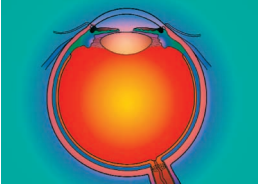


CHAPTER 8



The lens and cataract

LEARNING OBJECTIVES

To understand:

- The pathology of cataract; its symptoms, signs and causes.
- The reasons for undertaking cataract surgery.
- The principles of the different forms of cataract surgery.
- The complications of cataract surgery.

INTRODUCTION

The lens is biconvex and transparent. It is held in position behind the iris by the suspensory ligament whose zonular fibres are composed of the protein fibrillin which attach its equator to the ciliary body. Disease may affect structure, shape and position.

CHANGE IN LENS STRUCTURE

Cataract

Opacification of the lens of the eye (*cataract*) is the commonest cause of treatable blindness in the world. The large majority of cataracts occur in older age as a result of the cumulative exposure to environmental and other influences such as smoking, UV radiation and elevated blood sugar levels. This is sometimes referred to as *age-related cataract*. A smaller number are associated with specific ocular or systemic disease and defined physico-chemical mechanisms. Some are congenital and may be inherited.

OCULAR CONDITIONS

Trauma
 Uveitis
 High myopia
 Topical medication (particularly steroid eye drops)
 Intraocular tumour

Box 8.1 Ocular conditions associated with cataract.

SYSTEMIC CAUSES

Diabetes
Other metabolic disorders (including galactosaemia, Fabry's disease, hypocalcaemia)
Systemic drugs (particularly steroids, chlorpromazine)
Infection (congenital rubella)
Myotonic dystrophy
Atopic dermatitis
Systemic syndromes (Down's, Lowe's)
Congenital, including inherited, cataract
X-radiation

Box 8.2 Systemic causes of cataract.

SYMPTOMS

An opacity in the lens of the eye:

- causes a painless loss of vision;
- causes glare;
- may change refractive error.

In infants, cataract may cause *amblyopia* (a failure of normal visual development) because the retina is deprived of a formed image. Infants with suspected cataract or a family history of congenital cataracts should be seen as a matter of urgency by an ophthalmologist (see p. 88).

SIGNS

Visual acuity is reduced. In some patients the acuity measured in a dark room may seem satisfactory, whereas if the same test is carried out in bright light or sunlight the acuity will be seen to fall, as a result of glare and loss of contrast.

The cataract appears black against the red reflex when the eye is examined with a direct ophthalmoscope (see pp. 29–30). Slit lamp examination allows the cataract to be examined in detail and the exact site of the opacity can be identified. Age-related cataract is commonly nuclear, cortical or subcapsular in location (Fig. 8.1). Steroid-induced cataract is commonly posterior subcapsular. Other features to suggest an ocular cause for the cataract may be found, for example pigment deposition on the lens suggesting previous inflammation or damage to the iris suggesting previous ocular trauma (Fig. 8.2).

INVESTIGATION

This is seldom required unless a suspected systemic disease requires exclusion or the cataract appears to have occurred at an early age.

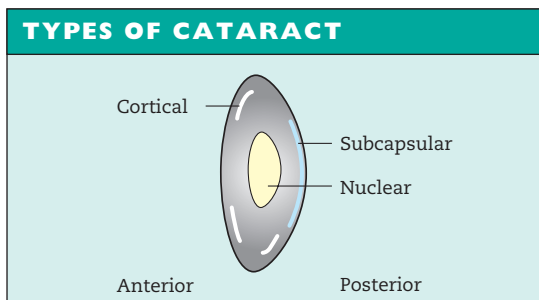


Fig. 8.1 The location of different types of cataract.

