

UNDERSTANDING AGE-RELATED CATARACT AND MODERN CATARACT SURGERY

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INTRODUCTION

Although opacities are sometimes present in the crystalline lens from birth, most cataracts develop later in life. Because the prevalence of cataract rises exponentially with advancing age, age-related (previously called “senile”) cataract is by far the most common type of cataract. As the life expectancy and proportion of elderly persons in the Singapore population increase, the prevalence of cataract is correspondingly on the rise^{1,2}.

Fortunately, cataract can be easily treated with surgery. The technology and techniques of cataract surgery have progressed at an extremely rapid pace in the last decade, making cataract surgery very safe and effective. This article serves to update the family physician on the symptoms of age-related cataract and the recent major advances in cataract surgery.

Definition of cataract

A cataract is an opacity in the crystalline lens of the eye. It becomes clinically significant when the transparency of the crystalline lens decreases

sufficiently to disturb vision. Visual disturbance is usually due to light scattering or absorption in the axial part of the cataractous lens. However, similar changes in the peripheral parts of the lens may exist without visual disturbance. Although these changes are strictly cataracts by definition, one may not wish to label them as such as long as the vision is normal. This distinction is useful so that patients with lens opacities, but no visual symptoms, are not worried unnecessarily by a premature diagnosis of cataract.

Cataract and cataract surgery in Singapore

A recent community-based study of 574 subjects aged 60 years and above in Singapore disclosed that the prevalence of cataract (defined as lens opacities observed by an ophthalmologist and a visual acuity of 6/9 or worse in the same eye) was 78.6%³. The percentage of persons with cataract increased from 63.6% in those between 60 and 64 years to 94.6% in those 75 years and older. The prevalence of blindness (defined as best-corrected visual acuity of 6/60 or worse in the better eye) and visual impairment (defined as best-corrected visual acuity of worse than 6/12 but better than 6/60 in the better eye) was 3.0% and 15.2% respectively in the same study. Cataract was the sole or contributory cause of blindness in 16 out of 17 cases and the sole or contributory cause of impaired vision in 86 out of 87 cases. It was also the most common ocular pathology found in these elderly individuals and the most frequent cause of visual loss.

Fortunately, modern cataract surgery is a very effective way in restoring vision in those afflicted with visual impairment due to cataract^{4,5}. Cataract surgery is the most commonly performed ophthalmic operation in Singapore and the rate

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of surgery has risen in recent years. Data from Medisave claims disclosed a significant increase in the number of cataract surgeries performed, from 5,679 operations in 1986 to 12,177 in 1995⁶. There was a steady increase in the rate of cataract surgery from 277.4 operations per 100,000 persons/year in 1991 to 465.0 per 100,000 persons/year in 1996⁷. This works out to be an average increase of 40 operations per 100,000 persons/year (95% confidence interval [CI], 28.6 – 52.8)⁷.

TYPES OF AGE-RELATED CATARACT AND THEIR SYMPTOMS

There are three common types of age-related cataracts and they may co-exist in the same eye.

Nuclear sclerotic cataract

Nuclear sclerotic cataract is characterised by an increased density of the central lens nucleus. This nuclear sclerosis induces an artificial myopia known as index myopia because it is caused by an increase in the refractive index of the lens. In the early stages, spectacles can correct this myopia. As time progresses, the rate of nuclear sclerosis tends to accelerate and spectacles may only improve the vision for several months before the patient seeks help again. Some elderly presbyopic patients with nuclear sclerotic cataracts may be able to read again without spectacles due to the induced myopia ("second sight of the aged".) In more severe cases, the vision is progressively reduced as the density of the cataract increases.

Cortical cataract

A cortical cataract is one in which the opacification involves the anterior, posterior or equatorial cortex of the crystalline lens. These radial spoke-like or

shield-like opacities progress from the periphery of the lens to the centre and often give blinding glare from oncoming headlights when driving at night or on bright, sunny days.

