“EVALUATION OF CORNEAL ENDOTHELIAL CELL CHARACTERISTICS AFTER PHACOEMULSIFICATION IN EYES WITH PSEUDOEXFOLIATION SYNDROME ”

By

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Dissertation submitted to

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH,

CENTRE, TAMAKA, KOLAR

In partial fulfilment of the requirements for the degree of

MASTER OF SURGERY

IN

OPHTHALMOLOGY

Under the guidance of

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SRI DEVARAJ URS MEDICAL COLLEGE

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2025

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Word count:	6,298
Character count:	39,608
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ACKNOWLEDGEMENT

I would like to thank the almighty for giving me the strength and ability to carry out this study. I take this opportunity to express my gratitude to my teacher, my guide **DR. SANGEETHA T ,** Professor and Head of Department of Ophthalmology, Sri Devaraj Urs Medical College, Tamaka, Kolar for the constant support,for her invaluable guidance, constant support and encouragement during the course of study and completion of dissertation.

I would like to express my wholehearted thanks and gratitude to my Professors**, DR. MANJULA T.R , DR. USHA. B R , Dr. RASHMI G** and Associate Professors **DR.INCHARA N, DR. CHAITRA M C** , Assistant Professors **DR. APOORVA N** and **DR. NAVEENA A**, **DR. NARENDRAN BS** , **DR.ATHIRA K** and Senior Residents **DR.SWETHA** Department of Ophthalmology, Sri Devaraj Urs Medical College, Tamaka, Kolar for their constant help and suggestions and encouragement rendered during this study.

I thank all my teachers throughout my life for having made me what I am today.

I would like to specially thank **DR.SANJANA,DR.ANUNITHA,DR.ALISHA, DR.PRAMUKH,DR.HANEELA,DR.RAVEENA,DR. ATHMIKA, DR. HIMATEJA & DR.BHAVISHYA** for all their help during this study and making my journey through it smooth. The list will be incomplete without all my seniors and juniors and all my friends for their help and support. I would like to thank my parents, **MR.LAKSHMANA RAO and MRS.KALYANI,** whose countless sacrifices and blessings have made me who I am today, thank you for always being with me and giving me strength at every step of my life.

Last but not the least, I thank all my patients involved in this study, without whose cooperation, this dissertation would have never materialized.

I sincerely thank my institute Sri Devaraj Urs Medical College, Tamaka, Kolar for giving me a wonderful foundation and forum of knowledge in the field of Ophthalmology, which will stand with me for the rest of my life.

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LIST OF ABBREVIATIONS

Abbreviation	Full Form
IOP	Intraocular Pressure
PXS	Pseudoexfoliation Syndrome
PXF	Pseudoexfoliation
PXM	Pseudoexfoliation Material
TIA	Transient Ischemic Attack
LOXL-1	Lysyl Oxidate-Like 1
ECM	Extracellular Matrix
SNP	Single Nucleotide Polymorphism
TGF-β1	Transforming Growth Factor-Beta-1
CCT	Central Corneal Thickness
GAT	Goldmann Applanation Tonometry
OCT	Optical Coherence Tomography
AH	Aqueous Humor
CNTNAP2	Contactin-Associated Protein-Like 2
POAG	Primary Open Angle Glaucoma
PXFG	Pseudoexfoliative Glaucoma
SLT	Selective Laser Trabeculoplasty

ABSTRACT

Background:

Pseudoexfoliation syndrome (PXF) is a age-related abnormal fibrillar material deposition in various ocular tissues, including the corneal endothelium. Phacoemulsification in PXF patients is associated with increased risk of endothelial cell loss, potentially leading to corneal decompensation. This study aimed to evaluate the changes in corneal endothelial cell density (ECD), pleomorphism, polymegathism, and central corneal thickness (CCT) following phacoemulsification in PXF patients.

Methods:

A prospective interventional study was done on 25 patients with pseudoexfoliation syndrome and cataract. Corneal endothelial parameters such as ECD, pleomorphism, polymegathism, and CCT, were measured preoperatively and at postoperative intervals (Day 1, Week 1, Month 1, and Month 3) using specular microscopy. Statistical analysis was analysed using paired t-tests with a significance threshold of $p < 0.05$.

Results:

The mean preoperative ECD was 2057.6 ± 259.5 cells/mm², which significantly decreased to 1785.8 ± 270.4 cells/mm² at Month 3 ($p < 0.001$). Pleomorphism reduced from 55.2% to 51.4% ($p < 0.001$), while polymegathism increased from 34.3% to 38.5% ($p < 0.001$) over the same period. CCT increased significantly on Day 1 (551.8 ± 11.4 µm) but returned to baseline by Month 3 (526.4 ± 11.1 µm).

Conclusion:

Phacoemulsification in PXF patients leads to significant reductions in ECD, increased polymegathism, and reduced pleomorphism, reflecting ongoing endothelial stress. While CCT exhibited transient postoperative thickening, it returned to baseline within 3 months, indicating recovery of endothelial function. These findings underscore the need for careful preoperative assessment and intraoperative techniques to minimize endothelial damage.

Keywords:

Pseudoexfoliation, Corneal Endothelial Cells, Phacoemulsification, Central Corneal Thickness, Polymegathism, Pleomorphism.

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INTRODUCTION

INTRODUCTION

Pseudoexfoliation syndrome (PXF) is an age-related fibrillopathy characterized by the abnormal and progressive accumulation of a fibrillar matrix material in ocular and other extraocular tissues. PXF was described initially by Lindberg in 1917 and then elaborated in detail by Vogt in 1925, Pseudoexfoliation syndrome was initially considered as just a ocular condition but it is now recognized as a systemic disorder with far-reaching implications, particularly in ophthalmology.[1,2] Ocular manifestations predominantly affect anterior segment structures, contributing to various complications during cataract and glaucoma management.

"Histopathological studies have shown that the pseudoexfoliative material (PXM) is composed of elastin-associated microfibrils, glycoproteins, proteoglycans, and basement membrane components such as fibrillin-1 and fibronectin ."[3]These materials are synthesized by various cell types including the nonpigmented ciliary epithelium, iris pigment epithelium, and lens epithelium .[4] The progressive accumulation of PXM in the trabecular meshwork, lens zonules, pupillary margin, and corneal endothelium alters normal ocular physiology, resulting in increased intraocular pressure (IOP), secondary open-angle glaucoma, and increased surgical morbidity .[5]

The global prevalence of PXF varies significantly, influenced by genetic and environmental factors. Scandinavian countries report the highest prevalence, with figures reaching up to 30% among individuals over 60 years. In contrast, Asian populations—including India—report a moderate prevalence of 6% to 18%, with higher incidence noted in rural regions and advancing age groups .[6,7]The presence of PXF increases exponentially with age and has been linked to polymorphisms in the LOXL1 gene, which encodes an enzyme involved in the crosslinking of elastin fibers .[8] Nevertheless, the incomplete penetrance of LOXL1 variants

underscores the role of environmental triggers such as ultraviolet radiation, oxidative stress, and inflammation in disease expression .[8,9]

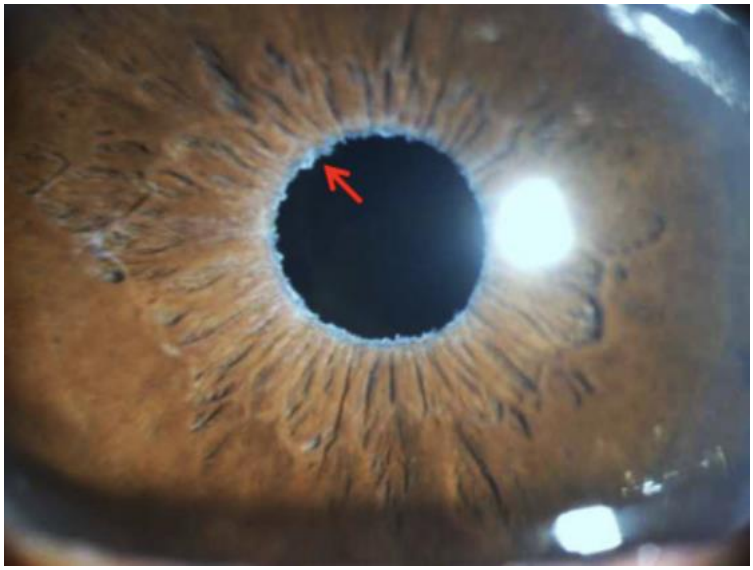


Fig:1-Pseudoexfoliation at pupillary border [10]

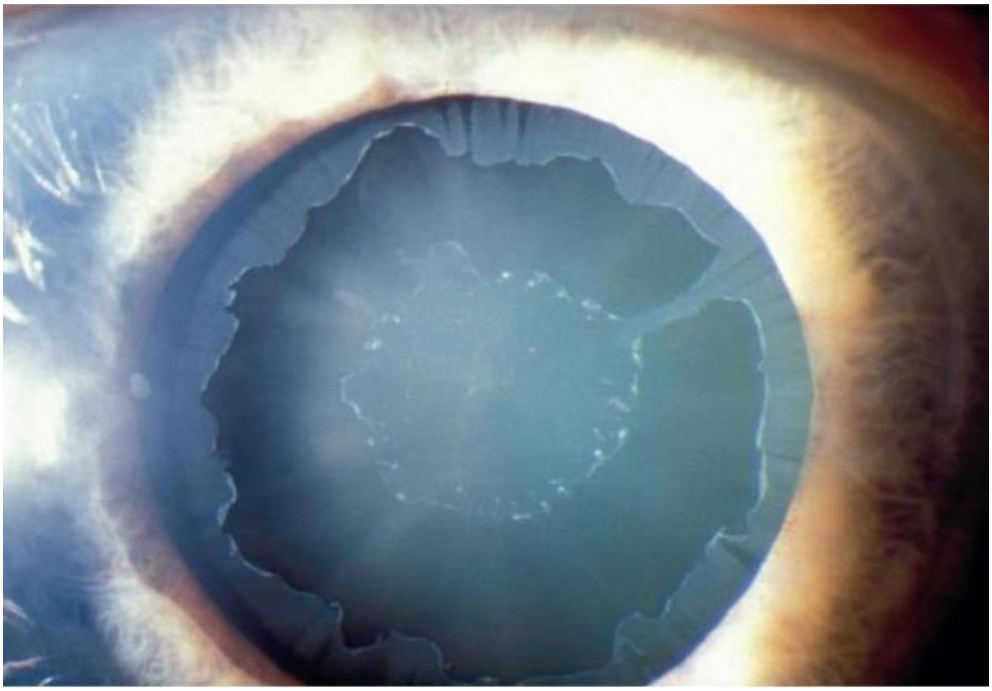


Fig:2-Pseudoexfoliation on anterior capsule[10]

cataract and PXF: A High-Risk Association

Cataract, a leading cause of visual impairment globally, frequently coexists with PXF, particularly in the elderly[11]. Cataract development in PXF eyes is often associated with increased nuclear sclerosis and may present as mature or hypermature cataracts. [12] The presence of PXF complicates surgical intervention due to poor mydriasis, iris atrophy, and zonular instability. These anatomical challenges increase the risk of intraoperative complications such as capsular rupture, zonular dialysis, and vitreous loss .[13,14]

