“A PROSPECTIVE STUDY OF CHANGES IN MACULAR THICKNESS FOLLOWING CATARACT SURGERY AND ITS CORRELATION WITH POST-OPERATIVE VISUAL ACUITY”

By

DR. RAMACHANDRA HIMATEJA C, M.B.B.S

Dissertation submitted to

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CENTRE, TAMAKA, KOLAR

In partial fulfilment of the requirements for the degree of

MASTER OF SURGERY

IN

OPHTHALMOLOGY

Under the guidance of

DR.RASHMI. G M.B.B.S., M.S.

DEPARTMENT OF OPHTHALMOLOGY

SRI DEVARAJ URS MEDICAL COLLEGE

TAMAKA, KOLAR

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Department of Ophthalmology,

Sri Devaraj Urs Medical College,

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DR. SANGEETHA. T.
Professor and HOD
Department of Ophthalmology,
Sri Devaraj Urs Medical College,
Tamaka, Kolar.

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Place: Kolar

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A PROSPECTIVE STUDY OF CHANGES IN MACULAR THICKNESS FOLLOWING CATARACT SURGERY AND ITS CORRELATION WITH POST-OPERATIVE VISUAL ACUITY

ABSTRACT

PURPOSE: The purpose of this study it to assess macular thickness following Small Incision Cataract Surgery in cataract patients and correlate the post-operative visual acuity with the changes in macular thickness.

MATERIALS AND METHODS: 100 patients underwent complete ophthalmic examination including macular OCT. Macular thickness was measured pre-operatively& post-operatively. Post-operative visual acuity was assessed & correlated with macular thickness.

RESULTS: The mean macular thickness pre-operatively was 205.14 ± 35.65 µm. Postoperatively, macular thickness was 254.28 ± 28.88 µm after one week and by 4th week postoperatively macular thickness decreased to 224.33 ± 28.73 µm. After one week, 70% of patients had visual acuity better than 6/9 which improved to 96% by the 4th week.

CONCLUSION: Though immediate post operative vision may be less than expected in uncomplicated cases it is often due to macular edema which usually resolves on its own without causing significant loss of visual acuity.

Keywords: Cataract surgery, Macular Thickness, Cystoid Macular Edema

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LIST OF ABBREVATIONS

OCT	**Optical Coherence Tomography**
SICS	**Small Incision Cataract Surgery**
CME	**Cystoid Macular Edema**
VA	**Visual Acuity**
MT	**Macular Thickness**
TMV	**Total Macular Volume**
IOP	**Intraocular pressure**
NS	**Nuclear Sclerosis**
PSCC	**Posterior Sub Capsular Cataract**
LOCS	**Lens Opacities Classification System**
ECCE	**Extracapsular Cataract Extraction**
IOL	**Intra-Ocular Lens**
OVD	**Ophthalmic Viscoelastic Device**
CCC	**Continuous Curvilinear Capsulorhexis**
BRB	**Blood-Retinal Barrier**
BCVA	**Best Corrected Visual Acuity**
FA	**Fluorescein Angiography**

ABSTRACT

PURPOSE:

The purpose of this study is to assess macular thickness following Small Incision Cataract Surgery in cataract patients and correlate the post-operative visual acuity with the changes in macular thickness.

MATERIALS AND METHODS:

100 patients underwent complete ophthalmic examination including macular OCT. Macular thickness was measured pre-operatively & post-operatively. Post-operative visual acuity was assessed & correlated with macular thickness.

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INTRODUCTION

A PROSPECTIVE STUDY OF CHANGES IN MACULAR THICKNESS FOLLOWING CATARACT SURGERY AND ITS CORRELATION WITH POST-OPERATIVE VISUAL ACUITY

INTRODUCTION

The word cataract is derived from the Latin word "Cataracta."Cataract is the opacification of the lens and its capsule. Accumulation or improper folding of the crystalline protein causes cataracts. Cataract is classified as congenital, age-related, sub-capsular, cortical, and nuclear sclerotic cataract.[1,2]According to the level of opacities and fluid accumulation, the maturity of the cataract is graded.[1]Cataract is usually managed surgically. The surgical management includes extra capsular cataract extraction, small incision cataract surgery (SICS), phacoemulsification and laser surgeries. Cataract surgery involves the removal of the cataractous lens and the implantation of an intra ocular lens.[3,4]

The SICS uses a small incision and is self-healing without sutures. SICS has the advantage of faster recovery and fewer post-operative complications like cystoid macular edema, iritis, etc.[4,5] Cystoid macular edema (CME) is an important complication occurring post cataract surgeries. It has the ability to alter visual acuity and macular thickness.

Macular thickness can be measured using a diagnostic modality called optical coherence tomography (OCT). The OCT is a non-invasive imaging tool that captures high-resolution, cross-sectional images.The OCT is based on the low-coherence interferometry principle. OCT is essential in diagnosing ocular pathologies.[6,7]The alterations of the macular thickness and visual acuity in the CME and their correlation after the SICS have to be seen in detail for better evaluation.

This study aims to measure the macular thickness and correlation between macular thickness and visual acuity after an uneventful small incision cataract surgery with posterior chamber intra-ocular lens implantation using OCT.

AIMS & OBJECTIVES

AIMS AND OBJECTIVES

Aims:

1. To evaluate the changes in macular thickness using Optical Coherence Tomography (OCT) following uneventful small incision cataract surgery (SICS) with posterior chamber intraocular lens (PCIOL) implantation.
2. To assess the correlation between changes in macular thickness and post operative visual acuity.

Objectives:

1. To measure macular thickness preoperatively and postoperatively at specified intervals of 1 week and 4 weeks using OCT.
2. To evaluate variations in macular thickness after uncomplicated small incision cataract surgery (SICS) with posterior chamber intraocular lens (PCIOL) implantation.
3. To assess visual acuity at postoperative intervals and analyze its correlation with corresponding macular thickness measurements.
4. To study the correlation between postoperative changes in macular thickness and corresponding visual outcomes.

REVIEW OF LITERATURE

REVIEW OF LITERATURE:

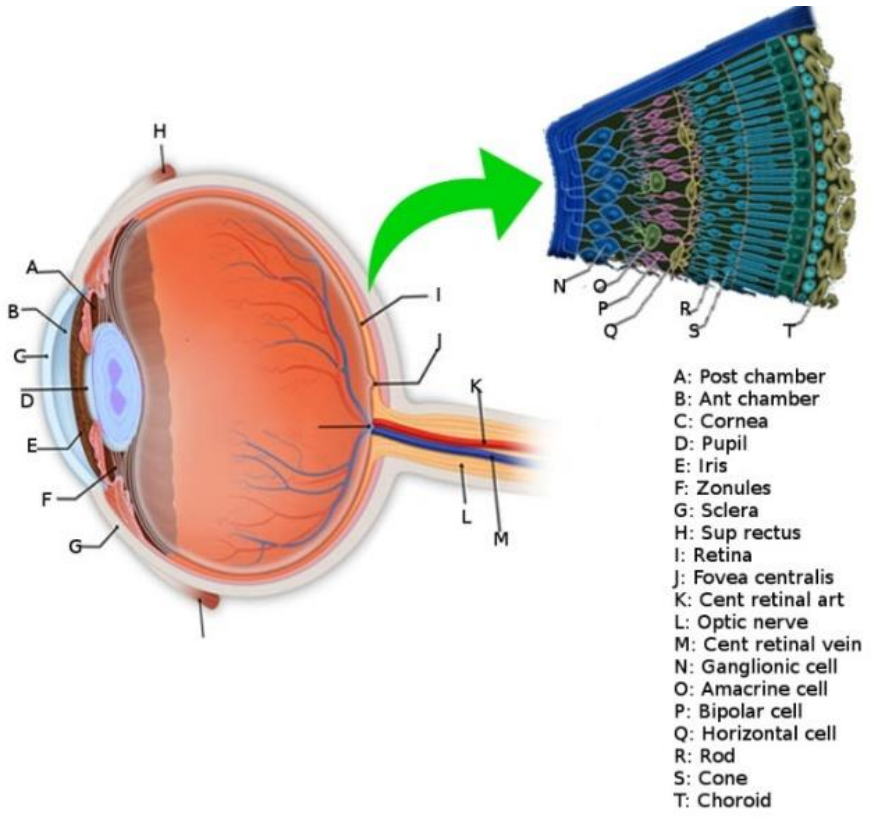
Anatomy of Retina:

The retina is the innermost, light sensitive layer situated in the posterior portion of the eye. The retina contains photoreceptor cells, which are rods and cones. The cones are present in the fovea in the center of the retina. Around six million cones and above a hundred million rods are present in the retina. Cones aid to see in bright light (photopic vision) and rods in the dark (scotopic vision).The types of cones are short-wavelength sensitive (S-cones), medium-wavelength sensitive (M-cones), and long-wavelength sensitive (L-cones) respectively. The rod cells are the composed of rhodopsin, a light-sensitive pigment responsible for the phototransduction pathway. The blood supply to the retina is by the central retinal artery, central retinal vein, long posterior ciliary arteries, short posterior ciliary arteries, and choroids. There are ten layers in the retina, which contain cells like rods, cones, retinal ganglion cells, bipolar cells, horizontal cells, and amacrine cells. The ten layers are[8,9]

1. **InternalLimiting Membrane –**It is the innermost layerof the retina, separating it from the vitreous humor. The outer border is composed of Müller glial cells, which maintain homeostasis.[8,10]
2. **Retinal Nerve Fiber Layer –** This layer is the second inner layer, made of axons of the retinal ganglion cell, astrocytes, and Muller cells processes.[8,11]
3. **Ganglion Cell Layer (GCs)–**This layer contains retinal GCs and displaced amacrine cells. The axons are projected out of the ganglion cell layers and form an optic nerve.
4. **Inner Plexiform Layer** –The bipolar cells contain axons, which synapse with ganglion cells in this layer. In this synaptic layer, the dendrites of amacrine cells also synapse.
5. **Inner Nuclear Layer –**Formed by horizontal cells, amacrine cells, and bipolar cells.[8,12]

6. **Outer Plexiform Layer** – The photoreceptor cell's projections and celldendrites of the inner nuclear layer synapse at this layer.
7. **Outer Nuclear Layer** – In this layer, the cell bodies of the rods and cones are present.
8. **External Limiting Membrane** – Between the photoreceptor cells and Muller cells, the gap-junctions are present, which constitute this membrane.
9. **Photoreceptor Layer** –The layer that includes both the inner and outer segments of rods and cones.The outer segment consists of rhodopsin, and the inner segment consists of mitochondria.[8,13]
10. **Retinal Pigment Epithelium (RPE)** – This is the outer retinal layer, present between the neural retina and the Bruch membrane. Here, the transport of ions and water and secretion of growth factors and cytokines takeplace.[8,9,14]

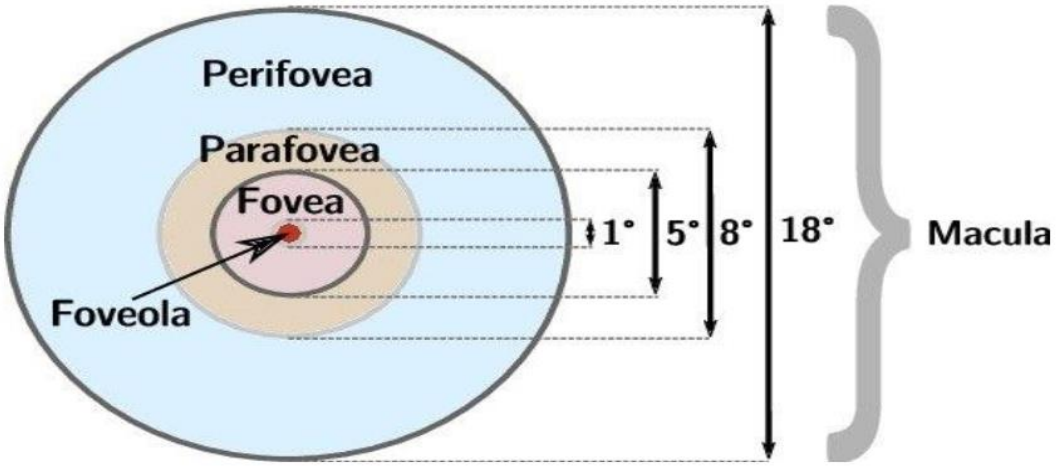
Figure 1: Anatomy of retina.[8]



Anatomy of Macula:

The macula is referred to as the macula lutea because of its yellow pigmentation. This yellow color is caused by carotenoids, specifically lutein and zeaxanthin. The macula is a highly sensitive region of the retina, responsible for providing the sharpest visual acuity. The central macula includes the fovea, an avascular depression. Cones are the photoreceptors responsible for sharp, detailed central vision and are densely concentrated in the fovea. In addition to having fewer rods than the rest of the retina, the smaller macular areas—including the foveola, parafovea, perifovea, foveal avascular zone, and umbo—also contain a higher concentration of cones.[8,15]

Figure 2: Zones of the Macula.



Cataract:

Burden/Prevalence:

Worldwide, over twelve million individuals are blind due to cataracts.[16]The White American race was mainly affected by cataracts, with 18%, followed by the Blacks with 13% per one

hundred individuals. From 1990 to 2019, the global cataract prevalence rose by 129.2%.The age-standardized prevalence rate from 1990 to 2019 increased by 0.4% yearly .Cataract affects all age groups, commonly seen in the elderly over 50 to 60 years. The prevalence is higher in females than males, with a ratio of 1.3:1.[1,17]In India, the prevalence increased from 7.7 to 8.3 million from 2001 to 2020. Blindness bilaterally is caused by around 50% to 80% in India due to cataracts.[18]In Central India, the cataract prevalence was higher above sixty years of age at 54%, and nuclear sclerosis (NS) prevalence was 65.2%among 2,621 cases in 2023.[19]

Types of cataracts:

Congenital cataracts: Around 20,000 to 40,000 children are born globally with congenital cataracts yearly. Congenital cataracts are present at the time of birth or develop shortly after birth. Gene mutations like CRYAA, CRYAB, etc, can cause congenital cataracts. Congenital cataracts are related to infections like rubella, toxoplasmosis and herpes simplex virus. It occurs with or without anterior segment abnormalities like micro-cornea and microphthalmia. This cataract is also caused by chromosome or genetic disorders, metabolic disorders like hypoglycemia, intrauterine infections, and developmental abnormalities.[1,2,20]

Age-related or senile cataracts: Individuals over five decades of age are significantly affected. The senile cataract is caused by oxidative stress, UV rays, smoking, alcohol, obesity, smoke from wood, elevated glucose levels, and diabetes. The types of age-related cataracts are nuclear sclerosis, cortical, and posterior subcapsular. Prior ocular surgery can also cause age-related cataracts.[1,2,21]

Nuclear sclerotic cataract: In nuclear sclerosis, urochrome pigment deposition is present on the nucleus, which is seen yellow on the slit lamp examination. In addition to the

accumulation of yellow pigment, the lens becomes denser with age, and the buildup of excess fiber layers leads to a condition known as nuclear sclerosis. Nuclear sclerosis is related to index myopia. [1,21,22]

Cortical cataract: Cortical cataracts develop in the outer layer of the eyes, involving the anterior, posterior, and equatorial cortex. The opacification leads to wedge-shaped opacity, seen commonly in the inferonasal quadrant. Cortical cataracts cause photophobia and glare.[1,21,23]

