INTRA OPERATIVE COMPLICATION AND VISUAL OUTCOME FOLLOWING PHACOEMULSIFICATION IN POSTERIOR POLAR CATARACT

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CERTIFICATE

This is to certify that this dissertation entitled **"*INTRA OPERATIVE COMPLICATION AND VISUAL OUTCOME FOLLOWING PHACOEMULSIFICATION IN POSTERIOR POLAR CATARACT*"** has been done by ***DR. ANNAPURANI*** under my guidance in Department of OPHTHALMOLOGY, Madurai Medical College, Madurai.

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I, **Dr. ANNAPURANI** solemnly declare that the dissertation titled ***"INTRA OPERATIVE COMPLICATION AND VISUAL OUTCOME FOLLOWING PHACOEMULSIFICATION IN POSTERIOR POLAR CATARACT"*** has been prepared by me.

This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement for the award of M.S.,(Ophthalmology) Branch - III degree Examination to be held in MARCH 2008.

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CONTENTS

INTRODUCTION

During the past two decades the advances in cataract surgery have not only been phenomenal but have also been gratifying to both the surgeon and the patient, especially to those patients who present with very early cataractous changes but with significant visual symptoms hindering normal day-to-day life. At present Phacoemulfication has been rapidly established as a widely accepted means of cataract removal. Even though it has improved over the years, there are various complication encountered during this procedure like the posterior capsular rupture with loss of nucleus into vitreous.

Posterior Polar Cataract presents a special challenge to the phacoemulsification surgeon because these eyes have a predisposition to posterior capsule dehiscence during the surgery. It is an important type of developmental cataract that affects vision in its early course. The lens may have evidence of a small opacity at birth but the cataractous changes take place later in life usually in the late 30`s or early 40`s. Hence surgery is very much warranted in such visually symptomatic early cataracts.

Cataract surgery using current phaco techniques offers a number of attractive benefits to both the surgeon and the patient. The principle advantage is a smaller incision size, which decrease the amount of tissue injury, reduces the amount of post operative pain & inflammation & provides more rapid refractive stabilization with less astigmatism than other procedures performed before.

DEVELOPMENT OF LENS

The rudimentary lens is first seen as a thickening of the surface ectoderm, the lens placode at 22 days of gestation, it overlies the optic vesicles. The lens placode invaginates and sinks below the surface ectoderm to form the lens vesicle, which consists of a single layer of cells covered by a basal lamina.

The cells forming the posterior wall of the lens now rapidly elongate, loose their nuclei and form transparent lens fibre. These are known as primary lens fibres. With the increase in length of these cells, the cavity of the lens vesicle gradually become obliterated .The lengthening of the cells first occur at the center of posterior wall, which projects forward into lens cavity. The nuclei of the lens fibres move anteriorly with in the cells to form a line convex forward called nuclear bow. The primary lens fibre now becomes attached to apical surface of anterior surface of anterior lens epithelium. The division of anterior epithelial cells at the equator forms all additional lens fibre. These are known as the secondary lens fibres. New secondary lens fibres are formed through out the life. The basal ends of fibres remain attached to the basal lamina, while their apical ends extent anteriorly around the primary fibres beneath the capsule.

In this manner the lens fibres are laid down concentrically, and the lens on section has laminated appearance. As new lens fibres are added the lens enlarges. This process continues through out life, and each lens fibre persists through out life. None of the fibres runs completely from anterior to the posterior surface of the lens. The ends of the fibres come into apposition at sites referred to as " SUTURES".

The fibres run in a curved course from the sutures on the anterior surface to those on the posterior surface. Since no fibres pass from pole to pole, those that begin near the pole on one surface of lens end near the peripheral extremity on the other and vice versa. The anterior suture line is shaped like an upright Y that is inverted on the posterior aspect.

In fetus the lens grows rapidly because it is supplied by the hyaloid artery, which form a plexus on the posterior surface of lens capsule. It is nearly aspherical in shape, is soft and has reddish tint. By the time the infant is born, its anteroposterior diameter is nearly equal to that of adult. Its equatorial diameter is about 2/3 rd of that reached in the adult. The increase in size of the equatorial diameter with age is due largely to the continued production of new secondary lens fibres. The lens increases in density during development as successive fibres become tightly apposed and the layers become interdigitated. Increase amount of fibrillar materials also appears with in the fibre cytoplasm.

THE LENS CAPSULE

The Lens capsule is formed from the mesenchyme that surrounds the lens. In the earliest stages of development it receives an abundant arterial supply from the hyaloid artery as the tunica vasculosa lentis. Later this blood supply regress and it disappears before birth.

THE CILIARY BODY & SUSPENSORY LIGAMENT OF THE LENS.

The mesenchyme situated at the edge of optic cup differentiates into the connective tissues of the ciliary body, the smooth muscle fibres of the ciliary muscles and the suspensory ligaments of the lens. The two layers of neuroectoderm forming the edges of optic cup grow into the posterior surface of the ciliary muscle, forming the two epithelial layers covering the ciliary body.

ANATOMY OF LENS

The lens is a transparent, biconvex structure situated behind the iris and the pupil and in front of the vitreous body. The convexity of its anterior surface is less than that of its posterior surfaces. The center points on its anterior and posterior surfaces are referred to as the Anterior & Posterior poles, respectively. A line joining the poles form the axis of the lens and the marginal circumference of the lens is called equator of the lens. In the adult the lens measure approximately 10 mm in diameter and 4 mm thick. The equator of the lens is encircled by the ciliary process of the ciliary body and lies 0.5mm from then. The lens, which has considerable flexibility, is kept in position by the suspensory ligaments. The diopteric power of entire eye is 58 diopters with the cornea responsible for most of this refractive ability. The lens contributes only 15 D to the total power. The importance of the lens is that it can change its diopteric power, allowing distant and near object to be focussed both on the retina. The range of diopteric power is reduced with age being about 8D by the age of 40 and only 1 to 2 D by the age of 60. The lens has a refractive index of about 1.36 in the periphery and 1.40 in the inner zone.

The lens continues to grow through out life, measuring about 6.5 mm in diameter at birth and 10 mm in the adult. It also increases in thickness, the thickness possibly reaching 5 mm in the aged.

STRUCTURE OF THE LENS

The lens is made up of three parts:

1). Elastic Capsule.

2). Lens Epithelium (Confined to anterior surfaces of lens).

3). Lens Fibres.

The Capsule of the lens is an elastic basement membrane that envelops the entire lens. It is thickest on the anterior and posterior surfaces close to the equator measuring about 20 micron, and thinnest at the posterior pole measuring about 3 micron. The thick Basement membrane is formed by the lens epithelium anteriorly and by the superficial lens fibres posteriorly.

Under the light microscope the capsule has a homogenous appearance, but with the electron microscope it is seen to consist of 40 lamellae. Each lamella resembles a unit basal lamina; consisting of numerous reticular fibres embedded in a matrix of glycoprotein and sulfated GAG.

The lens epithelium is cuboidal and lies beneath the capsule. It is formed only on the anterior surface of the lens. At the equator, these cells elongate and form columnar cells, which become arranged in meridional rows. It is at the equator that the lens epithelial cells become transformed into lens fibres. At the equator of the lens mitotic activity is at a maximum.

The lens fibres constitute the main mass of the lens. The fibres are formed by the multiplication and differentiation of lens epithelial cells at the equator. The lens cell elongates and runs meridionally. As the basal part of cells elongates, the process moves along the interval surface of the capsule in a posterior direction. As the apical part of the cell elongates, it slips beneath the interval surface of the adjacent lens cells. To begin with, the nucleus remain intact but later it fragments and disappears. This process continues and the preceding generations of cells are repeatedly pushed into the lens substance. As the cell progressively elongates anteriorly, the nucleus moves anteriorly, so that it takes up a position anterior to the nuclei of the more superficial cells. This anterior movement of the nuclei as the fibre passes deeper produces the nuclear pattern known as Lens Bow.

Each elongated lens cell is now called Lens fibre. It is hexagonal prism in cross section and very long measuring about 10 mm. The fibres run meridionally from the posterior to anterior lens surface, they are U shaped. The earliest formed fibres are those in the center of the nucleus of lens. Later fibres form the anterior cortex of lens. In this manner a lens cut on section has a Laminated appearance.

It will be remembered that in the fetus the ends of opposing lens fibre in the same layer meet about in a manner producing patterns known as SUTURES. Anterior suture is an exact Y shape, and the posterior is an Inverted Y. As the lens increase in size the lens fibres are unable to stretch the anteroposterior distance, so that progressively more complicated suture patterns are formed.

