Postoperative Refractive Error After Simultaneous Vitrectomy and Cataract Surgery

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■ PURPOSE: To evaluate the effect of vitrectomy on postoperative refraction after simultaneous vitrectomy and cataract surgery.

■ METHODS: We compared the spread between predicted and actual refractions in 206 eyes after a simultaneous vitrectomy, phacoemulsification, aspiration and acrylic lens insertion (combined surgery group), and in 67 eyes after cataract surgery only (cataract surgery group) as control. A vitrectomy was performed for diabetic retinopathy in 127 eyes, macular hole in 32 eyes, rhegmatogenous retinal detachment in 16 eyes, branch retinal vein occlusion in 15 eyes, and other conditions in 26 eyes. In the combined surgery group, 79 eyes had a gas tamponade after insertion of the intraocular lens.

■ RESULTS: The spread between predicted and actual refractions was $-0.05 \pm 1.18$ diopters (average $\pm SD$) in the combined surgery group and $+0.55 \pm 1.32$ D in the cataract surgery group. The actual refractive errors in the combined surgery group were found to shift toward myopia when compared with the controls. Among the combined surgery group, 127 eyes without a gas tamponade showed a postoperative refractive error of $+0.14 \pm 1.11$ D, while 79 eyes with a gas tamponade demonstrated an error of $-0.36 \pm 1.22$ D.

■ CONCLUSIONS: Use of a gas tamponade in the combined surgery group increased the myopic change and was thought to have pressed the intraocular lens forward.


INTRODUCTION

With the recent progress in vitrectomy and cataract surgery, these two procedures have been combined and performed with favorable results in patients with vitreoretinal diseases. In our institution, we selected small-incision cataract surgery in which a foldable lens is implanted in the capsular bag for early rehabilitation in visual function after surgery. At first we employed a silicone intraocular lens (IOL). Currently, we are using an acrylic IOL to increase the postoperative visibility of the fundus. We previously investigated postoperative refraction regarding postoperative visual function in 56 eyes in which triple surgery was performed using a silicone IOL. Our results showed that the actual refraction shifted toward myopia by 1.16 diopters from the predicted refraction calculated by the SRK-II formula. In the present study, we made a similar investigation in 206 eyes in which triple surgery was carried out using an acrylic
IOL. The spread between the predicted and actual refractions was compared with that of 67 eyes in which only cataract surgery was performed.

**PATIENTS**

We studied 206 eyes of 177 patients in which a simultaneous vitrectomy, phacoemulsification, aspiration, and acrylic IOL insertion were performed (combined surgery group) and 67 eyes of 54 patients in which only phacoemulsification, aspiration, and acrylic IOL insertion were carried out (cataract surgery group). The combined surgery group consisted of 103 males (125 eyes) and 74 females (81 eyes). Their ages ranged from 26 to 83 years (mean 56.2 years). The cataract surgery group was made up of 25 eyes of 21 males, and 42 eyes of 33 females; ages ranged from 11 to 84 years (mean 63.8 years). For the combined surgery group, the cause leading to vitrectomy was diabetic retinopathy in 127 eyes, macular hole in 32 eyes, rhegmatogenous retinal detachment in 16 eyes, branch retinal vein occlusion in 15 eyes, traumatic intravitreous hemorrhage in 3 eyes, and other conditions in 13 eyes (Table 1). Eyes that demonstrated a proliferative membrane or a retinal detachment including the macula were excluded.

**METHODS**

An acrylic IOL (MA60BM, Alcon, Ft. Worth, TX) was used. The power of the IOL was calculated by the SRK-T7 formula using the preoperative radius of the corneal curvature, axial length, and A constant of the IOL in accordance with the method used in our previous report.5 The A constant was set at 118.9 on the basis of previous data. The radius of the corneal curvature was determined by an automatic refractometer (ARK-900, Nidek), and the axial length by an ultrasound a-mode (AL-010, Tomey). The power of the IOL was approximately equal to the refraction of the fellow eye when surgery was performed in only one eye. When both eyes were being operated on, the power was set to achieve the predicted postoperative refraction of about −1.00 D.

In the triple surgical procedure, first, a 3 mm incision was made at the corneal limbus at the 12 o'clock position. Then, a continuous circular capsulorhexis, phacoemulsification, and aspiration were performed. The incision was sutured once with a 10-0 nylon suture using one stitch, then the vitrectomy was performed using a standard 3-port system. The vitreous body was removed as much as possible toward the periphery, and then a fluid-gas exchange and/or endophotocoagulation were added when needed before closing the 3-port system. Afterward, the incision on the corneal limbus was enlarged to 4 mm in length and the IOL was implanted in the capsular bag. A 20% SF6 gas tamponade was performed in 79 eyes following a fluid-gas exchange. No encircling procedure was performed. In the cataract surgery, an incision was made at the corneal limbus, as in the combined surgery. After phacoemulsification and aspiration, an IOL was implanted in the capsular bag. An acrylic IOL (MA60BM), 13.0 mm in length with an optical diameter of 6.0 mm, was used.