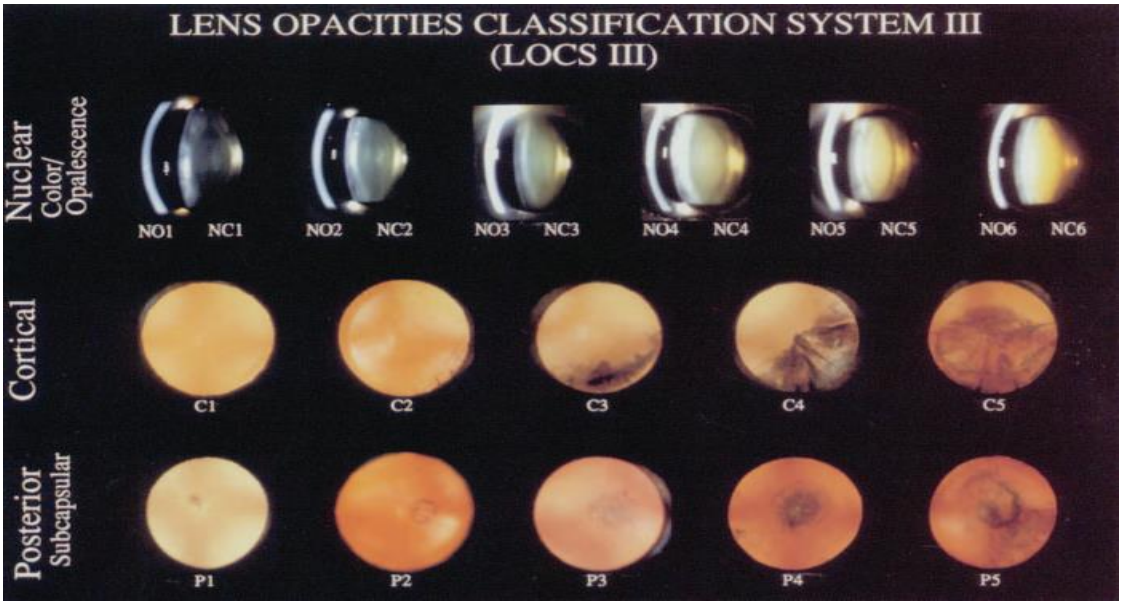
Subcapsular cataract: The subcapsular cataract (SCC) is of two types: anterior and posterior. The anterior SCC is present under the anterior lens capsule, whereas the posterior subcapsular cataract (PSCC) is present before the posterior capsule. In anterior SCC, the lens epithelial cells are developed into fibrous metaplasia. The PSCC has a granular appearance. The opacity formed on the posterior subcapsular area is localized at the eye's nodal point, causing photophobia, glare, and halos leading to visual impairment. The posterior subcapsular cataract is often linked to radiation exposure, steroid use, and metabolic imbalances.[1,24]

Lens Opacities Classification System (LOCS):

LOCS is agrading system for the classification of cataracts using a Slit-lamp. There are four classifications, and there is a range of scores,

- Nuclear Opalescence (NO): Graded based on the density of the lens from 0.1 – 6.9.
- Nuclear Color (NC): Graded based on colour intensity from 0.1 – 6.9.
- Cortical Cataract (CC): Graded based on the region of cortical opacities from 0.1 – 6.9.
- Posterior Subcapsular Cataract (PSC): Graded based on the central posterior opacified region from 0.1 – 5.9.[25,26]

Figure 3: Lens Opacities Classification System:[27]



Pathophysiology:

The eyes consist of a transparent structure called a lens, which is formed by the lens fibers and the lens epithelial cells. The lens is used to transmit, filter, and focus light into the retina. The transparency and refractive index of the lens is due to proteins like α, β, and γ crystallins. The epithelial cells of the lens are majorly responsible for metabolic activity. The equatorial zone of the cuboidal cells facilitates oxidation, structural, biochemical, and physiological alterations. The cuboidal cells of the lens transform into fiber cells, followed by mature cells, by losing their capacity for undergoing metabolic functions and intracellular organelles. These mature cells move to the lens nucleus and surround it with fibers. Which later develop into nucleosclerosis and cortical cataracts. In the elderly, the reduction in the antioxidant defense mechanism causes opacification of the lens.[1,28,29]The pathophysiology of cataracts involves factors like genetics, cell proliferation and differentiation, metabolic disturbance, osmotic regulation failure, calpains, protein modification, oxidation, and defensive mechanisms.[26]

Protein aggregation: The lens is composed of crystalline proteins that help maintain its transparency and ability to focus light. The altered protein undergoes structural changes, clumps together, and blocks light transmission, leading to light scattering. These proteins may also fold due to mutations in crystallin genes, resulting in a cloudy lens that gradually progresses to cataract.

Oxidative stress: UV light, free radicals, reactive oxygen species, endogenous and exogenous sources, and toxins are the oxidative agents. These oxidative agents can damage the lens by affecting the protein, nucleic acids and lipids causing protein disruption. Older age diminishes the antioxidant defense mechanisms, causing cataracts and oxidative damage.[1,28–30]

Management:

Surgical:[4]

Extracapsular Cataract Extraction (ECCE): In ECCE, an incision of about 9 to 13 mm is made at the limbus using 15 number blade and corneal scissors. The next step is anterior capsulotomy, followed by cataract removal by pressure-counter pressure method, removal of cortical matter using simcoe IA cannula and intra-ocular lens (IOL) implantation. The corneal wound is opposed using 10-0 silk with interrupted sutures. The duration of surgery is longer in ECCE; the recovery time is also longer, and postoperative astigmatism occurrence is high.[31,32]

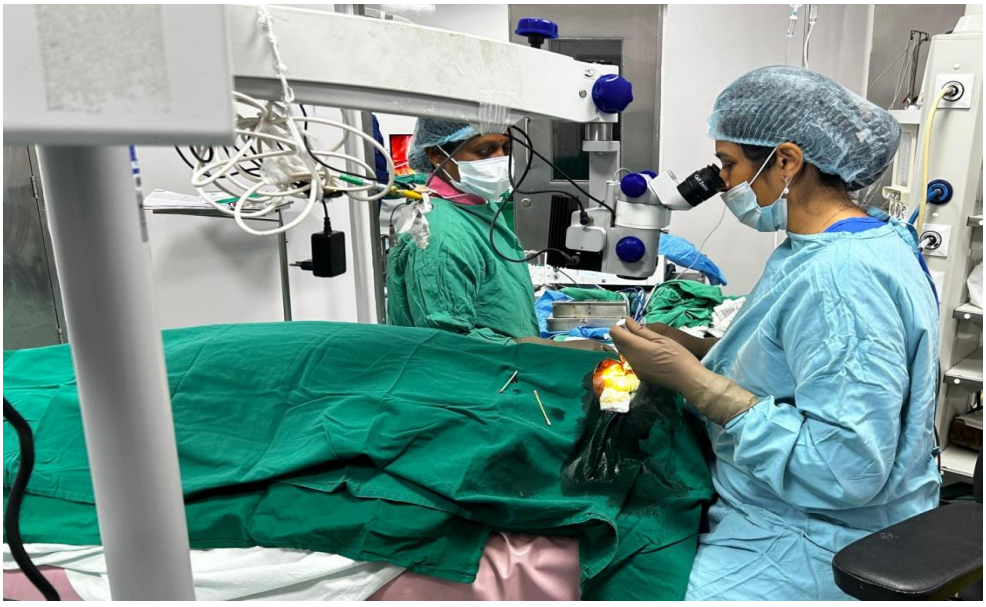
Small Incision Cataract Surgery:

Procedure:[33]

- Incision: The common site for incision is a superior location. Initially, the globe is secured, and a self-sealing sclerocorneal tunnel is made and the plane is advanced medially & laterally to facilitate nucleus delivery

- Anterior chamber entry: The paracentesis is performed for administration of trypan blue. The ophthalmic viscoelastic device (OVD) maintains the contour eye when it is injected into the anterior chamber.
- Capsulotomy: The continuous curvilinear capsulorhexis (CCC) is the most common method. The nucleus is detached using the hydrodissection. The nucleus is rotated to separate from the cortex and capsular bag.
- Nuclear prolapse and delivery: From the capsular bag, the nucleus is prolapsed using a Sinskey hook in the CCC method. The nucleus is then delivered using the sandwich technique, irrigating vectis, OVD-assisted viscoexpression, or Sinskey with a spatula.
- Cortical removal: The cortex is manually aspirated using a Simcoe IA cannula. The sub-incisional cortex is aspirated using a side port incision and IA cannula.
- IOL implantation: In the capsular bag, the one or three-piece polymethyl methacrylate (PMMA) IOL is implanted.
- Wound closure: The self-sealing incision is evaluated for watertight integrity and is left sutureless.[33]

Figure 4: A surgeon performing SICS



Phacoemulsification:

Phacoemulsification utilizes ultrasound energy to emulsify the cataract and aspirate the lens material while maintaining a stable and well-formed anterior chamber. It involves fragmentation, emulsification, and aspiration of the opacified lens nucleus. Under anesthesia, a self-sealing clear corneal incision is created using keratomes ranging in size from 1.8 mm to 3 mm. Under OVD, a continuous curvilinear capsulorhexis is performed using a bent cystitome or capsulorhexis forceps. The phaco probe is inserted through the small incision, delivering ultrasound waves to sculpt a groove in the lens nucleus. While the phaco tip stabilizes the nucleus, the chopper is used to break it into smaller fragments. The anterior chamber is kept stable and protected during fragmentation through continuous irrigation and aspiration of Balanced Salt Solution (BSS). The phaco tip aspirates the fragmented cataractous nucleus while the ultrasound energy emulsifies it, continuing the process until the entire nucleus is completely removed. The cortex and subincisional debris are cleared using irrigation and aspiration probes. Viscoelastic is injected into the capsular bag, followed by the implantation of the intraocular lens (IOL). After the IOL is implanted, the viscoelastic is removed, and the wound is hydrated to stabilize the anterior chamber. The various techniques employed in nuclear fragmentation include Divide and Conquer, Phaco Chop, and Tilt and Tumble supra-capsular phacoemulsification. The choice of surgical technique is influenced by factors such as pupillary dilation, nuclear density, and zonular integrity.[33]

Femtosecond laser-assisted cataract surgery (FLACS): The FLACS is a recent technique that uses the femtosecond laser to split the cataractous lens. The procedure uses laser of wavelength 1053 nm. This Femto laser is used to create corneal incisions, followed by anterior capsulorhexis and nucleus fragmentation. Corneal incisions are delineated using spatula. Under OVD the anterior lens capsule is removed and phaco probe is used to aspirate

the lens fragments with minimal energy. Lastly intraocular lens (IOL) implantation is done.[26,34]

Complications:

Intra-op Complications:

- Capsular tears
- Iris injury
- Hyphema
- Posterior capsular rupture and Posterior capsular rent (PCR)
- Zonulodialysis
- Iridodialysis
- Dropped nucleus[5,35]

Post-op Complications:

Table 1: Early and late post-op complications of SICS:[5,35]

Early Complication	Late Complications
Endophthalmitis	Posterior Capsular Opacification
Corneal Edema, Striate keratopathy	Cystoid Macular Edema
Elevation of Intraocular Pressure	Dislocation of IOL
Iritis,Hyphema	Retinal Detachment
Shallow Anterior Chamber	Anterior capsule contraction syndrome

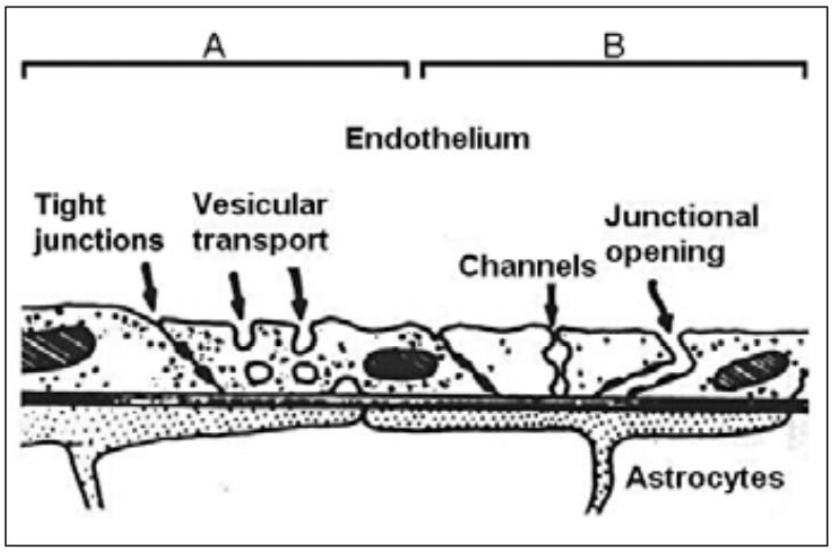
Cystoid macular edema:

Cystoid macular edema (CME) is the combination of macular thickening and fluid accumulation in the macula or central retina due to disruption in blood-retinal barrier. Cystoid macular edema arising after cataract surgery is known as pseudophakic cystoid macular edema (PCME). The incidence of CME causing visual impairment ranges from 0.1 to 3.8% after the cataract surgery.[36]The visual impairment occurs between four- and twelve weeks post-surgery.[37]After phacoemulsification, the CME incidence was 0.6 to 6%.[7]

Etiology:

CME can result from retinal blood vessel damage and leakage, abnormal growth of blood vessels in the inner retina, and disruption of the blood-retinal barrier. Owing to the stretching of the vessel tight junctions, the serum leaks abnormally into the retina from the blood stream. Post-fever retinitis is an inflammatory condition that could progress into CME (Fig: 5). The other common etiologies of CME are prolapsed or incarcerated vitreous, retinal vascular abnormalities, uveitis, postoperative inflammatory processes, diabetic retinopathy, retinal vein occlusion, retinal detachment, inherited retinal dystrophies, retinal tractional disorder, drug-induced reactions, light damage, and diabetes. The release of inflammatory mediators such as prostaglandins, vasopermeability factors, and cytokines during surgical trauma, alterations in the retinal microenvironment, and traction force on the macula can also lead to CME.[7,38–41]

Figure 5: Inner blood-retinal barrier pathway for solutes: A) Normal, B) Mechanism in the breakdown of blood-retinal barrier:[42]



Pathogenesis:

Cystoid macular edema occurs due to damage of the blood-retinal barrier (BRB) followed by accumulation of excess fluid in the macular region. The fluid accumulation extracellularly affects the structure and function of the retina. The accumulation of intracellular fluid in Müller cells, which are responsible for maintaining macular hydration, can damage retinal function. Intraocular inflammation is due to T-cell cytokines such as interferon-γ, 2, and10, and tumor necrosis factor-α.[43]The inflammatory mediators of CME are chemokines, prostaglandins, T-cell lymphocytes, and CD4+ subtype.[44]The flow of fluid into the retina is not completely understood. However, the transcellular route is involved in the fluid pathway. Chronic CME can completely damage the macular retinal cells associated with fibrosis, and retinal thinning.[45]In diabetic patients, the prior CME is aggravated by the cataract surgery. Post-surgical vitreous traction is the main reason for aphakic CME, leading to alterations of the anterior segment.[46]In short, pathogenesis can be listed as,

- Breakdown of the BRB: The BRB maintains hemostasis. The disruption of outer and inner BRB causes fluid to leak into the macula.
- Inflammation and Pro-inflammatory Mediators: The vascular permeability is increased by the inflammatory cytokines like prostaglandins, interleukins, and vascular endothelial growth factor (VEGF). The entry of inflammatory cells into the retina increases the edema.
- Vascular dysfunction: The BRB compromise leads to vascular dysfunction. The damage to the endothelial capillaries and retinal circulation increases the leakage and permeability. Vascular dysfunction can also occur during the release of hypoxia-induced VEGF.
- **Mechanical and Tractional Forces:**Vitreoretinal traction exerts mechanical stress on the macular architecture, disrupting retinal integrity and facilitating the accumulation of intraretinal and/or subretinal fluid.[38,45]

Clinical features:

- Blurred vision
- Postoperative visual loss
- Loss of contrast sensitivity
- Central scotoma
- Metamorphopsia.[39]

Diagnosis:[38]