As the result of this continuous production of lens fibre from the embryonic stage and the progressive internalization of the fibres, some writers refer to the earliest fibre mass in the center of the lens as the embryonic nucleus. This is followed by the fetal nucleus with its Y shaped sutures. Those fibres that are formed after birth constitutes the earliest part of fibre mass known as adult nucleus. The size of embryonic and fetal nucleus remains constant while that of the adult nucleus is always increasing. The area surrounding the adult nucleus containing the recently formed nucleated fibres, is referred to as Lens Cortex.

The lens fibres have a few small vesicles, monofilaments, microtubules, and an occasional mitochondria in their cytoplasm. The fibres are tightly packed, there being containing very little intracellular space. The interlocking of their adjacent plasma membrane holds the lens fibres together. In some places this takes the form of tongue and groove or ball and socket type of interdigitations. It is interesting to note that the interdigitations are less complicated in the superficial zones of the lens, and this may permit moulding of the lens shape during accommodation. In addition the lens fibres exhibit numerous gap junction, which may explain how deep lens fibres can survive some distance from the surface, and away from a source of nourishment.

SUSPENSION OF LENS

The lens is held in position by a series of a delicate, radially arranged fibres, collectively known as suspensory ligament of lens or zonules. The zonular fibres arise from the epithelium of ciliary process and run toward the equator of the lens. The fibre fuses to form about 140 bundles. The layer bundles are straight and reach the lens capsule in front of lens. Together they form the anterior zonular sheet. The smallest fibres curve backward and are attached to the posterior surface of the lens to form the posterior zonular sheet. As the zonular fibres reach the lens, they break up into fine fibres that become embedded in the anterior part of the lens capsule.

When the eye is at rest, the elastic lens capsule is under tension,causing the lens to assume a discoid shape. The equatorial region or the circumference of the lens is attached to the ciliary process of the ciliary body by zonules. The pull of the radiating fibres of the zonules tends to keep the elastic lens flattened permitting the eyes to focus on the distant objects.

POSTERIOR POLAR CATARACT

Posterior Polar Cataract is consist of dense white opacities axially occurring in the posterior Capsule. The central portion typically is circular and thick and has a characteristics whorl like appearance. It presumably arises before birth or in early infancy.

TYPE OF PPC.

1). One spot Polar cataract (stationary).

Consisting of well circumscribed circular opacity located on the central posterior capsule

2). Onion Polar Cataract. (Most Common).

Concentric thickened rings around the central plaque opacity gives Bull's eye like app.

3). Polar cataract with nuclear sclerosis.

4). Progressive type.

Changes that takes place in posterior cortex in the form of radiating rider opacities.

SIGNS: A preexisting opening may be strongly suspected at the time of initial biomicroscopic examination which may demonstrate particulates with in the S/L beam just behind the posterior capsule.

PSEUDOHOLE:

At times classical appearance suggestive of defect may be observed in posterior cortex when the posterior capsule actually remain intact. This phenomenon called pseudohole.

INCIDENCE:

5 / 1000 Individuals.

PATHOGENEIS OF PPC:

The precise mechanism of development of PPC is unknown. But it has been suggested that they are caused by persistence of hyaloid artery. Recent molecular genetics analysis showed the locus for an autosomal dominant posterior polar cataract (further defined as CPP 1) mapped to 16q22 by the finding of its linkage to the haptoglobin gene and another locus for autosomal dominant PPC (further defined as CP 2) assigned to chr 16q36. It has also been suggested that they are caused by persistence of the hyaloid artery of invasion of lens by mesoblastic tissue.

SYMPTOMS

Stationary type is compatible with good vision. Normally the patient seeks help in his or her thirties. The common symptoms are intolerance to light. Glare is more severe when the source of light is close to object of vision. For instance night driving becomes difficult. Forward light scattering (towards the retina) accounts for glare as well as for reduced contrast sensitivity and visual acuity. Symptoms worsen with the development of cortical rider opacities.

MANAGEMENT:

Principles of cataract surgery management in PPC are well established. Phaco is preferred over conventional ECCE. It gives better control because of closed chamber technique & understanding the basics of phaco fluid dynamics has increased the safety of such surgery. In ECCE, nucleus removal is traumatic and precipitate PCR. Peribulbar Anesthesia provides prolonged action & reduces positive pressure in vitreous. Cortical cleavage Hydro dissection is regarded as contraindication in PPC. A weak point can produce hydraulic PCR during hydro dissection. Well-controlled Hydro delineation is mandatory, providing epinuclues bowl, act as cushion during phaco.

SURGICAL MANAGEMENT OF PPC

PPC presents a special challenge to the phaco emulsifications surgeon because these have predisposition to posterior capsular dehiscence during cataract surgery.

The management of surgical techniques offers the following options:

1). In Extra Capsular Extraction where in the nucleus removal is more traumatic and can precipitate Posterior capsular rent.

2). Small Incision cataract surgery with CCC enables the IOL to be placed in the anterior capsular rim even in the presence of large posterior capsular ruptures.

3). Phaco is preferred over the other two surgical techniques mainly because the posterior polar cataract usually is easily phacoemulsifiable with soft nucleus. CCC with Hydro free dissection is possible which offers more safety to the posterior capsule. The only disadvantage would be the long learning curve to master the technique and understanding the basic phacodynamics.

PHACO EMULSIFICATIONS

HISTORY:

In 1967, Kelman described a single instrument technique for cataract extraction using ultrasound vibration to remove lens material through a 3mm corneoscleral incision. In this technique nucleus was prolapsed into anterior chamber and then emulsified. Between 1973 and 1979 the result of thousands of Kelman`s phacoemulsification cases performed by numerous surgeons were reported. In 1970, Sinskey due to difficulty in delivery of softer nuclei into AC used a 15-degree phacotip to sculpt the central nucleus down almost to posterior capsule before removing in the peripheral nuclear shell. By performing phacoemulsification posteriorly in the capsular bag and deep in the AC, the damage to endothelial cells was significantly reduced. In 1970 Little & Kratz popularized Two-handed phaco emulsification of the nucleus using a spatula as the 2-nd instrument, Kratz used the side port at 3 O'clock for the 2-nd instrument. Little passed 2 nd instrument into the AC directly along the side of ultrasound tip, after sculpting the nucleus centrally with 45 degree tip, remaining nucleus was tilted and prolapsed out of the superior equator of the capsular bag for further emulsification. Maloney also adopted the technique and taught it to many surgeons. In

1984 Gimbel developed the CCC technique and by 1985 he developed "Divide & Conquer nucleofractis" method of in situ phacoemulsification. In 1986, Gimbel applied the term Divide & Conquer to insitu phaco emulsifications, which is derived from Latin "Divide et Impara".

Modern day wound construction began with Kratz`s development of scleral tunnel incision (scleral pocket incision), which when compared to the limbal incision, is made more posterior to the limbus and a scleral tunnel and small corneal wedge are created. But this incision had to be closed with stitches that contained a vertical radial component their by creating with the rule astigmatism. Single stitch closure technique, Horizontal mattress suture by Shepard, Horizontal Anchor suture by Market and the Infinity suture by Fine. Michael Mc Farland (1990) was the first person to perform sutureless closure of scleral tunnel wound. Paul Ernest modified Mc Farland`s scleral wound technique by carrying forward the tunnel into the clear cornea there by creating an internal corneal lip to prevent fluid escape from anterior chamber. Thus began the modern day three step internal corneal lip incision.

INSTRUMENTATION.

A thorough understanding of the phacomachine is imperative for every phaco surgeons. Each machine has different design features. However the basic functions of all machine remains the same. It is critical that every surgeon learns about the machine parameters and their individual effects, how they interrelate and in total how they determine the surgical environment in which the surgery is performed.

BASIC FEATURES.

Every phaco machine has three basic features. These are Irrigation, Aspiration & Ultrasonic fragmentation. Correspondingly two-hand piece are used in phaco, the Irrigation aspiration hand piece and phaco or ultrasonic hand piece.

IRRIGATION – ASPIRATION HAND PIECE.

