

# Late Increased Risk of Retinal Detachment After Cataract Extraction

SHWU-JIUAN SHEU, LUO-PING GER, AND WAN-LING HO

- **PURPOSE:** To identify the possibility and characteristics of late increase in the cumulative risk of retinal detachment (RD) after cataract extraction and intraocular lens (IOL) implantation.
- **DESIGN:** Prospective cohort study of submitted claims records.
- **METHODS:** Records of 9388 consecutive insurance beneficiaries who underwent cataract extraction and IOL implantation between August 1, 1999 and December 1, 2001 were collected from the Bureau of National Health Insurance. Data included each patient's demographic characteristics, medical history, refractive status, axial length (AL), type of cataract extraction, and intraoperative complications. Posterior capsulotomy, diagnostic procedures, and treatment for retinal complications and other ocular diseases were identified by codes from physicians' billing records yearly to the end of 2007.
- **RESULTS:** The cumulative 8-year RD rate was 2.31% at the end of the follow-up. Factors with significant effect on the risk of RD included being male and younger, having an increased AL, and having a history of RD in the fellow eye. The cumulative risk of RD after cataract extraction and IOL implantation increased with time. There was a significantly late increased risk of RD after 4 years in the group of patients with high myopia (AL, > 26 mm;  $P = .026$ ), but not in the group of moderate myopia (AL 23 to 26 mm,  $P = .068$ ) or nonmyopia (AL, < 23 mm;  $P = .066$ ). The late increase appeared in male group, but not in the female group, even in those with high myopia (male,  $P = .042$ ; female,  $P = .068$ ).
- **CONCLUSIONS:** Our study showed that patients with high myopia may be at increased risk for late pseudophakic RD after 4 years, especially in males. (*Am J Ophthalmol* 2010;149:113–119. © 2010 by Elsevier Inc. All rights reserved.)

THE MYOPIC EYE GENERALLY IS CONSIDERED VULNERABLE to a range of ocular pathologic features, such as glaucoma, cataract, retinal detachment (RD), and macular degeneration,<sup>1–7</sup> especially when the level is more than 6 diopters. Unfortunately, the prevalence of myopia in young people has increased substantially over recent decades and now is approximately 10% to 25% in the West and 60% to 80% in the East.<sup>8</sup> Inasmuch as the World Health Organization reports myopia as the leading cause of visual impairment,<sup>9</sup> myopia-related complications remain an important concern for ophthalmologists. Myopia is a proven significant risk factor for RD after cataract extraction.<sup>3,4,7,10</sup> RD after cataract extraction is a serious and potentially sight-threatening complication that virtually always necessitates further surgical intervention. According to a long-term population-based study, the cumulative risk of RD after extracapsular cataract extraction (ECCE) and phacoemulsification was increased up to 20 years after surgery.<sup>11</sup> Being male, being younger, having myopia, and having increased axial length (AL) were associated significantly with RD.<sup>1,4,11–18</sup> Our previous studies also supported the significance of the above factors.<sup>10,19</sup> Moreover, the extended follow-up study showed the hint of a late wave of increased risk. Therefore, we propose to identify the possibility and characteristics of late increase in the cumulative risk of RD after cataract extraction and intraocular lens (IOL) implantation.

## METHODS

WE PERFORMED A PROSPECTIVE COHORT STUDY OF INSURANCE claims and medical charts of insurance beneficiaries who underwent ECCE (including phacoemulsification) and IOL implantation at the Sixth Branch of the Bureau of National Health Insurance of Taiwan between August 1, 1999 and December 1, 2001. Each patient was identified with a coded number in the Bureau of National Health Insurance databank (to which we did not have access) and no invasive procedures were involved. Data from these charts, including demographic characteristics; medical history; refractive status; AL; type of cataract extraction; and complications of capsular rupture, vitreous loss, or both were reviewed and recorded. Codes listed in physicians' billing records regarding posterior capsulotomies performed with a neodymium:yttrium–aluminum–garnet (Nd:YAG) laser, diagnostic procedures, and treatments for retinal com-

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**TABLE.** Demographic and Clinical Characteristics of the Patients at Risk for Retinal Detachment after Cataract Extraction