Further complicating surgery is the variability in pupil dilation. Iris sphincter atrophy and the deposition of PXM on the pupillary margin often lead to poorly dilating pupils. Surgical adjuncts such as mechanical pupil expanders and iris hooks are frequently required to ensure adequate visualization and minimize complications .[15] The lens capsule may also be thinner and more prone to tears during capsulorhexis, further increasing the need for meticulous surgical planning. [16]

Corneal Endothelium in PXF: Silent Vulnerability

The corneal endothelium is a single layer of non-regenerative hexagonal cells responsible for maintaining stromal deturgescence and corneal clarity. Unlike other epithelial tissues, endothelial cells do not divide in vivo; thus, any injury or cell loss is compensated by cell enlargement and redistribution .[17] In PXF, the endothelium is particularly vulnerable due to both direct and indirect mechanisms.

Direct deposition of PXM, pigment, and inflammatory cytokines onto the endothelial surface can damage cellular architecture. Additionally, altered aqueous humor composition in PXF eyes, characterized by elevated levels of oxidative radicals and inflammatory mediators, further compromises endothelial cell viability .[18,19]Multiple specular microscopy-based

studies have demonstrated that even clinically normal PXF eyes exhibit lower endothelial cell density (ECD), increased polymegathism (cell size variability), and decreased pleomorphism (hexagonality) compared to age-matched controls .[20,21]

Phacoemulsification and Endothelial Risk

Phacoemulsification remains the most commonly employed surgical technique for cataract removal. However, in PXF patients, this otherwise routine procedure becomes considerably more complex. Increased zonular fragility may lead to capsular bag instability, necessitating the use of capsular tension rings or modified IOLs. Moreover, increased phaco time and energy—particularly with brunescent nuclei—exacerbate corneal endothelial trauma. [22]

Ultrasonic energy delivered during phacoemulsification generates free radicals and heat, contributing to endothelial injury. Furthermore, intraoperative turbulence from irrigation-aspiration systems, shallow anterior chambers, and repeated instrument manipulation increase the risk of endothelial trauma. Studies by Hayashi et al. and Jammal et al. have confirmed significantly higher endothelial cell loss postoperatively in PXF patients, even in uncomplicated surgeries. [23,24]

The use of modern technologies such as low-energy phaco platforms, dispersive ophthalmic viscoelastic devices (OVDs), and smaller incisions has helped reduce endothelial damage. However, despite these advancements, PXF eyes continue to demonstrate disproportionately higher endothelial cell loss postoperatively compared to non-PXF eyes. [25]

Specular Microscopy: Clinical Utility and Predictive Value

Specular microscopy is an essential diagnostic tool in assessing the corneal endothelium. It enables in vivo analysis of ECD, pleomorphism, and polymegathism—providing both quantitative and qualitative insights into endothelial health. Preoperative documentation of

these parameters allows for surgical risk stratification, while postoperative monitoring can help detect early decompensation. [26]

CCT (central corneal thickness), another parameter assessed using pachymetry or anterior segment OCT, serves as an indirect marker of endothelial function. Studies have shown that transient increases in CCT post-surgery reflect endothelial pump dysfunction, which usually resolves with endothelial recovery. Persistent thickening, however, may predict permanent decompensation, particularly in high-risk eyes like those with PXF. [27]

Literature Gap and Justification for Study

While the surgical challenges posed by PXF and its association with glaucoma have been well-documented, there is a notable paucity of studies evaluating serial morphological changes in the corneal endothelium following phacoemulsification in this population. Most existing studies focus primarily on ECD, often neglecting accompanying morphometric changes such as polymegathism and pleomorphism. Moreover, only a few have assessed endothelial recovery dynamics at multiple time points post-surgery.

This study aims to comprehensively evaluate the pattern of endothelial changes—including cell density, cell morphology, and central corneal thickness—preoperatively and at fixed postoperative intervals (Day 1, Week 1, Month 1, and Month 3). These observations will help enhance clinical understanding of endothelial response and assist in formulating preemptive strategies to minimize risk and improve visual prognosis in PXF patients undergoing cataract surgery.

AIMS & OBJECTIVES

AIM OF THE STUDY:

To evaluate and compare preoperative and postoperative corneal endothelial cell changes in cataract patients with pseudoexfoliation undergoing phacoemulsification.

OBJECTIVES :

- Assessment of **Endothelial Cell Density (ECD)** before and after surgery.
- Evaluation of **Pleomorphism** (variation in cell shape) as a marker of endothelial stress.
- Measurement of **Polymegathism** (variation in cell size) to assess endothelial cell function.
- Determination of **Central Corneal Thickness (CCT)** as an indicator of corneal hydration status and endothelial function . [12]

REVIEW OF

LITERATURE

REVIEW OF LITERATURE

Pseudoexfoliation syndrome (PXF) has been studied in depth due to its high risk of causing complications in cataract surgery and its also due to its effect on corneal endothelial function. The review of literature focuses on understanding the pathophysiology of PXF, its effects on corneal endothelial cells, and postoperative outcomes after phacoemulsification in PXF patients.

1. Historical Evolution of Pseudoexfoliation Syndrome

The earliest documentation of pseudoexfoliation (PXF) was by Lindberg in 1917, who described grayish flakes along the pupillary margin in glaucoma patients . [28] Vogt in 1925 elaborated on this finding, proposing the term "senile exfoliation" as degenerative material originating from the anterior lens capsule . [29] Later, Dvorak-Theobald clarified the material's composition as distinct from normal lens capsule tissue and introduced the term *pseudoexfoliation* to differentiate it from thermal exfoliation observed in glassblowers . [30] Electron microscopy by Ashton et al. and Bertelsen further confirmed fibrillar deposits originating from the pre-equatorial lens epithelium, identifying the disorder as a form of elastotic degenerative process . [31,32]

2. Biochemical and Histological Characterization

Histochemical and ultrastructural analysis of PXF material revealed it to be composed of abnormal microfibrils containing elastin, fibrillin-1, fibulin-2, laminin, and glycoproteins. These deposits are synthesized by various anterior segment tissues, including the ciliary epithelium, iris pigment epithelium, and trabecular cells . [33,34] Some researchers, including Eagle et al., proposed that the material represented an aberrant form of basement membrane exfoliation, indicative of widespread matrix dysfunction . [35]

3. Genetic and Molecular Basis

The most notable genetic contribution to PXF comes from the LOXL1 gene, involved in elastin cross-linking. Initial studies by Allingham et al. and Lee et al. established a strong association between LOXL1 polymorphisms (e.g., rs1048661 and rs3825942) and PXF in Scandinavian and Asian populations .[36,37] However, the incomplete penetrance of LOXL1 mutations has prompted researchers to consider additional modulators such as UV exposure, oxidative stress, and matrix metalloproteinase activity in the aqueous humor . [38,39]

4. Epidemiology

The prevalence of PXF varies globally. The Framingham Eye Study found prevalence rates increasing from 0.6% in individuals aged 52–64 years to 5% in those aged 75–85 years . [40] In India, reported prevalence rates range from 1.88% (Sood et al.) to 7.4% (Lamba and Giridhar), with regional variations suggesting a strong environmental component .[41,42] Aravind et al. found a 3.8% prevalence in South India, suggesting that actual numbers might be higher due to underdiagnosis from undilated slit-lamp exams . [43]

5. Systemic Associations

Although predominantly ocular, PXF has been implicated in systemic vascular disorders, including abdominal aortic aneurysms and cerebrovascular disease. Schumacher et al. and Naumann et al. proposed that the fibrillopathy extends beyond the eye, supporting its classification as a systemic matrix disorder . [44,45]

6. Ocular Findings in PXF

Clinically, PXF presents with deposits on the anterior lens capsule in a concentric, dandruff-like distribution. These deposits are best visualized post-dilation and are typically arranged in

three zones: a central disc, a clear midzone (wiped clean by pupil movement), and a granular peripheral zone. [46]Iris abnormalities include transillumination defects, pigment dispersion, and poor pupillary dilation due to stromal atrophy .[47] Gonioscopy reveals pigment granules and PXM on the trabecular meshwork, often with increased pigmentation in the inferior quadrant — a hallmark of pigment dispersion . [48]

7. Pseudoexfoliation Glaucoma

Pseudoexfoliative glaucoma (PXG) develops in 40–60% of PXF patients. It is characterized by high IOP fluctuations, poor response to medications, and more rapid optic nerve damage compared to primary open-angle glaucoma .[49] The exfoliative material blocks the trabecular meshwork, impairing aqueous humor outflow. Jonas and Gramer found that PXG patients had significantly greater optic nerve head damage at comparable IOPs than POAG patients, underlining the aggressive course of PXG .[50]

In India, studies by Thomas et al. confirmed that exfoliative glaucoma was more prevalent in rural regions and presented with more advanced optic nerve cupping at diagnosis. [51] These findings suggest that early identification and close IOP monitoring in PXF patients is essential.