The I-A Hand piece has a silicone sleeve that fits snugly around the aspiration tip. Through this sleeve, irrigation is delivered. The I-A tips differs from the phaco tip, the sleeve may be turned to orient the irrigation port in any direction. The irrigation ports in the silicone sleeve should be perpendicular to the metallic aspiration port as this helps to direct the infusion fluid along the iris plane. This reduces iris flutter during surgeries. A variety of I-A tips are available; straight, 45 degree or

90 degree angulations; 0.2mm, 0.3mm, 0.7mm diameters. Most frequently used is the 0.3mm tip. During use for irrigation aspiration the foot pedal is on position 2.

ULTRASONIC HAND PIECE.

Phaco Emulsification surgery is based on ultrasonic power, which is a function of acoustic vibrators that have been incorporated into the ultrasonic hand piece. Attached to this vibrator is a hollow titanium needle on the phaco tip. The acoustic vibrator is either a magneto-restrictive or a piezoelectric device that converts electrical energy under the influence of an electrical signal. The acoustic vibrator oscillates longitudinally at a frequency between 30,000 – 60,000 Hz. This imparts a linear motion to the ultrasonic tips. The stroke amplitude of the linear movement is 3/1000 of an inch and the acceleration 80,000 – 2,40,000G.

PHACO TIP.

The energy so produced along the ultrasonic hand piece is then transmitted into the phaco tip. The phaco tip is made of titanium and is hollow with the distal opening functioning as the aspiration port. The phaco tip can have various bevel angles from 0 degree – 60 degree, the most commonly used are 30 degree and 45 degree phaco tips.

ASPIRATION PUMPS.

Depending on the machine, three kinds of pumps are used to control aspiration and produce the negative suction pressure i.e. vacuum. They are:

1). Peristaltic pump.

2). Venturi pump.

3). Diaphragmatic pump.

The peristaltic pump is also known as a `Constant Flow Pump` while the Venturi and the Diaphragmatic pumps are `Constant Vacuum` variety.

PERISTALTIC PUMP.

Peristaltic pump was popularized by heart lung machine. In these pumps a pressure differential is created by compression of the aspiration tubing in a rotatory motion. When the rotational speed is low; vacuum develops only when the aspiration port is occluded. On occlusion vacuum builds unto preset value in a stepladder pattern. By increasing the rotational speed, as in the newer generation machines a linear build up of vacuum occurs even with out occlusion of the tip. It can thus be made to simulate venturi or Diaphragmatic pump.

VENTURI PUMP.

Venturi pump uses compressed gas to create inverse pressure. Vacuum generated is related to gas flow, which in turn is regulated by a valve. Vacuum build up occurs linearly in a consistent manner from zero to preset value. The build up is almost instantaneous on pressing the foot pedal. Due to this, there is an increased risk of iris trauma and posterior capsular rents, which makes these, pumps unsafe, particularly for beginners.

DIAPHRAGMATIC PUMPS.

Diaphragmatic pump uses a flexible membrane with in a cassette to generate vacuum, build up of vacuum is more linear and reaches the preset level even with out occlusion. This makes it unsafe; lens material can be aspirated with out having to mechanically approach it.

FOOT PEDAL.

The position indicator shows the mode of operation in which the instrument is functioning on depressing the foot pedal in a linear manner.

Position 1: Only Irrigation solution is flowing.

Position 2: Irrigation/Aspiration occur simultaneously.

Position 3: Irrigation, Aspiration and Fragmentation take place simultaneously.

MECHANISM OF ACTION OF PHACO:

Factors involved include:

1). A mechanical impact of tip against the lens.

2). An acoustic wave transmitted through fluid in front of tip.

3). Cavitation: At the cessation of the forward stroke, the tip has imparted forward momentum to the fluid and the lens particle in front of it. As the tip being retracted the fluid cannot follow, there by creating a void in front of tip. The void is collapsed by the Implosion (Cavitation) of the tip there by creating additional shock waves.

4). There is an impact of fluid and lens particles being pushed forward in front of tip.

Considering the mechanism of phaco it is clear that there is attenuation of energy on phacoeing with in the nuclear material. This reduced the deleterious effect on the corneal endothelium. Therefore posterior chamber phaco helps maintain safety of the procedure by increasing the working distance from the endothelium.

PHACO PARAMETERS.

ULTRASONIC POWER.

The ultrasound power is usually about 50% to 70%. If the lens is soft it is decreased to about 30% and if it is hard, power is increased to 80% to 90%.

EFFECTIVE PHACOTIME.

It is a total phacotime at 100% phaco power. Effective phacotime is very significant as less effective phacotime indicates proportionately less energy delivered to the eye there by reducing the side effects of phaco power.

PHACOPOWER.

Phacopower is the ability of the phaco hand piece to cut or emulsify cataract. Phacopower is directly related to stroke length, frequency and efficiency of hand piece.

STROKE LENGTH.

Stroke length is the distance by which the titanium phacotip moves to and fro. It is the most important factor in deciding the phaco power. Changing the phacopower setting of the machines can alter the stroke length.

FREQUENCY.

Frequency is the number of times the tip moves and it is fixed for a particular phaco hand piece. It is measured in KHz. Power variables are adjusted intraoperatively depending on type of cataract and patient.

PROCEDURE:

1). SCLERAL TUNNEL (THREE PLANAR)

First of all the conjunctiva is reflected from the limbus and mild bipolar cautery applied for hemostasis. A caliper is used to mark the length of the incision that is needed for IOL implantation at a suitable distance from the limbus i.e, 2 – 2.5mm. A depth-preset knife (300 micron) is used to make the initial incision into the sclera in a perpendicular plane (external Incision). A crescent blade is taken and the dissection is begun. It is of utmost importance to begin dissection at the correct depth and then to maintain the same depth through out the length and breadth of incision there by creating the sclerocorneal pouch parallel to sclera. The dissection is carried forward across the limbus into the clear cornea tissue of about 1 – 1.5mm, again maintaining the same depth of dissection (Internal Incision). Once the tunnel is made paracentesis stabs are made at 10 O'clock and 2 O'clock position. A suitable sized (32 mm) keratome is taken and introduced into the tunnel in the central position of the frown and advanced along the dissected tunnel. When the tip of the keratome reaches the end of the tunnel, the tip is advanced into the corneal stroma, again remaining in the same plane. At the intended point of entry into the AC, the tip of the blade is dipped posteriorly and advanced slowly until the tip of blade just appears inside the chamber. At this point, the direction of tip of blade is again turned horizontally and entry completed. Viscoelastic material is injected either through paracentesis or through scleral tunnel.

2) CONTINUOUS CURVILINEAR CAPSULORHEXIS.

Using a bent needle of 23 – 26 G needle a perforation is made in the center of the anterior capsule. By extending this with the sharp edge of the needle, a horizontal incision is made. The tip of the needle is now used to redirect the tear in a clock wise direction. This creates a flap with a smooth curve at its beginning. The flap is then pulled along in a circular manner by a means of gentle traction with the needle tip. If the tear starts to extend peripherally it is usually the results of positive vitreous pressure which can be counteracted by reinflating the AC with viscoelastics. As the flap progresses, large amount of capsular folds will present and must be pushed out of the way, so that one can visualize the exact point at which to place the tip of the needle. Ideal size is 5 – 5.5mm.

When completing the capsulorhexis, one should overlap the tear in such a manner that the last part of the tear joins the first part from the outside towards the center, thus resulting in a continuous edge, circular shape.

3). HYDRODISSECTION:

In Hydro dissection the infusion fluid is injected exactly between the anterior capsule and the cortex so that the fluid wave dissects all around the capsular bag and separates it. The cortex is completely dissected from the capsule, freeing the entire lens nucleus, epinucleus and cortex from capsular bag. This facilitates nuclear rotation and manipulation during Phacoemulsification.

4. HYDRODELINEATION:

In Hydro delineation, the infusion fluid is injected between the epinuclues and nucleus. The fluid wave appears as a golden ring under the surgical microscope. The posterior epinucleus created by Hydro delineation acts as a cushion safeguarding to a certain extent the posterior capsule during the phacoemulsification. Apart from debulking the nucleus also enables a more realistic use of linear phacoemulsification.

PHACO PROCEDURES.

1). DIVIDE & CONQUER (NUCLEO FRACTIS).

A). TRENCH DIVIDE & CONQUER METHOD.

B). CRATER DIVIDE & CONQUER METHOD.

2). CRISS CROSS SCULPTING (SHAPED PHACOFRACTURE).

3). PHACO SWEEP.

4). PHACO CHOP (NAGAHARA`S TECHNIQUE).

5). STOP & CHOP TECHNIQUE.

6). CHIP & FLIP TECHNIQUE.

