Comparison of the Short-term Clinical Results of Silicone and Acrylic Intraocular Lens in Patients with Diabetes Mellitus

Ho-Kyung Choung, MD, Jin Hak Lee, MD

Department of Ophthalmology, College of Medicine, Seoul National University
Seoul, Korea

In order to compare the clinical results of silicone intraocular lenses (IOLs) and acrylic IOLs in patients with diabetes mellitus (DM), we reviewed the records of 69 diabetic patients (79 eyes - 40 eyes; silicone IOLs, 39 eyes; acrylic IOLs) who had undergone phacoemulsifications and posterior chamber intraocular lens (PCL) implantations between January 1994 and January 1999. Postoperative ocular examinations included measurements of uncorrected and best corrected visual acuity tests and recording any complication one day, one week and two months after surgery. There was no statistically significant difference in visual acuity between the eyes with silicone IOLs and those with acrylic IOLs. Additionally, there was no difference in visual acuity according to the method of blood sugar level control. The rate of posterior capsular opacity (PCO) was significantly lower in the patients with acrylic IOLs than in those with silicone IOLs (p<0.05). These results suggest that there is no difference in visual outcome between acrylic IOLs and silicone IOLs in patients with DM. However in view of the lower rates of PCO with acrylic IOLs, they may be a better choice for eyes in diabetic patients.

Key words: diabetes mellitus, silicone intraocular lens, acrylic intraocular lens, posterior capsular opacity

INTRODUCTION

The association between cataracts and diabetes mellitus (DM) is well known. The prevalence of cataract is higher in diabetic eyes than in non-diabetic eyes.1,2 The formation of diabetic cataract also correlates with the presence of diabetic retinopathy (DR)3 and the duration of DM.3 The frequency of cataract surgery is higher in diabetic eyes and diabetic patients require surgery at an earlier age than non-diabetics.4,5 DM is considered to be a risk factor for many complications, therefore the diabetic patient undergoing cataract surgery has a guarded prognosis.

In 1984 the first foldable IOLs made of silicone were implanted in humans. Since then, several other foldable IOL types have been documented. The acrylic IOL is one of these, and recent studies have revealed that it possesses several innovative features that distinguish it from other foldable IOLs. The acrylic IOL has improved viscoelastic properties (it
is not slippery when wet), slow and controlled folding, and excellent surface quality. Therefore, it has minimal surface alteration and minimal surface defects caused by folding. It also shows less anterior chamber reaction as compared to silicone and polymethyl methacrylate (PMMA) IOLs. In addition, it was reported that the incidence of posterior capsular opacity was significantly reduced with acrylic IOLs three years postoperatively.

Although silicone, PMMA, and acrylic IOLs are sufficiently biocompatible, the acrylic IOL is associated with lower giant cell counts, which may lead to better results in eyes with pre-existing blood-aqueous barrier (BAB) damage such as that seen in uveitic or diabetic patients.

Although studies have reported the advantages of the acrylic IOL, little is known concerning the clinical results of acrylic IOLs in DM patients. We hypothesized that acrylic IOLs may be more suitable than silicone IOLs in diabetic patients. In this study, we compared the clinical results of silicone and acrylic IOLs in diabetic patients.

**Patients and Methods**

**Patients**

We reviewed the records of 69 diabetic patients (79 eyes) who underwent phacoemulsification and posterior chamber IOL (PCL) implantation between January 1994 and January 1999. Silicone IOLs (AMO SI-30NB, Allergan) were implanted between January 1994 and December 1996. After December 1996, acrylic IOLs (MA 60 BM AcrySof®, Alcon) were implanted. Forty eyes were implanted with silicone IOLs, and 39 eyes were implanted with acrylic IOLs. The patients were followed for a minimum of two months after surgery. All patients were seen preoperatively by the same clinician, and tight inclusion criteria were used to define eligible cataracts in diabetics without retinal change or with nonproliferative DR.

Exclusion criteria included a history of ocular disease or intraocular surgery, glaucoma, previous uveitis, or significant posterior segment pathology that could preclude the postoperative visual outcome.

