" A ONE YEAR CROSS SECTIONAL STUDY OF COMPLICATIONS DURING CATARACT SURGERY IN PATIENTS WITH PSEUDOEXFOLIATION SYNDROME ADMITTED IN KLES DR.PRABHAKAR KORE HOSPITAL AND MEDICAL RESEARCH CENTRE, BELAGAVI"

By

REG. NO. BK0114005

Dissertation

Submitted to the KLE University, Belagavi, Karnataka. In partial fulfilment of the requirements for the degree of

MASTER OF SURGERY
IN
OPHTHALMOLOGY

DEPARTMENT OF OPHTHALMOLOGY,

JAWAHARLAL NEHRU MEDICAL COLLEGE,

BELAGAVI, KARNATAKA.

APRIL 2017

KLE UNIVERSITY, BELAGAVI,

KARNATAKA.

Endorsement by the Head Of Department, Principal/ Head of the Institution

This is to certify that the dissertation entitled **"A ONE YEAR CROSS SECTIONAL STUDY OF COMPLICATIONS DURING CATARACT SURGERY IN PATIENTS WITH PSEUDOEXFOLIATION SYNDROME ADMITTED IN KLES DR.PRABHAKAR KORE HOSPITAL AND MEDICAL RESEARCH CENTRE, BELAGAVI"** is a bonafide research work done by **REG. NO. BK0114005.**

Seal & Signature of the HOD

Dr. REKHA B. K DOMS, MS , PhD
Professor & Head,
Department of Ophthalmology,
J. N. Medical College,
Belagavi – 590010.
Karnataka, India.

Date :

Place: Belagavi

Seal & Signature of the Principal

Dr. (Mrs.) N. S. Mahantashetti MD (Paed)
Principal,
J. N. Medical College,
Nehru Nagar,
Belagavi - 590010.
Karnataka, India.

Date :

Place: Belagavi

LIST OF ABBREVIATIONS USED

AC	–	Anterior Chamber
ACA	–	Anterior Chamber angle
ACD	–	Anterior Chamber depth
BCVA	–	Best Corrected Visual Acuity
CTR	–	Capsular Tension Ring
CTS	–	Capsular Tension Segment
ECCE	–	Extracapsular Cataract Extraction
IOL	–	Intraocular Lens
IOP	–	Intraocular Pressure
LOXL1	–	lysyl oxidase-like protein 1
mCTR	–	Cionni modified capsular tension ring
OHT	–	Ocular hypertension
PCIOL	–	Posterior chamber intraocular lens
PCO	–	Posterior Capsular Opacification
PCR	–	Posterior capsular rent
Phaco	–	Phacoemulsification
PL	–	Perception of light present
PMMA	–	Polymethyl Methacrylate
POAG	–	Primary Open Angle Glaucoma
PXF	–	Pseudoexfoliation
SICS	–	Small Incision Cataract surgery
SIMC	–	Senile Immature Cataract
SNP	–	Single nucleotide polymorphism

ABSTRACT

Background and objectives

Pseudoexfoliation is common and clinically important systemic condition that affects elderly population, who are likely to undergo cataract surgery. It causes serious complications during cataract surgery due to pupillary rigidity and zonular weakness and instability. Preoperative reduced anterior chamber depth may indicate zonular instability in eyes with pseudoexfoliation syndrome and should alert the cataract surgeon to the possibility of intraocular complications related to zonular dialysis. The objectives of our study are:

1) To study the complications during cataract surgery in patients with pseudoexfoliation syndrome.
2) To know the association of anterior chamber depth with complications during cataract surgery in patients with pseudoexfoliation syndrome.

Methodology

The present one year Cross Sectional Study of 50 patients was conducted on patients with pseudoexfoliation syndrome. All patients diagnosed with pseudoexfoliation syndrome undergoing Small Incision Cataract Surgery were selected for the study. All the intraoperative complications were noted during the surgery.

Results

The average age of patients was 67.18 years and about 76 % patients were above 60 years of age. 24% of patients had clinical unilateral involvement of Pseudoexfoliation syndrome and 76% had bilateral involvement. Poor pupillary

dilatation was the most common finding. In the present study difficulty during anterior capsulotomy was noted in 8% cases, difficulty in nucleus delivery in 4%, corneal endothelial touch in 6%, Descements membrane stripping in 2%, Iridodialysis in 4%, zonular dialysis in 8%, Decentered IOL in 4%, Retained lens matter in 4%, intraoperative bleed in 2%, difficulty in prolapsing nucleus in 28% and sphincter tear was seen in 14% cases. In the present study the association of anterior chamber depth with complications during cataract surgery in patients with pseudoexfoliation syndrome is statistically not significant.

Conclusion

Inadequate mydriasis is one of the major preoperative factor in eyes with Pseudoexfoliation syndrome leading to the other intraoperative complications. Small incision cataract surgery in eyes with Pseudoexfoliation syndrome is associated with intraoperative complications but careful preoperative planning and intraoperative care ensures safe surgery and a successful postoperative outcome.

Keywords

Pseudoexfoliation syndrome, small incision cataract surgery, intraoperative complications, non dilating pupil, anterior chamber depth.

CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

INTRODUCTION

Pseudoexfoliation Syndrome (PXF) is an age related systemic disorder characterized by accumulation of extracellular grey white fibrillar material primarily in the anterior segment of the eye.

It is produced by abnormal basement membranes of ageing epithelial cells and deposited on the corneal endothelium, pupillary border of the iris, trabecular meshwork, anterior capsule of lens, ciliary body, zonules and anterior vitreous. Pseudoexfoliation material is recognised in many organs such as skin, liver, heart, kidney, gall bladder, blood vessels, extraocular muscles, orbital connective tissue, optic nerves and cerebral meninges suggesting that it is an ocular manifestation of a systemic disorder [(1)]. Greyish white material is deposited along the pre-equatorial region of the lens. These two areas are initially connected, but later get separated by the iris brushing against the lens.

Pre-operative diagnosis is made by examining the pupillary border for greyish white dandruff like material along with moth eaten transillumination defects seen at the pupillary border.

On dilating the pupil, the characteristic double ring appearance can be seen on the lens capsule with a central disc and peripheral band of pseudoexfoliation material and clear area in between.

On gonioscopy, trabecular meshwork shows pigmentation, sometimes with a pigmented sampaolesi line anterior to schwalbe's line and dandruff like flakes on the trabecular meshwork. Pseudoexfoliation Syndrome is associated with secondary open

angle glaucoma due to blockage of trabeculum by the exfoliative material and pigments. Angle closure glaucoma may also be seen sometimes due to pupillary block caused by forward displaced lens as a result of weakened zonules [(1)].

The corneal endothelium shows reduced cell count and pleomorphism causing early decompensation of the cornea at moderate elevation in intraocular pressure (IOP) and usually after cataract surgery. Corneal endothelium may show passive deposition of PXF flakes from aqueous [(2)].

The Pseudoexfoliative material infiltrate the zonules and the zonular attachments to the lens capsule and ciliary processes, leading to zonular instability, zonular dialysis, phakodonesis and lens subluxation. PXF material may be also found on surface of implanted intraocular lens (IOL) and hyaloid face in aphakic cases. In pseudoexfoliation syndrome dense nuclear cataracts are of common variety [(3)].

Intraoperative complications manifest as phakodonesis, zonular dehiscence, capsule tear/rupture, vitreous loss and dropped nucleus or fragment. Transient raised intraocular pressure is seen due to breakdown of blood-aqueous barrier. Increased postoperative inflammation as in increased aqueous flare and cells, fibrin reaction and posterior synechiae formation is caused by surgical trauma due to poorly dilated pupil and iris vessel pathology [(4)].

Late complications include posterior capsular opacification, decentration of intra-ocular lens, late in the bag intraocular lens subluxation, anterior capsular shrinkage and fibrosis and decompensation of corneal endothelium [(3)].

Pseudoexfoliation Syndrome induced iridopathy and phacopathy with zonular instability makes cataract surgery a challenging surgery and these patients have 5

times higher chances of complications intraoperatively during cataract surgery compared with cataract surgery in patients without pseudoexfoliation [5].

Pre-operative and intra-operative precautions to minimize these complications should include a careful slit lamp examination after complete pupillary mydriasis, control of intra- ocular pressure prior to surgery, adequate pupillary mydriasis, avoiding iris manipulation intraoperatively and use of steroids post-operatively.

This study was done with the aim of studying the intra-operative complications during the cataract surgery and also to know the association of anterior chamber depth with complications in patients with Pseudoexfoliation Syndrome. The study was conducted so as to suggest measures to minimize the likelihood of such complications to achieve a good visual outcome.

AIMS AND OBJECTIVES

1. To study the complications of cataract surgery in patients with pseudoexfoliation syndrome.
2. To know the association of anterior chamber depth with complications during cataract surgery in patients with pseudoexfoliation syndrome.

REVIEW OF LITERATURE

HISTORY

John G. Lindberg in 1917, a Finnish Ophthalmologist, for the first time ever described exfoliation. He wanted to execute Axenfeld's observations on iris changes in senile eyes. Two types of degeneration of the iris were described by Axenfeld : an atrophy of the iris pigment epithelium at the pupillary border and a hyaline degeneration of the pupillary margin of iris causing poor dilatation with mydriatics . He illustrated greyish flakes at the pupillary border of iris . In about 50% chronic glaucoma patients this phenomenon was seen. He believed that this material was created by an earlier inflammation. Lindberg published his results on exfoliation as a thesis at the University of Helsinki in 1917 [(6)].

In 1918 Alfred Vogt, a Swiss Ophthalmologist gave the full description of this disorder. He described the film on the anterior lens capsule, as a remanent of the pupillary membrane [(5)]. Later Vogt hypothesized that this material represented degenerative changes of the lens capsule followed by secondary desquamation. In 1925 he recommended that exfoliation was as a consequence of degenerative changes of the lens capsule and it was associated with a new type of glaucoma. One year later he changed his opinion and was convinced that exfoliation resulted in glaucoma [(6)].

Vogt [(6)] named this condition as "capsular glaucoma" since it was assumed that the grayish flaky material originated from the peeling of the anterior capsule of lens.

Electron microscopic studies suggested that the anterior capsule of the lens was frequently affected in patients with exfoliation. The pre-equatorial lens epithelial cells produced the abnormal fibrillar substance and the term fibrillopathia epitheliocapsularis was recommended.

One of the key changes proposed in pseudoexfoliation syndrome is overproduction of glycosaminoglycans coupled with abnormal metabolism. The proteineous element of pseudoexfoliation material is composed of both the epitopes of the elastic fiber system such as fibrillium and non collagenous basement membrane components [(7)]. The name basement membrane exfoliation syndrome was derived due to abnormal secretions of basement membrane seen in this condition. The terms pseudoexfoliation syndrome (PXF) and exfoliation syndrome are generally used interchangeably to address this disorder.

EPIDEMIOLOGY AND GENETICS

Pseudoexfoliation Syndrome has a global distribution. The prevalence of Pseudoexfoliation Syndrome differs widely both with and without glaucoma.

Patients presenting in one eye will definitely show pseudoexfoliation material in the other eye on conjunctival biopsy. The term unilateral or bilateral represents clinically detectable pseudoexfoliation material on slit lamp. Clinically in about > 50% of patients it is unilateral at the time of diagnosis, but electron microscopic studies show pseudoexfoliation debris also in unaffected other eye. Approximately 25% of patients with clinically unilateral disease will develop pseudoexfoliation signs in the other eye within 10 years [(3)].

A cross-sectional study was conducted in Central India which assessed 4646 study participants. All participants underwent a detailed examination. After complete pupil dilation pseudoxfoliative material was examined using slit lamp by an experienced ophthalmologist. 87 eyes in 69 subjects showed presence of pseudoexfoliation (prevalence: 1.49 ± 0.18%) and it was seen bilateral in 18/69 (26%) participants. Study concluded that pseudoexfoliation prevalence was significantly associated with elderly age, lower body mass index and higher diastolic blood pressure [(8)].

A study conducted in South India showed that the prevalence of pseudoexfoliation syndrome among the rural population is 3.8%. With increasing age the prevalence was considerably higher but no sex predilection. Pseudoexfoliation syndrome was clinically unilateral in 53 cases (49.1%) and bilateral in 55 cases (50.9%). In a known population, the actual prevalence of pseudoexfoliation syndrome is most likely double than that is visible on clinical examination. Many patients usually are not diagnosed due to poor mydriasis [(9)].

Krishnadas. R et al [(10)] in their study in southern districts of Tamil Nadu in Southern India dealt with total of 5,150 subjects. They concluded that the prevalence of pseudoexfoliation syndrome was 6.0% and prevalence increased with age and was greater in males.

Prevalence of pseudoexfoliation syndrome overall was 0.69% in a study conducted in the South Indian state of Andhra Pradesh and the prevalence was higher among subjects who were involved in outdoor activities [(11)].

A study stated the prevalence of pseudoexfoliation syndrome in 1117 patients posted for cataract surgery. The prevalence of pseudoexfoliation syndrome was 26.32%. 64.62% of the patients were males and 35.37% were females. Mean age of patients with pseudoexfoliation syndrome was 72.61 years. 47.96% patients presented unilateral and 52.04% bilateral [(12)].

It is now recognised that Pseudoexfoliation Syndrome is essentially a bilateral condition and unilateral cases only represent an earlier period in the natural history of the disease. When only one eye is involved clinically, the other eye often has abnormal aqueous humour dynamics or glaucomatous damage. The prevalence increases with age, the disease usually manifesting over the age of 50 years. But Pseudoexfoliation Syndrome might well be a condition that starts in mid-adulthood but manifest clinically only in later years.

Single nucleotide polymorphisms (SNPs) in the lysyl oxidase-like protein 1 (*LOXL1*) gene predisposed to the risk for pseudoexfoliative glaucoma. SNP in the first intron tagged susceptibility to pseudoexfoliative glaucoma and was equally present in pseudoexfoliation syndrome. The product of *LOXL1* is a protein that is involved in cross-linking of elastin fibers in the extracellular matrix.

A study investigated 6 islandic families each of which had at least 1 member affected by Pseudoexfoliation Syndrome by which it concluded that Pseudoexfoliation Syndrome is a genetically inherited condition with transmission to the 2nd generation through an affected parent. In each case the affected parent was the mother [(13)].

Kelvin Y.C. Lee et al [14] studied the prevalence of Pseudoexfoliation Syndrome in the Chinese population and it was about 0.2%–0.7%. There was a moderate association of G allele of *LOXL1* with pseudoxfoliation in the Chinese, hence these polymorphisms in *LOXL1* confer risk to the Chinese people. Asian populations including Indians reported association of pseudoexfoliation syndrome with *LOXL1* allele.

COMPOSITION OF PSEUDOEXFOLIATION MATERIAL

The Pseudoexfoliation Material contains irregular meshwork of randomly distributed cross-banded fibrils measuring about 30 nm in diameter within a loose fibro-granular matrix containing 6 - 10 nm microfibrils.

Davanger described the fibrils, as composed of a protein core surrounded by polysaccharide side chains. The core is made up of small number of filamentous subunits and are formed from lateral aggregations of filaments. This core is surrounded by a velvety material which projects at regular intervals from the fibrils[15,16].

Light microscopy demonstrated this abnormally produced Pseudoexfoliation material is Periodic acid Schiff positive, eosinophilic brush like feathery or nodular aggregate. These aggregates are composed of irregular tangle of fibrils as seen on electron microscopy. Transmission electron microscopy demonstrated normal capsule appearances in the region where there was no pseudoexfoliative material and focal condensations of fibrillogranular material along with cross banding where pseudoexfoliative material was present on the anterior lens capsule [17].

These fibrils are tangled with normal micro-fibrils and are embedded in an amorphous inter-fibrillar ground substance, most probably glycosaminoglycans. Presence of glycosaminoglycans on the surface of the fibrils is evidenced by staining with alcian blue and ruthenium red. Indirect and immune histochemical studies suggests of a complex glycoprotein/proteoglycan structure, glycosaminoglycans surrounding the protein core forming the amorphous substance. The extra-ocular Pseudoexfoliation Material is similar except that there is more matrix and less distinct banding pattern.

THEORIES ON ORIGIN OF PSEUDOEXFOLIATION MATERIAL

1. BASEMENT MEMBRANE THEORY

Pseudoexfoliation accumulation is as a result of both the factors, increased synthesis and incomplete degradation. Pseudoexfoliation syndrome is a disease of extra-cellular matrix characterized by abnormal breakdown and overproduction of basement membranes of ageing epithelial cells. Its origin is attributed to be basement membrane of the capsule of lens, iris, cilliary body and conjunctiva. The production of the exfoliation material may be related to disordered basement membrane metabolism. The fibrils contain basement membrane proteoglycan.

Elhawy E et al [(18)] studied immunohistochemical findings that suggested that pseudoexfoliation fibrils are composed of components of basement membrane system. Liquid chromatography along with tandem mass spectrometry demonstrated the presence of fibrillin-1, fibulin-2 and amyloid P component. It also identified the components of basement membrane like serum amyloid protein and fibronectin, laminin, the proteoglycans syndecan-3, desmosomal cadherins (desmocolin-2), and

versican metalloproteases of the 'A Disintegrin and Metalloprotease' (ADAM) family.

Schlotzer-Schrehardt U et al (1992) in their study showed studied the presence of all principal basement membrane components in precapsular deposits of pseudoexfoliation on anterior capsule of lens by immunofluorescence and electron microscopic immunogold techniques. They also concluded that presence of elastin epitopes indicates that the pseudoexfoliation material is a multicomponent expression of a abnormal extracellular matrix synthesis, including the incorporation of the non collagenous basement membrane components. The extensive labelling of pseudoexfoliation material for chondroitin sulfate indicates there is an excessive production and irregular metabolism of glycosaminoglycans [(19)].

Eagle et al [(20)] stated that "pseudoexfoliation of the capsule of lens " may be a disorder in which the cells produce degenerated basement membrane material. Hence "basement membrane exfoliation syndrome" was the term proposed for this condition. Typical exfoliative material is considered as a filamentous, banded basement membrane with a periodicity of 500-Å. Exfoliative material is also seen in the wall of a short posterior ciliary artery in the orbit indicating that the exfoliative process is not merely restricted to ocular tissues.

2. ELASTIC MICRO-FIBRAL THEORY

Exfoliation material is immunologically related to the elastic tissue. There are histochemical and antigenic similarities between zonular elastic microfibrils and exfoliation material**.** Mature and intermediate micro-fibrils adjacent to fibroblasts resemble close proximity to the conjunctival elastic tissue.

Ludwisiak-Kocerba et al explained pseudoexfoliation as a type of elastosis, affecting especially elastic microfibrils. Pseudoexfoliation material is made up of complex composition of glycoprotein/proteoglycan, containing glycosaminoglycans (heparan sulfate, hyaluronic acid, chondroitin sulfate, dermatan sulfate). The presence of elastic fiber epitopes, mainly elastic microfibrillar components (elastin, amyloid P, vitronectin, fibrillin-1) support the theory that pseudoexfoliation syndrome is a type of elastosis, especially affecting elastic microfibrils [(21)].

Histochemical staining properties of pseudoexfoliation material deposited in the anterior segment of the eye and the zonules of the lens are characteristics of the microfibrillar component of elastic tissue, oxytalan [(22)].

A study suggested that ultrastructurally Pseudoexfoliative material found in the conjunctiva had a close relation with components of the elastic system in 13 eyes of patients with pseudoexfoliation syndrome. Pseudoexfoliation fibrils were present in clumps of oxytalan around small elastic fibers. This intertangled Pseudoexfoliation material and elastotic fibres proposed that pseudoexfoliation fibrillopathy is a type of elastosis, due to abnormal aggregation of elements related to elastic microfibrils [(23)].

Schlotzer Schrehardt et al [(2)] studied the matrix of the pseudoexfoliation material by light electron microscopy and demonstrated certain epitopes as fibrillin positive fibers, supporting the elastic microfibril theory of its production.

3. AMYLOID THEORY

J Berlau et al examined aqueous humour in eyes with pseudoexfoliation syndrome for protein composition. Aqueous humour collected during cataract or glaucoma surgery was screened for amyloids. This screening was performed by Congo red staining coupled

with polarised light microscopy. Findings of the aqueous sample suggested that the pseudoexfoliation syndrome was associated with amyloid of a serum protein [24].

A study conducted noted the histological changes in the sphincter muscle of the iris and surrounding tissues in eyes with pseudoexfoliation syndrome. It examined biopsy specimens of iris tissue by light and electron microscopy in 17 patients with pseudoexfoliation syndrome undergoing extracapsular cataract surgery. Blood vessel walls were stained with Congo red. This proved that pseudoexfoliation material is associated with amyloid material [25].

4. LYSOSOMAL THEORY

A study, lysosomal enzymes activity in patients with pseudoexfoliation syndrome found that lysosomes are centres for cellular recycling which are responsibe for the physiological turnover of cell constituents. As the enzyme activity is insufficient it results in disturbance of the degradation process and causes accumulation of substrates for that specific enzyme, leading to various morbid changes. The study also found significantly higher activity of acid phosphatase in the aqueous humour of eyes with pseudoexfoliation syndrome than in patients without pseudoexfoliation syndrome [26].

Schlotzer-Schrehardt and Naumann used scanning and transmission electron microscope to examine 11 eyes to know the cause of zonular weakness in patients with pseudoexfoliation syndrome. The immunohistochemical report of the study demonstrated lysosomal enzymes within pseudoexfoliation aggregates suggesting that zonular disintegration is facilitated by proteolytic mechanisms. Histochemical evidence of high acid phosphatase activity was seen suggesting that lysozymes were

involved in the production of exfoliation material. Proteolytic enzymes present in lyzosomes may facilitate granular disintegration. Immunochemical studies have revealed heparin sulphate, chondroitin sulphate proteoglycans, laminin, amyloid P protein and fibronectin to be integral part of exfoliation material. Transmission electron microscopy showed pseudoexfoliation material to contain keratan and dermatan sulphate [27].

CLINICAL FEATURES OF PSEUDOEXFOLIATION SYNDROME

Can be described under 2 categories:

A. Ocular manifestations

B. Systemic manifestations

A) OCULAR MANIFESTATIONS [2, 28, 29, 30]

1) CONJUNCTIVA

Clinically the conjunctiva appears normal. Pseudoexfoliation syndrome leads to conjunctival surface changes and reduction of tear film functions. Histopathological presence of conjunctival goblet cells in patients with pseudoexfoliation demonstrate tear film stability. It alters basic morphology of goblet cells. In patients with clinically unilateral pseudoexfoliation syndrome transmission electron microscopy demonstrates presence of pseudoexfoliative material on conjunctival tissue in clinically unaffected eyes. Also there is loss of regular limbal vascular pattern as seen in fluorescein angiography.

2) CORNEA

The corneal endothelium shows evidence of passive deposition of pseudo exfoliation material from the aqueous and it also shows active local in situ production in the eyes affected with pseudoexfoliation syndrome. Confocal microscopy demonstrates lesser number of endothelial cells in the affected eyes along with higher rate of guttae due to intermittent raised levels of IOP. Structural changes of the endothelial cells are seen in both the size and shape of the cells in the affected as well as uninvolved fellow eyes. There may be even nonspecific changes of the corneal endothelial cells like thinning of the cells, cytoplasmic vacuolization, phagocytosis of melanin granules and abnormal extracellular matrix production. Central corneal thickness is increased hence reflecting early corneal dysfunction.

Zheng X et al [(31)] studied the density of corneal cells in the different layers and determined the morphological changes of nerve plexus in the cornea in eyes with pseudoexfoliation syndrome. They came to a conclusion that the eyes with pseudoexfoliation syndrome have reduced cell densities in the cornea along with significantly reduced sub-basal nerve density. Thus these findings correlated with decreased corneal sensitivity.

Since pseudoexfoliation is a bilateral condition, keratopathy of the other eye also requires frequent observation.

3) AQUEOUS HUMOR AND ANTERIOR CHAMBER

Aqueous humor production is reduced in eyes affected with pseudoexfoliation syndrome and is associated with a disrupted blood-aqueous barrier with raised levels of protein concentration in the aqueous resulting in mild aqueous flare. There are even

sudden changes in the levels of acid phosphatase, alpha1-lipoprotein and ceruloplasmin. Higher serum concentrations of anti Helicobacter pylori Immunoglobulin G-antibody (anti-HP IgG) is seen in patients with pseudoexfoliative glaucoma as compared to healthy patients.

Kuchle M et al [32] studied associations of preoperative A-scan ocular dimensions with complications observed during cataract surgery in eyes with pseudoexfoliation syndrome. They concluded that reduced anterior chamber depth preoperatively indicate zonular instability in eyes with pseudoexfoliation syndrome and the risk of intraoperative complications was 4 times more in these eyes with an anterior chamber depth less than 2.5 mm as compared in eyes with anterior chamber depth of more than 2.5 mm.

4) IRIS AND PUPIL

Pseudoexfoliative material is frequently observed on both the anterior and posterior surface of the iris. Due to the movement of iris against the lens there is deposition of grayish flakes over the pupillary margin making it appear irregular. It is usually associated with poor pupillary mydriasis due to atrophic and fibrotic changes sphincter muscle of iris because of tissue hypoxia. Also reduced stromal elasticity by accumulation of flaky material causes poor mydriasis. Iris appears more rigid. Pseudoexfoliation Syndrome leads to formation of synechiae between iris and the anterior capsule of lens. There is iris ischemia and neovascularisation due to deposition of pseudoexfoliative material on the vascular endothelium of the iris.