DIVIDE & CONQUER (NUCLEOFRACTIS)

The term `Nucleofractis` is coined to describe the process of fracturing or fragmenting the nucleus into pieces. Today it is referred to as Divide & Conquer because cataract is divided and fragmented rather than impaled by the phaco tip in a random fashion, is more easily conquered.

D & C incorporates 4 basic steps:

1). Sculpting until a very thin posterior plate of nucleus if any remains.

2). Fracturing the nucleus rim & posterior plate of the nucleus.

3). Fracturing again & breaking away a wedge shaped section of nuclear material for emulsification

4). Rotating the nucleus for further fracturing & emulsification.

The differing densities of cataract has created 2 different methods of sculpting, used as a broad varieties of D & C Method:

1) In Soft – Moderately hard nucleus, a vertical Trench is sculpted and the procedure called TRENCH DIVIDE & CONQUER METHOD.
2) In Moderately hard – Very hard nucleus, a deep crater is sculpted and the procedure called CRATER DIVIDE & CONQUER METHOD.

CRATER DIVIDE & CONQUER METHOD.

Initially deep, central sculpting is carried out resulting in a larger crater and leaving a dense peripheral rim to fracture into multiple pieces. Once central coring is completed, the nuclear rim is fractured, using the bimanual method in which the spatula & phaco tip create a counter pressure. The lens is rotated and a second crack is made, isolating a Pie Shaped section. The nuclear rim is then rotated clockwise, for systemic piece by piece Nucleofractis. The Harder the nuclear rim, the smaller the wedge shaped section must be to allow manageability & to reduce the tearing of posterior capsule. Once the fracturing is complete, each Pie – shaped wedge of nuclear rim is bought to the center of capsule where phaco is safely done.

TRENCH DIVIDE & CONQUER METHOD.

Principles:

In soft nucleus after making a central trench, a central fracture is created and then the left as well right side of lens is divided by fracturing In softer cataract the firm nucleus is small and epinuclues is quiet soft. The sculpting of the trench through the nucleus must be done cautiously, should be small, central & vertical to leave enough firm nucleus so that the force of two instruments can be applied in nucleofractis. In these soft nuclei the lens is split by exerting the lateral pressure with the Phacoemulsification tip & spatula at the center of lens. With this splitting usually starts in the posterior pole and extend to 6 O'clock & 12 O'clock position to complete the splitting process. The phaco tip is then used to impale the left & right hand section and quadrants are fractured. This can be done by changing the direction of phacotip to left & passing the tip deeply into the nucleus of left hemi section, which is kept stabilized with a spatula, the phaco tip is pushed and rotated clockwise to break off a pie-shaped section of lens, it is then emulsified. Similar procedure in right hemisection while the remainder is stabilized with cyclodialysis spatula.

PHACO FRACTURE (CRISS CROSS SCULPTING).

This technique was introduced by Shepard's, has made the in situ nuclear fracturing principle quiet graphic because of the 4 distinct quadrants that are developed by criss cross sculpting and fracturing. He used 30-degree phaco tip to make a deep groove from 12 O'clock to 6 O'clock as far as possible. Then by means of clockwise pressure exerted by both the phacotip and spatula the groove is rotated 90 degree. Crossing the original groove makes a similar crosshatch. These instruments are then pushed apart fracturing the nucleus completely. The lens is then rotated and the other groove fractured in a similar manner resulting in four wedges. These pie-shaped wedges are easy to emulsify with in the bag.

PHACO SWEEP

In traditional sculpting technique the phaco probe is moved from proximal to distal portion of the nucleus to create a groove. By using a phaco probe in a lateral motion the central nucleus can be sculpted quickly and deeply while maintaining constant visualization of the tip of the instrument. A 45-degree Kelman phaco tip performs more efficient phaco sweep. The bend of kelman tip focuses the ultrasound energy down into the nuclear mass, increasing the efficiency of the phaco emulsification where as straight phaco tips tend to shave lens material from the nuclear surface. As sculpting proceeds to deeper layers the phaco tip is still moved in a lateral sweeping motion. The lens is stabilized inferior to the groove with 2^{nd} instrument through the paracentesis. After lateral sculpting is deep, horizontal fracture is created as the upper portion of the nucleus is stabilized with phaco tip, while the 2^{nd} instrument pushes against the inferior wall of the groove. These pieces are then emulsified in the pupillary zone.

PHACO CHOP (NAGAHARA`S TECHNIQUE)

After completing capsulorrhexis and hydro dissection, the phaco emulsification tip is placed in the eye, burying it in the nucleus as far as superiorly as possible. In this position it has maximum support for its role as a chopping block. The only thing it has to do at this stage is firmly hold the nucleus keeping it from moving superiorly as the chop is performed. Next modified lens hook is placed in the eye through the side port incision and poked down into the nucleus. It is then pulled towards the phaco tip, ripping a narrow groove in the nucleus as it cut its way towards the chopping block there by chopping the nucleus into 2 pieces.

The nucleus is rotated 90 degree orienting the original chop horizontally and then the steps were repeated on the inferior half of the nucleus there by chopping the inferior half into quarters. Then 4 quarters are then emulsified. The most notable advantage with this technique is reduced total phaco time and emulsification powers, allows safer nucleofractis in the presence of anterior capsular tear due to reduced stretchability of capsule.

STOP & CHOP TECHNIQUE

Koch & Katzen modified the phaco chop technique to provide space for tissue separation, nucleus manipulation and ease of removal. They suggested opening up some space in the middle of the cataract first using standard sculpting technique and then chopping the rest. The sculpting strategies suggested were those described by Gimbel for use with his Divide & Conquer nucleofractis technique. In cases involving a soft cataract the nucleus is prepared using trench method, and for those with hard a crater method. The nucleus is nuddged into two halves and from then the nucleus is removed with chop technique.

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PHACOEMULSIFICATION IN POSTEIOR POLAR CATARACT

A PPC presents a special challenge to phaco surgeon because of its predisposition to the posterior capsular dehiscence during surgery.

COUNSELLING:

- Inform the patient of the possibility of nucleus drop intraoperatively due to posterior capsular rupture.
- Long operating time, Secondary posterior segment interventions.
- Delayed visual recovery, may need NdYAG Capsulotomy for residual plaque
- Possibility of preexisting amblyopia especially in unilateral PPC.

PERIBULBAR ANEASTHESIA WITH OCCULOPRESSURE.

Provides long action with soft globe there by decreasing vitreous pressure.

CAPSULORHEXIS:

Should not be larger than 5 mm, since large opening may not leave adequate support for a Sulcus fixated IOL, if posterior capsule is compromised.

HYDROPROCEDURES:

Cortical Cleavage Hydro dissection can lead to hydraulic PCR and should be avoided. Well-controlled Hydro delineation is mandatory to create a mechanical cushion of Epinuclues against which phaco can be done safely. In Conventional Hydro delineation, the cannula penetrates the lenticular substance & Causes the fluid to transverse from outside to inward – this effect can add stress to capsular bag. To avoid this we can follow Inside out hydro delineation, which provides excellent surgical control, easy performance & reduce stress on zonules.

NUCLEUS REMOVAL

Avoid Nuclear Complex rotation, because it can rupture posterior capsule.

Nuclear Sclerosis >grade 2:

Step by Step Chop in situ & Lateral separation:

Phaco parameters: 40 % - 50 % ultrasound.

Vacuum 150 – 250 mm Hg.

Aspiration flow rate 18-mL/ min.

Bottle height 70 – 90 cm.

Resultant fragments are removed by stop, chop, chop & stuff technique.

Nuclear Sclerosis < grade 2:

Aspirate entire nucleus with in the epinuclear shell.

Phaco parameters: Aspiration flow rate 16 mL/min.

Vacuum level 100 – 120 mm Hg.

EPINUCLEUS REMOVAL:

Phaco parameters: 30 % Ultrasound

Vacuum 80 – 100 mm Hg.

Aspiration flow rate 16 mL/min.

Bottle height 80 – 90 cm.

First to strip off the peripheral lower half of epinucleus keeping central half intact. Then Mobilize the peripheral upper half with gentle flow of BSS which flows along the cleavage plane between capsule & epinucleus with out threatening the integrity of posterior capsule. Fully aspirate the entire epinucleus including the central area. Viscodissection of the epinucleus done by injecting viscoelastics under the capsular edge to mobilize the rim of epinucleus which is then aspirated with coaxial I/A hand piece.

