"EVALUATION OF CAPSULAR TENSION RING IMPLANTATION IN PHACOEMULSIFICATION OF CATARACTS WITH PSEUDOEXFOLIATION SYNDROME"

By

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In partial fulfillment

Of the requirements for the degree of

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IN
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Under the Guidance of

DR. NARENDRA P DATTI, M.S.

DEPARTMENT OF OPHTHALMOLOGY

SRI DEVARAJ URS MEDICAL COLLEGE

TAMAKA, KOLAR (APRIL - 2016)

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Dedicated with

REVERENCE

to

MY PARENTS

LIST OF ABBREVIATIONS USED

SL NO	ABBREVATIONS	FULL FORM
1	BCVA	Best corrected visual acuity
2	CTDs	Capsular tension devices
3	CTR	Capsular Tension Ring
4	CTS	Capsular tension segments
5	IOL	Intraocular lens
6	IOP	Intraocular pressure
7	LOXL1	Lysyl oxidase like 1
8	PCO	Posterior capsular opacification
9	PMMA	Polymethyl methacrylate
10	PEX	Pseudoexfoliation
11	PXG	Pseudoexfoliation glaucoma
12	PXS	Pseudoexfoliation syndrome
13	POAG	Primary Open Angle Glaucoma

ABSTRACT

TITLE OF THE TOPIC: "**EVALUATION OF CAPSULAR TENSION RING IMPLANTATION IN PHACOEMULSIFICATION OF CATARACTS WITH PSEUDOEXFOLIATION SYNDROME"**

NEED FOR THE STUDY:

Pseudoexfoliation syndrome is a common clinically important systemic condition characterized by the pathological production and accumulation of an abnormal fibrillar extracellular material in many intraocular and extra- ocular tissues. Many studies have shown that pseudoexfoliation syndrome patients have higher rates of intraoperative and postoperative complications during cataract surgery compared to the patients without it.

OBJECTIVES OF THE STUDY:

1) To study the safety and efficacy of capsular tension ring in cataracts with pseudoexfoliation syndrome in terms of intraoperative and postoperative complications.
2) To assess the visual acuity postoperatively in CTR and non CTR implanted patients.

MATERIAL AND METHODS:

Source of Data:

Minimum of 100 patients diagnosed with cataract with pseudoexfoliation syndrome were selected for this prospective study at R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, TAMAKA, KOLAR attached to SRI DEVARAJ URS

MEDICAL COLLEGE between December 2013 and July 2015. Informed and written consent was taken from all the patients. After all necessary ocular and systemic examinations patients were divided into two groups of 50 each. Group I underwent CTR implantation and group II without CTR implantation and served as control group. Intraoperative, postoperative complications and postoperative visual acuity was compared between two groups and complications if any was noted. Statistical analysis was done by Chi square tests and student t test.

RESULTS:

1(2%) patient out of 50 patients who underwent CTR implantation had zonular separation compared to 6(12%) out of 50 patients in non CTR group which was statistically significant (p=0.013). Posterior capsular rupture was observed in 2(4%) patients in group I and 8(16%) patients in group II which was statistically significant (p=0.042). There were no statistical differences between the other intraoperative variables, postoperative complications and postoperative visual acuity.

CONCLUSION:

We found that, CTRs ensure safe removal of crystalline lens and stable placement of the IOL during phacoemulsification of eyes with pseudoexfoliation syndrome, thus preventing the risk of intraoperative & postoperative complications & improve patient outcomes.

KEYWORDS

Phacoemulsification, pseudoexfoliation syndrome, capsular tension rings

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INTRODUCTION

INTRODUCTION

Pseudoexfoliation syndrome (PXS) is an age-related systemic disease with primarily ocular manifestations. It is characterized by deposition of whitish-grey fibrillogranular amyloid like material on the anterior lens capsule, zonules, ciliary body, pupillary margin of the iris, corneal endothelium, anterior vitreous and trabecular meshwork.[1] It is frequently associated with cataract with zonular instability, open and closed angle glaucoma.[2] It is a disorder of the extracellular matrix more common in older age groups with most cases occurring in the late 60s and early 70s. PXS tends to be bilateral but presents in an asymmetrical fashion.[3]

Additional subtle clinical signs that help in early diagnosis are loss of pigment from peri-pupillary area producing transillumination defects, insufficient mydriasis and pigment dispersion into anterior chamber after mydriasis, deposition of melanin over trabecular meshwork and Schwalbe's line.

The increased incidence of open angle glaucoma in PEX patients is due to mechanical blockage of trabecular meshwork by PEX material. The active PEX accumulation within the trabecular cells causes their secondary degeneration. The presence of secondary open angle glaucoma is known as glaucoma capsulare. It has more serious clinical course and worse prognosis than primary open angle glaucoma (POAG), often not responding to medical therapy and requiring early surgical intervention. Angle closure glaucoma may also be seen due to pupillary block by forward displaced lens. PXS has a strong familial association and lysyl oxidase-like 1(LOXL1) gene has been strongly associated with this disorder.[4]

Making the diagnosis often requires a careful slit- lamp examination after pupillary dilatation as pseudoexfoliation syndrome frequently goes undiagnosed leading to unexpected problems in management and during surgery. Due to the involvement of virtually all structures by PEX material, patients have a significantly greater risk for a variety of complications during cataract surgery.

The small pupillary diameter and zonular fragility are presumed to be the most important risk factors for posterior capsular rupture and vitreous loss during cataract surgery.[5,6,7] Zonular weakness can be attributed to the deposition of PEX material on the zonular fibers and ciliary processes resulting in a proteolytic disintegration of the zonules that can lead to spontaneous devastation. Thus, a significant zonular instability can cause phacodonesis, spontaneous subluxation of the lens and angle closure glaucoma due to pupillary and ciliary block.

The incidence of phacodonesis and/or subluxation of the lens in eyes with PXS have been reported to be between 8.4% and 10.6%.[8,9,10] Late complications include posterior capsular opacification(PCO), secondary cataract and decentration of intraocular lens and decompensation of corneal endothelium. Phacoemulsification is the preferred method of cataract surgery in these patients. But presence of PEX makes surgery challenging for the surgeon, as these patients are more prone for intraoperative complications such as zonular dialysis, posterior capsule rent and vitreous loss as a consequence of weak insufficient zonules. These complications can be prevented by modified surgical techniques using large capsulorhexis and Capsular Tension Rings (CTR). Given their ability to stabilize the capsule,

CTRs are most commonly used in eyes with suspected or actual zonular weakness or dialysis, including eyes with pseudoexfoliation syndrome, high myopia, mature cataracts and lens subluxation.[11,12,13]

Capsular tension rings are polymethyl methacrylate (PMMA) intraocular implantation devices. With the introduction of CTR and its several modified versions, the ability to perform safe cataract extraction with the implantation of a stable and well centered intraocular lens (IOL) within the capsular bag has increased substantially. It is designed to be implanted into the capsular bag and left permanently in place. By increasing the overall bag stability, the risk of intraoperative complication is reduced.[14] In addition it decreases the postoperative capsular contraction and PCO and improves IOL centration.[15,16,17]

The Cionni modified CTR is an open ring designed with one or two fixation eyelets attached to the central ring. This implant provides a solution to the extensive and/ or progressive zonular damage. Modified CTRs with integrated iris shields have also been used to protect against glare or monocular diplopia in cases of aniridia, iris coloboma and uveal tumours involving the anterior segment that may require resection of the iris and ciliary body.

With recent advances in equipment and instrumentation, better surgical techniques and understanding of fluid dynamics, the surgeon is able to perform relatively safe phacoemulsification in the presence of compromised zonules.

In this study, we tried to evaluate the intraoperative and postoperative complication rates and visual outcome in cataracts with pseudoexfoliation syndrome where capsular tension ring implantation was done.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES:

1. To study the safety and efficacy of capsular tension ring in cataracts with pseudoexfoliation syndrome in terms of intraoperative and postoperative complications.
2. To assess the visual acuity postoperatively in CTR and non CTR implanted patients.

REVIEW OF LITERATURE

REVIEW OF LITERATURE:

In 1917, grayish or bluish flakes of material on the pupillary border was described in some patients with glaucoma.[18] It was later hypothesized that this material represented degenerative changes of the lens capsule followed by secondary desquamation and was proposed the term senile exfoliation of the lens capsule.[19] Subsequently it was shown that exfoliative material differed histochemically from lens capsule and to differentiate this condition from true exfoliation of the lens capsule secondary to infrared exposure, the term pseudoexfoliation of the lens capsule was suggested.[20]

The terms exfoliation syndrome and pseudoexfoliation syndrome are now most commonly used to designate this disorder and are used interchangeably in current literature. However, since recent ultrastructural studies indicate that the material on the lens capsule is derived, at least in part, from the lens, it is proposed that the disorder be called exfoliation syndrome.[21,22,23]

EPIDEMIOLOGY

The reported prevalence of PXS both with and without glaucoma has varied widely. In US population, the overall prevalence of PXS was found to be 0.6% in 52 – 64 years old, rising to 5% in 75 – 85 years old.[24] In India, the prevalence rates reported were 1.88% (1965) and 7.4% (1984).[25,26] The prevalence rate in south India is 3.8% (2003).[27] In a given population, the actual prevalence of PXS is probably twice that which is visible on clinical examination. Many cases go undetected because of failure to dilate the pupil or to examine the lens with the slit lamp after dilatation of the pupil.

The prevalence increases with age, the disease most commonly manifesting between 60–70 years. But PXS might well be a condition that starts in mid-adulthood but becomes frankly manifest only in later years. Sex ratio reports are conflicting.

Association of PXS with lysyl oxidase like 1 gene (LOXL1) on Chromosome 15q 21(1) was studied.[28] Asian populations including Indians reported associations with LOXL1 and PXS. It is an inherited condition with transmission to the 2nd generation through an affected mother.[29]

There are no unequivocal findings regarding the role of environmental factors in the development of PXS. It is now known that PXS is essentially a bilateral condition and unilateral cases only represent an earlier period in the natural history of the condition. When only one eye is involved clinically, the other eye often has abnormal aqueous humour dynamics or glaucomatous damage.

CLINICAL FEATURES

1. OCULAR MANIFESTATIONS[30, 31, 32, 33, 34, 35, 36]

a) LENS AND ZONULES

Deposits of white flaky material on the anterior lens surface are the most consistent and important diagnostic of PXS. The most consistent diagnostic feature is three distinct zones of PEX material seen on the lens capsule after full dilatation:

1. A translucent, central disc with occasional curled edges.

2. Middle clear zone corresponding to probable contact with the moving iris.

3. Peripheral granular zone, which may have radial striations.

(Central zone is absent in 20% or more cases, but peripheral defect is a consistent finding in all cases. Therefore, pupillary dilatation is a must before lens changes can be seen.)

A precursor of PEX material is thought to be initially deposited diffusely on the lens surface. A homogeneous “ground glass” or “matte” appearance of the lens surface in one eye compared to the other may represent a very early (pre-capsular) stage. In a perhaps slightly later (pre-granular) stage, there may be very faint radiant non-granular striae on middle third of the anterior capsule behind the iris.

Ultrastructuraly, the pre-capsular layer at this stage consists of micro-fibrils, but not mature exfoliation fibrils. To visualize the earlier stages at the slit lamp, placing the slit beam at 45° to the axis of observation reducing the light source and focusing temporarily 2 – 3 mm from the centre of the lens may help to highlight the subtle deposits on the lens surface. The intermediate clear zone is created by rubbing of the iris over the surface of the lens during pupillary movement. As the pre-capsular layer becomes thicker the iris sphincter begins to rub against it during normal pupillary movement. Faint clefts begin to form where PEX material is rubbed away in what will eventually become the clear zone. With time, these clefts increase in size and begin to become confluent. Eventually only small bridges may remain as an indication of the previous layer of PEX material in the intermediate zone. In some patients the central disk may become thick enough to peel away in sheets from the lens, as may the peripheral zone, giving rise to appearance of

true exfoliation syndrome. Chronic pupillary dilatation also permits undisturbed accumulation of PEX material.

CLINICAL CLASSIFICATION OF PSEUDOEXFOLIATION SYNDROME (Figure 1):

i) SUSPECT PSEUDOEXFOLIATION SYNDROME:

- Early Pseudoexfoliation Syndrome (Electron Microscopy)
- Pre-capsular layer.
- Masked/Suspected Pseudoexfoliation Syndrome.
- Posterior synechiae without any obvious cause.
-

ii) DEFINITE PSEUDOEXFOLIATION SYNDROME:

- Mini-Pseudoexfoliation Syndrome: Focal defects in pre-capsular layer especially superonasally.
- Classic Pseudoexfoliation Syndrome: Late stage.

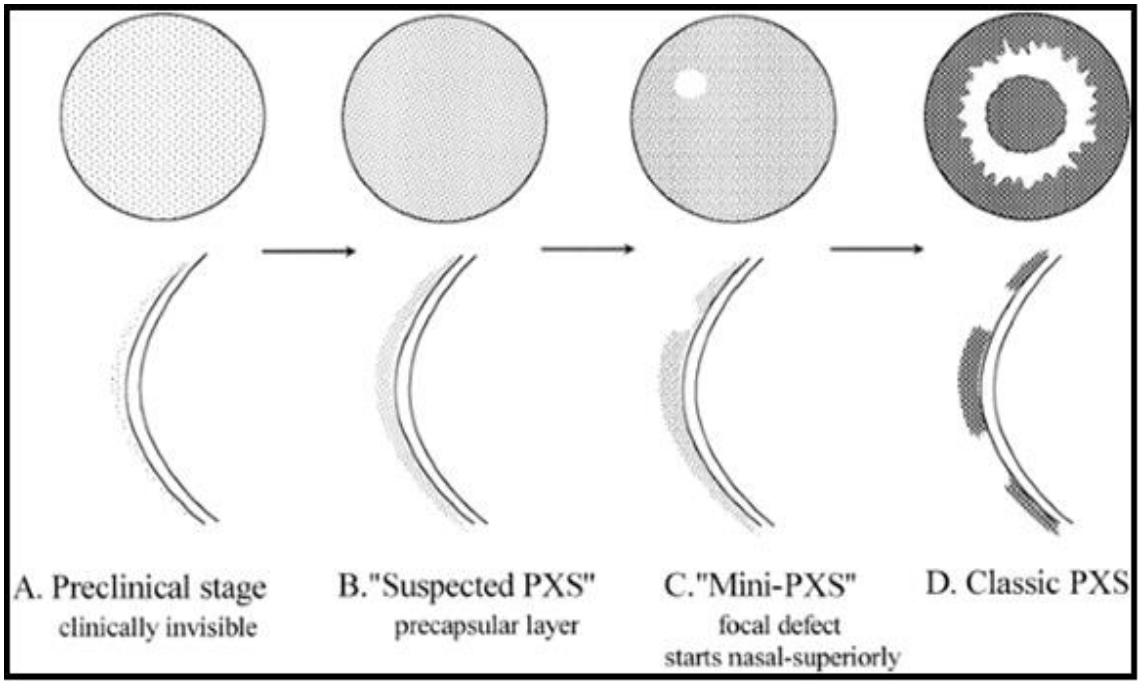


Figure 1: Clinical classification of pseudoexfoliation syndrome (PXS) based on morphologic alterations of the anterior lens capsule

Phacodonesis is common but not always associated with iridodonesis. Spontaneous subluxation and dislocation of lens can occur. The denser the PEX material, the more likely there is to be phacodonesis. Lens dislocation is more common inferiorly.

The Zonular fibrils coated with varying amounts of PEX material become stretched and eventually break. Break is not seen to occur from the attachment to the zonular lamellae but at their ciliary attachments. The broken fibers may be seen waving gently in the aqueous. Subsequently the fibers become shorter and thicker and finally appearing as irregular clumps on the lens surface. The fibers that break first are those behind the equator and those just anterior to the equator remain intact.

b) IRIS AND PUPIL

Pigment loss from the iris sphincter region and its deposition on the anterior chamber structures is the hallmark of PXS. Loss of iris pigment and its deposition throughout the anterior segment are reflected in iris sphincter region transillumination, loss of pupillary ruff, increased trabecular pigmentation and pigment deposition on the iris surface. Extensive depigmentation may be noted over the entire sphincter region, which appears as a diffuse starry sky pattern on transillumination or moth eaten appearance.

PXS predisposes to the formation of synechiae between iris pigment epithelium and the anterior lens capsule. Posterior synechiae are more prone to form between the iris and intra-ocular lens post operatively.

Iris blood vessel abnormalities include narrow or obliterate lumen, with marked alteration of iris vasculature, vessel dropout with collateral formation and iris hypo perfusion leading to patchy iris neo-vascularization. Inflammation after cataract extraction is more common and a transient fibrinoid reaction attributed to breakdown of blood-aqueous barrier may occur.

Intra-stromal haemorrhage after mydriasis is indicative of vascular damage. Atrophic changes of sphincter and dilator muscle tissues, possibly because of hypoxia and apparent impairment of muscle cells by PEX material may contribute to poor pupillary dilatation. Reduction of stromal elasticity by accumulating PEX material may also play a role in poor mydriasis. Dispersion of melanin granules after diagnostic mydriasis or surgery can be so pronounced that heterochromia iridium may be produced. The mechanism of melanin liberation is related to degenerative changes and cell membrane

ruptures of the posterior pigmented epithelial cells due to extra-cellular PEX material. Marked intra-ocular pressure rise after mydriasis correlates with the amount of the pigment liberated.

c) CILIARY BODY

The cilliary processes were examined clinically with special type of gonioscopy lens. Almost all eyes with exfoliation showed accumulation of material on the zonules and cilliary body.

d) GLAUCOMA AND PSEUDOEXFOLIATION SYNDROME [35,36]

While the existence of association between PXS and open angle glaucoma has been well known, the mechanisms are still not clarified. There is an increase in the aqueous outflow resistance probably due to trabecular cell dysfunction, blockage of meshwork by PXS liberated pigment and concomitant primary open angle glaucoma (POAG).

In patients with PXS, 20% have glaucoma and increased intraocular pressure (IOP) at the time of diagnosis. Patients who have PXS but not glaucoma should be considered vulnerable to glaucoma, because 15% of such patients develop increase in IOP within 10years. This underscores the need for careful follow-up in patients who have PXS. It accounts for 15-20% of cases of open angle glaucoma.

