract extraction with IOL implantation. Several studies evaluate the etiology, pathophysiology, and various factors that seem to both positively and negatively influence the progression of PCO.\(^6-10\)

Although Nd:YAG laser capsulotomy is the treatment of choice for PCO, it is associated with occasional significant complications. Careful elucidation of all possible variables influencing PCO formation is needed to minimize PCO and subsequent YAG laser capsulotomy. This includes the evaluation of techniques, implants, and drugs used during cataract surgery and their association with PCO.

One of the surgeons (RJO) heard unpublished data at a regional meeting implicating Miochol as a cause of capsular opacification. This retrospective review was instituted because of this claim and the concern the claim generated. Both Miostat and Miochol are often used by some surgeons intracamerally in cataract surgery.

MATERIALS AND METHODS

We examined the incidence of YAG laser capsulotomies for PCO in eyes treated with continuous curvilinear capsulorhexis (CCC) with subsequent phacoemulsification and IOL insertion. Our retrospective analysis included patients receiving silicone lenses during a five-year period from two surgeons who use similar techniques. The effect of different approaches to pharmacologic intraoperative miosis and resultant YAG laser capsulotomy rate was then evaluated for any statistically significant associations.
For each surgery, the patient's chart was reviewed for the following: age at surgery, gender, surgical complications, intraoperative miotic drug, IOL type, surgeon, best-corrected visual acuity pre/post-surgery, YAG laser capsulotomy, date of YAG capsulotomy, best-corrected visual acuity pre/post-YAG, date of most recent follow-up, complications associated with YAG therapy, pre/post YAG retinal pathology, other ophthalmic disease, and systemic medical problems associated with ocular pathology.

The number of eyes receiving each drug was tabulated for the five years, then grouped according to whether or not YAG capsulotomy was performed. Also, the interval from surgery to most recent follow-up and/or YAG capsulotomy was determined. The incidence of posterior capsular opacification requiring YAG treatment in the three different groups was then compared statistically.

All surgeries were performed by either RJO or ASC using a similar technique. Following local retrobulbar anesthesia, the conjunctiva was dissected back from the limbus with tenonectomy. Subsequently, a partial-thickness scleral groove was formed and shelved anteriorly. Next, the anterior chamber was inflated with viscoelastic material and CCC was performed. Hydrodissection and phacoemulsification of the nucleus was then completed using the "divide-and-conquer" technique, and the cortex was removed with automated irrigation/aspiration. Viscoelastic material was then inserted into the capsular bag followed by "in-the-bag" placement of the posterior chamber IOL. After removal of the viscoelastic material, a miotic drug was often instilled intracamerally and the wound was sutured if necessary. Afterwards, the patient received subconjunctival injections of methylprednisolone sodium succinate (Solu-Medrol) and gentamicin sulfate (Garamycin), and postoperative gentamicin sulfate (Garamycin) and prednisolone acetate (Pred Forte) drops.
YAG laser capsulotomy was performed when a subjective decline from best post-surgical visual acuity correlated with decreased Snellen visual acuity and significant PCO detected on dilated slit lamp exam.

Only routine cataract extractions by means of a CCC technique with phacoemulsification were included in this study. Furthermore, patients with any of the following were excluded: (1) previous ocular surgery; (2) multiple procedures at the time of cataract surgery; (3) IOL placement outside the capsular bag; (4) surgical or YAG related complications; (5) implants other than silicone IOLs; (6) significant retinal pathology; and (7) history of ocular trauma. An additional thirteen patients were excluded because they were followed-up for one week or less.

In analyzing the effect of miotics on PCO, an attempt was made to isolate a study population that minimized other risk factors for opacification. As described above, patients with additional ocular surgeries or pathology were excluded. Furthermore, only patients undergoing phacoemulsification with IOL placement directly in the capsular bag were included. Studies suggest that "in-the-bag" fixation of a biconvex lens seems particularly effective in deterring PCO. A previous study at our institution compared PMMA IOLs of such a description, reporting a statistically significant decrease in PCO in eyes receiving small (<13.5 mm) as opposed to large (>13.5 mm) overall length IOLs. A companion study comparing silicone IOLs showed that PCO rates, regardless of IOL size, approximated the lowest rate achieved by a PMMA lens. All patients in this study received biconvex silicone lenses. This would presumably diminish variance in PCO rate between groups related to IOL implant composition.
RESULTS

A total of 477 eyes that met our entrance requirements received silicone implants during 1988-92. Overall, the average follow-up time was 50 weeks. During this five-year period, 19.3% (92) of the total eyes evaluated received YAG capsulotomy, averaging 59 weeks until YAG.

The data was further analyzed according to drug group (Table I). A total of 116 eyes received Miostat, while 76 eyes had Miochol instilled. There were 285 patients in which the surgeon decided not to use a miotic. The use of miotic was routine early in the study for many of our surgeons with a transition occurring from routine use at about the time these patients had their cataract surgery. It eventually became extremely uncommon to use miotics except where there was concern about elevated intraocular pressure or the rare occurrence of iris prolapse. There is potentially a small bias against the miotics with slightly longer average follow-up time for both miotic groups. Of those receiving Miostat, 21.6% (25/116) eventually needed YAG capsulotomy. A smaller proportion of eyes treated with Miochol had significant PCO requiring YAG treatment, 18.4% (14/76). Similarly, 18.6% (53/232) of eyes in which no intraoperative miotic was used ultimately needed YAG capsulotomy.