Posterior subcapsular cataract

Posterior subcapsular cataract forms in the visual axis at the central posterior pole of the lens. Relatively minor degrees of this form of cataract can have an effect on vision that is out of proportion to the density of the opacity. Patients are typically troubled by headlights of oncoming vehicles and by bright sunlight. The vision in normal or dim room lighting may be much better than the vision outdoors on a bright, sunny day.

PRINCIPLES OF MANAGEMENT

The mere presence of a cataract is insufficient reason for its removal. Patients whose cataracts are causing a loss of quality of life, despite wearing an appropriate optical correction, may be considered for surgery. Modern, small-incision cataract surgery provides rapid visual rehabilitation with relatively low risk of complications. Indeed, with the surgery becoming safer and the results more predictable, it is rare for patients who have had cataract surgery performed to regret their decision to have surgery.

One must be wary of attributing all visual loss to cataract in patients with lenticular opacities. Cataract may mask subtle signs of co-existing chronic glaucoma, diabetic maculopathy and age-related macular degeneration by making fundal examination with the ophthalmoscope more difficult. Because blindness from co-existing ocular pathology may be irreversible, it is crucial to exclude these conditions before reassuring patients that their visual impairment is due entirely to cataracts.

TYPES OF CATARACT SURGERY

Recent advances in technology and surgical techniques have given ophthalmologists a safe and effective method of restoring vision, even at an early stage in the disease process where surgery would have been inadvisable in the recent past. There are four main types of cataract removal currently in use.

Intracapsular cataract extraction

Intracapsular cataract extraction (ICCE) is an old technique in which the entire lens and its capsule are removed together with the aid of a cryopencil. Most ophthalmologists in developed countries have abandoned this technique for routine cataract surgery, although it is still in use in some developing countries. However, ICCE still has a place in developed countries for the management of subluxated cataracts (Figure 1)^{8,9}.

Extracapsular cataract extraction

Extracapsular cataract extraction (ECCE) was the technique of choice for cataract surgery, until the last several years in Singapore. This technique requires a large surgical wound to remove the nucleus of the lens. The lens is delivered through an opening made in the anterior capsule, followed by removal of the cortical lens material in the capsular bag. The posterior capsule of the lens is retained in the eye to hold a posterior chamber intraocular lens. Approximately seven interrupted sutures are necessary to close the large surgical wound.

Phacoemulsification

Phacoemulsification is currently the most advanced technique for cataract removal (Figure 2). It is the surgery of choice for many surgeons in Singapore, as well as for most ophthalmologists in developed

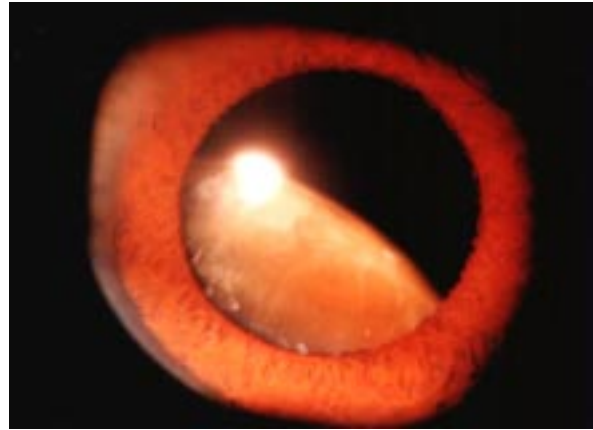


Figure 1: A hypermature subluxated cataract. Such a cataract is not suitable for phacoemulsification but may be removed with planned intracapsular cataract extraction. (From Au Eong KG, Lee SB. Test your eye-Q (No. 5): long standing loss of vision. *The Singapore Family Physician* 1998; 24(2): 32, with permission).