Glaucoma in PXS has a more serious clinical course and worse prognosis than POAG. There is a significantly higher frequency and severity of optic nerve damage at the time of diagnosis, worse visual field damage,

poorer response to medications, more severe clinical course and more frequent necessity of surgical interventions. Glaucomatous damage at the time of diagnosis is more severe and progression is also more rapid in eyes with pseudoexfoliation glaucoma (PXG).

A number of characteristics predispose to the development of angle closure glaucoma in eyes with PXS. Pupillary block may be caused by combination of posterior synechiae, increased iris thickness or rigidity or anterior lens movement secondary to zonular weakness or dialysis.

e) ANGLE CHARACTERISTICS:

As the iris is more rigid than normal, presence of aqueous in the posterior chamber causes it to bulge at the weakest point which is the iris root. Thereby, the localized iris bombe near the iris root narrows the angle, giving a pseudo-plateau iris configuration on gonioscopy and leads to chronic angle closure glaucoma.

Increased trabecular pigmentation is a prominent sign and is apparent in virtually all patients with clinically evident disease. It is an early diagnostic finding preceding the appearance of PEX material on the pupillary margin and the anterior lens capsule. It is almost always dense in the involved eye and increases in eyes with PXG. The degree of pigmentation correlates with elevated IOP. Pigment on Schwalbe's line is seen as a wavy line known as Sampolesi's line which is also an early sign of PXS.

f) VITREOUS:

A change in composition of aqueous in PXS could derange metabolism of hyalocytes leading to impaired production of hyaluronic acid and liquefaction of vitreous.

g) CONJUNCTIVA AND CORNEA:

Clinically the conjunctiva is normal. However, fluorescein angiography reveals loss of regular limbal vascular pattern and areas of neovascularisation and congestion of anterior ciliary vessels. Scattered flakes of PEX material may be observed on the endothelial surface of the cornea.

Specular microscopy demonstrates a significantly reduced endothelial cell density even with normal intra-ocular pressure, together with morphological changes in size and shape of the endothelial cells in both affected eyes and uninvolved fellow eyes. Decreased endothelial cell density does not necessarily correlate with the severity of glaucoma but it has been correlated with the extent of pigment dispersion.

Central corneal thickness is increased reflecting early corneal dysfunction. These changes may help in early diagnosis and in preoperative assessment prior to cataract extraction. These eyes can develop early corneal endothelial decompensation even with moderate rise of intraocular pressure or after cataract surgery.

2. SYSTEMIC MANIFESTATIONS: [37,38]

Ultrastructural studies performed on eyes during autopsy suggest that PXS is a multisystem disorder. PEX material has been found in a number of organs, which

include skin, lungs, gallbladder, liver, myocardium, kidney, bladder and meninges. The staining of the material in these organs is positive for elastin and human amyloid P protein, which is similar to the staining pattern characteristic of the material found in the eye.

MANIFESTATIONS OF PSEUDOEXFOLIATION SYNDROME		
TISSUE INVOLVED		**CLINICAL SIGNS**
Ocular	lens	Phacodonesis, subluxation, nuclear Cataract.
	Zonules	Zonular instability.
	Iris	Vasculopathy, Blood-aqueous barrier defect, pseudo-uveitis, anterior chamber hypoxia, capillary hemorrhage, iris rigidity, posterior synechiae, poor mydriasis, asymmetric pupillary reaction, stromal / pigment epithelial atrophy.
	Trabecular meshwork	Increased resistance to aqueous outflow, elevated intra-ocular pressure.
	Cornea	Reduced endothelial cell count. Corneal decompensation Corneal endothelial proliferation.
Extra-ocular	Skin, muscles, heart, liver, lung, kidney, meninges	

Table 1: Manifestations of pseudoexfoliation syndrome

THEORIES ON ORIGIN OF PSEUDOEXFOLIATION MATERIAL

1. BASEMENT MEMBRANE THEORY:

With the advent of the electron microscope, extensive studies on the PEX material were done and its origin was ascribed to be the basement membrane of the lens capsule, iris, ciliary body and conjunctiva. In 1992, systemic involvement of the viscera by PEX material using a transmission electron microscopy was confirmed. Typical PEX fibers were identified in autopsy tissue specimens of skin, heart, lungs, liver, kidney and cerebral meninges in addition to the classic intraocular locations leading to the term pseudoexfoliation syndrome.[37]

The production of the exfoliation material may be related to disordered basement membrane metabolism. In 1981, using the indirect immunoperoxidase method, it was found that the fibrils contained a basement membrane proteoglycan. Anti-basement membrane proteoglycan antibodies to lens material reacted strongly with exfoliation material, implicating lens epithelium and its production.[39]

2. ELASTIC MICRO-FIBRIL THEORY:

In 1987, histochemical similarities between zonular elastic micro-fibrils and PEX material and a resemblance of the larger micro-fibrils of a ground substance to zonular and other oxytalan micro-fibrils was found. The strong anatomic association between PEX fibers with elastosis in conjunctival specimens led to the suggestion that these fibers themselves might be a form of elastosis, possibly resulting from abnormal aggregation of components related to elastic micro-fibrils.[40]

In 1998, the matrix of PEX material was analyzed by electron microscopy and was demonstrated it to be fibrilin positive fibers, supporting the elastic micro fibril theory of its production.[1]

3. AMYLOID THEORY:

In 1996, it was shown that PEX material is associated with amyloid and in some eyes miosis is associated with degenerative changes, both in stromal tissue and in muscular layers of the iris.[41] Both primary familial amyloidosis and exfoliation was described in few patients.[42]

4. LYSOZOMAL THEORY:

Histochemical evidence of high acid phosphatase activity suggest that lysozymes were involved in the production of exfoliation material. Possible rupture of pigment epithelial cells may account for lyzosomal involvement.[43]

In 1982, the presence of lipoprotein was demonstrated in exfoliation material which might be the result of the high permeability of vessels in the anterior segment. It was also found that material was a sulphated glycosaminoglycan and that abnormal glycosaminoglycan metabolism precedes the formation of the material.[44]

Immunochemical studies have revealed heparin sulphate, chondroitin sulphate, proteoglycans, laminin, entactin, fibronectin and amyloid P protein to be integral constituents of exfoliation material. Type IV collagen is restricted to a micro-fibrillar layer interposed between the capsular surface and typical exfoliation material. Transmission electron microscopy and high resolution scanning electron microscopy demonstrated PEX material to contain keratan and dermatan sulphate.[45] None of the histochemical or enzymatic studies have succeeded in elucidating the exact source of PEX

material. This along with the increased chances of surgical complications continues to arouse great interest in PXS.

STRUCTURE OF PSEUDOEXFOLIATION MATERIAL:

The PEX material consists of an irregular meshwork of randomly oriented cross-banded fibrils measuring about 30 nm in diameter within a loose fibro-granular matrix containing 6-10 nm micro fibrils. Fibrils consists of a protein core surrounded by polysaccharide side chains. The fibrils are formed from lateral aggregations of filaments.[46,47]

The fibrils are intermingled with normal micro-fibrils and are embedded in an amorphous inter-fibrillar ground substance, most probably glycosoaminoglycans. The extra-ocular PEX Material is similar except that there is more matrix and less distinct banding pattern.

CATARACT SURGERY IN PSEUDOEXFOLIATION SYNDROME

Patients with PXS are much more prone to have complications at the time of cataract extraction. There is lesser pupillary dilatation and have greater incidence of capsular rupture, zonular dehiscence and vitreous loss. Pupillary diameter and zonular fragility have been suggested as the most important risk factors for capsular rupture and vitreous loss. The presence of phacodonesis, poor mydriasis, cataract, presence of glaucoma and trabecular pigmentation, reflect the severity of involvement and should serve a warning sign. A shallow anterior chamber may indicate zonular instability.

Zonular instability, which may lead to phacodonesis and lens subluxation, results from three different mechanisms:

1. Initially, active production of PEX material by the pre-equatorial lens epithelium with proliferation through the capsular surface disrupts the zonular lamella and their insertion into the anterior lens capsule.

2. The zonules are separated from their firm origin and anchored in the basement membrane of the nonpigmented ciliary epithelium by locally produced, intercalating PEX fibers.

3. PEX material contains proteolytic enzymes facilitating zonular disintegration.

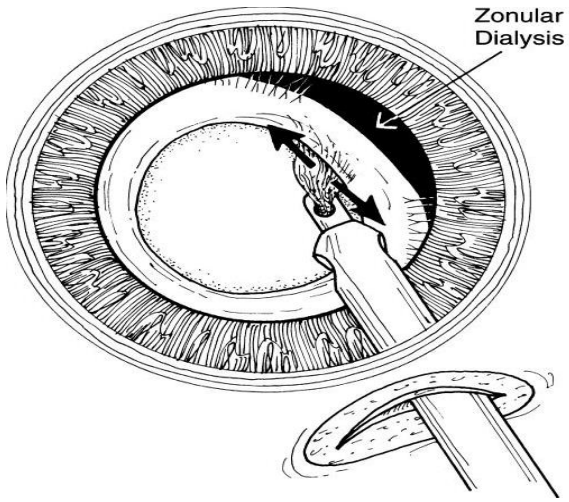


Figure 2: Zonular dialysis

Pre-operative phacodonesis, anterior chamber depth asymmetry and excessive lens movement during anterior capsulotomy should alert to the presence of zonular dialysis.[48]

Post-operatively, transient intraocular pressure elevations and posterior capsular opacification (PCO) are more common. Late postoperative decentration of intraocular lens and capsular bag are common and is related to zonular weakness. Secondary cataract is more common because of aggravated blood-aqueous barrier breakdown.

A study noted a seven fold increase in vitreous loss in 72 patients with PXS undergoing cataract surgery.[49]

Specular microscopy was performed on patients with PXS and the aqueous flare was quantified with laser flare cell meter. It showed that the corneal endothelial cell density was significantly decreased in eyes with PXS and an inverse correlation was shown with the flare. It was concluded that a decrease in the endothelial cells may correlate with a disruption of blood-aqueous barrier and thereby have higher frequency of secondary cataract post cataract surgery.[50,51]

A prospective study performed on 351 patients undergoing cataract surgery revealed that the prevalence of PXS was more in patients older than 70 years. It increased the risk of intra-operative complications either directly (rupture of zonules) or through poor dilation of pupil (rupture of posterior lens capsule). The occurrence of vitreous loss was four fold and the need to use anterior chamber intraocular lens was tenfold in these patients.[52]

Iridophacodonesis, poor dilatation of pupil and presence of glaucoma have been suggested as the clinical factors related to capsular rupture during cataract surgery.[53]

In a study, out of 868 patients who underwent cataract surgery, 10% had PXS and these patients had an increased incidence of insufficient dilatation of pupil, posterior capsular tears, vitreous loss, increase in post-operative intraocular pressure and more frequent opacification of posterior capsule.[54]

Pathophysiological alterations associated with PEX, the consequences of cataract surgery, and the considerations for surgical modifications and

intraocular lens selection was reviewed. Poor mydriasis was stressed as a prominent feature of pseudoexfoliative eyes and its management by injection of high viscosity viscoelastic agent, use of iris hooks, either plastic or metallic was highlighted. Performing sphincterotomy was cautioned, which resulted in persistent dilatation and poor postoperative chemosis. Use of capsular tension rings (CTR) was also advocated.[55]

Foldable intraocular lens is desirable to minimize the induction of blood-aqueous barrier breakdown and the accompanying increased risks for postoperative complications. Also hydrophobic acrylic and silicone are associated with a low rate of PCO, but hydrophobic acrylic has an additional advantage as it causes the least amount of capsular contraction.

CAPSULAR TENSION DEVICES (CTDs):

In 1991, "Equator ring" was introduced for the first time for the maintenance of the completely circular contour of the capsular bag equator after cataract removal and to prevent posterior capsular opacification (PCO) by blocking the posterior movement of the lens epithelial cells at the equator.[56] Later the ring was modified to an open ring with a slim loop.

INDICATIONS:

- All cases of subluxated lens (Focal zonular weakness/small localized zonular dialysis of<3-4 clock hours).
- Zonular laxity/ weakness(mild) - (Focal zonular weakness/small localized zonular dialysis of<3-4 clock hours)
- Pseudoexfoliation and traumatic lens displacement

- Others – Marfan's syndrome, Weil marchesani syndrome, microspherophakia, hypermature cataract, retinitis pigmentosa, lens coloboma, post vitrectomized eye, intra ocular neoplasms and iatrogenic.

TYPES:

1. Capsular tension ring : CTR- Most commonly used
2. Modified CTR : M CTR (Cionni)
3. Capsular tension segment : CTS

The **standard CTR** (Figure 3) is an open-ended, flexible horseshoe-shaped polymethyl methacrylate (PMMA) filament with two eyelets at their ends.[57,58]

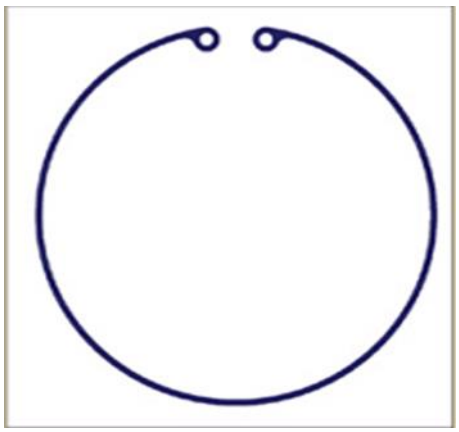


Figure 3: Standard capsular tension ring

Advantages of CTR:

1. Focal zonular dehiscence: Redistribution of capsular forces to stronger zonular support (Figure 4).
2. Reformation of capsular zonular anatomical barrier.

3. Centrifugal pressure applied by the ring makes the flaccid capsular bag more taut.
4. Prevents capsular shrinkage and IOL decentration postoperatively.
5. Prevents postoperative PCO.

The CTR can be inserted after the completion of capsulorrhexis but before hydrodissection.[59]

CTR will convert a high risk case into a routine case when there is compromised zonular integrity. CTR works because the ring diameter is larger than the capsule diameter so that there is centrifugal force on the capsular fornix and this distributes focal forces.[60]Any focal force on the capsule cannot be transmitted only to the adjacent zonules with an unzipping of the zonular apparatus. CTR makes that focal force distributed circumferentially to the entire zonular apparatus (Figure 5).

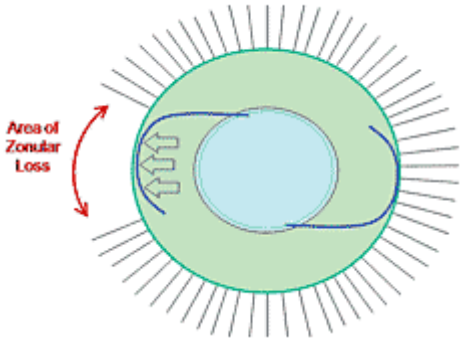


Figure 4: IOL placed in the capsular bag with the haptic at area of zonular loss

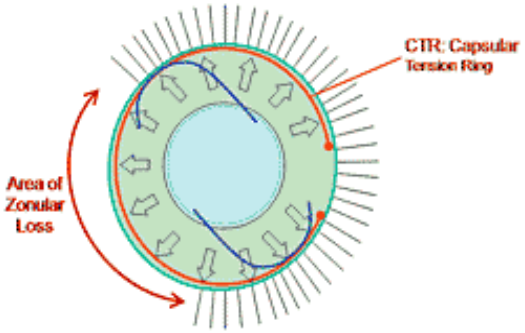


Figure 5: IOL placed in the capsular bag after insertion of CTR which distributes force over the entire capsule

MORCHER CTR TYPES:

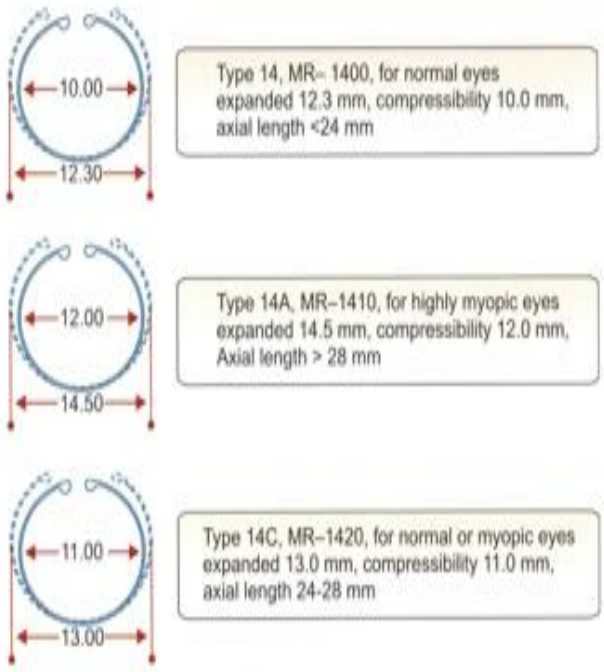


Figure 6: Morcher capsular tension rings

CIONNI CTR:

For a large zonular dehiscence, a suture-fixated, modified Cionni ring (Figure 7) with one or two fixation eyelets will re-expand the capsular bag and secure the capsular bag or intraocular lens complex to the sclera wall.

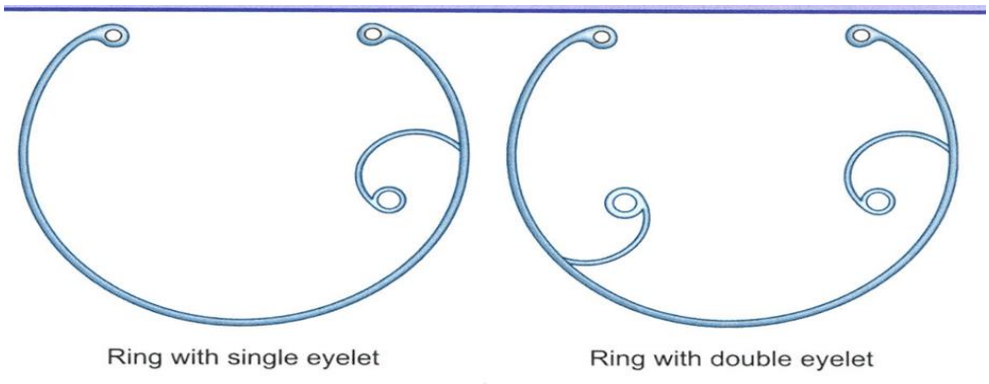


Figure 7: Modified Cionni capsular tension ring

HENDERSON CAPSULAR TENSION RINGS (HCTR):

It is an open C shaped loop made of single piece of PMMA. It features eight equally spaced indentations spanning the circumference of the ring creating a sinusoidal shape (Figure 8).