CORTICAL REMOVAL

Bimanual automated I/A using an aspiration flow rate of 20mL /min & vacuum 400 mmHg aids in complete removal of cortex.

PC DEHISCENCE:

If there is a defect in posterior capsule, we inject viscoat over the area before withdrawing the phaco probe from the eye. Then perform 2-port limbal anterior vitrectomy using a cutting rate 800 cuts/min, vacuum 300 mmHg & aspiration flow rate 25 mL/min.

IOL IMPLANT:

In eyes with posterior capsular defect, we implant IOL in the bag only if the defect is very small. If defect is large we place the lens over anterior capsule in the ciliary sulcus. After implanting IOL we remove viscoelastics by 2-port vitrectomy rather I/A since vitrectomy aspirates material in piece meal and gradual manner.

CLOSING OF PHACO INCISION

The capsular bag is inflated using viscoelastics, followed by implantation of IOL. The viscoelastics is removed from the chamber and in turn inflated with irrigating fluid. The high pressure inside the chamber forces the 2 lips of internal incision against each other and closes them. Depressing the posterior lip of the incision should check the integrity of the incision. If the incision is leaky, hydration of corneal stroma may be tried at the extreme ends of the incision. The corneal edema pulls the tissue against each other and helps in a leak proof closure. In case the incision still leaks a single horizontal 10-0 nylon or 10-0 vicyl should close the wound.

REVIEW OF LITERATURE

Posterior Polar Cataract occurs in 2 forms:

1). Stationary delimited form

2). A Progressive form, which is composed of radiating cuneiform formations running towards the equator between which dust like or punctate opacities develop. In both types is a strong hereditary tendency almost always dominant in character. In stationary type this has been well recognized since a pedigree comprising of cases in 4 generations was published by Harman (1909 – 10); other extensive pedigree have been reported by Zeigler griscom (1915, 24 members in 4 generations). Laane (1952, 4 Generations). An exceptional recessive type of PPC & Cortical cataract were reported by Saebo (1949). Fibrous tissue with fetal vascular system may actually invade the substance of lens through a gap in capsule again constituting a PPC. The invasion of mesoblast which may be vascularised is sometimes very extensive and may involve the entire lens substance producing a total cataract.

- DUKE ELDER

Posterior Polar Cataract may be associated with congenital defects in the posterior capsule, an association reported to occur in approximately 30% of cases. A preexisting opening may be strongly suspected at the time of initial examination if biomicroscopy demonstrates particulates with in the slit beam just behind the concavity of the posterior capsule. There is an onion like concentric morphology occupying both the posterior subcapsular and posterior cortical regions.

- ROBERT. H.OSHER MD 1997 JRCS Vol 23

Central PPC may significantly affect visual function even when the opacity is localized and relatively small. These patient suffer from glare and blurry vision but still have VA 20/20.

- EHUD.I.ASHA MD JCRS 1997 Vol 23.

Although a defect in posterior capsule does not exist in every case it is better to prepare for it than to lose the lens into the vitreous. It is important not to Hydrodissect or place too much pressure on the Posterior capsule. The nucleus should be removed leaving the epinucleus as a cushion.

- HIBOKO BISSEN, MIYA JIMA MD.

Glare while driving at night and difficult in reading fine print are typical symptoms in patient with PPC. If no further pathological changes have been observed, I would like to suggest a cataract operation as soon as patient has difficulty performing daily function such as driving, reading or working on handicrafts. Visual function test during an office examination will not suffice as an indication for surgery.

- JACK.A.SINGER MD JCRS 1997

Rober.H.Osher et al in 1990 in the journal of cataract and refractive surgery reports 26% of posterior capsular rupture in his study of 31 eyes of 22 patient with PPC. Two possible explanation for this phenomenon are firstly there might be excessively tight adherence of the plaque or an otherwise normal posterior capsule underlying the cataract is unusually thin and this inherent weakness could predispose to Posterior capsular Rent.

- OSHER ET AL JCRS 1990.

Abhay Vasavasde et al in their study in 1999 of 25 patient reports a posterior capsular rupture in 30 % of patient and plaque in 32% of cases. Vasavade et al conclude by saying :

1) Adopt a technique that places minimal stress on the capsular bed.
2) Minimise forward movements of the zonule capsular complex and vitreous.
3) Keep bottle height low through out.

- ABAY VASAVADE JCRS 1999.

AIMS AND OBJECTIVES

1) To study the intraoperative complications encountered during phacoemulsification procedure in Posterior Polar Cataract.

2) To study the Visual outcome following the Phacoemulsification procedure in Posterior Polar Cataract.

MATERIALS & METHODS

Prospective clinical study of 30 consecutive patients with Posterior Polar Cataract who underwent Phacoemulsification was done from October 2005 to August 2007.

The detailed preoperative evaluation included:

- Recording uncorrected, best corrected and pin hole visual acuity using snellen`s chart.
- Detailed slit lamp evaluation with dilated pupils was performed and all typical cataracts with Bull's eye appearance were taken up into the study. Congenital posterior capsular dehiscence was looked for during slit lamp examination.
- Other work up included intraocular pressure, Fundus examination, A scan & keratometry done.

Under peribulbar & facial block all the cases were operated by phacoemulsification procedure.

SURGICAL PROCEDURE:

Pupils in all cases were fully dilated preoperatively with tropicamide eye drops or cyclopentolate eye drops. 5 cc of 2% lignocaine was injected peribulbar and 4 cc of 2% lignocaine used for facial block.

A scleral tunnel incision was made after the conjuctival flap was reflected from the limbus and mild bipolar cautery applied. A Continuous curvilinear capsulorrhexis max of 5.5mm was performed with a cystitome under viscoelastics. Hydro free dissection was done using a cyclodialysis spatula, which was introduced through the original paracentesis or an additional paracentesis route to mechanically separate the cortex from the nucleus. No attempt was made to hydrodissect the cataract or to rotate the nucleus at this stage.

Phacoemulsification was performed by Divide & Conquer, Chip & Flip or Stop & Chop methods depending on the hardness of nucleus. The machine settings were power 50 – 70%, aspiration flow rate 15 – 20 mL/min, vacuum Bottle height was reduced by 10 – 15 cm in all cases. Epinucleus was stripped all around for 360 degree while the central plaque was lifted and aspirated at the last stage. However the plaque came off with the soft epinucleus. The epinucleus was removed using the irrigation & aspiration probe and in cases of posterior polar rupture with vitreous disturbance, automated vitrectomy was performed followed by cortex removal with simcoe cannula.

The presence of plaque or posterior capsular thinning and CPCD was noted, wherever necessary the posterior capsule was polished. A PMMA IOL was placed in the bag or AC IOL or left aphakic depending on the presence of intact PC or PC rupture and the size of posterior capsular rupture. The anterior chamber was reformed with saline, wound integrity ensured and conjunctiva reposited in place and edges cauterized. Intraoperative complications like extension of CCC, complication during phacoemulsification procedure, rotation of nucleus (independently or within the epinucleus), presence of CPCD, occurrence of posterior capsular rupture, stage of occurrence of PC rupture, presence of plaque, rotation of residual cortex was studied.

Patients were examined 3rd day, 1st month and 6th months postoperatively. During each visit visual acuity was checked with pinhole using snellen`s visual acuity chart. Postoperative complication were studied, an additional refraction were done for patient who came after 1 month & 6 month postoperatively

PROFORMA

Study of intraoperative complications and visual outcome in Phacoemusification procedures in Posterior Polar Cataract.

Study No. ------------

NAME -------------------- MRD No -------------- AGE ----- SEX -------

PREOPERATIVE EXAMINATION

Date ------------------

VISUAL ACUITY	RE	LE
Uncorrected V/A	-----------------	--------------------
Pin Hole V/A	------------------	--------------------
Best Corrected V/A	------------------	--------------------

INTRAOPERATIVE NOTES.

Eyes to be operated (RE, LE) Date --------------

(i). Section (scleral tunnel, limbal).

(ii). Capsulorrhexis.

Size of CCC ---------------

Extension of CCC to periphery ----------------.

(iii) Hydroprocedures

Hydro free dissection ----------

Hydrodelineation. -----------

(iv) Phacoemulsification

Divide & Conquer

Chip & Flip

Stop & Chop.

(v) Parameters for nucleus removal.

Power ------------ Vacuum ------------ Flow rate --------

(vi) Phaco time -------------------

(vii) Rotation of nucleus & epinucleus -------------------

(together, separately or no rotation).