Figure 2: A modern phacoemulsification machine for small-incision cataract surgery. (Photograph courtesy of Alcon).

countries such as the United Kingdom and United States of America. This state-of-the-art surgery is performed through a tiny self-sealing wound in the eye. As in ECCE, the posterior capsule is retained to hold a posterior chamber intraocular lens. The main advantage of phacoemulsification is that the period of visual rehabilitation is greatly reduced because the procedure causes less postoperative inflammation¹⁰ and less surgically induced astigmatism from the small incision.

Pars plana lensectomy

A cataract may be removed through the same approach as for vitreous surgery (vitrectomy). This is called pars plana lensectomy. This technique is sometimes used when cataract surgery is combined with pars plana vitrectomy for other co-existing vitreoretinal pathology such as diabetic vitreous haemorrhage or retinal detachment.

INTRAOCULAR LENS IMPLANTATION

An intraocular lens is the best mode of optical correction following cataract surgery. It provides better quality of vision compared to aphakia corrected with thick glasses. It is also more convenient than contact lenses, particularly in the elderly population. For these reasons, almost all cataract operations performed today are combined with intraocular lens implantation in the same sitting.

Because an intraocular lens of almost any power can be inserted during surgery, any pre-existing spherical refractive errors such as myopia or hypermetropia can be corrected. In addition, regular corneal astigmatism may be reduced or corrected by careful placement of the incision site or by making additional cuts in the cornea (arcuate keratotomy). Patients who benefit most are those

with moderate to high myopia who can abandon their heavy and thick glasses after surgery.

A number of patients who had cataract surgery more than a decade ago did not have an intraocular lens implanted at the time of the operation. These patients may benefit from secondary intraocular lens implantation¹¹.

COMPLICATIONS OF CATARACT SURGERY

The visual outcome of cataract surgery is usually excellent, unless there is co-existing pathology such as age-related macular degeneration^{12,13} or diabetic maculopathy that also impairs vision¹⁴. Cataract surgery, however, is not entirely without risks. The most feared complication is postoperative infection (endophthalmitis) which may result in total blindness^{15,16} (Figure 3). The incidence of endophthalmitis was reported to be 0.1% (95% CI, 0.1-0.2%) in a series of 15,787 patients in the National Cataract Survey in the United Kingdom¹⁷.

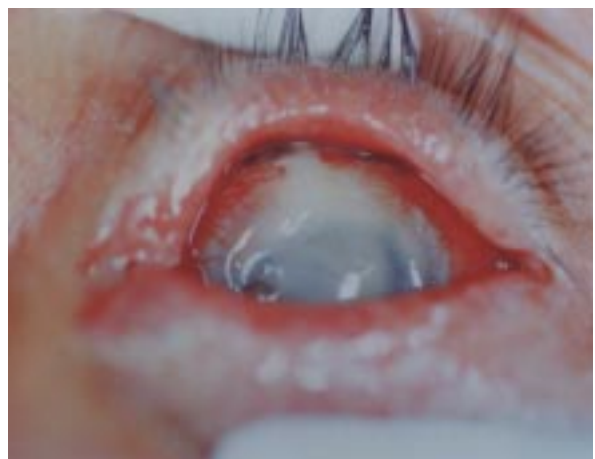


Figure 3. Postoperative bacterial endophthalmitis is a rare but sight-threatening complication of cataract surgery. (From Au Eong KG, Yip CC. Test your eye-Q (No. 9): a painful red eye following cataract surgery. *The Singapore Family Physician* 1999; 25(4): 31, with permission).

The most common intraoperative complication is posterior capsule rupture with or without loss of vitreous¹⁷. Occasionally, lens material may also drop into the vitreous cavity following rupture of the posterior capsule. Fortunately, these retained lens fragments can usually be removed with modern vitreoretinal techniques with good visual results¹⁸. Rupture of the posterior capsule may sometimes prevent the placement of a posterior chamber intraocular lens in the capsular bag. In this instance, the posterior chamber intraocular lens may be placed in the ciliary sulcus or be fixated to the sclera with nonabsorbable sutures. Alternatively, instead of a posterior chamber intraocular lens, an anterior chamber intraocular lens may be implanted.