Refraction was examined at postoperative 23.0 ± 10.1 days in the combined surgery group, and 25.3 ± 8.4 days in the cataract surgery group (Figures 1 and 2). The spread between the predicted refraction calculated preoperatively and the actual refraction was studied and defined as the postoperative refractive error and expressed in equivalent spherical degrees. The ARK-900 was used to determine the refraction. For patients in the combined surgery group in which a gas tamponade was used, the refraction was examined after the gas had dissipated. The mean refractive error was calculated attaching a + to the error shifted toward hyperopia and a − to that shifted toward myopia. Significance was determined by a Student’s t-test.

**RESULTS**

The predicted refraction calculated before surgery was −1.19 ± 0.85 D for the cataract surgery group and −0.86 ± 0.93 D for the combined surgery group. The actual refraction after surgery was −0.65 ± 1.73
D in the cataract surgery group and $-0.91 \pm 1.52$ D in the combined surgery group, respectively. The spread between predicted and postoperative actual refractions was $+0.55 \pm 1.32$ D for the cataract surgery group and $-0.05 \pm 1.18$ D for the combined surgery group. (Figures 1 and 2) The difference between these two values was 0.60 D, which was a statistically significant difference (Table 2, $P = 0.0014$).

The postoperative refractive errors in the major diseases were $+0.01 \pm 1.14$ D for diabetic retinopathy, $-0.48 \pm 1.22$ D for macular hole, $-0.14 \pm 1.31$ D for rhegmatogenous retinal detachment, and $+0.26 \pm 0.94$ D for branch retinal vein occlusion. Statistically significant differences in refraction were not only observed between eyes with diabetic retinopathy and those with macular holes (Table 3, $P = 0.045$), but also eyes with macular holes and those with branch retinal vein occlusion ($P = 0.028$).

Among the combined surgery group, 127 eyes of the subgroup without a gas tamponade showed a postoperative refractive error of $+0.14 \pm 1.11$ D, while 79 eyes of the subgroup with a gas tamponade demonstrated an error of $-0.36 \pm 1.22$ D. There was a statistically significant difference between the two groups (Table 4, $P = 0.0034$). Statistically significant differences were not only found between those without a gas tamponade in the combined surgery group and the cataract surgery group ($P = 0.13$), but also between those with a gas tamponade and the cataract surgery group ($P = 0.00004$).

**DISCUSSION**

The most compelling reason to perform combined vitrectomy and cataract IOL surgery is not because of the preoperative presence of a cataract, but to prevent a reduction in central visual acuity because of the postoperative progress of the cataract and to reduce the incidence of postoperative complications through a complete vitreoretinal treatment of the periphery.

A progressive cataract is an important postoperative complication that cannot be overlooked during surgery for a macular hole or premacular membrane that is carried out to improve central visual acuity. Moreover, it is difficult to treat the peripheral vitreous...
Table 2. Postoperative Refractive Error

<table>
<thead>
<tr>
<th></th>
<th>Cataract Surgery Group (n = 67)</th>
<th>Combined Surgery Group (n = 206)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corneal curvature (mm)</td>
<td>7.54 ± 0.25</td>
<td>7.68 ± 0.26</td>
</tr>
<tr>
<td>Axial length (mm)</td>
<td>23.60 ± 1.78</td>
<td>23.59 ± 1.40</td>
</tr>
<tr>
<td>Intraocular lens power (D)</td>
<td>21.34 ± 4.17</td>
<td>21.77 ± 2.99</td>
</tr>
<tr>
<td>Predicted postoperative refraction (D) (a)</td>
<td>-1.19 ± 0.85</td>
<td>-0.82 ± 1.16</td>
</tr>
<tr>
<td>Actual postoperative refraction (D) (b)</td>
<td>-0.65 ± 1.73</td>
<td>-0.91 ± 1.52</td>
</tr>
<tr>
<td>Postoperative refractive error (D) (b-a)</td>
<td>+0.55 ± 1.32</td>
<td>-0.05 ± 1.18</td>
</tr>
</tbody>
</table>

*1: t-test, P = 0.0014

when the lens is conserved. In these cases, the surgery is finished, but vitreoretinal traction remains in the vitreous base, around the incision in the sclera, and as vitreoretinal adhesion in the periphery. This result is likely to cause a variety of complications, including proliferative diabetic retinopathy and proliferative vitreoretinopathy with an expanding proliferative lesion. Therefore, the combined surgery is the preferred way to avoid these problems.