Calculating the number of weeks from IOL implantation until YAG capsulotomy showed that Miostat, Miochol, and the control group had similar interval times of 52, 48, and 48 weeks, respectively. A one-way analysis of variance indicated that the difference in follow-up time between the different groups was not significant. As shown in Table 1 the overall follow-up times were slightly longer for both miotic groups as explained above. If anything, longer follow-up should mean more PCO, so this bias further supports the concept that neither miotic induces PCO.
The rate of YAG capsulotomy in the groups was then statistically compared. A chi square analysis failed to measure a statistically significant difference in the frequency of YAG capsulotomy for the three groups (p>0.05). This indicated that there was insufficient evidence to demonstrate a notable decrease in the incidence of YAG laser capsulotomy for PCO between either drug groups and the control or the incidence is the same. The lack of a relationship between YAG capsulotomy and the use or non-use of intraoperative miotics assumes that the incidence of PCO remains constant over time.

DISCUSSION

Posterior capsular opacification (PCO) is the most repeatedly reported vision-disturbing complication following extracapsular cataract extraction. YAG laser capsulotomy is generally the treatment of choice for PCO. However, it is not without occasional, often serious drawbacks. Steinert indicates that the incidence of increased intraocular pressure, retinal tears/detachment (RD), and cystoid macular edema (CME) ranges from 0.56% to 1.23%. Some conclude that the risk of CME may be diminished if the onset of PCO and subsequent YAG treatment can be delayed, specifically, that CME and RD may be decreased in capsulotomies performed at least 12 months after surgery. Other reported YAG implicated problems include corneal endothelial damage, pitting of the intraocular lens, and uveitis. Therefore, means should be sought to decrease or delay PCO and subsequent necessity for YAG capsulotomy.

In order to manipulate the natural course of PCO formation, its etiology must be thoroughly understood. Several processes, alone or in combination, have been implicated in its pathogenesis. Presumably, PCO originates from epithelial cells which have migrated from the perimeter of the lens capsule across the posterior capsular surface. Proliferation of these reactive cells forms a diffuse coating on the posterior capsule. Secondary collagen deposition, lens fiber regeneration, and basement membrane duplication may follow producing progressive
opacification. Additionally, cells may undergo myofibroblastic transformation with subsequent contraction and microfolding. Also, accumulation of cell precipitates/inflammatory cells may deposit on the IOL and surrounding tissues causing opacification. 1,8-10

Multiple methods have been proposed for reducing the incidence of posterior capsular opacification. 10 Meticulous surgical technique combined with a precisely fitted IOL producing a taut posterior capsule with maximal contact most reliably reduces PCO. 1,8,11,12 Several other modalities are currently being evaluated: cryotherapy, 18 ultrasound, 19 lens epithelial cell proliferation and migration inhibitors, 20 monoclonal antibodies, 10 chemical treatment, wet-field coagulation, and vacuum cleaning of the posterior capsule. 11 Other areas of investigation include regulation of cell proliferation by drugs and hormones.

This study investigated the possibility that miotics routinely administered during cataract surgery may in some manner affect the development of PCO. The effect of these drugs on PCO has not been previously published in a clinical study. Depending on when the process of PCO begins, the effect of miotics, especially long-acting carbachol, could potentially influence PCO. The agents considered could inhibit, promote, or have an undetectable effect on PCO. We found no correlation with the use of miotics and capsular opacification in our study. This should be good news for any ophthalmologists who may have heard of a concern about miotics and PCO.
REFERENCES


TABLE I

Rate of Capsulotomy According to Drug Group

<table>
<thead>
<tr>
<th>Eye Number</th>
<th>Miostat</th>
<th>Miochol</th>
<th>Control</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without YAG</td>
<td>91 of 116</td>
<td>62 of 76</td>
<td>232 of 285</td>
<td>385 of 477</td>
</tr>
<tr>
<td>Capsulotomy</td>
<td>(78.4%)</td>
<td>(81.6%)</td>
<td>(81.4%)</td>
<td>(80.7%)</td>
</tr>
<tr>
<td>With YAG</td>
<td>25 of 116</td>
<td>14 of 76</td>
<td>53 of 285</td>
<td>92 of 477</td>
</tr>
<tr>
<td>Capsulotomy</td>
<td>(21.6%)</td>
<td>(18.4%)</td>
<td>(18.6%)</td>
<td>(19.3%)</td>
</tr>
</tbody>
</table>

Average Follow-up Time in Weeks

<table>
<thead>
<tr>
<th>Eye Number</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without YAG</td>
<td>52</td>
</tr>
<tr>
<td>Capsulotomy</td>
<td>47</td>
</tr>
<tr>
<td>With YAG</td>
<td>51</td>
</tr>
<tr>
<td>Capsulotomy</td>
<td>59</td>
</tr>
<tr>
<td>Average Total</td>
<td>52 ± SD</td>
</tr>
<tr>
<td></td>
<td>48 ± SD</td>
</tr>
<tr>
<td></td>
<td>48 ± SD</td>
</tr>
<tr>
<td></td>
<td>50 ± SD</td>
</tr>
</tbody>
</table>

A chi square analysis demonstrated that the YAG capsulotomy rates for eyes receiving Miostat, Miochol, or no intraoperative miotic were not significantly different (p>0.05)