Chapter 9

Refractive Lens Exchange: Risk Management

9

Emanuel Rosen

Core Messages

- Refractive lens exchange in myopic eyes carries a significant risk of postoperative retinal detachment.
- Particular risk factors are:
  - Higher myopia;
  - Younger age, (less then 50 years);
  - Surgical complications (capsule rupture and vitreous loss);
  - Neodymium:YAG capsulotomy relation to rhegmatogenous retinal detachment after refractive lens exchange is controversial and indeterminate

9.1 Introduction

About 60 years ago the concept of intraocular lens implantation was pioneered. About 30 years ago, small incision lens extraction by phacoemulsification was realized. Both pioneering efforts have subsequently led to perfecting the respective processes. Thus, refractive surgery, the correction of ametropia through lens-based surgery was initiated. The era of corneal laser surgery commencing about 25 years ago focused public and professional attention on the wider opportunity for permanent refractive correction and thereby created in practice the sub-specialty of refractive surgery. Lens-based refractive surgery was sidetracked for a time as the surgical process matured until it was able to offer ophthalmic surgeons with that interest more security and scope for intervention. Initially, surgical techniques evolved more rapidly than lens implant technology. The crystalline lens, whether cataractous or 'clear,' could be removed by sub-2.5-mm incisions. However, intraocular lens implants (IOLs), made of PMMA before the foldable materials were approved, required a 5- to 6-mm incision, not the ideal basis for a refractive surgical procedure. Gradually, though, lens implants became more refined and eventually developed spectacularly in form, effect, and enhanced small incision capability, an essential component of the refractive surgical process. Today, modern lens extraction and implant replacement is a safe, predictable, and stable process in general; however, nothing is absolute in this sense. All surgeons are aware that no surgical intervention is absolutely risk-free.

As we age, the crystalline lens is the ever-changing element in the eye. Its replacement (the lens implant) provides a permanent result in the optical sense, leaving the cornea for enhancement of effect if necessary. As with all surgical procedures there are risk factors to be weighed against the benefits. Refractive surgery in general is about risk management. One issue that requires in-depth exploration is retinal complications of refractive surgery. This applies in particular to refractive lens exchange (RLE) and especially its application in myopic eyes, which are more vulnerable in the retinal sense than hyperopic eyes.

9.2 RLE: Need to Know

A refractive surgeon needs to know the risks inherent in an RLE procedure, risks for hypermetropic eyes, and those for myopic eyes. The surgeon needs to know the risk odds so that the patient can be reliably informed what they are getting into. In the case of myopic eyes, evidence suggests that the degree of myopia or size of the globe is one type of risk that could be graded. Age is another as is surgical complications. A study of the literature enables the risks to be quantified,

Table 9.1 Meta analysis publications on refractive lens exchange (RLE) and myopic cataract surgery (1994–2005): variables

Variables include:
Eye axial length
Number of eyes studies
Follow up duration and range
Neodymium:YAG capsulotomy rates
Pre-operative retinal prophylaxis
Patient age range
Operative complications

despite the significant variations in study profiles (Tables 9.1, 9.2).

The literature is an aid to learning about the risk of RLE as well as the outcomes from cataract and lens implant surgery in myopic eyes. It is necessary to define risk factors as well as the outcome for myopic and hyperopic eyes that have suffered pseudophakic retinal detachments. Surgical complications are fortunately very rare in eyes undergoing RLE in experienced surgical hands. However, what are the risks and potential outcomes if complications do occur?

9.3 Cystoid Macular Edema

There are other retinal risks of RLE apart from rhegmatogenous retinal detachment (RRD), but they are of less importance in incidence and effect. Cystoid macular edema, which if unresolved will lead to permanent visual impairment through cystoid macular changes, is fortunately rare following uncomplicated surgery. It tends to be transient, causing short-term visual disturbances. Invariably, it will resolve with appropriate anti-inflammatory medication for it is mediated by the post-surgical inflammatory cascade and temporary loss of the blood–retinal barrier. The incidence and causes of clinical and angiographic cystoid macular edema (CME) after uncomplicated phacoemulsification and intraocular lens implantation in otherwise normal eyes were investigated by Mentes et al. [31]. Clinical and fluorescein angiographic macular edema was evaluated 45 days postoperatively in a study comprising 252 eyes following uncomplicated phacoemulsification with in-the-bag acrylic IOL implantation. Clinical CME was not detected in any eye at any postoperative visit, but angiographic macular edema was detected in 9.1% of eyes. The visual outcome did not differ between eyes with no clinical edema and those with fundus fluorescein angiography-detected edema. Treatment of clinically evident and visually disabling CME after RLE is by topical application of steroidal and non-steroidal anti-inflammatory agents coupled with low-dose acetazolamide. Only in circumstances where there is a poor response to topical therapy should systemic high-dose, short course steroid therapy be contemplated. Other aids include sub-Tenon's steroid or as a last resort intraocular steroids though this is a remote requirement.

