Clinical Practice Module

Quality Assurance in Cataract Surgery

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Jacques Daviel 1693-1762
The father of modern Ophthalmology

Dr. Jacques Daviel was a French ophthalmologist who became famous for originating the modern method of extracting a cataractous lens through a corneal incision. His paper describing the method, "A New Method of Curing Cataract by Extraction of the Lens," is one of the classics of Ophthalmology. Daviel's corneal flap incision with keratome and scissors persisted for a century until von Graefe advocated the modified linear scleral incision in 1865.

Daviel received his medical degree from the Medical Scool of Rouen. After graduation, he practiced for a time in Marseilles and became associated with its medical school. In 1728 he restricted his practice to Ophthalmology. He eventually moved to Paris, where the wisdom of his new operation for extracting cataracts, as opposed to couching, won him wide recognition. He received an appointment to the staff of the Hospital d'Invalides. He also became oculist to Louis XV and was summoned to other courts of Europe. He was honored by membership in the learned societies of many countries. He died of apoplexy while on a trip to Geneva, Switzerland.

Cataract Surgery

Definition

Any opacity of the crystalline lens or its capsule is called cataract.

Introduction

Although the vast majority of cataracts cannot be prevented, cataract is surgically curable. The commonest type being senile cataract, where visual loss is usually gradual, progressive and painless. Inexpensive and efficient surgery can reduce the large number of people blind from cataract. Cataract surgery is one of the most cost-effective public health interventions worldwide. The effort is to reduce the number of patients blind from cataract through improved ocular surgical care to under served populations. One of the major public Health challenges of our time is to determine through research how to prevent or delay the onset of cataract.

The purpose of any Cataract Management Programme is to

- Identify the presence of Cataract.
- Quantify its impact on the patient's vision and its effect on the patient's quality of life.
- To select the appropriate surgery that has to be done at the lowest cost possible.
- To provide good postoperative care and visual rehabilitation.

Epidemiology and Magnitude

As of the year 2000, approximately 50 million are blind the world over, of which 25% are in India – which is approximately between 12-15 million. Of this an estimated 81% is due to cataract.

At present the CSR (Cataract Surgery Rate) in India is 3500/million compared to 6000/million in the developed countries. So the backlog is around 8.4 million to which 2.2-2.8 million are added each year.

In India approximately 3.4 million cataract surgeries are being done per year which hardly meets the input due to incidence. Government of India is planning to achieve a Cataract Surgical Rate (CSR) of around 5000 to 6000 shortly.

Incidence of Cataract is expected to rise as

1. The population is rapidly increasing.
2. The life expectancy is increasing - so aged population (>60yrs) is increasing.

Although Cataract can occur at any age, most cataracts are related to aging. The majority of cataract-related blindness and visual disability occurs after 50 years of age. It is estimated that by the year 2020, there will be 1.2 billion people aged 60 years and older, and three-fourth of them will live in developing nations. As the global population grows and ages, cataract incidence will increase.

There are only one ophthalmologist /100,000 population in India.

Economic Burden

The economic loss due to blindness and visual disability from cataract is enormous. Cataract blind people are unable to work and able-bodied people are required to care of them. Thus due to lack of productivity the economic impact is a staggering 4.5 million rupees per year for every million population.

Reasons for the Cataract Backlog in India

- Inadequacy of trained manpower especially in rural areas which has now been addressed adequately through various programmes like World Bank Project, National Prevention of Blindness by Government of India.
- Poor access to eye care by rural population.

Etiology

- Senile cataract.
- Injury or traumatic cataract.
- Inflammation within the eye (usually Uveitis).
- Metabolic conditions.
- Congential cataract - due to intrauterine infections or due to hereditary factor.
- Other factors
  - Excessive exposure to UV spectrum of the sunlight
  - Poor nutrition
  - Acute diarrhea in early life
  - Smoking
  - Corticosteroids- both topical and systemic

Diagnosis and Preoperative Evaluation of Cataract

The diagnosis of cataract in clinical practice mainly depends on the history and the impact of cataract on the patients daily activities. There is no single test that adequately describes the effect of cataract on patient's visual status and functional ability[8]. The most important aspect is the evaluation of the functional impairment [5], which falls into two catagories:

- Those that measure the general health status example: The SF-36[1] and the sickness impact profile (SIP) [2]
- The disease specific measures for example:
  - Bernth-Peterson Visual Functioning Assessment [3]
  - The Visual Activities Questionnaire[12]
  - The Activities of Daily Vision Scale (ADVS) [4]
  - VF-14 [8]

The questionnaires of general health status are less related to the visual outcome following cataract surgeries. The clinical examinations of the lens opacity may reveal the extent of visual impairment for example, opacity in the visual axis may cause more functional visual deficit than a cortical cataract and the posterior subcapsular opacity may cause more symptoms of glare than a nuclear cataract. Thus a patient with nuclear cataract may undergo cataract surgery at a later date especially if the patient is elderly. The assessment of the functional status is a pertinent part of the patient's history and can be obtained by means of an interview or questionnaire, which includes details of patient's complaints.