Postoperatively, some patients may experience surgically related complications such as corneal oedema, raised intraocular pressure and uveitis. These complications are easily managed medically, are transient, and do not usually cause any permanent visual problems.

MODERN CATARACT SURGERY

Modern cataract surgery is typically a day surgery procedure using the technique of phacoemulsification with foldable intraocular lens implantation performed under local anaesthesia. The following sections briefly describe what a patient can expect during the various stages in the management of his cataract.

Preoperative evaluation

The ophthalmologist will first assess the patient in an outpatient setting. This will usually include measurement of visual acuity, an examination on the slit-lamp, measurement of intraocular

pressure and ophthalmoscopy through dilated pupils. None of these should be daunting to the patient as all these tests and examination are painless. The ophthalmologist will then discuss the potential risks and benefits of the surgery with the patient.

If a decision is made to proceed with surgery, a test called biometry will be necessary to calculate the power of the intraocular lens to be implanted during the operation. This involves a measurement of the curvature of the cornea (called keratometry) and an ultrasonic measurement of the axial length of the eye.

Ophthalmic anaesthesia

The majority of phacoemulsification is performed under topical or regional anaesthesia. General anaesthesia is used for the occasional patient who is unable to cooperate with the surgeon during topical or regional anaesthesia.

Regional anaesthesia involves either a retrobulbar or peribulbar injection of anaesthetic solution. The main disadvantages of injection anaesthesia are the risks of globe perforation, retrobulbar haemorrhage and inadvertent intracranial injection.

A recent development is the use of only topical anaesthetic eyedrops for phacoemulsification. Topical anaesthesia is gaining popularity with ophthalmic surgeons worldwide, because it avoids many of the potential systemic and ocular complications associated with injection anaesthesia techniques¹⁹. In addition, because there is no injection involved and the phacoemulsification wound is made in the avascular cornea, topical anaesthesia allows patients on aspirin or anticoagulation with warfarin to have cataract surgery without having to stop these medications.

Phacoemulsification and intraocular lens implantation

Following the administration of anaesthesia (either topical anaesthetic eyedrops or a regional anaesthetic injection), a self-sealing wound is constructed in the cornea. A circular tear is first made in the anterior portion of the lens capsule. Balanced salt solution is then injected under the remaining rim of anterior capsule to separate the capsule from the lens fibres. A phacoemulsification probe (Figure 4) is then introduced into the eye to remove the cataract.

The phacoemulsification probe performs a number of functions. The phacoemulsification needle has a very rapid oscillation forwards and backwards. This allows it to cut through solid lens matter and to “emulsify” the lens. A suction pump attached to the probe allows a controlled aspiration of the emulsified lens material. The probe has constant flow of fluid into the eye for irrigation and to maintain a constant intraocular pressure. All these functions of the probe are controlled by a foot pedal.

Once the majority of the harder nuclear lens material has been emulsified and aspirated, the residual peripheral soft lens matter is removed with an irrigation/aspiration probe. The capsule is then prepared for implantation of an intraocular lens.

Over the past several years, foldable intraocular lens implants (Figure 5) have gained popularity because they can be inserted through a small incision. This reduces the incidence and severity of postoperative astigmatism. The foldable intraocular lens is inserted into the eye using either special forceps (Figures 6 and 7) or an injector system (Figure 8 and 9).

At the end of the operation, antibiotics (e.g., gentamicin and cephazolin) and a corticosteroid (e.g., dexamethasone) are either applied topically

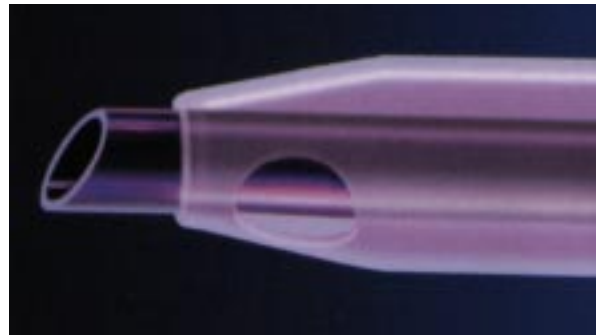


Figure 4: A phacoemulsification probe for modern cataract surgery. (Photograph courtesy of Alcon).