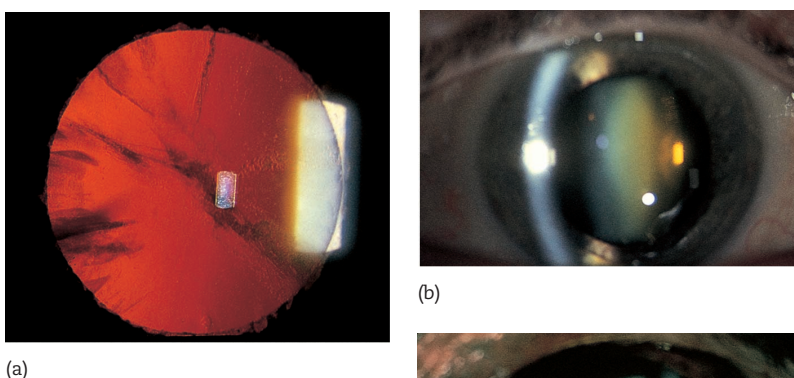


Fig. 8.2 The clinical appearance of: (a) a cortical; (b) a nuclear; (c) a posterior subcapsular cataract. The spoke opacities are silhouetted against the red reflex (a).

TREATMENT

Although much effort has been directed towards slowing progression or preventing cataract, management remains surgical. There is no need to wait for the cataract to 'ripen'. The test is whether or not the cataract produces sufficient visual symptoms to reduce the quality of life. Patients may have difficulty in recognizing faces, reading or achieving the driving standard. Some patients may be greatly troubled by glare. Patients are informed of their visual prognosis and must also be informed of any co-existing eye disease which may influence the outcome of cataract surgery.

Cataract surgery (Fig. 8.3)

The operation involves removal of most of the lens and its replacement optically by a plastic implant. It is increasingly performed under local rather than general anaesthesia. Local anaesthetic is infiltrated around the globe and the lids or given topically. If social circumstances allow, the patient can attend as a day case, without admission to hospital.

The operation can be performed:

- Through an extended incision at the periphery of the cornea or anterior sclera followed by *extra-capsular cataract extraction (ECCE)*. The incision must be sutured.
- By liquification of the lens using an ultrasound probe introduced through a smaller incision in the cornea or anterior sclera (*phacoemulsification*). Usually no suture is required. This is now the preferred method in the Western world.

The power of the *intraocular lens implant* to be used in the operation is calculated beforehand by measuring the length of the eye ultrasonically and the curvature of the cornea (and thus optical power) optically. The power of the lens is generally calculated so that the patient will not need glasses for distance vision. The choice of lens will also be influenced by the refraction of the fellow eye and whether it too has a cataract which may require operation. It is important that the patient is not left with a significant difference in the refractive state of the two eyes.

Postoperatively the patient is given a short course of steroid and antibiotic drops. New glasses can be prescribed after a few weeks, once the incision has healed. Visual rehabilitation and the prescription of new glasses is much quicker with phacoemulsification. Since the patient cannot accommodate he or she will need glasses for close work even if they are not needed for distance. Multifocal intraocular lenses are now in use. Accommodating intraocular lenses are being developed.

Complications of cataract surgery

- 1** Vitreous loss. If the posterior capsule is damaged during the operation the vitreous gel may come forward into the anterior chamber where it represents a risk of glaucoma or traction on the retina. It requires removal with an instrument which aspirates and excises the gel (*vitreotomy*). In these circumstances it may not be possible to place an intraocular lens in the eye immediately.
- 2** Iris prolapse. The iris may protrude through the surgical incision in the immediate postoperative period. It appears as a dark area at the incision site. The pupil is distorted. This requires prompt surgical repair.
- 3** Endophthalmitis. A serious but rare infective complication of cataract extraction (less than 0.3%). Patients present with:

- (a) a painful red eye;
- (b) reduced visual acuity, usually within a few days of surgery;
- (c) a collection of white cells in the anterior chamber (hypopyon).

The patient requires urgent ophthalmic assessment, sampling of aqueous and vitreous for microbiological analysis and treatment with intravitreal, topical and systemic antibiotics.

4 Postoperative astigmatism. It may be necessary to remove the corneal sutures in order to reduce corneal astigmatism. This is done prior to measuring the patient for new glasses but after the wound has healed and steroid drops have been stopped. Excessive corneal curvature can be induced in the line of the suture if it is tight. Removal usually solves this problem and is easily accomplished in the clinic under local anaesthetic with the patient sitting at the slit lamp. Loose sutures must be removed to prevent infection but it may be necessary to resuture the incision if healing is imperfect. Sutureless phacoemulsification through a smaller incision avoids these complications. Furthermore, placement of the wound may allow correction of pre-existing astigmatism.