9.4 Risk Management and Rhegmatogenous Retinal Detachment

A meta-analysis of papers concerning the incidence of retinal detachment after lens extraction and IOL implantation for 12 years between 1994 and 2005 reveals that these studies are not uniform in their protocols (Table 9.1) and most were retrospective reviews. There were many variables that have to be evaluated in an attempt to isolate the identifiable risk factors for RRD [1–3, 5–7, 9–12, 14, 16, 18–20, 22, 23, 25, 26, 28–30, 32, 36, 39, 40, 43–45, 48, 50, 52–54].

Factors not apparent from this study, but hinted at in some papers, are the consistently influential factor of age of the patient. Younger patients, i.e., less than 50 years old, have a disproportionately higher risk of RRD according to the general cataract studies of Polkingshorne and Craig [38], e.g. less than 50 years related to an incidence of 5.1% RRD (which is a more relevant rate for RLE comparisons) whereas over 70 years the rate was less than 0.7% [8]. One hundred and forty-one patients presented between May 1997 and April 1998 with an RRD, i.e., an annual incidence of 1.18 cases per 10,000 people (0.0118%), 5 of whom presented with bilateral RRD and the mean age at presentation was 53.9 years. RRD was more common in males than in females with a ratio of 1.3:1. *Ocular trauma, high myopia, and*

Table 9.2 Order of frequency of retinal detachment (RD) after refractive lens exchange (RLE) and cataract and IOL surgery in myopic eyes (1994–2005). *ECCE* extracapsular cataract extraction, *AC* anterior chamber, RRD rhegmatogenous retinal detachment

Reference	Year	Eyes in study	RD rate (%)	No. of eyes	Comment
[51]	2005	14	0	0	
[53]	2001	26	0	0	
[2]	1998	40	0	0	
[23]	1996	24	0	0	
[54]	1998	120	0	0	
[20]	1998	26	0	0	
[1]	1996	80	0	0	
[14]	2003	44	0	0	
[19]	2003	526	0	0	
[43]	2003	358	0.26	1	
[11]	1998	581	0.3	1	
Rosen	2005	583	0.3	2	Unpublished data
[52]	1999	38	0.7	1	
[12]	2002	72	0.7	1	
[39]	1995	430	0.8	4	
[18]	1997	386	0.8	1	Myopic cataract
[28]	1996	109	0.9	2	
[25]	1997	90	1.1	1	ECCE
[50]	2003	73	1.3	1	Aphakia
[32]	1998	245	1.4	4	ECCE
[22]	2002	125	1.7	2	
[9]	1999	118	1.7	2	
[10]	2004	190	2.1	4	
[30]	2005	194	2.1	4	Phakic IOL
[36]	2002	151	3.0	4	
[16]	2005	37	3.2	2	
[26]	1994	136	3.6	4	ECCE
[40]	2001	25	4.0	1	
[45]	1999	166	4.8	8	AC phakic IOL
[3]	1998	33	6.1	2	
[44]	2003	930	8.0	72	
[44]	2003	1020	1.2	10	Control group
[5]	1994	52	0	0	Same cohort
[6]	1997	49	1.9	2	Same cohort
[7]	1999	52	8.1	4	Same cohort

Table 9.2 *(continued)*

Reference	Year	Eyes in study	RD rate (%)	No. of eyes	Comment
Total eyes		**6,042**	**2.2**	(133)	**Mean RRD rate**
Hyperopia RLE					
[48]	1998	35	0	0	Hyperopia
Rosen	2005	433	0.25	1	Unpublished data
[29]	1997	20	0	0	Follow-up 3–60 months

cataract extraction were found to be significant risk factors in the development of RRD.