❖ **Slit-lampBiomicroscopy:** The first step in examining for macular edema involves slit-lamp biomicroscopy, typically conducted using a 90D or 78D lens. The biomicroscopic examination method identifies the presence and location of macular thickening, exudates, and cystoid spaces. A distinctive stellate or radially oriented pattern of perifoveal cysts attributed to the oblique arrangement of the Henle fiber layer characterizes cystoid macular edema. The

loss of foveal depression indicates CME by biomicroscopy. The biomicroscopy also identifies the intraretinal cystoid space. The light beam is distorted if there is edema or an uneven surface of the retina, denoting CME. The biomicroscopy obtains a stereoscopic image, making it easier to find the small changes. This stereoscopic view shows the surroundings of the macular region, its depth, height, swelling, and detachment.[47]

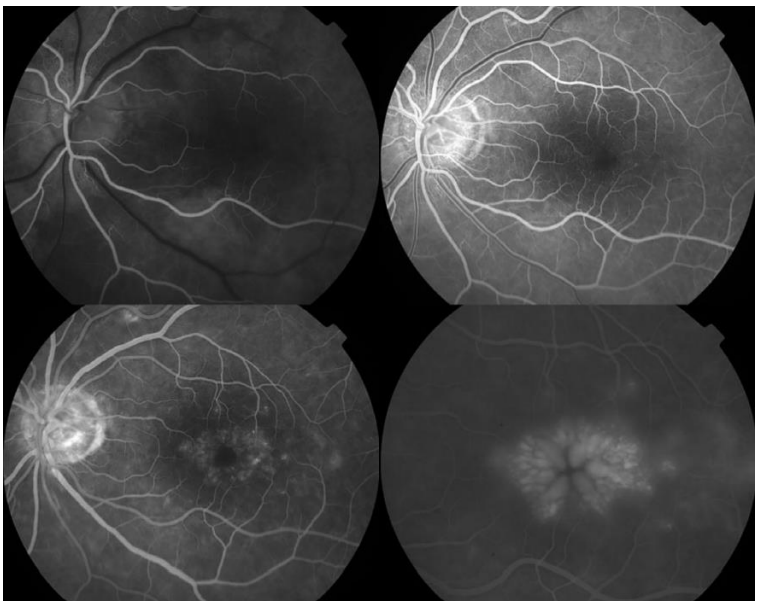
Figure 6: Slit-lamp Biomicroscopy

- **Fluorescein angiography (FA):**The early stage of CME is seen as faint hyper-fluorescence due to the visibility of the dye at the choroid. The dye is visible due to excess light transmission in the cystic areas, as there is a decrease in the macular pigment. In the mid-stage, the perifoveal capillaries visualize the progressive dye leak into the retinal cystic space. The later stage shows the cavities occupied by the dye, seen as multiple cysts or in a "petaloid" hyper-fluorescence. This petaloid pattern is an important characteristic of the CME (Figure 8).[48]
- The angiography identifies the stages of CME by the level of fluorescein leakage. Apart from diagnosis, the FA also aids in planning for the surgery.[38]

- Level 1: Edema < 360°surrounding the perifoveal area
- Level 2:Minimum leakage, but 360° surrounding the perifoveal area

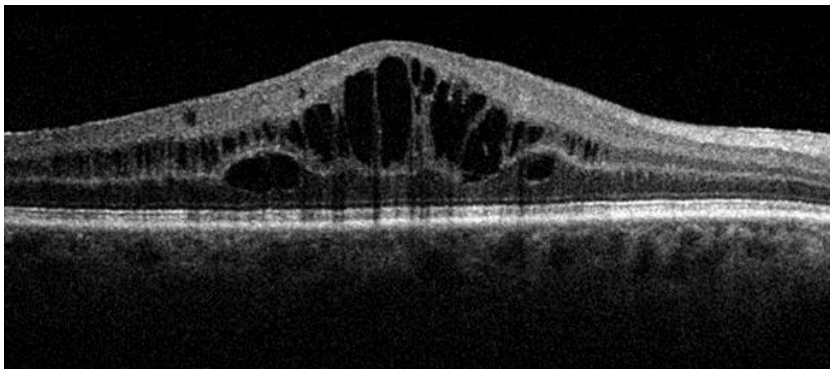
- Level 3: Moderate perifoveal edema.
- Level 4: Severe perifoveal edema.[37,49]

Figure 7: "Petaloid" appearance of CME by FA.[39]



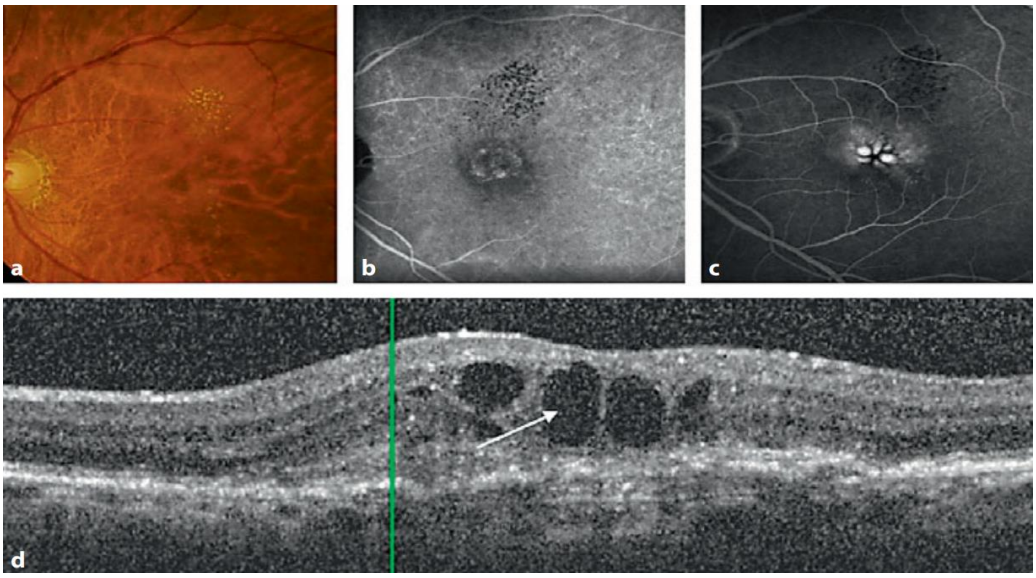
❖ **Optical Coherence Tomography (OCT):** The OCT is essential in visualizing the cystic spaces present in the outer nuclear layer in the CME (Fig: 9).

Figure 8: OCT of cystoid macular oedema.[50]



❖ The other diagnostic tools are stereoscopic fundus photography, scanning laser ophthalmoscope, and retinal thickness analyzer. Electroretinography and contrast sensitivity charts are used to identify the function of the retina and assist in CME treatment.[38]

Figure 9: Cystoid macular edema: a) color image, b) Early stage in FA, c) later stage in FA, d) OCT image (arrow-large cystoid space).[51]



Macular thickness:

Macular thickness is the measurement of the central region of the retina called the fovea centralis. The macular thickness is generally measured using optical coherence tomography. The macular thickness is normally measured in regions like Central Subfield Thickness (CST), such as the fovea (500-μm radius) and center, and the inner macular ring (1.5-mm radius) and outer macular ring (3-mm radius). The inner and outer rings are further measured in superior, inferior, temporal, and nasal. The average normal macular thickness in healthy eyes in the fovea was 212; in the center it was 170; in the superior, inferior, temporal, and nasal of the inner ring, it was 255, 260, 251, and 267; and in the outer ring were 239, 210, 210, and 246, respectively.[52,53]

Optical coherence tomography (OCT):

Optical coherence tomography is a non-invasive and no-contact imaging modality. The cross-sectional image of the retina is obtained by the OCT with higher resolution and provides real-

time images. It was first introduced in 1991. The OCT is similar to ultrasound B-scan, which uses sound waves, but OCT uses light waves. The OCT uses a near-infrared wavelength of about 840 nm. The OCT obtains the axial images of the fluid-accumulated structures; hence, it is considered superior.[38]It also finds abnormal fluid release from the capillary bed. The OCT provides images in an anteroposterior view and a 2-dimensional view.[51,54]

Figure 10: The PRIMUS 200 OCT system with computer display.

Principles:

The OCT uses the white light interferometry or low-coherence interferometry principle. The OCT directs light waves towards the tissue being examined. Then, the waves are reflected, and the differences in the delay of the light reflected are measured. The OCT uses near-infrared light, which travels at high speed. Since the light waves travel faster, the delay in reflection can't be measured by OCT alone; hence, the interferometer is used. The interferometer splits the light path from the OCT, with one part directed to the sample or

tissue and the other to the reference arm. This setup measures the length, with the light being reflected accordingly. The reflected light from both pathways is merged at the output of the interferometer or detector. This results in interference, which is used to measure light intensity and depth. Interference occurs only when the optical path lengths of the light from both pathways align. This is measured by photodetectors, which convert the signals into electrical signals, with the measurement unit in micrometers (µm).The resolution of OCT ranges from twenty to twenty five µm. The OCT is more sensitive when detecting reflected waves. Using an incident optical power of 20 microwatts, the very small reflection of about 5 $\times 10^{-10}$ can be detected with 10fW sensitivity.[6,54]

Technique:[54,55]

- **Time-domain OCT (TD-OCT)**: This technique analyzes deeper tissue layers by comparing them with the interferometer's reference value. TD-OCT uses a photodiode and a broadband light source. However, it is limited by delays in image acquisition, lower image quality, and noise, which restrict its use in many cases.

- **Spectral-domain OCT (SD-OCT)**: SD-OCT overcomes the limitations of TD-OCT by employing a wide spectrum of light sources, a constant-length interferometer, optical receiver, spectrometer, and array detector. Its advantages include higher-quality images, shorter scan times, and faster image acquisition through Fourier transform.

- **Frequency-domain OCT (FD-OCT)**: FD-OCT detects the signal using a single-element photodiode, with the interferometric fringe signal encoded in frequency. It uses a wavelength-swept laser and the Fourier technique. The benefits include a constant pathway length and the ability to reach a maximum depth of approximately 10 µm.

- **Circular ranging**: This method converts deeper information into circular data, enabling rapid image acquisition, real-time imaging, high resolution, and surgical guidance. It involves complex fringe generation using techniques like acoustic-optic frequency shifters, lithium niobate phase modulators, and polarization-based methods.

- **Polarization-sensitive OCT (PS-OCT)/Polarimetry**: PS-OCT utilizes dual-polarized channels and dual cameras for enhanced imaging.[54–56]

Procedure:

- First, the patient is seated, with their head positioned and chin rested to minimize movement. Pupillary dilation is often used for improved scanning.

- The OCT machine is adjusted to properly focus on the patient's eyes and macula.

- The OCT light beam is then directed into the eyes.

- The light beams are reflected from different retinal layers, which are captured and processed to create the image.

- The resulting image is used for diagnosing pathologies and making comparisons.[6,54,55]

Applications in ophthalmology:

- The OCT evaluates the optic nerve head, macula, retinal nerve fiber layer, choroidal thickness, as well as the structure and changes associated with various ophthalmic pathologies.[57]

- OCT plays a crucial role in diagnosing intraretinal fluid accumulations, including retinal edema, cystoid macular edema (CME), diffuse macular edema, serous retinal detachment, and subretinal fluid collections such as those seen in central serous chorioretinopathy.[58]

- Applications of anterior segment OCT (AS-OCT):AS-OCT is valuable for both preoperative and postoperative evaluation of intracorneal ring segments, Descemet-stripping endothelial keratoplasty (DSEK), filtration blebs, and penetrating keratoplasty (PK). AS-OCT facilitates detailed evaluation of the iris, aiding in the diagnosis of lesions such as iris cysts, nevi, and iridoschisis. It also serves as an essential tool in the assessment of glaucomatous changes and a wide range of corneal pathologies.[59]
- Enhanced depth imaging OCT (EDI-OCT): EDI-OCT is primarily utilized to assess choroidal thickness, volume, and perform choroidal thickness mapping. It is particularly valuable in the evaluation of conditions such as choroidal tumors, age-related macular degeneration, diabetic retinopathy, central serous chorioretinopathy, and glaucoma.[59]

Application in CME:

- CME is more effectively diagnosed using three-dimensional OCT (3D-OCT), which offers higher sensitivity.
- OCT can detect CME with macular thickening, a condition that is only seen in a limited number of cases.
- Early changes in CME, especially an increase in foveal volume, can be detected using OCT.
- In advanced cases of CME, OCT can visualize subfoveal detachment and cystic changes.[59]

Management of CME:[37]

- **Topical Therapy** [Non steroidal anti-inflammatory drugs (NSAIDs)]: Prophylactic intervention manages clinical and angiographically diagnosed CME. It prevents vision loss. The topical administration of cyclo-oxygenase inhibitors aims for higher aqueous levels. Ketorolac tromethamine is also used for CME management. Indomethacin eye drops are used

in chronic CME patients.[37,60]The high concentration of diclofenac controls the lipoxygenase product formation.[38]

- **Steroids:**The formation of prostaglandins and leukotrienes is controlled by steroids, as they have vasoconstrictive properties. Systemic and periocular corticosteroids improved CME management by being administered orally and parenterally. Also, the combination of ketorolac and prednisolone topically is an effective treatment.[61]CME with retinal vein occlusion, diabetic maculopathy, and uveitis can be treated with Intravitreal triamcinolone acetonide..[62] Triamcinolone acetonide improves central retinal thickness and electrical activity. The corticosteroid-based implants are dexamethasone biodegradable implant, helical triamcinolone acetonide, and fluocinolone acetonide.[38]
- **Carbonic Anhydrase Inhibitors:** Acetazolamide helps increase the retinal pigment epithelium function, improve vision, and reduce intraretinal fluid. It also improves the fluid resorption from the retina. CME, which can be associated with conditions such as retinitis pigmentosa and uveitis, may be managed with Acetazolamide therapy.[63]
- **Intravitreal Injections**: Anti-VEGF agents such as bevacizumab and ranibizumab or corticosteroids such as triamcinolone are used to decrease vascular permeability.
- **Laser treatment (Vitreolysis)**:The Nd:YAG laser promotes the resolution of CME resulting from vitreous incarceration at the incision site. When combined with anti-inflammatory eye drops, this approach yields enhanced therapeutic outcomes.[64]
- **Surgical Management:** Vitrectomy is employed in the management of chronic aphakic CME, vitreous incarceration, vitreomacular traction, and corneoscleral wound complications..[65]Vitrectomy followed by corticosteroids is effective.
- **Laser photocoagulation:** The laser photocoagulation procedure uses high powered laser for tissue coagulation.
- Periocular or intraocular corticosteroids treat resistant CME.[37]

- The sequential management for CME includes,
  - 1. Topical NSAIDs × 4/d + topical corticosteroids × 4/day (+ acetazolamide)
  - 2. Periocular corticosteroid
  - 3. Intravitreal triamcinolone (possibly intravenous antiangiogenic agents).[37]

Similar studies from the past:

The prospective study of **Nasreen et al.**[66](2020) included 25 post-SICS patients and measured theirvisual acuity and macular thickness using OCT. The average age (in years) of the patients was 61. The preoperative average visual acuity of 0.22 (~6/36p), increased to 0.63 (~6/9) postoperatively. The average macular thickness preoperatively was 166.5 µ. The postsurgical macular thickness increased in 1st week to 176.4 µ, followed by a reduction in 2nd week to 171.4 µ, 4th week to 167.8 µ, and in 3rd month was168.5 µ, ($p<0.05$).

Bhargava et al.[67](2021) analyzed the alteration of macular thickness and its correlation with BCVA in 120 patients who had undergone SICS. The average age (in years) of the patients was 62. The BCVA preoperatively was 0.15, which significantly increased postoperatively in 1st month (0.89) ($p<0.001$)and in 3rd month (0.95) ($p>0.05$).The average macular thickness,analyzed for the nine macular quadrants,significantly increased post-operatively till one month and obtained its initial value in the 3rd month ($p<0.001$).Between macular thickness and BCVA, no correlation was seen.