5 Cystoid macular oedema. The macula may become oedematous following surgery, particularly if this has been accompanied by loss of vitreous. It may settle with time but can produce a severe reduction in acuity.

6 Retinal detachment. Modern techniques of cataract extraction are associated with a low rate of this complication. It is increased if there has been vitreous loss. The symptoms, signs and management are described on p. 123.

7 Opacification of the posterior capsule (Fig. 8.4). In approximately 20% of patients clarity of the posterior capsule decreases in the months following surgery when residual epithelial cells migrate across its surface. Vision becomes blurred and there may be problems with glare. A small hole can be made in the capsule with a laser (*neodymium yttrium (nd)YAG laser*) as an outpatient procedure. There is a small risk of cystoid macular oedema or retinal detachment following YAG capsulotomy. Research aimed at reducing this complication has shown that the material used to manufacture the lens, the shape of the edge of the lens and overlap of the intraocular lens by a small rim of anterior capsule are important in preventing posterior capsule opacification.

8 If the fine nylon sutures are not removed after surgery they may break in the following months or years causing irritation or infection. Symptoms are cured by removal.

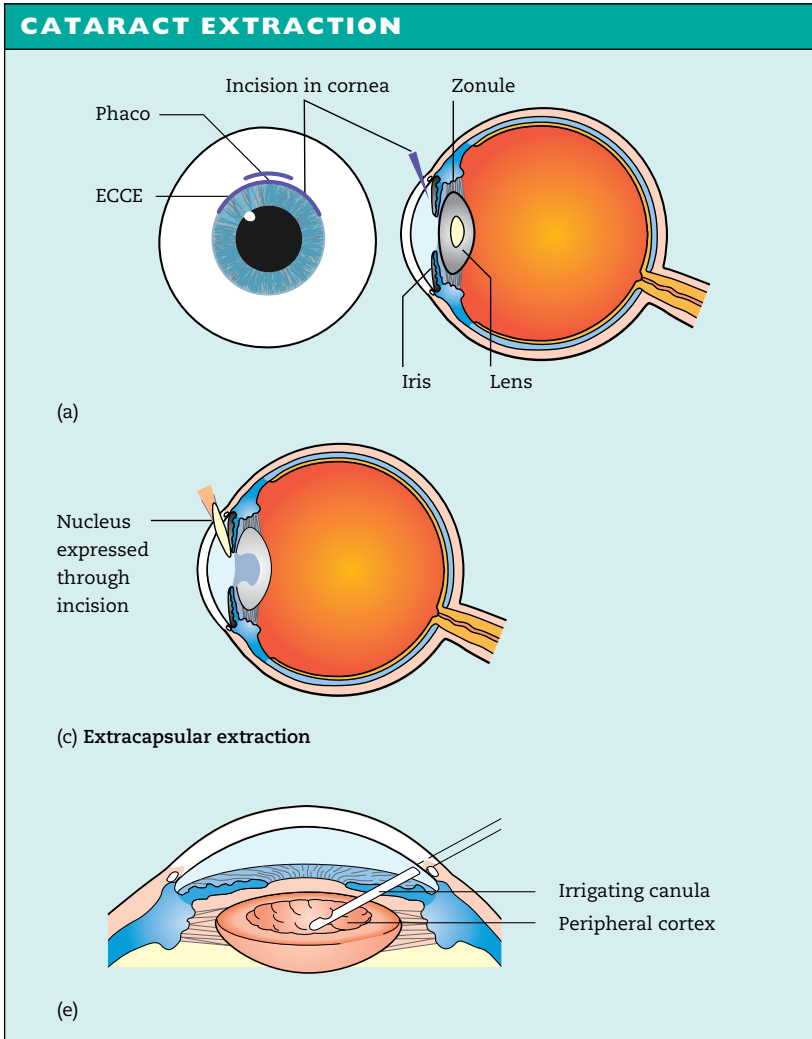
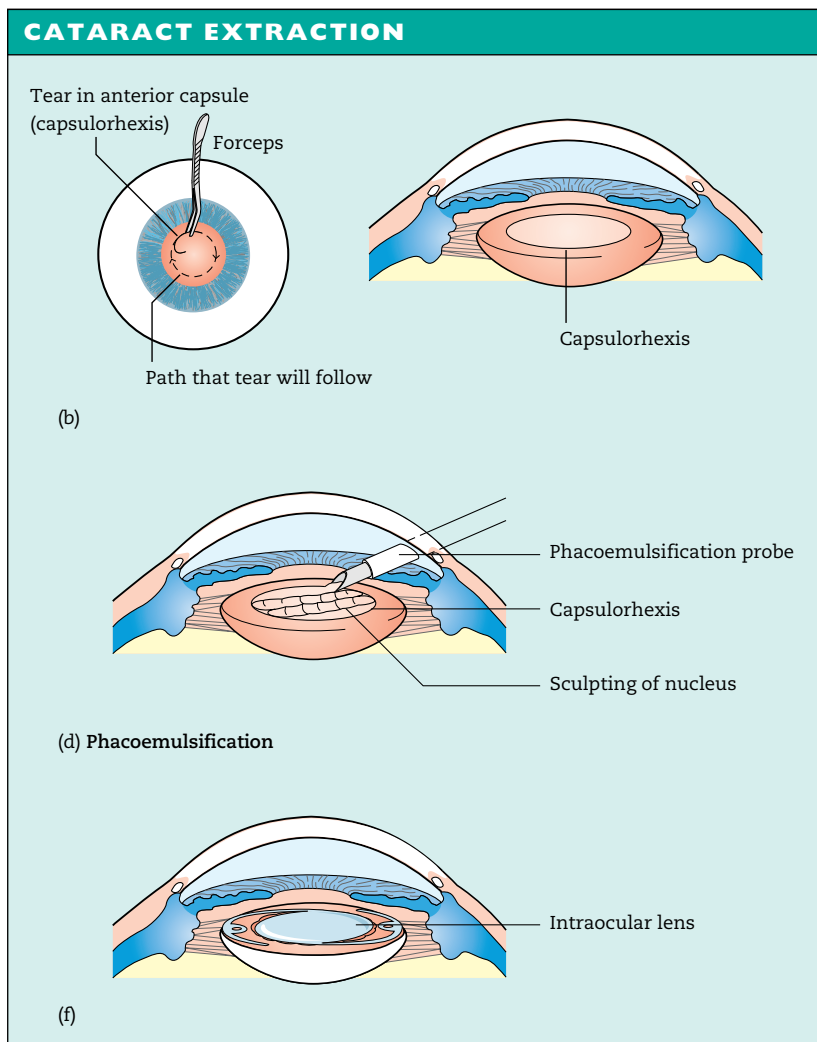