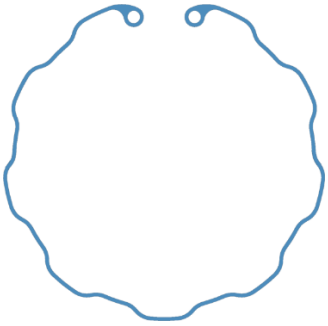


Figure 8: Henderson CTR

Advantage:

The new indentations allow for easier nuclear and cortical material removal while still maintaining the desired stretch of the capsular bag.

CAPSULAR TENSION SEGMENTS (CTS):

In cases of advanced zonulopathy with overt subluxation of the capsular bag, the Capsular Tension Segments (CTS) can be used instead of CTR.

The CTS (Figure 9) is a 120° partial CTR that features an islet positioned within the capsulorrhexis that can receive an iris hook for support. Two CTS can be used to support a very loose bag. The CTS can also be used in eyes with anterior or posterior capsular tears. The CTS are also designed for suture sclera fixation, for long term capsular bag centration.

Figure 9: Capsular tension segment

CONTRAINDICATIONS FOR CTR IMPLANTATION:

CTR implantation is contraindicated in cases where an anterior radial or posterior tear is present. In cases of non-continuous capsulorrhexis, implanting this ring device can be dangerous because the centrifugal forces generated by the CTR may provoke further extension of the capsular tear towards the posterior direction with increased risk of the CTR dislocating posteriorly.

DIFFERENCES BETWEEN CAPSULAR TENSION RING, MODIFIED – CTR AND CAPSULAR TENSION SEGMENT (Table 2):

	CTR	**M-CTR**	**CTS**
Requires continuous curvilinear capsulorhexis	Yes	Yes	No
May be placed prior to lens removal	With difficulty	With difficulty	Yes
Use with anterior capsular tear	No	No	Yes
Use with posterior capsular rent	No	No	Yes
Use with large zonular dialysis	No	Yes	Yes
Use in progressive zonulysis	No	Yes	Yes
Allow for suture fixation to sclera	No	Yes	Yes
May be easily removed from eye if needed	No	No	Yes
Cortical removal difficulty	Yes	Yes	No

CHOOSING THE RIGHT CAPSULAR TENSION DEVICES:

- Evidence of mild zonular instability - CTR based on localization of zonulysis (<4 clock hours)
- Moderate to severe zonular weakness - M-CTR and CTS

PREOPERATIVE EVALUATION:

1. Areas of zonular weakness.
2. Presence or absence of vitreous prolapse or phacodonesis.
3. Additional ocular pathologies affecting visual outcome.
4. Systemic examination.(Marfan's syndrome)

ASSESSMENT OF ZONULAR WEAKNESS:

- **Preoperative:**

1. Lens phacodonesis
2. Lens decentration
3. Lens edge and
4. Zonular dehiscence in clock hours

- **Intraoperative:**

1. Flacidity of anterior capsule
2. Capsular wrinkling/ infolding on initial puncture
3. Ovalization of CCC- mild zonular weakness
4. Movement of entire lens/ tilting of lens during capsulorhexis/phacoemulsification- moderate to severe weakness

INSERTION TECHNIQUES:

1) Using the universal CTR injector

- Step-I: load the injector
- Step-II: introduce the CTR into the capsular bag
- Step-III: disengage the CTR from the injector

2) Manual insertion of CTR

- Step-I: Grasp the CTR
- Step-II: introduce and dial the CTR into the capsular bag

COMPLICATIONS:

1. Endocapsular drop.
2. Trapping of cortex in the capsular fornix.
3. Iris chaffing.
4. Pigment dispersion.
5. Chronic uveitis.
6. Rarely IOL/CTR/capsular bag complex subluxation-Late postoperatively.

KEY POINTS TO SUCCESSFUL CTR IMPLANTATION:

- Use high-viscosity viscoelastic material.
- Making the incision at a meridian with intact zonules.
- Avoid damaging zonular fibers with the movement of the phacotip
- Perform slow-motion phacoemulsification with a low flow rate, low vacuum and low bottle height.

MANAGEMENT OF PSEUDOEXFOLIATION SYNDROME BY CATARACT SURGERY [60, 61, 62, 63]

There are several important points to remember for cataract surgery in eyes with PXS.

1. MAKING THE DIAGNOSIS:

Limited pharmacological mydriasis can adversely affect the ability to make the diagnosis. Flaky deposits on the corneal endothelium is one clue in assessing the condition. This material can be differentiated from true keratic precipitate by their bright white color and fluffy appearance. When differentiation is difficult, one to two week course of topical steroids can aid in diagnosis, as keratic precipitates change in appearance or location or disappear with topical steroid use but have no effect on PEX material.

An unusually shallow anterior chamber depth from zonular instability can indicate PEX especially if it is asymmetrical. Even if PEX material is not clinically visible on the corneal endothelium, the cell count may be significantly reduced and the cells that remain may not function well, hence additional endothelial protection including a “pseudoplastic” viscoelastic such as healon is advised.

2. MAXIMAL DILATATION OF PUPIL DURING SURGERY:

Poor mydriasis, a well-known feature of PXS can seriously hamper the surgeon’s view, additional pupillary dilatation may also be necessary. Several mechanical means can temporarily dilate the pupil during surgery.

These include flexible iris retractors, titanium iris retractors, flexible pupil dilating rings and rigid dilating rings. Pupil stretching maneuvers like sphincterotomies are an inexpensive and easier alternative. While these are effective, excessive inflammatory responses due to the compromised blood-aqueous barrier in these eyes are well documented. Further, the iris is more flaccid in PEX syndrome and more likely to be inadvertently aspirated; mechanical means to augment mydriasis is to also keep the floppy iris margin away from the aspiration port or cannula. Care should be taken to avoid excessive iris trauma and over-inflation of the anterior chamber with viscoelastic, which can cause posterior pressure on the lens and can further damage the weakened zonules.

3. ENSURING ADEQUATE CAPSULORHEXIS/CAPSULOTOMY.

Capsulorhexis/ capsulotomy creation is more difficult in these cases, as there is no counter-traction during tearing of the anterior lens capsule. This can present as a star pattern of capsular folds radiating from the instrument when piercing the anterior lens capsule with wrinkling and looseness of the capsule.

The solution, as described by Thomas Neuhann of Germany, is to provide counter-traction via the non-dominant hand using a chopper or other second instrument via the paracentesis, while using the dominant hand to perform the capsulorhexis via the main incision. Because of the tendency for anterior capsular phimosis and further zonular stress, a large capsulorhexis should be performed, at least 5.5 mm in diameter. Staining the capsule with

indocyanine green or trypan blue is useful. The PEX material has a higher affinity for indocyanine green stain than unaffected capsule.

4. ATTENTION TO PHACODONESIS WHILE PERFORMING CAPSULORHEXIS / CAPSULOTOMY:

Weak zonules is one of the most notorious, common and significant problem faced by cataract surgeon in PXS. The degree of weakening though highly variable appears to increase with apparently increasing amount of deposits. Dislocation of the nucleus into the vitreous cavity may occur even during routine hydrodissection. During capsulorhexis or capsulotomy creation, diffuse zonular weakness or laxity may be noted. Once this weakness is apparent, the risk of creating zonular dialysis is large. In such cases, flexible “iris” retractors can engage the capsulorhexis margin and stabilize the loosened capsular bag.

5. MANAGEMENT OF ZONULAR DIALYSIS:

If a small or moderate zonular dehiscence occurs, a standard capsular tension ring can re-expand the capsular bag and redistribute the mechanical stress evenly across the remaining zonules. The capsular tension ring (CTR) can be manually implanted into the fornix of the capsular bag or injected with the inserter device.

6. CHOICE OF INTRAOCULAR LENS:

Capsular contraction is more likely since there is reduced zonular counter-traction against the centripetal forces of the remaining lens epithelial

cells. Capsulorhexis of 5mm or greater and use of a capsular tension ring to reduce the risk of this complication is advisable. As capsular contraction is more common with silicone intraocular lens, therefore another material is preferred.

An intraocular lens with a sharp posterior edge to reduce lens epithelial cell migration and subsequent posterior capsular opacification is recommended. PXS adds to the challenges of cataract surgery. Some of these challenges are significant. With the use of dyes, capsule retractors and implant rings and meticulous attention to surgical technique, cataract surgery in PXS may be safely performed.

MATERIALS AND METHODS

MATERIALS AND METHODS:

TITLE OF THE STUDY:

Evaluation of capsular tension ring implantation in phacoemulsification of cataracts with pseudoexfoliation syndrome.

SOURCE OF DATA:

Patients admitted with cataract with pseudoexfolition syndrome at R.L.J. HOSPITAL AND RESEARCH CENTRE, TAMAKA, KOLAR attached to SRI DEVRAJ URS MEDICAL COLLEGE between December 2013 to July 2015 were prospectively analyzed. Total number of 100 cases of acquired cataract fulfilling the selection criteria were included in the study after their informed consent.

SAMPLE SIZE:

A total number of 100 patients of cataract with pseudoexfoliation syndrome, were selected for the study. These patients were divided into two groups:

Group I (50 eyes) had a CTR implanted during phacoemulsification after the initial steps of capsulorrhexis and hydrodissection.

The other **Group II** (50 eyes) had no CTR implanted during phacoemulsification procedure and served as a control group.

INCLUSION CRITERA:

Patients with cataract with pseudoexfoliation syndrome

EXCLUSION CRITERIA:

Patients with:

1. Complicated cataract (Secondary to glaucoma, uveitis, and high myopia.)
2. Traumatic cataract.
3. Cataract secondary to systemic diseases(secondary to diabetes, steroids, skin disease)

PREOPERATIVE EVALUATION:

1. Detailed ocular and systemic history was taken.
2. General physical examination was done.
3. Best corrected visual acuity was recorded.
4. Pupillary reactions were noted
5. Slit lamp biomicroscopic examination was done for the evidence of the following findings.

- Pseudoexfoliation material in the pupillary margins.
- Moth eaten appearance of the iris.
- Morphological alterations of the cornea
- Anterior chamber depth and pigment dispersion in the anterior chamber
- Iridodonesis.
- Presence of posterior synechiae.
- Zones of Pseudoexfoliation on the anterior surface of the lens capsule.
- Phacodonesis or frank subluxation/dislocation of lens.

6. Direct ophthalmoscopy and indirect ophthalmoscopy was done to assess the fundus and the presence of retinal breaks or detachments, apparent diabetic retinopathy/ maculopathy.
7. Gonioscopy with Goldmann three mirror lens was done.

8. Intraocular pressure measurement was done by applanation tonometry.
9. Lacrimal Syringing was done to check for patency of lacrimal passage.
10. B-scan was done to rule out posterior segment pathology in case of dense cataracts.
11. Keratometry was done for corneal curvature
12. A-scan was done for calculation of IOL power using SRK-II formula
13. Routine blood investigations, fasting blood sugar, postprandial blood sugar and urine tests were done for all patients.

Informed consent was taken from all the patients prior to the surgery. All patients received systemic (Tab Ciprofloxacin 500mg) and topical antibiotics (0.5% Moxifloxacin eye drops) one day prior to surgery. The topical antibiotics were instilled every two hours until the time of surgery. Eye lashes were trimmed on the previous day. On the day of surgery, pupils were dilated adequately with 0.8% tropicamide & 5% phenylephrine eye drops every 10 minutes, one hour before surgery. To sustain the dilatation 0.03% flurbiprofen was instilled half hourly for two hours before surgery. All operations were performed by a single experienced surgeon using the same technique.

SURGICAL TECHNIQUE:

GROUP 1: CTR IMPLANTATION TECHNIQUE DONE AS FOLLOWS:

- After peribulbar anaesthesia, a 3.2 mm temporal clear corneal incision was made with a crescent blade.
- The anterior chamber was filled with sodium hyaluronate 3.0%- chondroitin sulphate 4.0%.

- Trypan blue dye was used to stain and visualize the anterior lens capsule as and when required.
- Adequate capsulorhexis was performed with bent 26 G cystitome needle.
- All capsulocortical attachments were loosened by careful hydrodissection and a bimanual technique using two hooks was used to facilitate the gentle rotation of the nucleus.
- A polymethylmethacrylate (PMMA) injectable capsular Tension ring (CTR) was inserted under the capsulorhexis edge with a forceps. In eyes with normal axial length, 12 or 11 mm CTR was used. In eyes with axial length longer than 25 mm, a 13 mm CTR was implanted.
- Phacoemulsification was performed using a stop and chop technique in all cases.
- After the cortex removal, the capsular bag was filled with sodium hyaluronate 1%. Then a foldable hydrophobic acrylic intraocular lens was implanted in the bag.
- In cases with posterior capsular rupture without zonular dialysis, a 3 piece foldable IOL was implanted in the sulcus after anterior vitrectomy.

GROUP 2: WITHOUT CTR IMPLANTATION DONE AS FOLLOWS:

- After peribulbar anaesthesia, a 3.2 mm temporal clear corneal incision was made with a crescent blade.
- The anterior chamber was filled with sodium hyaluronate 3.0%- chondroitin sulphate 4.0%.
- Trypan blue dye was used to stain and visualize the anterior lens capsule as and when required.

- Adequate capsulorhexis was performed with bent 26 G cystitome needle.
- All capsulocortical attachments were loosened by careful hydrodissection and a bimanual technique using two hooks was used to facilitate the gentle rotation of the nucleus.
- Phacoemulsification was performed using a stop and chop technique in all cases.
- After the cortex removal, the capsular bag was filled with sodium hyaluronate 1%. Then a foldable hydrophobic acrylic intraocular lens was implanted in the bag.
- In cases with posterior capsular rupture without zonular dialysis a 3 piece foldable IOL was implanted in the sulcus after anterior vitrectomy.

Postoperatively all patients received a course of topical antibiotic (0.5% moxifloxacin) and steroid (1% prednisolone acetate) eye drops hourly followed by a tapering dose for 6 weeks along with 0.3% nepafenac eye drops TID for 4 weeks. Injection Diclofenac stat was given to patients who complained of pain. Systemic antibiotics Tab Ciprofloxacin 500mg was given for 5 days postoperatively.

All the surgeries were performed by single experienced surgeon and any intraoperative complications were noted. Postoperatively the patient was evaluated on 1st day, 1st week, 1st month, 3rd and 6th month for any postoperative complications.

The total duration of follow up was 6 months. At each postoperative visit, the patients were subjected to the following examinations:

1. Best corrected visual acuity for distant and near.
2. Slit lamp evaluation.
3. Fundus examination.

STATISTICAL ANALYSIS

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. The following assumptions on data is made, **Assumptions: 1.**Dependent variables should be normally distributed, 2.Samples drawn from the population should be random. Cases of the samples should be independent.

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

RESULTS

OBSERVATION AND RESULTS

A prospective, comparative study of evaluation of capsular tension ring implantation in phacoemulsification of cataracts with pseudoexfoliation syndrome was conducted at R.L.Jalappa hospital attached to Sri DevarajUrs Medical College. 100 cases were studied, of which 50 cases (Group 1) underwent phacoemulsification with PCIOL and CTR implantation and remaining 50 cases (Group 2) underwent phacoemulsification with PCIOL implantation and served as control group.

Table 3: Age distribution of patients

Age in years	Group I		Group II	
	No	%	No	%
<50	0	0.0	1	2.0
50-60	16	32.0	19	38.0
61-70	24	48.0	27	54.0
71-80	7	14.0	3	6.0
>80	3	6.0	0	0.0
Total	50	100.0	50	100.0
Mean ± SD	66.06±8.97		63.72±7.28	

Samples are age matched with P=0.155

Our study included 1 (1%) patient in age group <50 years, 35 (35%)patients in the age group 50-60 years, 51 (51%) patients in the age group 61-70 years, 10 (10%) patients in the age group 71-80 years and 3 (3%) patients >80 years. The mean age was 66.06±8.97 and 63.72±7.28 years in group I and group II respectively. p value by chi square test showed 0.15, indicating no statistical significance.

GRAPH 1: SHOWING AGE DISTRIBUTION

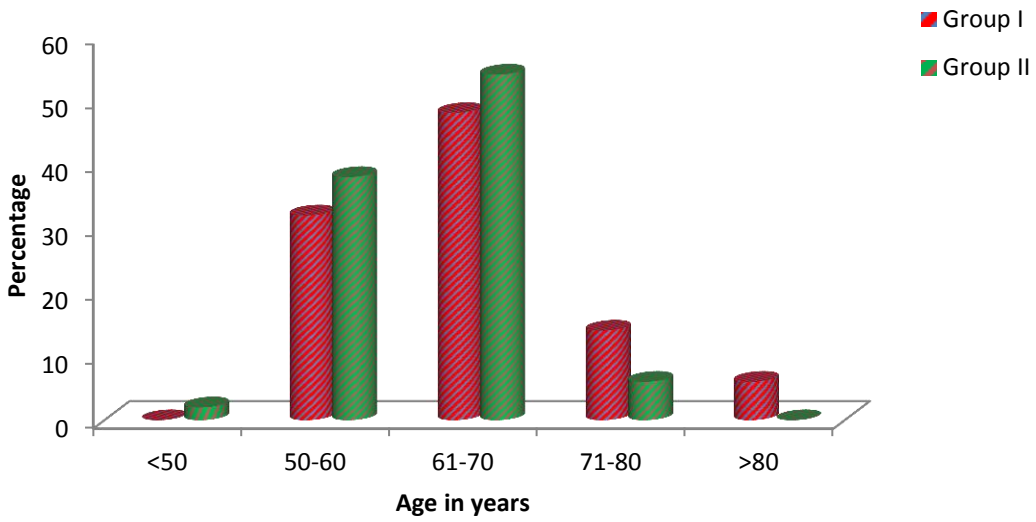


Table 4: Gender distribution of patients studied

Gender	Group I		Group II	
	No	%	No	%
Female	31	62.0	26	52.0
Male	19	38.0	24	48.0
Total	50	100.0	50	100.0

Samples are gender matched with P=0.313

Our study included 19(38%) males and 31(62%) females in group I and 24(48%) males and 26(52%) females in group II. p value by chi square test showed 0.313, indicating no statistical significance.