Scanning electron microscopy explains the saw tooth or serrated appearance of the pigment epithelium of iris that is characteristic in histological studies showing

pseudoexfoliation material bridging between the concentric folds of the posterior iris surface. The affected iris vasculature shows prominent pseudoexfoliation accumulations in adventitia, slow degenerative changes of smooth muscle cells, endothelial cells and pericytes leading to complete damage to the iris tissue [(2)].

Loss of pigment from the iris sphincter area and the pigment deposition in the anterior chamber structures is characteristic feature of Pseudoexfoliation Syndrome. The material on the lens causes dispersion of pigment epithelial cells of iris at the pupillary margin and sphincter area with deposition of pigment into anterior chamber. This loss of iris pigment and its deposition throughout the anterior segment structures is manifested in various ways as iris loss of pupillary ruff, increased trabecular pigmentation, sphincter region transillumination defect and pigment deposition on the iris surface. Extensive depigmentation of iris is seen all over the sphincter region, which gives a moth eaten appearance on transillumination at the pupillary area.

Melanin granules dispersion after surgery can be so evident that heterochromia iridum is seen. Melanin liberation is due to degenerative changes and cell membrane rupture of the posterior pigment epithelial cells due to extracellular pseudoexfoliation material accumulation.

Fluorescein iris angiography in pseudoexfoliation syndrome reveals loss of radial iris vasculature, heavy leakage of fluorescein dye from the pupillary margin, progressive neovascularisation of the iris in the outer 2/3 area and also a network of fine new vessels along the inner 1/3 of the iris stromal tissue in eyes with pseudoexfoliation syndrome. There was lessening of fluorescein leakage from the pupillary margin after cataract surgery. Fluorophotometry in the anterior focus in eyes showed higher fluorescein concentration in pseudoexfoliation than in unaffected eyes

or normal control eyes. These findings suggests that the neovascularisation is associated with patchy blockage of the iris vasculature seen in pseudoexfoliation that takes place in the anterior segment and this does not progress after lens extraction [(33)].

5) CILIARY BODY AND ZONULES

Weakness of the zonules is the peculiar characteristics of Pseudoexfoliation Syndrome leading to important cause of complication during cataract surgery. This zonular fragility is due to deposition of the flaky pseudoexfoliative material on the zonules and ciliary processes which causes phacodonesis. It is due to the pathological changes in the fibers and their altered anchorage in the defective basement membranes of ciliary body and lens. Mushrooming of pseudoexfoliative aggregates is seen in the pre-equatorial area on the lens capsule originating from the lens epithelium, erupting through the lens capsular surface leading to invasion of the lamella of zonules and thus separating the zonules from their insertion on the anterior lens capsule . Even at the zonular origin and attachment in the non pigmented ciliary epithelium, the bundles of zonules are separated from their firm attachment to the basement membrane of the non pigmented epithelium by locally produced pseudoexfoliative fibers which act like ice in the fissures of rock and expanding the separation. Zonular disintegration is also caused by proteolytic degradation as lysosomal enzymes (cathepsin B and metalloproteinases) are demonstrated immunohistochemically within Pseudoexfoliation material.

6) LENS

Accumulation of whitish material deposits is seen on the lens capsule. Typically the bull's eye pattern of deposition is due to the rubbing movement of the

iris on the surface of lens, producing a concentric double ring pattern. Three areas are observed. The inner central zone, equal to the pupil diameter (almost can be absent in 20% of cases). The intermediate clear zone, due to the rubbing of iris on the anterior surface of lens, peripheral area containing radial striations. It has been observed that these patients have higher percentage of nuclear sclerosis. Weakening of the zonules predisposes to phakodonesis. Spontaneous subluxation and dislocation of lens can occur, the denser the Pseudoexfoliation material, the more likely there are chances of phacodonesis. Lens dislocation is more common inferiorly. To avoid harder consistency of nuclear cataracts and increasing zonular instability in the later stages, early cataract surgery should be taken.

Clinically Pseudoexfoliation Syndrome is classified as [(2)].

SUSPECT PSEUDOEXFOLIATION SYNDROME:

- Early Pseudoexfoliation Syndrome (Electron Microscopy : Pre-capsular layer).
- Masked Pseudoexfoliation Syndrome: Posterior synechiae without any evident cause.

DEFINITE PSEUDOEXFOLIATION SYNDROME:

- Mini-Pseudoexfoliation Syndrome: Focal defects in pre- capsular layer supero-nasally.
- Classic Pseudoexfoliation Syndrome: Late stages.

Parmar P et al [(34)] described a central bulging ("lenticonus") on the anterior capsule of lens in some of the eyes with Pseudoexfoliation Syndrome. This bulging was associated with zonular fragility and

hence increased risk for zonular dialysis intraoperatively. They believed that it represented either a central disc of thick heaped up pseudoexfoliation material or a genuine conical protrusion of the anterior lens capsule resulting due to lax zonules.

7) GLAUCOMA AND PSEUDOEXFOLIATION SYNDROME [35, 36]

One of the commonest causes of secondary open-angle glaucoma or ocular hypertension is Pseudoexfoliation Syndrome. The prevalence of Pseudoexfoliation glaucoma in cohort study of glaucoma is significantly more than in age-matched non glaucomatous populations. It is usually asymmetric and bilateral. As compared to primary open angle glaucoma prognosis is generally worse due to higher fluctuations in IOP levels, more severe optic nerve and visual field damage. Patients present higher levels of IOP compared to those affected by primary open angle glaucoma. Usually failure of medical management is seen in these patients. The incidence of pseudoexfoliation glaucoma increases with age and prevalence is higher in 60 and 70 years of age, affecting men more than women. Probable causes of elevation of IOP include trabecular blockage possibly due to trabecular cell dysfunction due to a combination of blocking of the trabeculum by Pseudoexfoliation material and/or pigment released by iris causes increased resistance in the aqueous outflow.

A patient with unilateral Pseudoexfoliation glaucoma and only pseudoexfoliation in the other eye is at high risk (50% in 5 years) of developing glaucoma in the other eye.

Pseudoexfoliation syndrome accounts for 15-20% of cases of open angle glaucoma. In patients with pseudoexfoliation syndrome, at the time of diagnosis 20%

have glaucoma and increased IOP. Patients who have pseudoexfoliation syndrome but not glaucoma should be considered to have increased risk to glaucoma, as 15% of such patients develop increased IOP within 10 years. At the time of diagnosis glaucomatous damage is more severe and it progresses more rapidly in eyes with Pseudoexfoliation.

Pseudoexfoliation Syndrome may also lead to development of angle closure glaucoma. Pupillary block may be caused by combination of miotic-induced circular posterior synechiae, increased thickness of iris or iris rigidity or anterior subluxation and dislocation of lens due to zonular weakness or dialysis.

8) ANGLE CHARACTERISTICS

Gonioscopy should be performed in all eyes with pseudoexfoliation syndrome. Pigment and flecks of greyish material are seen over the structures of the angle, usually along the Schwalbe's line, where the pigment dispersion pattern is named as "Sampaolesi's line".

Angle characteristics in pseudoexfoiation syndrome are:

- Trabecular hyperpigmentation, mostly in the inferior angle. The pigment is seen on the trabecular surface and has a patchy distribution. It increases in eyes with Pseudoexfoliative glaucoma.
- A scalloped wavy band of pigment running on to or ahead of Schwalbe line (Sampaolesi line) which is an early sign.
- Flecks of pseudoexfoliation deposits on the trabeculum result in 'dandruff-like' appearance.

- Narrow angles if present there is an increased risk of angle closure, possibly due to zonular laxity.

Trabeculopathy

Electron microscopy shows pathologic changes in trabecular meshwork and deposition of pseudoexfoliative material in the juxtacanalicular tissue adjacent to Schlemm's canal. This suggests local production of pseudoexfoliative material in the juxtacanalicular portions of the meshwork, particularly by the Schlemm's canal endothelium. Progressive accumulation of pseudoexfoliative material in the advanced stages leads to edema of the juxtacanalicular tissue and a marked disorganization of Schlemm's canal architecture like tightening of the canal lumen, disruption of the endothelial lining, fragmentation into smaller channels, collapsing of both walls of the canal, and degenerating and partial obliteration endothelial cells.

Trabecular meshwork obstruction by pseudoexfoliative material and degenerative changes in the area of greatest outflow resistance seems to be contributory factors for the chronic raised pressure and glaucoma. Also there is increased aqueous protein levels due to defective blood-aqueous barrier and dispersion of melanin pigment from the iris pigment epithelium.

Corneal endothelial proliferation seen ahead of Schwalbe's line above the trabecular meshwork further contributes to ocular hypertension. Sometimes the trabeculum is covered by a pretrabecular layer of abnormal extracellular matrix, including pseudoexfoliative material produced by proliferating endothelial cells of cornea. This is consistent with the finding that, decreased oxygen content increases

the corneal endothelial cell proliferation in tissue culture and also with the hypoxia measured in the anterior chamber in eyes with pseudoexfoliation.

A study determined whether severity of the glaucoma correlates with gonioscopic features of the anterior chamber angle in patients with pseudoexfoliation syndrome. It demonstrated that there was no obvious association between severity of glaucoma and angle characteristics. Hence the mechanism of damage is similar to that seen in open angle glaucoma [(37)].

A study compared the morphology of iris and the anterior chamber angle (ACA) in eyes with pseudoexfoliation to that of their clinically unaffected fellow eyes and normal control eyes. The anterior chamber angle parameters and iris area were not significantly different among all three groups. The ACA parameters were significantly smaller in the pseudoexfoliation eyes than their clinically unaffected fellow eyes and the normal control eyes. So they concluded that morphological differences in the anterior segment are present between pseudoexfoliation and fellow eyes [(38)].

9) VITREOUS

Vitreous changes are routinely seen in Pseudoexfoliation Syndrome since hyaluronic acid and Pseudoexfoliation material are both acid mucopolysaccharides. A change in composition of aqueous in Pseudoexfoliation Syndrome deranges metabolism of hyalocytes causing impaired production of hyaluronic acid and liquefaction of vitreous.

10) RETINA

Increased incidence of vitreous loss and also the frequent need for Nd:YAG capsulotomy due to formation of secondary cataract, enhance the risk of retinal detachment. Hence pseudoexfoliation syndrome might be considered as a risk factor for the development of retinal detachment. Even central retinal vein occlusion seems to be more commonly seen in eyes with Pseudoexfoliation Syndrome.

B) EXTRAOCULAR SYSTEMIC MANIFESTATIONS

Electron microscopy demonstrates pseudoexfoliation material in various visceral organs and this changed the whole concept of this disorder since there is dealing with a generalized disease and not with a distinct ocular phenomenon. Hence the ophthalmologists are in the center of a "cell biologic problem of the first order".

There is involvement of skin, heart, lung, liver, cerebral meninges, kidney and gall bladder. Focally these pseudoexfoliation deposits are present in the interstitium of fibrovascular connective tissue septa of various organs, often neighbouring collagen fibers, elastic fibers, fibroblasts and blood vessel walls. The deposition of Pseudoexfoliation material in heart muscle cells and extraocular muscle cells suggest muscle cells are also involved. Pseudoexfoliation material shows similarities on ultrastructural and immunohistochemical studies both in intraocular and extraocular sites.

There are no proven clinical disorders of the systemic occurrence of pseudoexfoliation material known till now.

A study was conducted to show the association between abdominal aorta aneurysms and pseudoexfoliation syndrome. Histological studies of samples of aortic-

wall, obtained in patients with ocular pseudoexfoliation material, showed focal accumulation pseudoexfoliation material in the subendothelial connective tissue and adventitia, elastosis of the tunica intima and pronounced fibrosis. These findings suggested that there is an association between abdominal aorta aneurysms and pseudoexfoliation syndrome [(39)].

CATARACT SURGERY IN PSEUDOEXFOLIATION SYNDROME

Surgical and post-operative difficulties are often multifactorial and directly related to pathological changes of pseudoexfoliative materials on intraocular structures. Appropriate IOP control and the amount of glaucomatous damage must be taken into account, along with pupillary rigidity, corneal endotheliopathy and zonular instability while assessing patients with pseudoexfoliation syndrome for cataract surgery. Apparently, the zonular instability is more important than is poor pupil dilatation as it poses a potentially catastrophic complications during surgery. These patients have a greater incidence of zonular dehiscence, posterior capsular rupture and vitreous loss.

Good pupillary dilatation and a wider capsulorhexis are key factors for a successful visual outcome of the cataract surgery. However, acute visual loss may be seen in pseudophakic eyes as capsular shrinkage and zonular disintegration may lead to easier IOL luxation or dislocation into the vitreous. Due to compromised blood-aqueous barrier frequently seen in pseudoexfoliation syndrome higher risk of iris vascular leak and transient raised intraocular pressure may be commonly noticed postoperatively. Late post-operative decentration or dislocation of intra-ocular lens due to zonular weakness may be seen. Due to aggravated blood-aqueous barrier breakdown secondary cataract is more commonly seen in these patients.

Extracapsular cataract extraction (ECCE) performed in cases of Pseudoexfoliation syndrome not only had increased rates of intraoperative complications, but also a 10-fold higher rate of anterior chamber IOL placement in the Pseudoexfoliation group compared with controls. Also complication rates of cataract extraction in Pseudoexfoliation syndrome are lower using phacoemulsification technique compared with ECCE [(3)].

Two key features of pseudoexfoliation syndrome that can be attributed as risk factors for surgical complications are pupillary rigidity and zonular instability. Also the small pupillary size and zonular weakness are supposed to be the risk factors for posterior capsular rupture and vitreous loss during cataract surgery. Vitreous loss in patients with pseudoexfoliation seems to be five times more common than in patients without this disorder. Phacoemulsification is safer surgical modality of cataract extraction in eyes with pseudoexfoliation syndrome compared with other conventional methods [(1)].

A study concluded high frequency of capsular disinsertion or rupture is seen in extracapsular surgery in patients with pseudoexfoliation syndrome and suggested presence of glaucoma, insufficient mydriasis and phacodonesis as the leading factors related to posterior capsular rupture during cataract surgery [(40)].

Gillies W [(41)] studied the effect of lens removal in cases where pseudoexfoliative material deposition is seen on the lens capsule. He came to a conclusion that cataract extraction was difficult in these patients and the lens capsule seemed very liable to break and large hyphaemas frequently were seen. It was also associated with pupillary block postoperatively as there was a tendency for the pupil

to stick to the vitreous face. The poor visual outcome was due to dense pupillary fibrosis and advanced glaucoma.

Posterior capsule rupture complication rate increases in pseudoexfoliation syndrome as the grade of cataract maturity increases and accordingly leading to poor visual acuity [(42)].

A study evaluated Indian eyes for the intraoperative and postoperative outcome after phacoemulsification in eyes with pseudoexfoliation syndrome. It concluded that surgical experience makes phacoemulsification safe and effective in eyes with pseudoexfoliation syndrome in India. Although the flare response was higher in pseudoexfoliation eyes, the immediate postoperative behavior was similar to that in eyes with no coexisting pathology [(4)].

Moore et al [(43)] suggested cataract surgery in pseudoexfoliative patients is associated with a higher rate of complications even up to 5 and 10 times greater, which are more common in advanced stages of cataract. It is a challenging surgery mainly because of poor pupillary dilatation and zonular weakness. Late complications are also common and may present as secondary cataract or spontaneous IOL dislocation.

A study noted a longer axial length as a protective factor in opposition to the occurrence of zonular dialysis during phacoemulsification and also between the control group and pseudoexfoliation group there was no significant difference in the rate of any intraoperative complications [(44)].

Phacoemulsification puts immense stress on weakened zonules and pseudoexfoliation related corneal endothelium in eyes with pseudoexfoliation which

usually involves high ultrasound power, and hence higher rates of intraoperative complications like posterior capsule rupture and vitreous loss are seen in phacoemulsification when compared to ECCE. Hence the risks are minimal in extracapsular cataract extraction in pseudoexfoliation syndrome patients with mature and hypermature cataract [(45)].

A study reported phacoemulsification without an increased risk of complications during surgery or late intraocular lens (IOL) dislocation in a series of patients with pseudoexfoliation syndrome. The incidence of vitreous loss was 1.5% in eyes with pseudoexfoliation syndrome and 2.3% in eyes without pseudoexfoliation. Between the 2 groups the difference was statistically insignificant. There were no cases of zonular dialysis or posterior capsule rupture without loss of vitreous. Over a mean follow-up of 54.1 months there were no dislocated IOL's. This confirms lower rate of intraoperative complications during phacoemulsification [(46)].

Pseudoexfoliation syndrome as one of the risk factors for posterior capsule rupture and vitreous loss during phacoemulsification [(47)].

Pseudoexfoliation plays a significant role in the development of postoperative pupillary membranes after ECCE with PCIOL implantation, which could be successfully treated with the use of Nd:YAG laser [(48)].

PUPIL DILATATION IN PSEUDOEXFOLIATION SYNDROME DURING SURGERY

A common finding in pseudoexfoliation syndrome is poor pharmacologic dilatation. Many surgical approaches have been used to overcome a small pupil, including manual stretching with the Kuglen and Y-hooks, bimanual stretching

technique, iris retractor hooks, sector iridectomy and iris rings. The Beehler pupil dilator has been recommended for its ease in returning the pupil to a more physiologic size at the end of the surgery. However, the iris retractor hooks were the most time-consuming [(3)].

Sphincterotomies is inexpensive and easy alternative but excessive inflammatory responses due to the compromised blood-aqueous barrier may be seen in early post operative period. It even leads to distorted pupil and may cause pupillary capture of IOL.

Watson N et al [(49)] stated there was no difference prior to mydriasis in the pupil size of patients with pseudoexfoliation compared with the normals, diabetics or individuals with chronic open angle glaucoma groups. After dilatation the patients with pseudoexfoliation syndrome had significantly smaller pupils than other groups.

Akman A et al [(50)] in their study for small pupil size during phacoemulsification in eyes with pseudoexfoliation syndrome compared 4 methods for pupil dilatation intraoperatively. The various methods used were bimanual stretching, mechanical pupil dilatation with iris-retractor hooks, polymethyl methacrylate (PMMA) pupil dilator-ring and Beehler pupil dilator. The study concluded that mechanical dilatation of rigid pupils were effective procedures using these 4 methods in their study in patients with pseudoexfoliation syndrome. PMMA pupil-dilator ring and iris-retractor hooks were the most time consuming methods but considerably they had a advantage of a stable pupil size till the end of surgery. Among these, the least iris trauma was caused by PMMA pupil-dilator ring. Among the least time-consuming mechanical pupil dilatation methods were Beehler pupil dilator and bimanual stretching technique.

CAPSULORRHEXIS/CAPSULOTOMY IN PSEUDOEXFOLIATION SYNDROME

Capsulorrhexis/capsulotomy creation is more difficult in these cases, as there is no counter-traction during tearing of the anterior lens capsule. During capsulorrhexis or capsulotomy, diffuse zonular laxity is usually sensed. Once this weakness is apparent, the chance of creating zonular dialysis becomes evident.

Mohammadpour M et al [(51)] in their study stated that as soon as the surgeon starts to create the initial puncture on the anterior capsule for capsulorhexis, the cataract surgeon may feel the impact of zonular weakness impact. To avoid tilting away of the lens during the capsular puncture with the cystitome, the cataract surgeon may have to fix the lens with a micrograsper for the zonular stability. Furthermore reduced zonular force makes progress of rhexis unusually difficult. To manage this issue capsular hooks along with capsule retractor have been used.

ZONULAR DIALYSIS AND CAPSULAR TENSION RING (CTR)

If a small or moderate zonular dehiscence occurs, a capsular tension ring can re-expand the capsular bag and redistribute the mechanical stresses evenly across the remaining zonules.

A study used a new method in pseudoexfoliation syndrome cases during phacoemulsification of in situ nuclear disassembly and then evaluated the safety and incidence of intraoperative complications.It lowered the zonular stress by avoiding handling and rotation of the nucleus. The study conducted phacoemulsification in patients without rotation of the nucleus by using the flexible type of Kelman style

phaco tip to perform the lateral sweep sculpting and in situ cracking in cases of pseudoexfoliation in which zonular fragility is a concern. [52].

Use of a capsular tension ring (CTR) may be beneficial in cases of significant zonular weakness. CTRs also decrease postoperative IOL decentration and tilt. In addition pseudoexfoliation syndrome is characterized by a progressive zonulopathy whose course is not determined by the placement of a CTR at time of cataract extraction hence surgical repositioning of subluxated or dislocated CTRs may be required in eyes with involved zonular instability.

Capsular tension ring (CTR) could be injected prior to Phaco or after emulsification of the nucleus but prior to cortical irrigation-aspiration depending on zonular weakness or dialysis . In complicated cases Cionni modified-CTR (mCTR) or capsular tension segments (CTS) could be inserted either alone or in combination. If evident phacodonesis is present it is advisable to insert a CTR early after completing the capsulorhexis to stabilize the capsular bag for Phaco and cortical matter removal. In advanced zonular instability the mCTR or CTS both of which can be sutured to the sclera for improved fixation should be considered [1].

Bayraktar S et al [53] in their study stated that in cataract associated with pseudoexfoliation syndrome, they achieved lower rates of zonular dialysis, increased rate of capsular IOL fixation and good visual outcome only with implanting a CTR before phacoemulsification of the nucleus. Rotational and anterior–posterior forces stretched the weakened zonules that are created during nucleus manipulation (grooving, rotation). No attempt was made to rotate the nucleus before inserting the ring. Hence they concluded CTR implantation after capsulorhexis and hydrodissection but before nucleus emulsification reduced intraoperative complications.

INTRAOCULAR LENS AND PSEUDOEXFOLIATION SYNDROME

A) CHOICE OF INTRAOCULAR LENS (IOL)

Intraocular lens selection in cases of pseudoexfoliation syndrome should take into account the possibility of an early or late IOL decentration. To overcome the likelihood of IOL decentration a IOL of large optic is recommended. In cases of IOL decentration, aspheric IOLs with negative spherical aberration theoretically may lead to a worse visual outcome compared with an equally decentered spherical IOL because of 2nd and 3rd order aberrations induced by the decentration. If the zonular apparatus is not sufficient to support in-the-bag placement of an IOL, other alternative lens placements include the sulcus, anterior chamber or iris fixation. Careful consideration should be made before placement of an anterior chamber IOL in patients with pseudoexfoliative glaucoma.

Heparin surface modified posterior chamber IOLs are associated with lesser postoperative fibrinoid reactions, less frequent pigment and cellular deposits on the lenses and lower incidence of the posterior synechiae formation than other forms of IOLs. To avoid capsular contraction syndrome flexible silicone IOLs are not recommended. One-piece acrylic PCIOL may be considered best choice for minimal capsular and zonular stress. Also the springy nature of the PMMA haptics can provide tension to help support smaller areas of zonular dehiscence without insertion of CTR. In case of severe zonular instability and dialysis or loss of vitreous, scleral or iris fixated IOL may be considered [(1)].

To minimize zonular stress during implantation acrylic foldable IOL in the bag are favored as it provides better support to the capsule and also there is lower chance of anterior capsular opacification as compared to PMMA rigid PCIOL [(54)].

Heparin-surface-modified intraocular lenses reduce postoperative anterior segment inflammation. Permeability is reduced considerably three and six months after surgery in cases with heparin-surface-modified intraocular lenses. These lenses induce less foreign-body reaction and postoperative inflammatory response than PMMA IOLs. Also cause fewer cell deposits on the endothelium and the IOL surface [(55)].

B) PSEUDOEXFOLIATION MATERIAL ON INTRAOCULAR LENS

A study reported pseudoexfoliation material deposition on intraocular lens after many years of uneventful cataract surgery on three patients in whom pseudoexfoliation was absent before the cataract surgery. They put forward the hypothesis that IOL placed in the sulcus stimulates ciliary body surface and the production of material pseudoexfoliation. Hence Pseudoexfoliative material produced by one intraocular tissue can be deposited on other structures including a polymethylmethacrylate (PMMA) IOL [(56)].

Deposition of pseudoexfoliation on the optical zone of the intra-ocular lens (IOL) surface is called as pseudophakic pseudoexfoliation. It is a rare condition that can be observed after cataract surgery. Pseudophakic pseudoexfoliation is higher with PMMA IOL compared to other IOL materials [(57)].

C) DISLOCATION / SUBLUXATION OF INTRAOCULAR LENS

In pseudoexfoliation syndrome, IOL decentration, late in-the-bag intraocular lens subluxation, and anterior capsular shrinkage and fibrosis are frequently seen late complications. After surgery, pseudoexfoliation patients should undergo frequent examinations for early detection of IOL dislocation as the pseudoexfoliative process will continue even after the surgery. There may be even IOL-CTR capsule complex dislocation.

Krepste L et al [(58)] stated that after routine cataract surgery pseudoexfoliation syndrome as a important risk factors for late in-the-bag dislocation of intraocular lens. And even the time to in-the-bag IOL dislocation in the pseudoexfoliation group was shorter.