Fig. 8.3 Stages in the removal of a cataract and the placement of an intraocular lens. (a) An incision is made in the cornea or anterior sclera. A small, stepped self-sealing incision is made for phacoemulsification. (b) The anterior capsule of the lens is removed. A variety of different methods are used to do this. In ECCE a ring of small incisions is made with a needle to perforate the capsule allowing the centre portion to be removed. In phacoemulsification the capsule is torn in a circle leaving a strong smooth edge to the remaining anterior capsule. A canula is then placed under the anterior capsule and fluid injected to separate the lens nucleus from the cortex allowing the nucleus to be rotated within the capsular bag. (c) In ECCE the hard nucleus of the lens is removed through the incision, by



expression. Pressure on the eye causes the nucleus to pass out through the incision. (d) Alternatively the nucleus can be emulsified *in situ*. The phacoemulsification probe, introduced through the small corneal or scleral incision shaves away the nucleus. (e) The remaining soft lens matter is aspirated leaving only the posterior capsule and the peripheral part of the anterior capsule. (f) An intraocular lens is implanted into the remains of the capsule. To allow implantation through the small phacoemulsification wound, the lens must be folded in half or injected through a special introducer into the eye. The incision is repaired with fine nylon sutures. If phacoemulsification has been used the incision in the eye is smaller and a suture is usually not required.