Lois and Wong [27] quoted an incidence of RRD after phacoemulsification cataract surgery ranging from 0 to 3.6% and averaging 0.7% in the general population. They calculated that the excess risk of developing a retinal detachment after cataract surgery in the first 10 years over eyes without surgery was 5.5. Desai [8] estimated that 94% of retinal detachments occurring in the first year after surgery were the result of the surgery.

Ivanesivic and colleagues [17] studied the epidemiological characteristics of non-traumatic phakic RRD in a defined population of a county in Croatia. Of 278 eyes (272 patients) developed RRD during an 11-year period, 1988–1998, with a population of 465,947. The annual incidence was 0.54 per 10,000 of the population (0.005%). The mean age of patients was 58.3 years, and the sex distribution corresponded with that in the general population. Bilaterality was observed in 2.2%. The presence of myopia was diagnosed in 46.9% eyes, although the range was not disclosed

Li, in China [24], estimated the incidence and epidemiologic characteristics of RRD in Beijing, in a prospective population-based incidence study with 6.5 million subjects. A total of 526 patients with RRD were newly diagnosed between October 1999 and September 2000. There was an annual incidence of 0.8/10,000 people (95% confidence interval = 7.30–8.67; 0.008%). The 60–69 age group had the highest incidence (2.22/10,000 (0.022%). Three subtypes of RRD were identified; 0.0093% were related to blunt trauma, 0.0080% were either aphakic or pseudophakic, and 0.006.25% for non-traumatic phakic retinal detachment. High myopia greater than 6D was more prevalent in bilateral RRD (57.1%) than in the unilaterally affected patients (32.4%).

However, in considering refractive lens exchange as opposed to cataract extraction, inevitably the age range will be much lower and as noted above a significant risk factor for RRD after lens extraction is being under 50 years of age. The cause presumably relates to the vitreo-retinal interface and the promotion of posterior vitreous detachment by the volumetric change in the eye after removal of the crystalline lens even if it is replaced by a lens implant.

9.5 Complicated Lens Surgery

The effects of complicated or traumatic surgery were reported by Onal et al. [34] in another general cataract study that indicates that the rate for RRD was significantly magnified by that event. Bearing in mind that RLE applies to presbyopic patients in general and younger patients rather than older, it seems reasonable to presume that the more vulnerable myopic eye entertains an additional risk factor above and beyond the general risk because of its inherent retinal instability as defined by the above statistics.

Ripandelli et al. [44] discussed cataract surgery as a risk factor for retinal detachment in very highly myopic eyes. Studying 930 in a retrospective, paired-eye, case-control trial in which axial length ranged from 29.7 to 35.5 mm with a follow-up of 36 months and an neodymium: YAG rate of 34% utilizing IOLs made of PMMA, they noted a RRD rate of 8%, whereas in their control group it was only 1.2%.

Uhlman et al. [51] combined RLE with simultaneous pars plana vitrectomy (PPV) in the

management of severe myopia. Retrospectively, they reviewed 14 eyes of 8 patients who had RLE to treat myopia of –19.0±5.4 D in whom phacoemulsification posterior chamber (PC) IOL implantation, and standard three-port vitrectomy were performed. With a mean postoperative follow-up time of 2.5 years (range 1–4 years), 21.4% required Nd:YAG capsulotomy for posterior capsule opacification. No retinal detachments or cases of CME were observed during the follow-up. The authors considered that simultaneously performed PPV may reduce the risk of postoperative retinal detachment, but they advised that a definitive conclusion would have to be based on a prospective study.

In our own clinic we studied 583 eyes (selected after V-R review and prophylactic treatment if indicated) in which the mean axial length was 27.1 mm (range 24–31 mm) with a follow-up range of 3–96 months. The Nd:YAG rate was 35% utilizing both silicone and acrylic IOLs. The RRD was 0.3%, i.e., 2 eyes affected, both of which resumed near normal vision after retinal surgery. One patient, who had RRD 18 months after surgery with a preoperative best corrected visual acuity (BCVA) of 20/40 (amblyopic), achieved a postoperative BCVA of 20/40 18 months after RRD surgery. Another patient, who had RRD 20 months after RLE with a BCVA of 20/15, achieved a postoperative retinal repair BCVA of 20/30 within 3 months.

Martinez-Castillo et al. [30] and Ruiz-Moreno and Alio [45] investigated RRD following phakic IOL implantation, which has some parallels with RLE in myopic eyes. Their studies provide important information, not only on the incidence of RRD, but the mechanisms, treatment, and outcome investigated (see prognosis for RRD).

