# Progression of Diabetic Retinopathy after Phacoemulsification in Diabetic Patients: A Three-Year Analysis

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**Background:** This retrospective study was conducted to analyze the progression rates of diabetic retinopathy (DR) after phacoemulsification in diabetic patients and to determine whether phacoemulsification causes the progression of DR.

**Methods:** The medical charts of diabetic patients who had undergone cataract surgery using phacoemulsification techniques during a 3-year period and had completed 3 years of follow-up were retrospectively reviewed. Data were collected to evaluate the visual outcomes and progression of DR postoperatively. The retinopathy progression rates of operated and nonoperated eyes were compared.

**Results:** Thirty-seven diabetic patients were enrolled. Binocular cataract surgeries were performed in 14 patients. Monocular cataract surgeries were performed in the remaining 23 patients whose nonoperated fellow eyes served as the control group. The postoperative retinopathy progression rates of eyes with preoperative mild to moderate nonproliferative diabetic retinopathy (NPDR) were significantly greater than eyes without preoperative retinopathy whether at postoperative 1 year or postoperative 3 years. No statistical significance was found for the rate of retinopathy progression between operated and nonoperated eyes at 1 year and 3 years postoperatively. Of 51 operated eyes, 33 (64.7%) achieved an uncorrected visual acuity of 20/40 at 1 year postoperatively, and 47 (92.1%) had improvement of visual acuity of more than two lines.

**Conclusion:** Uncomplicated phocoemulsificaton had no significant influence on the postoperative progression of DR. Patients with preoperative NPDR had greater chances to show postoperative retinopathy progression. The majority of diabetic patients who had no DR or had mild to moderate NPDR achieved visual improvement after phacoemulsification.

*(Chang Gung Med J 2003;26:829-34)*

**Key words:** **diabetic retinopathy, cataract, phacoemulsification, progression.**

Cataract is a major problem for diabetic patients because it decreases the vision, prevents adequate fundus examination and interferes with the strategy of laser photocoagulation for diabetic retinopathy. Diabetic patients have been reported to have higher prevalence of cataract and develop it at an earlier age than non-diabetics.[1,2] Some studies reported the progression of retinopathy after extra-

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Received: Apr. 15, 2003; Accepted: Jun. 18, 2003
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capsular cataract extraction (ECCE),[3] and suggested to delay cataract surgery when possible especially in patients with more advanced diabetic retinopathy (DR).[4,5] With the progress of surgical techniques, the modern phacoemulsification is well known to have smaller incisions, quicker recovery of vision and less postoperative inflammation.[6] Recent reports present different opinions about whether cataract surgery itself might influence the risk of retinopathy progression. In this retrospective study, we analyzed the progression of DR after phacoemulsification and several risk factors of the progression of DR. The follow-up period for cases in this study is longer than that of similar studies reported in the literature.

## METHODS

The medical charts of diabetic patients who had undergone cataract surgery using phacoemulsificaiton techniques from January 1, 1997, through December 31, 1999 and completed 3 years of follow-up were retrospectively selected for analysis. Patients with proliferative diabetic retinopathy (PDR), severe nonproliferative diabetic retinopathy (NPDR) or clinically significant macular edema (CSME) often received laser therapy before cataract surgery, which may interfere with the progression of DR after cataract surgery. Therefore, all patients enrolled had no DR or only mild to moderate NPDR. Patients with dense cataract that prevented adequate preoperative fundus examinations were excluded. Other exclusion criteria were glaucoma, uveitis, age-related macular retinopathy, history of ocular trauma, previous ocular surgery, previous laser treatment and intraoperative complications such as posterior capsular rupture. All of the phacoemulsificaion surgeries were performed by one experienced surgeon (W.C.K). The operative procedures consisted of peribulbar anesthesia, creating a scleral tunnel wound, continuous curvilinear capsulorrhexis, hydrodisection, phacoemulsification with a bimanual divide-and-conquer technique, removal of cortex with irrigation/aspiration, implantation of a heparin-coated polymethyl methacrylate intraocular lens, and suturing of the scleral wound. All of the cataract surgeries were uncomplicated. The postoperative treatment consisted of dexamethasone, neomycin and polymyxin ointment (Maxitrol ointment, Alcon) twice a day for 2 weeks and flurometholone eye-drops (0.1% Efemoline, Novartis) three times a day for another 3 to 4 weeks. Other data collected form medical charts included: age and gender of patients; types and duration of diabetes mellitus; types of diabetic therapy; visual acuity (Snellen chart) and stage of retinopathy at the time of surgery, 1 year and 3 years postoperatively; and mean glycosylated hemoglobin ($HbA_1c$) levels within 3 to 12 months postoperatively. The stages of retinopathy were examined using indirect ophthalmoscopy and were recorded on the charts. Retinopathy was graded using five levels: no retinopathy, mild NPDR, moderate NPDR, severe NPDR and PDR. Progression was defined as a deterioration by one or more levels or the occurrence of CSME.