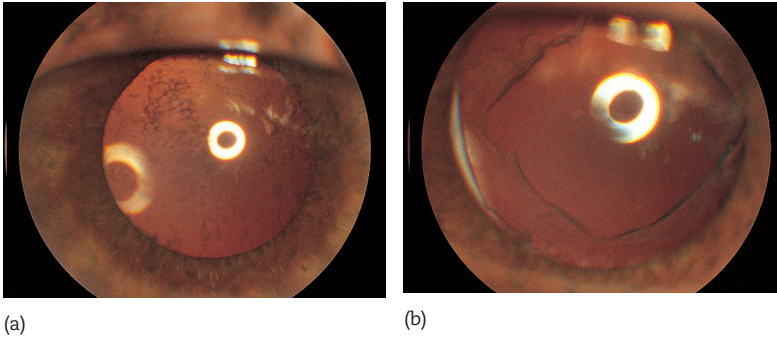


Fig. 8.4 (a) An opacified posterior capsule. (b) The result of laser capsulotomy.

Congenital cataract

The presence of congenital or infantile cataract is a threat to sight, not only because of the immediate obstruction to vision but because disturbance of the retinal image impairs visual maturation in the infant and leads to amblyopia (see pp. 170–171). If bilateral cataract is present and has a significant effect on visual acuity this will cause amblyopia and an oscillation of the eyes (*nystagmus*). Both cataractous lenses require urgent surgery and the fitting of contact lenses to correct the aphakia. The management of contact lenses requires considerable input and motivation from the parents of the child.

The treatment of unocular congenital cataract remains controversial. Unfortunately the results of surgery are disappointing and vision may improve little because amblyopia develops despite adequate optical correction with a contact lens. Treatment to maximize the chances of success must be performed within the first few weeks of life and be accompanied by a coordinated patching routine to the fellow eye to stimulate visual maturation in the amblyopic eye. Increasingly intraocular lenses are being implanted in children over 2 years old. The eye becomes increasingly myopic as the child grows, however, making choice of the power of the lens difficult.

CHANGE IN LENS SHAPE

Abnormal lens shape is very unusual. The curvature of the anterior part of the lens may be increased centrally (*anterior lenticonus*) in Alport's syndrome, a recessively inherited condition of deafness and nephropathy. An abnormally small lens may be associated with short stature and other skeletal abnormalities.

CHANGE IN LENS POSITION (ECTOPIA LENTIS)

Weakness of the zonule causes lens displacement. The lens takes up a more rounded form and the eye becomes more myopic. This may be seen in:

- Trauma.
- Inborn errors of metabolism (e.g. homocystinuria, a recessive disorder with mental defect and skeletal features. The lens is usually displaced downwards).
- Certain syndromes (e.g. Marfan's syndrome, a dominant disorder with skeletal and cardiac abnormalities and a risk of dissecting aortic aneurysm. The lens is usually displaced upwards). There is a defect in the zonular protein due to a mutation in the fibrillin gene.

The irregular myopia can be corrected optically although sometimes an aphakic correction may be required if the lens is substantially displaced from the visual axis. Surgical removal may be indicated, particularly if the displaced lens has caused a secondary glaucoma but surgery may result in further complications.

CATARACT—THE WORLD PERSPECTIVE

In the developed world cataract surgery is performed when visual symptoms interfere with the quality of life. Worldwide there are in excess of 20 million people blind due to bilateral dense cataract. This represents a huge cause of preventable blindness. The World Health Organization has established Project 2020 to manage this problem; the goal is to remove cataract as a cause of blindness by the year 2020.

KEY POINTS

- In adult cataract, extraction is indicated if the reduction in vision is interfering with the patient's quality of life.
- An infant with a family history of congenital cataract or a suspected cataract must be seen by an ophthalmologist as a matter of urgency.

Box 8.3 Key points in disease of the crystalline lens.