**Surgical Technique**

All operations were performed by one surgeon (JH Lee) using a standard phacoemulsification technique. Local (retrobulbar or topical) anesthesia was administered in all cases. Before surgery, the pupils were dilated by topical instillation of phenylephrine hydrochloride 10% and tropicamide 0.5%. Three drops of ciprofloxacin 0.3% were instilled 30 minutes before surgery. Epinephrine (0.5 ml) was added to 500 ml of buffered saline solution plus (BSS plus®) for aspiration and irrigation during phacoemulsification. A 3.2 mm scleral tunnel incision or clear cornea incision was made and the anterior chamber was reformed with viscoelastic, sodium-chondroitin sulfate-sodium hyaluronate (Viscoat®). A continuous curvilinear capsulorhexis (CCC) approximately 5.5 mm in diameter was made with a bent 26 gage needle. Following hydrodissection, phacoemulsification of the nucleus and cortical aspiration were performed. After the lens capsule was inflated with viscoelastic, the IOL was inserted in the capsular bag. Any surgical complication such as CCC rim tear, zonular dehiscence, failure to place the IOL in the capsular bag, posterior capsular rupture, or vitreous loss led to exclusion from the study.

Postoperatively, all patients were administered ciprofloxacin 0.3%, NSAIDs, (Decrol®), and Fluorometholon 0.1% four times a day for one month, and NSAIDs only were used for the next month. In order to prevent posterior synechia, homatropine 1% was used once daily for the first week.

Ocular examinations were performed before surgery and one day, one week, and two months after surgery, and included test of uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), and postoperative complications were checked.

**Statistical Analysis**

The statistical significance of the difference in visual acuity and of the complications between the silicone IOL group and acrylic IOL group was analyzed using a chi-square test. A p-value of less than 0.05 was regarded as significant.
RESULTS

The demographic characteristics of 69 patients enrolled in this study are shown in Table 1. No statistically significant differences were found in age, sex, the ratio between the left and right eye or the distribution of retinopathy (no vs nonproliferative DR) in each group.

The UCVA and BCVA at one day, one week and two months after surgery are shown in Table 2. Figures 1 and 2 show the percentage of eyes with visual acuity of 20/40 or better. The best corrected visual acuity for each group at two months was 20/40 or better in 37 of the 40 silicone IOL implanted eyes (92.5%), and 38 of the 39 acrylic IOL implanted eyes (97.4%). There was no significant difference in visual acuity between the two groups.

The percentage of the eyes with visual acuity 20/40 or better in the insulin treated group and in the group treated with oral hypoglycemic agents are shown in figure 3 and 4. There was no significant difference in visual acuity between the silicone IOL and acrylic IOL implanted groups, and there was also no significant difference according to the methods of controlling the blood sugar level.

During the two-month follow-up period, there was a significant difference seen in the percentage of patients with PCO requiring neodymium: YAG (Nd:YAG) laser posterior capsulotomy between the two of IOLs (p<0.05). Acrylic IOLs were associated with less PCO than silicone lenses (Table 5). In addition, PCO was not observed in 18 eyes out of the 17 patients implanted with acrylic IOLs who

---

Table 1. Demographics of patients

<table>
<thead>
<tr>
<th></th>
<th>Silicone IOL</th>
<th>Acrylic IOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>37</td>
<td>32</td>
</tr>
<tr>
<td>No. of eyes</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>mean age (years)</td>
<td>61.5 (51-81)</td>
<td>65.3 (41-80)</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>19/18 (51%/49%)</td>
<td>18/14 (56%/44%)</td>
</tr>
<tr>
<td>Laterality (Rt./Lt.)</td>
<td>20/20 (50%/50%)</td>
<td>18/21 (46%/54%)</td>
</tr>
</tbody>
</table>