Salwan et al.[68] (2021) examined the BCVA and macular thickness after SICS. This prospective study included 50 patients. The average age (in years) of the patients was 59. Maximum females with 56%.The average preoperative macular thickness was 223.4, which significantly increased to 238.3 in 1st week and decreased to 227.1 in the 12th week

(p<0.001). The average preoperative visual acuity was 0.258, significantly increasing to 0.78 in the 12th week (p<0.001).

Patel et al.[69] (2021) examined the macular thickness after SICS using OCT. This study included 33 patients who had undergone SICS. The average patient age (in years) was 60. The male to ratio was 1:1.35. The average central macular thickness (CMT) preoperatively was 176.3. Postoperatively, the average CMT increased to 198.1 in 1st month and decreased to 177.7 in 3rdmonth. Preoperative average macular thickness (AMT) was 253.4, significantly increasing to 266.3 in the postoperative 1st month and reduced to 261.8 in the 3rd month, p=0.001. The differences were significant, with a p-value of <0.05. The average BCVA postoperatively in 1st month was 0.69, which increased to 0.83 in the 3rd month. The macular thickness increase did not affect the BCVA.

Dabas et al.[70] (2022) evaluated the SICS with posterior chamber IOL implantation and the post-operative central macular thickness. This prospective study enrolled 120 subjects. The average age (in years) of the patients was 62. Females contributed 59%. The best corrected visual acuities (BCVAs) (average) preoperatively were 0.05, which gradually increased postoperatively in the 1st week (0.65), 6th week (0.66), and 12th week (0.67).Preoperatively, the average macular thickness was 217.03, which significantly elevated in the 1st week (221.6μm) and 6th week (224.6μm) and reduced in the 12th week (219.2μm) (p<0.0001).

The prospective study of **Kumar et al.**[71](2022) included 57 SICS underwent cases and measured the VA alterations.Preoperatively the VA of >6/18 was present in 12% of patients, and postoperatively was seen in 84% of patients. The VA of 6/24 - 6/60 was seen preoperatively in 53% and postoperatively was seen in 12% of patients. The VA of <6/60, preoperatively was seen in 35%, and postoperatively was seen in 3.5%. The values showed statistical significance with a p-value of <0.001.

Parajuli et al.[72] (2023) analyzed the macular thickness alteration after SICS. This prospective study included 62 patients (68 eyes). The average age (in years) of the patients was 58. Male predominance was 57%. The average preoperative BCVA was 0.59, significantly increased postoperatively at the 6th week to 0.19 logMAR unit, p <0.05. The average CMT (µm) preoperatively was 208.9, which significantly increased on the next day of the surgery to 243.8, on the 1st week to 255.1, and decreased on the 6th week to 246.4, p<0.001.

Deepika et al.[73] (2024) examined the visual acuity after SICS. This observational study included 100 subjects. The average age (in years) of the patients was 60 with maximum females 60%.The average BCVA preoperatively was 0.06; after surgery, the BCVA increased gradually from the 1st week to0.66, in the 6th week to 0.68, and in the 12th week to 0.69.

MATERIALS & METHODS

MATERIALS AND METHODS

SOURCEOFDATA:

This prospective, non-randomized hospital based study included a total of 100 patients fulfilling the inclusion criteria in the department of Ophthalmology, R.L.J. HOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICAL COLLEGE. KOLAR

STUDY DESIGN: Prospective, non-randomized, hospital based study

PERIOD: May 2023 to October 2024

INCLUSIONCRITERA:

- Patients with immature cataract above 18 years of age undergoing Manual SICS

EXCLUSIONCRITERIA:

- Mature Cataract
- Complicated cataracts, co-existing ocular pathology, previous ocular surgeries
- Pre-existing macular pathology like ARMD, macular edema
- Intra-operative complication

ETHICAL CLEARANCE

Prior to the commencement, the study was approved by the Ethics and Research Committee, Sri Devraj Urs Medical College, Kolar.

INFORMED CONSENT

All the patients fulfilling selection criteria were explained about the nature of the study. A written informed consent was obtained from all the participants before enrolment (Annexure)

METHOD OF COLLECTION OF DATA

A total of 100 patients fulfilling the inclusion criteria were included in this prospective observational study. Each patient were assessed by detailed history and clinical examination of both the eyes will be done by various methods as follows-

Setting- Ophthalmology Out Patient Department, R.L.Jalappa Hospital, Tamaka, Kolar

- Visual acuity by Snellens chart for distant vision. (converted to logMAR)
- Near vision.
- Slit lamp biomicroscopy.
- Fundus examination by + 90D lens assisted slit lamp biomicroscopy and indirect ophthalmoscopy.
- Macular thickness using OCT – Preoperative and post-operatively at 1 week and 4 weeks.
- Post-Operatively visual acuity will be assessed at 1 week and 4 weeks and correlated with Macular thickness.

The study subjects will be evaluated by OCT & the following parameters will be measured.

1. Central subfield macular thickness.

2. Total macular volume.

SAMPLE SIZE ESTIMATION

Open Epi info software was used for estimation. Mean and standard deviation between groups was used for estimation of sample size. With the confidence interval at 99% and power at 95%, with mean and standard deviation before and after surgery as per the study **Salwan A et al** [68] which was a prospective, comparative, observational study to assess the macular thickness and visual outcome before and after cataract surgery done at Amritsar, Punjab on 100 uncomplicated cataract patients from January 2019 to June 2020.

The sample size calculation is done by the following formula:

$$n_1 = \frac{(r+1)(Z_{\alpha/2} + Z_{1-\beta})^2 \, \bar{p} \, \bar{q}}{r(p_1 - p_2)^2}$$

and

$$n_2 = r \, n_1$$

where

n_1 = number of exposed

n_2 = number of unexposed

$Z_{\alpha/2}$ = standard normal deviate for two-tailed test based on alpha level (relates to the confidence interval level)

Z_{β} = standard normal deviate for one-tailed test based on beta level (relates to the power level)

r = ratio of unexposed to exposed,

p_1 = proportion of exposed with disease and $q_1 = 1-p_1$,

p_2 = proportion of unexposed with disease and $q_2 = 1-p_2$

$\bar{p} = \frac{p_1 + rp_2}{r+1}$ and $\bar{q} = 1 - \bar{p}$

Sample size was estimated to be 88 with the help of Open Epi software & with 13% as non-response rate, i.e 13% of 88 = 12, the total sample size is 88 + 12 = 100 samples.

STATISTICAL METHODS USED FOR THIS STUDY

- All the data collected will be coded and entered into Microsoft Excel spread sheet
- All the quantitative variables will be represented as frequencies, proportions, mean and standard deviation
- All categorical variables will be analyzed using ANOVA test
- P-value less than 0.05 will be considered as statistically significant
- SPSS version 22 will be used for analyzing the data

Data Analysis

Data was entered in MS excel and analysed by SPSS v27.0. Mean (SD) and median (IQR) was calculated for continuous variables. Categorical variables were expressed in frequencies and percentage. Spearman correlation was calculated between post-op VA and the macular thickness and volume, with p value below 0.05 taken as significant.

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RESULTS

RESULTS

Patients in the study were almost equally distributed between females (51%), and males (49%).

TABLE 2: Sex Distribution

		Frequency	Percent
	Male	49	49.0
	Female	51	51.0
	Total	100	100.0

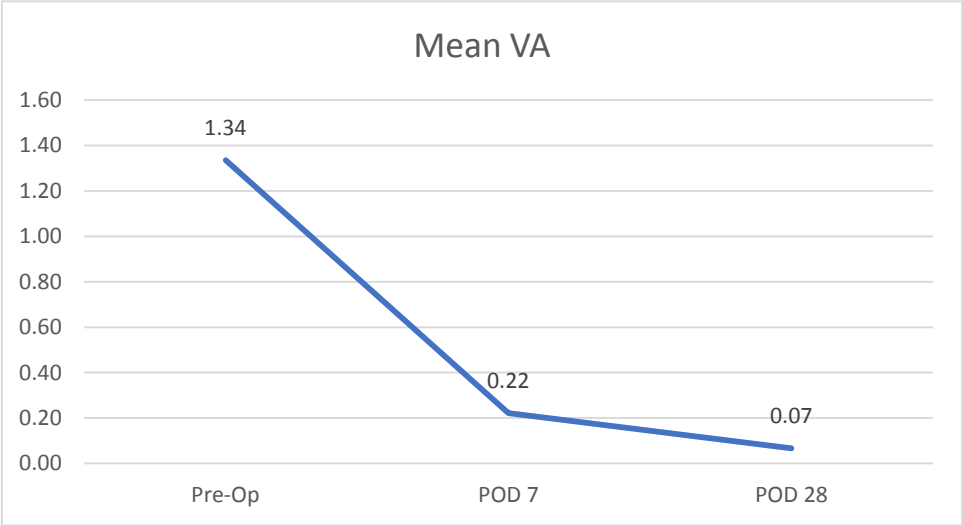
The patients had a mean age of 63.09 years and a median age of 65 years. The mean preoperative visual acuity (VA) was 1.34 logMAR, with a median of 1.30 logMAR. Preoperative macular thickness (MT) averaged 205.14 μm, with a median of 198 μm, while the total macular volume (TMV) had a mean of 8.43 cubic centimeters (cucm) and a median of 8.45 cucm. On postoperative day (POD) 7, the mean and median VA improved to 0.22 and 0.20 logMAR, respectively. The MT increased to a mean of 254.28 μm and a median of 254 μm, and the TMV rose to a mean of 9.33 cucm and a median of 9.3 cucm. By POD 28, the mean VA further improved to 0.07 logMAR, while MT decreased to a mean of 224.53 μm and a median of 224.5 μm. TMV also declined, with a mean of 8.94 cucm and a median of 8.90 cucm.

TABLE 3: Patient Demographics & Visual/Macular Parameters in Pre and Post-op period

	Mean	Median	SD	IQR
AGE (YEARS)	63.09	65.00	8.62	58,68.75
PRE-OP VA LogMAR	1.34	1.30	0.44	1.1,1.8
PRE-OP MT (μm)	205.14	198.00	35.65	179,234
PRE-OP TMV (cucm)	8.43	8.45	1.20	7.725,9.1
POD 7 VA LogMAR	0.22	0.20	0.25	0,0.3
POD 7 MT (μm)	254.28	254.00	26.68	236.25,274
POD 7 TMV (cucm)	9.33	9.30	0.98	8.6,9.8
POD 28 VA LogMAR	0.07	0.00	0.10	0,0.2
POD 28 MT (μm)	224.53	224.50	26.73	205,246
POD 28 TMV (cucm)	8.94	8.90	0.77	8.4,9.4

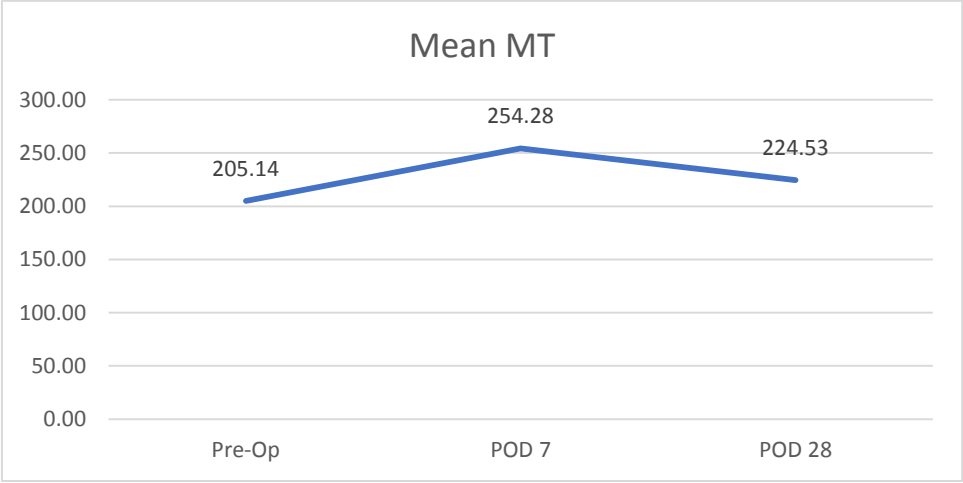
After one week, 70% of patients had visual acuity of 6/9 (logMAR: 0.2) or better, which improved to 96% by the 4th week irrespective of changes in the macular thickness.

GRAPH 1: Trend of Mean Visual Acuity from Pre-Op to Post-Op Day 28



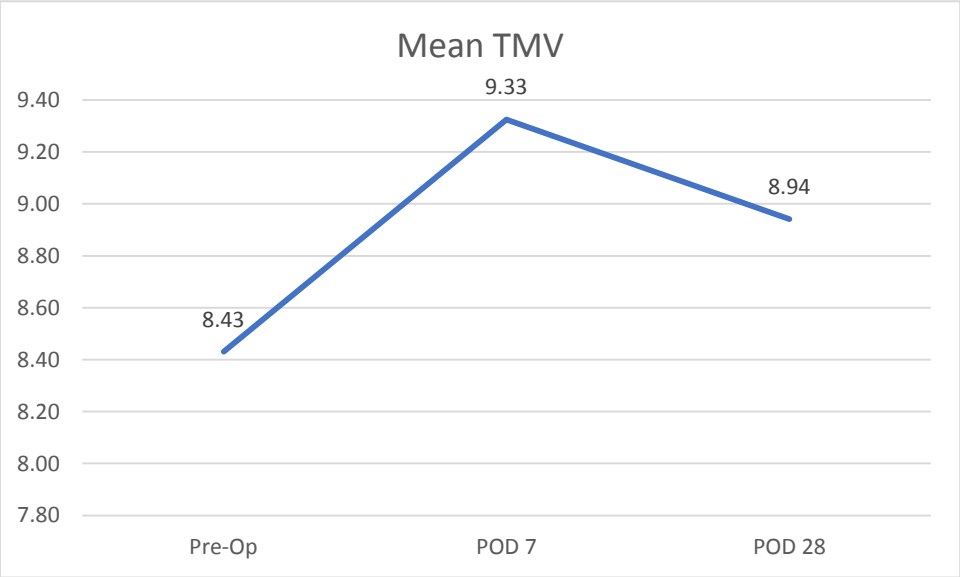
The mean macular thickness pre-operatively was 205.14 ± 35.65 µm. Postoperatively, macular thickness was 254.28 ± 26.68 µm after one week and by 4th week postoperatively macular thickness decreased to 224.53 ± 26.73 µm.

GRAPH 2: Pattern of changes in Macular Thickness from Pre-Op to Post-Op Day 28



The total macular volume pre-operatively was 8.43 ± 1.2 cm^3. Postoperatively, macular volume was 9.3 ± 0.98 cm^3 after one week and by 4th week postoperatively macular volume decreased to 8.94 ± 0.77 cm^3

GRAPH 3: Pattern of changes in Macular Volume from Pre-Op to Post-Op Day 28

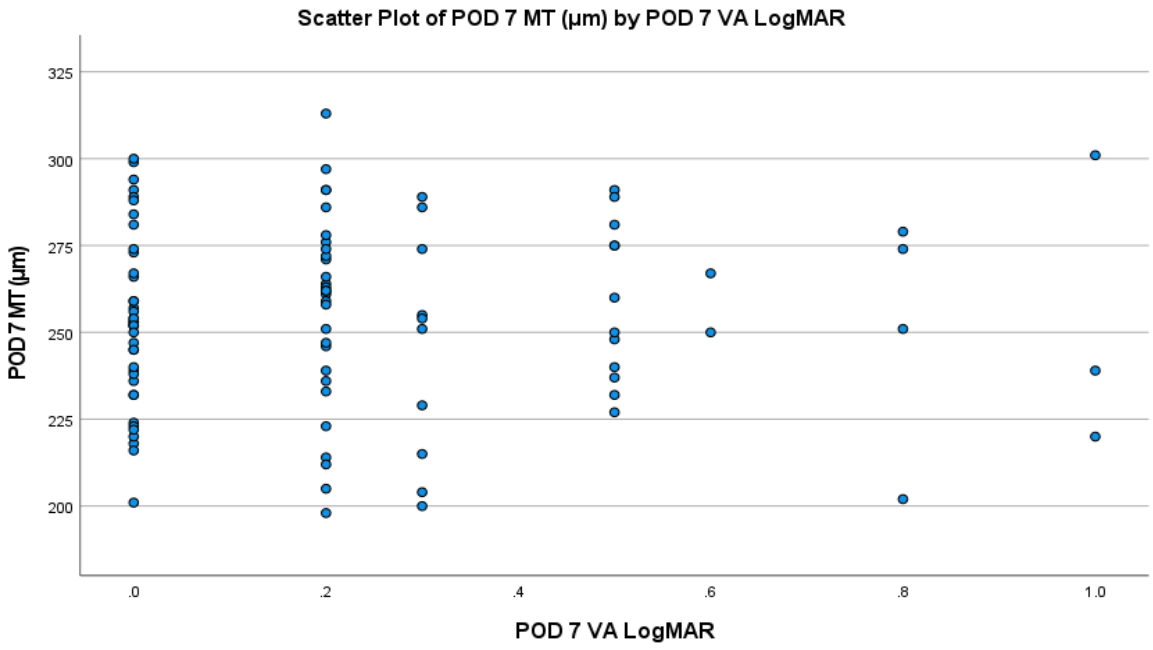


No significant correlation was found between VA and macular thickness and macular volume at post-op day 7.