(viii) Parameters for epinucleus removal

Power ------------- Vacuum ---------- Flow rate ------------

(ix) Parameters for Irrigation & aspiration

Power ------------- Vacuum ---------- Flow rate ------------

(x) Posterior capsular rent -----------------------

(xi) Stage of surgery in which rent occurred ----------------

(emusification of nucleus, epinucleus removal, cortex removal)

(xii) Anterior Vitrectomy done --------------------

(xiii) Type of IOL -----------------

(PC IOL, AC IOL).

(xiv) Placement of IOL -------------------

(in the bag, in the sulcus)

(xv) Status of posterior capsule -----------------

(plaque, demarcation zone, opacification)

(xvi) PC polishing done -----------------

(xvii) Residual cortex ---------------------

(xviii) Conversion ---------------------

(xix) Suturing done --------------------

(xx) Other complications. ------------------

POST OPERATIVE NOTES.

First day:

1) Detailed S/L examination.
2) Pin hole V/A.

One month & Six months.

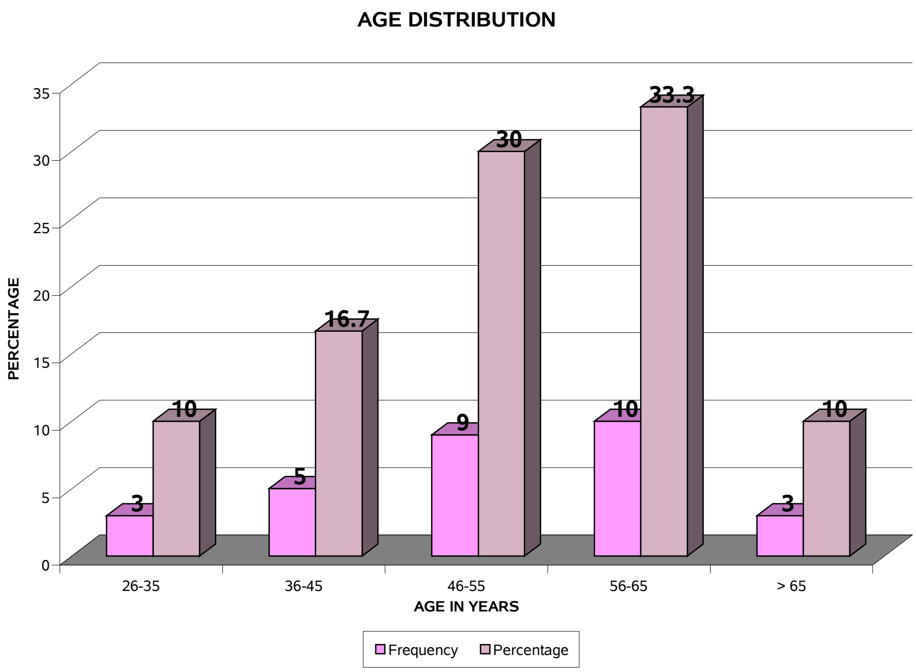
1) Detailed S/L examination.
2) Best corrected V/A.
3) Pin Hole V/A.

RESULTS AND ANALYSIS

1. AGE DISTRIBUTION

Age in Years	Frequency	Percentage
26-35	3	10
36-45	5	16.7
46-55	9	30
56-65	10	33.3
> 65	3	10
Total	30	100

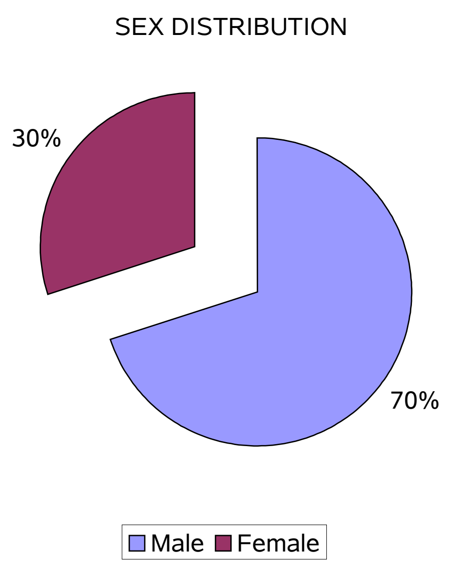
Though the age at which patient presented to us ranged from 25-65 years the majority were 45-65 years (63%).



a. SEX DISTRIBUTION

Sex	Frequency	Percentage
Male	21	70
Female	9	30

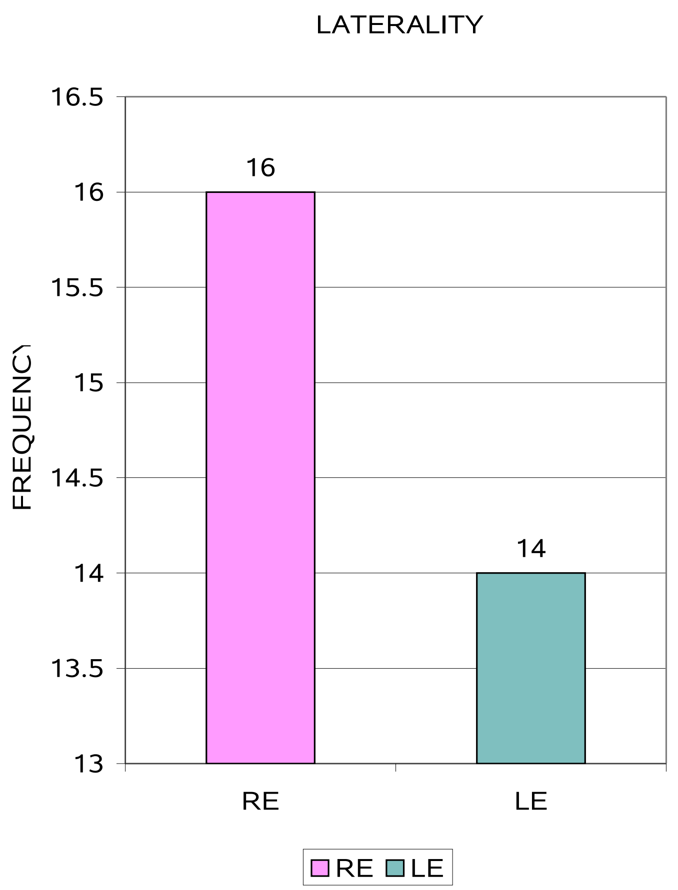
Males were predominant sex who presented to us with cataractous changes.



3. LATERALITY

Lateral	Frequency	Percentage
RE	16	53
LE	14	46
Total	30	100

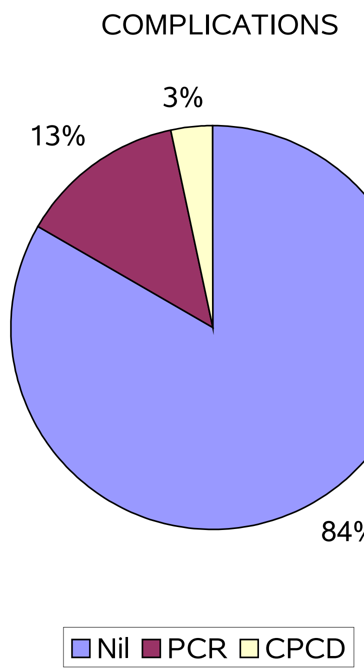
Our study showed almost equal presentations of RE 53.34% and LE 46.66%.__



4. COMPLICATIONS :

Complications	Frequency	Percentage
Nil	25	83.33
PCR	4	13.37
CPCD	1	3.33
Total	30	100

Among the 30 eyes which underwent phaco emulcification, 1 eye (3.33%) had pre existing well defined posterior capsular defect confirming a congenital posterior capsular dehiscence. 4 eyes (13.34%) developed a posterior capsular rupture which occurred either during phaco emulsification of nucleus, epinucleus or cortex removal.