9.6 Age and Pseudophakia in Myopic Eyes

Younger patients are more vulnerable to RD in pseudophakia so particular care in case selection, vitreo-retinal expert preoperative advice, and patient informed consent are essential.

An epidemiological study of RRD in a general population by Polkinghome and Craig [38] is provided for comparative purposes. Of 141 patients presenting between May 1997 and April 1998 with a RRD:

- Five presented with bilateral RRD;
- Mean age at presentation was 53.9 years;
- Annual incidence of RRD was 11.8 cases per 100,000 people;
- RRD was more common in males than in females (1.3:1);
- Ocular trauma, *high myopia*, and *cataract extraction* were found to be significant risk factors in the development of RRD.

9.7 Odds of RRD Occurrence

Because of the temporal sequence of events, RRD following RLE/cataract surgery is usually assumed to be causally related to the lens surgery. The evidence for this relation has been based on the observed frequency of such events following cataract surgery, particularly the excess frequency previously observed after intracapsular cataract extraction. Such studies were characterized by the lack of a control group of patients who did not have lens surgery and their experience of retinal detachment for comparison. Measures of effect, such as relative risk, provide some assessment of the magnitude of an association between myopic RLE/cataract surgery and RRD, indicating the likelihood of developing the condition in the exposed group relative to those who are not exposed. The identification of a control group (nonmyopic eyes) by Ripandelli and colleagues [44] permits this kind of assessment of the risk of RRD associated with RLE/cataract surgery in which they found a factor of 4 applied to the myopic group with very long eyes.

Norregaard et al. [33] suggested that about 60% of detachments following extracapsular cataract extraction (ECCE) and IOL occurred within 1 year, with about a quarter occurring after 3 or more years, which is consistent with previous reports that have indicated that up to 75% of detachments may occur within 1 year of surgery.

Polkinghome and Craig [38] demonstrated that for the general population undergoing Kelman's phacoemulsification (KPE) for cataracts the RRD rate was 1.17% per year, which is 100 times the rate for the unoperated eyes. Using their data,

in other words, removal of the crystalline lens and replacing it with a lens implant, dramatically increases the risk of RRD even if the actual rate is low, but nevertheless significant. The RRD rate in myopic eyes of axial length greater than 25 mm after KPE embracing both RLE and cataractous eyes was about 2.2% (see average of eyes affected by RRD in Table 9.2). This rate of occurrence of 220 eyes per 10,000 is double that of the general population rate or approximately 200 times the natural rate (Table 9.3). However, the rate of spontaneous retinal detachment in a population of myopic eyes with more than –10 D is quoted as 0.68% [35], which is equivalent to an axial length of more than 26 mm. Thus, comparing like with like as far as can be achieved, 0.68% increases to at least 2.2%, i.e., by a factor of 3 as a result of lens exchange.

Summary for Clinicians

- The overall rate of RRD in myopic eyes after RLE is a mean of 2.2% (range 0–8%).
- The mean time for occurrence of RRD after RLE is 39 months.
- PVD is an initiating factor.

9.8 Why Should Myopic Eyes Be Vulnerable to RRD?

Ramos and Kruger [41] articulate the widely held belief that volumetric changes in eyes undergoing removal of the crystalline lens induce the circumstances of exciting vitreo-retinal pathology.

Table 9.3 Annual incidence of RRD. *KPE* Kelman's phacoemulsification, *ICCE* intracapsular cataract extraction

Reference	Eyes in study	Incidence
[37]	General population	0.012% = 1.2:10,000
[24]	General population	0.008% = 0.8:10,000
	60–69 years	0.022% = 2.2:10,000
	Phakic blunt trauma	0.009% = 0.9:10,000
	Nontraumatic	0.006% = 0.6:10,000
[17]		0.005% = 0.5:10,000
[47]	General population	0.2% = 20:10,000
[35]	More than -10 D	0.68% = 68:10,000
[38]	After KPE	1.17% = 117:10,000
	<50 years	5.1% = 510:10,000
	>70 years	0.7% = 70:10,000
[24]	Pseudophakia and aphakia	0.008% = 0.8:10,000
Overall incidence of RRD following RLE for myopia		2.2% = 220:10,000
Risk of RRD following RLE for myopia		1 in 45 eyes
[41] RRD rate after	ICCE	= 0.40–3.6%
	ECCE	= 0.55–1.65%
	Phaco	= 0.75–1.65%.