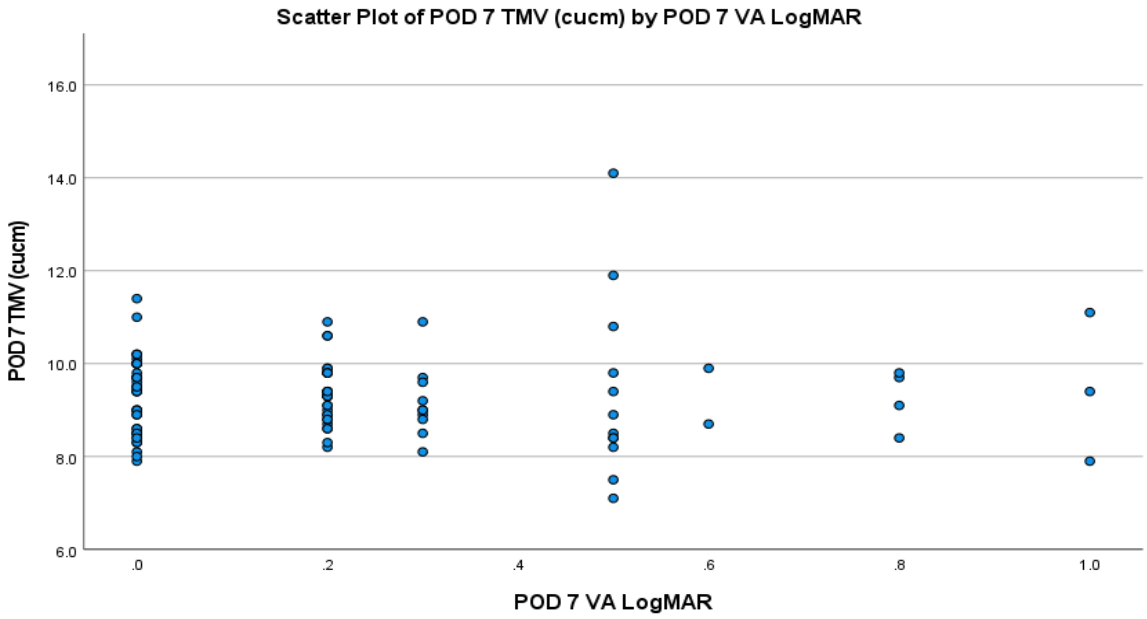
TABLE 4:Correlation between 7 day post-op VA and the macular thickness

	Correlation coefficient	P value
Macular thickness	0.029	0.777
Total Macular volume	-0.077	0.447

GRAPH 4: Correlation between Post-op Day 7 Visual Acuity and Macular Thickness



GRAPH 5: Correlation between Post-op Day 7 Visual Acuity and Macular Volume

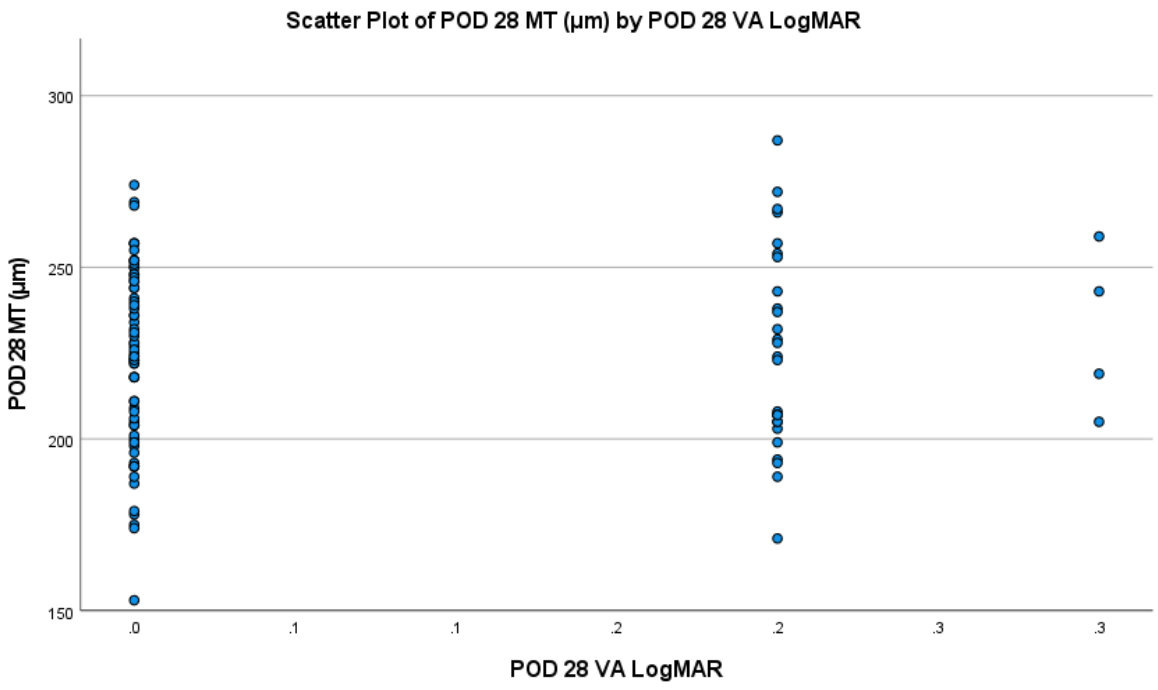


No significant correlation was found between VA and macular thickness, volume in post-op at 28 days.

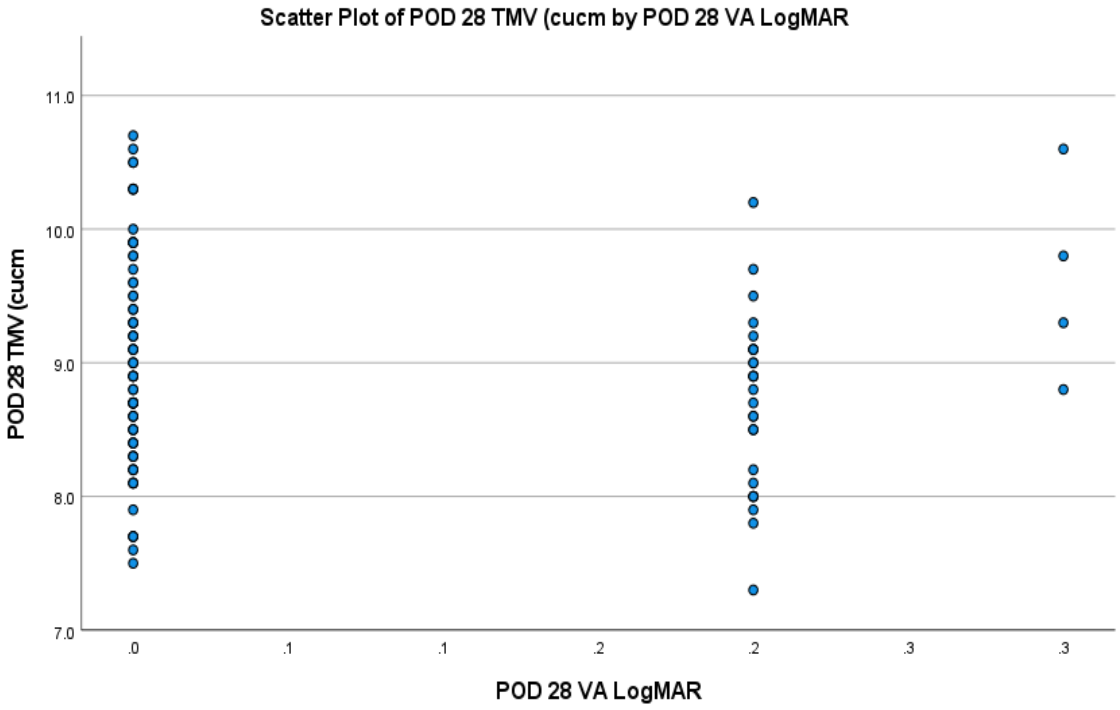
TABLE 5: Correlation between 28 day post-op VA and the macular thickness

	Correlation coefficient	P value
Macular thickness	0.040	0.695
Total Macular volume	-0.066	0.516

GRAPH 6: Correlation between Post-op Day 28 Visual Acuity and Macular Thickness



GRAPH 7: Correlation between Post-op Day 28 Visual Acuity and Macular Volume



DISCUSSION

DISCUSSION

Cataract is one of the most common pathology associated with the eye, and often, the visual acuity worsens with time due to progression of cataract. In our study, patients underwent SICS. This study measured the macular thickness and its correlation with visual acuity after the small incision cataract surgery with posterior chamber intra-ocular lens implantation using OCT. Although changes in macular thickness were noted in the majority of cases after cataract surgery, no correlation was identified between these changes and visual acuity.

Demography:

In our study, we enrolled 100 patients with a similar distribution of males and females, around 50% each. The average age (in years) of our study participants was 63. **Deepika et al.**[73]similarly documented the VA parameter after the SICS among 100 patients with two-thirds of the patients as female gender. However in our study, females contributed half of the study. **Parajuli et al.**[72] enrolled 68 eyes for SICS with average age of patients 58 years and **Dabas et al.**[70]study with 62 years comparable to our study participants inclusion. **Salwan et al.**[68] included patients undergoing SICS as the average age (in years) of the patients was 59 with 56% females comparable to our study.

Visual acuity:

In our study, the mean pre-op VA of the patients was 1.34logMAR. The mean visual acuity on postoperative day 7 of the patients was 0.22 logMAR. The mean value of visual acuity on the postoperative day 28 of the patients was 0.07 logMAR, i.e., the logMAR value decreased after surgery, indicating an improvement in visual acuity (a lower logMAR score corresponds to better vision). When visual acuity was converted to Snellen chart decimal values

(Decimal BCVA=$10^{-\log MAR}$), the values showed an increase over time, i.e., 0.04 on pre-op, 0.6 on post-op day 7, and 0.85 on post-op day 28.

Parajuli et al.[72] documented that the mean pre-operative VA improved following the procedure, i.e., logMAR value decreased from 0.59 to 0.19,which is similar to our study.

Patel et al.[69] documented that average BCVA as per Snellen's chart values, i.e., postoperatively in 1st month, was 0.69, which increased to 0.83 in the 3rd month. The pattern of improvement and the post-operative value of visual acuity were comparable in the studies. Similar to our study, **Dabas et al.**[70]documented an increase in VA as per Snellen's chart from preoperative (0.05) to postoperatively in the 1st week (0.65), 6th week (0.66), and 12th week (0.67).

Deepika et al.[73] observed that the preoperative VA as per Snellen's chart values increased from 0.06 to 0.66 at week one and 0.68 at week six. The increasing pattern of VA following the SICS was comparable in both studies. However, in our study, the assessment of VA was conducted only at two post-operative points, i.e., week one and four, but in the comparison study, it was done at three points till week 12.

The BCVA as per Snellen's chart values in the preoperative time was 0.15, which significantly increased postoperatively in 1st month (0.89) ($p<0.001$) and in 3rd month (0.95) in the study results of **Bhargava et al.**[67]In study results of **Nasreen et al.**[66]the preoperative average visual acuity was 0.22 which increased to 0.63 postoperatively similar to our study. The enhancement in visual acuity may be attributed to the removal of the opaque cataractous lens and its replacement with a clear intraocular lens (IOL), which enables proper focusing of light onto the retina.

Macular thickness:

In our study, mean pre-operative MT and TMV of the study patients was 205.14 and 8.43 cucm. Similarly, the mean value of post-operative day 7, MT and TMV were 254.28μm and 9.3 cucm. The mean value of MT and TMV post-operatively on day 28 were 224.53 μm and 8.94 cucm. The macular thickness increased post-operatively at one week and declined at 4 weeks. The pattern was similar in TMV. **Dabas et al.**[70] documented that preoperatively, the average macular thickness was 217.03, which significantly elevated in the 1st week (221.6 μm) and 6th week (224.6 μm) and reduced in the 12th week (219.2 μm) ($p<0.0001$). In comparison, the MT at week one was higher in our study (254 vs 221). The pattern of increase in week one and later decline of MT was similar to our study results. Similarly, **Parajuli et al.**[72] study showed that the MT increased from 208 μm in the preoperative period to 255 μm in week one and declined to 246 μm in week six.

The increase in MT and TMV in the early postoperative phase can be attributed to subclinical inflammation, which is a physiological response to surgical trauma. The inflammation (mediators such as prostaglandins and cytokines) may lead to disruption of the blood-retinal barrier and accumulation of fluid in the macular layers, detectable by OCT. Importantly, the resolution of macular thickening by the fourth postoperative week in most patients, as seen in our study, suggests that these changes are often transient and self-limiting. The self-limiting increase in macular thickness may be attributed to the physiological resorption of fluid in the later stages. Studies documented that the use of topical NSAIDs or corticosteroids post-surgery reduces prostaglandin synthesis and promotes faster resolution of macular edema.[74]

Deepika et al.[73] observed that the MT increased from 216 at preoperative time to 221 at week 1 and 224 at week 6. The pattern was different from our study results. The probable reasons for the difference might be inflammation or edema which may have peaked earlier and

resolved faster in our study patients. Secondly, there might be variations in the duration of SICS, wound construction, amount of irrigation fluid used and post operative care.

In **Patel et al.**[69] study, average macular thickness preoperatively was 253.4 which is higher than the present study. Postoperatively, MT significantly increased to 266.3 in the postoperative 1st month and reduced to 261.8 in the 3rd month. Although the macular thickness (MT) values in our study were lower than those in the Patel study, the pattern of change followed a similar trend, with an initial increase in the immediate postoperative period, followed by a decline in the later stages. However, unlike the Patel study, we did not estimate the post-operative MT at month three.

The previous studies hypothesized that the macular thickness increased immediately post-operatively, probably till week four, and declined thereafter. However, our study did not estimate the prolonged observations of macular thickness following SICS. The immediate increase in macular thickness may be attributed to fluid accumulation in the macula, often resulting from ocular aberrations and inflammation. Furthermore, factors such as the length of the incision and underlying comorbidities could impact the duration of the macular thickness increase after surgery.

The average preoperative macular thickness was 223.4, which significantly increased to 238.3 in 1st week and decreased to 227.1 in the 12th week in the study results in **Salwan et al.**[68]Though the pattern of increase in week 1 and decline in 12 weeks was comparable, the values of MT was higher in our study at week 1 (254 vs. 238). This difference may be attributed to inter-study variability in patient demographics, differences in hospital settings, or postoperative anti-inflammatory protocols. However, detailed information was not available in the comparison study.