	No. of Patients in Cataract Number (%)	8-year RD Rate (%)	Crude		Adjusted	
			RR (95% CI)	P value	RR (95% CI)	P value
Gender						
Female	5235 (55.8)	1.52	1		1	
Male	4153 (44.1)	3.28	1.75 (1.14 to 2.66)	.01	1.72 (1.12 to 2.64)	.013
Age (years)						
≤50 age	503 (5.4)	6.65	2.69 (1.44 to 5.00)	.002	2.35 (1.26 to 4.38)	.007
50 < age ≤ 60	1935 (20.6)	2.57	1.15 (0.68 to 1.95)	.614	1.16 (0.69 to 1.95)	.567
>60 age	6950 (74)	2.01	1		1	
DM (-)	8132 (86.6)	2.27	1		1	
DM (+)	1256 (13.4)	2.61	1.06 (0.87 to 1.94)	.864	1.39 (0.84 to 2.29)	.198
Hypertension (+)	1331 (14.2)	2.78	1		1	
Hypertension (-)	8057 (85.8)	2.24	0.80 (0.45 to 1.41)	.434	1.22 (0.70 to 2.14)	.491
AL (mm)						
<23	4445 (47.3)	1.57	1		1	
23 to 25	4394 (46.8)	2.44	1.78 (1.10 to 2.88)	.02	1.59 (0.97 to 2.60)	.066
≥26	549 (5.8)	6.14	4.61 (2.50 to 8.50)	<.001	4.19 (2.25 to 7.80)	<.001
Type						
ECCE	3550 (37.8)	1.66	1		1	
PHAC	5838 (62.2)	2.91	1.78 (1.13 to 2.79)	.013	0.55 (0.37 to 0.81)	.003
Intraoperative complication (-)	9293 (99)	2.32	1		1	
Intraoperative complication (+)	95 (1)	1.32	1.30 (0.18 to 9.31)	.797	0.84 (0.12 to 6.09)	.864
Capsulotomy (+)	688 (7.2)	4.72	1.55 (0.78 to 3.09)	.214	1.45 (0.80 to 2.65)	.224
Capsulotomy (-)	8700 (92.8)	2.16	1		1	
RD history (+)	6 (0.1)	33.33	17.34 (2.41 to 124.64)	.005	10.31 (1.40 to 75.83)	.022
RD history (-)	9382 (99.9)	2.28	1		1	

CI = confidence interval; DM = diabetes mellitus; ECCE = extracapsular cataract extraction; PHAC = phacoemulsification; RD = retinal detachment; RR = relative risk.

plications and other ocular diseases were identified and recorded from the date of operation to the end of 2007. If two cataract surgeries were identified for one patient during the study, the first procedure was chosen as the index event.

We excluded all cases of cataract surgery combined with other ocular procedures: corneal grafts, glaucoma treatments, or other posterior segment procedures. Exclusion criteria included age less than 18 years, history of ocular trauma, history of retinal breaks including lattice degeneration in the operative eye, and development of endophthalmitis. The detailed information of the excluded cases was not recorded and not analyzed. Subjects were followed up until one of the following occurred: an episode of RD was detected, any other intraocular procedure unrelated to RD repair was performed, the subject died, or the study period ended. Those who received other intraocular procedure unrelated to RD repair or who died during follow-up were assumed to change the risk for RD and were counted as being lost to follow-up.

• **STATISTICAL ANALYSIS:** Average numeric values were calculated as mean ± standard deviation. The person-years of follow-up for each subject were calculated from the date

of enrollment to one of the following: 1) date of diagnosis of newly developed RD, 2) date of any other intraocular procedure unrelated to RD repair, 3) date of death, or 4) the end of the study. Incidence rates were calculated by dividing the number of RD incidents by the number of person-years of follow-up. A Cox proportional hazards model was used to estimate the relative risk of RD by risk factor: gender, age, concurrent systemic diseases, medical history, AL, type of surgery, intraoperative complications, and subsequent neodymium: yttrium-aluminum-garnet (Nd:YAG) posterior capsulotomy. Significance levels were determined with use of two-tailed tests, and 95% confidence intervals for relative risks were also calculated. All statistical analyses were conducted with SPSS software version 12.0 (SPSS Inc, Chicago, Illinois, USA).