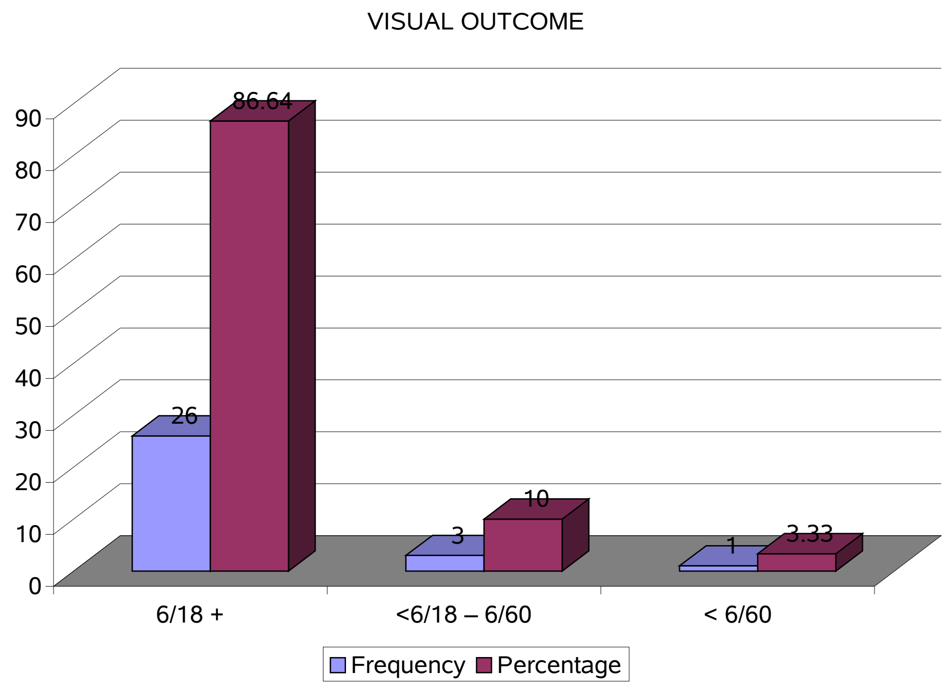


5. VISUAL OUTCOME

Post Operative Vision (Day 3)

Vision	Frequency	Percentage
6/18 +	26	86.64
<6/18 – 6/60	3	10.00
< 6/60	1	3.33
Total	30	100.00

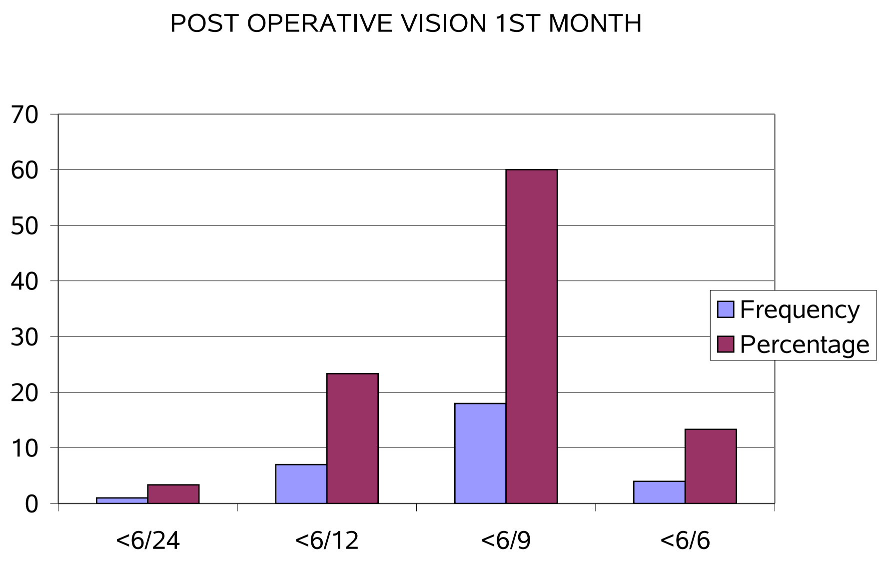
The visual acuity with pin hole on 3rd post operative day showed 86.64% of patient with V/A of 6/18 and better, 10% of patient with V/A of 6/18-6/60 & 3.33% showed 6/60 and worse. The reason for reduced vision in 1 case was immediate post operative corneal oedema and mild to moderate iritis which subsided with prompt treatment.



II – Post operative vision (1st month)

V/A	Frequency	Percentage
6/24	1	3.33
6/12	7	23.33
6/9	18	60.00
6/6	4	13.33
Total	30	100.00

Best corrected visual acuity recorded 1 month post operatively showed 22 out of 30 cases with 6/6 and 6/9 VA (13.33 % & 60.00%) respectively. 6/12 in 7 patients (23.33%) and 6/24 in 1 patient (3.33%).

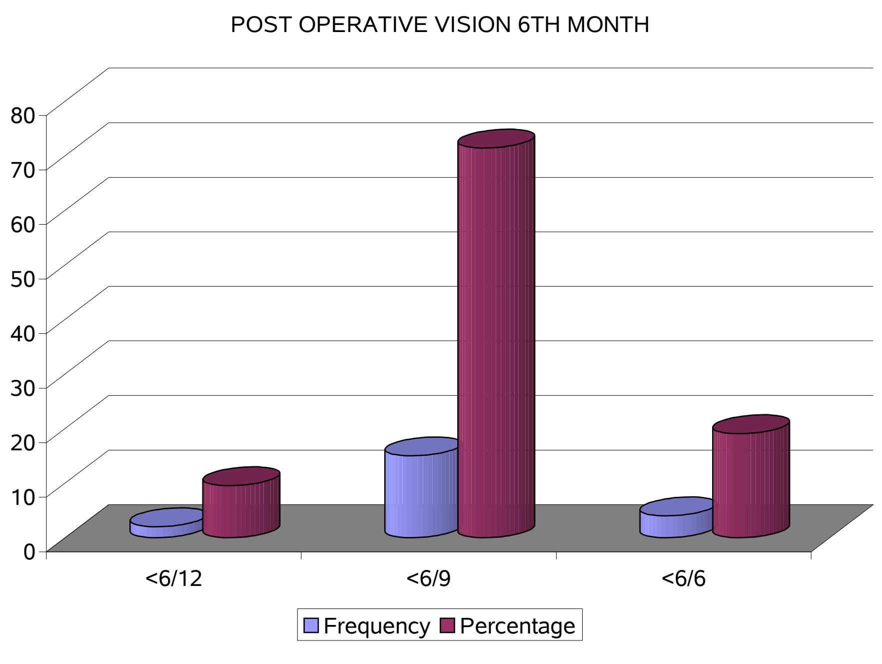


III - Post operative vision (6th months)

V/A	Frequency	Percentage
6/12	2	9.52
6/9	15	71.42
6/6	4	19.06
Total	21	100

Among 21 patient who were followed up 6 months post operatively,

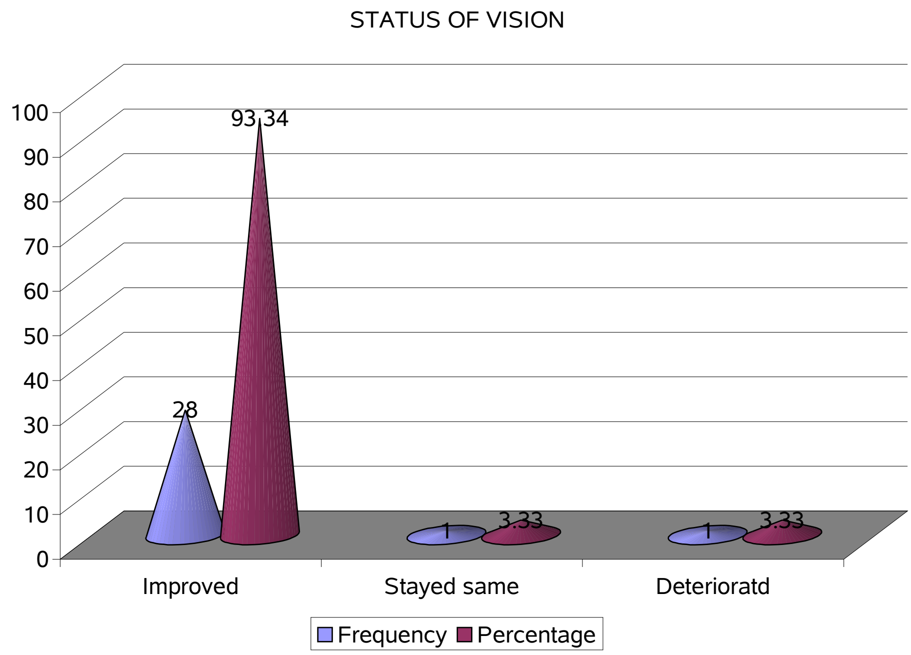
15 patients (71.42%) has a V/A 6/9, and 4 patient (19.06%) has 6/9 & 2 patient (9.52%) had a V/A 6/12.