Bhargava et al.[67]documented that the foveal thickness increased from 230 in pre-operative period to 235 in week one post-operation, further increased to 239 in week four, and declined in week 12 to 233. The pattern was similar to our study.

In our study, although a positive correlation was observed between macular thickness and visual acuity (VA), this correlation was not statistically significant at 7 days post-operation. Similarly, no significant correlation was found between VA and total macular volume. A similar lack of significant correlation was observed on the 28th postoperative day. This was because there was a significant increase in VA post-surgery in both day 7 and 28, while the macular thickness increased and declined over the postoperative period. In a similar study conducted by **Bhargava et al.**[67]there was no correlation between the visual acuity and macular thickness.

These findings suggest that routine short-term increase in macular thickness following SICS may not necessarily translate into poorer visual outcomes and do not require aggressive intervention unless clinically indicated (e.g., cystoid macular edema or visual complaints). Postoperative monitoring should continue to include OCT in selected high-risk cases (e.g., diabetics and intraoperative complications), but in uncomplicated cases, visual acuity remains a more immediate and practical indicator of recovery. Clinicians should also recognize that functional visual improvement can precede complete anatomical resolution, and short-term macular thickening may be a normal, self-limiting physiological response. The absence of a strong correlation between MT and VA could be due to pre-existing ocular factors such as lens opacity severity, undiagnosed retinal pathology, or early diabetic changes, which may not have been apparent preoperatively. Stratification of patients based on comorbid conditions could yield more detailed insights.[70]

Despite the anatomical changes, the consistent improvement in best corrected visual acuity postoperatively suggests that mild to moderate increases in MT may not adversely impact functional visual outcomes in the short term. This has important clinical implications, particularly in resource-limited settings where access to OCT may be restricted.

LIMITATIONS:

- In our study, patients were followed up only until four weeks after the SICS procedure. However, long-term follow-up and an analysis of changes in macular thickness beyond this period were not conducted.

- This study focused on the correlation between macular thickness and visual acuity following SICS. As a result, the generalizability of the findings regarding changes in visual acuity and macular thickness to other types of ophthalmic surgeries is limited.

- Patients with immature cataracts aged 18 years and older were included in the study, so the findings may not be applicable to individuals with mature cataracts.

CONCLUSION

CONCLUSION

In the early postoperative period, the changes in macular thickness and total macular volume are likely due to subclinical inflammation affecting the macular structure. However, these alterations did not have a significant impact on the quality postoperative vision suggesting that short-term anatomical changes may not predict visual outcomes. These findings support the use of OCT in high-risk or symptomatic patients but suggest that routine postoperative OCT may not be necessary in uncomplicated cases. Further, longitudinal studies with extended follow-up and advanced imaging modalities are warranted to understand better the dynamics between structural and functional recovery post-cataract surgery.

SUMMARY

SUMMARY

- Cataract is the opacification of the lens and its capsule, typically caused by the accumulation or improper folding of crystalline proteins.
- A prospective hospital-based study was conducted to measure macular thickness and evaluate its correlation with visual acuity following small incision cataract surgery with posterior chamber intraocular lens implantation, using optical coherence tomography (OCT).
- The study was carried out at a tertiary eye care institute in South India, involving 100 patients over the age of 18 with immature cataracts who underwent uneventful manual small incision cataract surgery (SICS).
- The patients had a mean age of 63.09 years and were almost evenly divided by gender, with 51% females and 49% males.
- The mean preoperative visual acuity (VA) was 1.34 logMAR. After one week, 70% of patients had visual acuity of 6/9 (logMAR: 0.2) or better, which improved to 96% by the 4^{th} week irrespective of changes in the macular thickness.
- Preoperative macular thickness (MT) averaged 205.14 μm. Postoperatively, macular thickness was 254.28 μm after one week and by 4^{th} week postoperatively macular thickness decreased to 224.53 μm.
- Total macular volume (TMV) had a mean of 8.43 cubic centimeters (cucm). Postoperatively, macular volume was 9.3 cm^3 after one week and by 4^{th} week postoperatively macular volume decreased to 8.94 cm^3
- No significant correlation was found between VA and macular thickness and macular volume at post-op day 7.

- No significant correlation was found between VA and macular thickness, volume in post-op at 28 days.
- In the early postoperative period, the changes in macular thickness and total macular volume are likely due to subclinical inflammation affecting the macular structure.
- However, these alterations did not have a significant impact on the quality postoperative vision suggesting that short-term anatomical changes may not predict visual outcomes.
- These findings support the use of OCT in high-risk or symptomatic patients but suggest that routine postoperative OCT may not be necessary in uncomplicated cases.

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ANNEXURE

ANNEXURE-1

CASE PROFORMA	
Name:	Case No:
Age:	Date:
Sex:	OP No:
Occupation:	DOE:
Address:	

Chief complaints:

H/O presenting illness:

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:

a. Pulse – c) RR –

b. BP – d) Temp –

Systemic examination:

a. CVS – c. RS –

b. PA – d. CNS –

OCULAR EXAMINATION						
TESTS	**RE**			**LE**		
1. HEAD POSTURE 2. OCULAR POSTURE 3. FACIAL SYMMETRY						
EXTRAOCULAR MOVEMENTS a) Ductions b) Versions						
1. VISUAL ACUITY: a) Distant b) Near						
1. ANTERIOR SEGMENT						
2. FUNDUS • Fundus examination by + 90D lens assisted slit lamp biomicroscopy • Indirect ophthalmoscopy						
	Pre-Operative	Post-Operative		Pre-Operative	Post-Operative	
OCT • CSMT • TMV		1 week	4 weeks		1 week	4 weeks
Post- Operative Visual acuity						

ANNEXURE-II

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR - 563101.

INFORMED CONSENT FORM

Case no:

IP no:

TITLE: A PROSPECTIVE STUDY OF CHANGES IN MACULAR THICKNESS FOLLOWING CATARACT SURGERY AND ITS CORRELATION WITH POST-OPERATIVE VISUAL ACUITY

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

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 understand that the data collected can be used for scientific publications and presentations.

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 the participation from this study at any time and this will not change the future care.

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

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

ಶ್ರೀದೇವರಾಜ್ಅರಸ್ಮೆಡಿಕಲ್ಕಾಲೇಜು, ಟಮಕ, ಕೋಲಾರ

ತಿಳಿವಳಿಕೆಯಸಮ್ಮತಿನಮೂನೆ

ಕೇಸ್ಸಂಖ್ಯೆ:

ಐಪಿಸಂಖ್ಯೆ:

ಶೀರ್ಷಿಕೆ: ಕಣ್ಣಿನ ಪೊರೆ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ಮೊದಲು ಮತ್ತು ನಂತರದ ಮ್ಯಾಕ್ಯುಲ ದಪ್ಪದಲ್ಲಿನ ಬದಲಾವಣೆಗಳು ಮತ್ತು ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ನಂತರದ ದೃಷ್ಟಿತೀಕ್ಷ್ಣತೆಯೊಂದಿಗಿನ ಪರಸ್ಪರ ಸಂಬಂಧದ ಪ್ರಾಸ್ಪೆಕ್ಟಿವ್ ಅಧ್ಯಯನ

ನಾನು, ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಮತ್ತು ಈ ಸಮ್ಮತಿಯ ರೂಪದಲ್ಲಿ ವಿವರಿಸಿರುವಂತೆ ವೈಯಕ್ತಿಕ ಮಾಹಿತಿಯ ಸಂಗ್ರಹ ಮತ್ತು ಬಹಿರಂಗ ಪಡಿಸುವಿಕೆಯನ್ನು ಅನುಮೋದಿಸಲು ಒಪ್ಪುತ್ತೇನೆ.

ಈ ಅಧ್ಯಯನದ ಉದ್ದೇಶ, ತಂತ್ರದ ಅಪಾಯಗಳು ಮತ್ತು ಪ್ರಯೋಜನಗಳನ್ನು ಮತ್ತು ಅಧ್ಯಯನದಸಮಯದಲ್ಲಿ ಸಂಗ್ರಹಿಸಲ್ಪಟ್ಟಿರುವ ಮತ್ತು ಬಹಿರಂಗಪಡಿಸುವ ಮಾಹಿತಿಯ ಗೌಪ್ಯತೆ ನಾನು ಅರ್ಥ ಮಾಡಿಕೊಂಡಿದ್ದೇನೆ. ಸಂಗ್ರಹಿಸಿದ ಮಾಹಿತಿಯನ್ನು ಸಂಶೋಧನೆಗೆ ಮಾತ್ರ ಬಳಸಲಾಗುತ್ತದೆ. ಈ ಸಂಶೋಧನೆಯಿಂದ ಹೊರಬರುವ ಮಾಹಿತಿಯನ್ನು ವೈದ್ಯರು ಯಾವುದೇ ಜರ್ನಲ್ನಲ್ಲಿ ಅಥವಾ ಕಾನ್ಫೆರೆನ್ಸ್ನಲ್ಲಿ ಪ್ರಕಟಿಸಲು ಅನುಮತಿ ಸೂಚಿಸಿರುತ್ತೇನೆ.

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

ಈ ಅಧ್ಯಯನದಿಂದ ಭಾಗವಹಿಸುವಿಕೆಯನ್ನು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ನಾನು ಹಿಂಪಡೆಯಲು ಮುಕ್ತವಾಗಿರುತ್ತೇನೆ ಮತ್ತು ಇದು ಭವಿಷ್ಯದ ಕಾಳಜಿಯನ್ನು ಬದಲಿಸುವುದಿಲ್ಲ ಎಂದು ನಾನುಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ.

ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವಿಕೆ ನನಗೆ ಯಾವುದೇ ಹೆಚ್ಚುವರಿ ವೆಚ್ಚ ಒಳಗೊಳ್ಳುವುದಿಲ್ಲ.

ಹೆಸರು	ಸಹಿ/ಹೆಬ್ಬೆಟ್ಟಿನಗುರುತು	ದಿನಾಂಕ	ಸಮಯ
ರೋಗಿಯಹೆಸರು			
ಸಾಕ್ಷಿಗಳ ಹೆಸರು			

ANNEXURE-III

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH,

TAMAKA, KOLAR - 563101.

PATIENT INFORMATION SHEET

This information is to help you understand the purpose of the study "**A PROSPECTIVE STUDY OF CHANGES IN MACULAR THICKNESS FOLLOWING CATARACT SURGERY AND ITS CORRELATION WITH POST-OPERATIVE VISUAL ACUITY**". You are invited 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.

Cataract is clouding of natural lens which causes gradual loss of vision. The purpose of this study is to changes of macular thickness before and after cataract surgery. The macular thickness will be analyzed on Optical Coherence Tomography before surgery and post-operative period of 1 week and 4 weeks.

Tropicamide eye drops are instilled in both eyes after slit-lamp examination. Macular thickness will be measured with OCT. If you are willing to take part in this study, you need to give clinical information and following procedures will be carried out:

1. Visual acuity by Snellens chart for distant vision.
2. Near vision – Jaeger chart.
3. Slit lamp biomicroscopy.
4. Fundus examination by 90D slit lamp biomicroscopy and indirect ophthalmoscopy, including optic disc evaluation.
5. Macular thickness on OCT.

You will not be charged for any of the tests. I the investigator will be bearing any additional charges. All the tests are routine tests and absolutely no risks are associated with various investigations.

If during the procedure, any unexpected event occurs like redness of eyes, itching, blurring, Doctor will take care of it.

If you participate in the study, the generated data might be helpful for further treatment protocol or to avoid complications. The collected data will be used for presentation in medical conferences and identity will not be revealed. Your medical information will be kept confidential by the study doctor and will not be made publicly available. Your original records may be reviewed by your doctor or ethics review board.

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.

Extra monetary benefits or money will not be paid for taking part in the study.

For further information/ clarification please contact DR. RAMACHANDRA HIMATEJA CH (PH NO: 9945615115) POST-GRADUATE, DEPT OF OPHTHALMOLOGY, SDUAHER, TAMAKA, KOLAR - 563101.

ಶ್ರೀ ದೇವರಾಜ್ ಅರಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಸಂಸ್ಥೆ,

ಟಮಕ, ಕೋಲಾರ - 563101.

ರೋಗಿಯ ಮಾಹಿತಿ ಪತ್ರ

ಈ ಮಾಹಿತಿಯು " ಕಣ್ಣಿನ ಪೊರೆ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ಮೊದಲು ಮತ್ತು ನಂತರದ ಮ್ಯಾಕ್ಯುಲ ದಪ್ಪದಲ್ಲಿನ ಬದಲಾವಣೆಗಳು ಮತ್ತು ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ನಂತರದ ದೃಷ್ಟಿತೀಕ್ಷ್ಣತೆಯೊಂದಿಗಿನ ಪರಸ್ಪರ ಸಂಬಂಧದ ಪ್ರಾಸ್ಪೆಕ್ಟಿವ್ ಅಧ್ಯಯನ" ಈ ಅಧ್ಯಯನದ ಉದ್ದೇಶವನ್ನು ಅರ್ಥ ಮಾಡಿಕೊಳ್ಳಲು ಸಹಾಯ ಮಾಡುವುದು. ಈ ಸಂಶೋಧನಾ ಅಧ್ಯಯನದಲ್ಲಿ ಸ್ವಯಂಪ್ರೇರಿತವಾಗಿ ಪಾಲ್ಗೊಳ್ಳಲು ನಿಮ್ಮನ್ನು ಆಹ್ವಾನಿಸಲಾಗಿದೆ, ಅಧ್ಯಯನದ ಉದ್ದೇಶ, ಕಾರ್ಯವಿಧಾನ, ಪ್ರಯೋಜನಗಳು ಮತ್ತು ಅಸ್ವಸ್ಥತೆಗಳನ್ನು ನೀವು ಓದುವುದು ಮತ್ತು ಅರ್ಥ ಮಾಡಿಕೊಳ್ಳುವುದು ಮುಖ್ಯವಾಗಿದೆ.

ಪೊರೆಯು ನೈಸರ್ಗಿಕ ಲೆನ್ಸ್ಮೋಡವಾಗಿದ್ದು, ಅದು ಕ್ರಮೇಣ ದೃಷ್ಟಿ ಕಡಿಮೆ ಆಗಲು

ಕಾರಣಆಗುತ್ತದೆ. ಈ ಅಧ್ಯಯನದ ಉದ್ದೇಶವು ಕಣ್ಣಿನ ಪೊರೆಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ಮೊದಲು ಮತ್ತು ನಂತರ ಮ್ಯಾಕ್ಯುಲರ್ದಪ್ಪದಲ್ಲಿನ ಬದಲಾವಣೆಯ ಅಧ್ಯಯನ. ಮ್ಯಾಕ್ಯುಲರ್ದಪ್ಪವನ್ನು ಆಪ್ಟಿಕಲ್ಕೊಹೆರೆನ್ಸ್ಟೊಮೊಗ್ರಫಿಯಲ್ಲಿ ವಿಶ್ಲೇಷಿಸಲಾಗುತ್ತದೆ.

ನೀವು ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಸಿದ್ಧರಿದ್ದರೆ, ನೀವು ಕ್ಲಿನಿಕಲ್ ಮಾಹಿತಿಯನ್ನು ನೀಡಬೇಕಾಗುತ್ತದೆ ಮತ್ತು ಕೆಳಗಿನ ಕಾರ್ಯವಿಧಾನಗಳನ್ನು ಕೈಗೊಳ್ಳಲಾಗುತ್ತದೆ.