## RESULTS

A TOTAL OF 9388 CASES WERE COLLECTED, INCLUDING 5235 females and 4153 males. One thousand and eighty-four cases were counted as lost to follow-up before the end of the study, including those who experienced other intraoc-

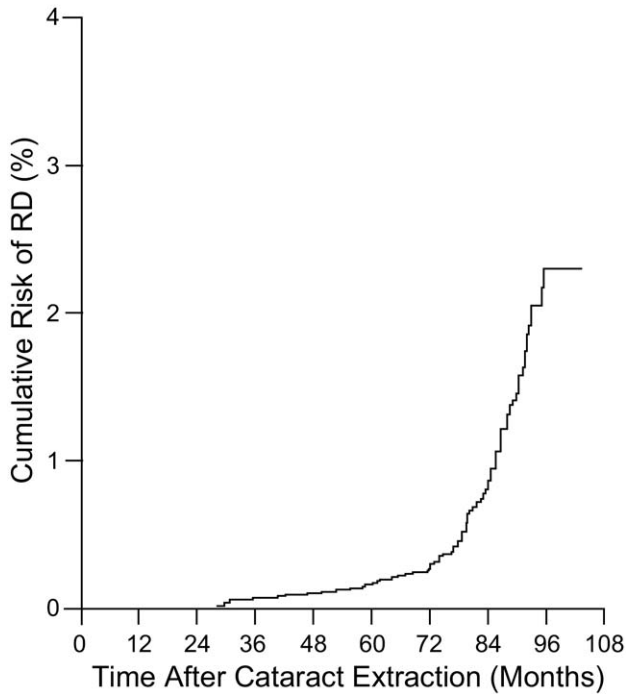


FIGURE 1. Graph showing the cumulative risk of retinal detachment (RD) over time. The cumulative risk of RD in the study increased with time and showed the tendency of late increase after 4 years, although this was not significant ( $P = .066$ , Wilcoxon signed-rank test).

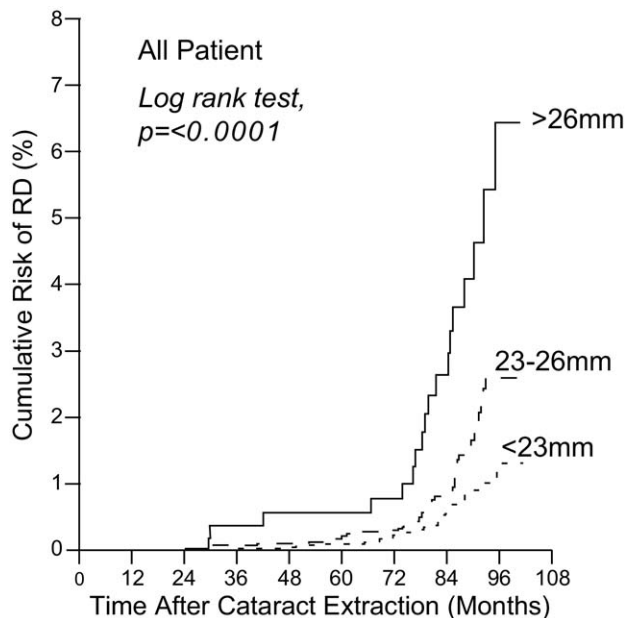


FIGURE 2. Graph showing the cumulative risk of retinal detachment (RD) over time for patients in different axial length (AL) range. There was a significantly late increased risk of RD after 4 years in the group of patients with high myopia (AL > 26 mm;  $P = .026$ , Wilcoxon signed-rank test), but not in the group of patients with moderate myopia (AL, 23 to 26 mm;  $P = .068$ ) or nonmyopia (AL < 23 mm;  $P = .066$ ).