GRAPH 2: SHOWING GENDER DISTRIBUTION

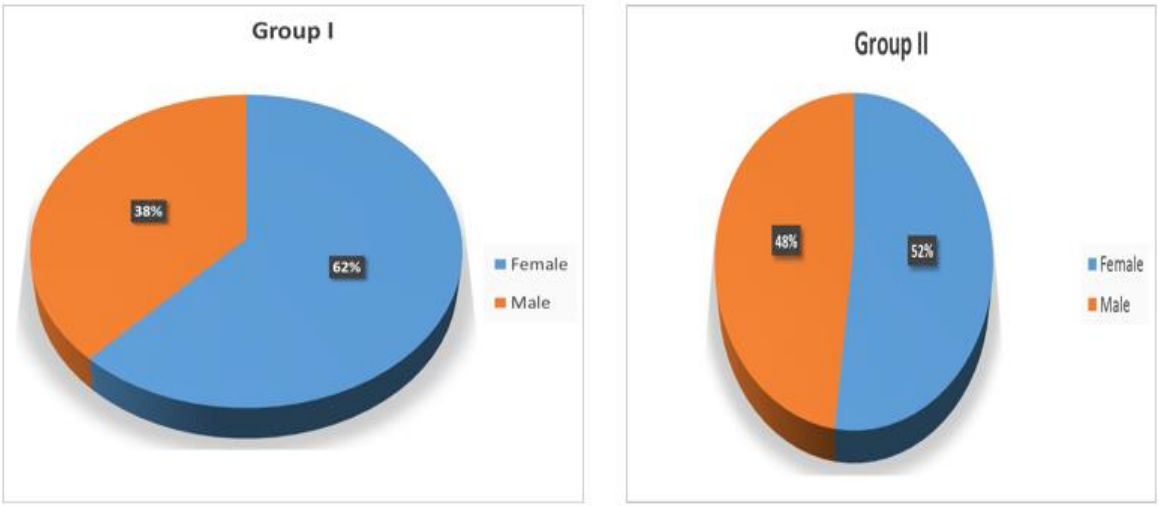


Table 5: Eye Involved in two groups of patients studied

Eye Involved	Group I		Group II	
	No	%	No	%
Left eye	16	32.0	19	38.0
Right eye	34	68.0	31	62.0
Total	50	100.0	50	100.0

P=0.529

Among the 100 patients 65 patients were operated for right eye and 35 patients were operated for left eye. p value by chi square test showed 0.529, indicating no statistical significance.

GRAPH 3: SHOWING LATERALITY IN EYES

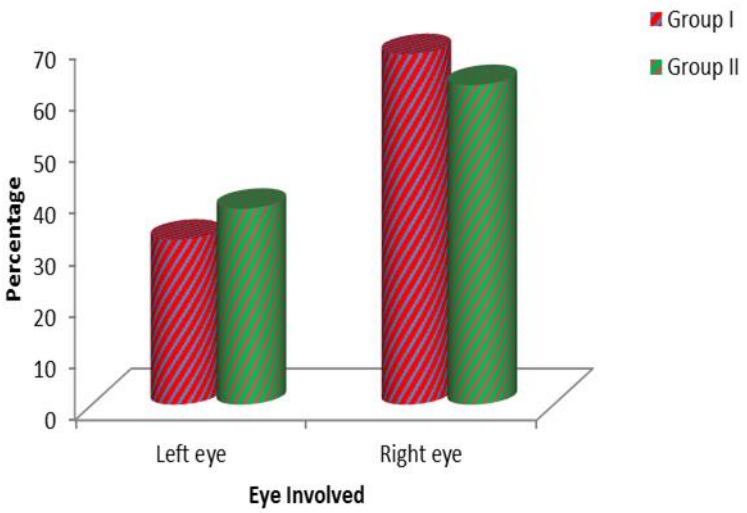


TABLE 6: PREOPERATIVE VISUAL ACUITY

VISUAL ACUITY	GROUP I		GROUP II	
	NO OF PATIENTS	%	NO OF PATIENTS	%
6/24-6/36	-	-	1	2%
</= 6/60	50	100%	49	98%
TOTAL	50	100	50	100

In the present study, preoperative visual acuity was recorded in both Group I i.e. Phacoemulsification with PCIOL and CTR implantation and in group II i.e. Phacoemulsification with PCIOL implantation only. In group I we see visual acuity was </= 6/60 in 50 (100%) patients. In group II we see visual acuity was 6/24-6/36 in 1(2%) patient and >/= 6/60 in 49 (98%) patients. p value by chi square test showed 0.4 indicating no statistical significance.

GRAPH 4: PREOPERATIVE VISUAL ACUITY

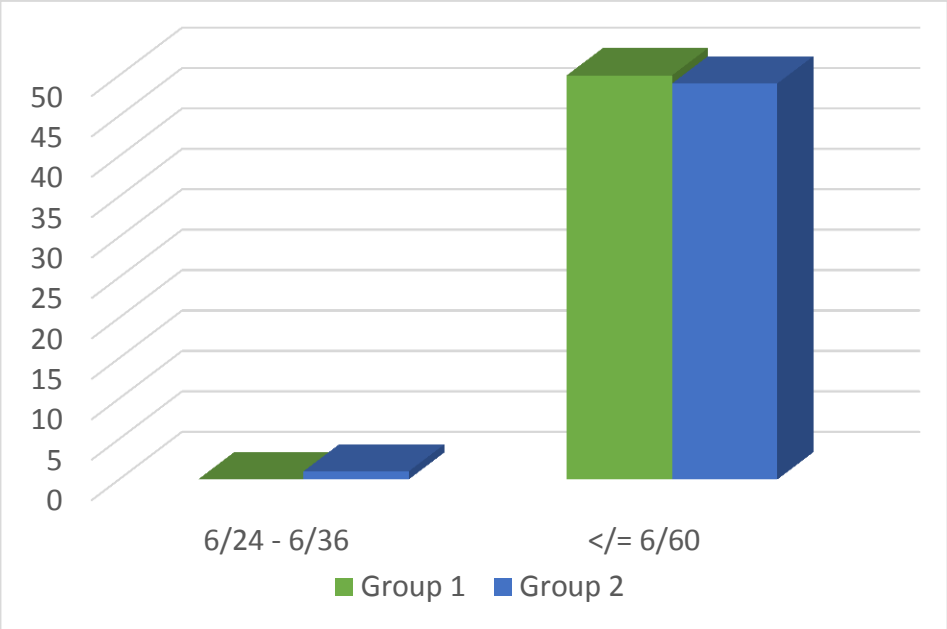


TABLE 7: INTRAOPERATIVE COMPLICATIONS

Intraoperative Complications	Group I (n=50)		Group II (n=50)		P value
	No	%	No	%	
Small pupil	10	20	11	22	0.247
Extension of capsulorhexis	2	4	2	4	0.614
Zonular separation	1	2	6	12	0.013
Posterior capsule rupture	2	4	8	16	0.042
Vitreous loss	1	2	4	8	0.173

In the present study intra operative complications was documented in both the groups. Small pupil was present in 10 (20%) patients in group I and 11(22%) patients in group II, which was not statistically significant (p =0.247). Extension of capsulorhexis was seen in 2(4%) patients in group I and group II with p value 0.614

which was not statistically significant**.** 1(2%) patient in group I had zonular separation while 6 (12%) patients in group II had zonular separation, **with p value 0.013 which was statistically significant**. Posterior capsular rupture was observed in 2(4%) patients in group I and 8(16%) patients in group II which **was statistically significant (p=0.042).** There was 1(2%) vitreous loss observed in group I and 4(8%) in group II which was not statistically significant (p = 0.173).

GRAPH 5: INTRAOPERATIVE COMPLICATIONS

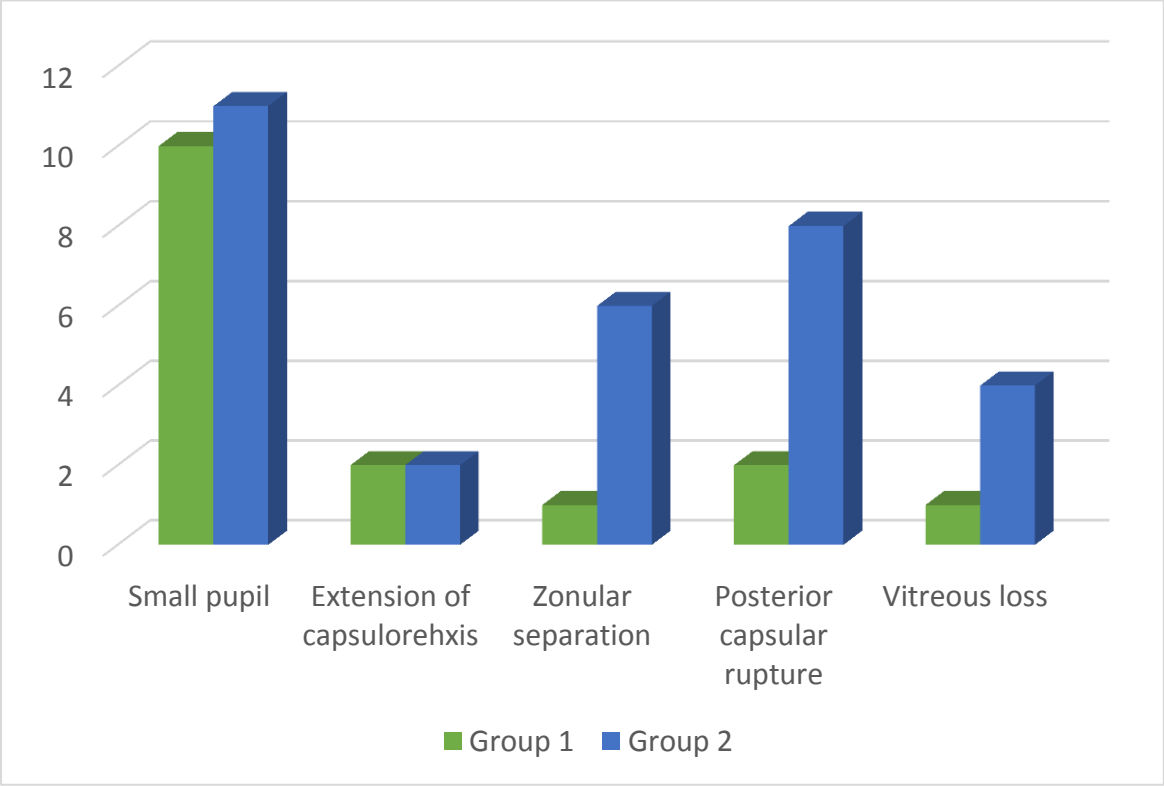


TABLE 8: POSTOPERATIVE BESTCORRECTED VISUAL ACUITY IN GROUP I (WITH CTR IMPLANTATION)

BCVA	1st day	1st week	1st month	3rd month	6th month
• 6/6-6/9	32(64%)	41(82%)	45(90%)	43(86%)	46(92%)
• 6/12-6/18	16(32%)	7(14%)	5(10%)	6(12%)	4(8%)
• 6/24-6/36	2(4%)	2(4%)	0(0%)	1(2%)	0(0%)
• < 6/60	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)

In the present study best corrected visual acuity was documented in both the groups. In group I, on first post-operative day 32(64%) patients had visual acuity in the range of 6/6-6/9, 16 (32%) patients had visual acuity in the range of 6/12-6/18 and 2(4%) patients had visual acuity in the range of 6/24-6/36. On 1 week post-operative, 41(82%) patients had visual acuity in the range of 6/6-6/9, 7(14%) patients had visual acuity in the range of 6/12-6/18 and 2(4%) patient had visual acuity in the range of 6/24-6/36. On 1 month post-operative, 45 (90%) patients had visual acuity in the range of 6/6-6/9, 5(10%) patients had visual acuity in the range of 6/12-6/18. On 3rd month post- operative, 43(86%) patients had visual acuity in the range of 6/6-6/9, 6(12%) were in the range of 6/12-6/18 and 1(2%) patient had visual acuity of 6/24-6/36. At the end of 6 months, 46(92%) patients had visual acuity in the range of 6/6-6/9 and 4(8%) patients had visual acuity of 6/12-6/18.

GRAPH 6: POSTOPERATIVE BESTCORRECTED VISUAL ACUITY IN GROUP I (WITH CTR IMPLANTATION):

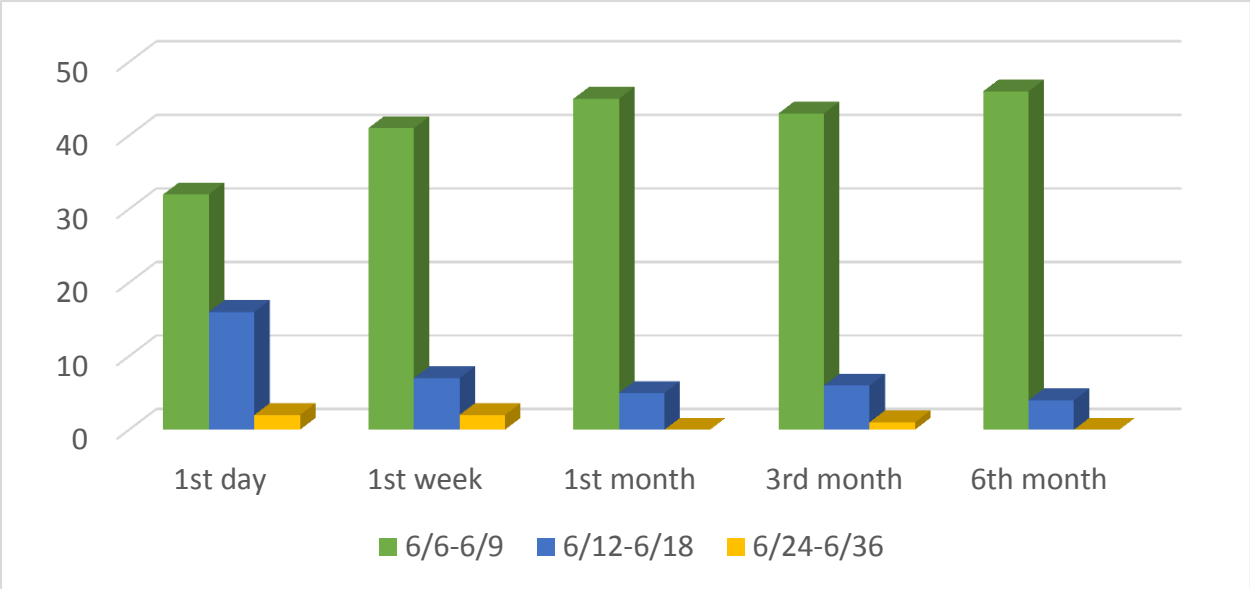


TABLE 9: POSTOPERATIVE BEST CORRECTED VISUAL ACUITY IN GROUP II (WITHOUT CTR IMPLANTATION)

BCVA	1st day	1st week	1st month	3rd month	6th month
• 6/6-6/9	25(50%)	38(76%)	41(82%)	43(86%)	44(88%)
• 6/12-6/18	25(50%)	12(24%)	9(18%)	7(14%)	6(12%)
• 6/24-6/36	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
• </= 6/60	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)

In group II, on first post-operative day, 25(50%) patients had visual acuity in the range of 6/6-6/9, 25(50%) patients had visual acuity in the range of 6/12-6/18. On 1 week post-operative, 38(76%) patients had visual acuity in the range of 6/6-6/9, 12(24%) patients had visual acuity in the range of 6/12-6/. On 1 month post-operative, 41(82%) patients had visual acuity in the range of 6/6-6/9 and 9(18%) patients had visual acuity in the range of 6/12-6/18. On 3rd month post-operative, 43(86%) patients had visual acuity in the range of 6/6-6/9 and 7(14%) had visual acuity of 6/12-6/18. On 6th month post-operative, 44(88%) patients had visual acuity in the range of 6/6-6/9 and 6 (12%) patients had visual acuity in the range of 6/12-6/18.

GRAPH 7: POSTOPERATIVE BESTCORRECTED VISUAL ACUITY IN GROUP II (WITHOUT CTR IMPLANTATION):

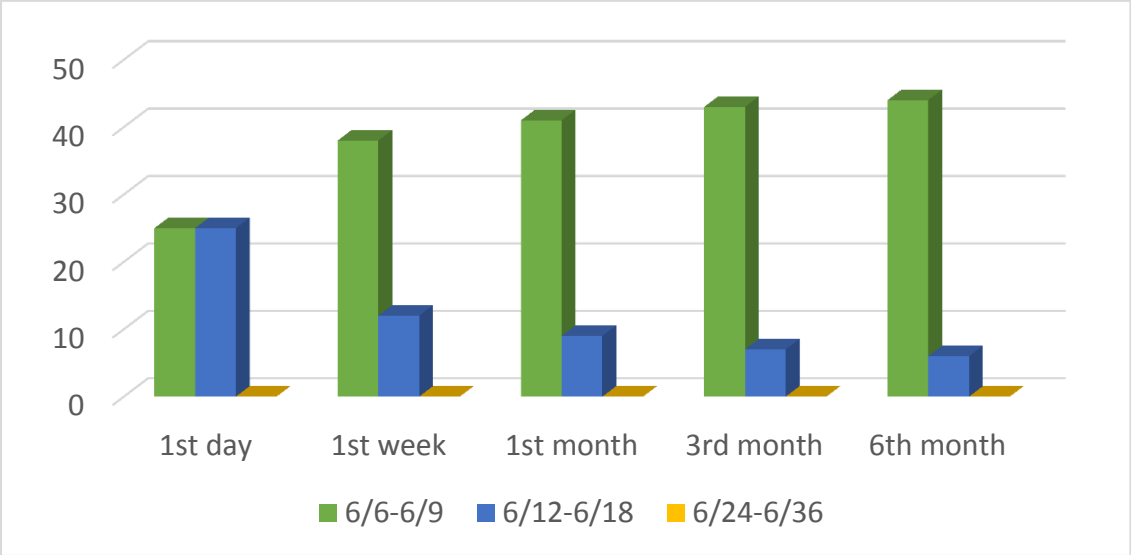
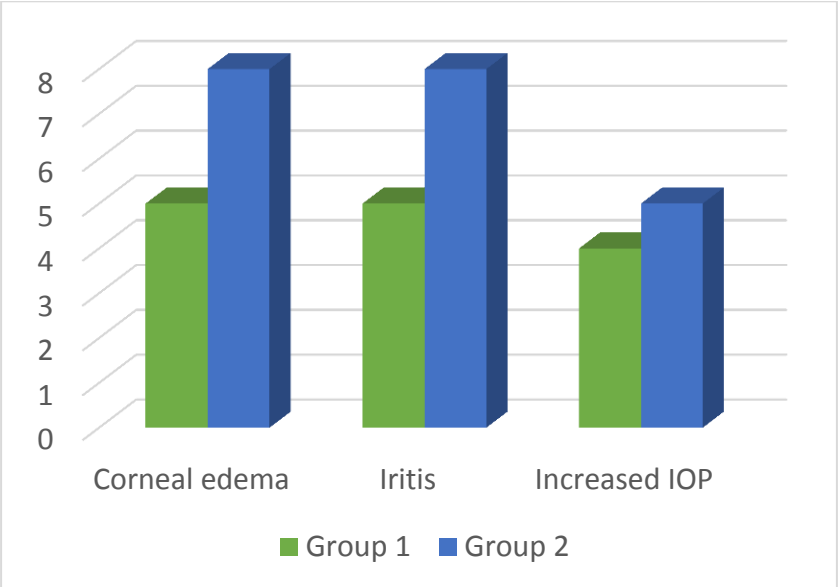


TABLE 10: POSTOPERATIVE COMPLICATIONS:

Postoperative Complications	Group I (n=50)		Group II (n=50)		P value
	No	%	No	%	
Corneal edema	5	10.0	8	16.0	0.372
Iritis	5	10.0	8	16.0	0.372
Increased IOP	4	8.0	5	10.0	0.632

In the present study postoperative complications was documented in both the groups. Corneal edema and iritis was observed in 5(10%) cases in group I and 8(16%) cases in group II (p value=0.372), which was not statistically significant. Also postoperatively there was rise in IOP in 4(8%) patients in group I and 5 (10%) patients in group II (p value = 0.632), which was not statistically significant.