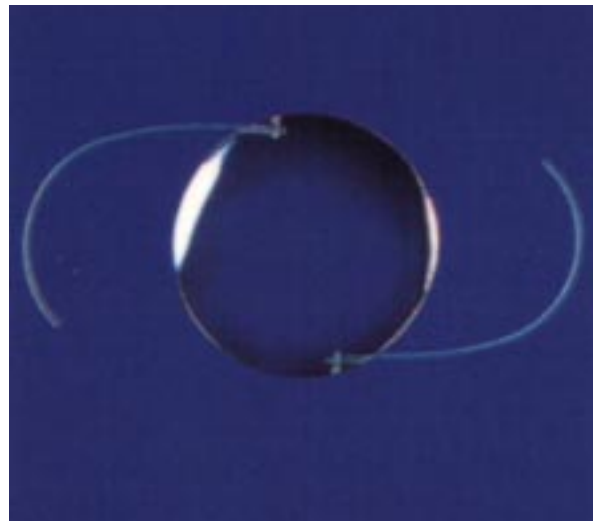


Figure 5: A foldable acrylic posterior chamber intraocular lens. (Photograph courtesy of Alcon).

for eyes operated under topical anaesthesia or are injected in the subconjunctival space for eyes operated under regional anaesthesia. The entire surgical procedure usually takes about 20 to 30 minutes.

Visual experience during cataract surgery

Can patients see with their operated eye during cataract surgery under local anaesthesia? There is a common misconception that patients would not be able to see much with their operated eye during surgery. Even the patient information leaflet



Figure 6: Folding of an intraocular lens with forceps prior to implantation. (Photograph courtesy of Alcon).

(Appendix I) in *Cataract Surgery Guidelines* published by the Royal College of Ophthalmologists London, states that patients given local anaesthesia during cataract surgery “will not be able to see what is happening, but will be aware of a bright light”²⁰. This advice in fact contradicts recent findings published in the literature²¹.

It is now known that many patients are aware of a variety of visual sensations in the operated eye during cataract surgery under topical,^{19;22;23} retrobulbar^{24,25} and peribulbar anaesthesia²⁶. These visual sensations include subjective perception of light, movement, flashes, one or more colours, surgical instruments, the surgeon’s hand/fingers, the surgeon and a change in light brightness²¹.

Postoperative management

Following phacoemulsification, patients are prescribed topical antibiotic (e.g. Gutte chloramphenicol) and topical anti-inflammatory (e.g. Gutte prednisolone acetate) eyedrops. The eyedrops are usually used for four to six weeks. If the operation was performed under topical anaesthesia, the postoperative drops are used several hours after the operation. If the operation was performed under regional anaesthesia and antibiotics and corticosteroid have been injected subconjunctivally, the eyedrops are usually used the

following day. No analgesic is usually necessary as severe pain is unusual following uncomplicated phacoemulsification.

Between four and six weeks after phacoemulsification, a refraction is commonly performed to determine the postoperative refractive error of the eye. If the refractive error is low and the uncorrected visual acuity is good, many elderly patients prefer not to wear glasses for convenience. Patients who have been rendered