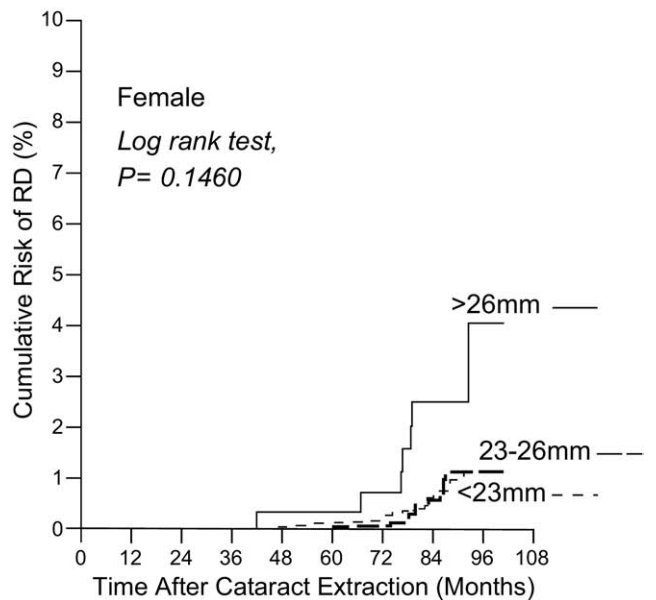
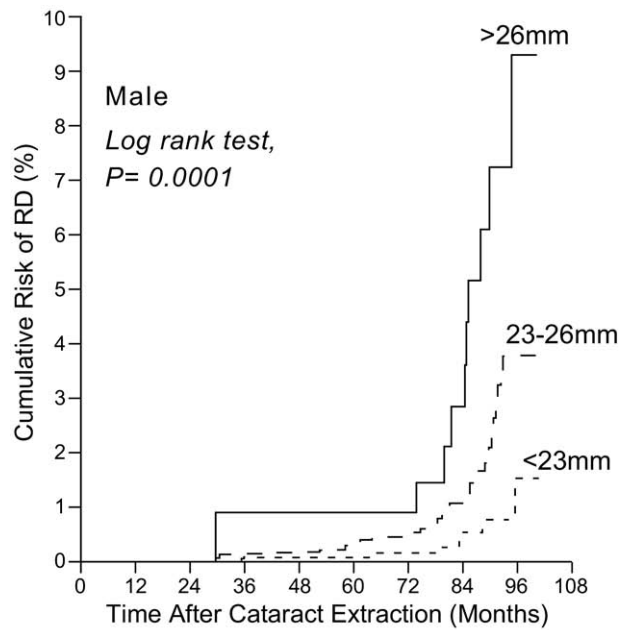
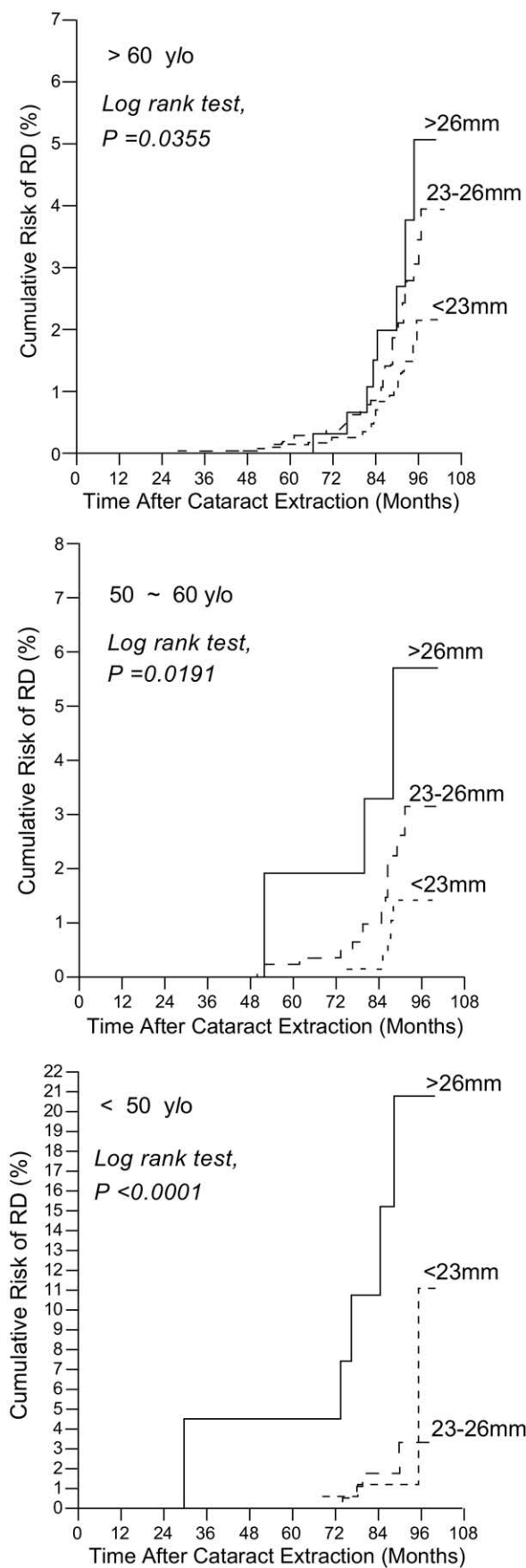