GRAPH 8: SHOWING POSTOPERATIVE COMPLICATIONS



DISCUSSION

DISCUSSION

This study was done to study the safety and efficacy of capsular tension ring implantation in cataracts with pseudoexfoliation syndrome in terms of intraoperative and postoperative complications and to assess the visual acuity postoperatively in CTR and non CTR implanted patients.

Hundred patients attending to outpatient department of ophthalmology, R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICAL COLLEGE, TAMAKA, KOLAR with cataracts with pseudoexfoliation syndrome fulfilling the inclusion criteria framed, were selected for the study between December 2013 to July 2015. The patients were randomly divided into two groups of 50 patients each (Group I- with CTR implantation & group II- without CTR implantation). Detailed preoperative evaluation of ocular and systemic examination was done.

As shown in **Table 3**, our study included 1 (1%) patient in age group <50 years, 35 (35%) patients in the age group 50-60 years, 51 (51%) patients in the age group 61-70 years, 10 (10%) patients in the age group 71-80 years and 3 (3%) patients >80 years. The mean age was 66.06±8.97 and 63.72±7.28 years in group 1 and group 2 respectively.

It usually occurs between 60 to 80 years, the average age being 70 years. Epidemiological studies of PXS have shown that it is more common in patients older than 60 years and prevalence further increases with age.[64] Population-based studies from south India has reported the prevalence of PXS to be between 3.8% and 6.0% among persons aged >40 years.[65] In this study, 64% of the patients are in the age group of 60 – 90 years which is in concurrence with the mentioned studies.

As shown in **Table 4**, 43 (43%) were males and 57 (57%) were females. Studies regarding the sex distribution of PEX syndrome are conflicting. Some studies showed male preponderance while **Aravind** et al. in 2003 showed no sex predilection.[27] **Avramides, Sakkias and Traindis** reported a female preponderance.[66]

Among the 100 patients, 65 patients were operated for right eye and 35 patients were operated for left eye as shown in **table 5**. Comparing the frequency of monocular versus binocular involvement, a study by **Bangal S** indicated bilateral involvement to be more common.[67] **Hammer, Schlotzer- Schrehardt, Naumann** in 2001 carried out an ultrastructural study which concluded that basically PXS is a bilateral disease with clinically marked asymmetric manifestations. Clinically unilateral involvement is often a precursor to bilateral involvement within 5- 10 years after diagnosis.[68]

Preoperative visual acuity recording in both group I and group II was done **(Table 6)**. After all necessary preoperative investigations patients were posted for phacoemulsification surgery. In group I CTR was implanted which was followed by phacoemulsification with foldable IOL implantation. In group II, patients underwent routine phacoemulsification with foldable IOL implantation.

In the present study intra operative complications was documented in both the groups **(Table 7)**. Small pupil was present in 10(20%) patients in group I and 11(22%) patients in group II with p = 0.247, which was not statistically significant. Extension of capsulorhexis was seen in 2(4%) patients in group I and group II with p value 0.614 which was not statistically significant. 1(2%) patient in group I had zonular separation during surgery. In group II, zonular separation occurred in 6 eyes (12%). The rate of intraoperative zonular dialysis was statistically significant between the 2 groups (p= 0.013). Posterior capsular rupture was found in 2(4%) patients in

group I and 8(16%) patients in group II, which was statistically significant (p=0.042). Our data indicates 2% vitreous loss in group I and 8% in group II, which is related to capsular rupture, which was not statistically significant (p = 0.173).

The small pupillary diameter and zonular fragility are presumed to be the most important risk factors for capsular rupture and vitreous loss during cataract surgery. According to some authors, zonular instability is more essential than poor pupil dilation.

Avramides S, Trainanidis P, Sakkias G in their study of 84 patients with PXS who underwent ECCE, noted that 61.90% of them had pupillary dilatation less than 5 mm.[66]

Asano N, Schlotze – Scherhardt, Naumann attributed poor mydriasis in PXS to degenerative changes of sphincter and dilator muscle tissues and apparent involvement of the muscle cells in PEX fiber formation.[69] **Repo L.P. et al** found degenerative changes in both the stromal tissue and in the muscular layer of iris and regarded this as one of the causes for miosis. The use of pupil stretching devices is reported to overcome the problems of insufficient mydriasis.[41]In our study, iris retractors and intracameral adrenaline were used to dilate the pupil.

According to **Fine H and Hoffman RS**, special care and attention is required while performing capsulorhexis because traction on the capsule can further damage the weakened zonules.[70]These forces should be neutralized to avoid an equatorial extension of the capsulorhexis. According to **Pranathi et al,** capsule splitting phenomenon may be observed in which multiple layers of split capsule may be raised. The false anterior layers are typically fragile and tear abnormally in comparison to the underlying true anterior capsule. It is important to identify this phenomenon to allow complete incision of true capsule.[71]

The decreased incidence of zonular dialysis in group I (CTR group) is evidence that the ring is effective in preventing zonular separation during phacoemulsification in eyes with PXS.

The CTR was implanted successfully in all eyes in group 1. The CTR can be inserted at any stage of cataract surgery. However, the optimal timing remains controversial. To support the area of zonular weakness and distribute the forces equally over all zonules, the CTR is usually inserted after hydrodissection and before phacoemulsification.[72]The placement of the ring allows the completion of surgery and IOL implantation without complications in the eyes with zonular dehiscence. After a mean follow-up of 6 months, we did not notice signs of IOL decentration, capsular contraction syndrome or extrusion of the ring through the bag.

Alfaite et al, in their study of 31 patients found zonular dehiscence to be more common in eyes with PXS but this was not statistically significant when compared to eyes without PXS. In a study by **Jawad et al**, 8 patients (4%) had zonular dialysis.[64] Intraoperative extension of the dialysis occurred in 2 eyes (9.52%) in a study by **Jacob S et al**.[72]

Küchle found an intraoperative complication rate of 13.4% in the eyes with an anterior chamber depth less than 2.5 mm and 2.8% in eyes with an anterior chamber depth of 2.5 mm or more.[73]This finding suggests that preoperative reduced anterior chamber depth indicates zonular instability and should therefore alert the surgeon to the possibility of intraocular complications related to zonular dialysis.

Capsular tension rings can also be used to help prevent intraoperative posterior capsule rupture by keeping the posterior capsule taut, preventing its anterior bulging and protecting it from being aspirated by phaco or irrigation/aspiration tips during phacoemulsification and cortical aspiration. This is consistent with previous report

that capsular rupture is more common in patients with pseudoexfoliation. Thus, CTR increases the rate of primary in the bag IOL implantation, preventing the complications of implantation of a different type of IOL at a different site and of a secondary procedure.

In a study by **Naumann et al,** although the posterior capsule is of normal thickness, capsular rupture is more common in the eyes with pseudoexfoliation with an occurrence of up to 27% as compared to 2% in the control eyes.[1]

. When a posterior capsular tear occurs (with or without vitreous loss), an intact anterior capsular ring can still provide excellent support for a posterior chamber intraocular lens (PCIOL) with the optic placed anterior to the capsulotomy and the haptics placed in the ciliary sulcus.

In a study by **Bayraktar et al**, there were no cases of zonular dialysis reported in CTR group while 5 eyes (12.8%) in the control group had intraoperative zonular dialysis. Posterior capsule rupture occurred in 2 eyes (5.2%) in CTR group and 3(7.7%) in control group.[11]

According to a study conducted by **Bangal S**, posterior capsular rupture was found in 6% of patients and 4% had vitreous loss, which is related to capsular rupture.[67]

Vitreous prolapse in 21 (10.5%) patients and posterior capsular rupture in 18 (9%) patients were the most common complications seen in pseudoexfoliation in a study conducted by **Jawad et al**.[64]

In a study by **Scorolli L et al**, the odds ratio for intraoperative complications such as capsular tears, zonular break, and vitreous loss was estimated to be 5.1 for patients with PEX compared to normal patients. PEX was associated with a statistically significant increase in intraoperative complications during cataract

surgery ($p<0.0001$).[74] **Drolsum et al.**, found a frequency of 9.6% of capsular tear, zonular tear or vitreous loss in eyes with PEX.[75]

According to **Zetterström C**, zonular instability increases the risk of lens subluxation, zonular dialysis or vitreous loss up to ten times.[76]In a study by **Naumann GO**, vitreous loss in patients with pseudoexfoliation has been reported to be five times more common than in patients without this disorder (9.0% vs.1.8%) which is related to an increased incidence of zonular dialysis, lens subluxation and capsular rupture.[8]

In our study postoperative best corrected visual acuity in group I (with CTR implantation) (Table 8) was in the range of 6/6-6/9 in 32(64%) patients on first post-operative day, 16 (32%) patients had visual acuity in the range of 6/12-6/18 and 2(4%) patients had visual acuity in the range of 6/24-6/36. On 1 week post-operative, 41(82%) patients had visual acuity in the range of 6/6-6/9, 7(14%) patients had visual acuity in the range of 6/12-6/18 and 2(4%) patient had visual acuity in the range of 6/24-6/36. On 1 month post-operative, 45 (90%) patients had visual acuity in the range of 6/6-6/9, 5(10%) patients had visual acuity in the range of 6/12-6/18. On 3rd month post- operative, 43(86%) patients had visual acuity in the range of 6/6-6/9, 6(12%) were in the range of 6/12-6/18 and 1(2%) patient had visual acuity of 6/24-6/36. At the end of 6 months, 46(92%) patients had visual acuity in the range of 6/6-6/9 and 4(8%) patients had visual acuity of 6/12-6/18.

In our study postoperative best corrected visual acuity in group II (without CTR implantation) (Table 9) was in the range of 6/6-6/9 in 25(50%) patients on first post-operative day,25(50%) patients had visual acuity in the range of 6/12-6/18. On 1 week post-operative, 38(76%) patients had visual acuity in the range of 6/6-6/9, 12(24%) patients had visual acuity in the range of 6/12-6/. On 1 month

post-operative, 41(82%) patients had visual acuity in the range of 6/6-6/9 and 9(18%) patients had visual acuity in the range of 6/12-6/18. On 3rd month post-operative, 43(86%) patients had visual acuity in the range of 6/6-6/9 and 7(14%) had visual acuity of 6/12-6/18. On 6th month post-operative, 44(88%) patients had visual acuity in the range of 6/6-6/9 and 6 (12%) patients had visual acuity in the range of 6/12-6/18.

Comparison of postoperative visual acuity in the two groups was done. BCVA was not statistically significant between the two groups (p= 0.575). Visual acuity results after phacoemulsification in eyes with zonular dialysis differ from case to case depending on the etiology of dialysis. Eyes with dialysis and pseudoexfoliation cataract may also have an unsatisfactory postoperative visual acuity because of the greater incidence of postoperative complications such as inflammation, raised IOP and corneal endothelial changes. Other factors such as posterior capsule opacification (PCO) may also affect the final visual outcome.[72]

Our study findings were similar to the study by **Bayraktar**, who found no statistical significance in BCVA between CTR group and control group.[11] In a study by **Jiraskova and coauthors,** the postoperative BCVA was 6/12 in 53.1% of cases.[77] Our study results were similar to the finding of **Sarda et al., Stefan et al., Shingleton et al.** who also concluded that the best corrected visual acuity after surgery was similar in the two groups.[78,79,80] In a study by **Siddiqui et al.**, postoperative BCVA of 6/12 or better was achieved in 19 (57.58%) eyes.[81] In another study by **Shastri L,** BCVA at one month was 20/40 or better in 40 eyes (88.88%).[82]

After surgery frequent follow-up examinations are important as early and late postoperative complications may occur more frequently in eyes with PEX material. In

the early period after cataract surgery the main complications include inflammation, keratopathy and IOP spikes while in the long term posterior capsule opacification, anterior capsule contraction (phimosis) and IOL decentration.

In our study, postoperative complications were noted in both the groups. One day postoperatively, corneal edema was present in 5 eyes (10%) in group I and 8 eyes (16%) in group II **(Table 10)**. The difference was not statistically significant (p=0.372). Corneal edema resolved in 2 to 7 days in all eyes. 10% and 16% cases in group I & group II respectively had severe anterior chamber reaction in immediate post-operative period. The difference between the two groups was not statistically significant (p=0.372). The intraocular pressure (IOP) was measured both preoperatively and postoperatively. On the 1st postoperative day, transient IOP spikes were observed in 4(8%) patients in group I and 5 (10%) patients in group II (p value = 0.632), which was not statistically significant. Early post-operative rise in IOP was because of inflammation which subsided with treatment after 1-2 weeks.

In a study by **Bayraktar,** corneal edema was present in 14 eyes (35.9%) in the CTR group and 12 eyes (30.8%) in the control group, which was not statistically significant.[11] In another study by **Jacob S**, minimal corneal edema occurred in 2 eyes (9.52%) which resolved by the first post-operative week.[72]

Post-operative inflammation is more common in eyes with pseudoexfoliation. Clinical reports on inflammatory reactions and fibrin formation in eyes with PEX following cataract extraction appear to be related to ultrastructural changes of the morphological correlates of the blood aqueous barrier.[77]

However, **Shastri** and **Vasavada** found normal inflammatory cell response and significantly higher flare cell response.[82] Postoperative fibrin reaction in the anterior chamber was seen in 3 eyes (7.7%) in the CTR group and in 7 eyes (17.9%) in control group in a study by **Bayraktar et al.**[11] In addition iris vessels are pathological with an increased permeability for protein in eyes with PEX. However, other studies found the inflammatory reaction after PEX in eyes with pseudo-exfoliation to be within normal limits.

According to a study conducted by **Bayraktar et al,** transient IOP spikes were observed in more control eyes than in eyes with a CTR but at the last visit, mean IOP was not significantly different between the 2 groups. They concluded that the IOP reduction despite of high intraoperative complication rates was a result of the deepening of the anterior chamber and widening of the filtration angle achieved by phacoemulsification surgery.[11]

Study by **Jacob S** showed that 3 eyes (14.28%) developed raised IOP. All responded well to medical therapy and returned to normal by the 2nd week.[72]

Intraocular lens decentration is more common even when the lens is entirely in the capsular bag, primarily due to decentration of the entire bag. In our study, no such cases were reported. Early follow up of CTR use in loose zonules found excellent IOL centration 2 to 11 months postoperatively in the study by **Gimbel et al**.[14] Another study by **Jacob S** of 21 eyes with zonular dialysis of < or = 150 degrees found a 90.5% success rate, post operatively, at a mean follow up of < 1 year, all eyes with a CTR placed had a well centered IOL within the bag.[72]

Our study had limitations. The mean follow-up was short; thus, we could only assess the influence of the CTR intraoperatively and in the early postoperative period. Several studies report high rates of posterior capsule opacification (PCO) and anterior capsule contraction resulting in late IOL dislocation in eyes with pseudoexfoliation syndrome.[84]This may be due to incomplete removal of cortical matter inability to polish the capsule due to loose zonules and poor visibility of peripheral cortex secondary to a small pupil. Capsular tension rings are reported to be effective in reducing these late complications in eyes with the syndrome.[85]A minimum of 1 to 2 years of follow-up will be needed to confirm that CTR implantation reduces the rates of IOL decentration and PCO.

CONCLUSION

CONCLUSION

In our study, we found that zonular separation and posterior capsular rupture occurred more in non CTR group than in CTR group which was statistically significant. There were no statistical differences between the other intraoperative variables measured such as small pupil, extension of capsulorhexis and vitreous loss.

At the end of six month postoperative period, both the groups had better visual outcome which was not statistically significant. Postoperative complications like iritis, corneal edema and rise in IOP were noticed in both the groups which resolved after 1 month, which also had no significant statistical differences.

So, CTR implantation in cataracts with pseudoexfoliation syndrome stabilizes the zonules and ensures safe surgery with reduced intraoperative and postoperative complications. Thus, increasing the rate of well centered in the bag IOL implantation.

SUMMARY

SUMMARY

This study was done to study the safety and efficacy of capsular tension ring implantation in cataracts with pseudoexfoliation syndrome in terms of intraoperative and postoperative complications and to assess the visual acuity postoperatively in CTR and non CTR implanted patients.

Hundred patients attending to outpatient department of ophthalmology, R.L.JALAPPA HOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICAL COLLEGE, TAMAKA, KOLAR with cataracts with pseudoexfoliation syndrome fulfilling the inclusion criteria framed were selected for the study between December 2013 to July 2015.

The patients were randomly divided into two groups of 50 patients each (Group I- with CTR implantation & group II- without CTR implantation). After detailed preoperative evaluation, phacoemulsification with foldable IOL implantation was performed.

Intraoperative variables such as small pupil, extension of capsulorhexis, zonular separation, posterior capsule rupture and vitreous loss were recorded and compared between two groups.