Pseudoexfoliation syndrome is a risk factor of late in-the-bag lens dislocation. IOL dislocation is due to a progressive zonular dehiscence and contraction of the capsular bag after many years of a uneventful surgery. Many of the spontaneous IOL dislocations occur several years after cataract surgery. In pseudoexfoliation cases the mean interval between cataract surgery and IOL dislocation is usually of 5.5–8.5 years. Late in-the-bag IOL dislocation in pseudoexfoliation syndrome was a prevalent association and that the rate of dislocation as per a study was >73.9% [(59)] and it accounts for more than 50% of the cases [(60)]. Hence Pseudoexfoliation is the most prominent known risk for IOL dislocation.

EFFECT ON IOP AFTER CATARACT SUGERY IN PSEUDOEXFOLIATION SYNDROME

On postoperative day one IOP spikes occur more frequently in eyes with pseudoexfoliation.

Tao Tran [61] suggested washout procedure of the trabecular meshwork and the irido-corneal angle, combined with cataract surgery in eyes with Pseudoexfoliation. The study stated that this method can reduce the IOP and further can reduce the number of hypotensive drugs needed after the cataract surgery.

A study noted that patients with pseudoexfoliation syndrome had a postoperative IOP reduction from baseline at all measurements. Phacoemulsification is the rational option for initial IOP management for a significant cataract with no advanced optic nerve injury. They stated that the source of pseudoexfoliative material (the anterior lens capsule) is removed by phacoemulsification and thus there is clearance of pigment and pseudoexfoliative debris from the anterior segment, particularly the trabecular meshwork [62].

SECONDARY CATARACT IN PSEUDOEXFOLIATION SYNDROME

Cataract extraction in pseudoexfoliation syndrome is often associated with breakdown of the blood-aqueous barrier which leads to inflammatory reactions and fibrin formation. This is a major factor leading to formation of secondary cataract. Alterations in the basement membrane of the iris vessels, endothelial cells and the non-pigmented ciliary body epithelium are seen on electron microscopy. Even non invasive laser flaremetry has demonstrated postoperative breakdown of the blood-

aqueous barrier, which has been shown to be significantly increased in eyes with pseudoexfoliation after cataract extraction with PCIOL implantation.

Kuchle M et al [(63)] performed a study to confirm their hypothesis that eyes with pseudoexfoliation have a higher frequency of secondary cataract. Several mechanisms account for this observation :

- Firstly, intraoperative factors are accountable for the higher numbers of secondary cataract. Poor pupillary mydriasis, posterior synechiae, loss of zonular integrity and corneal decompensation sometimes force the surgeon to minimize the aspiration of equatorial lens cortex and lens epithelium and also posterior capsule polishing, thus predisposing eyes to proliferation of lens epithelium and development of secondary cataract.
- Secondly, impairment of the blood-aqueous barrier and prolonged postoperative barrier breakdown in pseudoexfoliation provide a protein rich 'culture medium' with plasma factors and growth factors, thus supporting the proliferation of residual lens epithelium cells.
- Thirdly, fragile zonules may lead to focal areas of zonulolysis with capsular folds and this leads to successive facilitated migration of lens epithelium or fibrotic changes.
- Finally, it has been suggested that intraocular hypoxia exerts a strong stimulatory effect on proliferation of intraocular cells. As anterior chamber hypoxia has been seen in eyes with pseudoexfoliation, this induce proliferation of lens epithelium and cause secondary cataract.

Hence they concluded that higher frequency of secondary cataract should be considered as a potential late complication of cataract surgery in eyes with Pseudoexfoliation syndrome.

CATARACT AND GLAUCOMA SURGERY IN PSEUDOEXFOLIATION SYNDROME

Pseudoexfoliation syndrome is known to be one of the common causes of secondary open-angle glaucoma or ocular hypertension and early cataract development. The presence of pseudoexfoliative material in the eye makes surgical procedures for both cataract and glaucoma more complicated. Since eyes with pseudoexfoliative glaucoma poorly respond to medical therapy, these patients usually undergo laser or surgical therapy. Trabeculectomy is still the most common procedure in the surgical management when medical or laser treatment fails in controlling IOP levels in cases of advanced glaucomatous disease. A combined cataract and trabeculectomy procedure may be a good option in patients with pseudoexfoliative glaucoma. Careful examination and evaluation of all clinical aspects should be considered in order to choose the appropriate medical and surgical approach for glaucoma and cataract surgery.

A study compared long term intraocular pressure and glaucoma development after phacoemulsification cataract surgery in eyes with and without pseudoexfoliation syndrome. They suggested that pseudoexfoliation eyes benefit particularly from cataract surgery in terms of IOP and glaucoma development. The glaucoma incidence was markedly lower than expected in the 6–7 years after cataract extraction. Cataract surgery seemed to have protective effect on glaucoma development. This is possibly due to the removal of the lens and the central anterior capsule reduces the release of

pseudoexfoliative material and pigment and also additional 'wash out' of pseudoexfoliative material during the operation [64].

Drolsum L et al [65] reported that the success of trabeculectomy in pseudoexfoliative glaucoma patients when compared to primary open angle glaucoma patients to be similar or even better than and these patients further in addition did not need any medical therapy. Phacoemulsification when combined with trabeculotomy also was reported to be an effective treatment in patients with pseudoexfoliation syndrome. Trabecular aspiration as performed in trabeculotomy removes pseudoexfoliation deposites and thus opens up the trabecular meshwork.

METHODOLOGY

The present study was conducted in the Department of Ophthalmology, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi to study the complications during cataract surgery in patients with pseudoexfoliation syndrome during the period of 1st January 2015 to 31st December 2015. The study was approved by the Ethical and Research Committee of Jawaharlal Nehru Medical College, Belagavi.

SOURCE OF DATA:

All the patients with cataract and pseudoexfoliation syndrome undergoing manual SICS at Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi.

METHOD OF COLLECTION OF DATA

Study Design: A Cross Sectional Study

Study Period: One year – 1st January 2015 to 31st December 2015.

Sample Size:

Sample size of 50 cases.

Sampling Procedure :

Sample size for the study is calculated by following formula:

$n = z_\alpha^2 pq \div d^2$

Where, n = sample size

Z_α = for 95% confidence

p = complication rate (61%)

q = (100-p)

d = 15(error rate)

Selection criteria:

Inclusion criteria -

1. All patients diagnosed with pseudoexfoliation syndrome with cataractous lens requiring cataract surgery.
2. Patients willing to give informed consent.

Exclusion criteria-

1. Previous intraocular surgerical procedures.
2. Ocular trauma.
3. Complicated cataract.
4. Traumatic cataract.

METHODOLOGY PROPER

All the patients who satisfy the inclusion criteria were included in the study. The patients were enrolled into the study and written informed consent was taken from them by the investigator.

Data regarding demographic parameters such as age, sex, occupation and address were noted on a predesigned proforma by the investigator at the time of first visit.

Detailed history of following symptoms was noted:

- H/O Diminution of vision RE/LE
    - ✓ Duration
    - ✓ Gradual/Sudden
    - ✓ Progression/static

- ✓ Distant/Near vision
- ✓ Visual improvement with bright light or dim light
- ✓ Painful/ Painless

- Diplopia/Polyopia
- Photophobia
- Flashes of light
- Coloured halos
- Floaters
- Watering
- Redness
- Discharge
- Black spots in front of the eye
- H/O Curtain falling in front of the eyes
- H/O wearing glasses
- H/O Diabetes Mellitus, Hypertension.

History was followed by ocular examination that included:

1. Visual acuity testing for distance and near using Snellen's distant chart and Jaeger's near vision chart respectively, both unaided and aided.
2. External ocular examination.
3. Slit lamp biomicroscopic examination for evidence of the following findings.

- Pseudoexfoliation material at the pupillary margins.
- Pseudoexfoliation material on the cornea
- Anterior chamber depth
- Iridodonesis.

- Presence of posterior synechiae.
- Pseudoexfoliation on the anterior surface of the lens capsule.
- Phacodonesis or dislocation of lens / frank subluxation.
- Pupillary reaction
- Measurement of pupil size before and after dilatation of pupil.

4. Tonometry using Schiotz tonometer after using Proparacaine eye drops (0.5%).
5. Gonioscopy with Goldmann three mirror lens in all patients with pseudoexfoliation syndrome. Ocular surface was anaesthetized with 0.5% proparacaine, with instruction to patient to look up initially while placing the Gonio lens & subsequently to look straight. Slit lamp examination was carried out at low level of adequate illumination & with minimum slit width.The following points were specifically evaluated.

- Trabecular meshwork pigmentation.
- The presence of Sampolesi's line.
- The grading of angle width according to Shaffer's grading.

Grade	**Angle width (degree)**	**Configuration**	**Chance of closure**	**Structure visible on gonioscopy.**
4	35-45	Wide open	Nil	From Schwalbe's line to cilliary body
3	20-35	Open	Nil	From Schwalbe's line to scleral spur
2	30	Moderately narrow	Possible	From Schwalbe's line to trabecular meshwork
1	10	Very narrow	High	Schwalbe's line only
0	0	Closed	Closed	None of the structures visible.

6. The pupils were then dilated with a combination of Phenylephrine 5% and Tropicamide 0.8 %. 1 drop was instilled every 15 minutes for one hour.
7. This was followed by slit lamp examination for :

- Measuring pupil dilatation. 7 mm or more was considered sufficient dilatation and less than 7mm was considered insufficient.
- Examination of lens capsule for pseudoexfoliation material deposition.
- Evaluation of lens for the type of cataract.

8. Fundoscopy.
9. Lacrimal patency test.
10. Keratometry.
11. A-scan to measure the anterior chamber depth and to calculate intraocular lens power.

Other investigations included:

- Blood pressure.
- Random blood sugar.
- Xylocaine sensitivity test.

SURGICAL TECHNIQUE

All patients received one hourly topical antibiotic (Gatifloxacin 0.4%) eyedrops one day prior to surgery. Systemic antibiotic (Tab Ciprofloxacin 500mg B.D) was given one day prior to the surgery and on the day of surgery. On the day of surgery pupils were dilated using instillation of Tropicamide 0.8% and Phenylephrine 5% eye drops every 15 minutes, starting one hour prior to surgery.

SURGICAL TECHNIQUE

Under all aseptic precautions the eye to be operated was painted with povidine iodine and spirit and was draped. Local anesthesia was given using 2% xylocaine mixed with 1500 units of hyaluronidase. A universal wire speculum was placed and superior rectus (bridle) suture was placed to fix the eye in downward gaze and secured. A small fornix based conjunctival flap was made and sclera was exposed. Haemostasis was achieved by wet field cautery.

A straight incision of 6.5 mm was made 1.5 mm posterior to surgerical limbus with 11 number blade. A self sealing sclerocorneal tunnel was made using a crescent knife and dissection continued 1 mm into clear cornea. Anterior chamber was entered from the anterior limit of sclerocorneal tunnel using a 3.2 mm keratome. Viscoelastic was injected into the anterior chamber. Anterior capsulotomy was done by can-opener technique.

Depending on the degree of mydriasis sphincterotomy was done. Hydrodissection is done to separate cortico-nuclear mass from the posterior capsule. Tunnel was extended with keratome. Nucleus was prolapsed into anterior chamber and delivered out with sandwich technique. Cortical matter was removed by irrigation and aspiration with simcoe cannula. Posterior chamber intraocular lens, Polymethyl methacrylate (PMMA) was implanted. The viscoelastic was cleared from the anterior chamber. Subconjuntival gentamycin and dexamathasone was given at the end of the procedure. Antibiotic eyedrops was instilled. Eye padded and bandaged.

All the intraoperative complications were noted.

POST OPERATIVE CARE

Postoperatively all the patients received :

- Topical antibiotic eyedrops (Gatifloxacin 0.4%) 6 hourly.
- Prednisolone acetate 1% eye drops hourly for one week and tapered over 6 weeks.
- Mydriatic eyedrops (Tropicamide 0.8% and Phenylephrine 5%) once dialy for one week.
- Systemic antibiotic (Oral Ciprofloxacin 500 mg BD) was continued for 3 days postoperatively.

STATISTICAL ANALYSIS

- Percentage distribution of complications during cataract surgery was computed.
- To test the association between anterior chamber depth with the complications Chi Square Test / Fisher Exact Test was used. Significance level of the test was kept at 0.05.

Introduction

Objectives

Review of Literature

Methodology

Results

Discussion

Conclusion

Summary

Bibliography

Annexure-I

Annexure-II

Annexure-III

Annexure-IV

Annexure-V

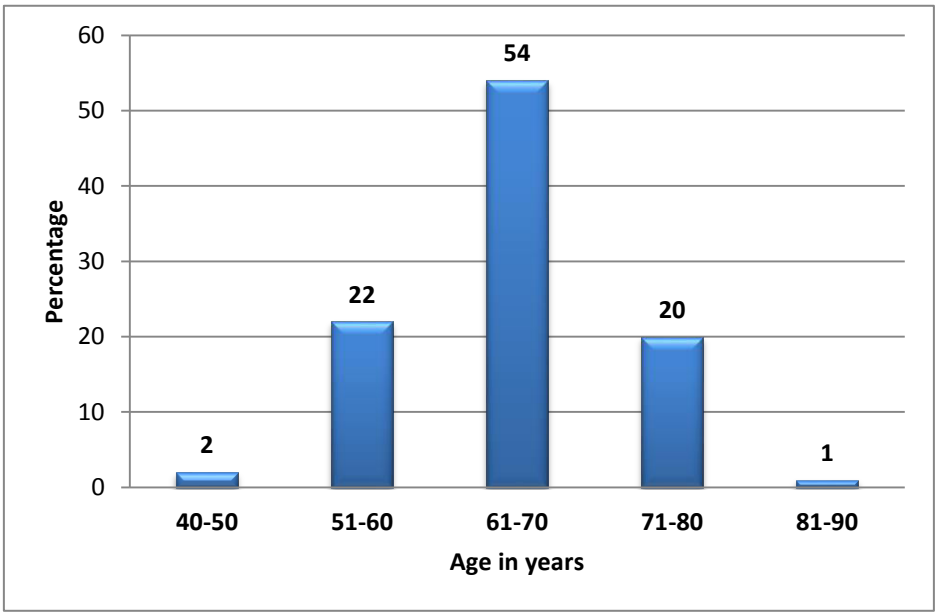
RESULTS

The present study was conducted on 50 eyes of 50 patients with Pseudoexfoliation syndrome undergoing SICS at Department of Ophthalmology, KLES Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Belagavi. The data obtained was tabulated as below.

TABLE 1: AGE DISTRIBUTION

AGE (YEARS)	No of cases	%
40 – 50	1	2
51 – 60	11	22
61 – 70	27	54
71 – 80	10	20
81- 90	1	2

GRAPH 1: AGE DISTRIBUTION



As shown in table 1, in our study there was 1 (2 %) patient in the age group of 40-50 years, 11 (22%) patients were of age group 51-60 years, 27 (54 %) of age group 61- 70 , 10 (20%) of age group 71-80 and 1 (2%) patient in the age group of 81-90 years.

TABLE 2: SEX DISTRIBUTION

SEX	No of cases	%
MALE	26	52
FEMALE	24	48

GRAPH 2 : SEX DISTRIBUTION

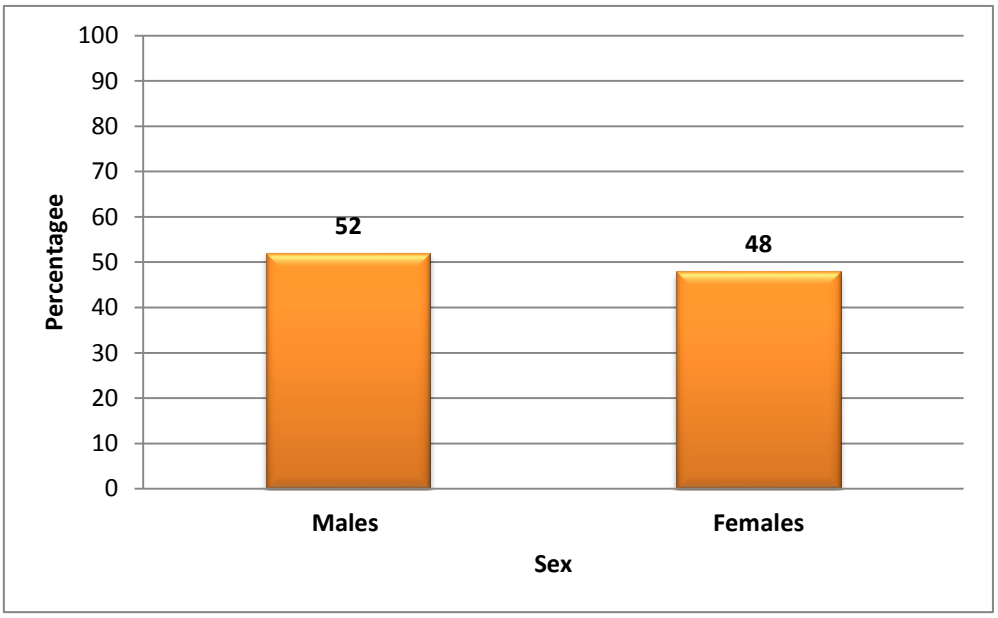
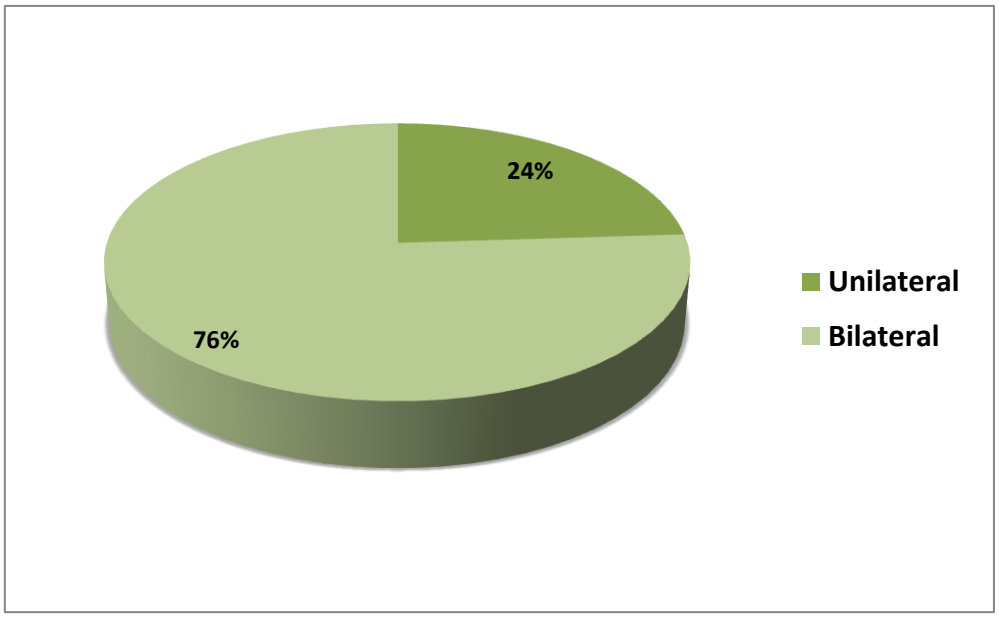


Table 2 shows that in our study 26 (52%) were males and 24 (48%) were females.

TABLE 3: LATERALITY

LATERALITY	No of cases	%
Unilateral	12	24
Bilateral	38	76

GRAPH 3: LATERALITY

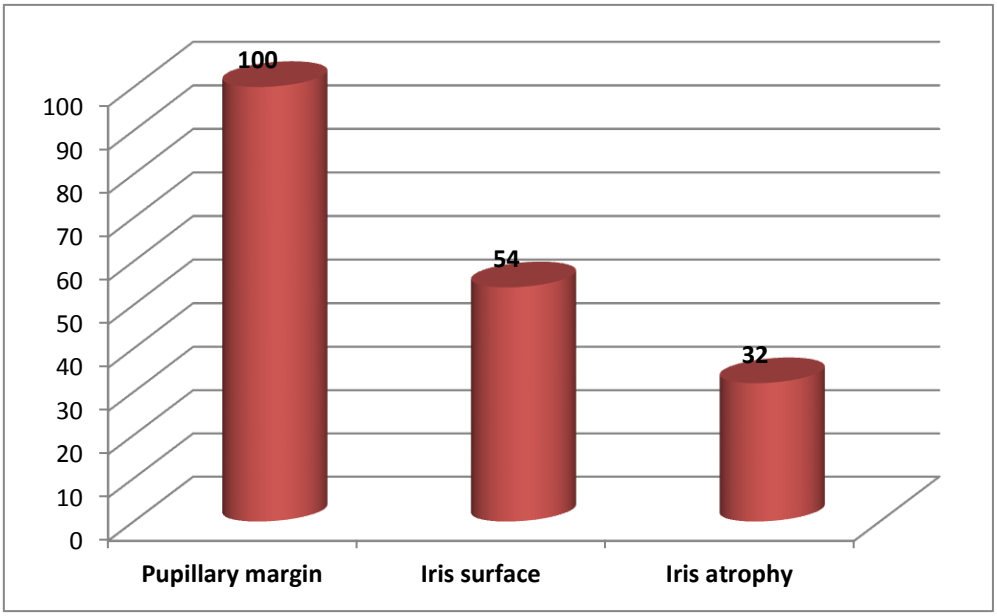


As shown in table 3, in our study 12 (24%) of patients had clinical unilateral pseudoexfoliation material in the anterior segment and 38 (76%) had bilateral involvement.

TABLE 4: IRIS CHARACTERISTICS

PXF	NO OF CASES	%
PUPILLARY MARGIN	50	100
IRIS SURFACE	27	54
IRIS ATROPHY	16	32

GRAPH 4: IRIS CHARACTERISTICS



In present study 100% of patients had pseudoexfoliation material on the pupillary margin, 27 (54%) on the iris surface and 16 (32 %) had iris atrophy as depicted in table 4.

TABLE 5: PXF MATERIAL ON LENS

PXF	NO OF CASES	%
YES	44	88
NO	6	12

GRAPH 5 : PXF MATERIAL ON LENS

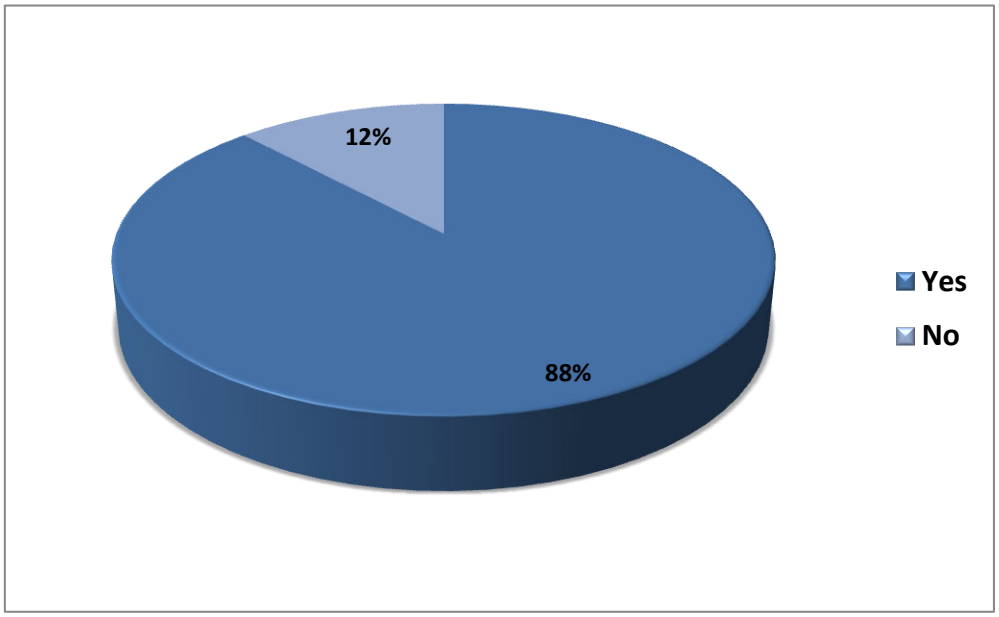
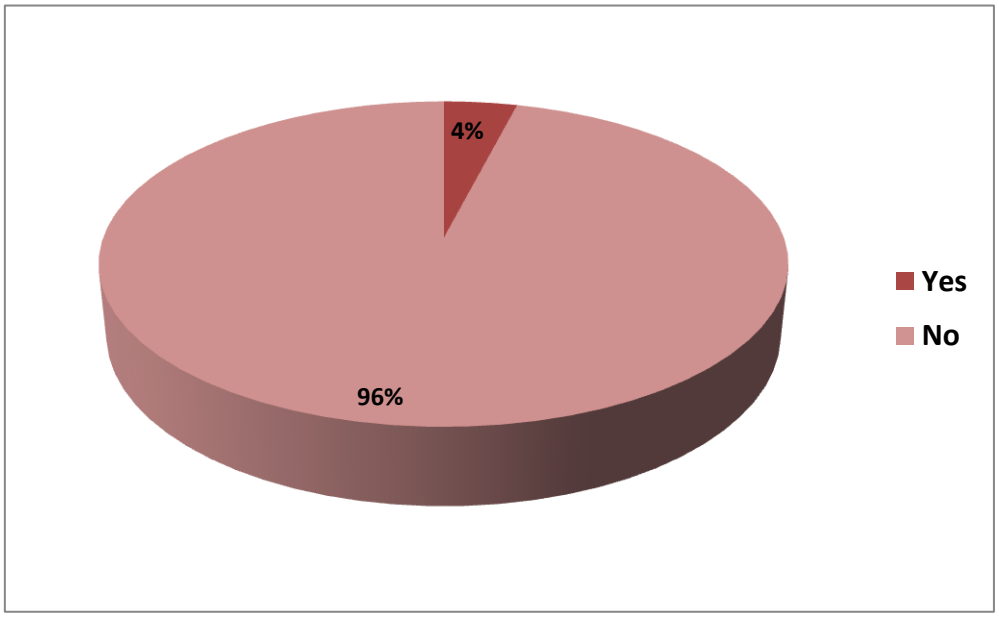


Table 5 showed that in our study 44 (88 %) of the patients had PXF material deposited on the anterior lens capsule and 6 (12 %) patients had no PXF deposition on lens capsule.