Preoperative Physical Examination

Cataract surgery is usually advised in a patient physically fit for surgery with no overwhelming medical problem. Thorough physical examination must be done to identify other ocular or systemic conditions that may contribute to the patients visual outcome or affect the surgical plan. The maximum interval between preoperative ophthalmic examination and date of surgery is three months, provided there has been no change in the symptoms during the time interval.

Special attention should be given to the control of systemic illness like diabetic (blood sugar-PPBS <200 mg%), hypertension (diastolic BP <100 mm of Hg), anemia and bronchial asthma. Patients with history of myocardial infarction should have a minimum of six months gap before cataract surgery, as the incidence of repeated infarction is less than 0.3%. Fresh ECG should be obtained in such cases before surgery. Physician opinion should be obtained regarding fitness for surgery if the situation warrants it. Other systems like the gastro-intestinal and genito urinary system should be assessed for any problems such as Benign Prostatic Hypertrophy (BPH), constipation, infection, gastritis etc. and treated if necessary before cataract surgery, although these conditions are not contraindications for cataract surgery.

Patients on anticoagulant therapy should stop the therapy temporarily one week before surgery and have their prothrombin time evaluated. Any history of allergy to drugs (eg. sulpha, lignocaine, cycloplegics) should be recorded. Apart from physical health it is important to ascertain the normal mental status of the patient being taken for surgery.

Preoperative Ocular Examination

The main aim is

- To diagnose and confirm the presence of operable cataract.
- To confirm that the cataract is causing significant functional impairment.
- To exclude other ocular problems which might contribute to the patient's visual impairment or might affect the surgical outcome.

The ophthalmic examination should include

- **Visual acuity:** Vision should be tested with and without glasses and with pinhole. In advanced and mature cataract, perception and projection of light should be tested in all the four quadrants to rule out gross retinal problems.
- **Refraction:** Both eyes; refraction should be done. If the extent of cataract does not correspond to the visual loss, posterior segment pathology should be ruled out by special tests.
- **Visual field (optional):** Amsler grid for assessing central fields, confrontation method/automated perimetry for peripheral field can be used.
- **Intraocular pressure:** Intraocular pressure should be checked by the Indentation method (shiotz) or applanation method, since glaucoma resulting from intumescent lens, phacolytic process, uveitis, progressive narrowing of angle of the anterior chamber etc. will alter the nature of surgery.
- **Gonioscopy:** Angle should be evaluated for the presence of angle closure or other abnormalities especially if the intraocular pressure is elevated.
- **Syringing:** Patency of nasolacrimal duct should be tested. If duct is partially free with clear fluid regurgitating or blocked completely conjunctival swab is taken for culture and sensitivity and hourly antibiotic drops are started.

The cataract surgery is performed only after the culture report reads sterile. If duct is not free, with mucus or purulent discharge, DCT or DCR is done and cataract surgery is done at a later date. IOL power calculations should be done on all eyes undergoing cataract surgery whether they get AC or PC IOL. Standard biometric equipments should be used by trained ophthalmic technician or surgeon himself.

- **Slit lamp examination:** The lids are examined for the presence of infection or inflammation like blepharitis, stye etc and are treated adequately. Lid deformities like entropion, ectropion are corrected before cataract surgery. The conjunctiva and the cornea is examined for the presence of infection or inflammation. The presence of opacity, degeneration and dystrophy in the cornea are noted and the endothelium is scrutinised for the presence of precipitates or deposits. The anterior chamber depth and AC reaction in the form of cells and flare is assessed. If flare and cells are present, it indicates iridocyclitis and should be well controlled before surgery. The size, shape and reaction (both direct and consensual) of the pupil should be tested for good visual outcome. The colour and pattern of iris should be examined and signs of atrophy, synechiae, coloboma, neovascularisation

etc., should be recorded. The type and density of cataract is confirmed and if the media is relatively clear, anterior vitreous is examined for cells indicating active inflammation or other abnormalities.

- **Fundus examination:** Both direct and indirect ophthalmoscopic examination is done through well dialated pupil to rule out posterior segment pathology.

Special Tests: (optional) (for projects and publications)

- **Glare disability assessment:** It is considered as a subjective visual response to light. Cataract disperses incoming light, creating forward light scatter and veiling luminescense that interferes with perception of visual object of regard [9]. Many instruments are available to measure it. Example: Miller nadler glare tester, Brightness Acuity Tester (BAT). A decrease in 3 lines or more in visual acuity measurement is considered as significant visual impairment. In general, patients do not complain of glare unless their contrast threshold is in the range of 40-50%.
- **Contrast sensitivity:** It tests the patient's ability to percieve the variety of coarse, intermediate or finer details at differing contrasts relative to the background. Patients with cataract may experience diminished contrast sensitivity even when snellen acuity is preserved. Arden gratings and Pellirobson charts are routinely used for this purpose.
- **Laser Interferometry:** It is the subjective tests of the maximum resolving power of the eye. It is useful in moderate cataracts. A small helium-neon light produces a collimated beam that is optically divided. The intersection of two beams projected posterior to the lens produces interference fringes that can be imaged on the macula to be perceived by the patients. The value got can be converted to standard visual acuity with the simple converting table. The main drawback is overestimation of visual acuity in amblyopic eyes.
- **Potential Acuity Meter:** This test projects a numerical or Snellens vision chart through a clear area in the cataract. The clinical rule of thumb indicates that an improvement of four lines of vision suggests a good visual outcome following cataract surgery.
- **Corneal topography, corneal pachymetry, specular microscopy**[10,11] **Flourescent angiography A, B-scan ultrasonography** - may provide valuable information on selected cases but are not routinely necessary. Objective potential acuity testing using electro retinogram (ERG), Visual evoked potential (VEP) [6,1] etc. have not shown specific advantages over thorough clinical examination.