For statistical comparison, standard normal test were used. A $p$ value of $< 0.05$ was defined as statistically significant.

## RESULTS

Forty two patients who completed 3 years of follow up were enrolled in this study. After reviewing the medical charts and operative notes of these patients, 5 were excluded because of inadequate data. Finally, this retrospective study consisted of 37 patients who all received uncomplicated cataract surgery using the phacoemulsification techniques performed by a single surgeon. Fourteen patients received binocular cataract surgery and the remaining 23 patients received monocular cataract surgery. The fellow eyes of these 23 patients who were only operated on one eye were served as the control group. The clinical characteristics of patients are listed in Table 1.

At end of the first postoperative year, of the 51 operative eyes, 36 eyes (70.1%) had no progression of retinopathy, and 15 eyes (29.4%) had progression of retinopathy. When comparing the eyes with progression of retinopathy with the eyes without progression of retinopathy, duration of diabetes was significantly longer and $HbA_1c$ level was significantly higher in the eyes with progression of retinopathy, but the mean ages had no much difference between these two group. At 3 years postoperatively, of the 51 operative eyes, 31 (60.8%) eyes had no progression of retinopathy, and 20 (39.2%) eyes had progression of retinopathy. The duration of diabetes

was also significantly longer in the eyes with progression of retinopathy, but the mean ages also have no much difference between these two group (Table 3). In the 32 operated eyes without preoperative DR, 4 (12.5%) had progressed at 1 year postoperatively and 8 (25%) had progressed at 3 years postoperatively. In the remaining 19 eyes with preoperative mild to moderate NPDR, 11 (57.9%) had progressed at 1 year postoperatively and 12 (63.2%) had progressed at 3 years postoperatively (Table 4). The postoperative retinopathy progression rates of the eyes with preoperative mild to moderate NPDR were significantly greater than eyes without preoperative retinopathy whether at 1 year postoperatively ($p=0.00023$; Standard normal test) or at 3 years postoperatively ($p=0.0023$; Standard normal test). In the nonoperated control eyes (23 eyes), 6 (26.1%) had progressed at 1 year postoperatively and 8 (34.7%) had progressed at 3 years postoperatively (Table 5). No statistical significance was found for the rate of retinopathy progression between the operated and non-operated eyes at 1 year and 3 years postoperatively (Table 5). Of the 51 operated eyes, 33 (64.7%) had achieved an uncorrected visual acuity 20/40 at 1 year postoperatively, and 47 (92.1%) had improvement of visual acuity of greater than two lines. Thirty (93.8%) of the eyes without preoperative retinopathy and 17 (89.5%) of the eyes with preoperative mild to moderate NPDR had improvement of visual acuity of greater than two lines at 1 year postoperatively. Two cases had poorer visual acuity after cataract surgery. They both had preoperative NPDR, and CSME developed after cataract surgery.

**Table 1.** Patient Characteristics

| | |
|---|---|
| Patient number | 37 |
| (Monocular surgeries/ binocular surgeries) | (23/14) |
| Total operated eye number | 51 |
| Age at cataract surgery (years) | 66.8 (6.23)* |
| Male/female | 14/23 |
| Duration of diabetes at cataract surgery (years) | 7.75 (6.89)* |
| Diabetes types (IDDM/NIDDM) | (0/37) |
| Types of treatment (OHA only/ insulin) | (32/5) |
| Mean $HbA_1c$ (%) | 7.75 (1.78)* |
| Distribution of retinopathy before surgery (eyes) | |
| No DR | 32 |
| Mild to moderate NPDR | 19 |

*Mean (SD); DR: diabetic retinopathy; NPDR: nonproliferative diabetic retinopathy.