TABLE 6: PXF MATERIAL ON CORNEA

PXF	NO OF CASES	%
YES	2	4
NO	48	96

GRAPH 6 : PXF MATERIAL ON CORNEA

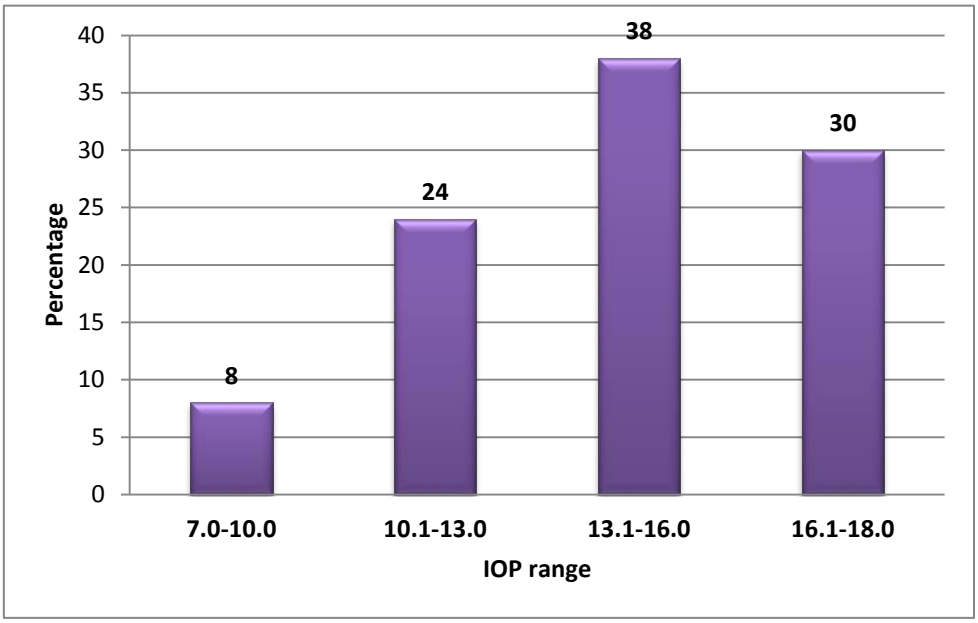


In our study 2 (4 %) of the patients had PXF material deposited on the corneal endothelium, 48 (96 %) had no PXF deposition on corneal endothelium as depicted in Table 6.

TABLE 7: IOP RANGE

IOP (mm Hg)	No.of Patients	%
7.0 – 10.0	4	8
10.1 – 13.0	12	24
13.1 – 16.0	19	38
16.1 – 18.0	15	30

GRAPH 7: IOP RANGE

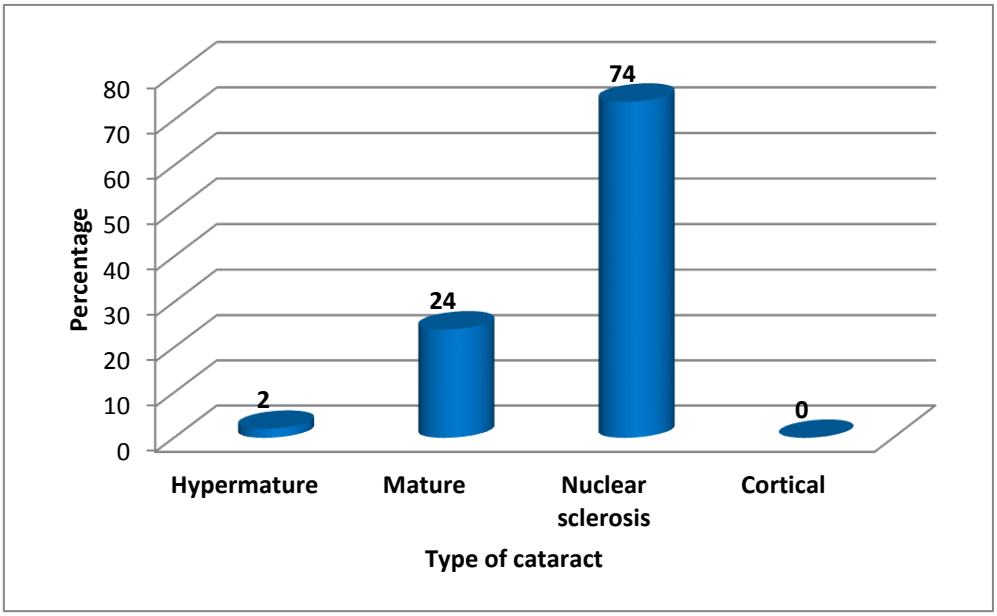


In our study 4 (8%) patients had IOP in the range of 7.0-10.0 mm Hg, 12(24%) in range of 10.1-13.0 mm Hg, 19 (38%) in range of 13.1-16.0 mm Hg and 15(30%) patients in range of 16.1-18.0 mm Hg as shown in Table 7.

TABLE 8: TYPE OF CATARACT

TYPE OF CATARACT	NO OF CASES	%
HYPERMATURE	1	2
MATURE	12	24
NUCLEAR SCLEROSIS	37	74
CORTICAL CATARACT	0	0

GRAPH 8 : TYPE OF CATARACT

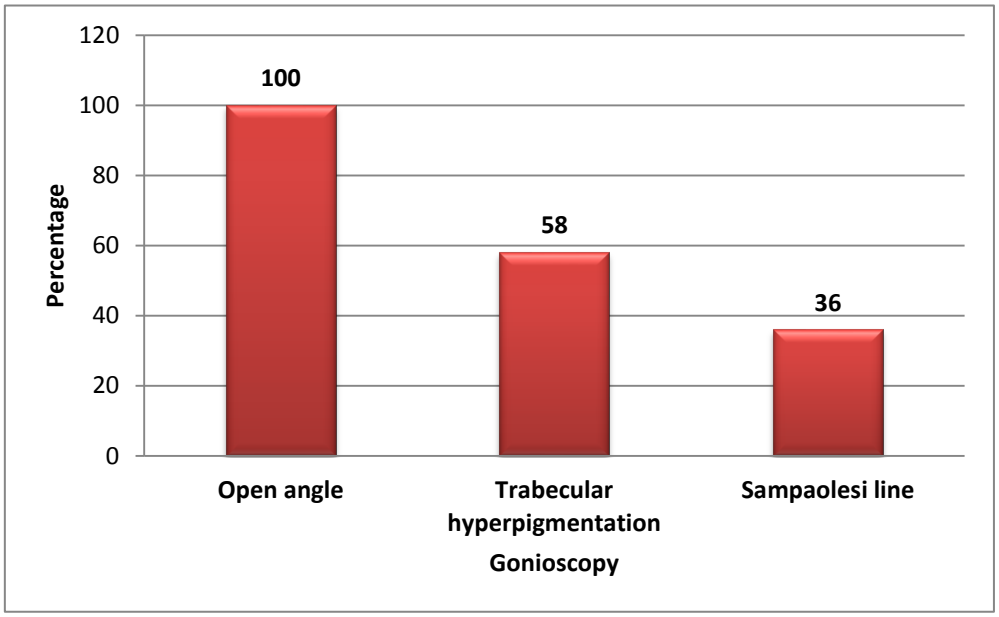


In present study 1 (2%) patient had hypermature cataract, 12(24%) patients had mature cataract and 37 (74) % patients had nuclear cataracts. None had isolated cortical cataract.

TABLE 9: GONIOSCOPY

GONIOSCOPY	NO OF CASES	%
OPEN ANGLE	50	100
TRABECULAR HYPERPIGMENTION	29	58
SAMPAOLESI LINE	18	36

GRAPH 9 : GONIOSCOPY

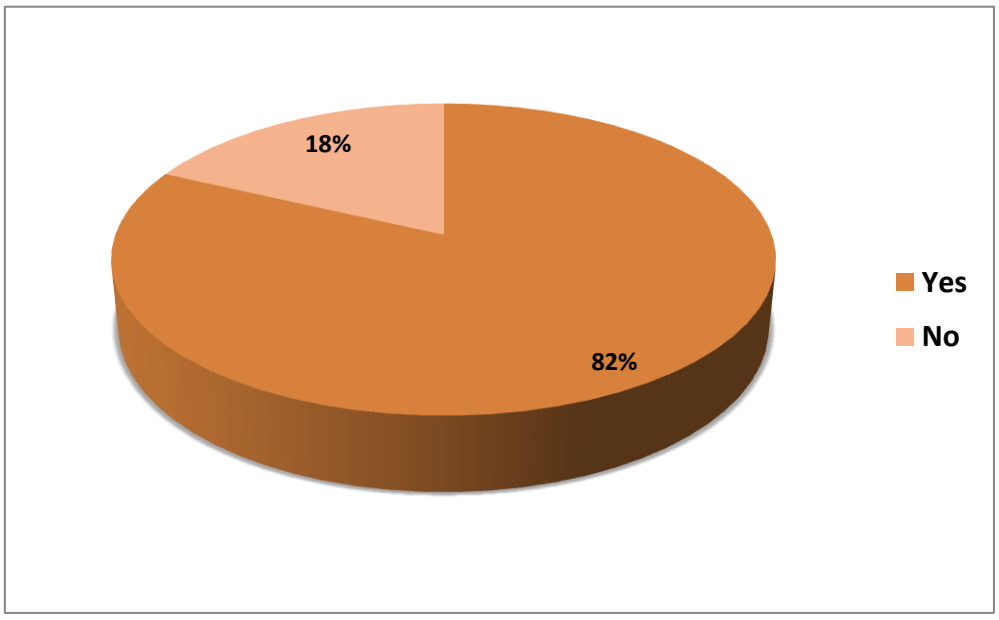


In our study all the 50(100%) patients had wide open angle on gonioscopy, 29 (58 %) of the patients had hyperpigmented trabecular meshwork and 18 (36%) patients showed sampaolesi line at the the angle as depicted in Table 8.

TABLE 10: NON DILATING PUPIL

	NO OF CASES	%
YES	41	82
NO	9	18

GRAPH 10 : NON DILATING PUPIL

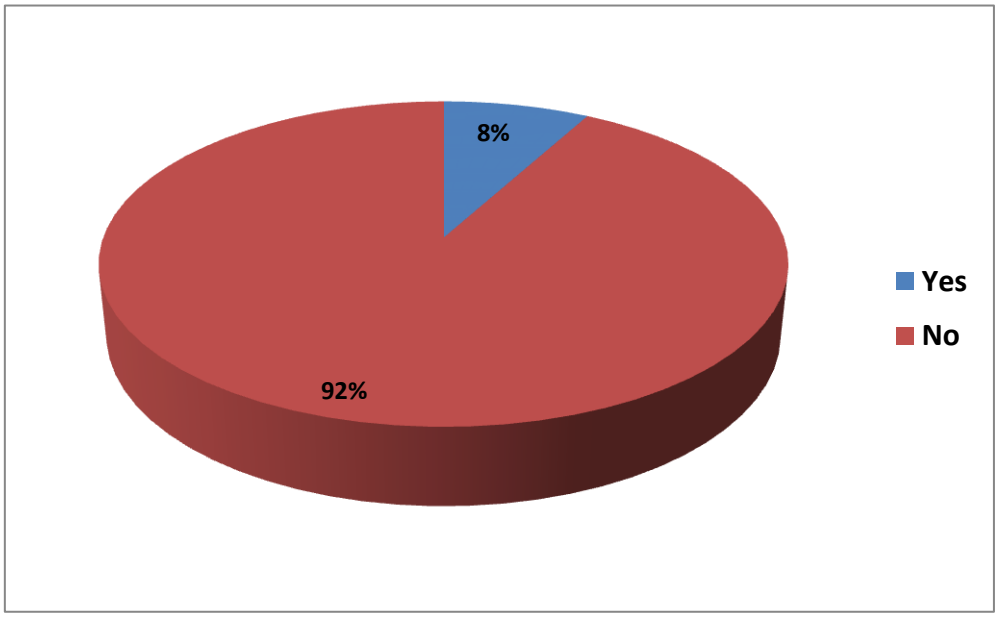


In our study 41 (82 %) patients had non dilating pupil (less than 7mm) and 9 (18%) patients had good dilating pupil (more than 7mm) as shown in Table 10.

TABLE 11: DIFFICULTY IN ANTERIOR CAPSULOTOMY

	NO OF CASES	%
YES	4	8
NO	46	92

GRAPH 11 : DIFFICULTY IN ANTERIOR CAPSULOTOMY

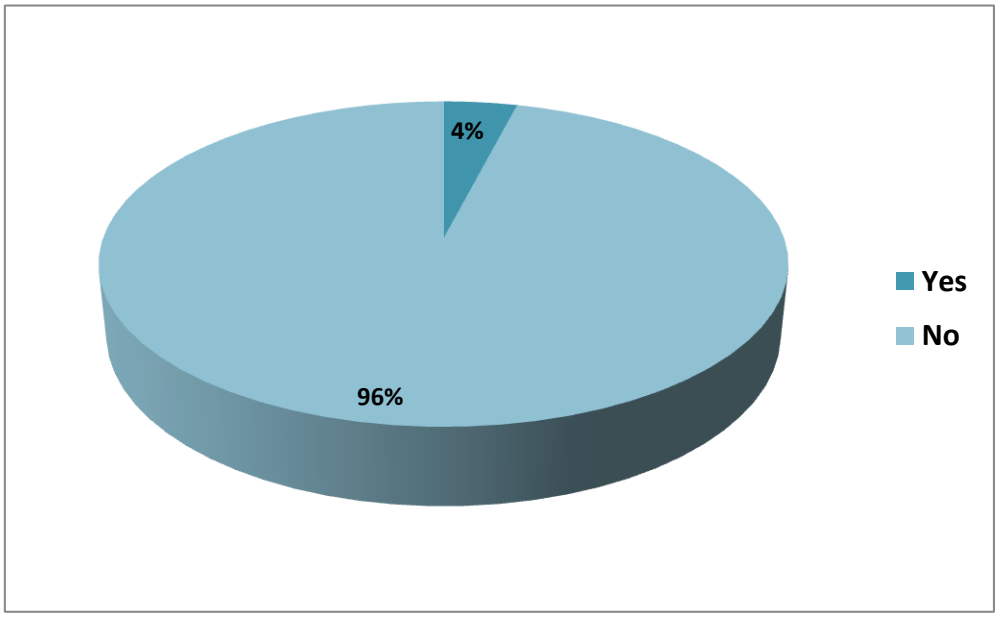


As shown in Table 11, difficulty during anterior capsulotomy was noted in 4 (8%) cases.

TABLE 12: DIFFICULTY IN NUCLEUS DELIVERY

	NO OF CASES	%
YES	2	4
NO	48	96

GRAPH 12 : DIFFICULTY IN NUCLEUS DELIVERY

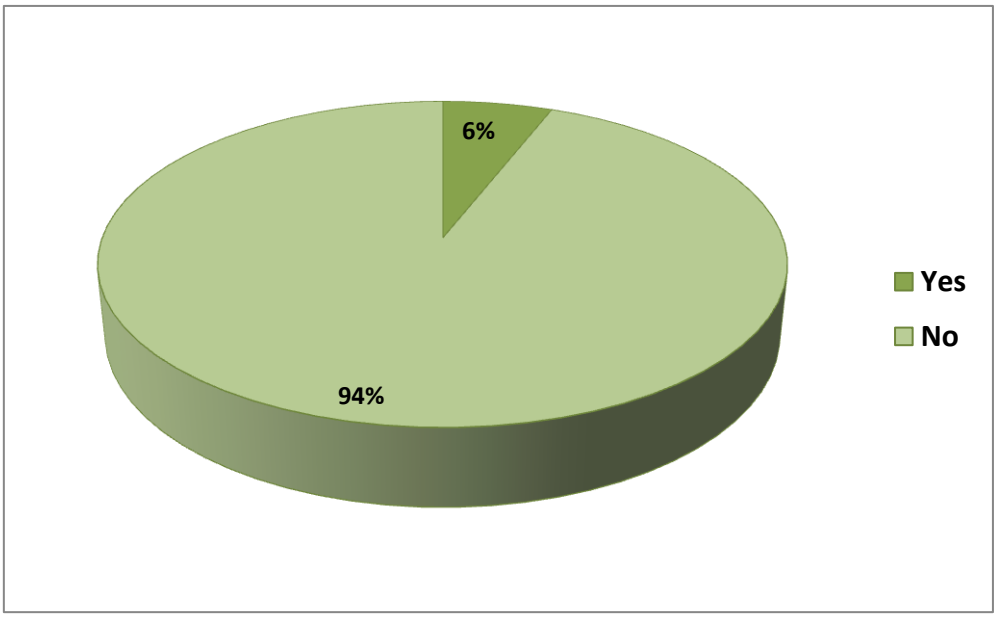


Difficulty in nucleus delivery was noted in 2 (4%) cases as depicted in table 12.

TABLE 13: CORNEAL ENDOTHELIAL TOUCH

	NO OF CASES	PERCENTAGE
YES	3	6
NO	47	94

GRAPH 13: CORNEAL ENDOTHELIAL TOUCH

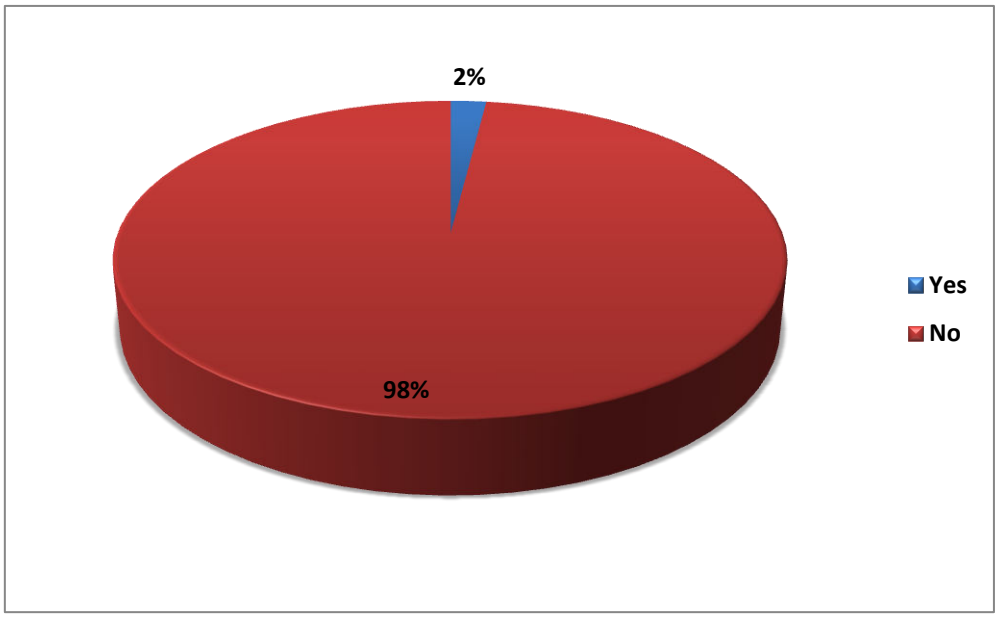


Corneal endothelial touch was noted in 3 (6%) patients in this study according to table no 13.

TABLE 14: DESCEMENTS MEMBRANE STRIPPING

	NO OF CASES	PERCENTAGE
YES	1	2
NO	49	98

GRAPH 14 : DESCEMENTS MEMBRANE STRIPPING

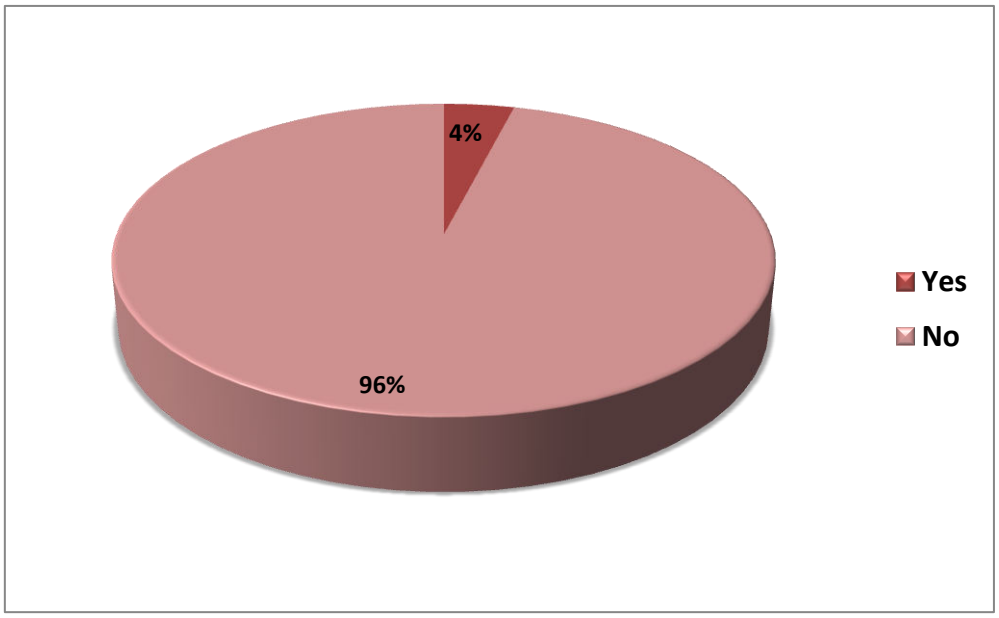


As shown in table 14, in our study only 1 (2%) patient had descements membrane stripping.

TABLE 15: IRIDODIALYSIS

	NO OF CASES	PERCENTAGE
YES	2	4
NO	48	96

GRAPH 15 : IRIDODIALYSIS

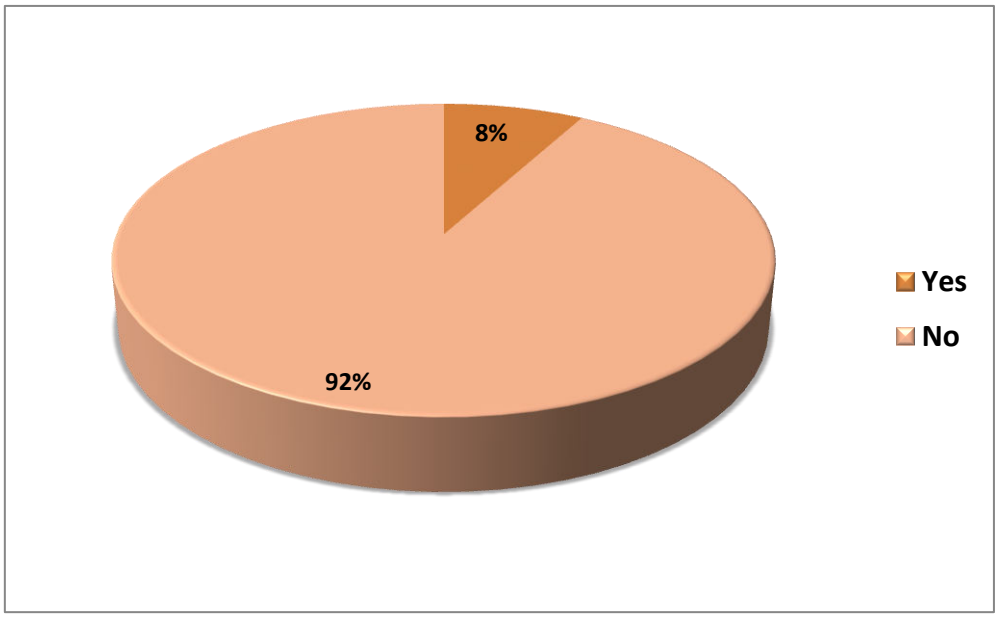


As shown in table 15, in our study iridodialysis was noted in 2 (4%) patients.