Simple and less expensive of clinical tools may be useful like the yellow filter test which indicates significant cataract if visual acuity worsens with the filter, or visual acuity recording with pinhole and brightly lit chart which can simulate potential acuity meter[12].

Tests of Macular function:

This can be done in very dense cataracts and cases of suspected macular pathology and may not be routinely done.

- **Two point discrimination test**
- **Colour perception**
- **Maddox rod test** any scotoma is represented as a loss or defect in the red line and should raise the possibility of significant macular disease.
- **Purkinje entoptic visualisation** - It is the ability of the patient to detect his/her own retinal vasculature when a rapidly oscillating light source is shown through closed eyelids.
- **Blue light endoscopy** - here the WBC shadows are visualised while they pass through the perifoveal capillairies while the patient views an intense homogenous blue lit background.
- **Photostress recovery time** - After bright light shown in the normal eye recovery period is necessary before the patient can identify the snellen letters recorded before the procedure. Normal values are 27sec with standard deviation of 11sec. 99% of normal eyes have 50sec or less recovery time. Prolonged recovery time indicates significant macular disease.

After the investigations it is important to take a well informed consent for surgery and counselling of the patient must be done by trained personal, about the procedure especially if the surgery is being done under guarded visual prognosis.

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Preoperative Medication

A good regimen is to use a combination of drugs that potentiate each other and at the same time exert lower toxicity. The commonly used preoperative medications are :

1. **Mydriatics or cycloplegics:** These are administered starting 90 minutes prior to surgery. Several agents are available. The most frequently used are ,
   - **a.** Tropicamide - 1%
   - **b.** Phenylephrine HCl - 5 or 10%
   - **c.** Cyclopentolate HCl - 1%
   - **d.** Homatropine - 2%
2. **NSAID:** NSAID like Flurbiprofen Sodium 0.03% is widely used because it prevents miosis during intraocular manipulations. Mostly used for phaco procedure.
3. **Antibiotics:** The value of preoperative antibiotics is still debated.There is little or no reason to give systemic antibiotics, but there may be value in giving local broad spectrum antibiotics. Local broad spectrum antibiotic drops are applied 4 - 6 times the day before the surgery and once or twice in the morning of the surgery.
4. **Povidine iodine:** A 5% solution of Povidine iodine is placed in the inferior conjunctival sac prior to surgery and is irrigated well with saline before cutting the tissue.This definitely minimite the bacterial colony count and reduces the rate of postoperative endophthalmitis[1].
5. **Acetazolamide:** To achieve ocular hypotension, Tab Acetazolamide 250mg is given an hour before surgery.
6. **Hyperosmotic agents:** These are also used preoperatively to soften the eye. Hyperosmotic agents are indicated in the cases of traumatic cataracts, dislocated lenses, resurgeries, secondary IOL's and lens induced glaucomas. Commonly used hyperosmotic agents are mannitol and glycerin (glycerol). The dose of mannitol 20% solution is upto 2 gm/kg infused intravenously as slow drip. The maximum dose for children is 2.25mg/kg. Glycerin (in a concentration of 0.6gm/ml) is given in a dose of 1 to 1.5gm/kg. In adults this corresponds to about ½ a tumbler full. Glycerin is metabolised causing hyperglycaemia and is therefore less suitable for diabetics.

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Anaesthesia

A variety of anaesthesia techniques are being used for cataract surgery which include local anaesthesia (eg. Retrobulbar, peribulbar, subtenon injection and topical) and general. In the recent years local anaesthesia has gained a great popularity in ophthalmology worldwide. Local anaesthesia is safe, economical and less time consuming as compared to General anaesthesia. Retrobulbar anaesthesia has been the commonest form of LA. In this form of anaesthesia the anaesthetic solution is injected behind the globe, inside the extra ocular muscle cone at the orbital apex to produce anaesthesia and akinesia of the globe[1].This form of anaesthesia is given using a 1.5 inch 22 or 25 gauge needle. The most commonly used anaesthetic solution is lignocaine 2% and bupivacaine 0.5 to 0.75% with hyaluronidase. If the patient is allergic to lignocaine, one can use Bupivacine. Allergy to lignocaine is very rare. For cardiac and hypertensive patients lignocaine without adrenaline is used. 2 to 4 ml of the anaesthetic solution is injected inside the muscle cone. With retrobulbar anaesthesia a separate injection for facial nerve has to be given. The various methods of achieving facial block are Van Lint, O' Brien, Atkinson and Nadboth Ellis akinesia. Of these O'Brien technique is in which the anaesthetic solution is injected just anterior to the tragus in the middle of the condyloid process.