Visual acuity unaided, with pinhole vision, best corrected visual acuity and complications if any were recorded in each patient postoperatively on first day, first week, first month, third month and sixth month.

Statistical analysis was applied to compare the intraoperative effects and visual recovery. Complications if any in between the two groups were also studied.

1(2%) patient out of 50 patients who underwent CTR implantation had zonular separation compared to 6(12%) out of 50 patients in non CTR group which was statistically significant (p=0.013). Posterior capsular rupture was observed in 2(4%) patients in group I and 8(16%) patients in group II which was statistically significant (p=0.042). There were no statistical differences between the other intraoperative variables measured such as small pupil, extension of capsulorhexis and vitreous loss.

At end of six month postoperative period, 46(92%) patients out of 50 patients in CTR group had postoperative visual acuity ranging between 6/6 -6/9 as compared to 44(88%) patients out of 50 patients in non CTR group. No statistical significant differences was noted between two groups in terms of visual outcome.

Complications like post-operative iritis, corneal edema and rise in IOP were noticed in both the groups which resolved after 1 month, which also had no significant statistical differences.

Thus, we conclude that CTRs ensure safe removal of crystalline lens and stable placement of the IOL during phacoemulsification of eyes with pseudoexfoliation syndrome, thus preventing the risk of intraoperative & postoperative complications & improve patient outcomes.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Naumann GO, Schlötzer-Schrehardt U, Küchle M. Pseudoexfoliation syndrome for the comprehensive ophthalmologist. Intraocular and systemic manifestations. Ophthalmology. 1998; 105: 951-968.
2. Schlötzer-Schrehardt U, Naumann GO. Ocular and systemic pseudoexfoliation syndrome. Am J Ophthalmol. 2006; 141: 921- 937.
3. Astrom s, Stenlund H, Linden C. Incidence and prevalence of exfoliations and open angle glaucoma in northern Sweden:II. Results after 21 years of follow-up. Acta Ophthalmol Scand. 2007; 85(8):832-837.
4. Challa P. Genetics of pseudoexfoliation syndrome. Curr Opin Ophthalmol.2009; 20: 88-91.
5. Tyagi AK MP. Pseudo exfoliation syndrome and spontaneous lens dislocation. Eye (Lond).1998; 12: 1033- 1034.
6. Kaštelan S, Bušic M. Pseudoexfoliation syndrome and cataract surgery. Ophthalmologia Croatica. 2003; 11: 37- 40.
7. Busić M, Kastelan S. Pseudoexfoliation syndrome and cataract surgery by phacoemulsification. Coll Antropol. 2005; 29(S1):163-6.
8. Naumann GO. Exfoliation syndrome as a risk factor for vitreous loss in extra capsular cataract surgery (preliminary report). Erlanger-Augenblätter-Group. Acta Ophthalmol.1988; Suppl 184:129-131.
9. Freissler K, Küchle M, Naumann GO. Spontaneous dislocation of the lens in pseudoexfoliation syndrome. Arch Ophthalmol. 1995; 113: 1095-1096.
10. Von der Lippe I, Küchle M, Naumann GO. Pseudoexfoliation syndrome as a risk factor for acute ciliary block angle closure glaucoma. Acta Ophthalmol (Copenh). 1993; 71: 277-279.

11. Bayraktar S, Altan T, Küçüksümer 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): 1620–1628.
12. Tribus C, Alge CS, Haritoglou C, et al. Indications and clinical outcome of capsular tension ring (CTR) implantation: A review of 9528 cataract surgeries. Clin Ophthalmol. 2007; 1(1):65–69.
13. Hasanee K, Ahmed II. Capsular tension rings: update on endocapsular support devices. Ophthalmol Clin North Am. 2006; 19(4):507–519.
14. Gimbel HV, Sun R, Heston JP. Management of zonular dialysis on phacoemulsification and IOL implantation using the capsular tension ring. Ophthal Surg Lasers. 1997; 28:273-81.
15. D'Eliseo D, Patena B, Longanesi L, Gristani F, Negrini V. Prevention of posterior capsule opacification using capsular tension ring for zonular defects in cataract surgery. Eur J Ophthalmol. 2003; 13(2): 151.
16. Kim JH, Kim H, Joo CK. The effect of capsular tension ring on posterior capsular opacity in cataract surgery. Korean J Ophthalmol.2005; 19(1):23.
17. Lee DH, Shin SC, Joo CK. Effect of the capsular tension ring on intraocular lens decentration and tilting after cataract surgery. J Cataract Refract Surg. 2002; 28(5):843.
18. Lindberg JG. Clinical investigations on depigmentation of the pupillary border and translucency of the iris in cases of senile cataract and in normal eyes in elderly persons. Acta Ophthalmol Suppl 1989; 190:1-96.

19. Vogt A: Ein neues Spaltlampenbid des Pupillargebietes: Hellblauer Pupilearsaumfillz mit Nautchenbildunz aus der Lisenvorderkapsel. Klin Monatsbl Augenheilkd 75:1, 1925.
20. Dvorak-Theobald G. Pseudoexfoliation of the lens capsule: Relation to "true" exfoliation of the lens capsule as reported in the literature and role in the production of glaucoma capsulocuticulare. Trans Am Ophthalmol Soc 1953; 51: 387.
21. Sunde OA. Senile exfoliation of the anterior lens capsule. Acta Ophthalmol, 1956; 45:1.
22. Layden WE, Shaffer RN. Exfoliation syndrome. Am J Ophthalmol 1974; 78: 835.
23. Tarkkanen A, Forsius H, eds. Exfoliation syndrome. Acta Ophthalmol 1988; 66(suppl. 184):1.
24. Christopher P et al. "Diagnosis and Management of Pseudoexfoliation glaucoma" Eye net 2006.
25. Sood N.N. "Prevalence of Pseudoexfoliation of the lens capsule in India". Acta Ophthal.1968; 46: 211-214.
26. Lamba P.A. and Giridhar A. "Pseudoexfoliation syndrome (prevalence based on random survey hospital data)" Indian Journal of Ophthalmology 1984; 32: 169 – 173.
27. Arvind H, Raju P, Paul PG, et al. Pseudoexfoliation in south India. The British Journal of Ophthalmology. 2003; 87(11):1321-1323.
28. Lee KYC, Ho SL, Thalamuthu A, et al. Association of LOXL1 polymorphisms with pseudoexfoliation in the Chinese. Molecular Vision. 2009; 15: 1120-1126.

29. R.R. Allinghan et al. Pseudoexfoliation syndrome in Icelandic families. British Journal of Ophthalmology. 2001; 85: 702 – 707.
30. M Bruce Shield's Text book of Glaucoma, 5th edition, Lippincott Williams & Wilkins, Philadelphia.
31. Deepak Gupta. Glaucoma Diagnosis and Management, Chapter 16 "Pseudoexfoliation syndrome", Lippincott Williams & Wilkins © 2005, Philadelphia, USA.
32. Jack J Kanski. Chapter 13 'Glaucoma', "clinical Ophthalmology" 6th edition, Printed in UK; Copyright © 2007 by Elsevier's health sciences rights department, 397-399.
33. L C Datta. Section 66 "pseudoexfoliation syndrome", Modern Ophthalmology 1st edition, printed in India; copyright © 1994 by Jaypee brother's medical publishers pvt ltd. 463.
34. Mizuno K, Muroi S. Cycloscopy of pseudoexfoliation. Am J. Ophthalmol. 1979; 87: 513.
35. Yanoff and Duker. Ophthalmology 3rd edition, Chapter 10.13, "Pseudoexfoliative glaucoma." Copyright © 2008 Mosby. An imprint of Elsevier.
36. William E. Layden, Becker Schaffer's The Glaucoma, Chapter 8 Exfoliation syndrome, Mosby Publication, © 1989, page 997 – 1013.
37. Schlötzer-Schrehardt UM, Roca MR, Naumann GO, Volkholz H: Pseudoexfoliation syndrome: Ocular manifestation of a systemic disorder? Arch Ophthalmol. 1992; 110:1752- 56.
38. Schumacher S. et al."Pseudoexfoliation syndrome and Aneurysms of Abdominal aorta", The Lancet, 2009; 357: 359 – 360.

39. Harnish J P, Barrach H J, Hassel J R, et al. “Identification of a Basement membrane proteoglycan in Pseudoexfoliation material”. Graefe’s Archcin Experimental Ophthalmology, 1981; 215 – 273.
40. Streeten BW et al. “Pseudoexfoliative fibrillopathy in the conjunctiva: a relation to elastic fibres and elastosis” – Ophthalmology 1987; 94:1439 – 1449.
41. Repo LP, Naukkarinen A. Pseudoexfoliation syndrome with poorly dilating pupil: a light and electron microscopic study of the sphincter area. Graefes Arch Clin Exp Ophthalmol. 1996; 234:171–176.
42. Tsukahara S, Matsuo T. Secondary glaucoma accompanied with primary familial amyloidosis. Ophthalmologica. 1977; 175(5):250–62.
43. Mizuno K, Hara S, Ishiguru S and Takei Y. “Acid phosphotase in eyes with Pseudoexfoliation”, American journal of Ophthalmology, 1980; 89: 482.
44. Baba H. “Histochemical and polarization – Optical investigation for glycosoaminoglycans in Pseudoexfoliation syndrome”. Graefe’s Archcin Experimental Ophthalmology, 1983; 221: 106.
45. Schlötzer-Schrehardt U, Dorfler S, Naumann GO: Immunohistochemical localization of basement membrane components in pseudoexfoliation material of the lens capsule. Curr Eye Res. 1992; 11:343–55.
46. Dabvanger M: A note on the pseudoexfoliation fibrils. Acta Ophthalmol. 1978; 56:114.
47. Davanger M: Studies on the pseudoexfoliation material. Graefes Arch Clin Exp Ophthalmol. 1978; 208:65.

48. Skuta G. L., Parrish R. K. et al. “Zonular dialysis during Extracapsular cataract surgery in pseudoexfoliation syndrome.” Arch Ophthal 1987; 105(5): 632-634.
49. Wang L, Yamasita R and Hammura S. “Corneal endothelial cell changes and aqueous flare intensity in eyes with pseudoexfoliation syndrome.” Ophthalmologica. 1999; 213: 387-391.
50. Kuchle M, Naumann.H et al. “Pseudoexfoliation syndrome and secondary cataract.” British journal of ophthalmology. 1997; 81:862-866.
51. Lumme P, Lattikaanen L. “Exfoliation syndrome and cataract extraction.” American journal of ophthalmology. 1993; 116(1): 51-55.
52. Moreno M.J., Duch S. “Pseudoexfoliation syndrome: Clinical factors related to capsular rupture in cataract surgery.”Acta Ophthal (Copenh) 1993; 71:181-184.
53. Stanila A. ‘The exfoliation syndrome. The risk factor in Extra-capsular surgery of the crystalline lens.” Ophthalmologica 1996; 40(4); 373-376.
54. Albert Galand, Michael Kuchle , Etienne Hachet. “Multiple surgical challenges of pseudoexfoliation” Symposium during 21st congress of the ESCRS 2004.
55. Hara T, Hara T, Yamada Y. Equator ring for maintenance of the completely circular contour of the capsular bag equator after cataract removal. Ophthalmic Surg 1991; 22: 358-9.
56. Nagamoto T, Bissen-Miyajima H. A ring to support the capsular bag after continuous curvilinear capsulorhexis. J Cataract Refract Surg 1994; 20: 417-20.

57. Legler UF, Witschel BM. The capsular ring: A new device for complicated cataract surgery. German J Ophthalmol 1994; 3:265.
58. Vickie Lee and Anthony Maloof. "Clinical practice –Cataract surgery in pseudoexfoliative syndrome" Comprehensive Ophthalmology update 2002; 3(1).
59. Howard Fine. "Pseudoexfoliation: A double Challenge", ASCRS Eye World, 2008; 10:10.
60. Roger F Steinert. Chapter 1 "The pathology of Cataract". Cataract surgery 2nd edition.
61. Norman S Jaffe et al. "Cataract surgery and its complication", 6th edition, Mosby – A Harcourt Health Sciences Company., 71, 301.
62. Aravind Eye hospital. Chapter 5 "Complications of Manual Small Incision Cataract surgery and their management", © 2000 by Aravind Publications, Aravind Eye Hospitals., 35 – 42.
63. Cionni R.J., Osher R.H. "Endocapsular Ring approach to the subluxated cataractous lens", Journal of Cataract and Refractive Surgery, 1995; 21:245–249.
64. Jawad M, Nadeem AU, Khan Au, Aftab M. Complications of cataract surgery in patients with pseudoexfoliation syndrome. J Ayub Med Coll Abbottabad 2009; 21:33-6.
65. Thomas R, Nirmalan PK and Krishnaiah S. Pseudoexfoliation in Southern India: The Andhra Pradesh Eye Disease Study – Investigative ophthalmology and visual sciences. 2005; 46(4):1170- 1176.
66. Avramides S, Traianidis P, Sakkias G. Cataract surgery and lens implantation in eyes with exfoliation syndrome. J Cataract Refract Surg 1997; 23:583-7.

67. Bangal S, Bhandari A, Gogri P. Outcome of Cataract Surgery in Patients with Pseudoexfoliation. Del J Ophthalmol. 2012; 23(3):183-186.

68. Hammer, Schlotzer- Schrehardt, Naumann. "Unilateral or Asymmetric Pseudoexfoliation syndrome? An electron microscopic study", Klin Monatsbl Augenheilkd 2001; 216(6): 388-392.

69. Asano N, Schlotze – Scherhardt, Naumann GO. "A histopathological study of iris changes in Pseudoexfoliation". Ophthalmology. 1996; 102: 1279-1290.

70. Fine HI, Hoffman RS. Phacoemulsification in the presence of pseudoexfoliation: Challenges and options, J Cataract Refract Surg.1997; 23:160-65.

71. Pranathi K, Magdum RM, Maheshgauri R, Patel K, Patra S. A study of complications during cataract surgery in patients with pseudoexfoliation syndrome. J Clin Ophthalmol Res 2014; 2:7-11.

72. Jacob S, Agarwal A, Agarwal A, et al. Efficacy of a capsular tension ring for phacoemulsification in eyes with zonular dialysis. J Cataract Refract Surg 2003; 29: 315-21.

73. Kuchle M, Viestenz A, Martus P, Handel A, Junemann A, Naumann GO. Anterior chamber depth and complications during cataract surgery in eyes with pseudoexfoliation syn- drome. Am J Ophthalmol. 2000; 129(3):281-5.

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

75. Drolsum L, Haaskjold E, Sandvig K. Phacoemulsification in eyes with pseudoexfoliation. J Cataract Refract Surg. 1998; 24:787–92.

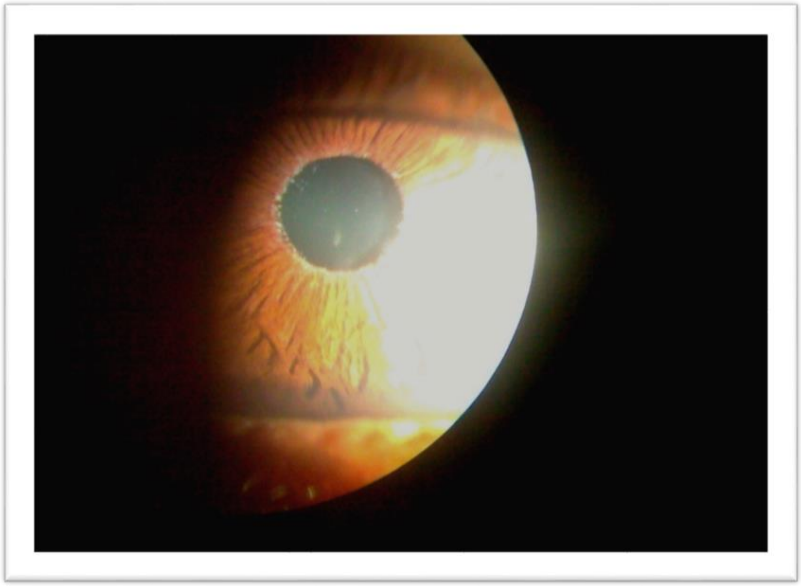
76. Zetterström C, Olivestedt G, Lundvall A (1992) Exfoliation syndrome and extracapsular cataract extraction with implantation of posterior chamber lens. Acta Ophthalmol (Copenh) 70: 85-90.
77. Jiraskova N, Rozsival P, Urminsky J. Results of 32 cataract operations with capsular tension ring. Cesk Slov Oftalmol 2001; 57: 165-168.
78. Sarda V, Rohart C, Fajnkuchen F, Nghiem Buffet S, Streho M, Chaine G. Pseudoexfoliation syndrome and phacoemulsification: Comparative study with a control population. J Fr Ophtalmol 2010; 33:319-26.
79. Stefan C, Nenciu A, Neacsu A, Ilie G, Dachin L. Phacoemulsification and pseudoexfoliative syndrome. Oftalmologia 2004; 48:44-50.
80. Shingleton BJ, Nguyen BK, Eagan EF, Nagao K, O'Donoghue MW. Outcomes of phacoemulsification in fellow eyes of patients with unilateral pseudoexfoliation: Single-surgeon series. J Cataract Refract Surg 2008; 34:274-9.
81. Siddiqui SN, Shaikh ZA, Khan A. Visual outcome and complications after modified Cionni endocapsular tension ring and intraocular lens implantation in eyes with subluxated lenses. Pak J Med Sci 2012; 28(4):639-642.
82. Shastri L, Vasavada A. Phacoemulsification in Indian eyes with pseudoexfoliation syndrome. J Cataract Refract Surg. 2001; 27: 1629–37.
83. Drolsum L, Davanger M, Haaskjold E. Risk factors for an inflammatory response after extracapsular cataract extraction and posterior chamber IOL. Acta Ophthalmol 1994; 72: 21–6.
84. Davison JA. Capsule contraction syndrome. J Cataract Refract Surg 1993; 19:582–589.

85. Nishi O, Nishi K, Menapace R. Capsule bending ring for the prevention of capsular opacification: a preliminary report. Ophthalmic Surg Lasers 1998; 29:749–753.