TABLE 16: ZONULAR DIALYSIS

	NO OF CASES	PERCENTAGE
YES	4	8
NO	46	92

GRAPH 16 : ZONULAR DIALYSIS

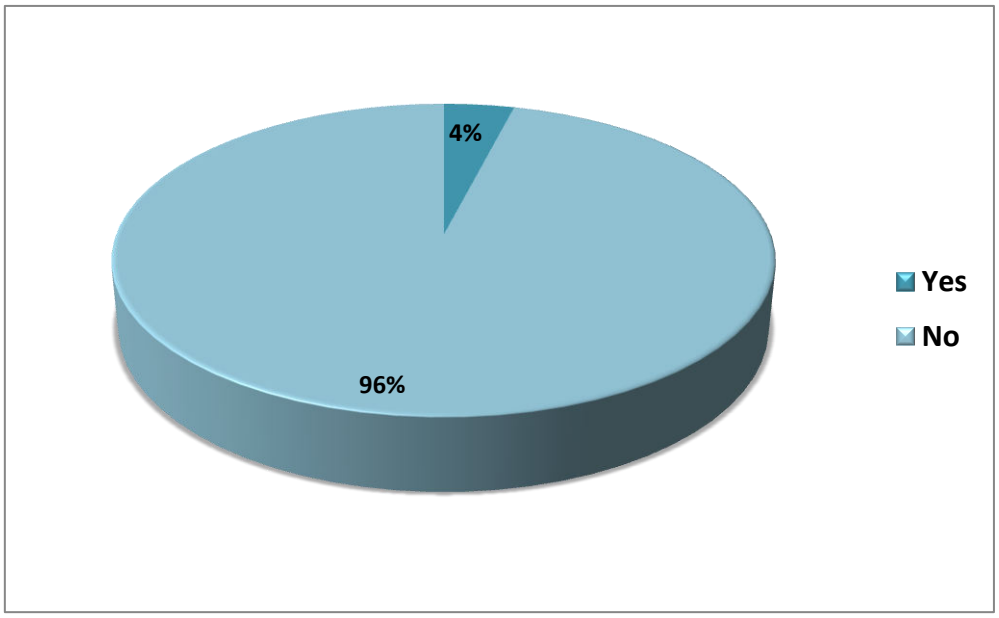


As shown in table 16, in our study zonular dialysis was noted in 4 (8%) patients.

TABLE 17: DECENTERED IOL

	NO OF CASES	PERCENTAGE
YES	2	4
NO	48	96

GRAPH 17 : DECENTERED IOL

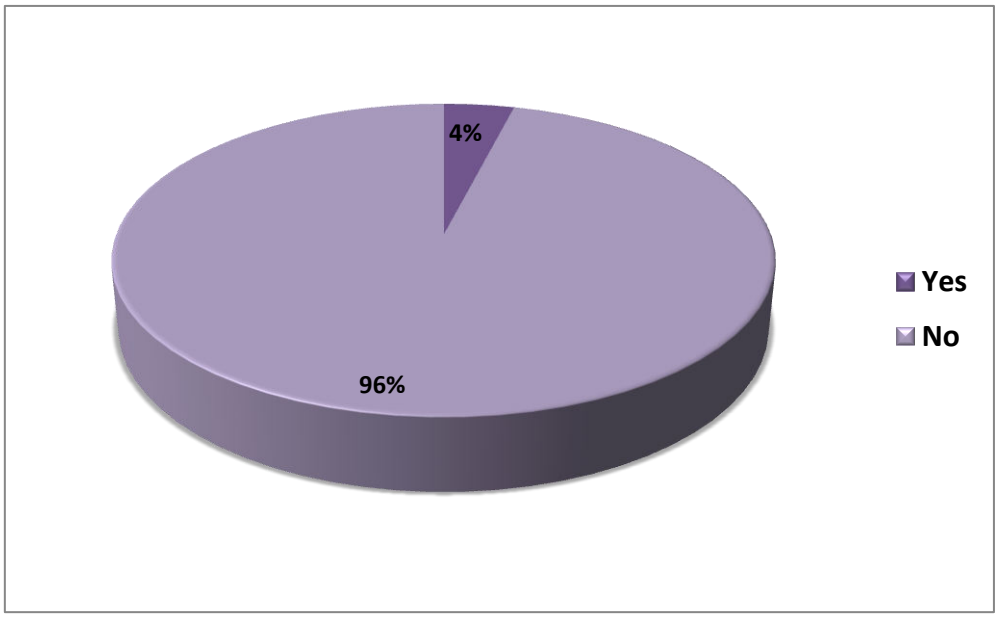


In our study decentered IOL was noted in 2 (4%) patients as shown in table 17. It was noticed soon after IOL insertion (intraoperative).

TABLE 18: RETAINED LENS MATTER

	NO OF CASES	PERCENTAGE
YES	2	4
NO	48	96

GRAPH 18 : RETAINED LENS MATTER

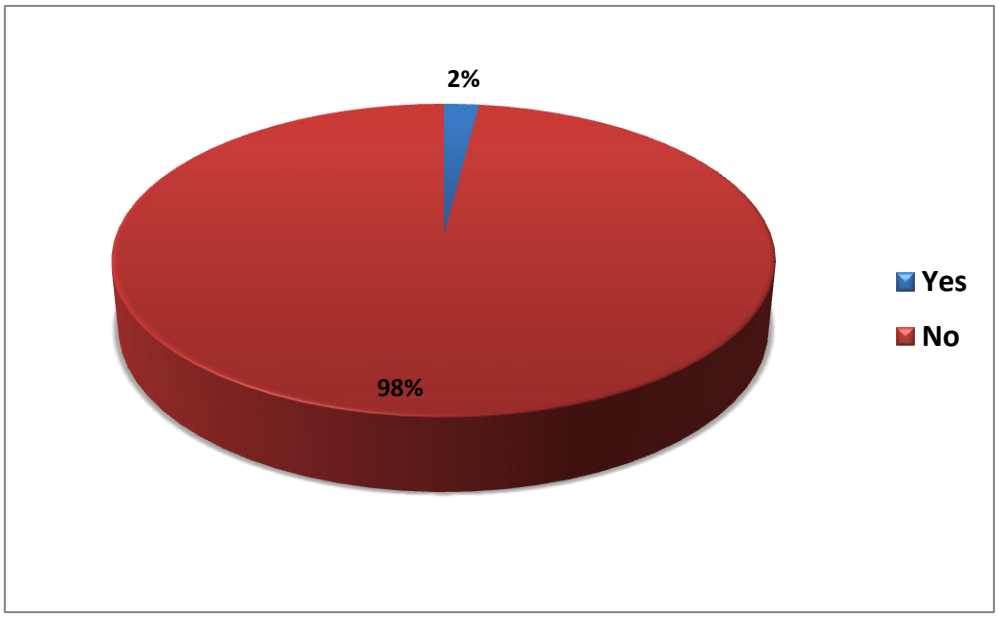


In the present study retained lens matter was noted in 2 (4%) patients as depicted in table 18.

TABLE 19: INTRAOPERATIVE BLEED

	NO OF CASES	PERCENTAGE
YES	1	2
NO	49	98

GRAPH 19 : INTRAOPERATIVE BLEED

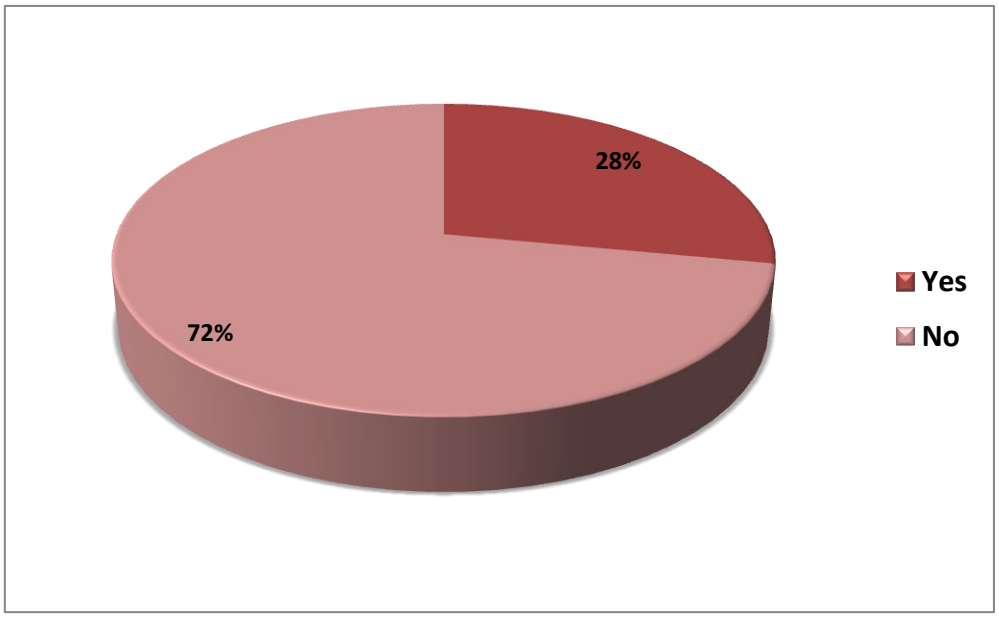


As shown in table 19, in our study intraoperative bleed was seen in 1 (2%) patient.

TABLE 20: A) DIFFICULTY IN PROLAPSING NUCLEUS

	NO OF CASES	PERCENTAGE
YES	14	28
NO	36	72

GRAPH 20: A) DIFFICULTY IN PROLAPSING NUCLEUS

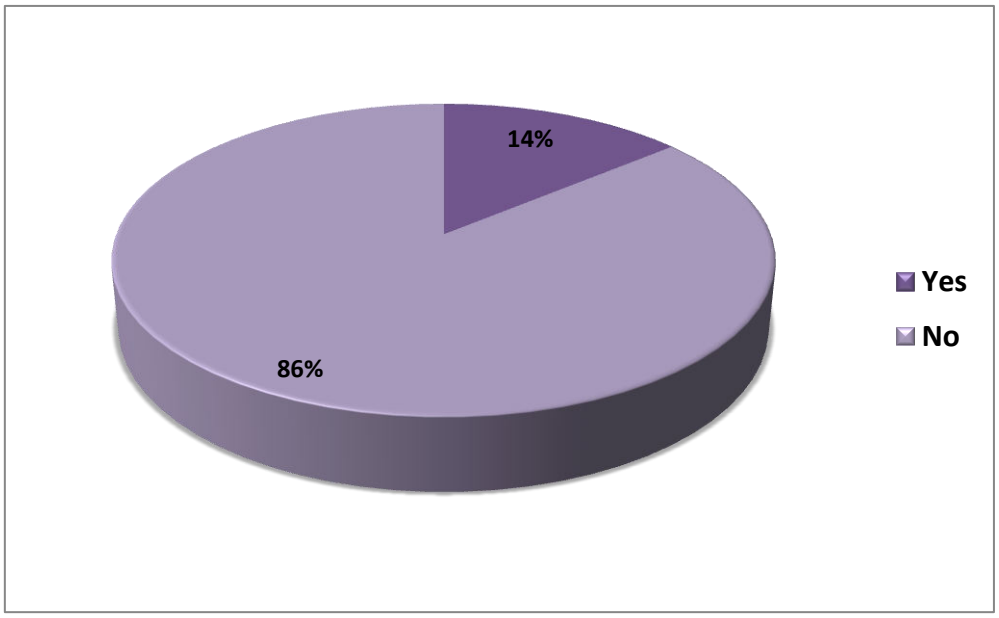


20. A) table shows that in our study difficulty in prolapsing nucleus was seen in 14 (28%) patients.

TABLE 20: B) SPHINCTER TEAR

	NO OF CASES	PERCENTAGE
YES	7	14
NO	43	86

GRAPH 20 : B) SPHINCTER TEAR

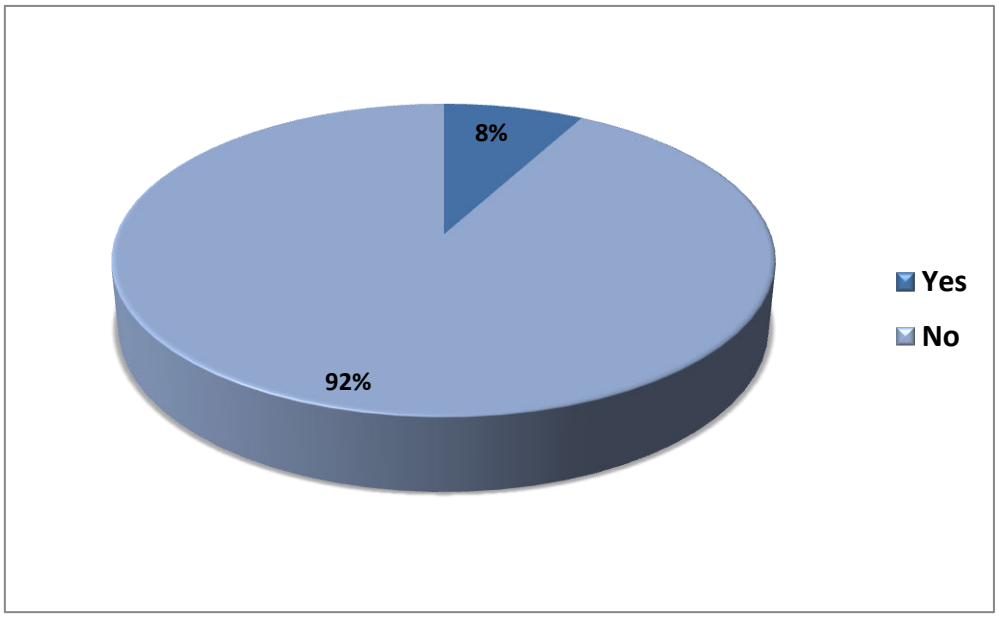


As shown in table 20. B) in our study sphincter tear was seen in 7 (14%) patients.

TABLE 21: SPHINCTEROTOMY

	NO OF CASES	PERCENTAGE
YES	4	8
NO	46	92

GRAPH 21 : SPHINCTEROTOMY

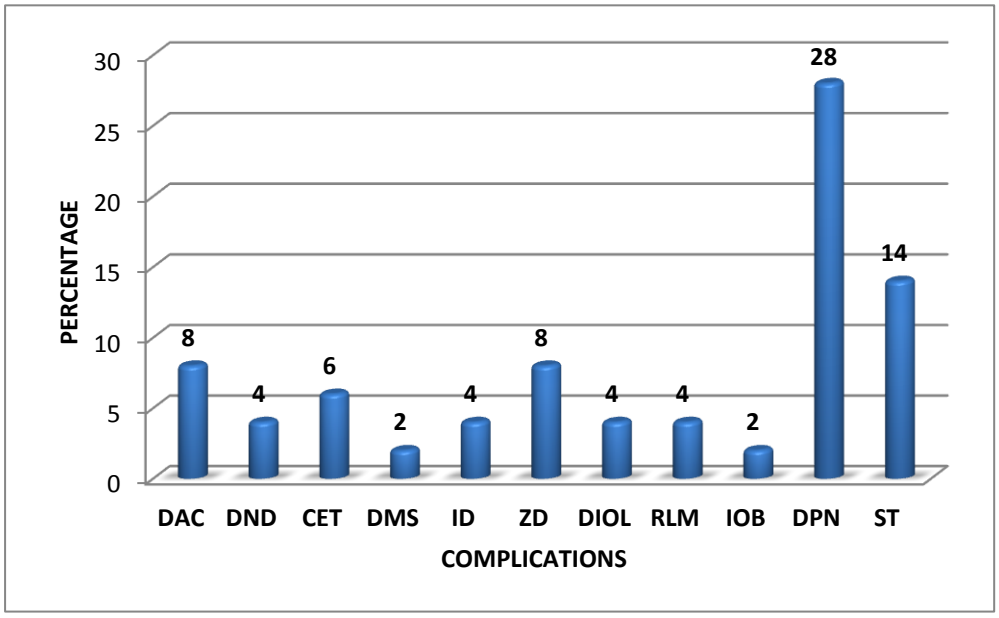


As shown in table 21, in our study sphincterotomy was done in 4 (8%) patients.

TABLE 22: ASSOCIATION OF COMPLICATIONS WITH PUPILLARY DIAMETER

COMPLICATION	NO OF CASES (n = 50)	%	MYDRIASIS			
			SUFFICIENT		INSUFFICIENT	
			NO OF CASES	%	NO OF CASES	%
DIFFICULTY IN ANTERIOR CAPSULOTOMY (DAC)	4	8	0	0	4	8
DIFFICULTY IN NUCLEUS DELIVERY(DND)	2	4	0	0	2	4
CORNEAL ENDOTHELIAL TOUCH (CET)	3	6	0	0	3	6
DESCEMENTS MEMBRANE STRIPPING (DMS)	1	2	0	0	1	2
IRIDODIALYSIS (ID)	2	4	0	0	2	4
ZONULAR DEHISCENCE (ZD)	4	8	0	0	4	8
DECENTERED IOL (DIOL)	2	4	0	0	2	4
RETAINED LENS MATTER (RLM)	2	4	0	0	2	4
INTRAOPERATIVE BLEED (IOB)	1	2	0	0	1	2
DIFFICULTY IN PROLAPSING NUCLEUS (DPN)	14	28	0	0	14	28
SPHINCTER TEAR (ST)	7	14	0	0	7	14

GRAPH 22 : ASSOCIATION OF COMPLICATIONS WITH PUPILLARY DIAMETER

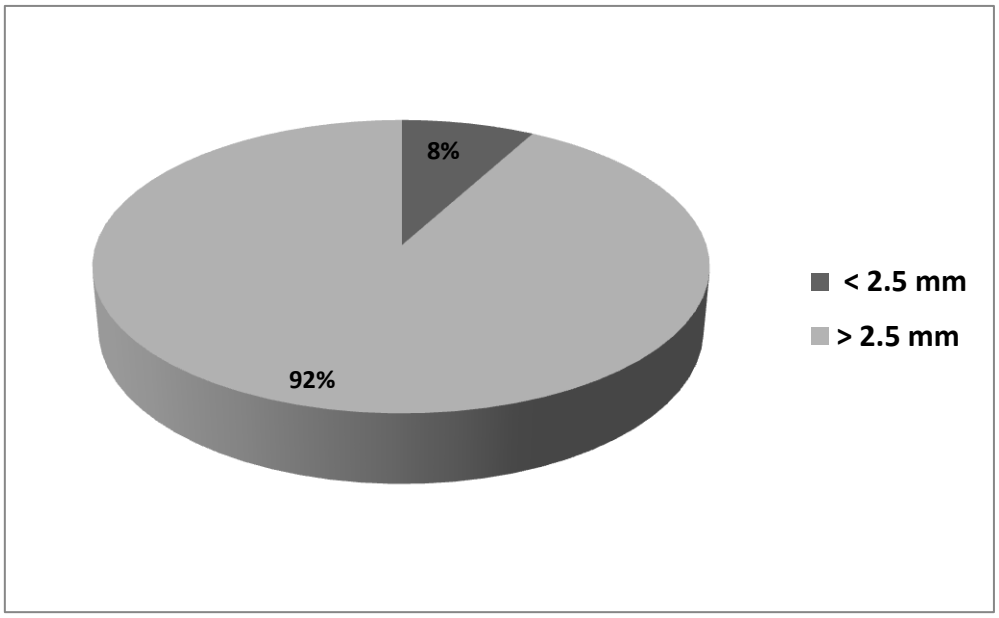


As shown in table no 22, in our study out of 50 patients, 41 patients had insufficient mydriasis (< 7mm) and complications were seen in one of these patients only. Patients with sufficient mydriasis (>7mm) had none of the complications. 4(8%) cases had difficulty in anterior capsulotomy, 2 (4%) cases had difficulty in nucleus delivery, 3 (6%) cases had corneal endothelial touch, 1 (2%) case had descements membrane stripping, 2 (4%) cases had iridodialysis, 4 (8%) cases had zonular dialysis, 2 (4%) cases had decentered IOL, 2 (4%) cases had retained lens matter , 1 (2%) case had intraoperative bleed , 14 (28%) cases had difficulty in prolapsing nucleus in anterior chamber and 7 (14%) cases had sphincter tear.

TABLE 23: ANTERIOR CHAMBER DEPTH

	NO OF CASES	PERCENTAGE
< 2.5 mm	**4**	**8**
> 2.5 mm	**46**	**92**

GRAPH 23 : ANTERIOR CHAMBER DEPTH

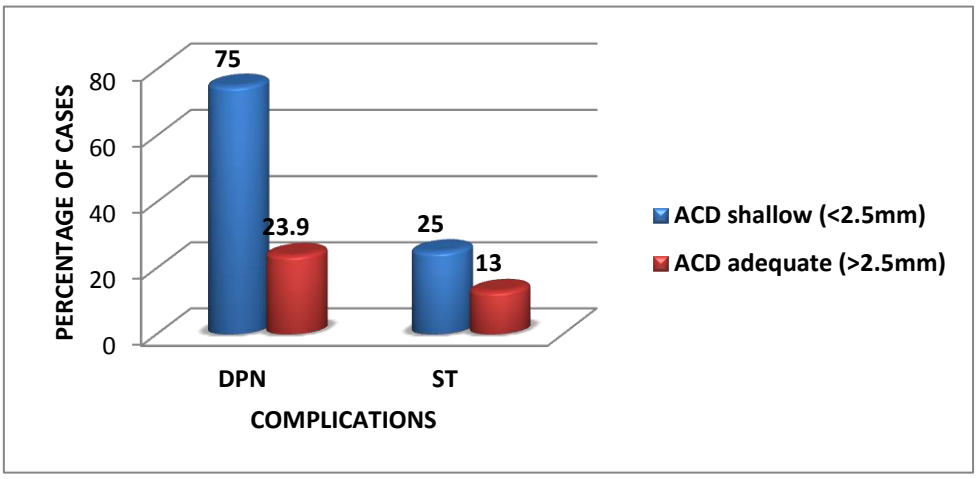


As shown in Table 23, in our study 4 (8 %) of the patients had anterior chamber depth of less than 2.5mm and 46 (92%) patients the anterior chamber depth was more than 2.5mm.

TABLE 24: ASSOCIATION OF ANTERIOR CHAMBER DEPTH WITH COMPLICATIONS

COMPLICATION	NO OF CASES (n = 50)	%	ACD (in mm)			
			< 2.5 mm [SHALLOW]		>2.5mm [ADEQUATE]	
			NO OF CASES (n = 4)	%	NO OF CASES (n = 46)	%
DIFFICULTY IN PROLAPSING NUCLEUS (DPN)	14	28	3	75	11	23.9
SPHINCTER TEAR (ST)	7	14	1	25	6	13

GRAPH 24 : ASSOCIATION OF ANTERIOR CHAMBER DEPTH WITH COMPLICATIONS



As shown in Table 24, 3 (75%) of the patients with ACD <2.5 mm and 11 (23.9%) with adequate ACD had difficulty in prolapsing nucleus in anterior chamber. 1 (25%) of the patient with ACD <2.5 mm and 6 (13%) patients with adequate ACD had sphincter tear. Only one patient with ACD <2.5 mm had no complication at all.

TABLE 25: ASSOCIATION OF ANTERIOR CHAMBER DEPTH WITH COMPLICATIONS (p VALUE)

AC DEPTH	COMPLICATION	%	NO COMPLICATION	%	TOTAL
< 2.5 mm	**3**	**75**	**1**	**25**	**4**
>2.5mm	**20**	**43.5**	**26**	**56.5**	**46**
TOTAL	**23**	**46**	**27**	**54**	**50**

As shown in Table 25, out of total 50 patients , 4 patients had AC depth of less than 2.5 mm and 3 (75%) of these had intraoperative complication. Out of 46 patients who had AC depth of more than 2.5mm, 20 (43.5%) patients had some or the other complication, while 26 (56.5 %) patients had no complication at all. Statistical analysis was done by using Fisher Exact Test, which showed a p - value of 0.322 which was statistically insignificant.

TABLE 26: POST OPERATIVE VISION ON DAY 1

VISION	NO OF CASES	PERCENTAGE
6/6 - 6/12	16	32
6/18 - 6/36	25	50
6/60 - PL	9	18

GRAPH 25 : POST OPERATIVE VISION ON DAY 1

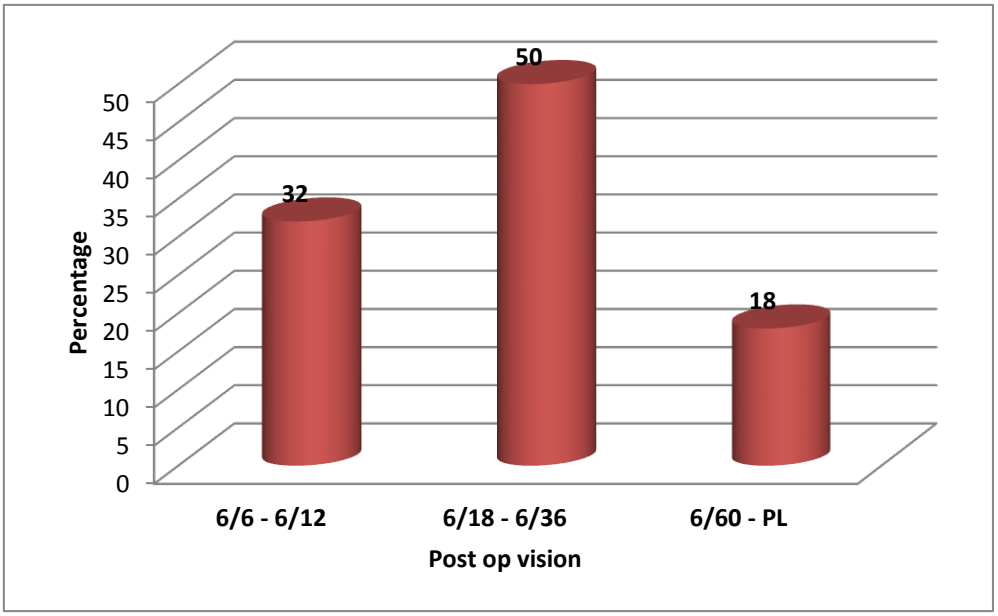


Table 26 shows that in the present study 16 (32%) patients had uncorrected visual acuity in the range of 6/6 - 6/12, 25 (50%) patients had uncorrected visual acuity in the range of 6/18 – 6/36 and 9 (18%) patients had in the range of 6/60 - PL.