The volume of the eye obviously varies according to its diameter. Myopic eyes are large and as is well accepted the retina does not expand but stretches. If the crystalline lens is removed the vitreous degenerates more so the larger the eye will expand to fill the void. Therein lies the problem, for if the vitreous is attached prior to lens exchange, the extra volume at its disposal sharply increases the risk of a posterior vitreous detachment. Because of the intrinsic vitreo-retinal pathology in large eyes, anomalous vitreo-retinal attachments are more likely than in emmetropic eyes or hyperopic eyes of smaller dimensions. As vitreous detaches it may tear the retina at the point of attachment and thereby create the conditions for the retina to detach (Table 9.4).

9.9 Prophylaxis

Therefore, retinal prophylaxis should have a marginal effect on the incidence of RD. The literature supports this view in terms of pre-existing identifiable retinal pathology (1999 data). Colin and colleagues' three papers [5–7] on retinal detachment in myopic eyes were based on a very small sample, of which 3 patients had 4 retinal detachments occurring some years after cataract extraction using methods not comparable to today's surgical procedure. He did demonstrate that prophylactic treatment seemingly had little value in preventing detachment. Particular risk factors he illustrated were higher myopia (>10 D) and the passage of time in a pseudophakic myopic eye, despite prophylactic retinal treatment. If a conclusion were to be reached on the basis of his findings it would have to be that regular sequential monitoring of myopic pseudophakic eyes is required to assess retinal pathology and then apply prophylaxis if clinical signs most likely to appear with or without symptoms warrant that degree of follow-up observation.

On the other hand Sharma et al. [46] studied 64 patients with an RRD in one eye, but who were phakic in the fellow eye. During an average follow-up of 57.4 months, 5 (7.8%) fellow eyes developed retinal detachment while still phakic. In addition to the 5 eyes with a phakic RD, 10 originally phakic fellow eyes underwent cataract surgery. Of these, 1 (10%) suffered an RRD. Thus, they concluded that the fellow eyes of patients with an RRD are at significant risk of RD even if they do not undergo cataract surgery. However, this does not mean that signs of impending RRD would be discernable or that prophylactic therapy was admissible. In terms of myopic eyes the need to carefully evaluate vitreo-retinal signs is thus demonstrated.

More circumstantial evidence of the effect of lens extraction on the eye's internal structures is offered by Grand [13], who studied the risk of a new retinal break or detachment following cataract surgery in eyes that had undergone successful repair of phakic break or detachment. In a 10-year study of patients who had undergone prior repair of retinal breaks or detachment, cataract surgery was associated with a 4.6% incidence of new breaks or detachment. Cataract surgery, i.e., lens extraction, appears to be an independent risk factor for retinal tears or detachments. It follows that a dilated retinal examination following cataract surgery is advisable in patients who have previously undergone repair of a phakic retinal tear or detachment, and even more so in myo-

Table 9.4 Axial length

Axial length	Approx. eye volume .	Approx. lens volume	Approx. IOL volume
26 mm	9 ml	0.5 ml	0.05 ml
28 mm	12 ml	0.5 ml	0.05 ml
30 mm	14 ml	0.5 ml	0.05 ml
32 mm	17 ml	0.5 ml	0.05 ml
34 mm	20.5 ml	0.5 ml	0.05 ml
36 mm	24 ml	0.5 ml	0.05 ml

pic eyes that become pseudophakic even without prior detachment or retinal tear, for this study seems to confirm the theory that expanding the internal volume of the eye by lens extraction and the internal dynamic changes that take place during the extraction process may be the precursor of retinal breaks and subsequent RRD.

Summary for Clinicians

- 75% of RRD after RLE occur within 12 months of RLE.
- 91% of RRD result in retinal attachment.
- The mean visual acuity loss is 2 Snellen lines.
- The corollary is that 9% do not repair, resulting in serious visual loss.

9.10 Nd:YAG Laser Posterior Capsulotomy and Retinal Detachment

Tielsch et al. [49] addressed the odds ratio for RRD after cataract surgery in general. "Conditional logistic regression models showed that a number of factors were associated independently with an excess risk of retinal detachment after cataract surgery. These included Nd:YAG laser capsulotomy (odds ratio [OR] = 3.8; 95% confidence interval [CI], 2.4–5.9), a history of retinal detachment (OR = 2.7; 95% CI, 1.2–6.1), a history of lattice degeneration (OR = 6.6; 95% CI, 1.6–27.1), axial length (OR = 1.21 mm; 95% CI, 1.03–1.43), refractive error (OR = 0.92/diopter; 95% CI, 0.88–0.95), and a history of ocular trauma after cataract surgery (OR = 6.1; 95% CI, 4.3–28.2)."