- ದೂರದ ದೃಷ್ಟಿಗಾಗಿ ಸ್ನೆಲೆನ್ಸ್ ಚಾರ್ಟ್ನಿಂದ ದೃಷ್ಟಿ ತೀಕ್ಷ್ಣತೆ (ಲಾಗ್ಮಾರ್ಗೆ ಪರಿವರ್ತಿಸಲಾಗಿದೆ)
- ಸಮೀಪ ದೃಷ್ಟಿ - ಜೇಗರ್ ಚಾರ್ಟ್.
- ಸ್ಲಿಟ್ ಲ್ಯಾಂಪ್ ಬಯೋಮೈಕ್ರೋಸ್ಕೋಪಿ.
- ಆಪ್ಟಿಕ್ ಡಿಸ್ಕ್ ಮೌಲ್ಯಮಾಪನ ಸೇರಿದಂತೆ 90D ಸ್ಲಿಟ್ ಲ್ಯಾಂಪ್ ಬಯೋಮೈಕ್ರೋಸ್ಕೋಪಿ ಮತ್ತು ಇಂಡೈರೆಕ್ಟ್ ಓಫ್ಥಲ್ಮೋಸ್ಕೋಪಿ ಫಂಡಸ್ ಪರೀಕ್ಷೆ.
- OCT ನಲ್ಲಿ ಮ್ಯಾಕ್ಯುಲರ್ ದಪ್ಪ

ಸ್ಲಿಟ್ ಲ್ಯಾಂಪ್ ಪರೀಕ್ಷೆಯ ನಂತರ ಟ್ರೋಪಿಕಮೈಡ್ ಕಣ್ಣಿನ ಹನಿಗಳನ್ನು ಎರಡೂ ಕಣ್ಣುಗಳಲ್ಲಿ ತುಂಬಿಸಲಾಗುತ್ತದೆ. ಫಂಡಸ್ಕೋಪಿ ಪರೀಕ್ಷೆ ಮತ್ತು ಮ್ಯಾಕ್ಯುಲರ್ ದಪ್ಪವನ್ನು OCT ಯೊಂದಿಗೆ ಅಳೆಯಲಾಗುತ್ತದೆ. ಮಾಕ್ಯುಲ ಓ ಸಿ ಟಿ ಪರೀಕ್ಷೆಗಳನ್ನು ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಗೆ ಮುನ್ನ ಮತ್ತು ಶಸ್ತ್ರಚಿಕಿತ್ಸೆಯ ನಂತರ 1 ವಾರ ಮತ್ತು 4 ವಾರಗಳಲ್ಲಿ ನಡೆಸುತ್ತೇವೆ. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನಡೆಸಲಾಗುವ ವಿವಿಧ ಪರೀಕ್ಷೆಗಳಿಂದ ನಿಮಗೆ ಯಾವುದೇ ಅಪಾಯಗಳಿರುವುದಿಲ್ಲ.

ಸಂಶೋಧನಾ ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ನಡೆಸಿದ ಯಾವುದೇ ಪ್ರಕ್ರಿಯೆಗಳಿಗೆ ನಿಮಗೆ ಹೆಚ್ಚುವರಿ ಶುಲ್ಕ ವಿಧಿಸಲಾಗುವುದಿಲ್ಲ. ನಾನು ತನಿಖಾಧಿಕಾರಿ ಯಾವುದೇ ಹೆಚ್ಚುವರಿ ವೆಚ್ಚವನ್ನು ಭರಿಸುತ್ತೇನೆ.

ಕಾರ್ಯವಿಧಾನದ ಸಮಯದಲ್ಲಿ, ಕಣ್ಣುಗಳು ಕೆಂಪಾಗುವುದು, ತುರಿಕೆ, ಮಸುಕು ಮುಂತಾದ ಯಾವುದೇ ಅನಿರೀಕ್ಷಿತ ಘಟನೆ ಸಂಭವಿಸಿದಲ್ಲಿ, ವೈದ್ಯರು ಅದನ್ನು ನೋಡಿಕೊಳ್ಳುತ್ತಾರೆ.

ನೀವು ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಿದರೆ, ರಚಿತವಾದ ಡೇಟಾವು ಹೆಚ್ಚಿನ ಚಿಕಿತ್ಸಾ ಪ್ರೋಟೋಕಾಲ್‌ಗೆ ಅಥವಾ ತೊಡಕುಗಳನ್ನು ತಪ್ಪಿಸಲು ಸಹಾಯಕವಾಗಬಹುದು. ಸಂಗ್ರಹಿಸಿದ ಡೇಟಾವನ್ನು ವೈದ್ಯಕೀಯ ಸಮ್ಮೇಳನಗಳಲ್ಲಿ ಪ್ರಸ್ತುತಿಗಾಗಿ ಬಳಸಲಾಗುತ್ತದೆ ಮತ್ತು ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮ ವೈದ್ಯಕೀಯ ಮಾಹಿತಿಯನ್ನು ಅಧ್ಯಯನ ವೈದ್ಯರು ಗೌಪ್ಯವಾಗಿಡುತ್ತಾರೆ ಮತ್ತು ಸಾರ್ವಜನಿಕವಾಗಿ ಲಭ್ಯವಾಗುವಂತೆ ಮಾಡಲಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮ ಮೂಲ ದಾಖಲೆಗಳನ್ನು ನಿಮ್ಮ ವೈದ್ಯರು ಅಥವಾ ಎಥಿಕ್ಸ್ ರಿವ್ಯೂ ಬೋರ್ಡ್ ಪರಿಶೀಲಿಸಬಹುದು.

ನೀವು ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ನಿರಾಕರಿಸಬಹುದು ಅಥವಾ ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವ ಮೊದಲು ನೀವು ಅರ್ಹರಾಗಿದ್ದ ಯಾವುದೇ ಪ್ರಯೋಜನಗಳ ದಂಡ ಅಥವಾ ನಷ್ಟವಿಲ್ಲದೆಯೇ ನೀವು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವುದನ್ನು ನಿಲ್ಲಿಸಬಹುದು.

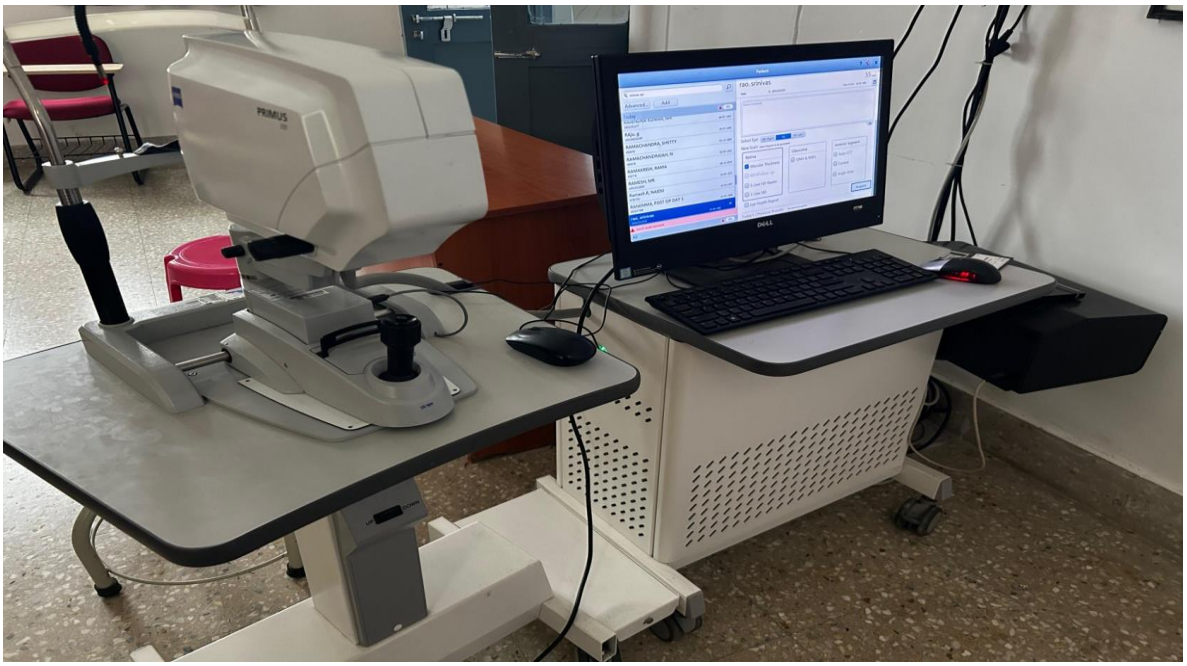
ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಿದ್ದಕ್ಕಾಗಿ ಹೆಚ್ಚುವರಿ ವಿತ್ತೀಯ ಪ್ರಯೋಜನಗಳು ಅಥವಾ ಹಣವನ್ನು ಪಾವತಿಸಲಾಗುವುದಿಲ್ಲ.

ಡಾ. ರಾಮಚಂದ್ರ ಹಿಮತೇಜ ಪೋಸ್ಟ್‌ಡಾಜುಯೇಟ್, ನೇತ್ರಶಾಸ್ತ್ರ ವಿಭಾಗ ಎಸ್. ಡಿ. ಯು. ಎಂ. ಸಿ. ಟಮಕ, ಕೋಲಾರ