IOL: intraocular lens

Table 2. Visual acuity in silicone and acrylic IOL patients

<table>
<thead>
<tr>
<th></th>
<th>BCVA</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Silicone IOL</td>
<td>Acrylic IOL</td>
<td>p-value</td>
<td>Silicone IOL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N=40</td>
<td>N=39</td>
<td></td>
<td>N=40</td>
</tr>
<tr>
<td>1 Day-N(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥20/20</td>
<td></td>
<td>9 (22.5%)</td>
<td>7 (17.9%)</td>
<td>NS</td>
<td>5 (12.5%)</td>
</tr>
<tr>
<td>≥20/30</td>
<td></td>
<td>26 (65.0%)</td>
<td>22 (56.4%)</td>
<td>NS</td>
<td>22 (55.0%)</td>
</tr>
<tr>
<td>≥20/40</td>
<td></td>
<td>33 (82.5%)</td>
<td>30 (76.9%)</td>
<td>NS</td>
<td>32 (80.0%)</td>
</tr>
<tr>
<td>≥20/200</td>
<td></td>
<td>38 (95.0%)</td>
<td>33 (76.9%)</td>
<td>NS</td>
<td>33 (82.5%)</td>
</tr>
<tr>
<td>1Week-N(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥20/20</td>
<td></td>
<td>10 (25.0%)</td>
<td>24 (61.5%)</td>
<td>NS</td>
<td>1 (2.5%)</td>
</tr>
<tr>
<td>≥20/30</td>
<td></td>
<td>14 (35.0%)</td>
<td>37 (94.9%)</td>
<td>NS</td>
<td>19 (47.5%)</td>
</tr>
<tr>
<td>≥20/40</td>
<td></td>
<td>37 (92.5%)</td>
<td>38 (94.9%)</td>
<td>NS</td>
<td>27 (67.5%)</td>
</tr>
<tr>
<td>≥20/200</td>
<td></td>
<td>39 (97.5%)</td>
<td>39 (100%)</td>
<td>NS</td>
<td>33 (82.5%)</td>
</tr>
<tr>
<td>2Months-N(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥20/20</td>
<td></td>
<td>28 (70.0%)</td>
<td>26 (66.7%)</td>
<td>NS</td>
<td>6 (15.0%)</td>
</tr>
<tr>
<td>≥20/30</td>
<td></td>
<td>37 (92.5%)</td>
<td>37 (94.9%)</td>
<td>NS</td>
<td>25 (62.5%)</td>
</tr>
<tr>
<td>≥20/40</td>
<td></td>
<td>37 (92.5%)</td>
<td>38 (97.4%)</td>
<td>NS</td>
<td>33 (82.5%)</td>
</tr>
<tr>
<td>≥20/200</td>
<td></td>
<td>39 (97.5%)</td>
<td>39 (100%)</td>
<td>NS</td>
<td>37 (92.5%)</td>
</tr>
</tbody>
</table>

Uncorrected visual acuity and best corrected visual acuity at one day, one week, and two months after surgery are shown. There was no statistically significant difference between the two groups by chi-square test.

IOL: intraocular lens, BCVA: best corrected visual acuity, UCVA: uncorrected visual acuity, NS: p>0.05, nonsignificant
were followed up for six months or more (mean follow-up: 12.3 months, range: 6 to 18 months).

## DISCUSSION

Although DM is considered to be a risk factor for many postoperative complications, improvements in surgical techniques have made cataract surgery a safe procedure even for diabetics. Many surgeons now routinely perform cataract surgery in diabetics in the same manner as in non-diabetics. Previous studies have found that cataract extraction with posterior chamber IOL implantation produced good visual acuity in diabetic patients with 48-94% achieving 20/40 or better. In addition, diabetics without retinopathy achieved visual results comparable to those of non-diabetic controls.9

In our study, the two groups both showed good visual results, which were comparable to previous reports. There was a tendency for the acrylic IOL group to demonstrate better visual acuity than the silicone IOL group, however no significant difference observed between the two groups.