Davis et al in 1986 suggested an alternative method of Peribulbar anaesthesia. This technique although safer than the retrobulbar anaesthesia is also associated with complications such as globe perforation, Acquired Browns Syndrome, Intracranial spread of the anaesthesia mixture, RBH and ptosis. If the patients develops Retrobulbar haemorrhage, the cataract surgery is postponed for few days to a week depending on severity. Peribulbar block is given as a single injection or two injections in periocular space with 3/4" 23.G. sharp or blunt needle. 4 -5 ml of anaesthetic agent is given followed by intermittent massage. Honan Balloon can also be applied for 15 to 20 minutes to achieve hypotony and anaesthesia. No massage is given in cases of traumatic cataract, subluxated and dislocated lenses, secondary IOL's, filtering blebs, resurgeries and corneal dystrophies. More recently local drops of amethocaine along with sub-conjunctival injection of Anaesthetic solution[10] and till recently only local drops of 0.5% tetracaine[11] have been employed to produce ophthalmic anaesthesia. Patients of various psychological disorders can be operated under local anaesthesia with adequate sedation either orally or intravenously either before anaesthesia or on the table. General anaesthesia is rarely used in adults.

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Surgical Procedure

(Use Operating Microscope)

Various surgical techniques namely intracapsular cataract extraction, extracapsular cataract extraction and small incision cataract surgery with either manual extraction or phaco aspiration of nucleus with rigid or foldable intraocular lens implantation, are available.

Choice among different surgical techniques can be considered by taking into account the rates of intraoperative and post operative complications, induced astigmatism and length of time for stable corrected visual recovery available facilities and experience of surgeon. The size, location construction and closure of incision can influence induced astigmatism and the time length for stable visual rehabilitation. Generally lens implant dictates the size of incision which can range in size from 3.2mm for foldable IOL to 6mm for the rigid implant.

Extra Capsular Cataract Extraction (ECCE)

ECCE with PC IOL is the most popular method. By convention extra capsular cataract extraction refers to a method of cataract surgery in which lens nucleus is delivered through a limbal incision of about 100°-150°. This method can be used for almost any cataract except subluxated or luxated lens. Making use of endocapsular ring in a mild and moderate subluxation of lens can prevent decentration or dislocation of implant. Due to its inherent disadvantage of suture related complications, SICS is becoming popular now. However greater margin of safety afforded by ECCE makes it safer for beginners in cases where operative exposure is difficult, small pupil, posterior synechiae or zonular integrity is doubtful (as after parsplana vitrectomy) Barraquer lid speculum and solid bladed Guyton park lid speculum can be used for exposure of eye with minimum pressure on globe. A fornix- based conjunctival flap is fashioned in an extent of 120 degrees or 4 clock hours. Location of the groove may be posterior limbal, midlimbal, or anterior limbal. A mid limbal location is recommended. A half-thickness, beveled groove in extent of about 100 degree, or 3 to 4 clock hours, measuring say about 8 to 10 mm in length should be adequate in most cases.

The anterior chamber is entered at a point in the groove, usually around 10 to 12 o'clock position. Various types of capsulotomies have been described. However, the most commonly used technique is the can-opener.

In mature and hypermature cataracts envelope capsulotomy is better. Incision is completed along the groove on either side of this opening with corneoscleral scissors keeping parallel to iris. By this way, benefits of two-plane incision can be achieved.

There are various methods by which the nucleus can be extracted. A very simple and probably the most commonly used method is the bimanual technique of pressure and counter pressure under visco cushion. A special situation where nucleus delivery becomes difficult is a very soft eye, small pupil, pseudoexfoliation. A simple technique to overcome the problem is to use an irrigating vectis for applying pressure over the posterior lip of the wound at 12 o'clock. This usually helps to guide the nucleus out. Following nucleus delivery, the cortex is commonly removed by a manual irrigation - aspiration system. Using Simcoe cannula, the anterior chamber is kept deep with a constant infusion of BSS/Ringer lactate through IV line. The bottle is kept approximately 60 cm above the level of the eye. Wound may be closed temporarily with 2-4 preplaced interrupted sutures. Unless contraindicated (e.g. Ischaemic heart disease), 0.5ml adrenaline 1:1000 is added into the BSS bottle at the beginning of the surgery. This helps to keep the pupil dilated. The port should always face the surgeon. The loose cortex at the center is removed first. The cortex at the periphery, underneath the peripheral anterior capsule is stripped by pulling the tip of the canula towards the center of the pupil. Once the cortex has been stripped and is lying loose in the pupillary area, it is aspirated by increasing suction. Special 'J' or 'U' shaped canulae for removal of 12 o'clock cortex are available.