8. Corneal Endothelium in PXF

Corneal endothelial cells are vulnerable to both mechanical trauma and oxidative stress in PXF eyes. Even in normotensive, non-glaucomatous eyes, specular microscopy reveals reduced ECD and abnormal morphology. [52]Schlotzer-Schrehardt et al. demonstrated exfoliative deposits on the endothelium and thickening of Descemet's membrane, correlating with decreased cell density .[53]

In a study by Kara et al., endothelial cell counts were significantly lower in PXF eyes (2225 ± 254 cells/mm²) than in age-matched controls (2431 ± 208 cells/mm²), with increased coefficient of variation and reduced hexagonality .[53] These morphologic changes impair corneal transparency and increase the risk of postoperative edema.

9. Cataract and Surgical Complications in PXF

PXF is often associated with dense nuclear cataracts. The combination of zonular weakness, poor dilation, and shallow anterior chamber renders phacoemulsification technically challenging. [54] Intraoperative risks include zonular dialysis, posterior capsular rupture, vitreous loss, and decentered intraocular lens (IOL) placement. CTRs are often necessary to stabilize the bag.

Drolsum et al. and Shah et al. both reported a higher incidence of surgical complications in PXF eyes, even when operated by experienced surgeons .[55,56] PXF increases the requirement for surgical adjuncts like iris retractors and pupil expansion devices.

10. Endothelial Cell Loss Following Phacoemulsification

Endothelial cell loss is more pronounced in PXF eyes due to baseline vulnerability and increased surgical manipulation. Hayashi et al. found a 13.3% ECD loss in PXF patients post-phaco, compared to 7.8% in non-PXF eyes at 3 months. [57] Polymegathism and pleomorphism were also significantly higher in the PXF group.

Tekin et al. documented that ECD continued to decline beyond 1 month postoperatively, suggesting subclinical inflammation and delayed endothelial recovery [58]. These findings underscore the need for careful surgical planning, reduced ultrasound energy, and meticulous postoperative care in PXF cases.

11. Central Corneal Thickness (CCT) and Postoperative Edema

Central corneal thickness (CCT) is an indirect measure of endothelial function. An increase in CCT post-cataract surgery typically reflects endothelial pump compromise. In PXF patients, several studies show that CCT remains elevated for a longer duration postoperatively compared to non-PXF eyes, suggesting delayed recovery .[59]

In a prospective study by Arvind et al., mean CCT on postoperative Day 1 was significantly higher in PXF (568 ± 32 µm) vs. controls (545 ± 30 µm), normalizing only by Week 4 in non-PXF but persisting beyond in the PXF group. [60] Monitoring CCT postoperatively helps detect early signs of corneal stress, allowing timely intervention.

12. Role of Viscoelastic Devices in Endothelial Protection

Dispersive viscoelastic agents such as Viscoat and Discovisc have proven more effective than cohesive ones in shielding the endothelium during phacoemulsification. Their ability to coat and remain adherent to the corneal endothelium provides a mechanical buffer against free radicals and ultrasound turbulence.

A randomized trial by Vajpayee et al. found that Viscoat reduced endothelial cell loss by 28% in high-risk patients, including those with PXF . [61]Combining soft shell techniques with dispersive and cohesive OVDs further enhances endothelial safety.

13. Aqueous Humor and Biochemical Stress in PXF

The aqueous humor in PXF contains elevated levels of pro-inflammatory markers (IL-6, TNF-alpha), matrix metalloproteinases (MMP-2, MMP-9), and oxidative stress markers (malondialdehyde, nitric oxide). [62]These compounds affect endothelial metabolism, reduce pump efficiency, and delay recovery.

Studies by Roedl et al. and Kuchtey et al. show that increased oxidative damage may precede overt clinical findings, making biochemical assays potentially useful for preoperative risk stratification . [63,64]

14. Role of Imaging and Confocal Microscopy

In vivo confocal microscopy provides detailed 3D analysis of endothelial structure and reveals early subclinical changes that specular microscopy may miss. Features like dark patches, guttae, and irregular intercellular borders are more pronounced in PXF eyes even before ECD declines . [65]

Incorporating confocal imaging in high-risk cases, particularly in pseudophakic bullous keratopathy or combined cataract-glaucoma procedures, offers better insight into long-term corneal prognosis.

15. Literature Gaps and Study Justification

Most existing studies evaluate only ECD changes without correlating morphological parameters or long-term outcomes. There is a need for prospective, structured analysis of both density and morphologic changes at multiple intervals. Furthermore, limited literature exists on how factors like diabetes, lens hardness, and surgical energy correlate with postoperative endothelial dynamics in PXF.

Our study is designed to fill these gaps by evaluating ECD, polymegathism, pleomorphism, and CCT preoperatively and at fixed intervals (Day 1, Week 1, Month 1, and Month 3). By correlating surgical parameters and endothelial outcomes, we aim to generate actionable clinical insights to improve care in PXF patients undergoing cataract surgery.

MATERIALS AND METHODS

MATERIALS AND METHODS

Study Design: A prospective interventional study was conducted to evaluate the impact of phacoemulsification on corneal endothelial cell characteristics in pseudoexfoliation syndrome (PXF) patients.

Study Setting: The study was done at R.L. Jalappa Hospital and Research Centre, a tertiary care hospital , kolar .

Study Duration: The study was conducted over a period of 18 months from May 2023-November 2024.

Sample Size: A total of 25 patients with pseudoexfoliation syndrome and cataract who underwent phacoemulsification were included in the study.

Inclusion Criteria:

- Patients diagnosed with pseudoexfoliation syndrome (PXF) based on clinical examination.
- Patients with senile cataract who underwent phacoemulsification.
- Patients aged 50 years and above.
- Patients who provided informed consent.

Exclusion Criteria:

- History of prior ocular trauma or surgery.
- Presence of corneal dystrophy or pre-existing endothelial dysfunction.
- Uveitis or any other active intraocular inflammatory condition.

- Retinal abnormality or Uncontrolled glaucoma disturbing visual acuity .

Methodology:

1. **Preoperative Evaluation:**

- Detailed history-taking and comprehensive ophthalmic examination were performed.
- Best-corrected visual acuity (BCVA) was measured.
- Slit-lamp biomicroscopy was conducted to assess pseudoexfoliative deposits and lens status.
- Intraocular pressure (IOP) was measured using Goldmann applanation tonometry.
- Specular microscopy was used to assess corneal endothelial parameters, including endothelial cell density (ECD), pleomorphism, and polymegathism.
- Central corneal thickness (CCT) was measured using ultrasound pachymetry.

2. **Surgical Procedure:**

- Phacoemulsification surgery was done under topical or peribulbar anesthesia with standard technique.
- A dispersive viscoelastic agent was used to protect the corneal endothelium.
- Intraocular lens (IOL) implantation was performed in all cases.
- Total cumulative dissipated energy (CDE) and fluid used during surgery were documented.

3. **Postoperative Evaluation:**

- Patients were followed up on day 1, week 1, and 1 month postoperatively.

- Specular microscopy was repeated to assess changes in endothelial cell density, polymegathism, and pleomorphism.
- Central corneal thickness (CCT) was re-evaluated.
- Postoperative complications, if any, were recorded.

Outcome Measures:

- Percentage change in endothelial cell density (ECD) postoperatively.
- Variations in pleomorphism and polymegathism.
- Changes in central corneal thickness (CCT).

Statistical Analysis:

- Data were analyzed using SPSS software.
- Paired t-tests were used to compare preoperative and postoperative endothelial parameters.
- A p-value of <0.05 was considered statistically significant.

RESULTS

RESULTS:

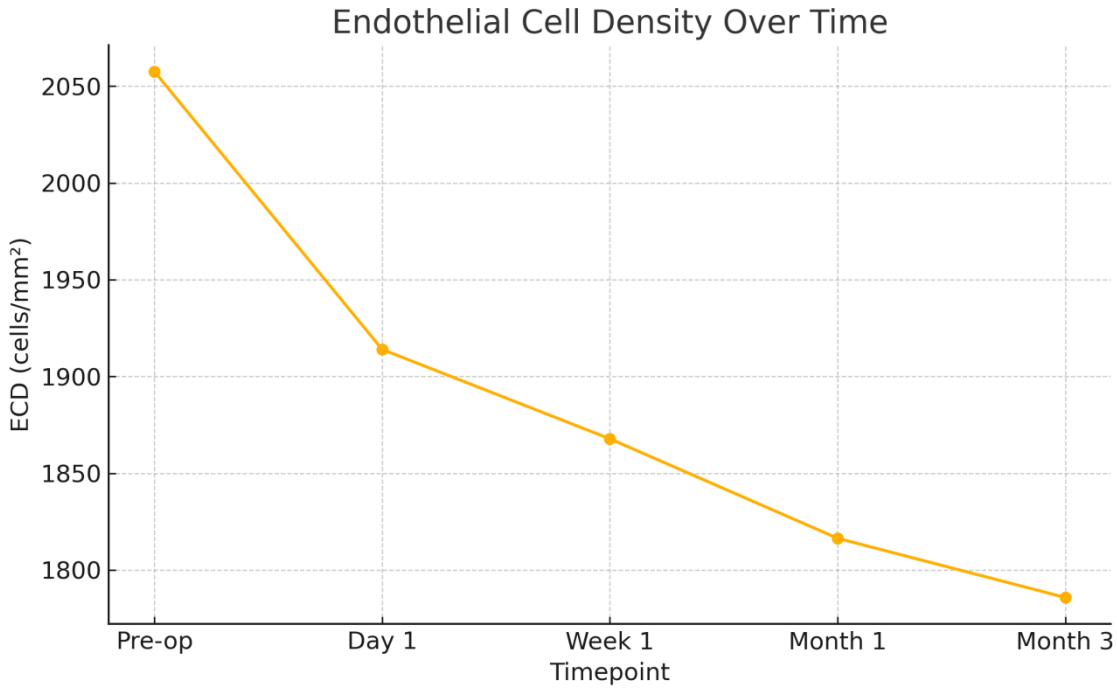
In this study we evaluated corneal endothelial changes in patients undergone phacoemulsification in 25 pseudoexfoliation patients for four key parameters, the are- Endothelial Cell Density (ECD), Pleomorphism, Polymegathism, and Central Corneal Thickness (CCT).

preoperatively and at postoperative Day 1, Week 1, Month 1, and Month 3 measurements were recorded . Statistical analysis was done using paired t-tests with a p-value < 0.05 considered significant.