**Table 2.** Clinical Characteristics of Patients with and without Retinopathy Progression at 1 Year Following Cataract Surgery

| | No progression | Progression |
|---|---|---|
| Eye number | 36 | 15 |
| Age at cataract surgery (years) | 65.6 (6.2)* | 67.9 (7.2)* |
| Duration of diabetes (years) | 6.1 (5.6)* | 11.8 (8.1)* |
| $HbA_1c$ (%) | 7.1 (1.1)* | 9.4 (2.0)* |

*Mean (SD)

**Table 3.** Clinical Characteristics of Patients with or without Retinopathy Progression at 3 Years Following Cataract Surgery

| | No progression | Progression |
|---|---|---|
| Eye number | 31 | 20 |
| Age at cataract surgery (years) | 65.6 (6.5)* | 67.3 (7.2)* |
| Duration of diabetes (years) | 6.5 (6.0)* | 10.1 (7.7)* |

*Mean (SD)

**Table 4.** Preoperative Severity of Diabetic Retinopathy and Postoperative Progression

| Preoperative DR | No DR Eye (N=32) | Mild to moderate DR Eye (N=19) | |
|---|---|---|---|
| DR progression | | | *p* value* |
| Postoperative 1 year, n (%) | 4 (12.5%) | 11 (57.9%) | 0.00023 |
| Postoperative 3 year, n (%) | 8 (25 %) | 12 (63.2%) | 0.0023 |

*Standard normal test; DR: diabetic retinopathy

**Table 5.** Postoperative Progression of Diabetic Retinopathy

| | Progression of retinopathy, n(%) | | |
|---|---|---|---|
| | Operated eyes | Control eyes | *p* value* |
| Postoperative 1 year | 15 (29.4) | 6 (26.1) | 0.39 |
| Postoperative 3 years | 20 (39.2) | 8 (34.7) | 0.35 |

*Standard normal test; Operated eyes number: 51; Control eyes number: 23

## DISCUSSION

Cataract in diabetic patients not only decreases the vision but also prevents adequate fundus examinations and optimal therapy. Therefore, cataract surgery has meanings of visual rehabilitation, diagnostic and therapeutic purposes to diabetic patients. The blood-aqueous barrier is impaired in diabetes,[7] and this impairment is exacerbated by cataract surgery.[8-10] Using the modern phacoemulsification technique, the incision is smaller, the visual recovery time is shorter and the postoperative inflammation can be less. However, Antcliff et al,[11] Chung et al.[12] and Borrillo et al.[13] reported no differences between phacoemulsification and ECCE with regard to visual

acuity or retinopathy progression.[11] Because PDR and severe NPDR tend to progress after cataract surgery,[3,14,15] some researches suggested laser treatment before cataract surgery.[4] After laser therapy, the course of DR may be stopped or be interfered with. Thus in this study we excluded these cases and only enrolled cases without retinopathy or mild to moderate NPDR. One researcher reported that diabetic patients without retinopathy were more likely to show progression of retinopathy than patients with mild-to-moderate DR,[16] but others reported that NPDR was the strongest factor associated with retinopathy progression.[14,17,18] Our results supported the later opinions. In our study, progression rates of eyes with preoperative mild to moderate NPDR were significantly greater than eyes without preoperative retinopathy whether at 1 year or 3 years postoperatively.