Methylcellulose made in India is cheaper and serves the purpose as performed by costly (10-20 times) imported viscoelastics. IOL implantation is best done under viscoelastics (methylcellulose). This opens the capsular bag widely and facilitates in the bag implantation.

The lens is then held firmly by its optic with a McPherson forceps or lens holding forcep. The inferior haptic is passed under the anterior capsular rim at 6 o'clock. The superior haptic is flexed sufficiently so its convexity can be passed under the superior iris and anterior capsule.

Peripheral Iridectomy seems unwarranted in a routine uneventful surgery except in complicated cataract, vitreous loss and paediatric cases. Wound closure is performed either with 8-0 Silk; 9-0 Nylon or 10-0 Nylon depending on the availability and surgeon's experience.

Secondary IOL

When patients get operated with IOL implantation in one eye, his other eye may be aphakic. In those patients one can go for secondary AC or PC IOL according to the existing capsular support.

Small Incision Cataract Surgery (SICS)

Small Incision Cataract Surgery (SICS) is likely to replace ECCE through the limbal section as the most prevalent method of cataract extraction, as the surgical outcome is comparable to phaco emulsification and due to its low cost.It has been found that SICS can result in low surgically induced astigmatism[1,2,3] early stabilization of refraction, favorable or less alteration in corneal shape[4,5]and less post operative inflammation.

Preoperative astigmatism can also be reduced by shifting the placement of incision taking into due consideration of the amount and axis of pre existing astigmatism. When low preoperative astigmatism is encountered the incision is made in the astigmatically neutral funnel with frown shape at the steeper meridian to retain the sphericity. In moderate degree a straight incision is made along the steep meridian to regain the sphericity. In higher degree of astigmatism a smile incision can be made along the steep meridian closer to limbus to reduce the asphericity[6].

A 5-7 mm scleral straight line or frown shaped partial (half) thickness groove is made 2-4mm behind the conjunctivo corneal junction depending upon the length of the incision. The tunnelling is extended upto 1-1.5mm into the clear cornea.

A 2mm wide stab entry is made perpendicular to the tunnel in the clear cornea just inside the limbus to aspirate the sub-incisional cortex and to reform the anterior chamber at the end of surgery.

Continous curvilinear capsulorhexis ensures a permanent verifiable and secure fixation of IOL in the bag. Thus patient is saved from autofixation of IOL leading to uveal implantation many times[7]. However in mature cataracts, small pupil and calcified and fibrosed anterior capsule and cases with III and IV Nuclear sclerosis canopener capsulotomy is safer.

In case of PCR, rhexis margin provides a good support in sulcus fixation of IOL.

In case of rhexis , nucleus can be hydroprolapsed into AC by injecting fluid under the rhexis margin and simultaneously pressing the nucleus downward. This combination of mechanical and hydrostatic forces causes the opposite pole of the nucleus to prop out of rhexis margin. The rest of nucleus can be dialled out of the bag.

In softer cataracts whole nucleus can be tumbled out of the bag with cannula while doing hydrodelineation.

In case of canopener capsulotomy there is no need of hydroprocedures and the nucleus is mechanically prolapsed into the anterior chamber with the help of sinskey hook after washing off the superficial loose cortex exposing the firm nucleus underneath.

Hypermature cataracts can be extracted after envelope capsulotomy as usual.

Nucleus extraction can be done through the tunnel by following methods.

Irrigating vectis technique basically uses combination of mechanical and hydrostatic forces to express out the nucleus.

With the sinskey hook in the dominant hand and vectis in the other nucleus is sandwiched and extracted[8a] .

For cases with nuclear sclerosis grade 3 and 4, Peter Kannas introduced the technique of Phacofracture. This technique can be performed using a bissector or trisector splitting the nucleus into two or three pieces[8b].

Gerald Keener 1983 used a nuclear snare (like a tonsillar snare) to cheese wire through the nucleus and divide into two halves[8c].

With the help of irrigating vectis prolapsed nucleus is delivered and in the process it is fractured at the exit from the tunnel.

Instead of visco elastic continuos fluid flow from an anterior chamber maintainer secured at an extra-beveled entries in the peripheral cornea is primarily responsible for the extrusion of nucleus. During extraction the bottle height is raised by 10 cm to 60-70cm[9].

Cortex aspiration in SICS is done in the same way as in ECCE except for a few special situations. After the extraction of endonucleus from anterior chamber, there remain mixture of epinucleus and viscoelastic material. It is difficult to aspirate with simcoe cannula. It is best extracted with an irrigating vectis.

Aspiration of 12 o'clock cortex can be managed by J shaped cannula or Sideport approach.

With canopener capsulotomy; technique of implantation is same as in routine ECCE. With capsulorhexis anterior chamber and bag is filled with viscoelastic. First Inferior haptic of IOL is placed in the capsular bag. Now optic and superior haptic junction is engaged with sinskey hook and introduced beneath the anterior capsular rim by moving the optic towards 9 o'clock.

The prime benefit of above mentioned three-plane incision is its watertight self-sealing character. Anterior chamber is filled with BSS tightly through the side port and thus internal corneal lip is pressed against the scleral lip sealing the incision. Paracentesis wound can be sealed by hydration of corneal stroma.