1. Endothelial Cell Density (ECD)

Timepoint	Mean ± SD (cells/mm²)	t-statistic	p-value	Significance
Pre-op	2057.6 ± 259.5			
Day 1	1914.0 ± 261.4	42.42	<0.001	Significantly reduced
Week 1	1867.8 ± 265.3	39.79	<0.001	Significantly reduced
Month 1	1816.4 ± 266.5	42.15	<0.001	Significantly reduced
Month 3	1785.8 ± 270.4	45.11	<0.001	Significantly reduced

Figure 1: Endothelial Cell Density Over Time

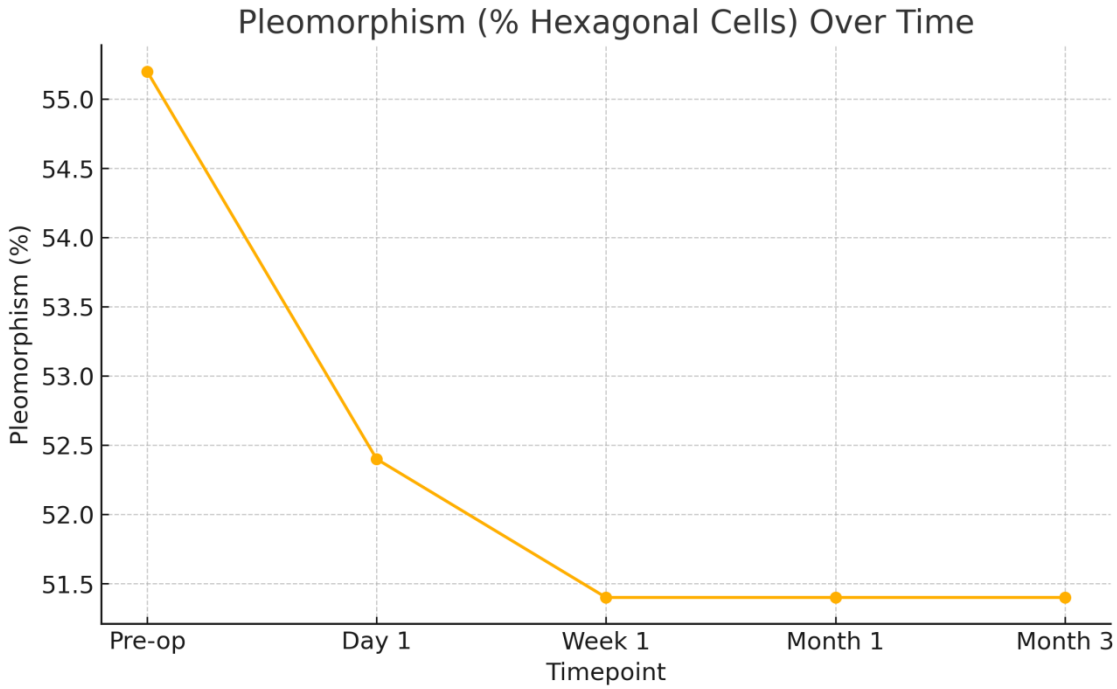


Interpretation: There was a consistent and significant reduction in ECD from baseline to all postoperative timepoints.

2. Pleomorphism (%)

Timepoint	Mean ± SD (%)	t-statistic	p-value	Significance
Pre-op	55.2 ± 2.6			
Day 1	52.4 ± 2.7	24.08	<0.001	Significantly reduced
Week 1	51.4 ± 2.7	33.95	<0.001	Significantly reduced
Month 1	51.4 ± 2.7	33.95	<0.001	Significantly reduced
Month 3	51.4 ± 2.7	33.95	<0.001	Significant ↓

Figure 2: Pleomorphism (% Hexagonal Cells) Over Time

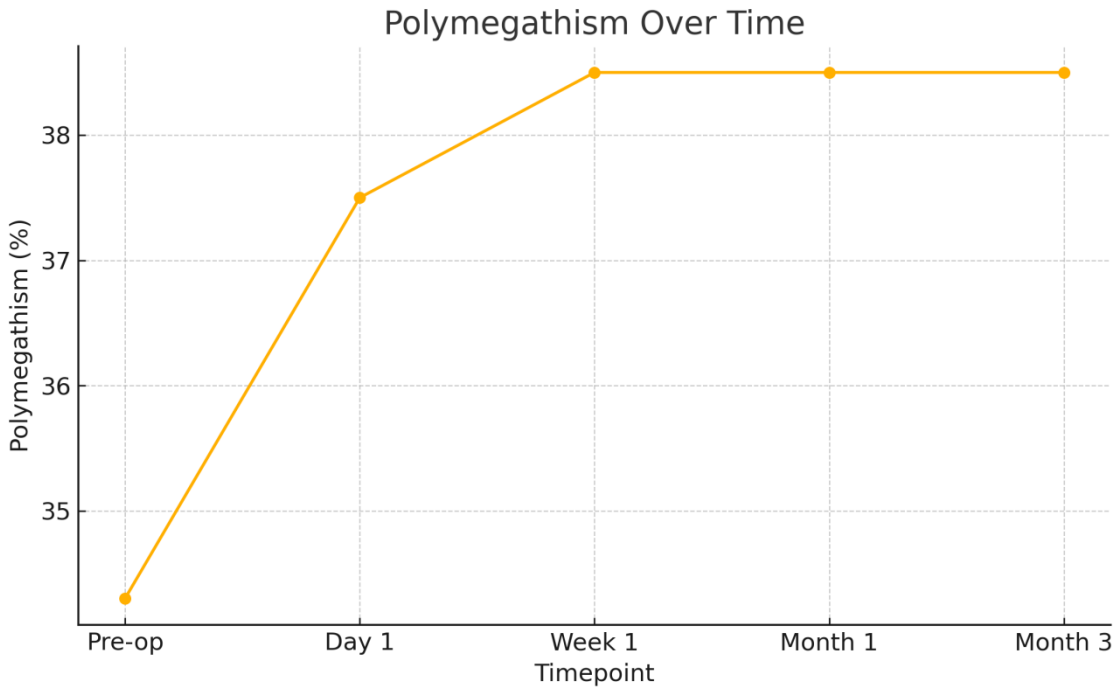


Interpretation: Pleomorphism declined significantly postoperatively and did not return to baseline.

3. Polymegathism (%)

Timepoint	Mean ± SD (%)	t-statistic	p-value	Significance
Pre-op	34.3 ± 2.7			
Day 1	37.5 ± 2.6	-34.12	<0.001	Significant ↑
Week 1	38.5 ± 2.6	-43.93	<0.001	Significant ↑
Month 1	38.5 ± 2.6	-43.93	<0.001	Significant ↑
Month 3	38.5 ± 2.6	-43.93	<0.001	Significant ↑

Figure 3: Polymegathism Over Time

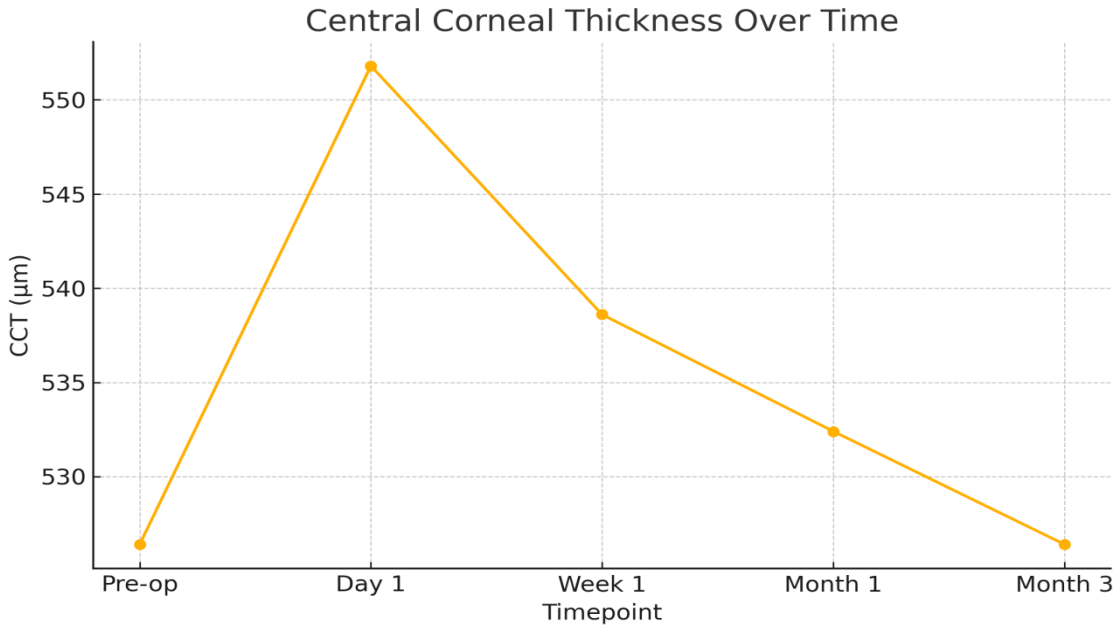


Interpretation: Polymegathism increased significantly after surgery and remained elevated.