The more vitrectomy procedures increase, the more a qualitative improvement of IOL implantation is needed. Postoperative refraction and selection of IOL power is extremely important in achieving the refractive goals of the triple surgery procedure.

In the present study, the effect of vitrectomy, on the degree of refraction was examined in the combined surgery group, and the results were compared with those of the cataract surgery group using an acrylic IOL. Cases with retinal detachment that included the macula, those with a proliferative membrane, and those treated concomitantly with an encircling procedure were excluded. As a result, the postoperative refractive error was −0.05 ± 1.18 D for the combined surgery group, and was +0.55 ± 1.32 D for the cataract surgery group. The combined surgery group showed a tendency for a postoperative refraction shift toward myopia by 0.60 D, as compared to that of the cataract surgery group (P = 0.0014). This result suggests that vitrectomy has an effect on postoperative refraction to a shift toward myopia when it is combined with cataract surgery and acrylic soft IOL implantation. Furthermore, in a study by types of surgeries, the refraction tended to shift toward myopia in cases associated with gas tamponade, as compared to those without gas tamponade (P = 0.0034).

Shiyoa et al. have reported that 36 eyes with a macular hole in the combined surgery group shifted toward myopia by an average of 0.5 D in comparison with 100 eyes in the cataract surgery group. The authors have pointed out that the reason for the myopia was caused by an error in preoperatively determining the axial because of retinal protrusion in the macular hole.

Nishigaki et al. compared the results between the combined surgery group and the cataract surgery group in patients with diabetic macular edema. They reported that the error at postoperative month one

Table 3. Diagnostic Subgroup and Postoperative Refractive Error

<table>
<thead>
<tr>
<th>Diagnostic Subgroup</th>
<th>Eyes</th>
<th>Postoperative Refractive Error (D)</th>
<th>Gas Tamponade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic retinopathy</td>
<td>127</td>
<td>+0.01 ± 1.14</td>
<td>21.3</td>
</tr>
<tr>
<td>Macular hole</td>
<td>32</td>
<td>-0.48 ± 1.22</td>
<td>100.0</td>
</tr>
<tr>
<td>Rhegmatogenous retinal detachment</td>
<td>16</td>
<td>-0.14 ± 1.31</td>
<td>100.0</td>
</tr>
<tr>
<td>Branch retinal vein occlusion</td>
<td>15</td>
<td>+0.26 ± 0.94</td>
<td>13.3</td>
</tr>
</tbody>
</table>

t-test, *1: P = 0.045, *2: P = 0.028
## Table 4. Gas Tamponade and Postoperative Refractive Error

<table>
<thead>
<tr>
<th>Eyes</th>
<th>Postoperative Refractive Error (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined surgery group with gas tamponade</td>
<td>79</td>
</tr>
<tr>
<td>Combined surgery group without gas tamponade</td>
<td>127</td>
</tr>
<tr>
<td>Cataract surgery group (control)</td>
<td>67</td>
</tr>
</tbody>
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\[ t_{-1} = 0.36 \pm 1.22, \quad t_{-2} = 0.14 \pm 1.11, \quad t_{-3} = 0.55 \pm 1.32 \]

1: Test, \( *_{-1} : P = 0.0034 \), \( *_{-2} : P = 0.00004 \), \( *_{-3} : P = 0.035 \)

was −0.48 D in the combined surgery group and −0.53 D in the surgery group. Their study indicated there was no difference in refractive error at postoperative month one between the cases of diabetic macular edema that did not need a gas tamponade, which is almost all of the cases, and those treated with cataract surgery. On the basis of these findings, it is thought that the patients treated with triple surgery might shift toward myopia more than those of cataract surgery because of the effect of the gas tamponade.

In the cataract surgery group and the combined surgery group without a gas tamponade, the foundation of the IOL should be located on the equator of the lenticular capsule; therefore, the optical portion should be fixed at the depth as planned. On the other hand, in the combined surgery group with a gas tamponade, the IOL should be implanted shallower than the expected depth shifted toward the lens. At this time, if the foundation of the IOL is fixed to slightly deviate to the anterior chamber from the equator of the lenticular capsule, it is expected that the depth of the chamber might be shallower than found in the cataract surgery group, even after the gas in the vitreous cavity has dissipated. Histological studies and a determination of the depth of the anterior chamber might be needed to prove this speculation.

### REFERENCES