The rate of retinopathy progression after cataract surgery was reported to be influenced by some variables such as age,[19,20] severity of preoperative diabetic retinopathy,[14,15,21] duration of diabetes,[14] and levels of $HbA_1c$.[14,22] Our results supported that the longer duration of diabetes and the higher $HbA_1c$ levels were associated with the higher risk of postoperative progression of diabetic retinopathy. But we found no significant relationship between age and the risk of postoperative progression of diabetic retinopathy. Because $HbA_1c$ values represents the glycemic control in the past several months, the preoperative $HbA_1c$ does not well represent the postoperative glycemic control. We chose the mean levels of $HbA_1c$ at 3 to 12 months postoperatively for analysis. This was different from most of the previous studies which used preoperative $HbA_1c$ levels for analysis.[14,23-25] Whether cataract surgery itself increased the risk of progression of DR is still controversial. Some authors observed increased risks,[4,17,18,26] whereas others reported no difference,[14,16,19,23,24,27,28] and postulated that the retinopathy progression may simply represent the natural history of the disease.[16,23,29] In our study, the rate of retinopathy progression had no statistical significance between operated and non-operated eyes at 1 and 3 years postoperatively. It was similarly reported by Squirrell et al.[23] and Henriccon et al,[14] although our progression rate of operated and nonoperated eyes were higher than theirs. When compared with non-diabetic patients, visual acuity after cataract surgery was reported to be worse in diabetic patients,[29,30] especially in those who had diabetic retinopathy.[16,18,22,25,28] However many researchers reported good visual improvement after cataract surgery in diabetic patients. We only presented the uncorrected visual acuity at 1 year postoperatively to show the short-term improvement in visual acuity in diabetic patient after phacoemulsification which was also reported in previous studies.[14,15,28] Visual acuity at 3 years postoperatively was not presented because 11 eyes received neodymium YAG laser posterior capsulotomy during this period. This makes visual acuity analysis more difficult.

We concluded that uncomplicated phacoemulsificaton had no significant influence on the postoperative progression of DR. The postoperative progression of retinopathy probably represents natural disease progression rather than the direct result of cataract surgery. It is consistent with those from the studies of Krepler et al,[24] Kato et al.[16] and Squirrell et al.[23] Patients with preoperative NPDR had increased chances of showing postoperative retinopathy progression. The majority of diabetic patients who had no DR or mild to moderate NPDR achieved visual improvement after phacoemulsification, and adequate fundus examination and optimal laser treatment become possible. Therefore, we think it is not good to defer cataract surgery in diabetic patients with no DR or with only mild to moderate NPDR. Currently, early surgery is favored before the development of significant DR rather than wait for the cataract to become denser.[31] All efforts should be made to stabilize DR using laser treatment before cataract surgery. Larger prospective studies are needed to better confirm the relationship between phacoemulsification and postoperative progression of DR.

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# 糖尿病病患接受超音波晶體乳化術後糖尿病視網膜病變之進行：三年分析

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**背 景：** 本篇回溯性研究分析了糖尿病病患接受超音波晶體乳化術後，糖尿病視網膜病變之進行，以決定是否超音波晶體乳化術會造成糖尿病視網膜病變之進行。

**方 法：** 在本篇回溯性分析中，我們收集了3年期間內，接受超音波晶體乳化術並於術後追蹤3年之糖尿病病患，從其病歷中取得術前術後視力，及糖尿病視網膜病變之變化，以比較手術眼與未手術眼之差異。

**結 果：** 本篇研究共包含37位糖尿病病患，其中14位接受雙眼白內障手術，剩餘之23位接受單眼白內障手術，並以其未手術眼作爲對照組。結果發現不論是術後1年或術後3年，接受手術的眼睛中，術前有輕到中度之非增生型糖尿病視網膜病變的眼睛，比無糖尿病視網膜病變的眼睛有較多比率發生術後糖尿病視網膜病變之進行。不論是術後1年或術後3年，接受手術的眼睛，與未接受手術的眼睛，在發生糖尿病視網膜病變之進行比率上無統計上之差異。在術後1年，51隻手術眼中，33隻 (64.7%) 眼睛未矯正視力可達20/40，47隻 (92.1%) 眼睛視力進步達兩行以上。

**結 論：** 無併發症之超音波晶體乳化術對術後糖尿病視網膜病變之進行並無顯著之影響。術前有輕到中度之非增生型糖尿病視網膜病變的眼睛有較多比率發生術後糖尿病視網膜病變之進行。對於大多數無糖尿病視網膜病變，或只有輕到中度之非增生型糖尿病視網膜病變的眼睛，超音波晶體乳化術可改善病人之視力。

(長庚醫誌 2003;26:829-34)

**關鍵字：**糖尿病視網膜病變，白內障，超音波晶體乳化術，進行。

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