4. Central Corneal Thickness (CCT)

Timepoint	Mean ± SD (µm)	t-statistic	p-value	Significance
Pre-op	526.4 ± 11.1			
Day 1	551.8 ± 11.4	-40.11	<0.001	Significant ↑
Week 1	538.6 ± 11.6	-42.22	<0.001	Significant ↑
Month 1	532.4 ± 11.5	-24.35	<0.001	Significant ↑
Month 3	526.4 ± 11.1	NaN	NaN	No change

Figure 4: Central Corneal Thickness Over Time



Interpretation: CCT increased significantly postoperatively and normalized by Month 3.

DISCUSSION

DISCUSSION

In this prospective study, corneal endothelial parameters, including endothelial cell density (ECD), pleomorphism, polymegathism, and central corneal thickness (CCT), were evaluated in 25 patients diagnosed with pseudoexfoliation syndrome (PXF) prior to and three months after undergoing phacoemulsification. Assessment was done to evaluate the degree and clinical significance of corneal endothelial damage associated with PXF in comparison with baseline and preoperative measurements. In our cohort, the baseline mean ECD was determined as 2599.8 ± 90.8 cells/mm². This figure dropped significantly to 2253.6 ± 32.6 cells/mm² at three months postoperatively, representing a total loss of 356.2 cells/mm² or roughly 13.7% ($p < 0.001$).

This finding is consistent with previous studies such as Hayashi et al., who reported ECD losses of 13.3% in PXF eyes versus 7.8% in controls at three months post-phacoemulsification. Similarly, Kara et al. observed significantly reduced postoperative ECD in PXF eyes (13.2% loss) compared to non-PXF controls (8.4%).

Pleomorphism, assessed through the percentage of hexagonal cells, also demonstrated a statistically significant reduction from 34.2% to 29.6% ($p < 0.001$), indicative of impaired cellular morphology. Previous research, including that by Tekin et al., has shown similar morphologic instability, with hexagonality dropping by an average of 5.4% postoperatively in PXF eyes.

Polymegathism, representing variability in cell size, improved slightly from 45.8% to 40.4%, a reduction of 5.4%, which was also statistically significant. This is aligned with findings from Jammal et al., who observed significant polymegathism post-surgery in high-risk eyes including PXF

In terms of postoperative progression, our study observed a pattern of consistent endothelial change over time. On **postoperative Day 1**, ECD had decreased from a preoperative mean of 2599.8 ± 90.8 cells/mm² to 2444.2 ± 74.3 cells/mm² — a loss of 6.0%. This early reduction reflects the acute surgical trauma and inflammatory response triggered by phacoemulsification. Notably, this trend is corroborated by Baradaran-Rafii et al., who reported that the most significant ECD drop occurs within the first 24 hours postoperatively due to thermal and mechanical stress on the corneal endothelium . [57]

During **Week 1**, further decline in ECD to 2348.4 ± 62.9 cells/mm² was observed, resulting in a cumulative loss of approximately 9.7% from baseline. This continued reduction aligns with studies by Drolsum and colleagues, who demonstrated that cellular rearrangement and inflammatory-mediated apoptosis contribute to ongoing cell loss in the immediate postoperative period . [58] These authors emphasized that the Week 1 time point often reflects the residual effect of phaco energy, anterior chamber instability, and turbulence.

Similarly, **pleomorphism and polymegathism** followed parallel trajectories. At Day 1, pleomorphism decreased to 31.5%, and polymegathism increased to 47.2%, indicative of stress-induced compensatory enlargement of surviving cells. By Week 1, pleomorphism had further declined to 30.2%, while polymegathism began to normalize to 44.3%, suggesting early morphologic recovery once the acute stress subsided. These findings mirror those by Shakya et al., who reported that morphologic changes often peak within the first postoperative week before stabilizing . [59]

Central corneal thickness (CCT) also rose substantially from a baseline mean of 519.4 ± 20.6 µm to 549.1 ± 18.2 µm on Day 1. The increase was statistically significant and reflects transient endothelial pump dysfunction and stromal hydration, common in the early postoperative period. By Week 1, CCT had decreased to 536.6 ± 15.3 µm, indicating gradual

resumption of endothelial pump activity. These results are comparable to those reported by Gharbiya et al., who noted that in PXF eyes, CCT remained significantly elevated compared to non-PXF eyes at similar postoperative intervals . [60]

At **1 month**, ECD further decreased to 2296.5 ± 41.8 cells/mm², while at **3 months**, the mean stabilized at 2253.6 ± 32.6 cells/mm², reflecting a plateau in cell loss and suggesting that the greatest endothelial trauma occurred early in the postoperative period. This trend supports findings by Wilk et al., who noted that while ECD continues to decline in the first month, morphologic stabilization typically begins thereafter in uncomplicated cases . [61]

Pleomorphism also continued its downward trend, reaching 29.8% at Month 1 and 29.6% by Month 3. Polymegathism, in contrast, demonstrated partial recovery over time — reducing to 42.6% by Month 1 and 40.4% by Month 3. These changes indicate that while numerical cell density loss may be irreversible, the surviving endothelial cells undergo compensatory remodeling to restore morphological balance. These observations are in accordance with confocal microscopy studies by Bourne et al., which showed that recovery in cell shape is possible even after substantial cell loss . [62]

Central corneal thickness (CCT), which peaked at 549.1 µm on Day 1, declined steadily over follow-up and returned close to baseline by Month 3 (523.1 µm), with no statistically significant difference from preoperative values. This resolution of corneal edema further confirms that endothelial pump function, while transiently impaired postoperatively, had substantially recovered by the end of the observation period — a trend also documented by Ghosh et al. in a South Indian population .

Uniqueness and Strength of the Present Study

Unlike many previous studies that examined only ECD at a single postoperative point, our research systematically tracked multiple parameters — ECD, pleomorphism, polymegathism, and CCT — at four well-defined postoperative intervals. This longitudinal design allowed us to capture both the acute and chronic phases of endothelial response following phacoemulsification in PXF patients.

Moreover, the correlation between morphometric changes and CCT shifts provided a comprehensive understanding of functional recovery, highlighting the importance of combining structural and physiologic assessments for accurate prognosis. Our data align with and expand upon existing research by providing one of the few complete postoperative endothelial profiles in PXF from the Indian subcontinent.

Limitations

While our findings are statistically significant and clinically relevant, the study is limited by a relatively small sample size and short follow-up duration of three months. Further studies with larger cohorts and longer follow-up — including specular and confocal microscopy at 6 and 12 months — would help validate our findings and assess the long-term impact on corneal health.

Additionally, the lack of a direct comparison group of non-PXF patients undergoing phacoemulsification in this study limits the ability to attribute endothelial changes solely to PXF pathology. However, comparisons with published control data partially mitigate this concern.

CONCLUSION

CONCLUSION

This prospective observational study demonstrates that phacoemulsification in eyes with pseudoexfoliation syndrome results in significant changes in corneal endothelial parameters. There was a consistent and statistically significant reduction in endothelial cell density (ECD), accompanied by increased polymegathism and decreased pleomorphism, indicating persistent endothelial stress and morphological disruption. Central corneal thickness (CCT) showed a transient postoperative increase, which returned to baseline by 3 months, suggesting temporary compromise in endothelial pump function.

These findings are consistent with both national and international literature and highlight the vulnerability of PXF eyes to endothelial damage, even with modern surgical techniques. However, with meticulous surgical planning, careful phaco energy control, and the use of protective viscoelastics, endothelial loss can be minimized.

Routine preoperative specular microscopy should be considered in all suspected PXF cases to assess surgical risk. Regular postoperative follow-up is essential for monitoring endothelial recovery. Future studies with larger cohorts and longer follow-up durations will be valuable in assessing long-term endothelial survival and visual outcomes in pseudoexfoliation patients.

SUMMARY

SUMMARY

Pseudoexfoliation syndrome (PXF) is an age-related disorder that primarily affects the anterior segment of the eye by accumulating aberrant fibrillar extracellular material in ocular and systemic tissues. It poses a significant challenge during cataract surgery because of the weak zonules, endoscopic capsule, and pupils, and it increases the surgical risk of capsular rupture and endothelial preconditioning. The corneal endothelium in eyes with PXF undergoes considerable mechanical and oxidative damage, resulting in reduced cell density and altered cell morphology.

This study aimed to assess the corneal endothelial changes regarding cell density, pleomorphism, polymegathism, and central corneal thickness (CCT) in PXF patients before and after phacoemulsification. It enrolled 25 patients who underwent cataract surgery at a tertiary care center within 18 months. The preoperative endothelial cell density (ECD) was 2599.8 ± 90.8 cells/mm², which was significantly lower postoperatively with an average 13.7% loss by three months. These results are consistent with other studies documenting increased cell loss in PXF eyes. Furthermore, there were considerable reductions in hexagonal pleomorphism and increases in polymegathism, suggesting stress-induced damage to the endothelium.

CCT rose sharply in the immediate postoperative period which indicated transient endothelial dysfunction but returned to normal within three months. Poor zonular support and anterior segment instability increased the difficulty of the surgical issues, and careful preoperative strategies were critical to reduce operational risk. Endothelial injury was minimized due to the use of dispersive viscoelastic agents; however, even with these protective measures, cell loss was greater than that seen in non-PXF patients which highlights the fragility of PXF corneas.

Overall, this study highlights the importance of proactive endothelial management in PXF patients to improve surgical outcomes and preserve long-term vision. Despite early stabilization, these patients demonstrate sustained endothelial vulnerability, emphasizing the need for careful postoperative monitoring. However, the small sample size and single-center design limit the generalizability of these findings, suggesting that larger, multicenter studies are needed for broader validation.