DISCUSSION

The present study was conducted on 50 eyes of 50 patients with cataract and pseudoexfoliation syndrome that underwent Small Incision Cataract Surgery at Department of Ophthalmology, KLES Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Belagavi during study period of 1 year from 1st January 2015 – 31st December 2015.

Pseudoexfoliation syndrome is not only an ocular disease but a generalized disorder involving abnormal production of extracellular matrix material. The exact etiology of this systemic condition is unknown. The intraocular changes can be diagnosed clinically without invasive methods. Pseudoexfoliation syndrome is a risk factor in cataract surgery both in the intraoperative and postoperative periods. There is usually difficulty in mydriasis associated with poor iris responsiveness, zonular laxity sometimes coupled with phakodonesis, lens subluxation, and posterior capsule fragility. These factors increase the probability of complications during cataract surgery. Furthermore, in the postoperative period, there is a higher risk of ocular hypertension and inflammation and increased pigment dispersion occurs more frequently after intraocular lens implantation. Pseudoexfoliation syndrome is often associated with glaucoma, also called capsular glaucoma, and even with cataract. Naturally, the difficulty of the surgery will depend on pupil dilatation, hardness of the nuclei and to a greater extent on zonular weakness. Well dilated pupil is one of the main requirements for a safe and successful surgery. This is even more important in eyes with pseudoexfoliation syndrome, in which surgery is more complicated because of the risks associated with loss of zonular integrity and poor pupillary dilatation.

Cataract surgery in pseudoexfoliation syndrome patients remains a challenge for surgeons, especially in cases with zonular instability and advanced cataract.

In the present study there was 1 (2 %) patient in the age group of 40-50 years, 11 (22%) patients of age group 51-60 years, 27 (54 %) of age group 61- 70years, 10 (20%) of age group 71-80 and 1 (2%) patient in the age group of 81-90 years. The average age of patients was 67.18 years and about 38 (76 %) patients were above 60 yrs of age. The prevalence of Pseudoexfoliation syndrome increases with age.

According to our study 26 (52%) were males and 24 (48%) were females suggesting that increasing age and male gender is significantly associated with pseudoexfoliation.

Similar profile was seen in the study conducted in Southern India which stated that the prevalence increased with age and was greater in males. The median age for participants in their study with Pseudoexfoliation syndrome was 63.0 years and 57.8% were men [(10)].

A study conducted by Gelaw Y et al stated that pseudoexfoliation syndrome was higher (41%) in the age group of 70 years and above, followed by age group of 60-69 years. Male patients were 68.75% and females 31.25% indicating that pseudoexfoliation is more common in males than females, the prevalence being similar to our study [(66)].

Studies regarding the sex distribution of Pseudoexfoliation syndrome are conflicting as few studies show greater prevalence in men while few studies have found equal or greater prevalence in women.

A study conducted in South India stated that women outnumbered men in the pseudoexfoliation group. Women constituted 54.6% of subjects and men constituted 45.4% of them [9].

In our study 12 (24%) patients had clinical unilateral involvement of Pseudoexfoliation syndrome and 38 (76%) had bilateral involvement. Clinically, most patients with pseudoexfoliation syndrome reveal only unilateral ocular involvement. The generalized nature of the disorder suggests that pseudoexfoliation syndrome is clinically asymmetric rather than strictly unilateral. There are subclinical alterations of contralateral eyes in clinically so called unilateral pseudoexfoliation syndrome that support the concept that it is basically a bilateral disorder with a clinically marked asymmetric manifestation [67] [68]. Clinically unilateral involvement is often a precursor to bilateral involvement within 5- 10 yrs after diagnosis.

PSEUDOEXFOLIATIVE MATERIAL ON PUPIL, LENS AND CORNEA

In the present study 100% of patients had Pseudoexfoliation material on the pupillary margin, 27 (54%) on the iris surface and 16 (32 %) had iris atrophy.

According to our study 44 (88 %) patients had pseudoexfoliation material deposited on the anterior lens capsule and 6 (12 %) patients had no pseudoexfoliation material deposition on lens capsule.

This is in concurrence with the study where 73% patients showed pseudoexfoliation material on the pupillary margin only and 27% showed pseudoexfoliation material both on the pupillary margin and a central disc on the anterior lens capsule [69]. The most prominent and consistent clinical finding is the pseudoexfoliation material at the pupillary border followed by anterior lens capsule.

In our study 2 (4 %) patients had pseudoexfoliation material deposited on the corneal endothelium, 48 (96 %) had no pseudoexfoliation material deposition on corneal endothelium.

There may be pseudoexfoliative material and pigment on the corneal endothelium that can be interpreted as inflammatory precipitates and these pigments on the corneal endothelium can be similar to the pigments seen in the pigment dispersion syndrome [30]. But in our study only pseudoexfoliative material was seen in 2 cases. None of the cases pigment was seen on the endothelium.

IOP IN PSEUDOEXFOLIATION SYNDROME

According to our study 4 (8%) patients had IOP in the range of 7.0 -10.0 mm Hg, 12(24%) in range of 10.1 -13.0 mm Hg, 19 (38%) patients in range of 13.1 -16.0 mm Hg and 15(30%) patients in range of 16.1 -18.0 mm Hg. In our study the mean IOP was 14.37 mm Hg. Only patients with normal IOP were included in the present study and patients with raised IOP was excluded from the study as this would hinder on the visual outcome.

In Southern India the mean IOP in subjects with pseudoexfoliation syndrome without glaucoma determined by applanation tonometry was 15.9 mm Hg which is similar to mean IOP of present study [10].

Pseudoexfoliation syndrome may serve as a marker for glaucoma and early detection of glaucoma may help reduce the burden of preventable blindness resulting from glaucoma in these patients. It is considered as one of the most common risk factor for open angle glaucoma. The percentage of patients with pseudoexfoliation syndrome who also have glaucoma varies between 2% up to 15% in different

populations. Glaucoma is 8 times more frequent in eyes with pseudoexfoliation syndrome than eyes without pseudoexfoliation syndrome. This indicates the need for regular follow-up for IOP in patients who have pseudoexfoliation syndrome for early detection of glaucoma.

The risk of conversion to glaucoma in patients with pseudoexfoliation syndrome and ocular hypertension (OHT) is twice than for patients who only have OHT. Very few studies researched the rate of progression to OHT or glaucoma in patients affected with pseudoexfoliation syndrome. The mean time for conversion from pseudoexfoliation syndrome onset seems to be 5.8 years to develop OHT and approximately 4.3 years for pseudoexfoliation glaucoma. The risk of conversion of pseudoexfoliation syndrome with normal IOP to OHT or glaucoma in 15 years appears to be of 44% [(70)].

CATARACT IN PSEUDOEXFOLIATION SYNDROME

In our study one (2%) patient had hypermature cataract, 12(24%) had mature cataract and 37 (74) % had nuclear cataracts. None had isolated cortical cataract suggesting that nuclear cataract is more common in pseudoexfoliation syndrome. Cortical cataract was present along with advanced nuclear cataract and none of the patients had isolated cortical cataract. There is increased prevalence of cataracts in eyes with pseudoexfoliation syndrome.

Nuclear sclerosis is predominant type of cataract in Pseudoexfoliation syndrome. Ascorbic acid is significantly reduced in the aqueous of cataract patients with pseudoexfoliation syndrome. And this may be one possible association between oxidative stress and ocular ischemia in pseudoexfoliation syndrome and hence the reason for the association between the two [(12)].

A study also reported that nuclear sclerosis was predominant in eyes with pseudoexfoliation syndrome compared to those without the pseudoexfoliation syndrome. Cortical and subcapsular cataracts were less common [(71)].

While few other studies showed that cataract other than nuclear may be predominant in pseudoexfoliation syndrome. A study showed combined form of cataract (cortical changes with nuclear changes with varying degree of posterior sub capsular cataract) was the predominant form of cataract in pseudoexfoliation syndrome patients [(69)]. Kovac B et al reported the most common cataract type in the pseudoexfoliation syndrome patients was mature cataract [(72)].

GONIOSCOPY IN PSEUDOEXFOLIATION SYNDROME

All the patients 50(100%) had wide open angle on gonioscopy, 29 (58%) of the patients had hyperpigmented trabecular meshwork and 18 (36%) patients showed sampaolesi line at the the angle. None of the patients showed any closed angle or pseudoexfoliative material at the angle.

Pseudoexfoliation syndrome is usually associated with a normal configuration of the drainage angle. There may be risk for narrow angles and angle closure glaucoma. An occludable angle is diagnosed if the pigmented trabecular meshwork was not visible in more than 180° of the angle. A rigid and sticky iris leads to posterior synechiae. Zonular weakness predispose to anterior lens subluxation and hence narrow angle.

Increased trabecular meshwork pigmentation is a prominent sign of pseudoexfoliation syndrome and the extent of trabecular pigmentation has been correlated to the degree of increased intraocular pressure [(73)].

Arvind H et al [9] noted occludable angles in 16 (14.8%) cases with pseudoexfoliation syndrome. Thomas R et al [11] in their study in Southern India detected pseudoexfoliation material on the trabecular meshwork only in one eye (0.9%).

In a study conducted, the results of gonioscopy showed an open angle in 80% of patients and remaining patients had occludable angle or closed angle. Trabecular hyperpigmentation and pseudoexfoliation material in the angle was also observed in few patients [74].

As seen in our study 41 (82 %) patients had non dilating pupil (insufficient mydriasis) and 9 (18%) patients had good dilating pupil (sufficient mydriasis). Pupil diameter of 7mm and more was considered as sufficient mydriasis and less than 7mm was considered as insufficient mydriasis that is non dilating pupil. In the present study, most frequent problem encountered was a rigid pupil leading to one or more complications. Thus non dilating pupil is very common in pseudoexfoliation syndrome.

Pranathi K et al [5] in their study considered 7mm or more pupillary diameter after dilatation as good dilatation and none of the pupils dilated more than 7 mm in spite of use of standard mydriatic drops.

According to a study the pupil diameter was smaller than 5.0 mm in 61.90% of the eyes and hence there was increased risk of intraoperative complications [75].

In the present study, a patient with a pupillary diameter of 4.5mm post dilatation, intracameral dilatating solution was injected intraoperatively. This solution was prepared by mixing 0.001% epinephrine and 0.5% lignocaine hydrochloride.

0.5 cc of above combined solution with 1.5 cc balanced salt solution was injected intracamerally. No additional dilatation effect was seen and the pupillary diameter remained 4.5 mm suggesting degenerative changes in the stromal tissue of iris which can be regarded as the cause for miosis.

The results of our study are in concurrence with the following study conducted by Moore R L et al [(43)] where in those patients who do not dilate enough with topical mydriatics, they injected an intracameral injection of lidocaine and adrenaline at the beginning of surgery, although this had little success. So they concluded that intracameral adrenaline or phenylephrine are not effective as they do not increase the previous topical dilatation.

COMPLICATIONS OBSERVED DURING CATARACT SURGERY

Difficulty during anterior capsulotomy was noted in 4 (8%) cases. This difficulty was experienced due to the small pupil size and also to avoid touching the iris during capsulotomy. In all the 4 cases the pupil size after dilatation was 4.5mm in 3 patients and 4mm in one patient causing hindrance in anterior capsulotomy. Shastri L et al [(4)] noted difficulty in performing the anterior continuous curvilinear capsulorhexis. The mean capsulorhexis size in eyes with pseudoexfoliation was significantly smaller than in control eyes. Similarly in our study patients with small pupil had small capsulotomy.

Difficulty in nucleus delivery was noted in 2 (4%) cases. The main reason behind this complication was the presence of large and hard nucleus as nuclear cataract is more common in pseudoexfoliation syndrome.

According to our study corneal endothelial touch was noted in 3 (6%) patients. This complication usually occurred during nucleus delivery and during sphincterotomy. It was noted by the operating surgeon intraoperatively and also correspondingly corneal edema was noticed on the next day of surgery.

Only one (2%) patient had descements membrane stripping. It was seen in whom there was more manipulation and more handling of the nucleus due to small pupil and an air bubble was injected to reattach the membrane.

Iridodialysis was noted in 2 (4%) patients. This was noted during prolapsing the nucleus in anterior chamber. Due to the rigid and small pupil in these patients it resulted in tearing of the iris.

Zonular dialysis was noted in 4 (8%) patients. This was noted by the surgeon during anterior capsulotomy. The surgeon noticed the movement of the capsular bag during each capsulotomy cut due to the weak zonules.

Decentered IOL was noted in 2 (4%) patients, this was noticed soon after IOL insertion in the intraoperative period only. This was seen due to the zonular weakness causing decentration of the capsular bag.

Retained lens matter was noted in 2 (4%) patients. Insufficient mydriasis as a result of rigid pupil and further constriction of pupil during the surgery due to iris manipulations, causes hindrance and posing difficulty in cortical matter aspiration. This usually leaves the lens matter behind after the surgery.

Intraoperative bleed was seen in one (2%) patient. Bleeding was seen from the iris due to iris manipulation. In the same patient sphincterotomy was also done. Bleeding was noticed at last during cortical wash.

Difficulty in prolapsing nucleus was seen in 14 (28%) patients. Due to the small pupil the nucleus did not flip easily in the anterior chamber.

In the present study sphincter tear was seen in 7 (14%) patients. As there was difficulty in prolapsing nucleus, forceful prolapsing without sphincterotomy in small pupil caused sphincter tears.

Tran T et al [(61)] in their study noted complications like iridodialysis due to the force of the water jet, the presence of hemorrhage from microvessels and peeling or tearing of the corneal endothelium due to direct contact with the cannula.

It was concluded from a study that there was sevenfold increase in the incidence of vitreous loss and posterior lens capsule rupture hence pseudoexfoliation is a potentially disastrous disease of the anterior segment of the eye [(76)]. Scorolli L et al [(77)] stated PXF was associated with a statistically significant increase in intraoperative complications during cataract surgery. Odds ratio for intraoperative complications (vitreous loss, capsular break, zonular break) was estimated to be 5.1 as compared to control. While in our study no patient had vitreous loss, posterior lens capsule rupture or lens dislocation.

Patients with pseudoexfoliation are at increased risk for development of complications [(78)]. According to a study done by Mohammad Jawad et al, they noted similar complications as in our study like damage to sphincter pupillae, iridodialysis , decentration of IOL, hyphaema, zonular dialysis and retained lens matter. They also observed vitreous loss, posterior lens capsule rupture and lens dislocation which was not seen in our study.

In our study posterior synechiae was in seen in one patient. This caused difficulty in prolapsing nucleus in AC.

Transitory fibrinoid reaction in eyes with exfoliation syndrome after cataract extraction attribute to breakdown of the blood aqueous barrier. Protein leakage also contribute to formation of posterior synechiae [(73)].

Sphincterotomy was done in 4 (8%) patients. All these 4 patients had pupillary diameter less than 4.5mm. In a study conducted by Pranathi K et al, 25% patients required sphincterotomy to facilitate capsulorhexis and nucleus delivery. Sphincterectomy thus provides more controlled enlargement of pupil but sphinterotomy and stretching have the disadvantage of causing post-operative distorted pupil, which may later even lead to the pupillary capture [(5)].

In our study out of 50 patients, 41 patients had insufficient mydriasis (< 7mm) and 9 had sufficient mydriasis (>7mm). In 46% patients complications were seen and all these patients had insufficient mydriasis, while in 54% patients no complications were seen. No patient with sufficient mydriasis had any intraoperative complications.

Good/adequate pupil dilatation for standard extracapsular cataract extraction is more difficult to be obtained in patients with pseudoexfoliation syndrome. Constricted pupil exposes the patient to more complications [(78)]. A well dilated pupil is one of the main requirements for a safe and successful cataract surgery. This is even more important in eyes with PXF syndrome, in which surgery is more complicated because of the risks associated with loss of zonular integrity and poor pupillary dilatation [(54)]. Hence complications are more common in eyes with poor pupillary dilatation.

ANTERIOR CHAMBER DEPTH AND COMPLICATIONS

According to our study 4 (8 %) patients had anterior chamber depth of less than 2.5mm and 46 (92%) patients the anterior chamber depth was more than 2.5mm.

As shown in the present study, 3 patients with ACD <2.5 mm and 11 patients with adequate ACD had difficulty prolapsing nucleus in anterior chamber. One among the 3 patients with ACD <2.5 mm and 6 patients with adequate ACD had sphincter tear. Only one patient with ACD <2.5 mm had no complication at all.

Out of total 50 patients in our study, 4 patients had AC depth of less than 2.5 mm and 3 (75%) of these had intraoperative complication. Out of 46 patients who had AC depth of more than 2.5mm, 20 (43.5%) patients had some or the other complication, while 26 (56.5 %) patients had no complication at all. By Fisher Exact Test, p value is 0.322. Hence in our study the association of anterior chamber depth with complications during cataract surgery in patients with pseudoexfoliation syndrome is statistically not significant because of the small sample size of patients with AC depth less than 2.5 mm. Therefore, there is no association of anterior chamber depth with complications during cataract surgery in patients with pseudoexfoliation syndrome.

A study was conducted to look for associations of preoperative A-scan ultrasound ocular dimensions with complications during surgery in eyes with pseudoexfoliation syndrome. The anterior chamber was significantly shallower in eyes with complications. Anterior chamber depth of less than 2.5 mm was associated with a risk of 13.4% for intraoperative complications [(32)].

Hemalatha BC in their study showed that there was a correlation with lesser the AC depth, more the complication risk [(79)].

In an another study conducted by Bayraktar S et al, the authors concluded that intraoperative risk was considerably higher when the ACD was less than 2.5 mm. ACD was 2.5 mm or less in 48.7% in the pseudoexfoliation syndrome group and 41.1% in the control group [(53)].

POST OPERATIVE VISION

As shown in table 26, in our study 16 (32%) patients had uncorrected visual acuity on post operative day one in the range of 6/6 – 6/12, 25 (50%) patients had uncorrected visual acuity in the range of 6/18 – 6/36 and 9 (18%) patients had in the range of 6/60 - PL. In our study majority of the patients had good post operative vision. Vision worse then 6/60 was usually seen due to corneal oedema, corneal endothelial touch and higher post-operative inflammatory response. This was most commonly seen patients with insufficient mydriasis who had intraoperative manipulations and in whom sphincterotomy was done.

Extracapsular cataract extraction is a safe and effective technique in eyes with pseudoexfoliation syndrome with cataracts and has favourable visual outcome [(45)]. The results of this study are similar to the results seen in our study.

CONCLUSION

From our study we conclude that:

- In patients of pseudoexfoliation syndrome with cataract thorough anterior segment examination has to be done and carefully looked for non mydriatic pupil, phacodonesis and zonular fragility.
- Rigid pupil was one of the major preoperative factor that made subsequent steps of surgery difficult due to poor peripheral visualization and is the cause for various intraoperative complications.
- Preoperative anterior chamber depth showed no association with complications during surgery.
- Thus pseudoexfoliation syndrome presents challenges that requires cautious intraoperative care for an uneventful surgery and a favourable visual outcome.

So we conclude that small incision cataract surgery is safe in eyes with pseudoexfoliation syndrome.

SUMMARY

The present study titled "A one year cross sectional study of complications during cataract surgery in patients with pseudoexfoliation syndrome admitted in KLES Dr.Prabhakar Kore Hospital and Medical Research Centre, Belagavi" 50 eyes of 50 patients with Pseudoexfoliation syndrome having cataract were included. The average age group of these patients was 67.18 years with male predominance.

In the present study, 24% of patients had clinical unilateral involvement of Pseudoexfoliation syndrome. All the patients had Pseudoexfoliation material on the pupillary margin with all of the patients having open angles and IOP within the normal range with mean IOP of 14.37 mm Hg. 88 % of the patients had pseudoexfoliation material deposited on the anterior capsule of the lens and 4 % patients had pseudoexfoliation material deposited on the corneal endothelium. 74 % of patients had nuclear sclerosis type of cataract. 82 % of the patients had insufficient mydriasis (< 7mm).

In the present study, 46% of the patients developed complications like difficulty during anterior capsulotomy, difficulty in nucleus delivery, corneal endothelial touch, descements membrane stripping, iridodialysis, zonular dialysis, decentered IOL, retained lens matter, intraoperative bleed, difficulty in prolapsing nucleus and iris sphincter tear. All the patients with intraoperative complications had insufficient mydriasis. Sphincterotomy was done in 8% of the patients to improve the outcome of the surgery in small pupils and give better visual acuity to the patients with Pseudoexfoliation syndrome.

In present study the association of preoperative anterior chamber depth with complications during cataract surgery in patients with pseudoexfoliation syndrome was statistically not significant.

BIBLIOGRAPHY

1. Snjezana K, Tomic M, Kordic R, Kalauz M and Rabatic J. Cataract Surgery in Eyes with Pseudoexfoliation (PEX) Syndrome. J Clin Exp Ophthalmol.2013;04(02).
2. Naumann GO, Schlotzer-Schrehardt U, Kuchle M. Pseudoexfoliation syndrome for the Comprehensive Ophthalmologist Intraocular and Systemic Manifestations. Ophthalmology. 1998;105(6):951-968.
3. Tanhehco T, Chen SH. Pseudoexfoliation Syndrome and Cataract Surgery. Int Ophthalmol Clin. 2010;50(1):81-93.
4. Shastri L, Vasavada A. Phacoemulsification in Indian eyes with pseudoexfoliation syndrome. J Cataract Refract Surg. 2001;27(10):1629-1637.
5. Pranathi K, Magdum R, Maheshgauri R, Patel K, Patra S. A study of complications during cataract surgery in patients with pseudoexfoliation syndrome. J Clin Ophthalmol Res. 2014;2(1):7.
6. Tarkkanen A, Kivela T. John G. Lindberg and the Discovery of exfoliation syndrome. Acta Ophthalmol Scand. 2002;80(2):151-154.
7. Ritch R, Schlotzer-Schrehardt U. Exfoliation syndrome. Surv Ophthalmol. 2001 Jan-Feb;45(4):265-315.
8. Jonas JB, Nangia V, Matin A, Bhojwani K, Sinha A, Khare A et al. Pseudoexfoliation: Normative Data and Associations. The Central India Eye and Medical Study. PLoS ONE. 2013;8(10):e76770.
9. Arvind H, Raju P, Paul PG, Baskaran M, Ramesh SV, George RJ et al. Pseudoexfoliation in South India. Br J Ophthalmol. 2003;87(11):1321-1323.

10. Krishnadas R, Nirmalan PK, Ramakrishnan R, Thulasiraj RD, Katz J, Tielsch JM et al. Pseudoexfoliation in a rural population of southern India: the Aravind Comprehensive Eye Survey. Am J Ophthalmol. 2003;135(6):830-837.

11. Thomas R, Nirmalan PK, Krishnaiah S. Pseudoexfoliation in Southern India: The Andhra Pradesh Eye Disease Study. Invest Ophthalmol Vis Sci. . 2005;46(4):1170-6.

12. Sufi AR, Mufti A, Nazir N, Qureshi T, Ramzan R. Prevalence of pseudoexfoliation syndrome in patients scheduled for cataract surgery in eye camps in Kashmir. J Clin Ophthalmol Res. 2014;2(3):137-139.

13. Allingham RR, Loftsdottir M, Gottfredsdottir MS, Thorgeirsson E, Jonasson F, Sverisson T et al. Pseudoexfoliation syndrome in Icelandic families. Br J Ophthalmol. 2001;85(6):702-707.

14. Lee KY, Ho SL, Thalamuthu A, Venkatraman A, Venkataraman D, Pek DC et al. Association of LOXL1 polymorphisms with Pseudoexfoliation in the Chinese. Mol Vis. 2009;15:1120 - 1126.

15. Davanger M. A note on the Pseudoexfoliation fibrils. Acta Ophthalmol (Copenh). 1978;56(1):114-20.

16. Davanger M. Studies on the Pseudoexfoliation material Albrecht Von Graefes Arch Klin Exp Ophthalmol. 1978; 208 (1-3):65-8.

17. Kirkpatrick JN, Harrad RA. Complicated extracapsular cataract surgery in pseudoexfoliation syndrome: a case report. Br J Ophthalmol. 1992;76(11):692-693.