FIGURE 3. Graphs showing the cumulative retinal detachment (RD) risk of different axial length (AL) ranges in different gender groups: (Top) male group (Bottom) female group. Both moderate and high myopic males showed significantly late increase of RD risk 4 years after cataract extraction and intraocular lens implantation. The survival curves of females were much more flat than males and did not show late wave of increased RD risk regardless of AL factors (AL < 23 mm,  $P = .068$ ; AL 23 to 26 mm,  $P = .109$ ; AL > 26 mm,  $P = .109$ , Wilcoxon signed-rank test).

ular procedure unrelated to RD repair ( $n = 44$ ) or those who died during follow-up ( $n = 1,040$ ). The age of patients ranged from 18 to 99 years, with a mean of  $65.96 \pm 9.33$  years. Mean follow-up time was  $79.21 \pm 15.56$  months (range, 5.1 to 103.3 months). The mean age was  $65.84 \pm$



9.55 years for males and  $66.06 \pm 0.15$  years for females ( $P = .56$ ). Five hundred and three patients (5.37%) were 50 years of age or younger, 1935 (20.61%) were 50 to 60 years of age, and 6950 (74.03%) were older than 60 years. Eyeball AL ranged 15.28 to 34.68 mm, with a mean length of  $22.85 \pm 3.60$  mm. An AL of less than 23 mm was found in 4445 eyes (47.34%), whereas in 4394 eyes (46.80%), the AL was 23 to 26 mm. Five hundred and forty-nine eyes (5.85%) had an AL of 26 mm or more. Refractive data were missing or unreliable (lenticular myopia) in some patients with high cataract density; we therefore decided to forgo analysis of refractive status as a risk factor. Cataract operations were performed by extracapsular lens extraction in 3550 eyes (37.81%) and by phacoemulsification in 5838 eyes (62.19%).

The cumulative 8-year RD rate in our study group was 2.31% in the total group. The mean interval between cataract extraction and diagnosis of RD was  $40.6 \pm 13.34$  months (range, 1.0 to 82.93 months). Factors significantly affecting RD risk after cataract extraction included male gender ( $P = .01$ ), age younger than 50 years ( $P = .002$ ), AL, RD history in the fellow eye ( $P = .005$ ), and phacoemulsification ( $P = .013$ ; Table). The greater the AL, the higher the risk of pseudophakic RD was (pairwise comparison for AL 23 to 26 mm vs AL of more than 26 mm,  $P = .0003$ ). Systemic diseases such as diabetes and hypertension did not show significant correlation with an increased risk of pseudophakic RD.

Intraoperative complications (posterior capsule rupture, vitreous loss, or both) occurred in 95 eyes (1.01%), but did not significantly affect the risk of developing RD after cataract surgery ( $P = .797$ ). Because the cost of cataract extraction was covered by case-payment policies, surgeons received no extra fees for performing vitrectomies or other related procedures, but did face a greater risk of litigation. Complications may have been underreported for this reason. Posterior capsulotomies performed with an Nd:YAG laser were carried out on 668 eyes after cataract extraction (mean,  $57.67 \pm 12.93$  months; range, 2.77 to 97.8 months). In the full study group, patients who received an Nd:YAG laser posterior capsulotomy were no different in their risk of developing RD ( $P = .214$ ; Table).