Other authors [19, 26, 39] are more reticent regarding the effect of Nd:YAG capsulotomy on RRD rates. Koch et al. [21] conducted a retrospective analysis of Q-switched Nd-YAG laser capsulotomies performed in 122 eyes between April 1984 and June 1987. Retinal complications occurred in 3 (2.5%) out of 121 eyes followed up for 1 year and in 2 (3.6%) out of 55 eyes followed up for 2 years. Four eyes developed RRD and 1 developed an acute symptomatic retinal tear that correlated with axial myopia, pre-existing vitreoretinal disease, male gender, younger age, vitreous prolapse into the anterior chamber, and spontaneous extension of the capsulotomy. However, if there is an increased risk of retinal detachment occurring in myopic pseudophakic eyes after Nd:YAG capsulotomy, the literature shows a significant variation of RRD rate and time after capsulotomy [1–3, 5, 6, 9, 10–12, 14, 16, 18–20, 22, 23, 25, 26, 28, 30, 32, 36, 39, 40, 43–45, 50, 52–54]. The methodology of Nd:YAG capsulotomy may be an explanatory factor causing the variance. The energy used during treatment, the diameter of the capsulotomy, and previous preoperative and postoperative retinal scrutiny may all play a part; however, this degree of detail can simply not be extracted from the literature [47, 49].

9.11 Relationship of RRD Occurrence to Surgical Complications of Lens Extraction

Several papers confirm the increased risk of retinal detachment if a capsular tear occurs, if an anterior vitrectomy is performed, or if vitreous loss is recorded [16]. Onal et al. [34] suggest that the odds for a complicated outcome of a capsular tear during phacoemulsification can be calculated. They suggest, for example, that retinal complications have the following ratios: 12:1 for RD and 26:1 for CME, which compare with 15:1 for raised IOP and 33:1 for IOL decentration (Tables 9.5–9.7).

9.12 Risk of RRD After RLE in Hyperopic Eyes

Hyperopic eyes do not have the intrinsic retinal pathology associated with myopia and increased axial length. In only one paper in the literature for RLE in hyperopia did the authors indicate that no retinal detachments occurred in that series [29]. This is mirrored in our (Rosen Eye Associates Clinic) results in a significant but unpublished series of 421 eyes studied with a minimum follow-up of 1 year and a maximum of 5 years in which 1 RRD occurred.

Table 9.5 Onal [34]: following capsule rupture during lens exchange. *CME* cystoid macular edema

• RD rate	8%	=	1:12
• CME rate	4%	=	1:26
• IOP rise	7%	=	1:15
• Dislocated IOL	3%	=	1:33

Table 9.6 Annual incidence of RRD and risk factors

In general population	=	**0.018%** [37]
After KPE in general population	=	**1.17% (100x) range** [8]
After KPE in myopic eyes	=	**2.2% (range 0–8.1%) (see Table 9.2)**
After KPE with capsular tear, etc.	=	**8.0%** [49]

Table 9.7 Annual incidence of RRD and risk factors expressed as :1,000 per annum

• **RRD in general population** [37]	=	**0.18:1,000**
• **RRD after KPE general population**	=	**11.7:1,000**
• **RRD after KPE myopic population**	=	**22:1,000**
• **RRD after KPE male myopic population**	=	**28:1,000**
• **RRD after KPE myopic population <50 years**	=	**55:1,000**
• **RRD after KPE myopic population with capsular tear**	=	**99:1,000**
Retinal reattachment rates after RRD	=	**90%+** [42]
Mean visual deficit	=	**2 lines** [42]
Retinal reattachment failure	=	**1 in 10 eyes** [42]

9.13 Prognosis of RRD Following RLE: Outcome of Pseudophakic Retinal Detachment

If retinal detachment does occur in pseudophakia, does it spell doom or can the retina be successfully reattached with a good visual outcome, i.e., what is the probable functional and anatomic outcome of RD in pseudophakic eyes?