18. Elhawy E, Kamthan G, Dong C, Danias J. Pseudoexfoliation syndrome, a systemic disorder with ocular manifestations. Hum Genomics. 2012;6(1):22.
19. Schlotzer-Schrehardt U, Dorfler S, Naumann GO. Immunohistochemical localization of basement membrane components in pseudoexfoliation material of the lens capsule. Curr Eye Res. 1992;11(4):343-355.
20. Eagle RC, Font RL, Fine BS. The Basement Membrane Exfoliation Syndrome. Arch Ophthalmol. 1979;97(3):510-515.
21. Ludwisiak-Kocerba L, Hevelke A, Kecik D. Pseudoexfoliation syndrome-etiopatogenesis and clinical course. Klin Oczna. 2006;108(1-3):82-6.
22. Garner A, Alexander RA. Pseudoexfoliative disease: histochemical evidence of an affinity with zonular fibres. Br J Ophthalmol. 1984;68(8):574-580.
23. Streeten BW, Bookman L, Ritch R, Prince AM, Dark AJ. Pseudoexfoliative Fibrillopathy in the Conjunctiva. Ophthalmology. 1987;94(11):1439-1449.
24. Berlau J, Lorenz P, Beck R, Makovitzky J, Schlotzer-Schrehardt U, Thiesen H et al. Analysis of aqueous humour proteins of eyes with and without pseudoexfoliation syndrome. Graefe's Arch Clin Exp Ophthalmol. 2001;239(10):743-746.
25. Repo LP, Naukkarinen A, Paljarvi L, Terasvirta ME. Pseudoexfoliation syndrome with poorly dilating pupil: a light and electron microscopic study of the sphincter area. Graefe's Arch Clin Exp Ophthalmol. 1996;234(3):171-176.
26. Lesiewska H, Malukiewicz G, Olszewska-Slonina D, Wozniak A. Lysosomal enzymes activity in patients with pseudoexfoliation syndrome. Acta Ophthalmol. 2014;93(2):e170-e171.

27. Schlotzer-Schrehardt U, Naumann GO. A Histopathologic Study of Zonular Instability in Pseudoexfoliation Syndrome. Am J Ophthalmol. 1994;118(6):730-743.

28. Jack J Kanski. Glaucoma. Chapter 10. Clinical Ophthalmology. 7th edition. China: Elsevier Publishers; 2011.

29. Yanoff M, Duker JS. Glaucoma associated with Pseudoexfoliative syndrome. Chapter 10.13. Ophthalmology. 4th edition. Copyright 2008 Mosby. An imprint of Elsevier

30. Plateroti P, Plateroti AM, Abdolrahimzadeh S, Scuderi G. Pseudoexfoliation Syndrome and Pseudoexfoliation Glaucoma: A Review of the Literature with Updates on Surgical Management. J Ophthalmol. 2015;2015:1-9.

31. Zheng X, Shiraishi A, Okuma S, Mizoue S, Goto T, Kawasaki S et al. In Vivo Confocal Microscopic Evidence of Keratopathy in Patients with Pseudoexfoliation Syndrome. Invest Ophthalmol Vis Sci. . 2011;52(3):1755-61.

32. Kuchle M, Viestenz A, Martus P, Handel A, Junemann A, Naumann GO. Anterior chamber depth and complications during cataract surgery in eyes with pseudoexfoliation syndrome. Am J Ophthalmol. 2000;129(3):281-285.

33. Brooks AM, Gillies WE. Fluorescein angiography and fluorophotometry of the iris in pseudoexfoliation of the lens capsule. Br J Ophthalmol. 1983;67(4):249-254.

34. Parmar P, Salman A. Anterior "lenticonus" in exfoliation syndrome. Indian J Ophthalmol. 2005;53(3):193-194.

35. Bruce Shield's Text book of Glaucoma, 2nd edition, Vol 2, chapter 47, Lippincott Williams & Wilkins, Philadelphia. Page 993-1022.

36. Becker Schaffer's The Glaucoma, Chapter 18 Exfoliation syndrome, 8th edition, Mosby Publication, 1989, page 269 – 270.

37. Cobb CJ, Blanco GC, Spaeth GL. Exfoliation syndrome angle characteristics: a lack of correlation with amount of disc damage. Br J Ophthalmol. 2004;88(8):1002-1003.

38. Zheng X, Sakai H, Goto T, Namiguchi K, Mizoue S, Shiraishi A et al. Anterior Segment Optical Coherence Tomography Analysis of Clinically Unilateral Pseudoexfoliation Syndrome: Evidence of Bilateral Involvement and Morphologic Factors Related to Asymmetry. Invest Ophthalmol Vis Sci. 2011;52(8):5679-84.

39. Schumacher S, Schlotzer-Schrehardt U, Martus P, Lang W, Naumann GO. Pseudoexfoliation syndrome and aneurysms of the abdominal aorta. Lancet. 2001;357(9253):359-360.

40. Moreno J, Duch S and Lajara J. Pseudoexfoliation syndrome :Clinical factors related to capsular rupture in cataract surgery. Acta Ophthalmol (Copenh). 1993; 71:181 – 184.

41. Gillies WE. Effect of lens extraction in pseudoexfoliation of the lens capsule. Br J Ophthalmol. 1973;57(1):46-51.

42. Bayramlar H, Hepsen IF, Yilmaz H. Mature cataracts increase risk of capsular complications in manual small-incision cataract surgery of pseudoexfoliative eyes. Can J Ophthalmol.. 2007;42(1):46-50.

43. Moore RL, Silva VR, Parga PV, Moreno C, Lorente B, Méndez J. Pseudoexfoliation and Cataract Surgery. J Emmetropia. 2013;4:39-47.

44. Hyams M, Mathalone N, Herskovitz M, Hod Y, Israeli D, Geyer O. Intraoperative complications of phacoemulsification in eyes with and without pseudoexfoliation. J Cataract Refract Surg. 2005;31(5):1002-5.

45. Al-Mujaini A, Wali UK. Visual outcome following extracapsular cataract extraction in mature cataracts with pseudoexfoliation syndrome: A retrospective study. Oman J Ophthalmol. 2013;6(1):23-26.

46. Nagashima RJ. Decreased incidence of capsule complications and vitreous loss during phacoemulsification in eyes with pseudoexfoliation syndrome. J Cataract Refract Surg. 2004;30:127–131.

47. Chen M, LaMattina K, Patrianakos T, Dwarakanathan S. Complication rate of posterior capsule rupture with vitreous loss during phacoemulsification at a Hawaiian cataract surgical center: a clinical audit. Clin Ophthalmol. 2014;8:375-8.

48. Kozobolis VP, Pallikaris IG, Tsambarlakis IG, Vlachonikolis GI. Nd:YAG laser removal of pupillary membranes developed after ECCE with PC-IOL implantation. Acta Ophthalmol Scand. 1997;75(6):711-5.

49. Watson NJ, Winder S, Green FD. Pupil dilatation in the pseudoexfoliation syndrome. Eye (Lond). 1995;9(Pt 3):341-3.

50. Akman A, Yilmaz G, Oto S, Akova YA. Comparison of Various Pupil Dilatation Methods for Phacoemulsification in Eyes with a Small Pupil Secondary to Pseudoexfoliation. Ophthalmology. 2004;111(9):1693-8.

51. Mohammadpour M, Erfanian R, Karimi N. Capsulorhexis: Pearls and pitfalls. Saudi J Ophthalmol. 2012;26(1):33-40.

52. Mahdy MA. Phacoemulsification in cases of pseudoexfoliation using in situ nuclear disassembly without nuclear rotation. Oman J Ophthalmol. 2012;5(2):83-6.

53. Bayraktar S, Altan T, Kucuksumer Y, Yilmaz OF. Capsular tension ring implantation after capsulorhexis in phacoemulsification of cataracts associated with pseudoexfoliation syndrome. Intraoperative complications and early postoperative findings. J Cataract Refract Surg. 2001;27(10):1620-8.

54. Dwivedi NR, Dubey AK, Shankar PR. Intraoperative and Immediate Postoperative Outcomes of Cataract Surgery using Phacoemulsification in Eyes with and without Pseudoexfoliation Syndrome. J Clin Diagn Res. 2014;8(12):VC01-VC05.

55. Ravalico G, Tognetto D, Baccara F. Heparin-surface-modified intraocular lens implantation in eyes with pseudoexfoliation syndrome. J Cataract Refract Surg. 1994;20(5):543-9.

56. Kaliaperumal S, Rao VA, Harish SB, Ashok L. Pseudoexfoliation on pseudophakos. Indian J Ophthalmol. 2013;61(7):359-61.

57. Sugihara K, Tanito M, Takai Y, Ohira A. Case series of pseudoexfoliation material on intra-ocular lenses. Acta Ophthalmol. 2015;93(7):e596-7.

58. Krepste L, Kuzmienė L, Miliauskas A, Januleviciene I. Possible Predisposing Factors for Late Intraocular Lens Dislocation After Routine Cataract Surgery. Medicina (Kaunas). 2013;49(5):229-34.

59. Werner L, Zaugg B, Neuhann T, Burrow M, Tetz M. In-the-Bag Capsular Tension Ring and Intraocular Lens Subluxation or Dislocation : A Series of 23 Cases. Ophthalmology. 2012;119(2):266-71.

60. Ascaso FJ, Huerva V, Grzybowski A. Epidemiology, Etiology, and Prevention of Late IOL-Capsular Bag Complex Dislocation: Review of the Literature. J Ophthalmol. 2015;2015:1-7.

61. Tran VT. Washout of pseudoexfoliation material combined with cataract surgery: a new surgical approach to lower intraocular pressure in pseudoexfoliation syndrome. Int Ophthalmol. 2015;35(2):209-14.

62. Merkur A, Damji KF, Mintsioulis G, Hodge WG. Intraocular pressure decrease after phacoemulsification in patients with pseudoexfoliation syndrome. J Cataract Refract Surg. 2001;27(4):528-32.

63. Kuchle M, Amberg A, Martus P, Nguyen NX, Naumann GO. Pseudoexfoliation syndrome and secondary cataract. Br J Ophthalmol. 1997;81:862–866.

64. Kristianslund O, Ostern AE, Råen M, Sandvik GF, Drolsum L. Does cataract surgery reduce the long-term risk of glaucoma in eyes with pseudoexfoliation syndrome?. Acta Ophthalmol. 2016;94(3):261-5.

65. Drolsum L, Ringvold A, Nicolaissen B. Cataract and glaucoma surgery in pseudoexfoliation syndrome: a review. Acta Ophthalmol Scand. 2007;85(8):810-21.

66. Gelaw Y, Tibebu Y. Clinical Characteristics of Cataract Patients with Pseudoexfoliation Syndrome at Jimma University Specialized Hospital, South West Ethiopia. Ethiop J Health Sci. 2012;22(1):1-6.

67. Hammer T, Schlötzer-Schrehardt U, Naumann GO. Unilateral or Asymmetric Pseudoexfoliation Syndrome? An Ultrastructural. Arch Ophthalmol. 2001;119(7):1023-1030.

68. Hammer T, Schlotzer-Schrehardt U, Junemann A. [unilateral or asymmetrical PEX syndrome? An electron microscopy study]. Klin Monbl Augenheilkd. 2000; 217(2):100-8

69. Sufi AR, Singh T, Mufti AA, Rather MH. Outcome of Phacoemulsification in patients with and without Pseudoexfoliation syndrome in Kashmir. BMC Ophthalmol. 2012, 12:13 .

70. Benitez-del-Castillo Sanchez J, Morion-Grande M, Marco-Garcia MC, Parron-Carreno T. Epidemiology of pseudoexfoliation syndrome:Demystifying legends and looking to the future. Arch Soc Esp Oftalmol. 2015;90(10):455-7.

71. Kaljurand K, Puska P. Exfoliation syndrome in Estonian patients scheduled for cataract surgery. Acta Ophthalmol Scand. 2004;82(3 Pt 1):259-63.

72. Kovac B, Vukosavljevic M, Janicijevic MP, Resan M, Jankovic J. The prevalence of pseudoexfoliation syndrome and possible systemic associations in patients scheduled forcataract surgery at the Military Medical Academy in Belgrade. Vojnosanit Pregl. 2014;71(9):839-44.

73. Ritch R. Exfoliation syndrome and occludable angles. Trans Am Ophthalmol Soc. 1994;92:845-944.

74. Al-Saleh SA, Al-Dabbagh NM, Al-Shamrani SM, Khan NM, Arfin M, Tariq M et al. Prevalence of ocular pseudoexfoliation syndrome and associated complications in Riyadh, Saudi Arabia. Saudi Med J. 2015;36(1):108-12.

75. Avramides S, Traianidis P, Sakkias G. Cataract surgery and lens implantation in eyes with exfoliation syndrome. J Cataract Refract Surg. 1997;23(4):583-7.

76. Naumann GO, Kuchle M, Schonherr U. [Pseudo-exfoliation syndrome as a risk factor for vitreous loss in extra-capsular cataract extraction. The Erlangen Eye Information Group]. Fortschr Ophthalmol. 1989;86(6):543-5.

77. Scorolli L, Scorolli L, Campos EC, Bassein L, Meduri RA. Ophthalmologica. Pseudoexfoliation syndrome: a cohort study on intraoperative complications in cataract surgery. 1998;212(4):278-80.

78. Jawad M, Nadeem AU, Khan Au, Aftab M. Complications of Cataract Surgery in patients with Pseudoexfoliation Syndrome. J Ayub Med Coll Abbottabad. 2009;21(2):33-6.

79. Hemalatha BC, Shetty SB. Analysis of Intraoperative and Postoperative Complications in Pseudoexfoliation Eyes Undergoing Cataract Surgery. J Clin Diagn Res. 2016;10(4):NC05-8.

ANNEXURE-I

CONSENT FORM

CONSENT FOR PARTICIPATION IN RESEARCH STUDY

ID NO. | | | |

Mr/Mrs/Ms_____

You are invited to participate in our research study titled **"**A ONE YEAR CROSS SECTIONAL STUDY OF COMPLICATIONS DURING CATARACT SURGERY IN PATIENTS WITH PSEUDOEXFOLIATION SYNDROME ADMITTED IN KLES Dr. PRABHAKAR KORE HOSPITAL AND MEDICAL RESEARCH CENTRE, BELAGAVI**"**

Respected Sir/Madam we request you to enroll yourself to participate in our study as you are eligible for doing so.Your participation in the study is voluntary. Your decision whether or not to participate in the study will not affect your relationship with the hospital. If you decide to participate you are free to withdraw at any time.

Objective and Purpose of the study:- Pseudoexfoliation causes serious complications during cataract surgery due to pupillary rigidity and zonular weakness and instability. The purpose of the research is to evaluate the Complications During Cataract Surgery in patients of Pseudoexfoliation Syndrome.

Procedure Involved:- If you agree to enroll yourself in this study, you will be asked to give detailed history. Then you will be clinically examined in detail by slit-lamp examination, fundoscopy, tonometry for measurement of intraocular pressure. Syringing for patency of the lacrimal sac, keratometry and A scan ultrasonography and investigations like blood pressure measurement, random blood sugar will be done. Then you will be undergoing Small Incision Cataract Surgery.

Risks and Benefits :- As such no major risks are involved, rare complications of surgery includes posterior capsular rent, vitreous loss, lens dislocation, expulsive choroidal hemorrhage for which all necessary precautions will be taken.

Your participation may benefit you and others suffering from same ailment in future, by helping us learn more about the disease process and better treatment modalities.

Alternatives:- If you are not willing to participate you will be treated according to the existing protocol & it will not affect your relationship with this hospital.

Costs for participating in this research:- There will not be any extra cost incurred by the participant. The participant will however have to pay for the investigations which are the part of the existing management protocol for this ailment. There is no commitment for any reimbursement or any other compensation for the participant.

Privacy and Confidentiality:- The only people to know that you are a research subject are members of the research team. No information about you or information provided by you during the research will be disclosed to others without your written permission.

Authorization to Publish Results:- When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with you will remain confidential.

Compensation:- In the event of injury related to the study, treatment will be made available through KLES Dr. Prabhakar Kore Hospital & MRC, Belagavi. There is no compensation or payment for such medical treatment by law. The doctors and the staff will provide facilities and medical attention to you.

Questions:- If you have any questions about the research you may please contact:

1. Dr. GANGA S. PILLI, CHAIRPERSON, JNMC, Belagavi and Chairman of Institutional Ethics Committee. Contact No. 08312471350

Consent for participation in research trial

I, Mr./Ms./Mrs _____ voluntarily agree for the participation as a subject of study. By signing this consent form I am not giving up any of my legal rights, I may withdraw from the study anytime. I am signing the consent form after having read or been read for me in vernacular language, including the risks and the benefits and having all my questions answered.

Subject Name: _____

Signature or the Left Thumb Print of Subject: _____

Witness Name: _____

Signature of Witness: _____

Investigators Name: _____

Signature of Investigator: _____

Date: _____

Place: _____

ANNEXURE-II

PROFORMA

PATIENTS ID NO: | | | |

NAME

(FIRST NAME)	(MIDDLE NAME)	(SURNAME)

AGE: | | Years

SEX: | | (1-Male; 2-Female)

ADDRESS: _____

_____

_____

_____

CONTACT NUMBER:- | | | | | | | | | | |

OP NUMBER: | | | | | | | | |

IP NUMBER: | | | | | | | | |

DATE OF ADMISSION | | | | | | | | | |

DATE OF SURGERY | | | | | | | | | |

DATE OF DISCHARGE | | | | | | | | | |

PROVISIONAL DIAGNOSIS:

SURGEON'S NAME:

SURGEON'S SIGNATURE:

DATE:

CHIEF COMPLAINTS:

DIMINUTION OF VISION ☐ RE Duration:

☐ LE Duration:

HISTORY OF PRESENT ILLNESS:

		RE	LE
1. DIMINUTION OF VISION	1- Gradual; 2- Sudden	☐	☐
	1- Progressive; 2- Static	☐	☐
	1- Painless; 2- Painful	☐	☐
	1- For distance; 2- For near; 3- Both	☐	☐
2. DIPLOPIA/POLYOPIA	1- Present; 2- Absent	☐	☐
3. COLOURED HALOS	1- Present; 2- Absent	☐	☐
4. BLACK SPOTS BEFORE THE EYES	1- Present; 2- Absent	☐	☐
5. WATERING	1- Present; 2- Absent	☐	☐
6. REDNESS	1- Present; 2–Absent	☐	☐
7. DISCHARGE	1- Present; 2 – Absent	☐	☐
8. H/O WEARING GLASSES	1- Present; 2 – Absent	☐	☐
	a-Distance; b-Near; c-Both	☐	☐

Duration: ☐☐ months/years

PAST HISTORY:

1. Yes 2. No (If 1, then duration)

	RE	LE
Intra-ocular Surgery		
Trauma		
Other		

Diabetes	
Hypertension	

ANY OTHER MEDICAL DISORDERS:

_____

PERSONAL HISTORY: ☐

1. Significant 2. Insignificant

If 1; specify _____

FAMILY HISTORY: ☐

1. Significant 2. Insignificant

If 1; specify _____

GENERAL PHYSICAL EXAMINATION:

Pulse: ☐☐☐ /minute

BP: ☐☐☐ / ☐☐☐ mm of hg

Temperature: ☐ (1- Febrile , 2 –Afebrile)

Respiratory rate: ☐☐ /minute

(1=Yes; 2=No)

Pallor		Clubbing	
Icterus		Lymphadenopathy	
Cyanosis		Oedema	

SYSTEMIC EXAMINATION:

1. Normal 2. Abnormal (if 2 then specify)

Respiratory system		
Cardiovascular system		
Per abdomen		
Central nervous system		

OCULAR EXAMINATION:

1 . Head posture: 1- Erect, 2- Tilted ☐

If 2, specify; _____

2 . Visual Axes: 1- Parallel, 2- Deviated ☐

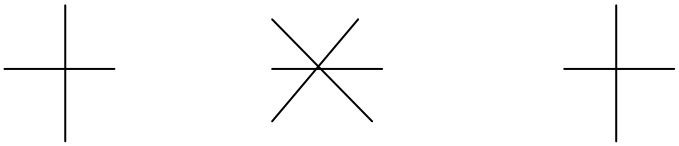
If 2, specify; _____

3 . Facial Symmetry: 1- Symmetrical, 2-Asymmetrical ☐

If 2, specify; _____

4 . Extra-ocular movements OD BINOCULAR

OS



5 . Visual Acuity:

	RE	LE
DISTANT		
PINHOLE		
NEAR		
AIDED		

6 . Anterior segment examination

	RIGHT EYE	LEFT EYE
1. Adnexa (1- Normal; 2-Abnormal) If 2 , specify		
2. Sclera (1- Normal; 2- Abnormal) If 2 , specify		
3. Conjunctiva (1-normal; 2- Abnormal) If 2 , specify		
4. Cornea (1- normal; 2- Abnormal) If 2 , specify		
5. Anterior chamber (1- normal depth; 2-shallow; 3-deep; 4- any other)		

6. Iris (1-normal colour& pattern; 2-Abnormal) PXF material on pupillary margin PXF material on surface Atrophy Iridodonesis (1-Yes ; 2-No)	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐
7. Pupil: • Size Undilated Dilated • Reactions: o Direct o Indirect (1=present; 2=absent; 3=sluggish)		
8. Lens (1=Clear; 2=Cataract, 3=pseudophakia, if 2 then specify the type) PXF on lens Phacodonesis Zonular dehiscence (1-Yes ; 2-No)	☐ ☐ ☐	☐ ☐ ☐

FUNDUS	RE	LE
GLOW		
MEDIA		
DISC		
C:D RATIO		
BLOODVESSELS		
BACKGROUND		
MACULA		

INVESTIGATIONS:

1. Tonometry

	RE	LE
IOP (mm Hg)		

2. Lacrimal sac

RE	LE

3. A-scan

K_1-

K_2-

AC avg-

Axl-

PCIOL-

4. Blood sugar:_____mg%

5. Gonioscopy:

Open / Closed		
Pigmentation, PAS		
Recession		
Neovascularisation		

DIAGNOSIS:-

OPERATIVE PROCEDURE: SMALL INCISION CATARACT SURGERY.

OPERATING SURGEON:

DATE:

OPERATING EYE:

ANAESTHESIA: PERIBULBAR BLOCK

COMPLICATIONS OBSERVED DURING SURGERY

	YES	NO
1) Non Dilating Pupil	☐	☐
2) Difficulty during anterior capsulotomy	☐	☐
3) Difficulty in nucleus delivery	☐	☐
4) Corneal endothelial touch	☐	☐
5) Descements Membrane Stripping	☐	☐
6) Iridodialysis	☐	☐
7) Zonular dialysis	☐	☐
8) Lens dislocation	☐	☐
9) Posterior capsule rupture	☐	☐
10) Vitreous loss	☐	☐
11) Decentered IOL	☐	☐
12) Retained lens matter	☐	☐
13) Intra operative bleed	☐	☐
14) Others	☐	☐

INTRA OCULAR LENS TYPE

1-PCIOL ☐

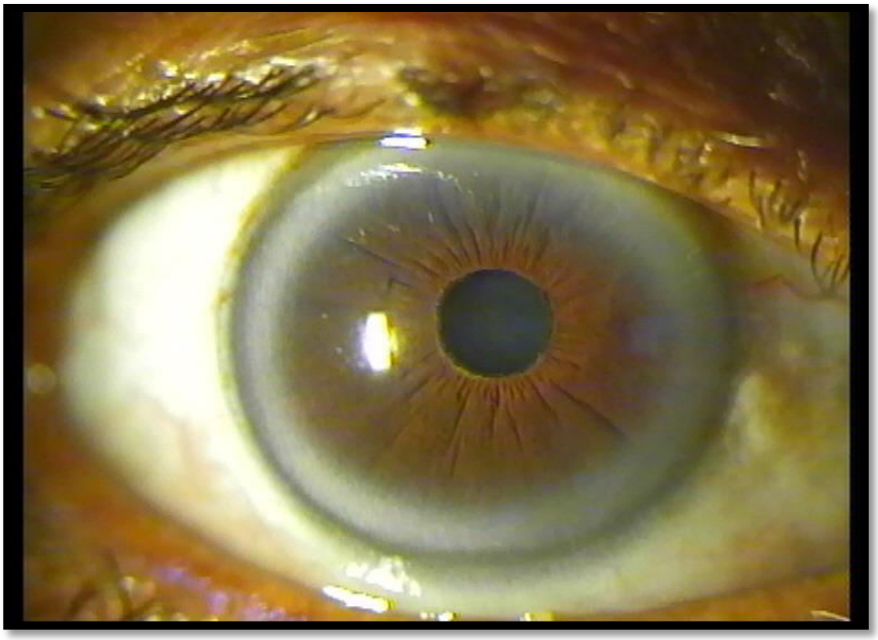
2-ACIOL

3-APHAKIA

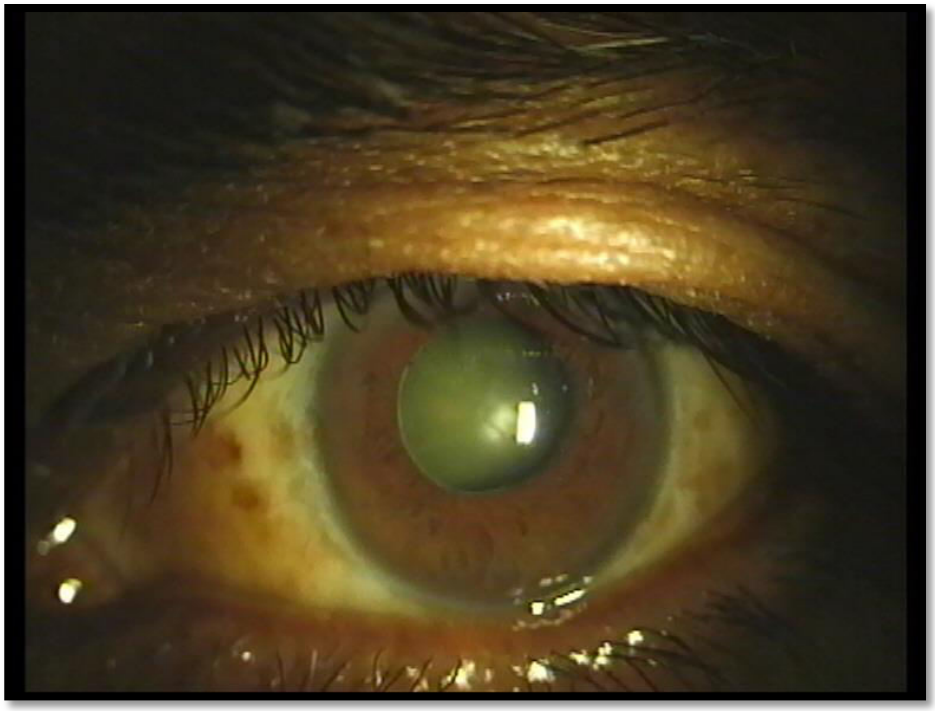
COMMENTS:

ANNEXURE III – PHOTOGRAPHS

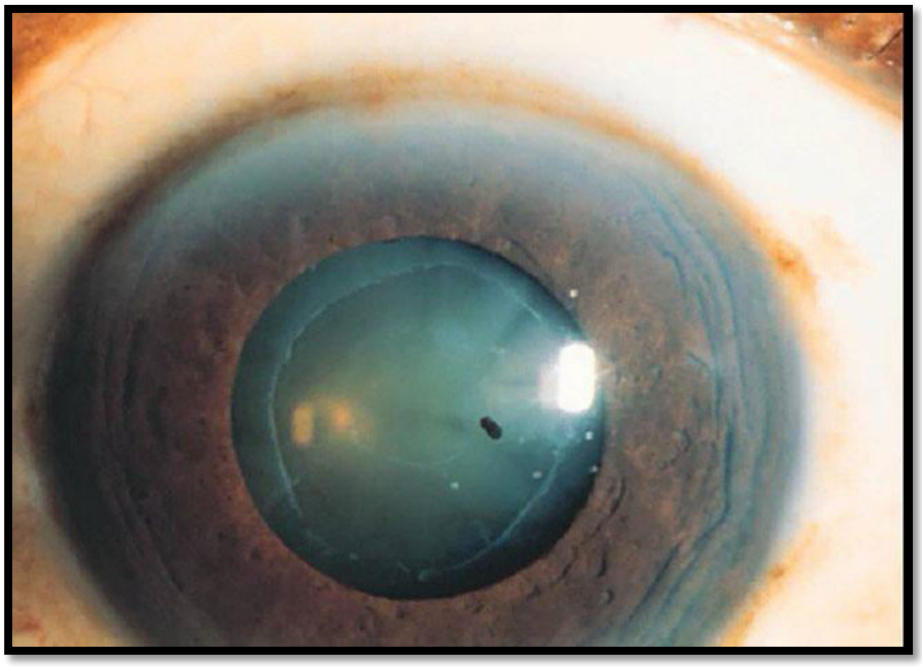
Photograph 1 – Slit lamp examination



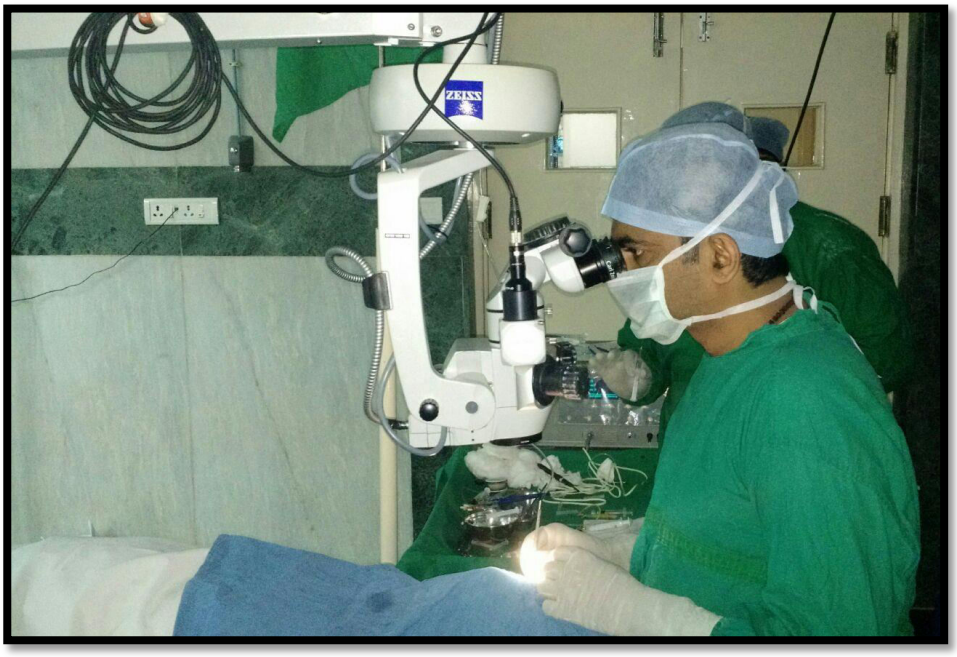
Photograph 2 – Pseudoexfoliation material on pupillary margin



Photograph 3 – Non Dilating pupil

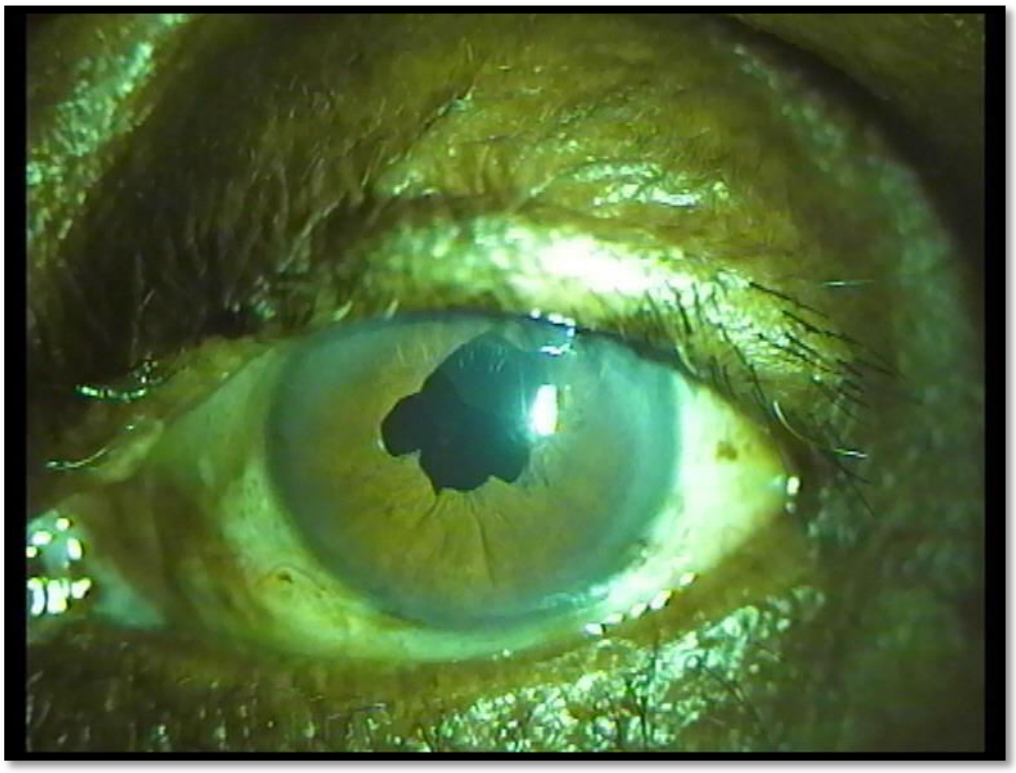


Photograph 4 – Pseudoexfoliation Material On Lens

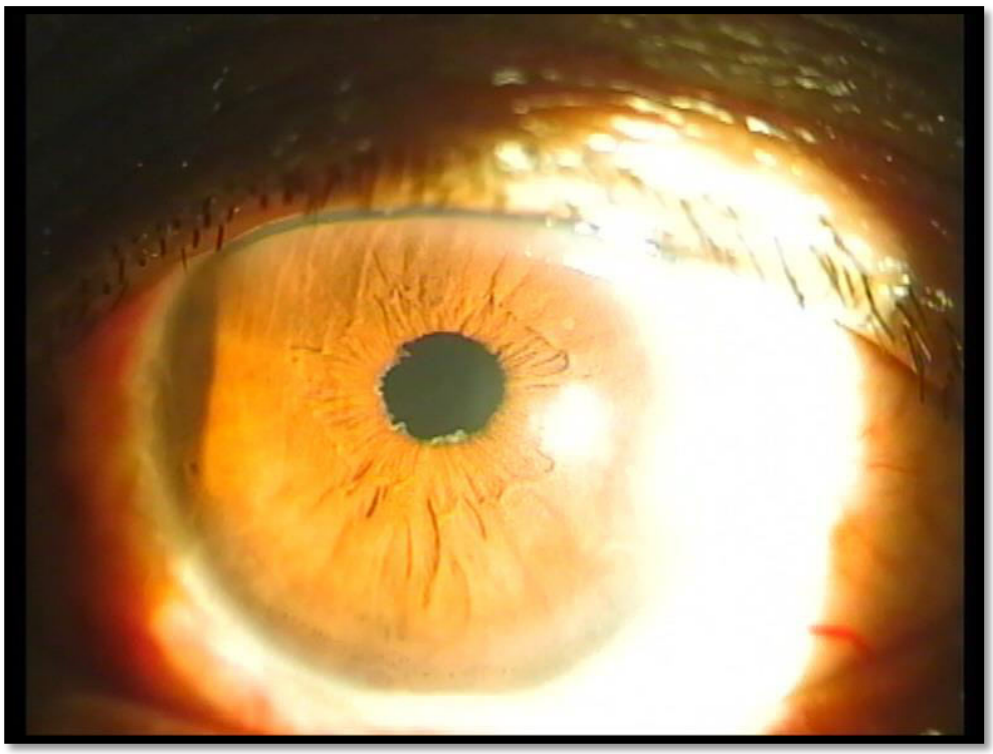


Photograph 5 – Operation theatre

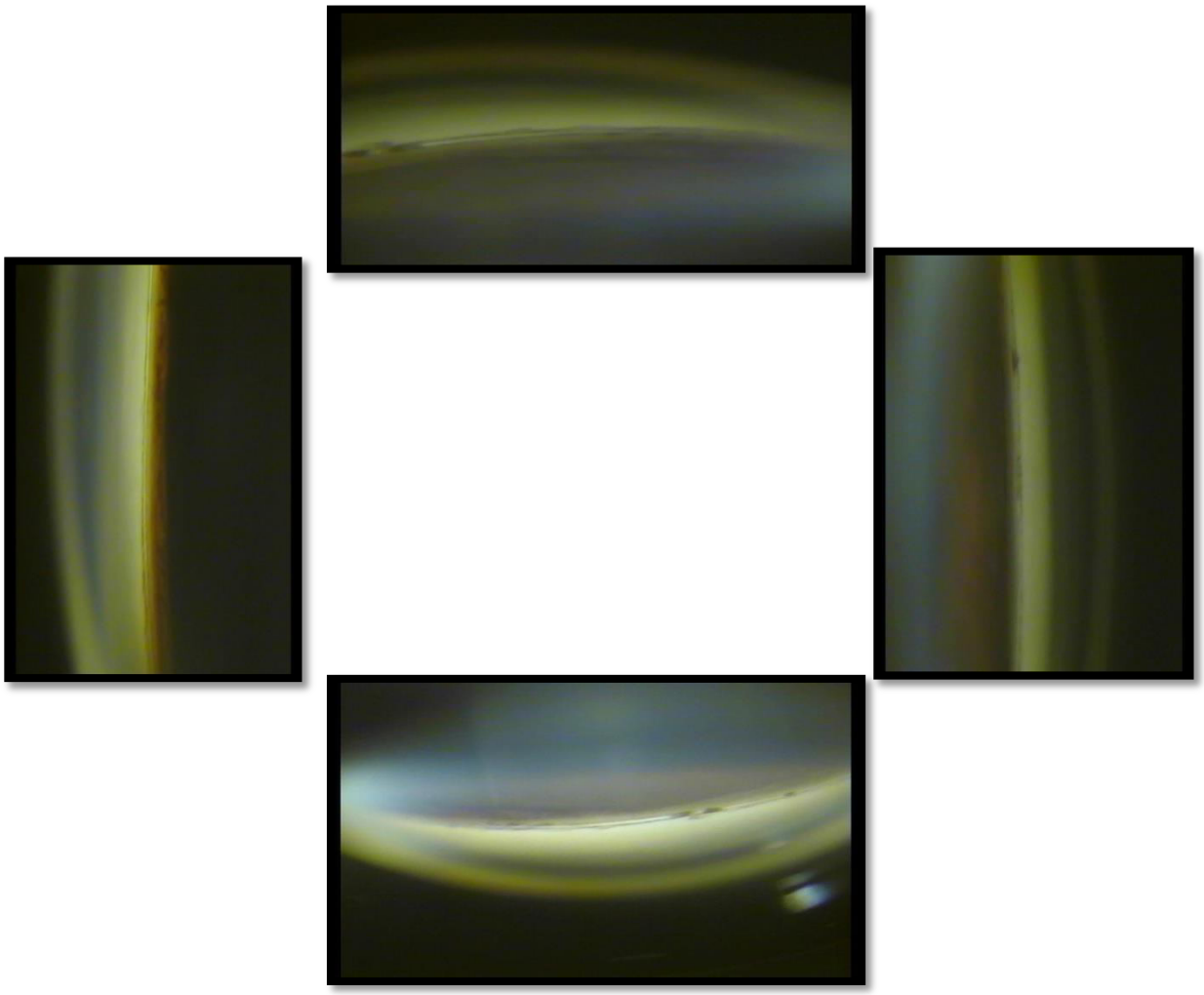
Photograph 6 – Cataract set in OT



Photograph 7 – Sphincterotomy



Photograph 8 –Post operative day 1



Photograph 9 – Gonioscopy showing trabecular hyperpigmentation

KEY TO MASTER CHART

ACD	–	Anterior chamber depth
CET	–	Corneal endothelial touch
CF	–	Counting fingers
CFCF	–	Counting fingers close to face
DAC	–	Difficulty in anterior capsulotomy
DIOL	–	Decentered IOL
DMS	–	Descements membrane stripping
DND	–	Difficulty in nucleus delivery
HMature	–	Hypermature cataract
HMCF	–	Hand movements close to face
HTM	–	Hyperpigmented trabecular meshwork
ID	–	Iridiodialysis
IOB	–	Intraoperative bleed
IOP	–	Intraocular pressure
IP No	–	Inpatient number
LD	–	Lens dislocation
LE	–	Left eye
M / F	–	Male / Female patient
NDP	–	Non dilating pupil
NS	–	Nuclear sclerosis
Op	–	Operated eye
Others – A	–	Difficulty in prolapsing nucleus in anterior chamber
B	–	Sphincter tear
PCIOL	–	Posterior chamber intraocular lens

PCR	–	Posterior capsular rent
PH	–	Pinhole vision
PL PR	–	Perception of light present and projection of rays accurate
Pre D / Post D	–	Pre dilatation / Post dilatation
PSC	–	Posterior subcapsular cataract
PxC	–	Pseudoexfoliation on cornea
PxL	–	PXF material on anterior capsule of lens
PxM	–	Pseudoexfoliation on pupillary margin
PxS	–	Pseudoexfoliation on iris surface
RE	–	Right eye
RLM	–	Retained lens matter
SL	–	Sampaolesi line
Sph	–	Sphinterotomy
UCVA	–	Uncorrected visual acuity
UL/BL Px	–	Unilateral/Bilateral pseudoexfoliation
VL	–	Vitreous loss
Vn Day 1	–	Vision day 1 (post op)
ZD	–	Zonular dialysis

Sl. No	IP No	Age	Sex	UL/BL Px	Eye	Pre op Vn	PxC	Iris			Pupil size		NDP	Lens		IOP	ACD	Gonioscopy			Complications during surgery												Sph	IOL type	Vn DAY 1	
								PxM	PxS	Atrophy	Pre D	Post D	+	Cataract	PxL			Angle	HTM	SL	DAC	DND	CET	DMS	ID	ZD	LD	PCR	VL	DIOL	RLM	IOB	Others			UCVA	PH
1	630930	60	F	BL	LE	CF 2MT	-	+	-	-	3	6	+	IINS+PSC	+	14.6	4.1	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/9
2	632500	68	M	BL	LE	CF 1MT	-	+	-	+	3	6.5	+	IIINS+PSC	+	15.9	3.42	OPEN	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	PCIOL	6/60	6/60
3	646919	60	M	BL	RE	HMCF	-	+	+	+	3	6	+	MATURE	-	15.9	2.62	OPEN	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	PCIOL	HMCF	HMCF
4	647846	68	F	BL	RE	6/60	-	+	-	-	3	5	+	IINS+C	+	11.2	3.25	OPEN	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/12
5	648197	65	F	BL	LE	6/60	-	+	+	-	4	6	-	IINS+PSC	+	18.9	2.62	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/24	6/18
6	651940	62	F	BL	RE	6/60	+	+	-	-	2	7	+	IINS+PSC	+	12.2	3.39	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/60	6/24
7	653261	60	M	BL	RE	CF 1MT	-	+	-	-	3	5.5	-	IINS+PSC	+	11.2	3.16	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+ A,B	-	PCIOL	CF2MT	6/18
8	653191	65	M	BL	RE	CFCF	-	+	+	-	2.5	7	+	IIINS+PSC	+	11.2	3.42	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/24	6/18
9	655662	74	M	UL	LE	CF 1MT	-	+	+	-	2.5	6.5	-	IINS+PSC	-	14.6	3.21	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/12	6/9
10	656536	70	F	UL	RE	CF 1MT	-	+	-	-	3	7.5	+	IINS+PSC	+	14.6	2.57	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/12
11	656429	85	M	BL	RE	HMCF	-	+	-	-	1.5	3.5	+	MATURE	-	10.2	3.32	OPEN	+	+	-	+	+	-	-	-	-	-	-	-	-	+ A	+	PCIOL	CF2MT	CF 2MT
12	657633	70	F	BL	RE	CFCF	-	+	-	-	4	6.5	-	IINS+PSC	+	17.3	2.84	OPEN	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	PCIOL	6/12	6/9
13	659733	70	F	BL	RE	PL PR	-	+	-	-	3	7	-	MATURE	+	15.9	3.97	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/9	6/6
14	659861	64	F	BL	LE	CF 2MT	-	+	-	-	2.5	7	+	IIINS+PSC	+	10.2	3.57	OPEN	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/9	6/6
15	662260	65	M	BL	RE	CF 3MT	-	+	+	-	2.5	6	+	IINS+PSC	+	17.8	3.28	OPEN	+	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	PCIOL	6/18	6/18
16	662271	65	F	BL	LE	CF 3MT	-	+	-	-	2.5	6.5	+	IINS+PSC	+	7.5	2.81	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/24	6/18
17	662747	70	M	BL	LE	CF 1MT	-	+	+	-	3	6	+	IIINS+PSC	+	17.3	2.6	OPEN	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	PCIOL	6/12	6/12
18	669164	70	M	UL	LE	CF 1MT	-	+	-	-	2.5	6	-	IINS+PSC	+	12.2	3.04	OPEN	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	PCIOL	CFCF	CFCF
19	671203	60	F	BL	RE	PL PR	-	+	-	-	3	7	-	MATURE	-	9.4	3.56	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/24	6/18
20	672599	72	F	UL	RE	CF 2MT	-	+	-	-	2	7.5	+	IINS+PSC	+	17.3	3.3	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/9
21	673312	75	M	BL	LE	6/24	-	+	-	-	2.5	6	+	INS+PSC	+	12.2	3.15	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/12	6/9
22	673809	60	M	UL	RE	CFCF	-	+	-	-	3	6	+	MATURE	+	17.3	2.87	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/12	6/12
23	673844	50	F	BL	RE	PL PR	-	+	-	-	3	6.5	+	MATURE	-	11.2	2.57	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/12
24	673827	74	M	BL	RE	PL PR	-	+	+	-	2.5	4.5	+	MATURE	+	14.6	2.48	OPEN	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+ A	-	PCIOL	6/60	6/60
25	675165	60	F	BL	LE	PL PR	-	+	+	-	3	6	+	HMATURE	+	15.9	2.59	OPEN	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/36	6/36
26	675496	75	M	BL	RE	CF 2MT	-	+	+	-	2.5	6.5	-	IINS+PSC	+	14.6	2.83	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/12

Sl. No	IP No	Age	Sex	UL/BL Px	Eye	Pre op Vn	PxC	Iris			Pupil size		NDP	Lens		IOP	ACD	Gonioscopy			Complications during surgery															Sph	IOL type	Vn DAY 1	
27	676889	64	M	UL	LE	CF 1MT	-	+	+	-	3	7.5	+	IINS+PSC	+	9.4	3.36	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/60	6/18
28	678320	60	M	BL	LE	6/36	-	+	+	+	3	6.5	+	IINS+PSC	+	17.3	3.24	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/24	6/18
29	681082	70	F	BL	LE	CF 1MT	-	+	+	+	3	5	+	IINS+PSC	+	15.9	2.69	OPEN	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+ A	-	PCIOL	6/24	6/24
30	682195	70	M	BL	RE	CF 1MT	-	+	+	+	2.5	5	+	IIINS+PSC	+	10.2	3.44	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+ B	-	PCIOL	6/18	6/12
31	686374	80	M	BL	RE	PL PR	-	+	-	-	2.5	4	+	MATURE	+	17.3	3.24	OPEN	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	PCIOL	6/24	6/12
32	690252	60	M	UL	LE	CF 2MT	-	+	+	-	3	6	+	IINS+PSC	+	8.5	2.83	OPEN	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/12
33	700880	70	F	UL	RE	6/60	-	+	+	-	2	4.5	+	IINS+PSC	+	15.9	2.96	OPEN	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+ A,B	-	PCIOL	6/18	6/9
34	707623	65	F	BL	RE	CF 1MT	-	+	+	+	2	4.5	+	IINS+PSC	+	17.3	3.46	OPEN	+	+	+	+	-	-	-	-	-	-	-	+	+	-	-	-	+ A	+	PCIOL	6/12	6/9
35	709504	64	M	UL	LE	6/24	-	+	-	-	3	6	+	IINS+PSC	+	15.9	3.17	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/12	6/9
36	715307	67	M	BL	RE	CF 2 MT	-	+	+	+	2	5	+	IIINS+PSC	+	12.2	2.04	OPEN	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+ A,B	-	PCIOL	6/18	6/18
37	716104	71	F	BL	LE	6/36	-	+	+	+	3	5	-	IINS+PSC	+	12.2	2.49	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+ A	-	PCIOL	6/12	6/12
38	716944	70	F	BL	LE	PL PR	-	+	-	-	3	7	+	MATURE	+	13.4	2.9	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/9	6/9
39	716989	70	F	BL	RE	6/60	-	+	-	-	4	6.5	+	IINS+PSC	+	18.9	2.79	OPEN	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/12
40	719770	60	F	UL	RE	PL PR	-	+	+	+	3	5.5	+	MATURE	+	14.6	2.4	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/12	6/9
41	722713	76	M	BL	RE	6/60	-	+	+	+	3	5	+	IINS+PSC	+	17.3	3.3	OPEN	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+ A,B	-	PCIOL	6/12	6/9
42	725586	66	M	BL	RE	PL PR	-	+	+	-	3	5	+	MATURE	+	17.3	3.89	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+A	-	PCIOL	6/18	6/18
43	726870	75	M	BL	LE	CF 2MT	-	+	-	+	4	6.5	+	IIINS+PSC	+	17.3	3.78	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/18
44	731848	60	M	BL	RE	CF 1MT	-	+	+	-	2	4.5	+	IINS+PSC	+	14.6	3.6	OPEN	+	-	+	-	-	-	-	+	-	-	-	+	-	-	-	+ A,B	-	PCIOL	6/18	6/12
45	733225	72	F	BL	LE	CF 2MT	-	+	+	+	3	6	+	IINS+PSC	+	14.6	3.3	OPEN	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+ A	-	PCIOL	6/12	6/12
46	733464	55	M	BL	RE	PL PR	-	+	+	+	4	6.5	+	MATURE	+	14.6	3.02	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/12	6/9
47	734209	70	F	UL	LE	6/60	-	+	-	-	3	6	+	IINS+PSC	-	17.3	3.17	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/18	6/9
48	734418	65	M	BL	RE	CF 3MT	-	+	+	+	4	5	+	IINS+PSC	+	17.3	3.67	OPEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+ A	-	PCIOL	6/18	6/12
49	735752	70	F	UL	LE	CF 3MT	+	+	+	+	4	6.5	+	IINS+PSC	+	13.4	3.46	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+ A,B	-	PCIOL	6/12	6/9
50	737022	72	F	BL	RE	CF 2MT	-	+	+	+	4	5.5		IIINS+PSC	+	14.6	3.44	OPEN	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PCIOL	6/60	6/60