Status of vision (From pre operative period to 1 month follow up)

V/A	Frequency	Percentage
Improved	28	93.34
Stayed same	1	3.33
Deteriorated	1	3.33
Total	30	100%

Among 30 patients operated 28 patient showed marked improvement of V/A post operatively (93.34%), 1 case stayed same because of Amblyopia and 1 case deteriorated due to development of posterior capsular opacity.

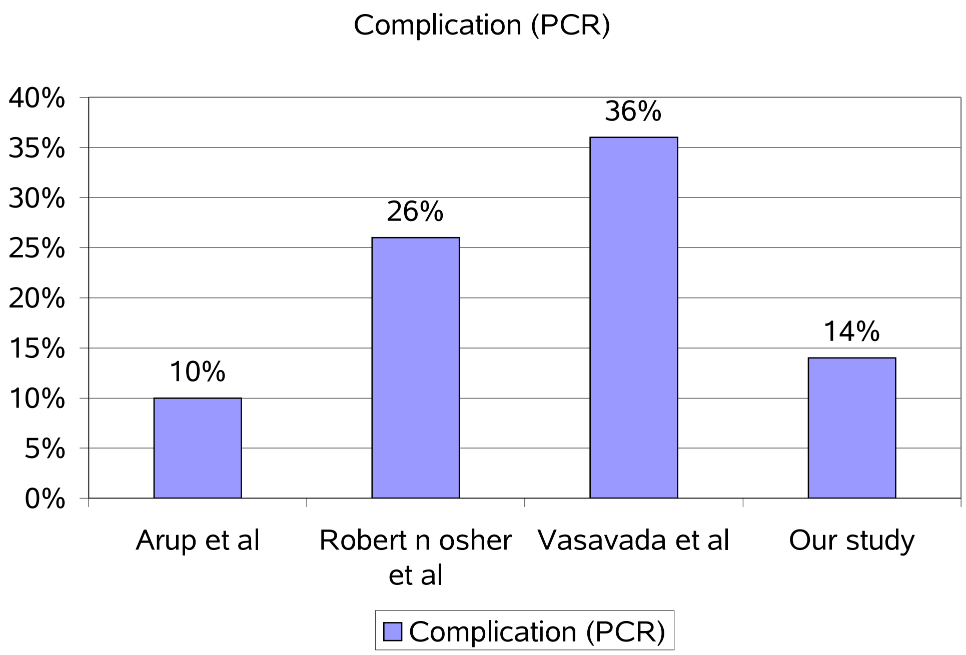


Comparison Studies :

Comparison Studies	Complication (PCR)
Arup et al	10 %
Robert n osher et al	26%
Vasavada et al	36%
Our study	14%

Only 4 cases out of 30 eyes gone for PCR

A comparison of our study with previous studies shows a PCR of 10% in the study done by Arup et al, 26% by Robert n osher et al, 36% by Vasavada et al as compared to 14% in our study.



SUMMARY OF RESULTS

1). Majority age of presentation is 45 – 65 years (63.33%).

2). Predominant sex were Males (70%).

3). Equal presentation of Right and Left eyes.

4). Percentage of PCR (13.34%) [4 cases out of 30 eyes].

CPCD (3.33%) [1 cases out of 30 eyes].

In 3 cases PCR occurred during Phacoemulsification of nucleus,

In 1 cases PCR occurred during Cortex removal.

5). Marked visual improvement post operatively in 93.34% of cases.

(28 out of 30 eyes).

Post operative vision improved in 28 cases,

1 case remained same due to amblyopia,

1 case deteriorated due to thick PCO.

DISCUSSION

Cataract surgery in Posterior polar cataract is challenging and many a times scary for the surgeon because of its predisposition to posterior capsular rupture or dehiscence. PPC is a type of development cataract which affect vision quite early causing significant glare and blurred vision otherwise.

In our study the age of patient varied from 25-65 years which clearly indicates that the study group included both the stationary and progressive type of PPC. There was a clear cut male preponderance in our study which does not mean the non involvement of other sex. The probable reason for this preponderance in our country may be that the females are usually confined indoors and males remains outdoors for longer time encountering more glare consistently.

Management of PPC though controversial earlier is now very clearly established whatever may be the surgical technique the main aim is preventing and delaying the capsular rupture and placement of IOL. Unlike other cataracts, PPC have to be operated even before their visual acuity is really compromised because of glare and difficulty in driving especially in the nights in mostly young patients.

Modalities of surgical technique are Conventional ECCE, Manual SICS & Phacoemulsification procedure.

- In ECCE, the nucleus extraction is more traumatic and can result in posterior capsular rupture and if a can opener capsulotomy is done, placement of IOL may be difficult.
- SICS is another modality in the management of PPC where in even when there is a posterior capsular rupture, there is a anterior capsular rim of capsulorrhexis where IOL can be placed. But this technique requires mastering of Hydrodelineation, prolapsing the nucleus into AC & extraction of nucleus through the tunnel & also the need of proper vitrectomy instrumentation.
- Phacoemulsification is now emerging as the preferred technique in managing these cataracts as it gives better control because of closed chamber technique. As these cataracts occurs commonly in younger patients the cataract is very soft and easily emulsifiable that some times it can even just be aspirated. But one has to understand the basic of phacodynamics to ensure the safety of the technique.

As described by many surgeons, Hydrodissection or Cortical cleavage dissection has to be strictly avoided because a weak point in the posterior capsule (CPCD) if present can produce a hydraulic PCR. It is mandatory to master the technique of hydodelineation as it provides the epinucleus bowl during phacoemulsification.The nucleus, which has been delineated can also be rotated with in the shell if required depending upon the technique of phacoemulsification adopted.

One most important points to be kept in mind during phacoemulsification is to avoid stress on the capsular bag. This can be done by adopting the following procedures:

- It is always better to avoid rotation of the nuclear complex (nucleus & epinucleus) as we have seen that in these cases there is more likely chances of increased stress on the zonules and also likely chances of PCR. So it is advisable always to rotate the nucleus separately and gently only when necessary.
- A technique is chosen that causes less stress on the bag. For e.g., adopting Stop & Chop technique which cause minimal stress on the zonules unlike 4 quadrant cracking of nucleus that can some times cause distortion of capsular bag and stress on the zonules.
- In softer nucleus one can initially do a central trenching and remove the nucleus by chip & flip method. Other technique for beginners is to place the second hand instrument (cyclodialysis

spatula) under the delineated nucleus and emulsifying the nucleus in the pupillary plane.

- In all techniques a low infusion bottle height, low ultra sonic power, low vacuum, low flow rate provides a stable chamber.
- The reduction of bottle height by 10 – 15 cm reduces the stress on the zonules there by preventing posterior capsular ballooning and closed chamber turbulence.

With all this cases phaco emulsification of the nucleus can be done safely leaving behind the epinucleus shell. Removal of the epinuclear shell is very crucial. It has to be stripped from the peripheral cortex gently, the central area being tackled the last, as there can be preexisting PCR. Care should be taken to avoid collapse of anterior chamber during epinucleus removal.

The surgeon should have adequate knowledge about vitrectomy. Vitrectomy also should be done with low flow rate, low vacuum, as advised above. It is always better to do a Bimanual Automated Vitrectomy with a dry infusion aspiration technique. If the PCR is small it can be converted to posterior capsulorrhexis there by placing the IOL in the bag. If the PCR is big there by preventing the placement of IOL in the bag then the IOL can be placed in the sulcus or in AC.

In our study 4 out of 30 cases has PCR, 1 case had CPCD. The ruptures occurred either during emulsification of nucleus, epinucleus removal or cortex removal. Though vitrectomy is expected to cause more endothelial cell damage due to excessive anterior chamber manipulation, no significant differences in these cases were noticed in our study.

The reason contributing to the minimal rate of complication in our study:

1). Proper preoperative assessment.

2). Thorough planning.

3). Modified technique and strategy as described.

4). Experience and skill of the surgeon.

5). Thorough knowledge of vitrectomy.

The main reason for PCR was found to be the rotation of nuclear complex (nucleus & epinucleus) nearly in 50 % of cases. In rest of the cases the rent was seen after the removal of the epinucleus.

CONCLUSION

Phacoemulsification in PPC is feasible and a good technique with all the necessary precautionary steps properly adopted. One has to always do a clear counselling to the patient explaining the type of cataract and the complication expected. The surgeon has to anticipate and try to prevent untoward complication rather than encountering and managing them. (Prevention is always better than cure).

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