In normal eyes, improved IOL designs and better surgical techniques have reduced the incidence of many postoperative complications, although they are still significant factors in eyes with a damaged blood-aqueous barrier (BAB) from uveitis, glaucoma or DM. In view of the fact that the most common complication of cataract surgery is posterior
capsular opacification (PCO), acrylic IOLs might have the advantages of a reduced degree of PCO and lower Nd: YAG laser rates. Although it is easy to clear the visual axis by Nd: YAG laser capsulotomy, this technique still has the possible postoperative risks. PCO itself can also be an obstacle to examination and retinal photocoagulation. Complications of Nd: YAG laser capsulotomy include intraocular pressure elevation, cystoid macular edema, retinal detachment, and endophthalmitis and these complications are more common in diabetics than in non-diabetics. In addition, a previous study reported that Nd: YAG laser treatment caused pitting of silicone IOLs in most cases, although this may have no effect on visual acuity. A recent study shows that the prevalence of vitreous opacification following Nd:YAG laser posterior capsulotomy, which reduces visual acuity and requires vitrectomy to remove the opaque tissue, was significantly higher in diabetic eyes than in non-diabetic eyes. Moreover, the disruption of the posterior capsule by the Nd: YAG laser may induce a breakdown of the BAB, leading to protein leakage and cellular reaction in the aqueous humor, and aggravating diabetic retinopathy.

Breakdown of the blood-aqueous, as well as blood-retinal barrier damage in diabetic eyes are likely to produce a greater incidence and severity of inflammatory complications and an increased risk of PCO. In this regard, such damage might stimulate the lens epithelial cells (LECs), which may in turn lead to a marked anterior capsule contraction, fibrosis and a higher rate of PCO. Previous studies have suggested that acrylic IOLs may produce good results in eyes with pre-existing BAB damage.

The mechanisms by which IOL materials and design influence PCO is unknown. However, several hypotheses have been proposed.

First, the anterior capsule remains more stable on the anterior surface of the acrylic IOL than on IOLs made from silicone or PMMA. Only minor capsule movement occurs over time, possibly because the

---

**Table 3. Postoperative complications**

<table>
<thead>
<tr>
<th>Complications</th>
<th>Silicone IOL</th>
<th>Acrylic IOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCO</td>
<td>3(7.5%)*</td>
<td>0</td>
</tr>
<tr>
<td>Macular edema</td>
<td>0</td>
<td>1(2.5%)</td>
</tr>
<tr>
<td>Posterior synechia</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hyphema</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>IOL decentration</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pupillary capture</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Uveitis</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

IOL: intraocular lens, PCO: posterior capsular opacification requiring ND:YAG laser posterior capsulotomy, *: P < 0.05, chi-square test.

During the two months follow-up period, acrylic IOL-implanted patients were associated significantly less with PCO requiring Nd:YAG laser posterior capsulotomy than silicone IOL-implanted patients.

---

**Fig. 4.** Uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA) in oral hypoglycemic agents treated group. There was a tendency for the acrylic IOL implanted group to show better visual acuity than the silicone IOL implanted group, but no significant difference was seen between the two groups by chi-square test.
anterior capsule is stuck to the anterior IOL surface.\textsuperscript{6,28} This provides indirect evidence for an adhesive relationship between the acrylic IOL and the capsule, which may prevent LECs from migrating and proliferating onto the posterior capsule, and thus keep the IOL in position. This is beneficial in view of postoperative fundus examination.

Second, the higher refractive index of the acrylic IOL (1.55) as compared to the silicone IOL (1.4-1.46) allows it to have much thinner optics. This facilitates insertion through a small incision.\textsuperscript{6} Considering that a large incision size has been correlated with increased postoperative BAB damage, this is another reason why acrylic IOLs are more suitable in diabetic eyes than other IOLs.

Third, biconvex lens design also reduces the incidence of PCO\textsuperscript{30,31} by causing less BAB damage and residual LEC density, and obliterating the space between the posterior IOL surface and the posterior lens capsule.

In addition, acrylic lenses have a more defined and more square edge profile and this acts as a mechanical barrier to LECs migration.

Our results suggest that acrylic IOLs produce as good a visual result in diabetic eyes as silicone IOLs, and that acrylic IOLs may be a better choice in diabetics when complication rates are taken into consideration. However, this must be confirmed by further randomized, prospective, and larger studies with longer follow up.

**REFERENCES**