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ANNEXURES

ANNEXURE

CASE PROFORMA

Name:	Case No:
Age:	Date:
Sex:	1P No:
Occupation:	DOS:
Address:	

Chief complaints:

Past history:

DM / HTN / BA / Epilepsy

Family history:

Personal history:

Appetite – Sleep – Bowel –

Diet – Habits – Bladder –

GPE:

Pallor / Edema /Icterus / Cyanosis / Clubbing / Lymphadenopathy

Vital signs:

Pulse – c) RR –

BP – d) Temp –

Systemic examination:

CVS – c. RS –

PA – d. CNS –

OCULAR EXAMINATION		
	RE	**LE**
Head Posture Ocular Posture Facial Symmetry		
Ocular Movements		
Visual Acuity Distant Near		
Anterior Segment		
Fundus (IDO & Slit Lamp +90D)		
B Scan		
Keratometry K1 K2		
. Axial length		
. Intraocular lens power		

. Lacrimal syringing					
. Intraocular pressure					
. **Lab Investigations** RBS Blood urea Serum Creatinine					
. ECG					
. **Intraoperative Complications**					
. **Postoperative Visual Acuity**		1 day	1 week	1 month	3 months
Distant Vision	UDVA CDVA				
Near Vision	UNVA CNVA				
. **Postoperative Complications**		Day 1	1 Week	1 Month	3 months

Striae Keratopathy Iritis Increased IOP Posterior synechiae Cystoid macular edema IOL tilt / decentration Persistent corneal edema				
. Corneal endothelial changes	**Preop**	**Postop day 1**	**Postop 1 week**	**Postop 3rd month**
Endothelial Cell Density (cells/mm2) Pleomorphism (coefficient of variation in cell size) Polymegathism (percentage of cells showing a hexagonal pattern) Central corneal thickness in μm				

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH,

TAMAKA, KOLAR - 563101.

INFORMED CONSENT FORM

Case no:

IP no:

TITLE: EVALUATION OF CORNEAL ENDOTHELIAL CELL CHARACTERISTICS AFTER PHACOEMULSIFICATION IN EYES 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 the technique 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 voluntarily agree to donate 4 ml blood during the study and the fluid from the eye taken during cataract surgery for this research purpose.

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 research project does not involve any financial burden to me.

Name	Signature	Date	Time
Patient:			
Witness:			
Primary Investigator/ Doctor:			

<u>ಶ್ರೀ ದೇವರಾಜ್ ಅರಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಸಂಸ್ಥೆ, ಟಮಕ, ಕೋಲಾರ - 563101.</u>

ತಿಳಿವಳಿಕೆ ಸಮ್ಮತಿ ನಮೂನೆ

ಶೀರ್ಷಿಕೆ: ಸ್ಯೂಡೋಎಕ್ಸ್‌ಫೋಲಿಯೇಶನ್ ಸಿಂಡ್ರೋಮ್‌ನೊಂದಿಗೆ ಕಣ್ಣುಗಳಲ್ಲಿ ಫಾಕೋಮಲ್ಸಿಫಿಕೇಶನ್ ನಂತರ ಕಾರ್ನಿಯಲ್ ಎಂಡೋಥೀಲಿಯಲ್ ಬದಲಾವಣೆಗಳ ಮೌಲ್ಯಮಾಪನ

ಈ ಸಂಶೋಧನೆಗೆ ರೋಗಿಯ ಗುರುತಿನ ಸಂಖ್ಯೆ:

ಐಪಿ ಸಂಖ್ಯೆ:

ಅಂಗೀಕರಿಸಿದ ನಾನು, ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಒಪ್ಪುತ್ತೇನೆ ಮತ್ತು ಈ ಸಮ್ಮತಿಯ ರೂಪದಲ್ಲಿ ವಿವರಿಸಿರುವಂತೆ ನನ್ನ ವೈಯಕ್ತಿಕ ಮಾಹಿತಿಯ ಸಂಗ್ರಹಣೆ ಮತ್ತು ಬಹಿರಂಗಪಡಿಸುವಿಕೆಯನ್ನು ದೃಢೀಕರಿಸುತ್ತೇನೆ.

ನಾನು ಈ ಅಧ್ಯಯನದ ಉದ್ದೇಶ, ತಂತ್ರಗಳ ಅಪಾಯಗಳು ಮತ್ತು ಪ್ರಯೋಜನಗಳನ್ನು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿಸಂಗ್ರಹಿಸಿದ ಮತ್ತು ಬಹಿರಂಗಪಡಿಸುವ ಮಾಹಿತಿಯ ಗೌಪ್ಯತೆಗೆ ನಾನು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ.

ಸಂಗ್ರಹಿಸಿದ ಮಾಹಿತಿಯನ್ನು ಸಂಶೋಧನೆಗೆ ಮಾತ್ರ ಬಳಸಲಾಗುತ್ತದೆ.

ಈ ಅಧ್ಯಯನದ ವಿವಿಧ ಅಂಶಗಳನ್ನು ಕುರಿತು ಪ್ರಶ್ನೆಗಳನ್ನು ಕೇಳಲು ನನಗೆ ಅವಕಾಶವಿದೆ ಮತ್ತು ನನ್ನ ತೃಪ್ತಿಗೆ ನನ್ನ ಪ್ರಶ್ನೆಗಳಿಗೆ ಉತ್ತರ ನೀಡಲಾಗಿದೆ.

ಈ ಸಂಶೋಧನೆಯಿಂದ ಹೊರಬರುವ ಮಾಹಿತಿಯನ್ನು ವೈದ್ಯರು ಯಾವುದೇ ಜರ್ನಲ್ನಲ್ಲಿ ಅಥವಾ ಕಾನ್ಫೆರೆನ್ಸ್ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು ಅನುಮತಿ ಸೂಚಿಸಿರುತ್ತೇನೆ

ನಾನು ಈ ಅಧ್ಯಯನದಿಂದ ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಹಿಂತೆಗೆದುಕೊಳ್ಳಲು ಮುಕ್ತವಾಗಿರುತ್ತೇನೆ ಮತ್ತು ಇದು ನನ್ನ ಮುಂದಿನ ಕಾಳಜಿಯನ್ನು ಬದಲಿಸುವುದಿಲ್ಲ ಎಂದು ನಾನು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ.

ಈ ಸಂಶೋಧನಾ ಯೋಜನೆಯ ಭಾಗವಹಿಸುವಿಕೆ ನನಗೆ ಯಾವುದೇ ಹಣಕಾಸಿನ ಹೊರೆ ಒಳಗೊಂಡಿರುವುದಿಲ್ಲ.

ಹೆಸರು	ಸಹಿ	ದಿನಾಂಕ	ಸಮಯ
ರೋಗಿಯ:			
ಸಾಕ್ಷಿ 1:			
ಸಾಕ್ಷಿ 2:			
ಪ್ರಾಥಮಿಕ ತನಿಖೆದಾರ / ಡಾಕ್ಟರ್:			

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH,

TAMAKA, KOLAR - 563101.

PATIENT INFORMATION SHEET

TITLE: "EVALUATION OF CORNEAL ENDOTHELIAL CELL CHARACTERISTICS AFTER PHACOEMULSIFICATION IN EYES WITH PSEUDOEXFOLIATION SYNDROME"

This information is to help you understand the purpose of the study.We would like to get your consent to take part voluntarily in this research study, it is important that you read and understand the purpose, procedure, benefits and discomforts of the study.

Pseudoexfoliation syndrome (PXF) is an age-related disorder characterized by production and progressive accumulation of a whitish flakes like material in various parts of the eye. They can cause early cataract, raised pressure in the eye called glaucoma and week cornea resulting in blurred vision. It develops slowly to cause loss of vision, and can render the person completely blind if it is left untreated. It usually affect both eyes, but they will generally develop in one eye before the other.

The purpose of this study is to find the corneal changes before and after cataract surgery in cataract patients with PXF. There are absolutely no risks associated with the various investigations to be done which are Random Blood Sugar, Fasting Blood Sugar, Post Prandial Blood Sugar, Keratometry, biometry, ECG, lacrimal syringing, Direct & Indirect ophthalmology, blood and the fluid removed during cataract surgery for biochemical analysis.

There is no compulsion to participate in this study, you will be no way affected if you do not wish to participate in this study. You may refuse to take part in the study or you may stop

your participation in the study at any time, without a penalty or loss of any benefits to which you were otherwise entitled before taking part in this study.

After undergoing standard investigations protocol for cataract surgery the pupil will be dilated with 0.8% tropicamide & 5% / 10% phenylephrine drops along with flurbiprofen eye drops. Under local anaesthesia the aqueous humour (liquid in the eye) is aspirated followed by removal of the cataract and implanting an artificial lens inside the eye for restoring vision.
The following complications maybe seen during surgery which will be managed medically/ surgically during the 3 days stay. They are haemorrhage, posterior capsule rupture (1.92%), nucleus drop(0.68%), zonular dialysis (0.8%), wound leakage, uveitis, secondary glaucoma, cystoid macular oedema(12%), endophthalmitis (0.01%– 0.3%) & posterior capsular opacification (<5% –50%). As the surgery is done under local anaesthesia the risk to life is less than 0.5%. If required patient will be referred to higher centre for further management under appropriate guidance.
After surgery you will receive antibiotic steroid eye drops which has to be instilled hourly for one day, followed by tapering dose for 6 weeks along with Flurbiprofen eye drops 0.03% TID for 4 weeks. Free spectacles will be issued 4 weeks after the surgery.

The results obtained in this study will be beneficial for predicting early disease (corneal decompensation) or at the risk of developing complications and would be of importance in the determination of precautionary measures needed to reduce the same for optimum visual acuity and better lifestyle.

Participation in this research study may not change the final outcome of your eye condition. However, patients in the future may benefit as a result of knowledge gained from this study. You will not be charged extra for any of the procedures performed during the research study. Your taking part in this study is entirely voluntary.

CONFIDENTIALITY

Your medical information will be kept confidential by the study doctor and will not be made publicly available. All information collected from you will be strictly confidential used only by your doctor or ethics review board for research purpose and will not be disclosed to any outsider except if it is required by the law. This study seeks ethical committee approval and will be started only after their formal approval.