In considering these issues in myopic eyes in particular, Ranta et al. [42] reported the outcome of 138 eyes treated by uncomplicated ECCE, but followed by RRD. There was a 35% Nd:YAG capsulotomy rate. Seventy-four percent achieved a successful retinal repair following one procedure. Overall, 91% achieved long-term retinal attachment, i.e., there was a 9% failure rate or 1 in 10 eyes. Many had some reduction of BCVA. Because of life-long risks of RRD in myopic eyes, those that undergo RLE or cataract extraction should have a large diameter IOL and wide CCC to facilitate postoperative retinal scrutiny. Silicone IOLs should be avoided to limit PCO and emulsification of silicone oil if it is required. It should also be noted that the mean time for an RRD to occur postoperatively is 39 months.

In a study of 114 cases of RRD after phacoemulsification, Haddad et al. [15] indicated that once RRD occurred, there was no statistically significant correlation between the final visual outcome and KPE intraoperative complications including: posterior capsular rupture, vitreous loss, and posteriorly dislocated lens fragments.

Christensen et al. [4] compared pre- and postoperative findings in 120 pseudophakic patients and 280 phakic patients who had RRD surgery over a 4-year period. An identical scleral buckling procedure was used for primary surgery in both groups. Cataract surgery had been performed using ECCE in most eyes; phacoemulsification was used in 67.5% of the pseudophakic eyes. The mean follow-up was 13.5 months. Pseudophakic patients with RRD presented with significantly worse preoperative visual acuity than phakic patients due to a higher frequency of total RRD and macula-off RRD. Retinal breaks were found significantly less frequently and reoperations were performed with a higher frequency in pseudophakic patients than in phakic patients.

Table 9.8 Data after phakic IOL implantation with regard to RRD [30]

- The incidence of RRD after PCP IOL implantation was 2.07%
- Mean patient age was 32.9 years (range, 23–46)
- Nine patients underwent bilateral PCP IOL implantation (60%)
- Primary RRD developed in 16 eyes of 15 patients
- Prophylactic laser photocoagulation was performed in 3 eyes in 3 patients (18.75%)
- Mean preoperative spherical equivalent (SE) was −17.3±2.47 D (range, −13.75 D to −22 D)
- Rhegmatogenous retinal detachment occurred between 1 and 70 months after PCP IOL implantation (mean, 29.12 months)
- Each of 11 RRDs (68.75%) had one causative break
- Fourteen breaks (60.86%) were horseshoe tears and 9 (39.14%) were atrophic holes
- Scleral buckling was performed in 10 eyes (62.5%)
- Pars plana vitrectomy alone was performed in 5 cases (31.25%) with posterior breaks. Initial reattachment rate was 90.9%
- Final retinal reattachment was 100%. Mean postoperative BCVA was 20/28 (0.72±0.25)
- Mean follow-up after retinal detachment surgery was 35.25±17.29 months (range, 12–67 months)

Table 9.9 Odds for RRD

Perkins [35] more than -10 D 1 in 140 unoperated eyes will suffer RRD
Polkinghome and Craig [37] suggest that 1 in 8,333 (all) eyes will suffer RRD on an annual basis
Polkinghome and Craig [38] suggest that 1 in 85 (all) eyes will suffer RRD on an annual basis after uneventful KPE
Table 9.2 suggests mean figure of 2.2% for RRD, i.e., for every 1,000 myopic eyes 22 will suffer RRD at some time after lens surgery = 1:48
If a peak figure of 8% is accepted (Ripandelli et al. [44] and Colin [7]) then 80 myopic eyes will suffer RRD at some time after lens surgery = 1:12
If a capsule rupture were to occur during lens surgery the rate increases to 1 in 12 (irrespective of myopia)
If the patient is less than 50 years, rates may increase by a factor of 5 (Polkinghome and Craig [38])
If the patient is male rates may increase by factor of 1.25 (Polkinghome and Craig [38])

The overall anatomic reattachment rate was 94% and 96% in the two groups respectively, and the visual outcome was also similar, with a visual acuity better than 0.4 in about 60% of patients. The authors concluded that the anatomic and visual prognosis of pseudophakic detachments was identical to that of phakic detachments.

In a recent study, Martinez-Castillo et al. [30] provide the most detailed information, albeit in relation to phakic IOL implantation in myopic eyes. Although the surgical process is different, the phakic IOL is an additive process, whereas RLE removes the crystalline lens. Nevertheless, it is reasonable to suppose that in many if not all operated eyes the interior milieu of the eye fluctuates with consequentially adverse effects on the vitreous body. Therefore, it is not unreasonable to infer that RRD data may be relevant to the consideration of RRD following RLE. The authors' data are summarized in Table 9.8. For a wider summary of odds for RRD see Table 9.9.