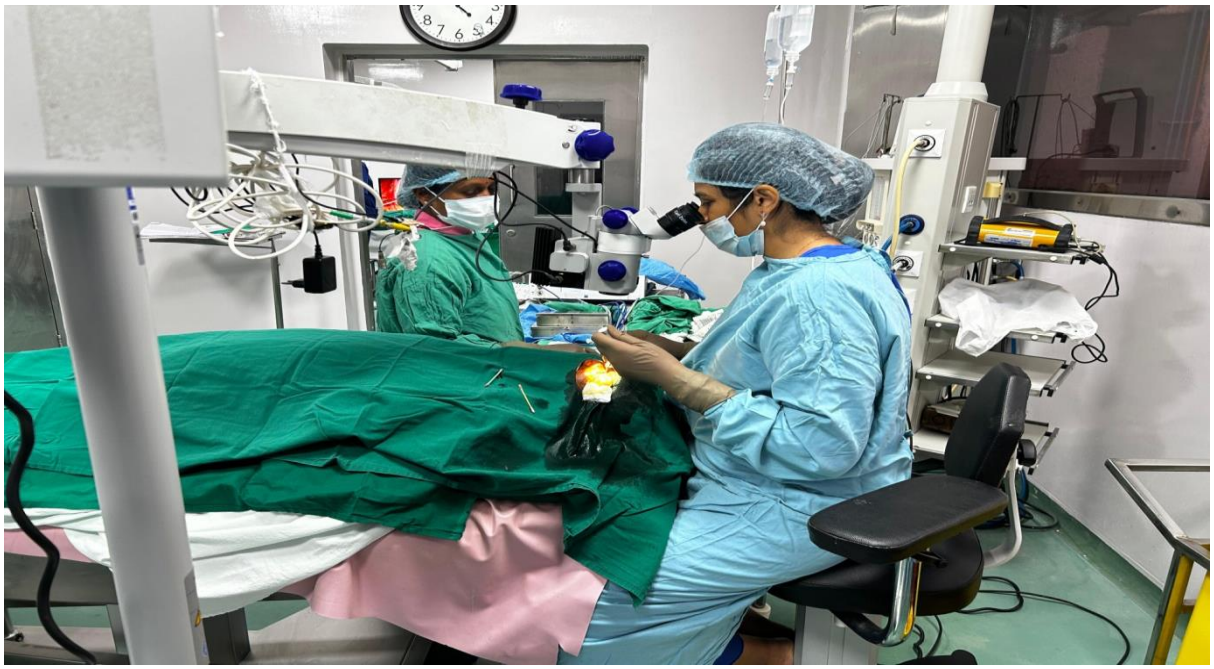
ಸಂಪರ್ಕ ಸಂಖ್ಯೆ: 9945615115

ANNEXURE-IV

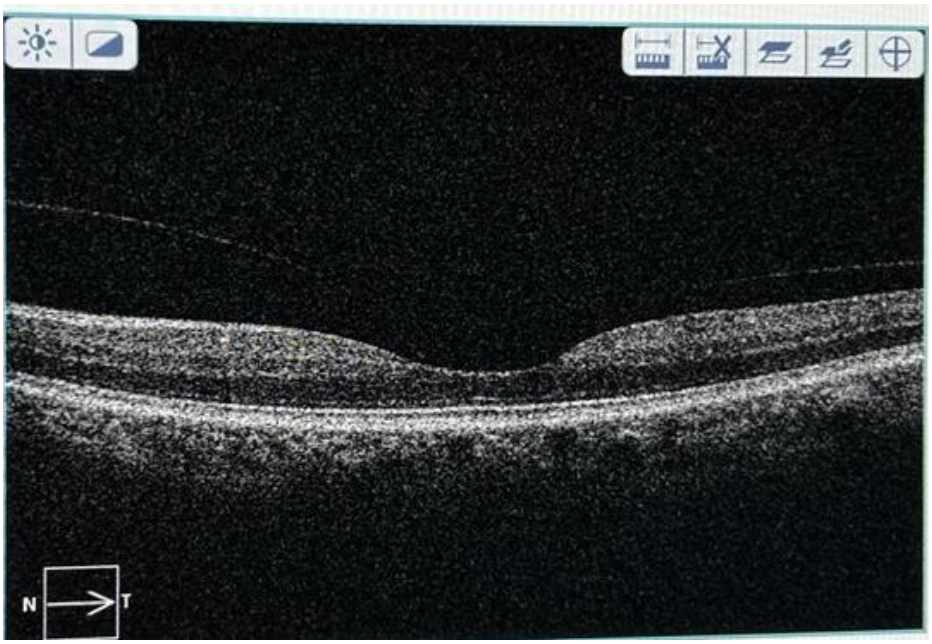
PHOTOGRAPH1: THE PRIMUS 200 OCT MACHINE



PHOTOGRAPH 2: A TRAINED SURGEON PERFORMING SICS



PHOTOGRAPH 3: POST-OP OCT OF A PATIENT



PHOTOGRAPH 4 : SLIT LAMP BIOMICROSCOPY

PHOTOGRAPH 5 : OPTICAL COHERENCE TOMOGRAPHY

MASTER CHART

S.NO	UHID	AGE (YEARS)	SEX	PRE-OP VA	PRE-OP VA LogMAR	PRE-OP MT (µm)	PRE-OP TMV (cucm)	POD 7 VA	POD 7 VA LogMAR	POD 7 MT (µm)	POD 7 TMV (cucm)	POD 28 VA	POD 28 VA LogMAR	POD 28 MT (µm)	POD 28 TMV (cucm
1	308514	50	F	CF 2 MTS (RE)	1.5	246	9.8	6/36 (RE)	0.8	251	9.7	6/9 (RE)	0.2	208	10.2
2	308506	64	M	6/36 (LE)	0.8	236	9.2	6/6 (LE)	0	273	9.4	6/6 (LE)	0	234	9.9
3	308509	70	M	CF 1 MTS (LE)	1.8	225	8.1	6/60 (LE)	1	239	7.9	6/12 (LE)	0.3	219	8.8
4	316472	60	F	CF 1 MTS (LE)	1.8	220	9.8	6/6 (LE)	0	257	10.2	6/6 (LE)	0	228	10.7
5	326664	64	F	CF 3 MTS (RE)	1.3	227	9.3	6/9 (RE)	0.2	214	9.3	6/6 (RE)	0	198	9.1
6	229817	60	F	CF 1 MTS (RE)	1.8	231	9.3	6/9 (RE)	0.2	233	9.1	6/9 (RE)	0.2	254	9.1
7	328930	65	M	6/60 (RE)	1	215	9.1	6/9 (RE)	0.2	246	9.9	6/6 (P) (RE)	0	223	9.5
8	309240	55	F	CF 4 MTS (LE)	1.2	242	9.8	6/9 (LE)	0.2	212	9.8	6/6 (P) (LE)	0	250	9.9
9	426481	60	F	CF 3 MTS (LE)	1.3	247	9	6/18 (LE)	0.5	275	9.8	6/9 (LE)	0.2	238	8.9
10	271223	60	F	CF 1 MT (LE)	1.8	164	7.2	6/60 (LE)	1	220	9.4	6/12 (P) (LE)	0.3	259	9.8
11	328949	71	M	CF 5 MTS (RE)	1.1	201	7.2	6/6 (RE)	0	266	10	6/6 (RE)	0	187	9.7
12	334832	66	M	CF 4 MTS (LE)	1.2	195	11	6/6 (P) (LE)	0	236	11	6/6 (LE)	0	205	10.3
13	334857	54	F	CF 5 MTS (RE)	1.1	256	9.1	6/6 (P) (RE)	0	252	9.5	6/6 (RE)	0	252	9.3
14	337774	62	F	CF 4 MTS (LE)	1.2	231	8.6	6/6 (P) (LE)	0	224	8.4	6/6 (LE)	0	227	8.5
15	337773	80	F	CF 3 MTS (LE)	1.3	243	8.6	6/18 (LE)	0.5	275	7.1	6/9 (P) (LE)	0.2	237	8.5
16	337782	45	F	CF 3 MTS (LE)	1.3	239	8	6/6 (LE)	0	218	9.5	6/6 (LE)	0	228	9
17	342202	50	M	CF 1 MTS (RE)	1.8	209	8.5	6/6 (P) (RE)	0	291	8.6	6/6 (RE)	0	204	8.8
18	342211	75	M	CF 2 MTS (LE)	1.5	271	9.5	6/6 (P) (LE)	0	254	10	6/6 (LE)	0	274	10.3
19	317714	53	M	CF 1/2 MTS (RE)	1.9	159	8.7	6/9 (RE)	0.2	198	8.9	6/9 (RE)	0.2	189	9
20	341011	38	F	CF 1/2 MTS (LE)	1.9	238	9.1	6/6 (LE)	0	223	9.4	6/6 (LE)	0	236	9.2
21	345073	51	F	6/36 (RE)	0.8	259	10.4	6/9 (RE)	0.2	251	8.2	6/6 (P) (RE)	0	257	8.9
22	345345	55	F	CF 2 MTS (RE)	1.5	256	9.6	6/6 (P) (RE)	0	252	11.4	6/6 (RE)	0	257	10.5
23	341233	74	F	CF 1 MTS (RE)	1.8	226	8.9	6/6 (P) (RE)	0	216	9.7	6/6 (P) (RE)	0	223	9.8
24	321224	60	F	CF 5 MTS (LE)	1.1	177	6.6	6/12 (RE)	0.3	200	8.1	6/6 (P) (RE)	0	175	8.3
25	451244	66	F	CF 3 MTS (RE)	1.3	255	8.3	6/9 (RE)	0.2	276	9.4	6/6 (RE)	0	257	9.1
26	348991	51	F	CF 2 MTS (LE)	1.5	238	9.5	6/6 (LE)	0	259	9.7	6/6 (LE)	0	241	9.5
27	451796	56	F	6/18 (RE)	0.5	269	9.5	6/6 (RE)	0	253	9.8	6/6 (RE)	0	269	10.5
28	345027	68	F	CF 3 MTS (LE)	1.3	184	7.6	6/9 (LE)	0.2	239	9	6/9 (LE)	0.2	194	8.7
29	498722	72	M	CF 1 MT (LE)	1.8	172	7.8	6/9 (P) (LE)	0.2	205	8.7	6/6 (LE)	0	174	8.1
30	398617	70	F	CF 3 MTS (RE)	1.3	286	8.8	6/12 (RE)	0.3	289	9	6/9 (RE)	0.2	287	9.1

S.NO	UHID	AGE (YEARS)	SEX	PRE-OP VA	PRE-OP VA LogMAR	PRE-OP MT (µm)	PRE-OP TMV (cucm)	POD 7 VA	POD 7 VA LogMAR	POD 7 MT (µm)	POD 7 TMV (cucm)	POD 28 VA	POD 28 VA LogMAR	POD 28 MT (µm)	POD 28 TMV (cucm
31	471320	55	F	CF 3 MTS (RE)	1.3	248	9.3	6/6 (RE)	0	267	9.7	6/6 (RE)	0	255	9.6
32	375613	65	F	CF 2 MTS (RE)	1.5	253	9.1	6/36 (RE)	0.8	279	9.8	6/9 (P) (RE)	0.2	253	9.3
33	375598	75	M	CF 2 MTS (RE)	1.5	195	9.2	6/9 (P) (RE)	0.2	223	8.6	6/6 (RE)	0	204	8.7
34	317715	65	F	CF 2 MTS (RE)	1.5	162	7.8	6/12 (RE)	0.3	251	8.9	6/6 (RE)	0	225	9.1
35	458271	65	M	CF 5 MTS (RE)	1.1	136	8.2	6/18 (RE)	0.5	248	8.2	6/9 (P) (RE)	0.2	193	7.8
36	365433	60	M	CF 1 MT (LE)	1.8	130	6.8	6/6 (P) (LE)	0	201	9	6/6 (LE)	0	178	8.9
37	463561	62	M	6/60 (RE)	1	148	8.7	6/12 (RE)	0.3	215	8.8	6/9 (RE)	0.2	203	9.5
38	507411	65	F	CF 1 MT (LE)	1.8	244	9.7	6/9 (LE)	0.2	236	9.3	6/9 (LE)	0.2	199	9.7
39	471598	50	M	6/60 (RE)	1	147	10.4	6/36 (RE)	0.8	202	9.1	6/6 (P) (RE)	0	196	8.4
40	471521	54	M	CF 1 MTS (LE)	1.8	280	8.6	6/9 (P) (LE)	0.2	261	8.6	6/9 (LE)	0.2	272	7.9
41	309509	70	M	CF 1 MTS (RE)	1.8	133	9.1	6/6 (RE)	0	289	9	6/6 (RE)	0	179	8.5
42	320065	65	F	CF CF (RE)	0.01	198	8.5	6/18 (RE)	0.5	232	8.9	6/6 (P) (RE)	0	193	8.9
43	509980	65	F	CF 2 MTS (RE)	1.5	185	8.7	6/18 (RE)	0.5	260	8.5	6/6 (RE)	0	153	9
44	510001	65	F	6/24 (P) (RE)	0.6	176	8.4	6/12 (RE)	0.3	204	9.2	6/9 (RE)	0.2	171	9.2
45	321224	65	F	CF 2 MTS (RE)	1.5	183	8.3	6/18 (RE)	0.5	227	9.4	6/6 (P) (LE)	0	200	8.1
46	510003	65	F	6/18 (RE)	0.5	194	9.4	6/9 (RE)	0.2	247	9.1	6/6 (RE)	0	209	8.5
47	536169	65	M	CF 1 MT (RE)	1.8	133	9.1	6/12 (RE)	0.3	229	9.7	6/9 (RE)	0.2	205	8.9
48	350349	57	M	CF 2 MTS (LE)	1.5	218	9.1	6/9 (LE)	0.2	278	9.9	6/6 (LE)	0	240	9.4
49	518243	65	M	CF 1 MTS (LE)	1.8	179	8.1	6/6 (LE)	0	256	9.6	6/6 (LE)	0	230	8.6
50	458282	65	F	CF 1 MTS (RE)	1.8	247	9.3	6/6 (RE)	0	299	9.4	6/6 (RE)	0	222	9.2
51	554602	65	M	6/60 (RE)	1	159	8.6	6/6 (RE)	0	220	10.2	6/6 (RE)	0	250	9.8
52	116597	65	M	CF 3 MTS (RE)	1.3	225	8.1	6/6 (RE)	0	300	8.9	6/6 (RE)	0	252	8.6
53	566902	65	F	CF 3 MTS (RE)	1.3	183	9	6/9 (RE)	0.2	264	9.8	6/6 (RE)	0	236	9.2
54	521517	65	M	CF 2 MTS (RE)	1.5	235	8.1	6/18 (RE)	0.5	291	8.4	6/9 (RE)	0.2	257	8.2
55	520024	77	F	CF 2 MTS (RE)	1.5	189	8.1	6/6 (RE)	0	245	8.5	6/6 (RE)	0	206	8.2
56	528538	72	M	CF 2 MTS (RE)	1.5	223	7.5	6/9 (RE)	0.2	313	8.3	6/9 (RE)	0.2	266	8
57	508828	61	M	CF 5 MTS (LE)	1.1	198	7.6	6/24 (LE)	0.6	267	8.7	6/9 (LE)	0.2	207	8.6
58	508828	61	M	CF 3 MTS (RE)	1.3	192	7.5	6/6 (RE)	0	294	8.3	6/6 (RE)	0	251	7.5
59	600884	65	F	6/36 (LE)	0.8	162	7.2	6/6 (LE)	0	232	8.1	6/6 (LE)	0	224	7.9
60	319406	65	M	CF 1 MT (RE)	1.8	163	8	6/12 (RE)	0.3	255	9	6/6 (RE)	0	244	8.4

S.NO	UHID	AGE (YEARS)	SEX	PRE-OP VA	PRE-OP VA LogMAR	PRE-OP MT (µm)	PRE-OP TMV (cucm)	POD 7 VA	POD 7 VA LogMAR	POD 7 MT (µm)	POD 7 TMV (cucm)	POD 28 VA	POD 28 VA LogMAR	POD 28 MT (µm)	POD 28 TMV (cucm
61	520035	52	M	CF 4 MTS (LE)	1.2	162	7.8	6/9 (LE)	0.2	259	8.8	6/9 (LE)	0.2	229	8.1
62	594520	75	M	CF 2 MTS (RE)	1.5	195	7.3	6/18 (RE)	0.5	281	7.5	6/9 (RE)	0.2	207	7.3
63	508822	55	M	6/24 (RE)	0.6	189	8.2	6/6 (RE)	0	259	9.7	6/6 (RE)	0	238	8.7
64	595993	65	F	CF 1 MT (RE)	1.8	180	7.1	6/6 (RE)	0	247	8.3	6/6 (RE)	0	211	7.7
65	313625	71	F	CF 1 MT (LE)	1.8	180	7.5	6/9 (LE)	0.2	263	9.4	6/6 (LE)	0	222	8.6
66	313625	71	F	6/60 (RE)	1	178	7.6	6/6 (RE)	0	245	8.5	6/6 (RE)	0	218	7.6
67	525066	63	F	CF 1 MT (RE)	1.8	171	7.3	6/36 (RE)	0.8	274	8.4	6/6 (RE)	0	208	8.8
68	578151	50	F	CF 3 MTS (LE)	1.3	176	7.8	6/9 (LE)	0.2	271	8.9	6/6 (LE)	0	192	8.2
69	302522	50	F	CF 2 MTS (LE)	1.5	223	8	6/6 (LE)	0	239	9	6/6 (LE)	0	189	8.7
70	595946	53	F	6/60 (LE)	1	176	7.3	6/9 (LE)	0.2	272	9.3	6/6 (LE)	0	218	8.7
71	345020	44	F	CF 1 MT (LE)	1.8	179	7.5	6/6 (LE)	0	281	7.9	6/6 (LE)	0	248	7.7
72	589076	65	M	6/36 (RE)	0.8	193	7.6	6/6 (RE)	0	288	8.9	6/6 (RE)	0	232	8.3
73	514562	82	M	CF 5 MTS (RE)	1.1	177	7.8	6/12 (RE)	0.3	254	8.5	6/9 (RE)	0.2	205	8
74	548115	58	F	CF 3 MT (RE)	1.3	197	7.7	6/6 (RE)	0	253	8.6	6/6 (RE)	0	223	8.1
75	548115	58	F	CF CF (LE)	0.01	193	8	6/9 (LE)	0.2	266	8.8	6/9 (LE)	0.2	207	8.5
76	525993	65	M	CF 1 MT (LE)	1.8	199	7.9	6/18 (LE)	0.5	289	8.4	6/9 (LE)	0.2	243	8
77	514073	64	M	6/24 (LE)	0.6	210	7.8	6/6 (LE)	0	284	8.5	6/6 (LE)	0	246	8.2
78	589397	65	F	CF 1 MT (LE)	1.8	182	7.3	6/6 (LE)	0	254	8	6/6 (LE)	0	226	7.7
79	248255	70	M	CF 1 MT (RE)	1.8	174	8	6/6 (RE)	0	238	8.4	6/6 (RE)	0	211	8.3
80	553292	69	M	CF 3 MTS (RE)	1.3	214	7.6	6/24 (RE)	0.6	250	9.9	6/9 (RE)	0.2	224	8.6
81	553295	70	M	CF 3 MTS (RE)	1.3	224	7.1	6/6 (RE)	0	252	10.1	6/6 (RE)	0	224	8.4
82	553294	80	M	CF 1 MT (RE)	1.8	192	8.4	6/9 (RE)	0.2	286	9.4	6/6 (RE)	0	252	8.7
83	491090	70	F	6/60 (LE)	1	156	8.8	6/6 (LE)	0	250	10	6/6 (LE)	0	244	9.3
84	553299	63	F	CF 2 MTS (LE)	1.5	265	8.9	6/6 (LE)	0	274	10.2	6/6 (LE)	0	268	9.9
85	549164	61	M	6/24 (RE)	0.6	204	8.8	6/6 (RE)	0	240	10	6/6 (RE)	0	231	9.3
86	548635	64	M	CF 2 MTS (RE)	1.5	224	8.7	6/9 (RE)	0.2	262	9.8	6/6 (RE)	0	192	9.4
87	545217	68	F	6/18 (LE)	0.5	196	11	6/18 (LE)	0.5	237	14.1	6/6 (LE)	0	201	10.6
88	541774	76	M	6/24 (LE)	0.6	179	8.4	6/12 (LE)	0.3	274	9.6	6/9 (LE)	0.2	228	9
89	542106	54	M	CF 1 MT (RE)	1.8	184	7.4	6/6 (RE)	0	232	10	6/6 (RE)	0	192	8.7
90	541830	41	M	6/12 (LE)	0.3	192	7.7	6/6 (LE)	0	222	9.5	6/6 (LE)	0	199	8.9

S.NO	UHID	AGE (YEARS)	SEX	PRE-OP VA	PRE-OP VA LogMAR	PRE-OP MT (µm)	PRE-OP TMV (cucm)	POD 7 VA	POD 7 VA LogMAR	POD 7 MT (µm)	POD 7 TMV (cucm)	POD 28 VA	POD 28 VA LogMAR	POD 28 MT (µm)	POD 28 TMV (cucm
91	541077	68	M	CF 2 MTS (RE)	1.5	192	9.9	6/9 (RE)	0.2	262	10.6	6/6 (RE)	0	218	10
92	540047	75	M	CF 1 MT (LE)	1.8	261	10.1	6/18 (LE)	0.5	250	11.9	6/6 (LE)	0	248	10.3
93	538474	65	M	CF 4 MTS (RE)	1.2	224	7.4	6/9 (RE)	0.2	274	9.8	6/9 (RE)	0.2	232	8.8
94	538473	68	F	CF 3 MTS (RE)	1.3	214	9	6/18 (RE)	0.5	240	10.8	6/12 (RE)	0.3	205	9.3
95	533400	79	M	CF 1 MT (RE)	1.8	192	9.9	6/9 (RE)	0.2	258	10.6	6/9 (RE)	0.2	223	8.9
96	532380	60	M	CF 1 MT (RE)	1.8	208	9.7	6/12 (RE)	0.3	286	10.9	6/6 (RE)	0	247	9.9
97	532343	72	F	CF 4 MTS (LE)	1.2	224	9.9	6/60 (LE)	1	301	11.1	6/12 (LE)	0.3	243	10.6
98	544962	69	M	CF 3 MTS (LE)	1.3	239	1	6/9 (LE)	0.2	291	10.9	6/6 (LE)	0	246	9.6
99	556616	53	M	CF 3 MTS (LE)	1.3	255	8	6/9 (LE)	0.2	297	9.3	6/9 (LE)	0.2	267	9.1
100	476541	59	F	CF 1/2 MTS (LE)	1.9	206	8.5	6/9 (LE)	0.2	291	9.4	6/6 (LE)	0	239	9