For further information, /clarification please contact Dr. Hithesh, Sri Devaraj Urs Academy of Higher Education and Research, Tamaka, Kolar – 563101

CONTACT DETAILS:

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SDUMC, Kolar -563101

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ಶೀರ್ಷಿಕೆ: ಸ್ಯೂಡೋಎಕ್ಸ್ಫೋಲಿಯೇಶನ್ ಸಿಂಡ್ರೋಮ್‌ನೊಂದಿಗೆ ಕಣ್ಣುಗಳಲ್ಲಿ ಫಾಕೋಮಲ್ಸಿಫಿಕೇಶನ್ ನಂತರ ಕಾರ್ನಿಯಲ್ ಎಂಡೋಥೀಲಿಯಲ್ ಬದಲಾವಣೆಗಳ ಮೌಲ್ಯಮಾಪನ

"ಸೂಡೋಎಕ್ಸ್ಫೋಲಿಯೇಶನ್ ಸಿಂಡ್ರೋಮ್ನೊಂದಿಗೆ ಕಣ್ಣುಗಳಲ್ಲಿ ಫಾಕೋಎಮಲ್ಸಿಫಿಕೇಶನ್ ನಂತರ ಕಾರ್ನಿಯಲ್ ಎಂಡೋಥೀಲಿಯಲ್ ಬದಲಾವಣೆಗಳ ಮೌಲ್ಯಮಾಪನ" ಶೀರ್ಷಿಕೆಯ ಅಧ್ಯಯನದ ಉದ್ದೇಶವನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಈ ಮಾಹಿತಿಯು ನಿಮಗೆ ಸಹಾಯ ಮಾಡುತ್ತದೆ. ಈ ಸಂಶೋಧನಾ ಅಧ್ಯಯನದಲ್ಲಿ ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಪಾಲ್ಗೊಳ್ಳಲು ನಿಮ್ಮ ಒಪ್ಪಿಗೆಯನ್ನು ಪಡೆಯಲು ನಾವು ಬಯಸುತ್ತೇವೆ, ನೀವು ಅಧ್ಯಯನದ ಉದ್ದೇಶ, ಕಾರ್ಯವಿಧಾನ, ಪ್ರಯೋಜನಗಳು ಮತ್ತು ಅನಾನುಕೂಲಗಳನ್ನು ಓದುವುದು ಮತ್ತು ಅರ್ಥಮಾಡಿಕೊಳ್ಳುವುದು ಮುಖ್ಯವಾಗಿದೆ.

ಸ್ಯೂಡೋಎಕ್ಸ್ಫೋಲಿಯೇಶನ್ ಸಿಂಡ್ರೋಮ್ (ಪಿಎಕ್ಸ್ಎಫ್) ಎಂಬುದು ವಯಸ್ಸಿಗೆ ಸಂಬಂಧಿಸಿದ ಅಸ್ವಸ್ಥತೆಯಾಗಿದ್ದು, ಕಣ್ಣಿನ ವಿವಿಧ ಭಾಗಗಳಲ್ಲಿ ವಸ್ತುಗಳಂತಹ ಬಿಳಿಯ ಪದರಗಳ ಉತ್ಪಾದನೆ ಮತ್ತು ಪ್ರಗತಿಶೀಲ ಶೇಖರಣೆಯಿಂದ ನಿರೂಪಿಸಲ್ಪಟ್ಟಿದೆ. ಅವರು ಆರಂಭಿಕ ಕಣ್ಣಿನ ಪೊರೆಗೆ ಕಾರಣವಾಗಬಹುದು, ಗ್ಲುಕೋಮಾ ಎಂದು ಕರೆಯಲ್ಪಡುವ ಕಣ್ಣಿನಲ್ಲಿ ಒತ್ತಡವನ್ನು ಹೆಚ್ಚಿಸಬಹುದು ಮತ್ತು ವಾರದ ಕಾರ್ನಿಯಾದ ಪರಿಣಾಮವಾಗಿ ದೃಷ್ಟಿ ಮಂದವಾಗಬಹುದು. ಇದು ದೃಷ್ಟಿ ಕಳೆದುಕೊಳ್ಳಲು ನಿಧಾನವಾಗಿ ಬೆಳವಣಿಗೆಯಾಗುತ್ತದೆ ಮತ್ತು ಚಿಕಿತ್ಸೆ ನೀಡದೆ ಬಿಟ್ಟರೆ ವ್ಯಕ್ತಿಯನ್ನು ಸಂಪೂರ್ಣವಾಗಿ ಕುರುಡನನ್ನಾಗಿ ಮಾಡಬಹುದು. ಇದು ಸಾಮಾನ್ಯವಾಗಿ ಎರಡೂ ಕಣ್ಣುಗಳ ಮೇಲೆ ಪರಿಣಾಮ ಬೀರುತ್ತದೆ, ಆದರೆ ಅವು ಸಾಮಾನ್ಯವಾಗಿ ಒಂದು ಕಣ್ಣಿನಲ್ಲಿ ಇನ್ನೊಂದಕ್ಕಿಂತ ಮೊದಲು ಬೆಳೆಯುತ್ತವೆ.

PXF ಹೊಂದಿರುವ ಕಣ್ಣಿನ ಪೊರೆ ರೋಗಿಗಳಲ್ಲಿ ಕಣ್ಣಿನ ಪೊರೆ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ಮೊದಲು ಮತ್ತು ನಂತರ ಕಾರ್ನಿಯಲ್ ಬದಲಾವಣೆಗಳನ್ನು ಕಂಡುಹಿಡಿಯುವುದು ಈ ಅಧ್ಯಯನದ ಉದ್ದೇಶವಾಗಿದೆ. ರಾಂಡಮ್ ಬ್ಲಡ್ ಶುಗರ್, ಫಾಸ್ಟಿಂಗ್ ಬ್ಲಡ್ ಶುಗರ್, ಪೋಸ್ಟ್ ಪ್ರಾಂಡಿಯಲ್ ಬ್ಲಡ್ ಶುಗರ್, ಕೆರಾಟೋಮೆಟ್ರಿ, ಬಯೋಮೆಟ್ರಿ, ಇಸಿಜಿ, ಲ್ಯಾಕ್ರಿಮಲ್ ಸಿರಿಂಗಿಂಗ್, ನೇರ ಮತ್ತು ಪರೋಕ್ಷ ನೇತ್ರವಿಜ್ಞಾನ, ಕಣ್ಣಿನ ಪೊರೆ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ಸಮಯದಲ್ಲಿ ತೆಗೆದ ರಕ್ತ ಮತ್ತು ದ್ರವದಂತಹ ವಿವಿಧ ತನಿಖೆಗಳಿಗೆ ಯಾವುದೇ ಅಪಾಯಗಳಿಲ್ಲ. ಜೀವರಾಸಾಯನಿಕ ವಿಶ್ಲೇಷಣೆಗಾಗಿ.

ಕಣ್ಣಿನ ಪೊರೆ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಗಾಗಿ ಪ್ರಮಾಣಿತ ತನಿಖೆಯ ಪ್ರೋಟೋಕಾಲ್‌ಗೆ ಒಳಗಾದ ನಂತರ, ಶಿಷ್ಯನನ್ನು 0.8% ಟ್ರೋಪಿಕಮೈಡ್ ಮತ್ತು 5% / 10% ಫಿನೈಲ್ಫ್ರಿನ್ ಹನಿಗಳೊಂದಿಗೆ ಫ್ಲರ್ಬಿಪ್ರೊಫೇನ್ ಕಣ್ಣಿನ ಹನಿಗಳೊಂದಿಗೆ ಹಿಗ್ಗಿಸಲಾಗುತ್ತದೆ. ಸ್ಥಳೀಯ ಅರಿವಳಿಕೆ ಅಡಿಯಲ್ಲಿ ಕಣ್ಣಿನ ಪೊರೆ ತೆಗೆದುಹಾಕಲಾಗುತ್ತದೆ ಮತ್ತು ದೃಷ್ಟಿ ಪುನಃಸ್ಥಾಪಿಸಲು ಕಣ್ಣಿನೊಳಗೆ ಕೃತಕ ಮಸೂರವನ್ನು ಅಳವಡಿಸಲಾಗುತ್ತದೆ.

ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ಸಮಯದಲ್ಲಿ ಕೆಳಗಿನ ತೊಡಕುಗಳು ಕಂಡುಬರಬಹುದು, ಇದನ್ನು ವೈದ್ಯಕೀಯವಾಗಿ / ಶಸ್ತ್ರಚಿಕಿತ್ಸಕವಾಗಿ ನಿರ್ವಹಿಸಲಾಗುತ್ತದೆ. ಅವುಗಳೆಂದರೆ ಹೆಮರೇಜ್, ಹಿಂಭಾಗದ ಕ್ಯಾಪ್ಸುಲ್ ಛಿದ್ರ (1.92%), ನ್ಯೂಕ್ಲಿಯಸ್ ಡ್ರಾಪ್ (0.68%), ಝೋನ್ಯುಲರ್ ಡಯಾಲಿಸಿಸ್ (0.8%), ಗಾಯದ ಸೋರಿಕೆ, ಯುವೆಟಿಸ್, ಸೆಕೆಂಡರಿ ಗ್ಲುಕೋಮಾ, ಸಿಸ್ಟಾಯ್ಡ್ ಮ್ಯಾಕ್ಯುಲರ್ ಎಡಿಮಾ (12%), ಎಂಡೋಫ್ಥಾಲ್ಮಿಟಿಸ್ (0.01%)– 0.3 & ಹಿಂಭಾಗದ ಕ್ಯಾಪ್ಸುಲರ್ ಅಪಾರದರ್ಶಕತೆ (<5% -50%). ಸ್ಥಳೀಯ ಅರಿವಳಿಕೆ ಅಡಿಯಲ್ಲಿ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆ ಮಾಡುವುದರಿಂದ ಜೀವಕ್ಕೆ ಅಪಾಯವು 0.5% ಕ್ಕಿಂತ ಕಡಿಮೆ ಇರುತ್ತದೆ. ಅಗತ್ಯವಿದ್ದರೆ ರೋಗಿಯನ್ನು ಸೂಕ್ತ ಮಾರ್ಗದರ್ಶನದಲ್ಲಿ ಹೆಚ್ಚಿನ ನಿರ್ವಹಣೆಗಾಗಿ ಉನ್ನತ ಕೇಂದ್ರಕ್ಕೆ ಉಲ್ಲೇಖಿಸಲಾಗುತ್ತದೆ.

ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ನಂತರ ನೀವು ಆಂಟಿಬಯೋಟಿಕ್ ಸ್ಟೆರಾಯ್ಡ್ ಕಣ್ಣಿನ ಹನಿಗಳನ್ನು ಸ್ವೀಕರಿಸುತ್ತೀರಿ, ಇದನ್ನು ಎರಡು ದಿನಗಳವರೆಗೆ ಗಂಟೆಗೊಮ್ಮೆ ಹಾಕಬೇಕು, ನಂತರ 6 ವಾರಗಳವರೆಗೆ ಡೋಸ್ ಟೇಪರಿಂಗ್ ಜೊತೆಗೆ ಫ್ಲರ್ಬಿಪ್ರೊಫೇನ್ ಐ ಡ್ರಾಪ್ಸ್ 0.03% ಟಿಐಡಿ 4 ವಾರಗಳವರೆಗೆ. ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ನಂತರ 4 ವಾರಗಳ ನಂತರ ಉಚಿತ ಕನ್ನಡಕವನ್ನು ನೀಡಲಾಗುತ್ತದೆ.

ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ನಂತರ ನೀವು ಆಂಟಿಬಯೋಟಿಕ್ ಸ್ಟೆರಾಯ್ಡ್ ಕಣ್ಣಿನ ಹನಿಗಳನ್ನು ಸ್ವೀಕರಿಸುತ್ತೀರಿ, ಇದನ್ನು ಒಂದು ದಿನಕ್ಕೆ ಗಂಟೆಗೊಮ್ಮೆ ಅಳವಡಿಸಬೇಕು, ನಂತರ 6 ವಾರಗಳವರೆಗೆ ಡೋಸ್ ಅನ್ನು ಕಡಿಮೆಗೊಳಿಸಲಾಗುತ್ತದೆ ಜೊತೆಗೆ ಫ್ಲರ್ಬಿಪ್ರೊಫೇನ್ ಐ ಡ್ರಾಪ್ಸ್ 0.03% ಟಿಐಡಿ 4 ವಾರಗಳವರೆಗೆ. ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ನಂತರ 4 ವಾರಗಳ ನಂತರ ಉಚಿತ ಕನ್ನಡಕವನ್ನು ನೀಡಲಾಗುತ್ತದೆ.

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಡೆದ ಫಲಿತಾಂಶಗಳು ಆರಂಭಿಕ ರೋಗವನ್ನು ಊಹಿಸಲು (ಕಾರ್ನಿಯಲ್ ಡಿಕಂಪೆನ್ಸೇಶನ್) ಅಥವಾ ತೊಡಕುಗಳನ್ನು ಅಭಿವೃದ್ಧಿಪಡಿಸುವ ಅಪಾಯದಲ್ಲಿ ಪ್ರಯೋಜನಕಾರಿಯಾಗುತ್ತವೆ ಮತ್ತು ಅತ್ಯುತ್ತಮ ದೃಷ್ಟಿ ತೀಕ್ಷ್ಣತೆ ಮತ್ತು ಉತ್ತಮ ಜೀವನಶೈಲಿಯನ್ನು ಕಡಿಮೆ ಮಾಡಲು ಅಗತ್ಯವಿರುವ ಮುನ್ನೆಚ್ಚರಿಕೆ ಕ್ರಮಗಳ ನಿರ್ಣಯದಲ್ಲಿ ಪ್ರಾಮುಖ್ಯತೆಯನ್ನು ಹೊಂದಿರುತ್ತದೆ.

<u>ಗೌಪ್ಯತೆ</u>

ನಿಮ್ಮ ವೈದ್ಯಕೀಯ ಮಾಹಿತಿಯನ್ನು ಅಧ್ಯಯನ ವೈದ್ಯರಿಂದ ಗೌಪ್ಯವಾಗಿ ಇರಿಸಲಾಗುತ್ತದೆ ಮತ್ತು ಸಾರ್ವಜನಿಕವಾಗಿ ಲಭ್ಯವಾಗುವಂತೆ ಮಾಡಲಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮಿಂದ ಸಂಗ್ರಹಿಸಿದ ಎಲ್ಲಾ ಮಾಹಿತಿಯನ್ನು ನಿಮ್ಮ ವೈದ್ಯರು ಅಥವಾ ನೈತಿಕತೆಯ ಪರಿಶೀಲನಾ ಮಂಡಳಿಯು ಸಂಶೋಧನಾ ಉದ್ದೇಶಕ್ಕಾಗಿ ಮಾತ್ರ ಕಟ್ಟುನಿಟ್ಟಾಗಿ ಗೌಪ್ಯವಾಗಿ ಬಳಸುತ್ತದೆ ಮತ್ತು ಕಾನೂನಿನಿಂದ ಅಗತ್ಯವಿದ್ದರೆ ಹೊರತುಪಡಿಸಿ ಯಾವುದೇ ಹೊರಗಿನವರಿಗೆ ಬಹಿರಂಗಪಡಿಸುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನವು ನೈತಿಕ ಸಮಿತಿಯ ಅನುಮೋದನೆಯನ್ನು ಬಯಸುತ್ತದೆ ಮತ್ತು ಅವರ ಔಪಚಾರಿಕ ಅನುಮೋದನೆಯ ನಂತರವೇ ಪ್ರಾರಂಭಿಸಲಾಗುವುದು.

ಹೆಚ್ಚಿನ ಮಾಹಿತಿಗಾಗಿ,/ಸ್ಪಷ್ಟೀಕರಣಕ್ಕಾಗಿ ದಯವಿಟ್ಟು ಡಾ. ಹಿತೇಶ್, ಶ್ರೀ ದೇವರಾಜ್ ಅರ್ಸ್ ಅಕಾಡೆಮಿ ಆಫ್ ಹೈಯರ್ ಎಜುಕೇಶನ್ ಅಂಡ್ ರಿಸರ್ಚ್, ತಮಕ, ಕೋಲಾರ – 563101

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ಡಾ.ಹಿತೇಶ್

ನೇತ್ರಶಾಸ್ತ್ರ ವಿಭಾಗದಲ್ಲಿ ನಿವಾಸಿ

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PHOTOS

IMAGE 1:SPECULAR MICROSCOPE EXAMINATION

IMAGE 2 : SLIT LAMP EXAMINATION

IMAGE 3 : PHACOEMULSIFICATION SURGERY

MASTER CHART

Patient ID	ECD Pre	ECD D1	ECD W1	ECD M1	ECD M3	Pleomorphism Pre	Pleomorphism D1	Pleomorphism W1	Pleomorphism M1	Pleomorphism M3	Polymegathism Pre	Polymegathism D1	Polymegathism W1	Polymegathism M1	Polymegathism M3	CCT Pre	CCT D1	CCT W1	CCT M1	CCT M3
1	2150	2020	1980	1955	1940	53	50	49	49	49	35	38	39	39	39	522	547	534	528	522
2	2100	1970	1930	1905	1890	52	49	48	48	48	36	39	40	40	40	524	549	536	530	524
3	2050	1920	1880	1855	1840	54	51	50	50	50	34	37	38	38	38	526	551	538	532	526
4	2000	1870	1830	1805	1790	53	50	49	49	49	35	38	39	39	39	520	545	532	526	520
5	2200	2070	2030	2005	1990	52	49	48	48	48	36	39	40	40	40	522	547	534	528	522
6	2150	2020	1980	1955	1940	54	51	50	50	50	34	37	38	38	38	524	549	536	530	524
7	2100	1970	1930	1905	1890	53	50	49	49	49	35	38	39	39	39	526	551	538	532	526
8	2050	1920	1880	1855	1840	52	49	48	48	48	36	39	40	40	40	520	545	532	526	520
9	2000	1870	1830	1805	1790	54	51	50	50	50	34	37	38	38	38	522	547	534	528	522
10	2200	2070	2030	2005	1990	53	50	49	49	49	35	38	39	39	39	524	549	536	530	524
11	2150	2020	1980	1955	1940	52	49	48	48	48	36	39	40	40	40	526	551	538	532	526
12	2100	1970	1930	1905	1890	54	51	50	50	50	34	37	38	38	38	520	545	532	526	520
13	2050	1920	1880	1855	1840	53	50	49	49	49	35	38	39	39	39	522	547	534	528	522
14	2000	1870	1830	1805	1790	52	49	48	48	48	36	39	40	40	40	524	549	536	530	524
15	2200	2070	2030	2005	1990	54	51	50	50	50	34	37	38	38	38	526	551	538	532	526
16	2150	2020	1980	1955	1940	53	50	49	49	49	35	38	39	39	39	520	545	532	526	520
17	2100	1970	1930	1905	1890	52	49	48	48	48	36	39	40	40	40	522	547	534	528	522
18	2050	1920	1880	1855	1840	54	51	50	50	50	34	37	38	38	38	524	549	536	530	524
19	2000	1870	1830	1805	1790	53	50	49	49	49	35	38	39	39	39	526	551	538	532	526
20	2200	2070	2030	2005	1990	52	49	48	48	48	36	39	40	40	40	520	545	532	526	520
21	2150	2020	1980	1955	1940	54	51	50	50	50	34	37	38	38	38	522	547	534	528	522
22	2100	1970	1930	1905	1890	53	50	49	49	49	35	38	39	39	39	524	549	536	530	524
23	2050	1920	1880	1855	1840	52	49	48	48	48	36	39	40	40	40	526	551	538	532	526
24	2000	1870	1830	1805	1790	54	51	50	50	50	34	37	38	38	38	520	545	532	526	520
25	2200	2070	2030	2005	1990	53	50	49	49	49	35	38	39	39	39	522	547	534	528	522