The conjunctival flap is replaced over the incision and edges are opposed with cautery or left as such.

Suturing becomes necessary if:

1. Scleral tunnel incision length is more than 6.5mm even if it is self-sealing to avoid against the rule astigmatism postoperatively.
2. A leaking tunnel.
3. Premature entry.
4. Combined surgery as with trabeculectomy.
5. In paediatric cataract (due to thin scleral).
6. Scleral disinsertion.

Wound closure in SICS

Vertical, radial or X sutures are used to appose the external lip which results in opening of internal wound lips but by taking deep bites in the scleral bed opening of the internal wound can be prevented.

Horizontal sutures are less likely to cause astigmatism than radial sutures because of a more physiologic incision closure and less possibility of misalignment of internal wound. Shepherds single horizontal suture[10] and Fine's infinity suture[11] give satisfactory results.

Intraoperative Complication

Most of the complications are encountered in SICS also but some have different impact on the outcome of surgery and requires different management. Some complications are specific to SICS as mentioned here:

Incision should be placed at a distance of 3-4mm from the anterior border of limbus. Incision anterior to this has poor self-sealing effect and are prone to increased against the rule (ATR) astigmatism and requires suturing.

In posterior incision increased risk of bleeding, difficult instrument manipulations and nucleus delivery and premature entry are entailed. Incase of premature entry suturing the incision becomes mandatory.

Long incision leads to poor approximation, wound leak and increased ATR astigmatism. Incision longer than 6.5mm should be sutured.

Superficial dissection may lead to button holing which requires separate deep tunnel at the opposite end of the incision.

Deep dissection may lead to premature entry requiring suturing of the incision and separate superficial tunnel is fashioned at the other end of incision

A deep groove incision can cause scleral disinsertion and requires radial sutures.

Hydrodissection and hydroprolapse of the nucleus entails some increased risk of posterior capsule tear and may lead to dreaded complication of nucleus drop in the vitreous. If detected early, viscoelastic material is injected under the nucleus with a supporting vectis underneath the nucleus and incision is converted into limbal section and nucleus is extracted out. Once nucleus has sunk into the vitreous the case must be referred to vitreo retinal surgeon.

In case of SICS, eye is much less prone to positive vitreous pressure and can be managed by injecting ringer-lactate or viscoelastic through side port, thus forming the anterior chamber.

Expulsive haemorrahage is rare in SICS and can be managed by simply forming anterior chamber by injecting ringer-lactate through side port and IV mannitol infusion and suturing the incision.

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Phacoemulsification Technique

Phacoemulsification which is fast becoming the most prefered method of cataract extraction, is a technique by which is removed nucleus through a small incision i.e 3-4 mm. It uses an ultrasonically driven tip to fragment the nucleus of the cataract and aspirate the lens.

Phacoemulsification can be done through a self sealing scleral, limbal or clear corneal tunnel incision. Continous tear circular capsulorhexis is the preferred anterior capsulotomy technique as it provides more stable and smooth edge to the anterior capsular opening that resists radial tears and maintains integrity of the bag which is essential for phacodynamics as well as for the placement of IOL in the bag. Capsulorhexis is followed by hydrodissection and hydrodelination which facilitates nuclear rotation during phaco emulsification and hydrates the peripheral cortex making it easier to aspirate it after nucleus removal. A small paracentesis is placed approximately two or three clock hours away from the scleral tunnel to provide an entry site for the second instrument used to manipulate the lens in most two handed techniques. Nucleus is then emulsified in the posterior chamber. Advantage of posterior chamber phacoemulsification is to reduce the risk of corneal endothelial trauma. According to Marc.A .Michelson there was no endothelial cell loss in 42 to 60% of cases and minimal endothelial cell loss (4%) in 20-30% of cases where posterior chamber phacoemulsification was done. Removal of endonucleus can be done with either cracking or non-cracking techniques. Epinucleus and cortex is then aspirated and IOL placed in the bag after enlarging the tunnel to the size of optic. Newer foldable IOLs made of materials like silicon and acrylic have the advantage that they can be placed in the bag through the same tunnel which maintain the astigmatic neutrality of the incision.

Intraoperative Complication of Phacoemulsification

- During phaco heat may be transferred from the probe to cornea.Wound that is too tight or the occlusion of irrigation (or aspiration) tubing can be the cause for such heat transfer. The heat transferred can cause corneal wound burns. Holding phaco tip close to corneal endothelium during surgery can be a cause for loss of endothelial cells.
- Thermal burn of scleral or corneal wound management includes suturing the tunnel to minimize the risk of faulty closure, wound leak and excessive induced astigmatism.
- Careless insertion of phaco tip can damage descemets membrane, detachment of descemet's membrane (0.4 to 0.5%)[1], iridodialysis and chaffing of iris.
- Two tight incision or improper manipulation of phaco tip can lead to excessive globe movement and scleral burn.
- Recurrent chamber collapse: The different causes of chamber collapse includes foot switch inattentiveness, insufficient in flow, excessive outflow, external globe compression or when the technique selected uses the high aspiration rate and a high vaccum level.
- Iris trauma by either iris prolapse (0.6%)[2] or direct injury from tip.
- Zonular dialysis may result from traumatic capsulectomy, excessive manouvering of the nucleus or aspiration of either the anterior or posterior capsule with the irrigation or aspiration tip.
- Incidence of Posterior Capsule Rupture varies according to surgeon experience. Overall incidence is 3%. According to Crush et-all incidence of PCR - 9.9% in resident learning phaco. PCR can occur during capsulotomy and hydrodissection, sculpting, rotation of nucleus, emulsification and cortex aspiration and during or after IOL implantation.