9.14 Ethical and Medico-Legal Considerations

While the potential benefits of RLE can be successfully argued, the Ophthalmic Mutual Insurance Company of USA (OMICS), which insures more than 3,500 policyholders (35% of whom perform refractive surgery), takes a conservative approach. According to OMICS data, the company has offered coverage for RLE since 1999 and revisited its guidelines when the Crystalens was approved by the FDA for use in cataract surgery.

Table 9.10 Percentage of Ophthalmic Mutual Insurance Company of USA (OMICS) ophthalmologists insured for different types of refractive surgery

Laser assisted in situ keratomileusis	**29.2%**
Photorefractive keratectomy	**28.9%**
Radial keratotomy	**12.7%**
Refractive lens exchange	**8.0%**
Conductive keratoplasty	**2.3%**
Laser thermokeratoplasty	**1.8%**
Intacs	**1.6%**
Phakic intraocular lens implantation	**0.6%**

Refractive surgery patients have higher expectations, but need to fully comprehend the risks of intraocular surgery. The frequency of complications may not be great but the seriousness of the possible risks is an issue. Ophthalmologists could have a difficult time in front of a judge or jury, to defend this procedure in the event of an adverse outcome, especially if the patient is relatively young with minimal refractive error and no evidence of cataract. Sometimes patients may have unrealistic expectations and be very disappointed with the ultimate results. Near, intermediate, and distance vision are considerations that may lead to patient dissatisfaction with outcome.

Insurance by OMICS generally provides cover only for cases performed on patients with more than -10 D of myopia or between +3 and +15 D of hyperopia, ranges for which other refractive procedures are not as effective as they are for lower refractive errors. OMIC is also willing to consider exceptions to these patient selection criteria on a case-by-case basis due to special situations (Table 9.10).

In the UK, professional indemnity to cover the practice of refractive surgery has escalated proportionately to the rise in litigation, although the majority of refractive litigation is laser corneal surgery-based.

9.15 Conclusion

Emmetropization of myopic eyes by lens exchange embraces risk the scale of which can be deduced by a comparison of RRD rates in a general population and by grading the severity of the myopia (axial length) and patient age in particular. Table 9.3 indicates the wide disparity in the annual incidence of RRD in unoperated eyes in a general population. To compare like with like requires an annual figure for RRD in myopic eyes after RLE or cataract surgery that is impossible to derive. Nevertheless, it does represent a starting point for comparisons that can be refined with the passage of time and accumulation of more data. Perkins' data suggest a natural risk of RRD in myopic eyes more than –10 D of 1 per 140 eyes over a lifetime [35]. This compares with Polkinghome and Craig's figure of 1 eye in every 8,333 eyes on an annual basis [37]. The same authors suggest that 1 eye in 85 is at risk of RRD following lens extraction by KPE (annual rate), i.e., lens exchange enhances the risk by a factor of 100. Assuming the overall figure of RRD following RLE/cataract surgery in myopic eyes is 2.2% (for the mean figure see Table 9.2), then the overall risk of RRD doubles again to 1 in 45 eyes. If the highest value of 8% (see Table 9.2) is accepted, then 1 in 12 eyes run the risk of RRD after surgery. Onal et al. [34] suggest that 1 in 12 eyes will succumb to RRD following lens extraction complicated by capsule rupture. Polkinghome and Craig [38] quantified the age factor noting that the annual rate of RRD after lens extraction was 1.17% increasing to 5.1% for the under 50 age group. In other words, a patient with myopic RLE aged less than 50 years who has had a complicated lens extraction is at exceptionally high risk of RRD, the longer the axial length adding to the cumulative risk.

Pseudophakia in myopic eyes carries a higher risk of RD than in formerly emmetropic or hyperopic eyes consequent upon the intrinsic vitreo-retinal pathology associated with greater eye globe axial length and the consequent stretching/degeneration of both vitreous and retina.

Refractive lens exchange for myopia, relevant to higher degrees of myopia, is a most effective process where risk factors are clearly identifiable and should be discussed fully with prospective candidates. Long-term case control studies of a high volume of myopic eyes undergoing RLE would undoubtedly be valuable in further quantifying risk (Table 9.8).

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