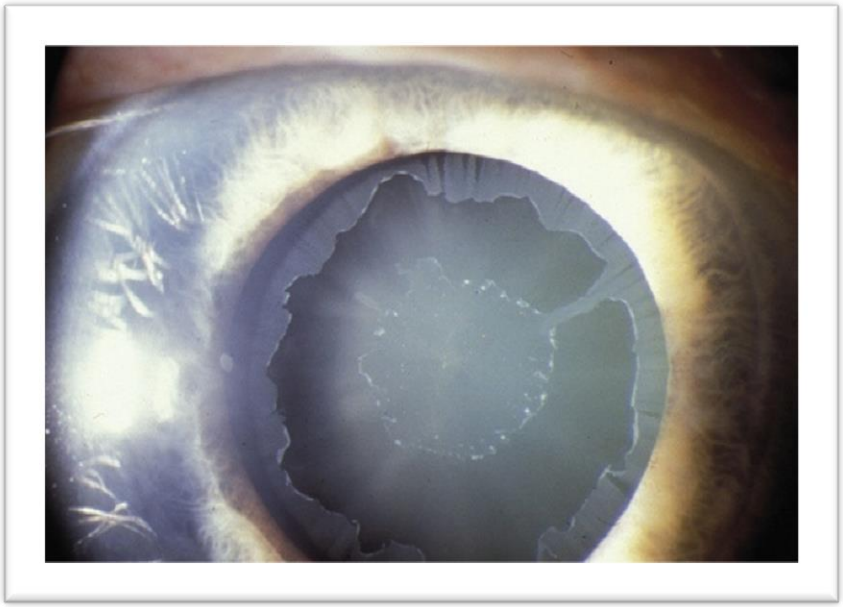
ANNEXURES

ANNEXURE 1: PHOTOGRAPHS

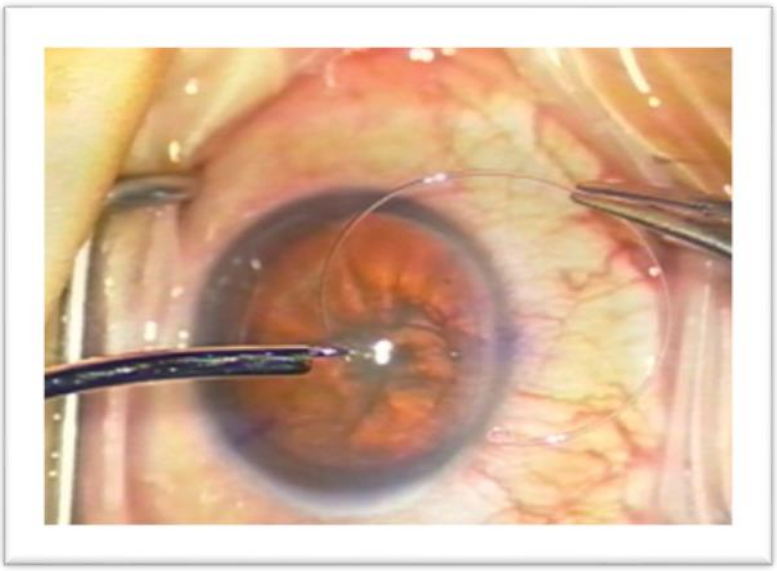
Photograph 1: Slit lamp examination



Photograph 2: Pseudoexfoliation material at the pupillary margin and anterior surface of lens capsule with undilated pupil.



Photograph 3: Zone of pseudoexfoliative material on the anterior capsule of lens after pupillary dilatation



Photograph 4: Insertion of capsular tension ring

Photograph 5: Phacoemulsification

ANNEXURE 2: PROFORMA

EVALUATION OF CAPSULAR TENSION RING IMPLANTATION IN PHACOEMULSIFICATION OF CATARACTS ASSOCIATED WITH PSEUDOEXFOLIATION SYNDROME:

CASE NO:

Name:	I.P. No.:
Age:	O.P.No.:
Sex:	Date of Admission:
Address:	Date of Surgery
	Date of Discharge:

CHIEF COMPLAINT:

HOPI:

PAST HISTORY:

PRE-OPERATIVE EVALUATION

Head Posture

Ocular Posture

OD: OS:

- Lids and Adnexa
- Conjunctiva
- Cornea
- Anterior chamber
- Iris
- Pupil
    1. Size
    2. Shape
    3. Reaction
- Lens
- Extra Ocular Movements
- Anterior Vitreous
- Visual Acuity (BCVA)
    1. Distant
    2. Near
    3. Refraction
- Intra Ocular Pressure (Applanation tonometry)
- Distant Direct Ophthalmoscopy
- Direct Ophthalmoscopy
- Indirect Ophthalmoscopy
- Keratometry

  K1

  K2
- Axial Length
- Capsule tension ring diameter
- Intra Ocular Lens Power
- Lacrimal Syringing
- Lab Investigations-Urine: Albumin, Sugar and Microscopy.

GENERAL PHYSICAL EXAMINATION

Pallor Icterus Clubbing Cyanosis Oedema Lymphadenopathy

Pulse: Blood Pressure:

Cardiovascular System:

Respiratory System:

Gastro Intestinal System:

INTRA OPERATIVE NOTES

TYPE OF SURGERY:

INTRAOPERATIVE OUTCOME MEASURES: GROUP 1 GROUP 2

Rate of intraoperative zonular separation:

Posterior capsular rupture without zonular separation:

Vitreous loss:

Any other:

POSTOPERATIVE OUTCOME GROUP 1 GROUP 2
BCVA

1 DAY

1 WEEK

1 MONTH

6 MONTHS

POSTOPERATIVE COMPLICATIONS GROUP 1 GROUP 2

1. Corneal edema
2. Iritis
3. Increased IOP
4. CTR dislocationn
5. IOL decentration

ANNEXURE 3: INFORMED CONSENT FORM

EVALUATION OF CAPSULAR TENSION RING IMPLANTATION IN PHACOEMULSIFICATION OF CATARACTS ASSOCIATED WITH PSEUDOEXFOLIATION SYNDROME

I, the undersigned, agree to participate in this study and authorize the collection and disclosure of my personal information as outlined in this consent form.

I understand the purpose of this study, the risks and benefits of two techniques (capsular tension ring implantation no CTR implantation) and the confidential nature of the information that will be collected and disclosed during the study. The information collected will be used only for research.

I have had the opportunity to ask questions regarding the various aspects of this study and my questions have been answered to my satisfaction.

I understand that I remain free to withdraw from this study at any time and this will not change my future care.

Participation in this study does not involve any extra cost to me.

Subject's name and signature /thumb impression Date:

Name and signature of witness Date:

Name and signature of person obtaining consent Date:

ANNEXURE 4: KEY TO MASTER CHART

SI No: Serial Number

IP No: In Patient Number

M: Male

F: Female

NS: Nuclear sclerosis

SMC: Senile mature cataract

PSC: Posterior subcapsular cataract

PEX: Pseudoexfoliation

UCDV: Uncorrected distant vision

UCNV: Uncorrected near vision

BCDV: Best corrected distant vision

BCNV: Best corrected near vision

IOP: Intraocular pressure

EOC: Extension of capsulorhexis

PCR: Posterior Capsule Rent

VL: Vitreous Loss

ZD: Zonular dialysis

MASTER CHART

Sl no	Names	Age	Sex	I.P.no	Diagnosis	Eye	UCDV	UCNV	GROUP
1	MURUGAN	63	M	953536	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF1	N36	I
2	SUBANNA	57	M	943414	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF3	N18	I
3	VENKATESHAPPA	75	M	946693	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
4	VENKATAMMA	70	F	946692	NS4+PEX(RE) SIMC+PEX (LE)	RE	CF2	N36	I
5	NARAYANAPPA	55	F	946700	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF4	N12	I
6	GAURAMMA	85	F	949460	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF3	N18	I
7	CHANDRAMMA	50	F	949457	SIMC+PEX(RE)SMC+PEX(LE)	LE	HM	N-	I
8	GOWRAMMA	65	F	949469	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF4	N12	I
9	KADIRAMMA	65	F	949480	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
10	NARAYANAPPA	65	M	956917	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF2	N24	I
11	NAGAPPA	65	M	956905	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF3	N18	I
12	RAMANNA	75	M	962680	SMC+PEX(RE)SMC+PEX(LE)	LE	HM	N-	I
13	MAQBOOL UNNISA	70	M	962679	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF2	N12	I
14	JAYAMMA	70	F	963317	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF5	N24	I
15	GANGAMMA	65	F	963319	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
16	NARAYANASWAMY	65	M	963313	CORTICAL+NS2+PEX(LE>RE)	LE	CF4	N12	I
17	KITTAPPA	52	M	964629	SMC+PEX(RE)SMC+PEX(LE)	LE	HM	N-	I
18	THIRUMANGALAMMA	50	F	965679	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF5	N12	I
19	RAFIQ	53	M	965664	SMC+PEX(LE>RE)	LE	HM	N-	I
20	NARAYANAMMA	85	F	965670	CORTICAL+NS2+PEX(LE>RE)	LE	CF3	N18	I
21	SRIRAMAPPA	62	M	966698	SIMC+PEX(RE)SMC+PEX(LE)	LE	HM	N-	I
22	VENKATAMMA	65	F	966701	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF4	N12	I
23	RAMAKKA	60	F	967439	CORTICAL+NS2+PEX(LE>RE)	LE	CF3	N18	I
24	LAKSHMAKKA	80	F	967447	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF4	N36	I
25	MUNIVENKATAPPA	67	M	970792	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF3	N18	I
26	VENKATAMMA	80	F	970790	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF2	N12	I
27	NARYANAGOWDA	80	M	972740	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
28	MUNIYAMMA	58	F	972739	PSP(RE) CORTICAL+PSC+PEX(LE)	LE	CF3	N12	I
29	VENKATESHAPPA	68	M	969579	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF5	N36	I
30	SRINIVASIAH	65	M	976537	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF3	N24	I
31	NARAYANAMMA	70	F	978601	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
32	MUNIYAMMA	60	F	979297	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
33	ESHWARAPPA	60	F	979296	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF3	N18	I
34	MUNIVENKATAMMA	85	F	982833	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF1	N36	I
35	IRUMALLAPPA	70	M	982838	SIMC+PEX(RE)SIMC+PEX(LE)	LE	CF4	N18	I
36	GANGAMMA	60	F	983834	SMC+PEX(RE)SMC+PEX(LE)	LE	HM	N-	I
37	BASAKKA	60	F	983536	CORTICAL+NS2+PEX(LE>RE)	LE	CF2	N36	I
38	NARAYANAMMA	80	F	983526	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF5	N36	I
39	CHOWDAMMA	65	F	984988	PSP(RE) CORTICAL+PSC+PEX(LE)	LE	CF3	N18	I
40	MUNIYAMMA	74	F	987149	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
41	SADAMMA	60	F	987216	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF4	N36	I
42	LAKSHMAMMA	54	F	987218	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF3	N18	I
43	GANGAMMA	64	F	990100	SMC+PEX(RE)SMC+PEX(LE)	LE	HM	N-	I
44	LAKSHMAMMA	70	F	990102	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF4	N36	I
45	LAKSHMAKKA	55	F	990116	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
46	NARAYANAPPA	70	M	992292	CORTICAL+NS2+PEX(LE>RE)	LE	CF4	N24	I
47	ESHWARAMMA	59	F	979233	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF5	N36	I
48	CHANNAPPA	67	M	994247	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	I
49	VENKATARAMANAGOWDA	65	M	994261	PSP(RE) CORTICAL+PSC+NS3+PEX(LE)	LE	CF2	N24	I
50	VENKATAMMA	70	F	996834	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF1	N36	I
51	VENKATARAMAIAH	70	M	997240	SIMC+PEX(RE)SMC+PEX(LE)	LE	HM	N-	II
52	SHABEENA	57	F	1002171	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF5	N36	II
53	GANGAMMA	65	F	1002978	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF3	N24	II
54	VANNAMMA	70	F	1002976	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	II
55	AMEER JAAN	60	M	1002973	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF4	N36	II
56	GANGULAPPA	60	M	1008032	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF3	N12	II
57	NARAYANAMMA	70	F	1008086	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	6/24.	N36	II
58	MUNIYAMMA	60	F	1008039	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM	N-	II
59	MUNIVENKATAPPA	70	M	1009398	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF3	N36	II
60	VENKATAMMA	55	F	968834	CORTICAL+NS2+PEX(LE>RE)	LE	CF5	N18	II
61	ABDUL RASHID	55	M	721625	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	6/60	N36	II
62	NAGARATNAMMA	50	F	759560	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	6/60	N24	II
63	JAYAMMA	60	F	769184	SMC+PEX(RE)SMC+PEX(LE)	LE	HM +	N-	II
64	CHINNAPPA	70	M	778346	NS4+PEX(RE) SIMC+PEX (LE)	RE	6/60	N24	II
65	KRISHNAPPA	70	M	801805	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	6/60	N36	II
66	SHANTHA BAI	65	F	822171	CORTICAL+NS2+PEX(LE>RE)	LE	6/36	N24	II
67	APPANNA	68	M	772305	SMC+PEX(RE)SMC+PEX(LE)	RE	HM +	N-	II
68	SIDDAGANGAMMA	70	F	779024	CORTICAL+NS2+PEX(RE)PSP(LE)	RE	CF 2m	N-	II
69	MOHAN	66	M	771010	SMC+PEX(RE)SMC+PEX(LE)	LE	HM +	N-	II
70	GURAPPA	70	M	778340	CORTICAL+NS2+PEX(LE>RE)	LE	CF 3m	N-	II
71	VENKATASWAMY	65	M	778340	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	LE	CF 1m	N-	II
72	LAKSHMAMMA	65	F	797109	SMC+PEX(RE)SMC+PEX(LE)	RE	CF 5m	N36	II
73	SHARADAMMA	65	F	782146	CORTICAL+NS2+PEX(RE)PSP(LE)	LE	CF 3m	N36	II
74	CHINNAPAPAMMA	37	F	819286	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	6/60	N24	II
75	DODDAMUNIYAPPA	70	M	819299	SMC+PEX(RE)SIMC+PEX(LE)	RE	HM +	N-	II
76	RAMAKKA	60	F	821112	CORTICAL+NS2+PEX(LE>RE)	RE	CF 4m	N36	II
77	SHANTHA BAI	65	F	822171	SMC+PEX(RE)SMC+PEX(LE)	RE	CF 5m	N-	II
78	KRISHNAMMA	65	F	821116	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF 4m	N36	II
79	NARAYANAMMA	60	F	828415	SMC+PEX(LE>RE)	LE	CF 2m	N-	II
80	LAKSHMAMMA	60	F	760846	CORTICAL+NS2+PEX(LE>RE)	LE	CF 5m	N36	II
81	SEETHAMMA	60	F	832797	SIMC+PEX(RE)SMC+PEX(LE)	RE	CF 5m	N24	II
82	MUNIYAPPA	68	M	839908	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	LE	HM +	N-	II
83	SUBRAMANI	55	M	843698	CORTICAL+NS2+PEX(LE>RE)	LE	CF 5m	N24	II
84	MUNISWAMY	70	M	769163	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	HM +	N-	II
85	NARAYANAMMA	65	F	771023	CORTICAL+NS2+PEX(RE)PSP(LE)	LE	CF 3m	N24	II
86	MUNIVENKATAMMA	60	F	782118	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	LE	CF 5m	N36	II
87	RAMAKKA	70	F	824153	SMC+PEX(RE)SIMC+PEX(LE)	RE	CF 5m	N-	II
88	MUTHAMMA	65	F	832805	PSP(RE) CORTICAL+PSC+PEX(LE)	RE	CF 4m	N24	II
89	GOPALAPPA	65	M	829911	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF 5m	N36	II
90	VENKATESHAPPA	63	M	836720	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF 4m	N-	II
91	PUJARI MALLAPPA	55	M	834391	SMC+PEX(RE)SIMC+PEX(LE)	RE	CF 3m	N-	II
92	MALLESHAIAH	72	M	839944	SMC+PEX(RE)SIMC+PEX(LE)	LE	HM +	N36	II
93	RAJAMMA	52	F	846758	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	LE	CF 4m	N24	II
94	GUNDAPPA	58	M	851405	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	RE	CF 5m	N36	II
95	KADIRAPPA	77	M	860494	SIMC+PEX(RE)SIMC+PEX(LE)	RE	6/60	N-	II
96	SHARFUNISSA	60	F	868366	SMC+PEX(RE)SMC+PEX(LE)	LE	HM +	N-	II
97	GANGAPPA	60	M	872871	CORTICAL+NS2+PEX(LE>RE)	LE	CF 4m	N36	II
98	VENKATARAMAPPA	70	M	879278	PSC+CORTICAL+PEX(RE) SIMC+PEX (LE)	LE	CF 5m	N24	II
99	NAGAMMA	70	F	880310	PSP(RE) CORTICAL+PSC+PEX(LE)	RE	CF 5m	N-	II
100	NANJUNDAPPA	78	M	855041	SMC+PEX(RE)SIMC+PEX(LE)	RE	CF 4m	N-	II