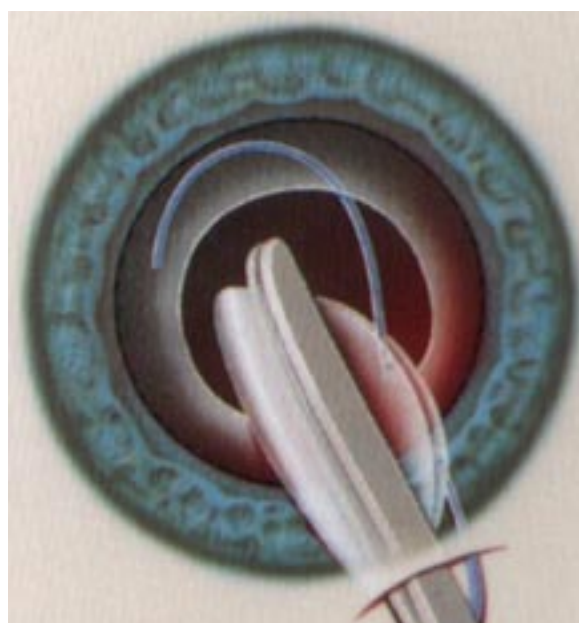


Figure 7: A foldable posterior chamber intraocular lens being implanted into an eye using forceps. (Photograph courtesy of Alcon).



Figure 8: A foldable posterior chamber intraocular lens being loaded into an injector prior to implantation. (Photograph courtesy of Alcon).

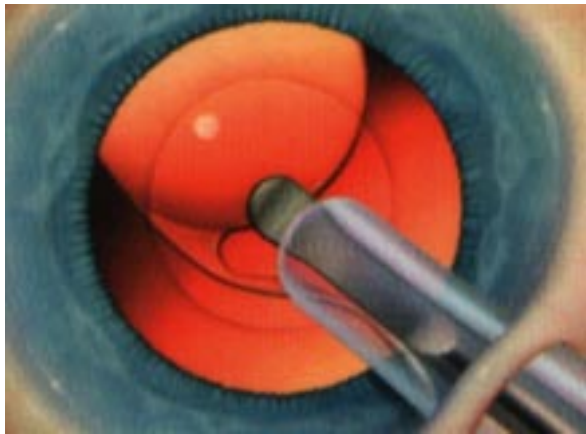


Figure 9: A foldable posterior chamber intraocular lens being implanted into an eye using an injector. (Photograph courtesy of Alcon).

emmetropic after the surgery will require reading glasses for near vision. This is because the intraocular lens has a fixed focal length and is unable to accommodate.

Postoperative restrictions

There are less restrictions following phacoemulsification than after other forms of cataract surgery (Table 1). Typically, a patient may resume most sedentary activities the day after the

Table 1: Postoperative advice for patients following phacoemulsification and foldable intraocular lens implantation. There is less postoperative restriction following phacoemulsification than after conventional extracapsular cataract extraction.

Postoperative advice

- κ You may resume most activities the day after surgery but please avoid direct trauma to your operated eye, including rubbing it.
- κ You may watch television programmes or read.
- κ You may cook the day after surgery. Wearing glasses while cooking prevents cooking oil from spattering into the eye.
- κ You may bend down or bend your head forward the day after surgery.
- κ When washing your hair, avoid shampoo in the operated eye.
- κ Showering is permitted, but avoid being struck in the eye by the water jet.
- κ Avoid swimming for four weeks.
- κ There is no restriction to your diet as far as the cataract surgery is concerned.
- κ Marital relations may be resumed 1 week after surgery

surgery. Marital relations may be resumed after one week. Patients are advised to wear a protective eye shield when they sleep and to avoid pressure on their eyes for about one to two weeks after surgery. They should also abstain from swimming for four weeks.

Surgery for second eye

Many patients with bilateral cataracts will identify the other eye with less cataractous changes as deficient shortly after phacoemulsification in the more severely affected eye and desire a similar operation on the second eye. This second surgery can be performed one week or later after the first surgery. The advantages of spacing the two operations by a short interval include the convenience of combining the postoperative visits for both eyes and to have glasses made for both

eyes at the same time. Many surgeons avoid simultaneous bilateral cataract surgery because of the possible, albeit small, risk of bilateral endophthalmitis.

CONCLUSION

As the proportion of elderly individuals in Singapore increases, the prevalence of age-related cataract is correspondingly on the rise. Fortunately, those afflicted with cataracts need not live with impaired vision because modern cataract surgery is very safe and effective.

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