Cataract extractions in our group were performed more often by phacoemulsification than by traditional ECCE, especially in the second year (56.5% in the first year and 71.8% in the second year). Surgeons were transitioning

FIGURE 4. Graphs showing the cumulative RD risk of different AL ranges in different age groups: (Top) older than 60 years; (Middle) 50 to 60 years of age; (Bottom) younger than 50 years. Young patients showed a high risk of RD right after cataract extraction, but no significantly late increase. Only the nonmyopic oldest patients showed an insignificant tendency for late increase of RD risk (AL < 23 mm, age > 60 years,  $P = .066$  Wilcoxon signed-rank test).

from ECCE to phacoemulsification during the study period. Phacoemulsification appeared to be significantly more risky than ECCE in the study group as a whole ( $P = .013$ ). However, the difference disappeared in cases collected in the second year (first year,  $P = .016$ ; second year,  $P = .964$ , Student  $t$  test), although the other risk factors (gender, age, AL) remained the same.

The cumulative risk of RD increased with time (Figure 1). Moreover, the survival curves revealed that patients in different AL ranges ran differently on the change in cumulative risk of RD after cataract extraction (Figure 2). There was a significantly late increased risk of RD after 4 years in the group of patients with high myopia, but not in the group of patients with moderate myopia or nonmyopia (AL > 26 mm,  $P = .026$ ; AL 23 to 26 mm,  $P = .068$ ; AL less than 23 mm,  $P = .066$ ; Wilcoxon signed-rank test). This change appeared in the male group, but not in the female group (Figure 3; male,  $P = .042$ ; female,  $P = .068$ ; Wilcoxon signed-rank test). In the male group, both moderate and high myopic patients showed a significantly late increased risk of RD 4 years after cataract extraction and IOL implantation (AL > 26 mm,  $P = .024$ ; AL 23 to 26 mm,  $P = .027$ ; Wilcoxon signed-rank test). Because young age is also an important risk factor for pseudophakic RD, we analyzed the age factor as well. Those who aged 50 years or younger showed a tendency toward late increase, but one that was not significant (Figure 4; age < 50 years,  $P = .068$ ; age 50 to 60 years,  $P = .180$ ; age > 60 years,  $P = .109$ ; Wilcoxon signed-rank test).

## DISCUSSION

MYOPIA IS A COMMON OCULAR CONDITION, ESPECIALLY IN Asia.<sup>20,21</sup> In Taiwan, a national survey revealed that subjects aged 16 to 18 years have a rate of myopia of 84%.<sup>20</sup> The prevalence of high myopia is 18% among young Taiwanese males and 24% among young Taiwanese females.<sup>20,22</sup> Myopia poses a significant public health problem because it is associated with an increased risk of such profound ocular diseases as glaucoma, cataract, RD, and macular degeneration.<sup>1-7</sup> Both myopia and young age are known risk factors for RD after cataract extraction.<sup>1,4,11-15</sup> However, high myopia is also associated with cataract,<sup>13</sup> and a relationship between myopia and cataract has been suggested.<sup>14,15</sup>

The cumulative risk of RD in our study group was 2.31%, well within the range reported in the literature. Our results confirmed recognized long-term risk factors for pseudophakic RD, including being male, being young, having long AL, and having a history of RD in the fellow eye. The greater the AL, the greater the risk for RD after cataract extraction was in this study. Although many report intraoperative complication and Nd:YAG laser posterior capsulotomy as a significant risk factor for RD after cataract extraction,<sup>13-15,17</sup> they did not show signif-

icance on RD risk in our results. As stated above, the complication rate might have been underreported because of insurance or litigation considerations, and this may have influenced our evaluations of RD risk. Previous studies have shown that Nd:YAG laser posterior capsulotomy increases the risk of RD after cataract extraction up to 4.9-fold.<sup>2,13,15,18</sup> In our study, capsulotomy did not influence the cumulative 8-year risk of RD after cataract extraction significantly, although the 6-year cumulative risk analysis showed an insignificantly higher trend. Moreover, because nearly half of capsulotomies were performed more recently, our results may provide indirect support that delayed capsulotomy is safer in terms of RD risk.