POST OPERATIVE VISUAL ACUITY												
		Ist DAY		Ist WEEK		I st MONTH		3 rd MONTH		6th MONTH		GROUP
SL NO	NAMES	BC DV	BCNV	BCDV	BCNV	BCDV	BCNV	BCDV	BCNV	BCDV	BCNV	
1	MURUGAN	6/9	N12	6/9	N12	6/6	N12	6/6	N24	6/6	N8	I
2	SUBANNA	6/12	N8	6/9	N8	6/9	N8	6/6	N24	6/6	N10	I
3	VENKATESHAPPA	6/24	N12	6/24	N12	6/12	N12	6/9	N10	6/9	N12	I
4	VENKATAMMA	6//24	N10	6/18	N10	6/36	N10	6/12	N12	6/12	N24	I
5	NARAYANAPPA	6/60	N10	6/12	N10	6/6	N18	6/6	N24	6/6	N24	I
6	GAURAMMA	6/24	N18	6/24	N18	6/24	N18	6/12	N12	6/9	N10	I
7	CHANDRAMMA	6/9	N12	6/9	N12	6/9	N12	6/9	N10	6/9	N12	I
8	GOWRAMMA	6/24	N8	6/12	N8	6/12	N8	6/9	N18	6/9	N18	I
9	KADIRAMMA	6/18	N18	6/18	N18	6/6	N24	6/6	N18	6/6	N10	I
10	NARAYANAPPA	6/18	N12	6/18	N12	6/12	N12	6/12	N12	6/9	N8	I
11	NAGAPPA	6/24	N18	6/12	N18	6/12	N18	6/24	N12	6/12	N24	I
12	RAMANNA	6/18	N10	6/18	N10	6/18	N10	6/6	N10	6/6	N18	I
13	MAQBOOL UNNISA	6/18	N18	6/18	N18	6/18	N18	6/6	N24	6/6	N24	I
14	JAYAMMA	6/24	N12	6/24	N12	6/18	N12	6/12	N8	6/9	N10	I
15	GANGAMMA	6/12	N10	6/12	N10	6/9	N10	6/9	N18	6/9	N12	I
16	NARAYANASWAMY	6/18	N18	6/18	N18	6/18	N18	6/12	N12	6/12	N24	I
17	KITTAPPA	6/24	N12	6/18	N12	6/12	N12	6/6	N24	6/6	N18	I
18	THIRUMANGALAMMA	6/24	N10	6/6	N10	6/6	N10	6/6	N24	6/6	N10	I
19	RAFIQ	6/24	N8	6/12	N8	6/12	N8	6/18	N10	6/12	N12	I
20	NARAYANAMMA	6/12	N18	6/9	N18	6/6	N24	6/6	N10	6/6	N18	I
21	SRIRAMAPPA	6/12	N12	6/12	N12	6/12	N12	6/6	N24	6/6	N24	I
22	VENKATAMMA	6/18	N10	6/18	N10	6/6	N10	6/6	N8	6/6	N8	I
23	RAMAKKA	6/12	N24	6/9	N24	6/9	N24	6/9	N24	6/9	N12	I
24	LAKSHMAKKA	6/12	N12	6/6	N12	6/6	N12	6/9	N10	6/9	N18	I
25	MUNIVENKATAPPA	6/12	N24	6/12	N24	6/9	N24	6/9	N18	6/9	N10	I
26	VENKATAMMA	6/9	N12	6/9	N12	6/9	N12	6/9	N18	6/9	N12	I
27	NARYANAGOWDA	6/12	N18	6/9	N18	6/9	N18	6/6	N10	6/6	N24	I
28	MUNIYAMMA	6/18	N8	6/24	N10	6/12	N10	6/6	N12	6/6	N12	I
29	VENKATESHAPPA	6/18	N24	6/12	N24	6/12	N24	6/24	N12	6/12	N18	I
30	SRINIVASIAH	6/12	N12	6/12	N12	6/12	N12	6/9	N18	6/9	N12	I
31	NARAYANAMMA	6/9	N18	6/18	N18	6/9	N18	6/6	N10	6/6	N10	I
32	MUNIYAMMA	6/24	N12	6/24	N8	6/12	N8	6/12	N8	6/6	N18	I
33	ESHWARAPPA	6/9	N24	6/9	N24	6/9	N24	6/9	N18	6/9	N12	I
34	MUNIVENKATAMMA	6/12	N10	6/12	N10	6/9	N10	6/9	N10	6/9	N24	I
35	IRUMALLAPPA	6/24	N12	6/18	N12	6/9	N12	6/9	N10	6/9	N10	I
36	GANGAMMA	6/24	N12	6/12	N10	6/9	N10	6/9	N12	6/9	N18	I
37	BASAKKA	6/12	N24	6/12	N24	6/9	N24	6/9	N18	6/9	N12	I
38	NARAYANAMMA	6/9	N12	6/9	N12	6/9	N12	6/9	N18	6/9	N10	I
39	CHOWDAMMA	6/6	N18	6/6	N18	6/6	N18	6/6	N12	6/6	N18	I
40	MUNIYAMMA	6/24	N18	6/24	N18	6/12	N18	6/9	N24	6/9	N12	I
41	SADAMMA	6/18	N10	6/6	N10	6/6	N10	6/6	N12	6/6	N10	I
42	LAKSHMAMMA	6/9	N12	6/9	N24	6/9	N12	6/9	N10	6/9	N24	I
43	GANGAMMA	6/24	N12	6/12	N24	6/9	N24	6/6	N18	6/6	N12	I
44	LAKSHMAMMA	6/9	N18	6/9	N18	6/6	N18	6/6	N12	6/6	N18	I
45	LAKSHMAKKA	6/12	N12	6/12	N24	6/9	N12	6/9	N8	6/9	N12	I
46	NARAYANAPPA	6/24	N10	6/18	N10	6/9	N10	6/9	N12	6/9	N8	I
47	ESHWARAMMA	6/9	N10	6/9	N10	6/9	N10	6/9	N10	6/9	N10	I
48	CHANNAPPA	6/9	N12	6/9	N24	6/6	N12	6/6	N12	6/6	N12	I
49	VENKATARAMANAGOWDA	6/12	N18	6/12	N18	6/9	N18	6/9	N12	6/9	N18	I
50	VENKATAMMA	6/12	N10	6/9	N10	6/6	N10	6/6	N18	6/6	N10	I

51	VENKATARAMAIAH	6/36	N10	6/12	N10	6/6	N18	6/6	N24	6/6	N24	II
52	SHABEENA	6/24	N18	6/24	N18	6/12	N18	6/9	N12	6/9	N10	II
53	GANGAMMA	6/9	N12	6/6	N12	6/6	N12	6/6	N10	6/6	N12	II
54	VANNAMMA	6/12	N8	6/9	N8	6/9	N8	6/6	N18	6/6	N18	II
55	AMEER JAAN	6/18	N18	6/18	N18	6/6	N24	6/6	N18	6/6	N10	II
56	GANGULAPPA	6/18	N12	6/12	N12	6/12	N12	6/12	N12	6/12	N8	II
57	NARAYANAMMA	6/12	N18	6/12	N18	6/9	N18	6/9	N12	6/9	N24	II
58	MUNIYAMMA	6/18	N10	6/18	N10	6/18	N10	6/6	N10	6/6	N18	II
59	MUNIVENKATAPPA	6/18	N18	6/18	N18	6/18	N18	6/6	N24	6/6	N24	II
60	VENKATAMMA	6/24	N12	6/36	N12	6/18	N12	6/12	N8	6/12	N10	II
61	ABDUL RASHID	6/6	N12	6/6	N12	6/9	N12	6/6	N24	6/6	N12	II
62	NAGARATNAMMA	6/12	N8	6/9	N8	6/9	N8	6/6	N24	6/6	N18	II
63	JAYAMMA	6/36	N10	6/12	N10	6/6	N18	6/6	N24	6/6	N24	II
64	CHINNAPPA	6/24	N18	6/24	N18	6/12	N18	6/9	N12	6/9	N10	II
65	KRISHNAPPA	6/9	N12	6/6	N12	6/6	N12	6/6	N10	6/6	N12	II
66	SHANTHA BAI	6/24	N12	6/36	N12	6/18	N12	6/12	N8	6/12	N10	II
67	APPANNA	6/18	N18	6/18	N18	6/6	N24	6/6	N18	6/6	N10	II
68	SIDDAGANGAMMA	6/18	N12	6/12	N12	6/12	N12	6/12	N12	6/12	N8	II
69	MOHAN	6/12	N18	6/12	N18	6/9	N18	6/9	N12	6/9	N24	II
70	GURAPPA	6/18	N10	6/18	N10	6/18	N10	6/6	N10	6/6	N18	II
71	VENKATASWAMY	6/18	N18	6/18	N18	6/18	N18	6/6	N24	6/6	N24	II
72	LAKSHMAMMA	6/24	N12	6/36	N12	6/18	N12	6/12	N8	6/12	N10	II
73	SHARADAMMA	6/18	N10	6/18	N10	6/18	N10	6/6	N10	6/6	N18	II
74	CHINNAPAPAMMA	6/18	N18	6/18	N18	6/18	N18	6/6	N24	6/6	N24	II
75	DODDAMUNIYAPPA	6/24	N12	6/36	N12	6/18	N12	6/12	N8	6/12	N10	II
76	RAMAKKA	6/6	N12	6/6	N12	6/9	N12	6/6	N24	6/6	N12	II
77	SHANTHA BAI	6/24	N12	6/36	N12	6/18	N12	6/12	N8	6/12	N10	II
78	KRISHNAMMA	6/36	N10	6/12	N10	6/6	N18	6/6	N24	6/6	N24	II
79	NARAYANAMMA	6/24	N18	6/24	N18	6/12	N18	6/9	N12	6/9	N10	II
80	LAKSHMAMMA	6/9	N12	6/6	N12	6/6	N12	6/6	N10	6/6	N12	II
81	SEETHAMMA	6/12	N8	6/9	N8	6/9	N8	6/6	N18	6/6	N18	II
82	MUNIYAPPA	6/18	N18	6/18	N18	6/6	N24	6/6	N18	6/6	N10	II
83	SUBRAMANI	6/18	N12	6/12	N12	6/12	N12	6/12	N12	6/12	N8	II
84	MUNISWAMY	6/12	N8	6/9	N8	6/9	N8	6/6	N18	6/6	N18	II
85	NARAYANAMMA	6/18	N18	6/18	N18	6/6	N24	6/6	N18	6/6	N10	II
86	MUNIVENKATAMMA	6/18	N12	6/12	N12	6/12	N12	6/12	N12	6/12	N8	II
87	RAMAKKA	6/12	N18	6/12	N18	6/9	N18	6/9	N12	6/9	N24	II
88	MUTHAMMA	6/18	N10	6/18	N10	6/18	N10	6/6	N10	6/6	N18	II
89	GOPALAPPA	6/18	N18	6/18	N18	6/18	N18	6/6	N24	6/6	N24	II
90	VENKATESHAPPA	6/24	N12	6/36	N12	6/18	N12	6/12	N8	6/12	N10	II
91	PUJARI MALLAPPA	6/24	N12	6/36	N12	6/18	N12	6/12	N8	6/12	N10	II
92	MALLESHAIAH	6/18	N18	6/18	N18	6/18	N18	6/6	N24	6/6	N24	II
93	RAJAMMA	6/24	N12	6/36	N12	6/18	N12	6/12	N8	6/12	N10	II
94	GUNDAPPA	6/6	N12	6/6	N12	6/9	N12	6/6	N24	6/6	N12	II
95	KADIRAPPA	6/24	N12	6/18	N12	6/9	N12	6/9	N10	6/9	N10	II
96	SHARFUNISSA	6/12	N8	6/9	N8	6/9	N8	6/6	N18	6/6	N18	II
97	GANGAPPA	6/18	N18	6/18	N18	6/6	N24	6/6	N18	6/6	N10	II
98	VENKATARAMAPPA	6/9	N12	6/9	N12	6/9	N12	6/9	N18	6/9	N10	II
99	NAGAMMA	6/36	N10	6/12	N10	6/6	N18	6/6	N24	6/6	N24	II
100	NANJUNDAPPA	6/24	N18	6/24	N18	6/12	N18	6/9	N12	6/9	N10	II

COMPLICATIONS											
				TRAOPERATI			POSTOPERATIVE				GROUP
SL NO	NAMES	Small pupil	EOC	ZS	PCR	VL	CORNEAL EDEMA	IRITIS	INCREASED IOP	Increase in IOP	
1	MURUGAN	–	–	–	–	–	–	–	–	–	I
2	SUBANNA	–	–	–	–	–	–	–	–	–	I
3	VENKATESHAPPA	–	–	–	–	–	–	–	–	–	I
4	VENKATAMMA	–	–	–	–	–	–	–	–	–	I
5	NARAYANAPPA	–	–	–	–	–	–	–	–	–	I
6	GAURAMMA	–	–	–	–	–	–	–	–	+	I
7	CHANDRAMMA	+	–	–	–	–	+	+	–	–	I
8	GOWRAMMA	–	–	–	–	–	–	–	–	–	I
9	KADIRAMMA	–	–	–	–	–	–	–	–	–	I
10	NARAYANAPPA	–	–	–	–	–	–	–	–	+	I
11	NAGAPPA	–	–	+	–	–	–	–	–	–	I
12	RAMANNA	–	–	–	–	–	–	–	–	–	I
13	MAQBOOL UNNISA	–	+	–	–	–	–	–	–	–	I
14	JAYAMMA	–	–	–	–	–	–	–	–	–	I
15	GANGAMMA	–	–	–	–	–	–	–	–	–	I
16	NARAYANASWAMY	–	–	–	–	–	–	–	–	+	I
17	KITTAPPA	+	–	–	–	–	–	–	–	–	I
18	THIRUMANGALAMMA	–	–	–	–	–	–	–	–	–	I
19	RAFIQ	–	–	–	–	–	–	–	–	–	I
20	NARAYANAMMA	–	–	–	–	–	–	–	–	–	I
21	SRIRAMAPPA	–	–	–	–	–	+	+	–	–	I
22	VENKATAMMA	+	–	–	–	–	–	–	–	–	I
23	RAMAKKA	–	–	–	–	–	–	–	–	+	I
24	LAKSHMAKKA	–	–	–	–	–	–	–	–	–	I
25	MUNIVENKATAPPA	–	–	–	–	–	–	–	–	–	I
26	VENKATAMMA	+	–	–	–	–	–	–	–	–	I
27	NARYANAGOWDA	–	–	–	–	–	–	–	–	–	I
28	MUNIYAMMA	+	–	–	–	–	–	–	–	–	I
29	VENKATESHAPPA	–	–	–	–	–	–	–	–	+	I
30	SRINIVASIAH	–	–	–	–	–	–	–	–	–	I
31	NARAYANAMMA	+	–	–	–	–	–	–	–	–	I
32	MUNIYAMMA	–	–	–	–	–	–	–	–	–	I
33	ESHWARAPPA	–	–	–	–	–	–	–	–	–	I
34	MUNIVENKATAMMA	–	–	–	–	–	–	–	–	–	I
35	IRUMALLAPPA	–	–	–	–	–	+	+	–	–	I
36	GANGAMMA	+	–	–	–	–	–	–	–	–	I

37	BASAKKA	–	+	–	–	–	–	–	–	–	I
38	NARAYANAMMA	–	–	–	–	–	–	–	–	–	I
39	CHOWDAMMA	–	–	–	–	–	–	–	–	–	I
40	MUNIYAMMA	+	–	–	–	–	–	–	–	–	I
41	SADAMMA	–	–	–	–	–	+	+	–	–	I
42	LAKSHMAMMA	–	–	–	–	–	–	–	–	–	I
43	GANGAMMA	+	–	–	–	–	–	–	–	–	I
44	LAKSHMAMMA	–	–	–	–	–	–	–	–	–	I
45	LAKSHMAKKA	–	–	–	–	–	–	–	–	–	I
46	NARAYANAPPA	–	–	–	–	–	–	–	–	–	I
47	ESHWARAMMA	–	–	–	–	–	–	–	–	–	I
48	CHANNAPPA	+	–	–	–	–	–	–	–	–	I
49	ENKATARAMANAGOWI	–	–	–	–	–	+	+	–	–	I
50	VENKATAMMA	–	–	–	–	–	–	–	–	–	I
51	VENKATARAMAIAH	–	–	–	–	–	–	–	–	–	II
52	SHABEENA	–	–	–	–	–	–	–	–	–	II
53	GANGAMMA	–	–	–	–	–	–	–	–	+	II
54	VANNAMMA	–	–	–	–	–	–	–	–	–	II
55	AMEER JAAN	–	–	–	–	–	–	+	–	–	II
56	GANGULAPPA	–	–	–	–	–	–	–	–	–	II
57	NARAYANAMMA	–	–	–	–	–	–	–	–	–	II
58	MUNIYAMMA	+	–	–	–	–	–	–	–	+	II
59	MUNIVENKATAPPA	–	–	–	–	–	–	–	–	–	II
60	VENKATAMMA	–	–	–	–	–	–	–	–	–	II
61	ABDUL RASHID	–	–	–	–	–	–	–	–	–	II
62	NAGARATNAMMA	+	–	–	–	–	–	–	–	–	II
63	JAYAMMA	–	–	–	–	–	–	+	–	–	II
64	CHINNAPPA	–	–	–	–	–	+	–	–	–	II
65	KRISHNAPPA	–	–	–	–	–	–	–	–	+	II
66	SHANTHA BAI	–	–	+	–	–	–	+	–	–	II
67	APPANNA	–	–	–	–	–	–	–	–	–	II
68	SIDDAGANGAMMA	+	–	–	+	+	–	–	–	–	II
69	MOHAN	–	–	–	–	–	+	–	–	–	II
70	GURAPPA	–	–	–	–	–	–	–	–	–	II
71	VENKATASWAMY	+	–	–	–	–	–	–	–	–	II
72	LAKSHMAMMA	–	–	–	–	–	–	+	–	+	II
73	SHARADAMMA	–	–	–	–	–	–	–	–	–	II
74	CHINNAPAPAMMA	–	–	–	–	–	+	–	–	–	II
75	DODDAMUNIYAPPA	+	–	+	–	–	–	–	–	–	II

76	RAMAKKA	–	–	–	–	–	–	+	–	–	II
77	SHANTHA BAI	–	–	–	+	+	+	–	–	–	II
78	KRISHNAMMA	–	–	–	–	–	–	–	–	–	II
79	NARAYANAMMA	–	–	–	–	–	–	–	–	–	II
80	LAKSHMAMMA	+	–	–	–	–	–	–	–	–	II
81	SEETHAMMA	–	–	–	–	–	–	–	–	–	II
82	MUNIYAPPA	–	–	–	–	–	+	–	–	–	II
83	SUBRAMANI	–	–	–	–	–	–	+	–	–	II
84	MUNISWAMY	+	–	–	–	–	–	–	–	–	II
85	NARAYANAMMA	–	–	–	–	–	–	–	–	–	II
86	MUNIVENKATAMMA	–	+	–	–	–	+	–	–	–	II
87	RAMAKKA	–	–	–	–	–	–	–	–	–	II
88	MUTHAMMA	+	–	–	–	–	–	+	–	–	II
89	GOPALAPPA	–	–	–	–	–	–	–	–	–	II
90	VENKATESHAPPA	–	–	–	–	–	+	–	–	–	II
91	PUJARI MALLAPPA	–	–	+	+	+	–	–	–	–	II
92	MALLESHAIAH	+	–	–	–	–	–	–	–	–	II
93	RAJAMMA	–	+	–	–	–	–	–	–	+	II
94	GUNDAPPA	–	–	–	–	–	–	+	–	–	II
95	KADIRAPPA	–	–	+	–	–	–	–	–	–	II
96	SHARFUNISSA	–	–	–	–	–	+	–	–	–	II
97	GANGAPPA	+	–	–	–	–	–	–	–	–	II
98	VENKATARAMAPPA	–	–	–	–	–	–	–	–	–	II
99	NAGAMMA	–	–	–	–	–	–	–	–	–	II
100	NANJUNDAPPA	–	–	–	–	–	–	–	–	–	II