Management of PCR include

- Low flow irrigation.
- Remote cortex should be removed initially.
- Low flow bimanual vitrectomy.
  IOL placement in posterior chamber depends on size of PCR and surgeons experience.
- According to Thomas et-all incidence of dropped nucleus is 1% in the resident learning phaco. Management include removal of nucleus by doing vitrectomy, if difficult, case should be referred to vitreo retinal surgeon.

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Post-Operative Care

Post operative care is the interval from the conclusion of surgery to the achievement of stable visual rehabilitation. It is the ethical obligation and responsibility of the surgeon because he or she has a unique perspective and thorough understanding of the patient's intra operative course and response to surgery.

At the end of the surgery an antibiotic steroid drop is instilled topically or subconjunctively and eye is patched with a sterile pad. The patient can usually be sent home following the surgery, provided there is no systemic illness preventing ambulation, the vital signs are stable, the patient is in a normal mental state and if there is no nausea or significant pain. The patient is instructed not to turn to the side of the operated eye and to start taking soft diet after 2 hours.

Ocular complications that call for hospitalisation and careful management include hyphaema, uncontrolled elevated IOP, expulsive (suprachoroidal) haemorrhage, retrobulbar haemorrhage and severe ocular pain. Other conditions that require hospitalisation are one eyed, non ambulatory and mentally debilitated patient.

Post-Operative Medications

1. Analgesic, usually tablet form whenever necessary.
2. Sedative, usually diazepam (5mg) tablet on the night if the patient is restless.
3. Ocular hypotensive agent, depending on the surgeons judgement.
4. Other medications for systemic diseases, if any, to continue.
5. Topical Medications:
    a. Antibiotic – steroid either in combination or separately, 1 drop 4 times daily, tapered off over a period of 4-6 weeks. In Phaco one can stop the drops at the end of 4 weeks. Choose an antibiotic which is cheaper, broad spectum least toxic and available even in small towns. Steroids without combination of antibiotics is preferable.
    b. Cycloplegics – Optional. Cyclopentolate 1% or Homatropine 2% can be recommended once or twice daily for first 1 or 2 weeks.
6. Systemic antibiotics or steroids are not recommended routinely.

Post Operative Follow up

1. The first examination is done on the next day in the morning, whether they are inpatient or under ambulant care. The eye is cleared with sterile cotton with aseptic care. A thorough slit lamp examination is done. This serves the purpose of early detection and treatment of complications such as wound leak, hypotony, raised IOP and iritis. There is usually some amount of reaction, little or no change in cornea and mildflare and cells in the anterior chamber. Centering of IOL should be assessed and look for good red glow under dilated pupil.
2. The second check up is usually done after a week following surgery. This helps in early detection and treatment of infection. In the absence of complications, the frequency and timing of additional visits is left to the discretion of operating surgeon based on the type of surgery performed and the distance travelled by the patient. If the surgeon has sharing partners or known ophthalmic centres, he can direct the patient to have postoperative care under them.

3. The final examination and refraction to provide an accurate prescription for spectacles is usually performed six weeks after surgery in case of standard ECCE with PC IOL and four weeks in case of small incision sutureless surgery; unless one come across very high astigmatism.

   Each post-operative examination should include

   - Assessment of visual function either by refraction or pinhole.
   - IOP, preferably by applanation (preferred than Shiotz) Shall be recorded in needy patients.
   - Check the drugs used by the patient.

A dilated ophthalmic examination should be performed atleast once during the post operative period to visualise the lens capsule, centration of IOL and retinal examination upto the periphery. Diabetics should have detailed fundus examination at the final visit.

Post-Operative Instructions

These are to be followed for six weeks in case of ECCE with IOL and 2-4 weeks in case of sutureless cataract surgery.

1. Do not lift heavy weight.
2. Do not stoop or bend over.
3. Do not touch the operated eye with bare hands.
4. Avoid head bath for 2-4 weeks.
5. Face can be cleaned with wet cloth. Shaving allowed. Avoid vigorous shaking of head and exercises like yogasanas, jogging etc.
6. Avoid dirty and crowded places.
7. Avoid smoking, alcoholic drinks and usage of snuff. There are no special diet restrictions.
8. In case of cough or constipation, consult a physician for treatment.
9. They can use previous corrective spectacles. Use dark glasses outdoors. The dark glasses should have side shields.
10. Use an eye shield during sleep at night.
11. The eye should be cleaned by an attendant in the manner as shown by the surgeon, twice daily.
12. Use medications as prescribed.
13. In case of persistent pain, sudden marked redness, excessive discharge, lid swelling, sudden decrease in vision, the patient is instructed to call the surgeon or check with local ophthalmologist immediately.