Phacoemulsification was reported to carry either similar or an even lower risk than ECCE,<sup>11,14-18</sup> however, Javitt and associates found pseudophakic RD to be higher after phacoemulsification in the years soon after its introduction as a new surgical technique.<sup>13</sup> The discrepancy of RD risk of the patients collected in the first year and second year in our study was compatible with their findings. We speculate that it may be the result of underreported complications during phacoemulsification during the surgeons' learning curve in the first year. With the maturity of surgical skills, phacoemulsification actually would have no difference on the long-term accumulative risk of RD resulting from ECCE. Because of the limits of chart recording, systemic disease and past history also may be underreported. Usually, only remarkable history will be recorded in the chart. With the relatively low rate of pseudophakic RD, any minor change of RD cases will influence the statistical results greatly. Our results did show significant differences based on RD history, but not systemic diseases, which is consistent with the literature.

The cumulative risk of RD in our extended follow-up study group was compatible with the previous report showing that cumulative risk of RD increased with time.<sup>11</sup> Moreover, our analysis on the individual survival curve by group showed that even the change of cumulative risk behaved differently. Groups with ALs of less than 26 mm produced a smoother curve than those with ALs larger than 26 mm. Patients with ALs of more than 26 mm tend to have a late wave of increased RD after 4 years. Both moderate and highly myopic males showed a significantly late increase of RD risk 4 years after cataract extraction. Interestingly, we could not see the same change in female group, even with high myopia. Unlike gender factor, age factors showed less difference in the aspect of late increase; only young patients showed an insignificant tendency of late increase.

It has been documented that human vitreous humor alters after cataract extraction on both molecular and structural levels.<sup>23</sup> Types and locations of retinal tears tended to be different between patients in whom RD developed early or late after cataract surgery. The anterior tears that cause most RDs long after cataract extraction were the result of persistent chronic traction on the

vitreous base.<sup>24–27</sup> Although we did not have data about the characteristics of RD in our study, we speculate that anomalous posterior vitreous detachment developed years after cataract extraction and caused the late wave of increased risk for pseudophakic RD in our results. However, this speculation could not explain the lack of late increase in females. A possible explanation is that the history of trauma was underreported. Like the incidence of other trauma, men are more prone to have trauma attributable to their lifestyle and work. They may forget to report a history of trauma if the trauma did not cause damage immediately. Because the postoperative data were obtained by a physician bill system in our study, the trauma factor might have been underestimated and might have become the underlying factor for the late increase on the RD risk in male patients.

Some population-based studies have shown an association between myopia and cataract onset, especially nuclear sclerosis. Patients with axial myopia tend to have cataract surgery earlier than others.<sup>6,28</sup> Most highly myopic eyes achieve good visual improvement and good postoperative visual acuity after cataract surgery, except those with preexisting retinopathy (maculopathy).<sup>29,30</sup> Cataract sur-

gery in highly myopic eyes remains relatively risky, although Neuhann and associates reported that the risk for pseudophakic RD in myopic eyes might be the result of the natural risk for RD in myopic eyes.<sup>31</sup> Inclusion criteria and follow-up might have influenced the results; to avoid these, we excluded all pediatric cases and those receiving combined surgery. Because highly myopic patients often receive cataract extraction at an earlier age, their cumulative lifelong risk of RD after cataract extraction is considerable, because the average life span in our country is approximately 80 years. Patients who no longer wear glasses after cataract extraction usually forget their myopia with time. In Asia, myopia prevalence is much higher than in the West. Our results revealed the possibility that highly myopic eyes not only behave worse in terms of RD incidence right after cataract extraction and IOL implantation, but also carried the risk of late increase of pseudophakic RD, especially in men. Our findings support the need for a full preoperative explanation and continued education of the long-term risk of RD in high-risk patients, especially myopic men. Prophylactic treatment of any suspicious retinal break also may be required in high-risk patients after cataract extraction.

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### **Biosketch**

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