Post-operative Complications

Immediate post-operative complications include corneal edema (8.65%, hyphema (6.28%) and IOP greater than 30 mm (5.6%)[1].

Posterior capsular opacification (PCO) is the most common complication of modern cataract surgery occuring in upto 50% of patients by 2 years post-operatively[2].

Major complications that are potentially sight threatening although rare in patients, who had ECCE or Phaco may occur, they include, endophthalmitis (0.1-0.4%), Bullous Keratopathy (0.3%), CME detected by physical examination (1.4%), angiographically demonstrated CME (3.5%), Retinal detachment (0.7%), and IOL dislocation (1.1%)[1].

Less common but also sight threatening complications of cataract surgery include secondary glaucoma (0.2 – 1.2%) suprachoroidal effusion and/or hemorrhage (0.3%) and vitreous haemorrhage (0.3%).

Less severe complications are wound gape (0.6%), sterile hypopyon (0.2%) posterior capsule rupture (3.1%), vitreous loss (0.8%) and Iritis (0.8%)[1].

Despite all precautions prior to suture removal, cases of bacterial endopthalmitis after suture removal are reported[3].

Brief description about operating microscope

Currently most of the ophthalmologists even in developing countries use operating microscope. It could be simple one or a fancy piece. Basically you need a floor mounted scope with coaxial illumination and sufficient working distance. Video attachment, observerscope, X-Y movement are for training centres. The parts should be cheaper and available locally.

Sterilisation of Equipments and Linen

Pre-operative sterilisation

A regular autoclave serves the purpose; you may need gas steriliser to sterilise special instruments used by posterior segment surgeons. Linen works out cheaper than disposable drapes.

Intraoperatively

Better to avoid chemical sterilisation, except in emergencies. Routinely cataract instruments can be sterilized using autoclave in between surgeries.

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Aravind Eye Hospital
& Postgraduate Institute of Ophthalmology
(Run by Govel Trust)

Informed Special Consent
Permission for Operative Procedure(s) and / or Treatment(s)

Patient's Name : _____ Age: _____

MR. No. : _____

Diagnosis RE/LE/BE : _____

Procedure/Surgery : _____

I have been clearly explained about the condition of the RE/LE/BE. I have also been explained the pros and cons of the surgery. The staff of the hospital has fully explained to me the purpose of the operation(s) / procedure(s) and has also informed me of expected benefits and complications (from known and unknown causes), attendant discomforts and risks that may arise, as well as possible alternatives for the proposed treatment(s) including no treatment. I have been given an opportunity to ask questions and all my questions have been answered fully and to my satisfaction.

I understand that during the course of the operation(s) or procedure(s) unforseen conditions may arise which necessitate procedures different from those contemplated. I therefore consent to the performance of additional operatio(s) and procedure(s), which the surgeon may consider necessary.

Patient's Signature : _____

Witness's Signature : _____

Name of the Witness : _____

Relationship to the Patient : _____

IOL In-Patient Record

MR No.: _____

Date: _____

Name: _____ Age: _____ Sex: M/F

Address	Admitted on:
	Discharged on:
	Readmission on:

Positive findings in the eyes:

	Right Eye	Left Eye
Anterior Segment		
Lens		
Posterior Segment		
Vision Uncorrected		
Vision corrected		

Type of cataract
(in eye to be operated)
RE/LE

- ☐ 1. Senile
  - ☐ Immature
  - ☐ Mature
  - ☐ Hypermature
  - ☐ PSC
- ☐ 2. Traumatic
- ☐ 3. Congenital
- ☐ 4. Complicated

Duct	BP
Tension	Urine sugar

Right Eye/Left Eye	Surgeon:
Estimated IOL Power AC PC	Assisted by:
K Reading:	Nurse:
Axial length	Date:
Conjunctival flap: Limbal/Fornix	Case No. for the Day:

Extraction Extra/Intra/Phaco/SICS	Solution used for irrigation Ringer Lactate/BSS/BSS+
Any intracameral injection: None/Healon/Vision/Miochol/Moistat	Section: Corneal/Limbal
Rent in Posterior capsule: Yes/No/Doubtful Vitreous Disturbance: Yes/No	Iridectomy: SI/PI Iridotomy Sphincterotomy
Vitrectomy Done: Yes/No Automated/Weckspong e	Iris fixation suture: Yes/No
If AC IOL: Planned/Unplanned If unplanned reason:	Paster IOL sticker in this area If Sticker is not available fill in the details here

Suture material: Nylon/Silk	8°/9°/10°	Type: Interrupted/Continuous	No. of Sutures:

Any Complication:	Iridodialysis/Zonular rupture/ Left out cortex/Endo. damage/Descemet's stripping/PC Rent/ Bleeding dropped fragments of lens

Other: